**TANK T-90M**

# Manual

# Part 2. Intended use

# 188M.RE1

**Content**

This operating manual (hereinafter referred to as the manual) is the main document in accordance with which the T -90M tank (hereinafter referred to as the tank) must be operated. The guide consists of three parts.
The first part of the manual contains the main tactical and technical characteristics of the tank, a description of the purpose, design and operating principles of the tank's systems and mechanisms.
The second part of the manual contains information on the rules of operation of the tank and its components, including maintenance, storage and transportation.
The third part of the manual (album of drawings) contains illustrations that explain and supplement the text of the first and second parts of the manual.
During the operation of the tank, along with this manual, it is necessary to use the operational documentation supplied with the tank according to the list of operational documents 188M.VE.
Persons who have undergone special training in the operation and maintenance of the tank are allowed to work on the tank.

## 1 Operating restrictions

**PROHIBITED:**

**- TANK MOVEMENT AND ENGINE OPERATION WHEN THE MAXIMUM PERMISSIBLE PARAMETERS SPECIFIED IN TABLE 1 OF THIS MANUAL ARE EXCEEDED;**
**- STARTING THE ENGINE WHEN THERE IS 20 LITERS OR LESS OF OIL IN THE ADDITIONAL TANK;**
**- TURNING ON THE STARTER AND MZN BUTTONS FOR STARTING FROM THE TOWGER WHILE THE ENGINE IS RUNNING, AS WELL AS EARLIER THAN 5 S AFTER ITS COMPLETE STOP;**
**- STARTING THE ENGINE WHEN WATER GETS INTO IT!**

To remove water from the engine cylinders, it is necessary to crank the crankshaft with compressed air without fuel supply (by starting the engine with an air starting device, section 3.1.2.3) by pressing the EPK button for no more than 1 s. If necessary, repeat the procedure. Drain the oil from the lubrication system and engine crankcase and fill with at least 45 liters of fresh oil. Start the engine and run for 5 minutes, then drain the oil and wash the MAF and MC filters. Maintain the air cleaner and refill the lubrication system with fresh oil.

Table 1

| Controlled parameter | Recommended (optimal) parameter value | Allowable (limit) parameter value |
|---|---|---|
| Engine idle speed, rpm | 800 - 2000 | 800 - 2300 |
| Engine crankshaft speed under load, rpm | 1600 - 1900 | 1300 - 2000 |
| Oil pressure in the engine lubrication system at recommended temperatures and engine speeds кгс/см$^2$: | | |
| - in oils ВНИИНП М − 5$_з$/16Д$_2$, М − 14Г$_2$(к)Mobil 1 | 5 - 11 | 2$^{*1}$- 4$^{*2}$-14$^{*3}$ |
| - in oilМ − 12Г$_2$ | 4 - 10 | 2$^{*1}$- 3,5$^{*2}$-14$^{*3}$ |
| Oil pressure in the transmission lubrication system,кгс/см$^2$ | 2 - 3 | 0,5$^{*1}$- 1.5 - 3 |
| Water temperature in the engine cooling system, °C | 70 - 100 | 65 - 125 - (130) *$^4$ |
| Temperature of low-freezing coolant in the engine cooling system, °C | 70 - 95 | 65 - 100 -(110)$^{*4}$ |
| Oil temperature in the engine lubrication system, °C | 70 - 100 | 65 - 125 -(130)$^{*4}$ |

*1 At the minimum stable crankshaft speed at idle speed (from 800 to 950 rpm).
*2 After 300 hours of engine operation.
*3 At oil temperature from plus 55 to plus 65 °C.
*4 Long-term operation is allowed, without a time limit, at water and oil temperatures at the engine outlet of no more than 125 °C, and with a cooling system filled with low-freezing liquid - no more than 100 °C. To increase the dynamic properties of the tank, operation is allowed for a limited time, no more than 15 minutes, at water and oil temperatures in the range from 125 to 130 °C and low-freezing coolant in the range from 100 to 110 °C.
N o t e - Pressure values are indicated for engine speeds from 1600 to 1900 rpm.

During operation, you must follow the instructions and recommendations issued by the DKMV, as well as the instructions in Table 2.

Within 15 minutes allowed for short-term operation, or if the maximum temperatures of the coolant, oil and exhaust gases are exceeded, take measures to reduce them.

To reduce the coolant temperature, it is necessary to switch to a lower gear and increased engine speed, to reduce the oil temperature, it is necessary to switch to a lower gear and lower speed, and to reduce the exhaust gas temperature, it is necessary to reduce the load on the engine and switch to a lower gear. If these measures do not lead to a decrease in temperatures below the maximum permissible, stop the engine, find out and eliminate the cause of the temperature increase.

If, while driving with the fuel pedal pressed all the way, the engine speed decreases, it is necessary to shift to a lower gear.

If vibration of the engine and tank occurs, switch the engine to another operating mode that eliminates vibration.

table 2

| Contents of the information frame | Diagnosed fault | Actions of the driver | |
|---|---|---|---|
| | | When using the product | When using the product in combat conditions |
| 1 STARTING IS PROHIBITED NO ENGINE OIL PRESSURE OR TEMPERATURE CONTROL | 1 Failure of the engine oil temperature receiver circuit in the tank<br>2 Engine lubrication pressure receiver circuit failure | Take corrective action | At the direction commander turn on the SPECIAL toggle switch on the driver's shield and continue performing the combat mission |
| 2 STOP ENGINE NO CONTROL OF ENGINE OIL PRESSURE OR TEMPERATURE | 1 Engine Oil Temperature Receiver Circuit Failure<br>2 Engine lubrication pressure receiver circuit failure | If there are no readings on the engine oil pressure scale on the APU, turn off the engine; if there are readings, you can continue driving to the repair site.<br>Take corrective action | At the direction commander turn on the SPECIAL toggle switch on the driver's shield and continue performing the combat mission |
| 3 PTO WORKS NO TEMPERATURE CONTROL | 1 Engine Oil Temperature Receiver Circuit Failure<br>2 Coolant temperature receiver circuit failure<br>3 Exhaust manifold thermocouple circuit failure<br>4 Thermocouple cold junction temperature receiver circuit failure | It is allowed to continue driving to the repair site.<br>Take corrective action | At the direction of the commander, turn on the SPECIAL toggle switch on the driver’s shield and continue performing the combat mission |
| 4 NO TEMPERATURE CONTROL The frame is displayed when the SPECIAL switch is on on the driver's panel | 1 Engine Oil Temperature Receiver Circuit Failure<br>2 Coolant temperature receiver circuit failure<br>3 Exhaust manifold thermocouple circuit failure<br>4 Thermocouple cold junction temperature receiver circuit failure | Take action to correct the problem as soon as possible | Continue completing the combat mission |
| 5 DRIVING IS ALLOWED IN GEARS 1, 2, 3, 4, 3X | 1 Speedometer sensor circuit failure<br>2 Selector lock solenoid circuit failure<br>3 Gear number sensor circuit failure | Continue driving in permitted gears.<br>Take corrective action | Continue completing the combat mission |
| 6 DRIVING IS PROHIBITED NO TRANSMISSION OIL PRESSURE CONTROL | Transmission Lubricant Pressure Receiver Circuit Failure | Take corrective action | Continue completing the combat mission |
| 7 HEATER STARTING IS PROHIBITED NO COOLANT OR FUEL CONTROL | 1 Coolant temperature receiver circuit failure<br>2 Coolant level sensor circuit failure | Take corrective action | As directed by the commander, start the engine using the air propellant. Continue completing a combat mission without using a heater |
| 8 START WITH PVV DISABLED START HEATER | 1 Failure of spark plug circuit PVV1<br>2 Failure of spark plug circuit PVV2<br>3 Failure of the PVV solenoid valve circuit | Take corrective action | Start the heater. Start the warm engine. Continue completing the combat mission |
| 9 WATCH THE TEMPERA. PTO OFF | PTO solenoid circuit failure | Monitor the engine coolant and oil temperatures using the appropriate scales on the APU. Take corrective action | Continue completing the combat mission |
| 10 NO FUEL LEVEL CONTROL | 1 Failure of the fuel meter circuit in the left tank<br>2 Failure of the fuel meter circuit in the right tank | It is allowed to continue operation while monitoring the amount of fuel visually using the dipstick.<br>Take corrective action | Continue completing the combat mission |

| Contents of the information frame | Diagnosed fault | Actions of the driver | |
|---|---|---|---|
| | | When using the product | When using the product in combat conditions |
| ele NO COOLANT PULLING<br>venCONTROL<br>The frame is displayed when the engine is not running | Coolant flow sensor circuit failure | Check that the cooling system is completely filled. When the cooling system is fully charged, the engine can be started. Take corrective action | At the direction of the commander, continue the combat mission |
| 12 WATCH THE TEMPERA. COOLING FAN WORKS | 1 Tachometer sensor circuit failure<br>2 Engine Oil Temperature Receiver Circuit Failure<br>3 Coolant temperature receiver circuit failure<br>4 Cooling fan solenoid circuit failure | Maintain the required engine temperature using the blind drive.<br>Take corrective action | Continue completing the combat mission.<br>Maintain the required engine temperature using the blind drive |
| 13 AMS DISABLED WORK IN MANUAL MODE | 1 Speedometer sensor circuit failure<br>2 Tachometer sensor circuit failure<br>3 Fuel pedal sensor circuit failure<br>4 Shift cycle sensor circuit failure<br>5 Gear number sensor circuit failure<br>6 APP motor circuit failure | It is allowed to continue operation, while changing gears manually.<br>Take corrective action | Continue performing the combat mission, while changing gears manually |
| 14 COOLING FAN DRIVE FAILURE | The fan does not rotate when the engine is running and when the coolant temperature is more than 90 °C | Visually check the operation of the fan by observing the intense air output from the outlet louvres. If there is no air outlet, stop the engine and repair the fault in accordance with paragraph 7.7.1of this manual. When air escapes from the outlet louvers, continue the task and repair the electrical circuit of the fan rotation sensor as soon as possible | |
| 15 THERE ARE FAULTS<br>The frame is displayed together with frames according to paragraphs. 1-14 | Any malfunction from the above | Follow the instructions in paragraphs 1-14. After stopping the tank, turn off the engine. In the submenu KTS - FAILURES, familiarize yourself with the identified malfunctions and take measures to eliminate the malfunctions | |

Additional operating restrictions, as well as safety precautions that must be observed when using the tank for its intended purpose, are set out in the relevant sections of the manual.

## 2 Preparing the tank for use

### 2.1 Safety precautions when preparing a tank for use

**PROHIBITED:**

**- USE FAULTY TANK HEATING MEANS;**
**- RUN THE HEATER OR ENGINE TO WARM UP THE TANK IN A CLOSED ROOM WITHOUT VENTILATION;**
**- LEAVE THE HEATER RUNNING WITHOUT MONITORING ITS OPERATION;**
**- HOLD ONTO THE EDGES OF THE HATCHES WITH YOUR HAND(S) WHEN CLOSING THE HATCH COVERS;**
**- SUCK THE COOLANT THROUGH THE HOSE WITH YOUR MOUTH;**
**- EAT OR SMOKE WHILE WORKING WITH COOLANT;**
**- USE COOLANT FOR PURPOSES OTHER THAN ITS INTENDED PURPOSE!**

When working with coolant It is recommended to use safety glasses.

Work to prepare the tank for use must be carried out by the crew assigned to the tank.

Crew members who have undergone special training and have a tank driving license are allowed to drive.

Starting the engine and moving the tank away should only be done at the command of the tank commander.

Before starting the engine and driving, you must sound a warning signal.

Check the operation of the rangefinder, turret and gun drives in places that are safe for others, at the command of the tank commander.

At the end of refueling, the remaining antifreeze (antifreeze) must be returned to the warehouse, and your hands must be thoroughly washed with soap and water.

When conducting live firing, along with official instructions and other documents, it is necessary to strictly observe the safety measures that exist at firing ranges and shooting ranges.

Safety measures that must be observed when using the tank for its intended purpose are set out in the relevant sections.

### 2.2 Inspecting the tank before use (control inspection)

A control inspection is carried out before each use of the tank. The list of control inspection operations is presented in Table 3.

Table 3

| Maintenance operations performed | Directions on implementation | Tools and accessories used and materials |
|---|---|---|
| **Operations to be performed before any use** | | |
| Check that the cooling system is completely filled and top up if necessary. | On a horizontally mounted tank, when the engine is not running, there should not be a “CHECK COOL LEVEL” message on the driver’s APU. | Key-hand about yatka 27 mm , bucket, coolant , funnel with mesh, rags |
| Check the oil level in the additional tank of the engine lubrication system, refill if necessary | The oil level in a fully filled tank corresponds to the “65” mark on the rod. Starting the engine is not allowed if there is oil in the tank of 20 liters or less per rod | 27 mm handle wrench, rod for measuring oil and fuel levels in tanks, rags, engine oil |
| Check the position of the AZR on the driver's panel, on the AB protection unit, as well as the BCN - TDA switch on the driver's panel, in the DCMV, make sure that the WATER - ANTIFREEZE setting corresponds to the type of liquid filled in the cooling system | All AZR must be turned on, except for BCN-TDA and WATER PUMP on the driver's panel. The BCN-TDA switch must be in the middle (off) position | - |
| Check the charge of PPO cylinders | About the charge of the corresponding cylinders signal inscriptions 1B, 2 B , 3B And 4B on remote control P13, burning at full heat at included switch b batteries | - |
| Check the operation of the engine and transmission unit | When running engine on the VS The driver must absent messages about failure x .<br>Grids weekend blinds must be dry and h pure | - |
| Check the blade mounting in position "in the usual way " | Clamps must be rotated socks down, are you too tight ? | Key 27 mm |
| Make sure in the installation of protective covers on the muzzle and government parts of the gun , on the embrasure there is a paired bullet of meta | Check external inspection | - |

| Maintenance operations performed | Directions on implementation | Tools and accessories used and materials |
|---|---|---|
| Stop the tower fix the gun with a rod | - | - |
| Prepare a set of communications equipment for operation. Do not enter radio data, setup data and key information into the KSS equipment | Carry out, guided by the instructions of paragraph 3.5.3.3of this manual | - |
| At necessity clean optical surfaces of prisms surveillance devices, optical surfaces of TSN, television cameras SN V, rear view cameras, input windows of OR heads, PMF screen | Metal parts rub vet about sewing, optical surfaces - napkin from single sets of spare parts TSN and CH B (from a single set of spare parts for the tank). S o p tic surfaces first remove dust and grains of sand , soak the dirt with water , then wipe with a clean napkin , doing circular movement from the center to the edges | Rags, napkins made from single Spare parts TSN and START |
| At using a stabilizer weapons and AZ make sure in absence foreign objects interfering rotation of the tower And VT | Check tower And VT manual drives No less than and two cassettes. P outsiders items delete | - |
| **Operations performed at rest stops** | | |
| Inspect the cannon and machine gun armament | Carry out in accordance with the operational documentation for weapons supplied with the tank | - |
| Make sure in the absence leaks from power systems mouth but in to and , hydraulic systems transmission installations | Check according to the state of the output grids of the blinds . Grids output blinds should be dry and h pure | - |
| In accessible places, visually check the condition of the components and bolted connections of the chassis elements and flanges of the final drives | If the fastening is loosened, tighten the bolts . To loosen a bolt , check the situation by hammering it . Check the chassis components in accordance with clause 5.8.13.1 | Hammer , track maintenance wrench, keys 27, 36, 41 mm |
| Refill the system GPO, water (at operation in summer ) | Carry out, guided by the instructions of clauses 5.8.19.1, 5.8.19.2of this manual | Key 22 mm , funnel with filter and tip , clean water |
| At necessity clean optical surfaces of prisms surveillance devices, optical surfaces of TSN, TV cameras SN V, rear view cameras, input windows of OR heads | Metal parts rub vet about sewing, optical surfaces - napkin from single sets of spare parts TSN and CH B (from a single set of spare parts for the tank). S o p tic surfaces first remove dust and grains of sand , soak the dirt with water , then wipe with a clean napkin , doing circular movement from the center to the edges | Rags, napkins made from single Spare parts TSN and START |
| **Operations performed before shooting** | | |
| Remove protective covers from the cut of a gun barrel, government gun parts and embrasures coaxial machine gun | C h e h ly st o live in the box Z IP tank | - |
| Perform operations within the scope of a control inspection of the gun | Carry out in accordance with the operating instructions. document on the cannon attached To tank | - |
| Check the condition of the gun bores, coaxial machine gun , DPU machine gun, launchers installations systems 902 | Channels trunks must be clean and without soot. T cracks And the trunk is swollen , the presence of foreign substances items, the presence of lubricant is not allowed | Portable lamp |
| At necessity clean the optical surfaces of PNM , PKP , PDT , e wounds VS U, prismatic surveillance devices, body cameras TSN, SN V, entrance windows to the heads IL I , sensor and bending ( measuring and optical units) And wind sensor fairing receiving holes | Wipe metal parts with a cloth, optical surfaces - napkin from single spare parts TSN and SN V. Soptical surfaces first remove dust and grains of sand , soak the dirt with water , then wipe with a clean napkin , doing circular movement from the center to the edges | Rags, napkins from single sets of spare parts TSN and START |
| Check and at necessity Clean and clean the surface of the pallet ejection hatch | On personal preferences ejection hatch surfaces Not there must be dust, dirt, snow, ice | Rags, compressed air |

| Maintenance operations performed | Directions on implementation | Tools and accessories used and materials |
|---|---|---|
| **Operations performed when probabilities and applications WMD** | | |
| Remove shield ok caps from the VZU cover and put in the ZI P box . Remove the caps from the fittings air to anal armor VZU protective cover | - | - |
| Check excess pressure (backup) in the habitable compartment | Check, guided by the instructions in paragraph 3.17.4of this manual | - |
| Check the presence of smoke filter tape in block B-2 instrumentation of the PKUZ-1AM complex | Check on a scale frame counter | - |
| Set up the instrument complex PC U Z -1A | Carry out following the instructions in paragraph. 3.17.3 This manual | - |
| **Operations to be performed before using the diesel generator set** | | |
| Check the oil level in the diesel engine crankcase, top up if necessary | Check, guided by clause 5.8.15.1of this manual | 19 mm wrench, rag |
| Check the coolant level in the diesel generator cooling system | The coolant level should be at the level of the lower edge of the filler neck of the expansion tank | - |

### 2.3 Rules and procedure for filling a tank with fuel and lubricants and coolant

#### 2.3.1 Refueling capacity of main components and systems

The amount of fuel and lubricants filled into the main components and systems is given in Table 4.

Table 4

| Name of system, node | Quantity of fuels and lubricants | Note |
|---|---|---|
| Engine lubrication system | 78 l | Filling capacity of oil tanks 65 l per rod |
| Engine cooling system | 90 l | - |
| Transmission hydraulic system | 57 l | Oil tank filling capacity 42 liters per rod |
| Diesel engine lubrication system | 2.5 l | - |
| Diesel engine cooling system | 4.5 l | - |

| Name of system, node | Quantity of fuels and lubricants | Note |
|---|---|---|
| Track tensioner | 1-1.5 kg | - |
| Support roller | 380-400 g | - |
| Final drive carrier cavity | 500 g | Amount of lubricant required for refilling |
| Track roller | 1.5 kg | Same |
| Balancer bearings | 150-200 g | » |
| Guide wheel bearings | 600 g | » |
| Turret rotating mechanism | 200-300 g | » |
| Tower shoulder strap | 300-400 g | » |
| Weapon stabilizer | 3 l | Approximately |
| Thermoelectric air conditioner cooling system | 13 l | KHP cooling system capacity |

### 2.3.2 Fuel, lubricants and special liquids and gases used in the tank

The fuels and lubricants and special liquids with which the tank is filled at the manufacturer are indicated in the certificate pasted into the form.

hydraulic lubricants, special liquids and gases used in operation is given in Table 5.

### 2.3.3 Checking the cooling system charge

**ATTENTION:**

**WHEN CHECKING THE COMPLETENESS OF FILLING A HEATED COOLING SYSTEM, HOT COOLANT MAY BE RELEASED!**

The coolant level in the cooling system is controlled by the DKMV. On a horizontally mounted tank (visually), the engine is stopped and the DCMV is turned on, there should not be a message “CHECK COOLANT LEVEL” on the driver’s APU.

If necessary, the coolant level in a cold cooling system can be checked by unscrewing the expansion tank cap. When the cooling system is fully charged, the liquid level should cover the lower edge of the expansion tank filler pipe.

To check the charging of a heated cooling system, you must:

– install the tank horizontally (visually);

– clean the filler plugs of the expansion tank or radiator from dirt and dust;

– Unscrew the filler cap of the expansion tank or radiator until liquid appears. The cooling system is considered filled if the coolant begins to protrude through the gap between the plug and the neck; in this case, do not turn the plug completely out;

– tighten the plug.

### 2.3.4 Refueling (refueling) of the cooling system

To fill the cooling system in summer operating conditions, use clean fresh water (tap or from open reservoirs) without mechanical impurities, with a three-component anti-corrosion additive.

**ATTENTION:**

**THREE-COMPONENT ADDITIVE AND LOW-FREEZING COOLANT - POISONS!**

If using water from open reservoirs, filter the water through a cotton napkin (available in the spare parts kit) or let the water stand for at least 3 hours.

To prepare 100 liters of water with a three-component additive, you must take each component of the additive in the amount indicated in Table 6.

Table 6

| Component name | Standard | Amount of component, g |
|---|---|---|
| Trisodium phosphate | GOST 201-76 | $50^{+3}$ |
| Sodium nitrite | GOST 19906-74 | $50^{+3}$ |
| Potassium (or sodium) bichromate technical | GOST 2652-78 | $100^{+5}$ |

To separate salts and prevent them from entering the cooling system, it is necessary to follow the following procedure for preparing water with a three-component additive:

– prepare the required amount of each additive component in crushed form;

– dissolve trisodium phosphate with stirring in a volume of 100 to 110 liters of water (for one tank), heated to a temperature of 60 to 80 ° C, let the solution sit for at least 3 hours and pour without sediment into another container, leaving about 1/10 part of the solution (do not use the rest);

– dissolve the remaining two components of the additive in the resulting softened water while stirring.

The cooling system can be refilled with clean water without a three-component additive if the water loss is no more than 10 liters. When adding a large amount of water without an additive to the cooling system, it is necessary to replace the water in the cooling system as soon as possible.

In exceptional cases, it is allowed to fill the cooling system with water without a three-component additive. After this, as soon as possible, flush the cooling system and fill it with water with a three-component additive.

To fill the cooling system in winter operating conditions, use low-freezing coolants listed in Table 5 . It is allowed to use low-freezing liquids at an ambient temperature of no more than plus 10 ° C (in spring and autumn).

The main part of the low-freezing liquid is water. During operation, it evaporates, as a result of which the concentration of ethylene glycol increases over time and the performance of the low-freezing coolant deteriorates.

To restore the original composition of the low-freezing coolant, clean boiled water must be periodically added to the cooling system.

If the level of low-freezing coolant decreases and is not associated with a leak in the cooling system, replenish the cooling system with boiled water.

When the cooling system is fully charged, the liquid level should cover the lower edge of the expansion tank filler pipe.

The procedure for filling (refueling) the cooling system is as follows:

– install the tank horizontally (visually);

– unscrew the filler plugs of the expansion tank and radiator, having first cleaned them of dirt and dust;

– pour coolant into the system through the radiator neck using a funnel with a mesh and screw in the filler plugs. It is allowed to fill the system through the necks of the radiator and expansion tank;

– start the engine and let it run at minimum idle speed for 1 to 2 minutes to remove air pockets, then refuel the cooling system (do not start the engine after refueling);

– in the DCM menu, select the SETTINGS item, select COOLANT TYPE, press the SELECT button, use the UP, DOWN buttons to select the liquid filled into the cooling system and confirm the selection with the SELECT button.

When starting the engine while warming it up with a heater, you must:

– upon completion of filling the coolant, turn on the heater in the purge mode;

– check the change in the liquid level in the filler necks when turning the heater on and off in the purge mode. Fluctuations in the level indicate that the heater is filled with coolant and that there are no air pockets in the pipelines of the cooling system;

– close the filler plugs;

– start the heater.

If, when turning the heater on and off in the purge mode, the level of coolant in the filler necks does not change, you need to make sure that the supply pipelines are not clogged or frozen, paying special attention to hose 18 (Figure 2.5) for releasing air from the water pump of the heater.

**ATTENTION:**

**IT IS PROHIBITED TO RUN THE HEATER IN HEATING OR WARMING MODE WITHOUT REMOVING AIR CLAMPS FROM THE COOLING SYSTEM, OR IF THE COOLING SYSTEM IS UNDERCHARGED BY MORE THAN 10 L.**

### 2.3.5 Features of filling the cooling system with water and coolant

To fill the cooling system during summer operation at ambient temperatures above plus 5 °C, use clean, fresh water with the addition of a three-component additive.

Mechanical impurities contained in water clog pipelines, radiators, cylinder block jackets and lead to local overheating. In the case of using water from fresh natural reservoirs (rivers, lakes, irrigation ditches, etc.), pour the water through a funnel with a cotton filter (napkin) made of dense fabric placed on the mesh of the filling funnel, attached to a single set of spare parts for the tank, or allow the water to settle for at least 3 hours, after which use the settled water to fill the cooling system.

Impurities of salts dissolved in water promote scale deposits, impair thermal conductivity, cause corrosion and can lead to engine overheating. To separate salts and prevent them from entering the cooling system, strictly follow the procedure for preparing summer coolant set out in paragraph 2.3.4of this manual.

It is allowed to use low-freezing coolants at an ambient temperature of no more than plus 10 °C (in spring and autumn).

When using the tank, periodically, but no less than during seasonal maintenance, check the quality of the low-freezing liquid, as indicated in the tank's operating instructions.

Do not allow petroleum products (oil, diesel fuel, kerosene, etc.) to enter the cooling system, as this will impair thermal conductivity and reduce the heat capacity of the low-freezing coolant, which can lead to engine overheating.

When switching to summer or winter operation, as well as when putting the tank into storage, it is necessary to flush the cooling system, for which:

– completely drain the previously filled coolant from the cooling system in the sequence in accordance with the tank's operating manual;

– Fill the system completely with clean fresh water to flush the system;

– start the engine and let it run for 5 to 10 minutes, then stop it;

– completely drain the flushing water from the cooling system;

– Fill the cooling system with liquid (water with a three-component additive or low-freezing coolant) taking into account the temperature conditions of the upcoming operation or storage.

### 2.3.6 Refueling (refueling) and monitoring the engine oil level

Fill the engine lubrication system with oil according to the list of fuels and lubricants given in Table 5.

**IT IS PROHIBITED TO START THE ENGINE WHEN THE OIL LEVEL IN THE REPLACEMENT TANK IS 20 L OR LESS THAN THE ROD.**

**IT IS PROHIBITED TO USE OTHER BRANDS OF OILS, AS WELL AS MIXING APPLIED BRANDS OF OILS WHEN FILLING AND REFILLING THE SYSTEM.**

**IT IS PROHIBITED TO USE BRANDS OF OILS NOT SPECIFIED IN THIS MANUAL WHEN FILLING AND REFILLING THE LUBRICATION SYSTEM.**

**ATTENTION:**

**FILL THE LUBRICATION SYSTEM ONLY WITH CLEAN OIL AND OIL CHECKED BY THE PASSPORT OR CERTIFICATE FROM A CLEAN CLOSURE CONTAINER THROUGH A MESH FILTER.**

Fill the lubrication system with oil using an oil filler equipped with a filter, or an MZA filling unit, replacing the fuel filter with an oil filter.

If the specified filling agents are not available, fill the lubrication system from a clean container through a funnel with a mesh.

At ambient temperatures below plus 5 °C, fill the lubrication system with heated oil. In the absence of heating means, it is recommended to refill the lubrication system from the external oil tank immediately after stopping the engine, when the oil in the tank is warmed up.

Fill the outer tank with oil using a bucket through a funnel with a mesh to the bottom edge of the filling neck (tank filling capacity is 30 l).

The internal and external oil tanks must be filled with the same brand of oil.

The procedure for filling (refueling) the lubrication system is as follows:

– install the tank horizontally (visually);

– open the hatch cover above the filler neck of the additional oil tank;

– clean the plug and flange of the oil tank from dust and dirt and unscrew the plug;

– fill (refill) the lubrication system to the “65” mark on the rod, do not start the engine after refueling;

– Upon completion of refueling, screw the plug into the filling neck of the oil tank, making sure that the gasket is intact, and install the hatch cover.

After filling the lubrication system, in which there was no oil, start the engine for 2 to 3 minutes to fill the lines of the lubrication system and top up the system to the mark “65” on the rod.

Check the oil level in the system using a rod to measure the fuel and oil levels no earlier than 15 minutes after stopping the engine. The recommended oil temperature during control should not be lower than plus 70 ºC.

When checking, direct the rod to the lower part of the tank along the front wall; at the top of the tank, the rod must be pressed under its own weight against the threaded surface of the tank filler neck flange.

Before starting the engine after storage or long-term parking of the tank (more than one month), do not refuel the engine lubrication system, if there is oil in the additional tank. In this case, determine the oil level after starting and stopping the engine.

### 2.3.7 Fuel quantity control

To control the amount of fuel, the tank should be installed on a horizontal (visual) platform.

In internal tanks, the presence of fuel is controlled by displaying the QUANTITY OF FUEL slide on the driver’s APU separately in the right group of tanks (right bow and right tank) and the left bow tank.

In external tanks and barrels, fuel is measured with a fuel and oil metering rod through the filler necks of each tank or barrel.

The amount of fuel in all internal tanks can be further checked using a fuel and oil level gauge through the filler neck of the right tank.

It must be remembered that the error in determining the amount of fuel with a fuel meter increases when filling the fuel system with kerosene.

### 2.3.8 Refueling

The fuel to be refilled must be clean, free of mechanical impurities and water. The presence of water and mechanical impurities in the fuel causes destruction of the cardboard filter plates in the fine fuel filter and failure of the engine fuel equipment due to abrasive wear, and in winter - failure of the engine due to the formation of ice plugs in pipelines and filters. If water gets into the fuel, work to remove it must be carried out in accordance with the requirements set out in this manual, while the filter packages of fine fuel filters must be replaced regardless of the timing of replacement and maintenance. Take filter bags from the group spare parts kit. The use of substandard fuel leads to a reduction in engine service life.

The tank can be filled with fuel:

– mobile and stationary refueling means;

– a small-sized refueling unit (hereinafter - MZA), located in the spare parts kit for the tank;

– with a bucket through a funnel with a mesh (from the tank spare parts kit).

Refueling using dispensing taps with a filler pipe diameter of 38 to 40 mm is carried out through adapter 172.33.222sb-1 from a single set of spare parts for the tank. It is recommended that tankers assigned to the unit be retrofitted with these adapters.

Before refueling the tanker, drain the sediment from it until clean fuel appears.

Fill the internal tanks through the filling neck of the right tank, and the external tanks and barrels sequentially, each through its own filling neck, starting from the front external tank.

When refueling, the shut-off valve for external fuel tanks must be constantly in the ON position. (with external tanks installed, operational and connected to the system).

The filling procedure is as follows:

– open the filler necks of the right tank and the front outer tank;

– display the message QUANTITY OF FUEL on the driver's APU;

– place the dispensing valve in the neck of the right tank and close the neck hole with the adapter plug with a slight force;

– fill the internal tanks with a closed stream, monitoring the driver's APU for filling the left bow tank. When the amount of fuel filled approaches 180 liters (full tank), open the filler neck by lifting the dispensing valve and continue refueling until the right tank is full.

During the refueling process, regulate the fuel supply to prevent it from splashing out and forming foam.

When filling external tanks, direct the fuel stream along the tank wall to prevent fuel from splashing out of the neck. To reduce foaming, direct the jet under the fuel level. When refueling barrels, insert the adapter through the neck into the barrel and when fuel appears in the neck, finish refueling.

Before closing the necks of tanks and barrels with stoppers, you must first ensure that the sealing gaskets are intact. Replace gaskets that have become unusable with new ones from a single set of spare parts for the tank.

When using refilling means that are not equipped with filters, it is necessary to insert a funnel with a mesh into the neck of the tank being refilled.

### 2.3.9 Features of refueling empty internal tanks with less than 400 liters of fuel for refueling

In this case, refueling can be done either by bulk or using an MZA through a drain fitting located on the bracket with fuel devices.

The filling procedure is as follows:

– tightly screw the adapter with hose 172.91.125sb for filling the left bow tank into the drain fitting, into the other end of the hose insert a funnel with a mesh, retrofitted with a tip 188MS.91.023sb for filling gas tanks;

– open the filler neck of the right tank;

– set the handle of the fuel distribution valve to the PUMP-OUT position;

– fill 90 to 100 liters of fuel through a funnel with a mesh into the left bow tank;

– set the fuel distribution valve handle to the TANK ON position;

– fill the remaining fuel through a funnel with a mesh into the right tank.

The procedure for refueling using MZA is as follows:

– tightly screw the adapter with hose 172.91.125sb for filling the left bow tank into the drain fitting;

– connect the second end of the hose to the MZA dispensing valve via adapter 175.91.077sb, available in a single tank spare parts kit;

– open the filler neck of the right tank;

– set the handle of the fuel distribution valve to the PUMP-OUT position;

– fill all fuel through the left bow tank;

– Set the fuel distribution valve handle to the TANK ON position.

Upon completion of refueling you must:

– unscrew the hose adapter for filling the bow fuel tank from the drain fitting;

– Replace the plugs of the fitting and the filling neck of the right tank;

– bleed the BCN or RPM system with the air release valve open.

It is recommended to refuel from barrels using MZA at high ambient temperatures (plus 35 °C and above) through nozzle 1 72.33.271sb with a filter, located in a single set of spare parts for the tank, while installing an oil filter in the MZA intake extension instead of the fuel filter .

### 2.3.10 Monitoring the oil level in the hydraulic system tank of the transmission unit

During operation, if a leak is detected, as well as in the event of pressure instability, the sufficiency of oil in the system is determined by its level in the tank. The oil level in the tank after the engine has been running for at least 1 minute should not be lower than the mark "22" on the rod. If the oil level is below marks "22", movement is not allowed. It is necessary to check that the hydraulic system of the transmission unit is completely filled and, if necessary, refill.

To control the oil level in the tank:

– pump out oil from transmission units;

– open the roof over the transmission;

– clean the filler plug of the transmission oil tank from dust and dirt and unscrew the plug;

– Check the oil level in the tank with a rod. The oil level in the tank should not be lower than the "40" mark and not higher than the "42" mark on the rod.

If the level is insufficient, the system must be refilled.

### 2.3.11 Filling the hydraulic system of the transmission unit with oil

The procedure for filling oil is as follows:
– open the roof over the transmission;
– clean from dust and dirt and unscrew the filler cap of the oil tank;
– make sure that there is no oil in the transmission tank by checking the oil level in the tank using the rod;
– pour 42 liters of oil into the oil tank (in winter it is necessary to fill in hot oil);
– start the engine, run for 2 to 3 minutes, then pump out the oil from the units;
– measure the oil level in the tank and fill in the missing amount of oil. After refueling, the oil level in the tank should not be lower than the “40” mark and not higher than the “42” mark on the rod.

Pour oil from a clean container through a funnel with a mesh.

The total amount of oil required to fill the hydraulic system of the transmission unit is approximately 50 to 57 liters.

### 2.3.12 Refilling the hydraulic system of the transmission unit with oil

**ATTENTION:**

**TO AVOID OVERFLOWING THE HYDRAULIC SYSTEM OF THE TRANSMISSION UNIT AND DESTRUCTION OF THE OIL TANK, REFILL THE SYSTEM ONLY AFTER PUMPING OIL FROM THE TRANSMISSION UNITS!**

The procedure for refilling oil is as follows:
– prepare the necessary tools and equipment;
– pump out oil from the units;
– open the roof over the transmission;
– clean from dust and dirt and unscrew the filler cap of the oil tank;
– measure the oil level in the tank. The oil level in the tank should not be lower than the “40” mark and not higher than the “42” mark on the rod. If the oil level in the tank is below the “40” mark on the rod, refill the system.

Pour oil from a clean container through a funnel with a mesh.

The oil level in the tank after refueling should not be lower than the “40” mark and not higher than the “42” mark on the rod.

## 3 Using the tank

### 3.1 Driving a tank

The basis for safe driving of a tank in various weather and terrain conditions, its towing and evacuation is compliance with the requirements of this operating manual and the current “Guide to the Rules for Driving Combat Vehicles (RPVBM-82).”

#### 3.1.1 Security measures

**PROHIBITED:**

**- MOVEMENT OF A TANK WITH AN UNLOCKED TURRET, GUN OR CONTROL PANEL WHEN THE CORRESPONDING GUIDANCE DRIVES ARE TURNED OFF;**
**- START DRIVING WITH THE HATCH COVERS UNLOCKED;**
**- OPEN AND OPEN HATCH COVERS UNLESS ABSOLUTELY NECESSARY WHILE DRIVING;**
**- DRIVING IN THE SEVENTH, SIXTH AND FIFTH GEARS WITH A FAULTY GEAR SELECTOR LOCKING DEVICE!**

**ATTENTION:**

**WHEN DRIVING WITH THE CLUTCH PEDAL PRESSED OR WITH THE NEUTRAL SELECTOR ON, THE TANK IS NOT CONTROLLED BY THE TURN LEVERS!**

**ATTENTION:**

**− WHEN STOPPING AND PARKING, ALWAYS APPLY THE PARKING BRAKE TO THE TANK;**
**− START THE ENGINE ONLY WITH THE STOPPING BRAKE PEDAL DEPRESSED AND LOCKED;**
**− START THE ENGINE AND START MOVING ONLY AT THE COMMAND OF THE COMMANDER;**
**− EMERGENCY ROTATION OF THE TURRET BY THE DRIVER MUST BE CARRIED OUT ONLY AFTER NOTIFYING ALL CREW MEMBERS;**
**− RUN THE HEATER OR ENGINE TO WARM UP THE TANK IN A CLOSED ROOM WITHOUT VENTILATION!**

**WHEN STOPPING THE COLUMN, IT IS PROHIBITED:**

**− EXIT THE TANK TO THE LEFT SIDE;**
**− STOP THE TANK IMMEDIATELY AFTER A SHARP TURN (ASCENT)!**

**DURING PULLING OUT THE TANK, IT IS PROHIBITED TO:**

**− BE NEAR THE TENSIONED CABLES AT A DISTANCE CLOSER THAN THE LENGTH OF THE CABLE;**
**− STAND BEHIND THE TANK BEING PULLED OUT OR BE IN IT;**
**− STAND ON THE SIDE OF THE TANK (WHEN PULLING YOURSELF OUT USING A LOG) IN THE DIRECTION OF THE AXIS OF THE LOG, CLOSER THAN 5 M!**

**WHEN TOWING A TANK IT IS PROHIBITED:**

**− BE BETWEEN THE TOWED TANK AND THE TRACTOR;**
**− SIMULTANEOUS OVERCOMING OF ASCENTS AND DESCENTS WITH TWO COUPLINGS;**
**− TOW A TANK WITH A NON-WORKING STOPPING BRAKE ON A SOFT HITCH!**

#### 3.1.2 Starting the engine

##### 3.1.2.1 General instructions

When parked, it is necessary to slow down the tank with the parking brake. Before engaging the parking brake pedal, set the gear shift lever to neutral and release the clutch pedal completely. When parking for a long time (more than 2 hours), it is necessary to close the valves of the air cylinders.

When preparing to move, it is recommended to use the VENT switch. Set the CO on the driver's panel to the AUTO position.

With the engine running, the manual fuel supply handle must be used to fix the minimum stable engine idle speed from 800 to 950 rpm. A higher rotation speed can be set using the manual fuel supply handle only while the engine is warming up, the tank is starting on an uphill slope, starting from a tug, overcoming a water obstacle, or reducing the coolant temperature before stopping the engine.

When the tank is moving in reverse, it is recommended to operate the engine at no more than 1600 rpm of the crankshaft.

### 3.1.2.2 Preparing the engine for starting

The engine can be started with compressed air (the main starting method) or with a starter-generator. If necessary, starting is possible in a combined way, i.e. using a starter-generator and air at the same time.

If it is impossible to start using the indicated methods, the engine can be started from an external source of compressed air or electricity, as well as from a tugboat.

It is necessary to take into account that starting the engine by any method (except for starting with PVV) is possible (not blocked by DCMV) if the following conditions are met:

– the oil temperature in the main oil tank is not less than plus 3 °C. When the oil temperature in the engine oil tank is less than plus 3 °C, the " " indicator flashes on the remote TV display ⚠, and on the driver's APU on the TEMP scale. OIL (engine) indicator flashes and the message STARTING THE ENGINE IS IMPOSSIBLE is displayed. HEAT THE COOLANT;

– a pressure in the engine lubrication system of at least 2 kgf/cm $^{2}$ has been previously created .

N o t e s

1 If the pre-created oil pressure in the engine lubrication system is insufficient (less than 2 kgf/cm $^{2}$) and the oil temperature in the main oil tank is from plus 3 to plus 35 ° C, engine starting is blocked, but messages are not displayed on the APU.

2 When the oil temperature in the main engine oil tank is more than plus 35 °C, the pre-created pressure in the lubrication system of the DKMV engine is not controlled.

3 In emergency cases, to remove the engine start blocking based on oil pressure and temperature, turn on the SPECIAL switch on the driver's panel .

When preparing the engine for starting, you must:

– carry out a control inspection of the tank, guided by clause 2.2of this manual;

– set the handle of the fuel distribution valve to the TANK ON position;

– open the valves of the air cylinders and check the pressure in them (reliable start-up is ensured at an air pressure of at least 75 kgf/cm2; $^{turn}$ on the battery switch;

– bleed the fuel supply system using the BCN pump or the RNM manual fuel priming pump while simultaneously pressing the air release valve button for 5 to 10 s;

– warm up the engine with a heater if the driver's APU displays the message STARTING ENGINE IMPOSSIBLE. HEAT THE COOLANT;

– make sure that the manual fuel supply handle is in the zero supply position, the gear selector lever is in the neutral position, and the stopping brake pedal is in the latch;

– sound a warning sound.

### 3.1.2.3 Starting the engine with an air starter

Set the COMBINATION switch to the off position.

Display and fix on the APU using the "↑" and "↓" buttons the OIL PRESSURE scale. Create in the engine lubrication system by pressing the MZN DV button. the maximum possible pressure, but not less than 2 kgf/ $^{cm2}$ . Without releasing the MZN DV. button, press the EPK button, crank the engine crankshaft with compressed air without fuel supply, and then press the fuel pedal about 1/2 of a stroke to start.

As soon as the engine starts, release the EPK button, after 10 s release the MZN DV button. Set the minimum engine idle speed by moving the manual fuel feed handle forward until it stops at lever 19 (Figure 3.22).

The duration of a single supply of compressed air should not exceed 5 s. MZN DV button. keep pressed in summer for no more than 1 minute, in winter for no more than 2 minutes.

### 3.1.2.4 Starting the engine with a starter-generator

Set the COMBINATION switch to the off position.

Press and hold the STARTER button, crank the engine without supplying fuel, then depress the fuel pedal approximately 1/2 of a stroke to start the engine. As soon as the engine starts, release the STARTER button, and the engine MZ will automatically turn off after 10 s. Set the minimum engine speed at idle by moving the manual fuel feed handle forward until it stops at lever 19.

The duration of the starter activation should not be more than 8 s. If the start attempt fails, restart the starter-generator after waiting for at least 15 s. Up to three restarts of the starter-generator are allowed, after which a break of at least 15 minutes is required to cool down the electrical equipment . During the break, it is necessary to find out why the engine does not start, eliminate the detected faults and repeat the start.

When starting the engine from the starter-generator, the image on the driver's APU may briefly go dark.

### 3.1.2.5 Starting the engine using a combined method

Start the engine using a combined method:

– at negative ambient temperatures (with preheating of the coolant by a heater);

– when using the PVV system.

To start the engine using the combined method, you must:

– set the COMBINED switch to the on position;

– press and hold the STARTER button and the OIL PUMPING FROM Gearbox switch - the starter will turn on, after which the electric pneumatic starting valve will automatically turn on;

– after a time of 2 to 3 s from the moment the electro-pneumatic valve is turned on, depress the fuel pedal approximately 1/2 of a stroke and start the engine;

– After starting the engine, release the STARTER button, and the engine MZ will automatically turn off after (10±3) s. Hold the Gearbox OIL PUMPING switch for at least 2 minutes with the engine running;

– set the minimum engine speed at idle by moving the manual fuel feed handle forward until it stops at lever 19.

The duration of the starter activation is no more than 8 s. When the ambient temperature is above minus 20 °C, it is allowed to start the engine using a combined method without turning on the OIL PUMPING FROM GEARBOX switch.

**3.1.2.6 Starting the engine from an external current source**

As an external current source for starting the engine, it is allowed to use only a similar tank connected in accordance with Figure 20.1, or a buffer group of batteries assembled in accordance with the diagram presented in Figure 10.6.

The starting procedure is as follows:

– turn off the battery switch and all consumers on both tanks;

– remove the plugs from the sockets and remove the caps from the external start plug connectors on both tanks;

– connect the set of wires and the external start connecting cable to the sockets and plug connectors strictly according to the diagram presented on the plate attached to the battery casing;

– turn on the battery switch on the tank power source;

– on the tank being started, without turning on the battery switch, prepare for starting and start the engine with the starter-generator in the usual way.

After starting the engine you must:

– disconnect the set of wires and cable, starting from the tank being started (disconnect the negative wire first);

– insert the plugs into the sockets and screw the caps onto the electrical connectors of the external start;

– turn on the battery switch.

A set of wires and an external start connecting cable are included in the group spare parts kit for the tank.

**3.1.2.7 Starting from a compressed air source**

The air system of a similar tank can be used as an external source of compressed air to start the engine.

The starting procedure is as follows:

– take two hoses 175.86.016sb from the single spare parts kits for tanks for filling the air system cylinders with air and connect them with the adapter fitting 172.60.172, located in the single spare parts kit for the tank;

– close the air bleed valves on both tanks;

– close the valves of the air cylinders on the tank being launched and open them on the source tank;

– connect the free ends of the hoses to the air bleed fittings on both tanks and open the air bleed valves ;

– prepare for starting and start the engine with an air starting device.

After starting the engine, it is necessary to close the air bleed valves on both tanks, disconnect the hoses , disconnect them and place the fitting and hoses in single sets of spare parts for the tanks, tightly screw the plugs on the air bleed fittings, and open the air bleed valves.

**3.1.2.8 Starting the engine from a tug**

Start the engine from a tugboat only if it is impossible to start the engine using an air starting device, a starter-generator, a combined method and external starting means.

To start the engine from a tugboat, perform the following work.

Before towing:

– prepare the engine for starting;

– connect the tanks with towing cables and turn the turret on the towed tank in the direction opposite to the direction of movement;

– engage 1st, 2nd or 3rd gear or reverse gear (it is recommended to engage the same gears with the towing tank);

– set the TOW START switch on the driver's panel to the on position;

– press and hold the MZN button START FROM TUG for a period of 15 to 20 s. At the same time, the driver’s APU displays the message START FROM TOWGER. STARTING WITH THE STARTER IS IMPOSSIBLE, signaling that the electromagnet of the starter-generator drive is turned on to the tug start position;

– press the MZN DV button. and create a pressure of at least 2 in the engine lubrication system $кгс/см^2$;

– set the manual fuel supply handle to the middle position;

– on command, start moving smoothly.

While towing:

– press the buttons MZN START FROM TUG and MZ DV. and hold them until the engine starts.

After starting the engine:

– depress the clutch pedal;

– if necessary, apply the stopping brake to the tank, preventing it from colliding with the towing tank;

– release the buttons MZN START FROM TUG and MZ DRIVE;

– set the handle of the TUG START switch to the off position;

– set the gear shift lever to neutral position;

– set the minimum rotation speed using the manual fuel supply handle;

– stop the tank on command, disconnect and put the tow ropes in place.

N o t e - Starting the engine with the starter when the TOW START switch is in the on position is impossible.

**3.1.2.9 Starting the engine using PVV**

Start the engine using the intake air heating system when exiting on alarm in winter conditions without warming up the engine or to reduce the engine preheating time when starting in the specified conditions using a heater.

Starting an engine with PVV is ensured at ambient air, coolant and oil temperatures not lower than minus 20 °°C. At lower temperatures, start-up is carried out after warming up the engine with a heater to a coolant temperature not lower than plus 60 °C.

No more than 20 engine starts using PVV are allowed during the warranty period of the engine. On the DKMV in the START FROM PVV mode, the number of remaining ALLOWED starts is displayed on the APU; when they are exhausted, the number of used EMERGENCY starts and the warning ENGINE SAFETY IS NOT GUARANTEED. When emergency starts are exhausted, the starting mode with emergency starting mode is blocked, and the message ENGINE LIFE FOR STARTING WITH ELV EXHAUSTED is displayed on the APU.

To start the engine using the PVV system, the following conditions are required:

– the engine lubrication system is filled with M-12G2, or M-5 $_{Z}$ /16D $_{2}$, or Mobil 1 oil;

– the oil has been pumped out from the gearbox housings and the input gearbox;

– the fuel system is filled with winter or arctic diesel fuel or TS-1, T-2, RT;

– pressure in air cylinders is not less than 100 кгс/см$^2$;

– batteries are charged to at least 75% of their rated capacity.

Prepare the engine for starting, guided by the instructions in paragraph 3.1.2.2, excluding instructions on heating with a heater, if the ambient temperature is not lower than minus 20 °C.

To start the engine you must:

– set the COMBINED switch to the on position;

– turn on the BCN;

– On the DCMV, press the MENU button, select the START WITH PVV mode. After the message CONFIRM START WITH PVV KN appears. SELECT press the SELECT button - the engine starting program with PVV begins. The engine oil pressure scale is displayed on the APU, the inscription START WITH PVV 240 s, the timer report begins in seconds from 240 to 0 s (if the start fails - from 240 to 105 s), voltage is supplied to the PVV spark plugs;

– at 180 s of the timer, the engine MZ is turned on;

– at 120 s of the timer the message PRESS THE STARTER BUTTON is displayed on the APU;

– sound a warning signal and press the STARTER button - the message PRESS THE STARTER BUTTON is removed, after 4 to 5 seconds the message START THE ENGINE WITH THE FUEL PEDAL is displayed;

– by pressing the fuel pedal 1/2 of its stroke, start the engine;

– release the STARTER button - the inscription START THE ENGINE WITH THE FUEL PEDAL is removed;

– in case of starting the engine, within 4 to 5 s, the inscription ENGINE STARTED WITH PVV is displayed, after a time of 20 to 30 s, the engine MSP is turned off and the inscription ENGINE MSP IS RUNNING is removed;

– set the engine speed from 1200 to 1400 rpm;

– at 90 seconds of the timer, the PVV candles are turned off;

– At 0 s of the timer, the start-up program with the PVV ends, the DCMV switches to the main operating mode - turn off the central station and warm up the engine.

If the engine with PVV fails to start, the engine MZN and the PVV spark plugs are switched off, the APU is cleaned and the message ENGINE WITH PVV NOT STARTED is displayed. TURN OFF the MCP.

Before attempting to start the engine again using the PVV, it is necessary to turn off and turn on the BCN switch again; when the BCN is turned off, the inscription ENGINE WITH PVV NOT STARTED is removed. TURN OFF the MCP.

The third attempt to start the engine using PVV is carried out no earlier than 10 minutes later at an air pressure in the cylinders of at least 90 kgf/cm $^2$ , while the APU displays the message TIME DELAY BEFORE THE NEXT START UP WITH PVV and the time is counting down from 10 min to zero .

**3.1.3 Warming up the engine**

Warm up the engine with the exhaust shutters closed at minimum idle speed; as it warms up, gradually switching to a mode from 1500 to 1700 rpm until the temperature of the oil in the engine lubrication system and coolant reaches plus 30 ° C, after which driving in lower gears is allowed. It is allowed to start driving when the pressure on the gearbox lubricant is unsteady, when the readings of the PRESSURE scale fluctuate. OIL (transmission) from 0 to 3 $кгс/см^2$.

The engine is considered warmed up and ready for normal operation at a coolant and oil temperature of plus 55 °°C. Long-term engine operation (more than 30 minutes) at a coolant temperature below plus 65 °C is not allowed, since this will cause tarring of the engine.

To speed up warming up, at low ambient temperatures it is recommended to close the exit blinds, and, if necessary, additionally cover the entrance blinds with an insulating mat. After the engine has warmed up, the exit and entrance shutters must be fully opened.

### 3.1.4 Warming up the engine

The engine must be warmed up at an oil temperature in the engine lubrication system of minus 5 °C or lower.

To warm up the engine you need to:

– start up the heater in accordance with clause 3.6.1and, depending on the ambient temperature, heat the coolant in accordance with Table 7;

– create the maximum possible pressure in the engine lubrication system by pressing the MZN DV. button without turning off the heater. At a pressure of at least 2 kgf/cm2 · turn off the heater and start starting the engine.

If there is no pressure, press the MZN DV button and crank the engine crankshaft without fuel supply. If this does not lead to the appearance of pressure, it is necessary to stop the heater and repeat the heating procedure no earlier than after 10 minutes, if necessary, more than once.

Table 7

| Ambient air temperature range, °C | Coolant temperature range, °C |
|---|---|
| minus 10 and above | 60 - 70 |
| from minus 10 to minus 20 | 70 - 80 |
| from minus 20 to minus 30 | 80 - 90 |
| from minus 30 to minus 40 | 90 - 105 |
| N o t e - Extreme values of coolant temperatures are given respectively for extreme values of ambient air temperatures. | |

### 3.1.5 Monitoring the operation of power and transmission units

The main parameters of the power plant and transmission are under the control of the DCMV. If the monitored parameters go beyond the recommended or limit values, the relevant information is automatically displayed on the DKMV APU and on the remote TV display.

If necessary, the parameters of the power plant and transmission can be controlled using information displayed on the driver's APU in manual mode. Recommended and permissible values for the operating parameters of the power plant and transmission are given in Table 1.

### 3.1.6 Stopping the engine

Before stopping the engine, run for at least 2 minutes at idle speed at engine speed (from 800 to 950 rpm).

Before stopping the engine, the coolant temperature should not be more than plus 90°C. To reduce the coolant temperature, it is recommended to let the engine idle at the following speeds: first at a speed of 1600 to 1900 rpm, then for at least 2 minutes at a speed of 800 to 950 rpm.

To stop the engine, move the manual fuel supply handle to the rear position with the fuel pedal released.

### 3.1.7 Features of operating the tank in the "SPECIAL" mode

The "SPECIAL" mode is intended to remove the restrictions of the DCM in the event of failures and malfunctions to ensure the mobility of the tank when performing combat missions.

The "SPECIAL" mode is turned on with the SPECIAL switch on the driver's shield strictly on the orders of the tank commander in anticipation of combat missions.

When the SPECIAL switch is turned on, the tank operates with the following differences:

– the engine is allowed to start at low pressure in the engine lubrication system and low engine oil temperature in the tank;

– automatic engine stop is blocked when coolant is lost;

– The operation of the engine power limiting mechanism is blocked when the coolant, engine oil or engine exhaust gases overheat, as well as when the coolant, engine oil or engine exhaust gases temperature sensors fail.

In the “SPECIAL” mode, control over the parameters of the engine and transmission rests entirely with the driver. In this case, in the event of overheating of the coolant or oil, exceeding the temperature of the exhaust gases, operation at low oil pressure and loss of coolant, engine failure is possible.

### 3.1.8 Tank movement

#### 3.1.8.1 Moving the tank

##### 3.1.8.1.1 Moving the tank on level ground

In automatic gear shift mode, start driving from first gear.

On dry and hard ground, in manual gear shift mode, movement can be started from second gear; in difficult road conditions (sand, deep snow, mud, etc.) - only from first gear.

To move the tank you need to:

– start the engine;
– remove the parking brake pedal from the latch and release it;
– depress the clutch pedal;
– engage first or second gear;
– give a warning sound;
– quickly but smoothly release the clutch pedal while increasing the fuel supply.

##### 3.1.8.1.2 Starting the tank on the rise

To move off a tank that is slowed down by a parking brake on an uphill slope, you must:

– remove the stopping brake pedal from the latch and, holding the pedal with your foot, do not allow the tank to roll;
– Depress the clutch pedal and engage first gear;
– give a warning sound;
– move and hold both steering control levers to the final position (towards you);
– release the clutch pedal and the stopping brake pedal;
– increase the fuel supply and move the steering control levers to their original position with a slight advance of one lever relative to the other.

If the tank rolls back down a slope with the engine running and the gear engaged, you must quickly depress the clutch pedal and stop the tank with the parking brake. Try to start again.

When stopping the engine, it is allowed to start it no earlier than 5 seconds after the tank and engine have completely stopped.

If the driver did not have time to depress the clutch pedal in a timely manner and the engine started in the opposite direction, the engine will automatically stop, and the message MOD ACTIVED will appear on the driver’s APU. REVERSE START OD.

In this case it is necessary:

– stop the tank with the stopping brake;
– set the selector lever to the neutral position;
– put the brake pedal on the latch;
– set the manual fuel supply handle to the rearmost position;
– connect MOD;
– start the engine and try to start again.

##### 3.1.8.1.3 Starting the tank on the descent

To move off a tank that is slowed down on a descent by the stopping brake, you must:

– start the engine;
– remove the parking brake pedal from the latch and hold the pedal with your foot;
– depress the clutch pedal;
– engage 1st gear;
– give a warning sound;
– release the brake pedal and clutch pedal.

Start driving on descents at a reduced engine speed, and on steep descents - at a minimum.

The inscription HIGH ENGINE SPEED appears on the driver's APU. BRAKE (and the speech information “Brake” in the headphones of the headset) indicates an increase in the engine crankshaft speed above the permissible one, in this case the tank must be immediately braked until the inscription goes out.

### 3.1.8.2 Gear shift

Gear shifting can be carried out in two modes: automatic and manual.

The transition between modes is carried out by the automatic transmission system switch installed in the gear selector housing.

#### 3.1.8.2.1 Shifting gears in automatic mode

When driving in automatic gear shift mode, the driver operates only the fuel pedal and the brake pedal.

The transition from a lower gear to a higher gear is carried out at the request of the driver by pressing the fuel pedal all the way, while the speed of the tank must be sufficient to engage the highest gear, and the engine crankshaft speed is close to the maximum.

It is possible to engage an overdrive at medium engine speeds by pressing a button located in the right turn lever. In this case, the driver must independently assess, depending on the engine load and road conditions, the feasibility of such a switch.

The transition from a higher gear to a lower gear is carried out when the speed of the tank and the engine speed are reduced to values that allow the inclusion of a lower gear. When making a turn, gear shifting is blocked.

The driver has the ability to disable the automatic transmission while driving to switch to manual gear shifting mode. To do this, it is necessary to turn off the automatic transmission with the switch on the selector, make sure that the selector handle is in the groove of the comb, and only then engage the necessary, from its point of view , transmission with the shift lever. If the automatic transmission is turned off during a gear shift cycle, the system will complete the shift cycle and only then turn off.

When the maximum coolant temperature is reached, upshifting does not occur. Downshifting occurs when the tank speed decreases to a speed that allows downshifting and at a higher engine speed.

#### 3.1.8.2.2 Manual gear shifting

When engaging reverse gear and when switching from reverse gear to first or second gear, the gear shift lever must be placed in neutral and the tank must be stopped. Engage the gear only after the tank has come to a complete stop.

It is not recommended to allow sudden acceleration or deceleration of the tank's movement (jerks) when changing gears. When driving in difficult road conditions (through a swamp, deep snow, on loose soil), on obstacles, when overcoming a ford, when loading onto vehicles, when driving in parks and pits, use the manual gear shift mode. In these conditions, it is necessary to engage the desired gear in advance.

#### 3.1.8.2.3 Changing from a low gear to a high gear when shifting manually

To change from a low gear to a higher gear you must:

– gradually increasing the fuel supply, accelerate the tank in gear to the maximum engine speed;

– quickly depress the clutch pedal and simultaneously release the fuel pedal;

– set the selector lever to the position corresponding to the next highest gear;

– release the clutch pedal and increase the fuel supply.

When switching from fifth to sixth gear, to prevent the tank from “dipping” after engaging sixth gear, it is allowed to hold the clutch pedal depressed for no more than 5 seconds.

#### 3.1.8.2.4 Changing from high gear to low gear when shifting manually

To change from a higher gear to a lower gear you must:

– release the fuel pedal (when switching from seventh to sixth, from sixth to fifth and from fifth to fourth gear, brake the tank if necessary);

– quickly depress the clutch pedal;

– set the selector lever to the position corresponding to the next lowest gear;

– release the clutch pedal and at the same time increase the fuel supply.

The tank is equipped with a gear selector blocking device, which is designed to eliminate the possibility of gear shifting from the seventh, sixth and fifth gears to one step lower at tank speeds higher than those calculated for engaging a lower gear in order to prevent the engine crankshaft speed from increasing beyond the permissible speed (overspeeding).

If absolutely necessary (for emergency braking of the tank by the engine, etc.), it is allowed to switch locked gears. To do this, while moving the selector lever, press the knob of the SELECTION LOCK switch to the OFF position. (up). As soon as possible, restore the broken seal and add information about the circumstances of using the switch to change from high to low gear in the “Special Notes” section of the tank’s registration form.

A sign of a malfunction of the locking device is the presence of the inscription GEAR SELECTOR LOCK ELECTROMAGNET CIRCUIT FAILURE on the driver’s APU or the failure of the downshift lock to operate in the engine speed range from 1600 to 2000 rpm in fifth, sixth and seventh gears.

In exceptional cases that require driving at high speeds with the locking device not working, driving in higher gears is allowed, while shifting gears from high to low at an engine speed of no more than 1600 rpm.

### 3.1.8.3 Tank rotation

When turning, increase the fuel supply to avoid engine stalling.

Rotate the tank by moving the corresponding lever to the final or intermediate position.

When the lever is moved to its extreme position, the tank turns with a constant turning radius for a given gear engaged. When the lever is moved to its extreme position with first gear or reverse gear engaged, the tank turns relative to the center of the braked track.

When moving the lever to any intermediate position, it is necessary to take into account that the lagging track is kinematically disconnected from the transmission and the turning radius in this case becomes free , i.e. depends on the condition of the soil under the tracks (the heavier or softer the soil, the smaller the turning radius will be).

General rules for turning a tank:

– operate the steering control levers as smoothly as possible;

– for turning, choose sections of the path with less resistance to turning (use hillocks and hills for turning);

– avoid turning the tank on steep climbs, descents and slopes;

– make turns on steep ascents and descents by quickly moving the lever from the initial position to the final position without delay in the intermediate position;

– It is not recommended to turn the tank sharply when driving on ice, a swamp, when overcoming a water obstacle, on sand, loose soil and deep snow;

– if the tank skids, stop turning by returning the lever to its original position;

– When exiting a turn, you must return the lever to its original (front) position.

### 3.1.8.4 Tank braking

The tank can be braked using the engine, the stopping brake (a braking device or the brake pedal), or in combination, i.e. simultaneously the motor and the stopping brake. Engine braking is achieved by reducing the fuel supply. Engine braking of a tank on descents is allowed at a crankshaft speed of no more than 2000 rpm. When engine braking is not enough, use a braking device to brake the tank, which requires removing your foot from the fuel pedal and briefly pressing the braking button on the left steering control lever. At the same time, simultaneously with braking, the stopping brake pedal moves forward to a more convenient position for braking. In second and third gears, braking (as well as movement of the stopping brake pedal) may be absent.

The braking device operates effectively when the air pressure in the air system is at least 70 $кгс/см^2$.

If, after releasing the braking button and the stopping brake pedal, the stopping brake pedal remains in the forward position, you must immediately stop the tank and turn off the braking device, for which you close the valves of the air cylinders and release air from the air system by pressing the valve lever with the valve of the GPO system. To avoid failure of gearboxes, do not use a faulty braking device (do not press the braking button).

The braking device should be restored to working order as soon as possible.

To avoid increased wear of the gearbox friction discs, it is necessary to avoid sharp braking of the tank with the brake pedal when driving in sixth and seventh gears.

### 3.1.8.5 Stopping the tank

To stop the tank you must:

– release the fuel pedal;

– slow down the tank using the engine or stopping brake until it stops completely;

– Without stopping the engine, depress the clutch pedal;

– Set the gear selector lever to the neutral position, release the clutch pedal and engage the parking brake pedal.

To stop the tank on an ascent and descent in first gear and reverse gear, you must:

– reduce engine speed;

– press the stopping brake pedal and, without stopping the engine, depress the clutch pedal;

– move the gear selector lever to neutral position;

– release the clutch pedal and, without allowing the tank to roll, set the brake pedal to the latch.

In all cases of holding the tank on an ascent (descent), it is recommended to keep the engine crankshaft speed at least 1300 rpm.

### 3.1.9 Features of driving a tank in various terrain and weather conditions

When driving a tank in difficult road conditions and with an engine load close to the maximum, it is possible to increase the temperature of the coolant, or engine oil, or engine exhaust gases to the maximum permissible values .

In this case, an indicator in the form of an isosceles triangle with an exclamation mark will begin to flash on the remote TV display, and a flashing marker "▼" will appear on the driver's APU above the scale with a parameter

whose value is outside the recommended or acceptable limit. In such a situation, the driver must take preventive measures to reduce the temperature.

If the driver does not take measures to reduce the temperature, the engine power limiting mechanism will work. At the same time, the message PTO WORKING will appear on the driver's APU. GO TO A LOWER GEAR, the voice and information "Shift to a lower gear" will be output to the headphones of the headset.

When driving a tank in the "traveling" position of the driver, the driver receives the necessary information about the operation of the tank systems and its individual parameters from the remote TV display.

#### 3.1.9.1 Driving a tank in winter conditions

Start moving the tank from a standstill smoothly in low gear. After a long stay, the first 200 m should be driven in low gear to warm up the lubricant in the undercarriage components and free the tracks from ice (snow).

When the tank moves along a compacted road (especially in icy conditions), the adhesion of the tracks to the road surface decreases. To avoid skidding and sliding of the tank, it is not recommended to brake sharply or make sharp turns.

Overcome short snow drifts on the move, using the inertia of the tank, without making turns and without reducing the engine crankshaft speed. If the tank does not overcome the snowdrift on the move, you need to move back along the old trail and repeat the technique.

In deep snow, you should avoid stopping and driving along ravines and hollows. If possible, move in a straight line, without sharp turns, to avoid slipping and loss of stability of the tracks in the contour. If the tank gets slightly stuck, it should be reversed along the old track.

On steep slopes, an attempt to brake the tank can lead to skidding and side sliding, and when encountering obstacles, the possibility of the tank overturning cannot be ruled out.

When overcoming ups and downs in winter, you must follow the following rules:

– overcome short climbs with acceleration, selecting the required gear in advance;

– if possible, do not change gears, make turns or stops;

– on a slippery slope, choose the direction of travel with the smallest slope and drive in second, third or fourth gear.

The descent should begin at low engine speed, braking the tank with the engine. If the tank skids due to sliding of the tracks, increase the engine speed and level the tank.

#### 3.1.9.2 Driving a tank in a desert-sandy area

Moving the tank in sandy areas should be done in first gear.

Select areas with hard ground or vegetation cover for movement. Soaked saline and clayey areas should be bypassed, and if it is impossible to bypass, overcome after preliminary reconnaissance.

Overcome short sandy sections and low dunes on the move, without changing to a lower gear.

Overcome long sandy areas and large dunes in low gear.

Overcome dunes at right angles without turning or sharply changing engine speed. When crossing the crest of a dune, do not reduce the fuel supply. Use the descent from the dune to switch to higher gear.

If possible, do not make sharp turns to avoid loss of stability of the tracks in the contour.

When moving in a column through deep sand, do not follow the trail of the tank in front.

If the air is very dusty, move in a column at increased distances. When passing through a thick dusty strip, do not make turns, but move in the previously chosen direction. During this time, all crew members must monitor the area.

It must be taken into account that due to slipping of the tracks due to insufficient traction with the ground when moving on loose sand, the trip meter readings may be no more than 15% greater than the actual distance traveled .

When the engine is running at minimum idle speed for more than 30 minutes, it is necessary to briefly, within 3 to 5 minutes, set the crankshaft speed from 1800 to 2000 rpm.

#### 3.1.9.3 Driving a tank in a wooded area

Massifs of continuous forest should be passed along clearings and forest roads or bypassed along the edge. In small forests you should move in low gears, breaking trees with the frontal part of the tank.

In a sparse forest, move between the trees, resorting to felling trees when there are no ways around. Cut down large trees from the middle of the frontal part of the hull in low gear, turning the turret with the gun backwards and closing the tank hatches.

In cleared or burned forests, you should drive in low gear and carefully observe the area, as grass and bushes can hide stumps, stones and other obstacles.

Stumps with a height below the ground clearance of the tank should be passed under the bottom, and taller ones that cannot be bypassed should be overcome in low gear, directing one of the tracks towards the stump.

Overcome logs and fallen trees lying in the path of the tank in low gears at a right angle, and if that fails, then point the tank at a log at an angle of 45° to 60°, and when hitting it with the middle road wheels, turn the tank and at a straight line. slide off the log at an angle.

When moving a column through a wooded area, it is necessary to follow the trail of the tanks in front.

#### 3.1.9.4 Driving a tank in a swampy area

Avoid wetlands if possible. If a detour is not possible, then cross the wetland after careful reconnaissance.

When approaching a wetland, position the tank in the selected (marked) direction and engage low gear. While driving, maintain the operating speed of the engine crankshaft, avoiding gear changes, turns and stops. In case of a forced stop, move off smoothly, avoiding the tracks slipping.

To align the direction of movement, smoothly turn the tank without braking the track.

Do not follow the trail of tanks in front.

Small swampy areas with good soil on the approach can be overcome on the move in high gears, using the inertia of the tank. In the event of a slight jam, evacuate the tank using self-extrication.

### 3.1.9.5 Driving a tank in a mountainous area

Cope with steep climbs in low gear, avoiding gear changes, stops and turns.

If the tank rolls back down a slope with the engine running and the gear engaged, you must quickly depress the clutch pedal, stop the tank with the parking brake and set the gear selector lever to the neutral position. When stopping the engine, it is allowed to start no earlier than 5 seconds after the tank and engine have completely stopped.

Cope with gentle ascents and descents in the highest possible gear. Overcome steep descents in low gear with engine and brake braking, not allowing the engine crankshaft speed to increase above 2250 rpm, as evidenced by the appearance of the inscription HIGH ENGINE SPEED on the driver's APU. BRAKE.

In mountainous areas, premature operation of the steam-air valve and loss of fluid from the cooling system are possible due to a decrease in barometric pressure with increasing altitude above sea level. To avoid this, drive when the coolant temperature is lower than recommended. If the coolant temperature rises sharply, stop driving and eliminate the cause.

At an altitude of more than 2000 m, it is not recommended to operate the engine at a speed less than 1700 rpm, for which purpose select a gear one step lower than road conditions allow.

Drive the tank along mountain roads, clinging to the side opposite the cliff, and carefully watch the movement of the tank in front.

When driving on long ascents and descents, keep the distance between tanks from 70 to 100 m; on serpentines, the distance between tanks may be reduced.

Do not start moving up a steep climb (descent) until the tank in front has overcome it.

If, while overcoming a rise, the tank begins to slide backwards and braking does not ensure its stopping, stop the tank by pointing it at a rock ledge or other local object, if possible, avoiding a strong impact.

On sharp turns (especially on serpentines), if it was not possible to turn the tank in one step, it is necessary to turn it alternately backwards and forwards at the command of the commander.

On sections of the route with closed turns, gorges, landslides, as well as in other places dangerous for movement, the commander must control the movement, moving in front of the tank. Move through the gorges with the gun turned towards the stern.

When fording mountain rivers, direct the tank downstream at an angle of approximately 30° relative to the shore, make turns with extreme caution to avoid jamming of the chassis, rupture and throwing off the tracks due to stones getting between the road wheels. In the event of a forced stop of the tank, take all measures for its immediate evacuation.

When driving off-road, choose the direction with the smallest angles of ascent (descent, roll) and the least amount of stones. If it is impossible to bypass separate stones, overcome them by driving over one caterpillar and directing the other to the free part of the path. Do not allow the bottom to hit rocks, as this can lead to sagging of the bottom and disruption of the installation of units and mechanisms.

On dry ground and shallow cover, on ascents, descents and slopes, choose areas covered with vegetation for movement. If the soil is wet, choose rocky areas.

Before overcoming sections of the road with screes and landslides, they must be reconnoitered, the possibility of a tank moving along them must be determined and, if necessary, cleared.

To stop the tank, choose safe places with the smallest angle of ascent (descent, roll) and hard ground.

When stopping on an ascent (descent), brake the tank with the stopping brake, setting the pedal to the latch, and place stones or a log under the tracks.

Do not stop the tank near ravines, on narrow roads, at sharp turns and in places where there are likely to be collapses.

### 3.1.9.6 Driving a tank in low visibility conditions

When driving in a convoy, to avoid a collision, move at increased distances with the side lights on. The entire crew must monitor the road and the tank ahead.

When passing through a particularly thick strip of dust, fog or smoke for a short time, avoid turning, changing speed, and stopping.

### 3.1.9.7 Driving a tank using a navigation system

**ATTENTION:**

**DO NOT TURN OFF THE POWER TO THE TANK. WHEN THE POWER IS DISCONNECTED, A REORIENTATION MUST BE CARRIED OUT;**

**IT IS PROHIBITED TO MOVE WITH THE ORIENTATION SYSTEM TURNED ON AT ANGLES OF TILTING OF THE TANK BODY MORE THAN 30º!**

The orientation system is turned on when the UARMk is turned on and operates as part of the PTK.

While the tank is moving, the commander gives instructions to the driver to ensure the tank moves along the chosen route.

The driver has the opportunity to observe on the APU in the “Direction of Movement” mode the current directional angle of the tank, the distance to the destination, the deviation from the direction to the destination or from the given direction.

In cases where it is possible to move the tank to its destination in a straight line, the driver drives the tank so that the moving index on the APU is aligned with the marker. In the event of a forced deviation from the course (detours around ravines, swamps, etc.), after overcoming an obstacle, the driver turns the tank, trying to align the moving index with the marker.

When the tank turns to the right, the directional angle on the driver's APU increases, and when the tank turns to the left, it decreases.

To eliminate the additional error in measuring the path during the process of overcoming swampy terrain, crossing water obstacles and getting the tank stuck, use the “Snap at water obstacles” mode, which ensures that the coordinates are redefined after overcoming the obstacle.

**ATTENTION:**

**IT IS PROHIBITED TO MOVE THE TANK DURING UNDERWATER DRIVING WITH THE ORIENTATION SYSTEM OFF!**

When driving underwater, it is necessary to drive the tank so that the moving index is kept near the marker, and the value of the directional angle is kept near the value determined before overcoming the water obstacle.

### 3.1.10 Overcoming obstacles and barriers

#### 3.1.10.1 General rules for overcoming obstacles

All obstacles and obstacles, as a rule, are under enemy fire. Based on this, the following rules for overcoming obstacles (barriers) must be observed.

You should approach and move away from an obstacle at the highest possible speeds allowed by the terrain, using hidden approaches for approach.

Overcome an obstacle, usually at a right angle, smoothly, without impacts, having previously engaged a gear in which the obstacle can be overcome.

Avoid turning and changing gears on an obstacle. Do not stop the tank before, on or behind an obstacle.

When overcoming certain obstacles (barriers), the gun should be given a maximum elevation angle or rotated towards the stern.

#### 3.1.10.2 Rules for overcoming the most common obstacles

Funnels (pits), the diameter of which is not larger than the tank track width, should be passed between the tracks. Overcome deep craters (pits) strictly in the center, turning the turret with the gun backwards. Smoothly lower the bow of the tank into the funnel, to reduce the fuel supply. At the moment when the front rollers touch the bottom of the funnel, sharply increase the fuel supply. When lifting from the hopper, maintain a uniform engine speed. When exiting the funnel, when the bow of the tank begins to sink to the ground, reduce the fuel supply.

Overcome trenches up to 1.3 m wide at right angles at the highest possible speed.

Trenches with a width of 1.3 to 2.65 m that do not have hard slopes (rocky, concrete, ice) must be overcome at right angles at the maximum possible speed.

Trenches with a width of 1.3 to 2.65 m, having hard slopes (rocky, concrete, ice) must be overcome at right angles in 3rd gear, in a steady state of movement (in the absence of tank acceleration).

Anti-tank ditches must be crossed using passages or bridges. Overcoming an anti-tank ditch, in which passages have been made, is carried out similarly to overcoming deep craters.

Bends on descents and ascents, as well as vertical walls up to 0.85 m high, must be overcome by waddling. To overcome these obstacles, you need to switch to 1st gear, smoothly move the tank towards the obstacle and, as soon as the tank touches the wall, increase the fuel supply as you climb the obstacle. When the tank crosses the crest of an obstacle, reduce the fuel supply to avoid a sharp impact of the rollers on the ground. After the front rollers touch the ground, increase the fuel supply.

To overcome (at high speeds) limited passages and minefields, the tank should be directed in advance, at a distance of 20 to 30 m from the entrance, in the center of the passage to avoid turns. If necessary, rotate (level) the tank smoothly, without jerking, while slightly increasing the fuel supply.

Gouges and hedgehogs can be crossed along the passages, shooting them or destroying them with the tank tracks. Direct the tracks at the crosshairs of the hedgehogs and the tops of the gouges, avoiding hitting them with the tank body.

### 3.1.10.3 Features of driving and operating a tank equipped with a trawl

When installing a KMT-8 track mine trawl with or without an EMT electromagnetic attachment on a tank, or an EMT electromagnetic attachment, when operating the tank, you must follow the operating instructions for the KMT-8 trawl and the EMT electromagnetic attachment.

Installation and operation of trawls should be carried out in accordance with the requirements of instructions 232 TO and 283 TO, as well as taking into account the features specified in this section.

Installation of elements of pneumatic systems and electrical equipment of trawls should be carried out in accordance with Figures 20.2 and 20.3.

A crew that has undergone special training in the rules for operating tanks with trawls and an EMT attachment is allowed to operate a tank equipped with a trawl.

Remove the front folding flaps 2 (Figure 20.5) with the mud flaps 1 installed on them, as well as the axles 3 securing the flaps. Secure the 4 dismantled elements in the rear of the tank with wire in accordance with the drawing. Additional fastening to any protruding parts at the stern is allowed.

When installing the KMT-8 track mine trawl, it is necessary to install adapter strips 188M.04.102 pos. between the trawl fastening strips welded to the lower frontal sheet and the brackets 10 (Figure 20.4) of the coupling device. 8, 188M.04.103 pos. 9. Secure the trawl coupling brackets with bolts 188M.04.111 pos. 7, 188M.04.112 pos. 6 and bolts 229.05.010 pos. 11 (located in the box with the trawl pneumatic system) with spring washers. Adapter strips (188M.04.102, 188M.04.103) and bolts (188M.04.111, 188M.04.112) are located in a single spare parts kit for the tank.

The location of the pneumatic system hoses between the mounting points may differ from those shown in the figures due to the design features of the modification of objects.

When installing an EMT electromagnetic attachment on a tank, it is necessary between the trawl fastening strips welded to the lower frontal sheet and the brackets of 1 electromagnetic attachment EMT install adapter strips 188M.04.104 pos. 5 188M.04.105 pos. 2. Secure the brackets of the electromagnetic attachment EMT with bolts 188M.04.128 pos. 3 with spring washers 4. Adapter strips (188M.04.104, 188M.04.105) and bolts (188M.04.128) are located in a single spare parts kit for the tank. When installing an EMT electromagnetic attachment on a tank, it is allowed to rest the EMT bracket against the blade mounting clamps without interfering with installation.

When installing the KMT-8 trawl and the EMT electromagnetic attachment together on a tank (283 TO, Figure 10), install bracket 17 with a turn under the first bolt for fastening the trawl brackets.

Install the control panel of the electromagnetic attachment EMT in the control compartment on the bottom rail in front of the driver's seat, extend the external start cable using extension cord 188.70.091sb from a single set of spare parts for the tank. Install the negative terminal of the wire under any bolt of the tank body. Secure the wires inside and outside with a belt 229.06.38 (from the trawl kit) and PVC tape (from a single spare parts kit for the tank) to the fixed parts of the tank.

Connect the control valve for the air system for transferring the knife sections of the KMT-8 trawl with a gearbox to the air bleed fitting using adapter 172.60.068sb from a single set of spare parts for the tank, installing gaskets 229.03.007 and 232.08.017 from the trawl kit.

Before starting work, check the reliability of fastening of all parts and assemblies of the trawl and the EMT electromagnetic attachment to the tank and their serviceability. The movement of the tank with the KMT-8 trawl installed in the stowed position is carried out depending on road conditions at speeds that ensure the normal operating mode of the tank. While on the march, the tank commander must continuously monitor the road, warning the driver when approaching obstacles.

Before making the march, it is necessary to move the knife sections of the KMT-8 trawl to the stowed position and lock them with ties. Set all toggle switches (switches) of the EMT electromagnetic device control panel to the off state.

When driving a tank with a trawl, additionally observe the following rules:

– overcome obstacles with the trawl smoothly in low gears, at right angles, avoiding impacts of the blade sections and the trawl's UTM on objects on the ground (stones, boulders, stumps, etc.);

– overcome obstacles in the form of ditches and trenches with steep walls no more than 2.5 m wide in 1st gear;

– Make turns smoothly, with large radii, shift gears quickly, avoiding jerking of the tank.

In anticipation of mine sweeping, it is necessary:

– remove the ties securing the blade sections of the trawl;

– close all hatches;

– set the gun to the maximum elevation angle.

The knife sections of the KMT-8 trawl are transferred from the traveling position to the working position in front of the minefield by the driver at the command of the tank commander, while the tank must move in 1st gear. Trawling with the electromagnetic attachment EMT is carried out when the “PKU” toggle switch is turned on on the control panel of the electromagnetic attachment.

The speed of movement of the tank with the trawl in the working position should be no more than 15 км/ч(1st or 2nd gear). The movement should be as straight as possible.

After crossing the minefield, move the blade sections of the trawl to the stowed position, and turn off the “PKU” toggle switch on the control panel. Move the knife sections to the stowed position with the engine running and the pressure in the tank air system at least 110 kgf/cm $^2$ .

**ATTENTION:**

**TO AVOID BREAKAGES OF THE KNIFE SECTIONS OF THE KMT-8 TRAWL, IT IS PROHIBITED TO WORK WITH THEM ON STOCKY SOILS, FROZEN SOILS WITH A FREEZING DEPTH OF MORE THAN 5 CM, AS WELL AS IN SHRUBS AND IN AREAS WITH A LARGE NUMBER OF NATURAL AND ARTIFICIAL FUCKING;**
**DO NOT ROTATE THE TANK SHARPLY WHEN THE KNIFE SECTIONS ARE IN THE WORKING POSITION!**

When trawling mines installed in snow (on snow) and frozen ground, install winter trawling devices on the blades of the working parts.

Install the spare parts box for the KMT-8 trawl on the rightmost mounting bracket for the fuel barrel on top of the mounting bracket for the feed grates through the adapter bracket 184-4.01.001sb ( located in a single spare parts kit for the tank ). Before trawling, the barrels are removed, and the stern grid sector is hinged downwards.

The entry of a tank with a trawl onto bridges and trailers is carried out with the mechanism for lifting the knife sections turned on (in the air) or on tie rods. Before driving the tank with the trawl onto the trailer, it is recommended to tighten the lever (see 232 TO) with the roller of the bracket for the coupling device of the trawl knife sections, moving the pin to hole “1”.

To avoid damage to the blade sections, it is not recommended to move the tank in reverse with the blade sections in the working position. Limited movement of the tank in reverse is allowed to facilitate the transfer of the knife sections to the stowed position.

After dismantling the trawl from the tank, install the previously removed front flaps with the mud flaps installed on them, as well as the axles for attaching the flaps.

To maintain the functionality of the tank’s mechanisms, its total mileage with the trawl should not be more than 300 км, including no more 30 кмwhen the knife sections are in working position.

### 3.1.11 Towing and evacuation of a tank

#### 3.1.11.1 Preparing the tank for evacuation and towing

As a rule, the tank is towed by a tractor. Towing a tank with a tank is allowed in exceptional (emergency) cases, and the use of the tank as a tractor must be short-term.

Before towing, the following work must be done on a towed tank:

– inspect the tank to be towed, check its technical condition (primarily the condition of the chassis and the operation of the stopping brake);

– repair the chassis, if necessary;

– Pump oil into the left and right gearbox crankcases using the tug's MZN pump (when towing the tank over a distance of more than 5 km), for which:

- open the roof over the transmission;
- make sure that there is oil in the hydraulic system tank of the transmission unit and that there is no oil loss;
- use the gear selector lever to engage second or fourth gear;
- set the switch on the driver's panel START FROM TUG to the ON position;
- press the button MZN START FROM TOW;
- with the MZN pump running, periodically press the clutch pedal all the way and release the clutch pedal, while oil will be pumped from the tank to both gearboxes;
- pump oil into the gearbox until the oil level in the tank reaches mark “B” on the rod for measuring the level of fuel and oil in the tanks;
- set the gear selector lever to neutral position;
- set the TUG START switch to the OFF position;
- close the roof over the transmission.

In case of failure of the tug's oil pump, each gearbox must be filled with oil through the hatches of the distribution mechanisms, for which:

– drain the oil from the oil tank of the hydraulic system of the transmission unit until the oil level in the tank reaches mark “B” of the rod for measuring the level of fuel and oil in the tanks;

– remove the hatch covers on the right and left distribution mechanisms;

– pour the oil drained from the tank equally into each gearbox through the hatches;

– Reinstall the removed covers of the distribution mechanism hatches.

It is allowed to tow a tank for no more than 5 km without additionally filling the gearbox housings with oil, if the oil has not been pumped out of the gearbox before.

In the event of loss of oil from the hydraulic system of the transmission unit and the need to tow the tank, it is permissible to fill the gearbox housings with the oil used for the engine lubrication system. In this case, 10 to 12 liters of oil should be poured into each gearbox housing through the hatches of the distribution mechanisms, after first draining the remaining transmission oil from the gearbox housings.

As soon as possible, the oil from the system must be drained and the oil used in the hydraulic system of the transmission unit must be refilled, after flushing the system.

### 3.1.11.2 Towing a tank

On a towed tank, it is recommended to turn the gun in the direction opposite to the direction of towing, lock the turret, the driver should be in the control compartment, and the driver's hatch should be closed when towing by the front lugs. The tank is towed using tow ropes hooked to towing eyes located on the bow or to tow hooks located at the stern of the tank.

A tank with an inoperative engine cannot be controlled by the turning levers, since the hydraulic control system does not work.

When towing a tank, the following rules should be followed:

– connect the tractor and the towed tank with two crosswise cables of the same length; with this connection method, the traction force is transmitted to both cables more evenly both when moving in a straight line and in turns;

– the towing speed should be, if possible, uniform and meet the safety requirements set out in the “Guide to the Rules for Driving Combat Vehicles (RPVBM-82)”, including taking into account visibility, ground conditions and other factors;

– move away smoothly, having previously tensioned the cables;

– To avoid a collision with the tractor, if necessary, briefly apply the parking brake to the towed tank;

– frequent and prolonged braking is not permissible in order to avoid failure of gearboxes;

– in the case of using two or three tractors, the lead tractor starts moving, and the others move off in sequence;

– for towing, choose a route with slight slopes and without sharp turns;

– The driver-mechanic of a towed tank is obliged to monitor the cables, keeping them taut at all times;

– change gears quickly, avoiding a sharp slowdown in the movement of the towed tank, to do this, give the tractor a smooth acceleration, and then engage the highest gear;

– after switching on the gear, gradually pick up speed, since at the moment of shifting the cables sag and can break when jerking;

– before stopping the tractor, the driver must give an audible warning signal, take his foot off the fuel pedal and, after the tractor has been moving for some time at minimum engine speed, depress the clutch pedal, and the tractor will stop; the cables should be slack at the moment of stopping; to overcome short steep climbs, use long cables so that when the towed tank is moving on the climb, the tractor is, if possible, on a horizontal section;

– when wading through a narrow water obstacle, use long ropes so that the towed tank and the tractor are not in the water at the same time;

– make turns at low speed and, if possible, with a large radius, and make sharp turns in several stages;

– when towing a tank with a non-working stopping brake, as well as when towing a tank on terrain with steep descents and ascents, use rigid couplings (rods) or tow with two tractors; In this case, the second tractor is coupled to the towed tank from behind and is used for braking .

## 3.2 Weapon complex

### 3.2.1 Ammunition placement

The gun's ammunition capacity is 40 rounds, which are placed:

– 22 shots - in the rotating conveyor of the automatic loader;

– 8 shots - in non-mechanized mountings of the fighting compartment;

– 10 shots - in non-mechanized stowage of the turret aft module.

Any type of shot can be loaded into the rotating conveyor of the automatic loader.

Non-mechanized stacks can only accommodate certain types of shots.

As shots from the VT are used, the crew replenishes the VT with shots from non-mechanized stacks or manually loads the gun with shots from non-mechanized stacks. In this case, first of all, you should use shots from non-mechanized stowage of the aft module of the tower, replenishing them with VT or loading them into non-mechanized stowage of the fighting compartment.

**PROHIBITED:**

**- PLACE ARMOR-PIERCING SUB-CALIBER ROUNDS 3VBM22 AND 3VBM23 IN ALL NON-MECHANIZED INSTALLATIONS;**

**- PLACE ALL TYPES OF SHOTS EXCEPT ARMOR-PIERCING SUB-CALIBER IN NON-MECHANIZED STOWAGE OF THE TURRET AFT MODULE!**

Eight rounds in the non-mechanized stowage of the fighting compartment are placed:

– four shells of any type - at the MTO partition on the right;

– four shells of any type - at the MTO partition on the left;

– eight charges are in the rack near the MTO partition.

Ten rounds in the non-mechanized stowage of the aft module of the tower are placed:
– five armor-piercing sub-caliber shells - in the right compartment of the aft module;
– five armor-piercing sub-caliber shells - in the left compartment of the aft module;
– ten charges - in the middle compartment of the aft module.

In non-mechanized stowage of the fighting compartment, it is possible to place 3UBK14 (3UBK14F) or 3UBK20 guided rounds.

**ATTENTION:**

**WHEN LOADING GUIDED SHOT WITH TWO TYPES OF GUIDED MISSILES, ONE OF THE TYPES OF GUIDED MISSILES (HIGH EXPLOSIVE OR CUMULATIVE) SHOULD BE PLACED IN NON-MECHANIZED STORAGES OF THE COMBAT COMPARTMENT AND USED WITH MANUAL LOADING!**

The ammunition load of the coaxial 7.62 mm machine gun is 2000 rounds (five magazines with 400 rounds of ammunition each) which are placed:
– one belt - in the magazine on a machine gun mount;
– one tape - in the store on the VT flooring in front of the commander's seat;
– two tapes - in magazines on the VT flooring behind the commander's seat;
– one tape - in the store on the VT flooring behind the gunner's seat.

The ammunition load of the 12.7 mm DPU machine gun is 300 rounds, which is placed in the magazine on the machine gun mount.

The ammunition load of three AKS-74U assault rifles is 360 rounds (three pouches for four magazines of 30 rounds each) which are placed:
– one pouch - in a rack on the VT flooring under the commander’s seat;
– one pouch - in a rack on the VT flooring under the gunner's seat;
– one pouch is on the casing of the AB racks to the left of the driver.

Ten F-1 hand grenades are packed in five bags (two grenades each) which are placed:
– one bag - on the box for TVN-5 to the right of the driver;
– two bags - in a rack on the VT flooring under the commander’s seat;
– one bag - in a rack on the VT flooring under the gunner's seat;
– one bag is in a rack on the bottom sheet of the turret behind the commander’s seat.

Twelve cartridges for the signal pistol are placed in two cartridge belts (six cartridges each) which are placed in a rack on the VT flooring under the commander’s seat.

The placement of ammunition in the tank is shown in Figure 9.12.

### 3.2.2 Handling shots

Personnel who have studied the design of shots and the rules for handling them in accordance with the current instructions for categorizing ammunition, technical descriptions and operating instructions for ammunition and guidelines for the storage and conservation of artillery weapons and ammunition in the military are allowed to work with shots. The shots are safe and reliable when handled correctly.

Violation of the rules for handling shots can lead to their incorrect action, damage to the gun, as well as premature rupture of cumulative or high-explosive fragmentation shells in the gun barrel or along the trajectory. Therefore, it is necessary to know the structure, operation and rules for handling shots and their elements, as well as strictly comply with the given requirements.

#### 3.2.2.1 Safety precautions when handling shots

**IT IS PROHIBITED TO SHOOT:**

**- FINALLY FILLED (WITH FUSES) WITH CUMULATIVE AND HIGH-EXPLOSIVE SHELLS THAT FALLED SIDE OR TO THE BOTTOM OF THE PROJECTILE FROM A HEIGHT OF MORE THAN 1.5 M OR ON THE HEAD FROM ANY HEIGHT, AND ALSO SUBJECT TO SHARP IMPACTS AND A VARIATIONS;**
**- GUIDED MISSILE SHOTS FALLED UNPACKED FROM A HEIGHT OF UP TO 1.5 M OR IN PACKAGING FROM A HEIGHT FROM 1.5 TO 3 M (THEY ARE SUBJECT TO RETURN TO THE AMMUNITION WAREHOUSE). GUIDED MISSILE SHOTS FALLED IN A PACKAGE FROM A HEIGHT OF 3 M OR MORE OR FROM A HEIGHT OF 1.5 M OR MORE WITHOUT PACKAGING ARE CLASSIFIED AS DANGEROUS AND ARE DESTROYED IN THE ESTABLISHED PROCEDURE;**
**- SHOT IN WHICH THE FUSES HAVE BEEN COMPLETELY OR PARTIALLY UNSCREWED;**
**- SHOTS THAT HAVE DEFECTS IN THE FUSES IN EXTERNAL APPEARANCE (DUMPSED CASE OR SAFETY CAP, PRESENCE OF CORROSION PRODUCTS ON THEM, TORNED, SELLED, PUNCHED CAPS);**

**- SHOTS IN WHICH THE BALLISTIC TIPS OF ARMORS-PIECING SUB-CALIBER PROJECTILES ARE BENT OR THEIR MOUNTING IS LOOSE;**
**- SHOTS THAT HAVE PLAY AT THE JOINTS OF THE ROCKET, DENTS ON ITS CASE;**
**- SHOTS THAT HAVE DEFECTS IN THE BURNING CASE CASE, PAN AND BURNING PARTS OF THE MAIN CHARGE, CUT-OUTS AND TORN AREAS OF THE CIRCLES GLUED TO THE COVERS;**
**- SHOTS IN WHICH THE BURNING CASE CASE AND THE BURNING CYLINDER OF THE ADDITIONAL AND MAIN CHARGE HAVE CRACKS AND OTHER SIGNS OF VIOLATION OF INTEGRITY;**
**- SHOTS THAT HAVE A DISRUPTION IN THE CONNECTION OF THE BURNING CYLINDER WITH THE MAIN CHARGE CASE;**
**- SHOTS THAT HAVE MOVEMENT OF THE BURNING CYLINDER OF AN ADDITIONAL CHARGE RELATIVE TO THE PROJECTILE;**
**- SHOTS THAT HAVE NO MARKINGS OR DISTINGUISHING COLORING;**
**- SHOTS THAT HAVE CORROSION CELLS ON THE SURFACE OF THE PROJECTILE CASE WITH A DEPTH MORE THAN 1 MM;**
**- SHOTS THAT HAVE NOTCHES ON THE LEADING (OBTURING) BELT WITH A DEPTH OF MORE THAN 0.5 MM;**
**- THERE ARE DAMAGES TO THE PARTS OF THE STABILIZER BLADES LOCKING MECHANISM;**
**- THERE ARE PARTIALLY OR COMPLETELY UNSCREWED AXLES OF THE STABILIZER BLADES;**
**- THERE ARE DENTS ON THE TOP AND SIDE SURFACES OF THE BPS TIPS;**
**- THERE ARE DELAYS IN THE MATERIAL OF THE CASE OF THE BURNING CASE;**
**- THERE ARE ANY VIOLATIONS IN THE INTEGRITY OF THE BURNING MATERIAL OF THE CASES AND CYLINDERS, RAMMER COVERS AND LIMITER COVERS;**
**- THERE ARE DEFECTS IN THE THREAD OF THE CASE SELLER THAT PREVENT THE SCREWING IN OF CAPSULE BUSHINGS OR DO NOT ENSURE THE RELIABILITY OF THEIR ATTACHMENT AND CANNOT BE CORRECTED;**
**- THERE ARE CORROSION SITS ON THE SURFACE OF THE CASE;**
**- THERE IS A CONCAVENESS OR CONVEXENCE IN THE BOTTOM OF THE CHARGE TRAY;**
**- THE CAPSULE BUSHINGS ARE SOAKED WITH TRACES OF OXIDATION PRODUCTS;**
**- THE CAPSULE BUSHINGS HAVE TRACES OF CORROSION PRODUCTS THAT CANNOT BE REMOVED WITH A DRY RAG;**
**- THE FLAMMABLE COMPOSITION OF TRACERS HAS TRACES OF CRYSTALLIZATION, BOLDING AND WETTERING;**
**PROJECTILES WITH DAMAGED FUSES, AS THE MOST DANGEROUS IN HANDLING, SHOULD BE RETURNED TO THE AMMUNITION STORAGE FIRST.**

**PROHIBITED:**

**- CHARGE THE CANNON WITH A GUIDED ROCKET WITH THE MAIN CHARGE OF AN ARTILLERY SHOT. IN THE CASE OF SUCH LOADING, THE GUN SHUTTER WEDGE WILL NOT CLOSED DUE TO THE MAIN CHARGE PROJECTING. IT IS NECESSARY TO REMOVE THE MAIN CHARGE FROM THE GUN AND REPLACE IT WITH A 9X949 PROPELLER DEVICE TAKEN FROM A NON-MECHANIZED STACK OR REMOVED FROM THE AZ CASSETTE IN THE MODE OF SEMI-AUTOMATIC UNLOADING OF SHOT FROM A ROTATING T TRANSPORTER (WITHOUT REMOVING THE COMMANDER'S SEAT);**
**- DISASSEMBLE FUSES OR CORRECT THEIR PARTS IN MILITARY UNITS OR AMMUNITION DEPARTMENTS;**
**- DEAL WITH GUIDED MISSILE SHOTS IN THE TROOPS;**
**- TRANSPORT COMPONENT PARTS OF SHOTS WITHOUT PACKAGING, AND ALSO CARRY PACKAGES WITH SHOTS WITH THE COVER DOWN, TURN OR THROW THEM WHEN LOADING OR UNLOADING;**
**- CARRY OUT ROUTINE CHECKS OF A GUIDED MISSILE SHOT UNDER HIGH VOLTAGE TRANSMISSION LINES, AND ALSO AT A DISTANCE OF LESS THAN 300 M FROM TRANSMITTING RADIO STATIONS OR RADAR STATIONS;**
**- TAKE IN YOUR HANDS A SHARED UNEXPLODED ROCKET, AND ALSO TOUCH IT;**
**- USE COMBAT OR PRACTICAL SHOTS, AS WELL AS THEIR ELEMENTS AS TRAINING SHOTS;**
**- COOL PROJECTILES, DISASSEMBLY OR DO ANY WORK WITH PROPELLING CHARGES;**
**- TOUCH OR CARRY FIRELED UNEXPLODED HEAT OR HIGH EXPLOSIVE SHELLS, A FAILED GUIDED MISSILE OR ITS WAR UNIT. SUCH AMMUNITION SHALL BE DESTROYED AT THE SITE OF FALL;**
**- USE AMMUNITION PACKED IN CONTAINERS (BOXES, PENALTY CASES, CASES, ETC.), UNSUITABLE FOR STORAGE AND TRANSPORTATION (SEALING BREAKDOWN, LOSS OF**

**STRENGTH, MECHANICAL DAMAGE, ETC.). SUCH AMMUNITION IS ALLOCATED FOR SEPARATE STORAGE.**

### 3.2.2.2 Handling ammunition when loading it into a tank

The final loaded rounds are delivered to the tank packed in standard containers. Before loading shots into the tank, boxes with shots must be stored in dry cellars, ditches or niches, while the bottom rows of boxes with shots must be placed on linings made of auxiliary material so that they do not come into contact with soil water.

To reduce the dispersion of projectiles when firing, one should strive to ensure that the shots of each type delivered to the tank and loaded into it are from the same assembly batch, cumulative and high-explosive fragmentation projectiles have the same or similar weight signs (the weight sign is indicated on the projectile body and on packaging).

When loading shots with armor-piercing sabot shells into a tank, placing them in ammunition racks or automatic loader cassettes, it is necessary that the main charges and shells with additional charges be from the same assembly batch. The 3VBM11 rounds with the 3BM26 projectile, 3VBM13 with the 3BM32 projectile and 3VBM17 with the BM42 projectile must be equipped with the main charge 4Zh63; 3VBM22 rounds with a 3BM59 projectile and 3VBM23 rounds with a 3BM60 projectile must be equipped with the main charge 4Zh96, the remaining artillery rounds with the main charge 4Zh40 or 4Zh52.

It should be borne in mind that a difference in at least one letter or number of the marking indicates that the shots belong to different batches.

The correspondence of the shots to the gun is determined by the markings on the packaging, charges and projectiles .

Removing shots from the packaging must be carried out with precautions to prevent the possibility of projectiles or charges falling out of boxes, pencil cases and cases or damage to the burning casings of cartridges and burning cylinders, as well as the possibility of snow, dust, sand, etc. getting on the charges or projectiles. In the presence of grease, sand, snow, dust, projectiles or charges must be cleaned of them and wiped, while the markings of projectiles and charges must not be damaged or erased. Excess lubricant from the liners must be removed with a dry rag, and the grease should not come into contact with the burning part of the liner. Pay special attention to the cleanliness of the galvanic impact bushing GUV -7.

**ATTENTION:**

**IT IS PROHIBITED TO PLACE CHARGES ON THE BOTTOM OF THE SLEEVE FOR SAFETY REASONS AND TO PREVENT DAMAGE TO THE GUV-7 GALVANIC IMPACT BUSHING;**
**IT IS PROHIBITED TO PLACE ROCKET PROPULSION DEVICES ON THE BOTTOM OF THE CARTRIDGE CASE WITHOUT A JUMPER FOR SAFETY REASONS AND TO PREVENT DAMAGE TO THE INDUCTOR SLEEVE!**

If the GUV-7 bushing protrudes beyond the bottom cut of the sleeve, it must be tightened with a KV key (fixed inside the turret on the starboard side) so that it does not protrude beyond the bottom cut.

Shots removed from the packaging are ready for combat use. Shots must be covered with a tarpaulin or other auxiliary material to protect them from rain, snow, sunlight, sand and dust.

When loading rounds into a tank, placing them in an ammunition rack or in automatic loader cassettes, as well as when manually loading a gun, shells and charges should be handled with care:

– do not allow shots, their elements to fall or be struck;

– do not damage the integrity of the varnish coating of the charges.

If a projectile with an unscrewed fuse is found, the fuse should be tightened.

Guided missile rounds are loaded from a package installed on the tank hull.

**ATTENTION:**

**LOADING AN AUTOMATIC LOADER INTO CASSETTES OR PLACING AN ARTILLERY ROUND CHARGE IN NON-MECHANIZED STOWAGE BOXES INSTEAD OF THE 9X949 THROWING DEVICE IS NOT ALLOWED!**

Before loading the 9X949 throwing device into the automatic loader cassette, it is necessary to remove the jumper from it. When laying the 9X949 throwing device in a non-mechanized installation, do not remove the jumper. In this case, remove the jumper only before loading the automatic loader into the cassette or, when loading the gun manually, immediately before loading the gun.

**ATTENTION:**

**WHEN STACKING GUIDED SHOT WITH TWO TYPES OF GUIDED MISSILES, ONE OF THE TYPES OF GUIDED MISSILES (HIGH EXPLOSIVE OR CUMULATIVE) SHOULD BE PLACED IN NON-MECHANIZED STACKS AND USED WITH MANUAL LOADING!**

When placing high-explosive fragmentation shells into the automatic loader and into the fighting compartment of the tank, do not remove cap 1 (Figure 7.2) from the B-429E fuse; make sure that the installation tap 13 is set to the "O" position.

The B-429E fuse can have the following settings:

– for fragmentation action (the tap is set to position "O", the cap is removed);

– for high-explosive fragmentation action (the valve is set to the "O" position, the cap is on);

– for high-explosive action (the valve is set to position "Z", the cap is on).

To set it to the required action, the fuse has an installation tap, on the outer end of which there is an arrow. On the side surface of the fuse body there are marks marked "O" (the valve is open) and "Z" (the valve is closed). The valve is set to the required action using the RGM key, the cap is screwed together with the KVZ key (the keys are placed in the bag of a single set of spare parts for the gun). During rain or hail, as well as if there is an assumption of possible shooting through the branches of trees and bushes, do not remove the safety cap from the B-429E fuse when firing at any range and at any target.

### 3.2.2.3 Handling ammunition during shooting

Before shooting (after a long march or a long break in shooting), you must:

– check the serviceability and cleanliness of ammunition located in the automatic loader cassettes or other ammunition racks of the tank (if necessary, remove faulty ammunition and clean contaminated ammunition);

– make sure that there is no sand, dirt, foreign objects, grease, etc. in the gun bore, as this can cause swelling and even rupture of the barrel when firing armor-piercing sub-caliber projectiles or premature rupture of the projectile when firing cumulative or fragmentation high-explosive shells;

– Immediately before shooting, you must make sure that there is no cover on the muzzle of the gun barrel.

Special muzzle covers made of rubberized fabric, designed to seal the muzzle of the barrel when the tank overcomes a water barrier, may not be removed from the gun barrel before firing if the situation does not allow this.

When working with ammunition Lubricants, oils, fuel, solvents, and moisture are not allowed to come into contact with the burning part of the cartridge case, as this can lead to incomplete combustion of the cartridge case body in the charging chamber of the gun. Burning and smoldering remains of the cartridge case can cause a fire. It is necessary to take measures to immediately extinguish burning and smoldering residues.

The gun is usually loaded with an automatic loader. It is allowed, if necessary, to manually load the gun with the commander's and gunner's guards removed.

**ATTENTION:**

**REMOVING A PROJECTILE (GUIDED MISSILE) FROM THE CANNON BARREL IS CARRIED OUT ONLY BY FIRING. IN THIS CASE, THE GUIDED MISSILE IS REMOVED USING A 9X949 THROWING DEVICE. THE PROCEDURE FOR FIRING IN THE EVENT OF A FAILURE OF THE FIRING CIRCUITS IS SET OUT IN PARAGRAPH 3.2.3.3OF THIS MANUAL!**

### 3.2.2.4 Handling ammunition when unloading it from a tank

When unloading artillery ammunition from a tank, shells and charges must be packed in standard wooden boxes or metal cases. Before installation in a wooden box, the charge is placed in a paper or metal case, an armor-piercing sub-caliber projectile is placed in a paper or metal case; cumulative and high-explosive fragmentation shells are placed in boxes without cases.

A projectile with an appropriate charge is placed in a metal case 3YAK22 (1210 mm long) without canisters or cases.

One shot is placed in a wooden box or metal case. The markings on the shot and the box (case) must match.

When unloading a shot with a guided missile from a tank, place the rocket and the throwing device in the 9YA513 package, while the jumper removed before loading the shot must be placed on the tray of the throwing device.

Before packing, the shots must be inspected, contaminated shells and charges must be wiped dry, and loose fuze caps must be tightened. Shots with defects for which shooting is prohibited should be sorted. For B-429E fuses, the setting tap must be turned to the "O" position, and the safety caps, if removed, must be screwed on tightly.

**PROHIBITED:**

**- STORE AND TRANSPORT SHOTS WITH FUSES WITHOUT SAFETY CAPS;**
**- UNLOAD AMMUNITION DIRECTLY ON THE GROUND!**

After firing, if the situation allows, the spent pallets are collected, placed in packaging from live rounds and sent to the bases.

### 3.2.2.5 Handling ammunition on the march

When preparing for a march or when marching (at rest stops) on a tank with loaded ammunition, you should turn the automatic loader and inspect all the tank's ammunition racks in order to check the reliability of the shots and the presence of caps on the fuses. If necessary, secure the shots.

In order to prevent moisture from entering during rain, hail, or snow on the shots located in the tank's ammunition rack, the tank's hatches should, if possible, be closed.

If water gets into the tank, shots exposed to water must be removed from the ammunition load or replaced with new ones.

After the march at a halt, the shots must be inspected. Wipe contaminated shells, charges, galvanic impact bushings with a dry rag, tighten loose safety caps on the fuses, and securely secure the rounds in the ammunition racks.

Shots with defects in which firing is prohibited must be removed from the tank and returned to the ammunition depot.

#### 3.2.2.6 Ammunition storage

Packaged rounds should generally be stored in storage.

Temporary storage of ammunition in packaging in open areas is permitted in places that prevent them from being hit by bullets or shrapnel or from direct exposure to precipitation or solar radiation (cellars, ditches, niches, etc.).

**ATTENTION:**

**IT IS PROHIBITED TO STORE SHOTS OUTSIDE THE TANK IN DEPRESSURIZED CANISTERS AND CASES!**

In case of preservation of the tank for a long period, moisture-absorbing substances must be placed in the tank, which are periodically replaced during regular inspections.

#### 3.2.2.7 Transporting shots

The rounds can be transported in tank ammunition racks or in standard packaging by road, rail, water or air transport, as well as on armored personnel carriers.

Precautions when loading or unloading ammunition into vehicles are the same as when loading into or unloading from a tank.

#### 3.2.2.8 Handling training rounds

The rules for handling training rounds during loading and unloading operations, storage, transportation, etc. are the same as with combat rounds, in accordance with the above requirements.

During training, training shells are knocked out from the muzzle of a tank gun barrel with a bar (sixth) with a diameter of 60 to 70 mm, manufactured by military units.

After training, training armor-piercing sabot shells and training charges must be placed in cases or canisters, respectively, after which the shots must be placed in boxes.

Training cumulative and high-explosive fragmentation shells are placed in boxes without cases. The requirements for packaging training rounds are similar to the requirements for packaging combat rounds.

### 3.2.3 Using the gun

When working with a tank gun, use these operating instructions, as well as the technical description and operating instructions for the tank gun (2A46M.TO and 2A46M.TO1), taking into account the features relating to guns of the 2A46M-5 type.

#### 3.2.3.1 Security measures

When working with a gun, it is necessary to strictly comply with safety requirements.

All operations when working with the gun should be performed in the established sequence, with the possible combination of related operations and in compliance with the necessary precautions.

When loading a gun and firing a shot, strictly comply with the requirements of the shooting rules.

When charging manually, the galvanic igniter and electromagnetic release circuits must be de-energized.

The manual release must always be blocked, except in cases where it is used as specified in these instructions.

When moving, do not allow the trunk to stick into the ground, make sure that no foreign objects get into the trunk.

**IT IS PROHIBITED TO LEAVE THE GUN LOADED WHEN THE BARREL HAS BEEN SIGNIFICANTLY HEATED BY PREVIOUS SHOTS.**

When loading and firing, monitor the condition and operation of the gun. If any malfunctions are detected, stop loading and firing until they are eliminated.

**PROHIBITED:**

**- TROUBLESHOOT AND MAINTAIN THE GUN WHEN THE GUN IS LOADED, WITH THE WEAPON STABILIZER TURNED ON, WHEN THE TANK IS MOVEMENT WITH THE GUN UNFOCUSED "AT WAY";**
**- WHEN FIRING, BE IN THE GUN RECALL ZONE;**
**- KNOCK THE PROJECTILE OUT OF THE BARREL FROM THE MUZZLE. UNLOAD THE GUN WITH A SHOT ONLY;**
**- CARRY OUT SHOTS BY NON-STANDARD MEANS;**
**- LEAVE THE GUN CHARGED FOR A LONG TIME AND MAKE LONG MARCHES WITH A CHARGED GUN;**
**- DISCONNECT THE COLLECTION DEVICES FROM THE CRASH AND RELEASE THE PRESSURE FROM THE KRUB ON THE GUN TO WHICH IS GIVEN AN ELIZATION ANGLE;**
**- FIRE FROM THE GUN WITH THE LUBRICANT NOT REMOVED FROM THE BARREL AND CHAMBER;**
**- FIRE FROM THE GUN IN THE ABSENCE OF EXCESSIVE PRESSURE (BACKUP) IN THE HABITABLE COMPARTMENTS;**
**- FIRE FROM A GUN IN THE PRESENCE OF BULLING, CRACKS IN THE BARREL AND NICKNESSES ON THE OUTER SURFACE OF THE BARREL, RESULTING IN BULGING OF THE SURFACE OF THE BARREL BORE;**
**- USE COMBAT SHOTS AS TRAINING SHOTS;**
**- OPEN THE SHUTTER WEDGE WHEN THE SHOT IS DELAYED EARLIER THAN THE TIME SPECIFIED IN P. 3.2.3.3OF THIS MANUAL AFTER RELEASED THE STRIKE THREE TIMES;**
**- USE THE SAME CONTAINER FOR OIL AND POZH-70 LIQUID, EVEN WITH THOROUGH WASHING;**
**- OPEN THE SHUTTER WEDGE WHEN THE TANK MOVES AND THE HV DRIVE IS ENABLED;**
**- FIRE FROM A CANNON (EXCEPT FOR FIRING FROM CLOSED FIRING POSITIONS) WITHOUT BRINGING THE SIDE PROTECTIVE FENCES AND THE COMMANDER'S LEG GUARD INTO WORKING POSITION.**

When cleaning a barrel with an RFS solution, it is necessary to take into account that it is poisonous, and you should:

– protect your eyes;
– After cleaning, wash your hands thoroughly;
– protect eyes and electrical equipment from contact with radiofrequency radiation solution;
– Pour the used solution into a specially dug ditch.

Anti-recoil fluid POZH-70 is an aqueous solution of ethylene glycol with anti-foam and anti-corrosion additives.

If it comes in contact with the skin, the liquid has no harmful effect. When liquid enters the body, it acts as a poison, mainly on the central nervous system, kidneys and causes severe poisoning. The lethal dose when liquid enters the body is from 50 to 100 g.

Working with POZH-70 liquid is described in the gun operating instructions.

**ATTENTION:**

**IT IS PROHIBITED TO SUCK LIQUID INTO YOUR MOUTH THROUGH THE HOSE TO CREATE A SIPHON WHEN TRANSFUSING IT!**
**DO NOT SMOKE OR EAT WHILE WORKING WITH LIQUID!**
**IT IS PROHIBITED TO ALLOW PERSONS WHO ARE NOT FAMILIAR WITH ITS PROPERTIES AND RULES FOR WORKING WITH IT TO WORK WITH POZH-70 LIQUID!**

To prevent poisoning with POZH-70 liquid, observe the following safety precautions:

– be sure to use safety glasses to prevent liquid from getting into your eyes when it may splash during work; if there is pain in the eyes and irritation of the respiratory tract, rinse the eyes with clean water and put on a general-purpose filter gas mask;
– After finishing working with the liquid, wash your hands thoroughly with warm water and soap;
– If POZH-70 liquid gets inside the body, consult a doctor immediately. First aid is as follows: induce vomiting, rinse the stomach generously with water or a five percent solution of baking soda; create warmth and provide the victim with a flow of fresh air.

### 3.2.3.2 Preparing the gun for firing

Preparing the gun for firing includes inspecting and checking the operation of its mechanisms and devices in accordance with the technical description and operating instructions for the tank gun (2A46M.TO and 2A46M.TO1) supplied with the tank (see tables 3 and 16).

When preparing to fire from closed firing positions, install a side level on the left shield of the gun fence. In this case, move the gunner's guard to its extreme forward position.

### 3.2.3.3 Shooting from a cannon

To fire from a cannon you must:

– turn on the FVU supercharger to ensure the operation of electric releases and support in the fighting compartment;

– open the shutter wedge;

– turn on the fire control system, prepare sights, weapons stabilizer, and automatic loader for operation;

– load the gun and make sure there is backup;

– point the gun at the target and fire in accordance with the instructions in paragraph 3.3.5of this manual.

If the electric trigger fails, fire the shot using a manual trigger, having first unlocked the manual trigger handle and made sure that the CBM frame is in its original position.

If after the first release the shot does not occur, then it is necessary to re-cock the firing pin and release it. If after repeated release the shot does not occur, repeat the cocking and descent operations. If after the third descent the shot does not fire, wait at least 1 minute when firing an artillery shot or at least 10 minutes when firing a guided missile shot.

Replace the charge in the chamber with a new one, for which:

– stop the tank;

– turn off the weapon stabilizer;

– turn off the AZR “EL. DESCENT";

– set the switch "AUTO - MANUAL" on the loading panel to the “MANUAL” position;

– lock the manual release handle;

– move the gunner's guard to the extreme forward position;

– open the bolt wedge, remove the faulty charge from the chamber (avoiding impact with the primer sleeve), remove it from the tank or place it in a non-mechanized ammunition rack, depending on the situation;

– load the cannon with a new charge manually, and for artillery shots use charges 4Zh40, 4Zh52, 4Zh63, 4Zh96, and for a guided missile use only the 9X949 throwing device. Use a new charge from a non-mechanized stowage or, in the absence of one, remove it from the AZ cassette - in the mode of semi-automatic unloading of shots from a rotating conveyor.

**ATTENTION:**

**FOR A GUIDED MISSILE, USE ONLY THE 9X949 LAUNCHER!**

– set the AUTOMATIC - MANUAL switch. on the loading panel (hereinafter referred to as PZ) to the AUT position;

– turn on AZR EL, Descent;

– aim the gun and fire.

The charge remaining after re-launch and the projectile from which the charge was used should be returned to the ammunition depot.

During shooting, observe the position of the rollback indicator, which should not go beyond the STOP mark.

Take measures to prevent the trunk from sticking into the ground, as this entails swelling or rupture of the trunk.

**ATTENTION:**

**IN CASE OF INCOMPLETE CLOSING OF THE BOLT WEDGE WHEN LOADING THE GUN, YOU MUST FOLLOW THE FOLLOWING INSTRUCTIONS STRICTLY!**

– stop the tank;

– turn off the weapon stabilizer;

– turn off the AZR "AZ UPR." on the right switchboard;

– set the switch "AUTO - MANUAL" on the loading panel to the “MANUAL” position;

– open the shutter wedge;

– remove the charge from the chamber and hold it on your knees (performed by the commander);

– inspect the charge and check that the galvanic impact bushing is completely screwed in;

– inspect the seat under the bolt wedge in the breech and the wedge guides (if necessary, remove foreign objects and remove excess grease);

– close the shutter, make sure the shutter is completely closed;

– open the bolt wedge and load the previously removed charge manually.

**ATTENTION:**

**CARRY OUT MANUAL LOADING ONLY WITH A STANDARD ROMER!**

– turn on AZR AZ CONTROL, set the AUT.-MANUAL switch. to position AVT.;

– turn on the weapon stabilizer and continue shooting.

During breaks in shooting to cool the barrel, keep the bolt open, if possible. Make sure that there is no fluid leakage from the recoil and retraction brakes.

After shooting you must:

– turn off the fire control complex;

– turn off the FVU supercharger 8 to 10 minutes after the end of firing or before the crew exits the tank;

– clean and lubricate the barrel bore, bolt and barrel bore blowing mechanism. If the necessary conditions are not available, thickly lubricate the bore and bolt with lubricant and clean the gun as soon as possible;

– move the gun to the stowed position, install it on traction and cover it.

After firing, the presence of working fluid in the form of separate drops on the rods of recoil devices is allowed (up to three drops after 10 to 15 shots are fired).

During operation, displacement of sections of the thermal protective casing and ties of no more than 10 mm, warping of sections of the casing, as well as other damage that does not affect the protective and operational properties of the casing are allowed.

If systematic deviations of projectiles from the aiming point are detected during firing, as well as in cases where there is an assumption of a possible change in the deviation from the straightness of the barrel bore axis (for example, when the barrel “sticks”, side impacts of the barrel on obstacles, etc.), it is necessary to carry out built-in alignment control in accordance with this manual and, if there is no misalignment, check that the main armament complex is brought to normal combat in accordance with this manual.

During shooting and operation of the tank, it is possible that the reflector glass of the bend sensor may become dirty (snow, dirt, etc. gets under the reflector visor) installed at the end of the gun tube. If contamination is detected, as soon as possible, remove the contamination using any available method, while eliminating the abrasive effect on the reflector glass.

After firing from 100 to 150 shots, it is necessary to adjust the backlash selecting devices, guided by the instructions in paragraph 5.8.1.1of this manual

After firing from 15 to 20 shots with an armor-piercing sabot projectile or from 60 to 80 shots with other types of ammunition, check the moment of unbalance of the gun, guided by the instructions in paragraph 5.8.1.3of this manual.

After firing 15 to 20 shots with an armor-piercing sabot projectile, check the wear of the barrel bore at a distance of 850 mm from the rear (breech) end of the barrel. Measure wear in a vertical plane using a wear monitoring device PKI-26 in accordance with its instructions. Determination of wear can be carried out using another device designed for these measurements. The wear value is entered into the ballistic computer block according to the instructions in this manual. In the absence of the PKI-26 device, to take into account in the ballistic computer, the wear of the barrel bore can be taken from the table “Accounting for gun fire” in the tank log.

When the diameter of the barrel bore, in the above section, reaches a value of 128.3 mm or after 1000 shots have been fired (registered in the tank's log), the gun barrel must be replaced.

If KPM type 1I37 is available in places of operation, it is allowed to categorize the trunks using KPM equipment and documentation.

### 3.2.4 Using machine guns

#### 3.2.4.1 Security measures

Personnel authorized to fire a coaxial machine gun and DPU are required to know the materiel and strictly adhere to the safety measures set out in the operational documentation for the tank as a whole and for the weapons.

**PROHIBITED:**

**- LOAD THE MACHINE GUN IF THERE ARE FOREIGN OBJECTS IN THE BARREL;**
**- BE IN FRONT OF THE BARREL OF A LOADED MACHINE GUN WHILE LOADING, UNLOADING AND ELIMINATING DELAYS;**
**- PERFORM ANY ACTIONS WITH MACHINE GUNS (LOADING, UNLOADING, ELIMINATING DELAYS, ETC.) WITH THE MACHINE GUN DRIVES AND FIRING CIRCUITS TURNED ON;**
**- FIRE FROM MACHINE GUNS WITH OPEN TANK HATCHES;**
**- USE EXPIRED CARTRIDGES, CARTRIDGES AND CARTRIDGE STRIPS THAT ARE DAMAGED;**
**- REMOVE THE BARREL WITH THE CARTRIDGE IN THE CHAMBER AND WHEN THE MOVING PARTS DO NOT REACH THE EXTREME FORWARD POSITION;**
**- LOWER THE MOVING PARTS FROM THE SEAR WITH THE BARREL REMOVED!**

When the cartridge strip is partially fired, the machine gun remains cocked, therefore, if further shooting is not carried out, the machine gun should be unloaded.

If you experience a delay that cannot be eliminated by reloading, you should also unload the machine gun.

The order of unloading the machine gun:

– if the machine gun is cocked (the moving parts are in the rear position), set the safety switch to the “PR” position;

– if the machine gun is not cocked (the moving parts are in the forward position), cock the machine gun by the reloading handle and set the safety switch to the “PR” position;

– open the receiver cover and receiver base. When opening the lid, it is necessary to hold the moving parts by the reloading handle to prevent spontaneous firing;

– remove the cartridge strip and cartridge from the receiver;

– make sure that there is no cartridge in the chamber or remove the remaining cartridge;

– close the receiver cover;

– move the fuse to the “OG” position;

– carry out a control descent of the moving parts from the sear.

#### 3.2.4.2 Using a coaxial machine gun

**ATTENTION:**

**- BEFORE INSTALLING AND DISMANTLING THE MACHINE GUN, MAKE SURE THAT THE MACHINE GUN IS UNLOADED, THE DRIVE AND FIRING CIRCUITS ARE TURNED OFF, AND THE GUN IS IN A LOCKED POSITION;**

**- WHEN INSTALLING AND DISMANTLING THE MACHINE GUN, DO NOT ALLOW EXCESSIVE FORCE OR IMPACTS ON THE U-SHAPED SPRING OF THE FRONT SLIDE OF THE MACHINE GUN!**

Install the machine gun in the following sequence:

– separate the barrel from the machine gun, put bushing 6 on it (Figure 9.1), insert gas exhaust tube 11 into the side hole of the bushing;

– attach the barrel so that the gas tube 12 of the machine gun fits into the hole in the gas outlet body 11;

– insert the protrusions on the front support of the machine gun into the grooves of the front slide 4 and secure the machine gun with a pin. The machine gun handle E should fit into the groove Z of the bracket attached above the machine gun;

– secure the machine gun with a pin on the rear slider 18;

– connect the electrical connector of the machine gun's electric trigger.

Dismantling the machine gun is carried out in the following sequence:

– disconnect the electrical connector for the machine gun's electric trigger;

– remove the pins from the rear slider 18 and the front slider 4;

– remove the machine gun by sliding it back.

When installing and removing a machine gun in everyday use, the front and rear slide remain on the product, and the gas outlet remains on the machine gun.

Installing a new machine gun on a tank should be made complete with front and rear sliders.

Replace the sliders in the following sequence:

– remove the rear slider 18 from the frame guides 17 by unscrewing the pin chain screw several turns (to ensure removal);

– remove the front slider 4 from the frame guides 17 by unscrewing the nuts from the shock absorber screw;

– install the sliders from the new machine gun kit on the frame;

– Lock the shock absorber screw nuts, maintaining a dimension of (16±1) mm between the rear end of the slider and the frame eye.

##### 3.2.4.2.1 Preparing for shooting, loading and unloading a coaxial machine gun

Inspect and check the technical condition of the machine gun and installation components before use in the following sequence:

– make sure that the guidance drives and firing circuits are turned off and the gun is in a locked position;

– make sure that the machine gun is not cocked (the bolt frame is in the forward position);

– open the receiver cover and, pulling the bolt frame back by handle D (Figure 9.1), make sure that there is no cartridge in the chamber of the machine gun;

– make sure that the machine gun safety box is in the “FIRE” position;

– check the operation of the moving parts of the machine gun, for which cock the machine gun manually and lower it. The moving parts must return vigorously to the forward position;

– by external inspection, check the serviceability of the installation parts and the reliability of their fastening;

– release, if necessary, the lower catcher 26 from spent cartridges and cartridge belts;

– in anticipation of firing, wipe the machine gun barrel dry;

– check the position of the gas regulator of the machine gun.

Reliable operation of the machine gun's automation is ensured by setting the gas regulator to the number “1” or “2”. Firing from a new machine gun, until 2000 to 3000 rounds have been fired, must be done in position “2” of the gas regulator, after which, if there are no delays in firing due to the moving parts not reaching the rear position, the regula-

tor must be moved to position “1”. Position “3” of the gas regulator is intended for shooting in difficult operating conditions when the machine gun is heavily soiled, when there are delays in firing at position “2” of the gas regulator.

When preparing to fire blank cartridges, it is necessary to screw a sleeve for firing blank cartridges onto the muzzle of the barrel instead of a flash suppressor, and insert a special frame into the base of the receiver. The bushing and frame are located in a single set of spare parts for the machine gun.

Loading the coaxial machine gun is carried out in the following sequence:

– make sure that the guidance drives and firing circuits are turned off and the gun is in a locked position;

– open the lid of the box 14 and release a piece of cartridge tape from 5 to 15 links long through the exit window;

– close the lid of the box 14, install the box in the cavity of the lower catcher 26 and secure it with a spring loop;

– open the cover of the machine gun receiver;

– load the cartridge strip into the machine gun by passing it through the guide tray 25. The first cartridge with the edges of the cartridge case must fit into the hooks of the extractor;

– close the cover of the machine gun receiver;

– in anticipation of firing, cock the machine gun, to do this, move the moving parts of the machine gun by the handle D back until it stops and return the handle to the forward position;

– set the fuse box D to the “PR” position.

**ATTENTION:**

**TO THE FIRE POSITION. MOVE THE SAFETY CATCH ONLY IMMEDIATELY BEFORE SHOOTING!**

Unload the coaxial machine gun in the following sequence:

– make sure that the guidance drives and firing circuits are turned off and the gun is in a locked position;

**ATTENTION:**

**IF THE CARTRIDGE BELT IS NOT COMPLETELY SHOT, THE MACHINE GUN IS COCKED!**

– if the machine gun is cocked (the moving parts are in the rear position), set the safety switch to the “PR” position;

– if the machine gun is not cocked (the moving parts are in the forward position), cock the machine gun by the reloading handle and set the safety switch to the “PR” position;

– open the receiver cover. When opening the lid, it is necessary to hold the moving parts by the reloading handle to prevent spontaneous firing;

– remove the cartridge strip and cartridge from the receiver;

– make sure there is no cartridge in the chamber or remove the remaining cartridge;

– close the receiver cover;

– move the fuse to the “EG” position and lower the moving parts from the sear;

– perform manual cocking and control descent.

#### 3.2.4.2.2 Shooting from a coaxial machine gun

The coaxial machine gun is served by the tank commander in battle. The gunner or commander conducts the shooting.

Aim at the target and fire from a machine gun in accordance with paragraph 3.3.5of this manual .

The machine gun should be cocked in anticipation of firing, and the safety lever should be moved to the “FIRE” position immediately before firing.

To increase efficiency and save ammunition, it is recommended to fire a machine gun in short bursts of 5 to 10 shots.

After shooting one magazine, it is necessary to empty the lower catcher from spent cartridges and cartridge belts.

During intense shooting, after firing 400 rounds (one magazine), the machine gun barrel should be cooled .

If you experience a delay in firing from a machine gun, you should reload. If the delay is not eliminated by reloading, the machine gun should be unloaded in the prescribed manner in compliance with safety requirements, and the cause of the delay should be eliminated.

#### 3.2.4.2.3 Preparing ammunition for a coaxial machine gun

Before equipping cartridge belts, you should inspect the cartridges, belts and magazines.

Inspect the cartridges for the absence of through cracks, deep scratches, dents, protruding nicks on the outer surface, punctures, green deposits or rust on the igniter capsule. Cartridges with these defects must be removed from circulation and destroyed in the prescribed manner.

It is allowed to use cartridges that have minor scratches and dents on the cartridges obtained when loading the cartridge belt. It is allowed to fire cartridges if a small green coating and rust are removed with a dry, clean rag.

Cartridge strip links 6L7 should not be broken, bent or cracked. Replace pieces of tape with the indicated defects.

Magazines for cartridge strips should not have significant dents. Magazine covers must be held securely in the closed position.

For installation in each magazine, equip a piece of cartridge strip on 400 rounds. The equipment must be carried out manually or using a equipment machine (designed by Rakov). When loading, control the complete loading of cartridges into the links of the cartridge belt. The cut of the cartridge case muzzle must coincide with the end of the cartridge strip. The tape must be equipped without gaps. If the cartridge belt is not fully loaded, leave the first links empty.

When loading, it is prohibited to hit the cartridge case and primer with anything.

Place the cartridge strip in the magazine in accordance with the laying diagram (Figure 9.1 ). Lay horizontal rows of cartridge strip evenly along the entire length of the magazine. The direction of the cartridge belt bullets must correspond to the indicator located on the magazine cover.

### 3.2.4.3 Using a remote machine gun mount

**ATTENTION:**

**BEFORE INSTALLING AND DISMANTLING THE MACHINE GUN, MAKE SURE THAT THE MACHINE GUN IS UNLOADED, THE DRIVES AND FIRING CIRCUITS ARE TURNED OFF, AND THE CONTROL PANEL IS IN A LOCKED POSITION!**

Install the machine gun in the following sequence:

– fold back the casing 11 (Figure 9.3) by unscrewing screw 8;

– place machine gun 3 on cradle 22 and, raising the breech, insert carriage 24 of the cocking mechanism from below into the groove of the machine gun reloading rod;

– insert the protrusions on the receiver of the machine gun into the longitudinal grooves of the cradle 22, move the machine gun forward and fix the pin 25 on the shock absorber rod;

– connect the electrical connector for the machine gun's electric trigger;

– install casing 11 to its original position.

Dismantling the machine gun is carried out in the following sequence:

– disconnect the electrical connector for the machine gun's electric trigger;

– remove pin 25 and move the machine gun back until it exits the guide grooves of the cradle;

– lifting the breech, disconnect the carriage 24 of the cocking mechanism from the reloading rod and remove machine gun.

#### 3.2.4.3.1 Preparing for shooting, loading and unloading a DPU machine gun

Inspect and check the technical condition of the machine gun and installation components before use in the following sequence:

– make sure that the guidance drives and firing circuits are turned off, the control panel is in the locked “stowed” position (about 3 degrees up and 10 degrees to the left along the way) .

If it is necessary to bring the DPU cradle into a locked “stowed” position (in the event of an abnormal (emergency) shutdown of the DPU drives), you should manually tighten the cradle until the axis 17 of the HV stopper coincides. 18 with a hole in the cradle corresponding to the “stowed” position. In this case, to unlock the cradle, it is necessary to pull back the stopper lever 19.

If it is necessary to bring the DPU into a locked “stowed” position -along the GN (in the event of an abnormal (emergency) shutdown of the DPU drives), you should manually tighten the DPU until the stopper axis coincides with the hole in the turret gear chase corresponding to the “stowed” position. In this case, to unlock the DPU along the GN, it is necessary to turn the GN stopper shaft pos. 4 counterclockwise .

– fold back the DPU cradle cover;

– make sure that the machine gun is not cocked (the bolt frame is in the forward position);

– open the receiver cover and, pulling the bolt frame back by the cocking mechanism handle, make sure that there is no cartridge in the chamber of the machine gun;

– make sure that the machine gun safety switch is in the “OG” position;

– check the operation of the moving parts of the machine gun, for which cock the machine gun manually and lower it. The moving parts must return vigorously to the forward position;

– by external inspection, check the serviceability of the installation parts and the reliability of their fastening;

– in anticipation of firing, wipe the machine gun barrel dry;

– check the position of the gas regulator of the machine gun.

The gas regulator must be in position “1”. Position “2” is used in cases of delays associated with difficult operating conditions when the machine gun is heavily contaminated.

Load the DPU in the following sequence:

– install magazine 4 (Figure 9.3) on bracket 5 and fix it with locking axis 7, turning the flag to a horizontal position;

– fold back the cradle cover 11 by unscrewing screw 8;

– open the magazine cover, pass the cartridge strip through the tape feed 6 and tray 1 to the receiving window of the machine gun;

– open the cover of the machine gun receiver and place the first cartridge behind the locking fingers of the receiver tray;

– holding the tape with your hand, close the receiver cover and, pulling the tape towards you, make sure that it is securely fastened in the machine gun;

– cock the machine gun in anticipation of shooting. To do this, use the handle 20 of the cocking mechanism 21 to pull the reloading rod of the machine gun back until it stops and, holding the handle, return the reloading rod to the forward position;

– set the fuse box to the “PR” position, make sure that it is securely fixed.

**ATTENTION:**

**THE TRANSLATOR IS PLACED IN THE “PR” AND “OG” POSITIONS ONLY WITH MOVING PARTS LOCATED ON THE SEAR (REAR POSITION);**
**TO THE “OG” POSITION. MOVE THE SAFETY CATCH ONLY IMMEDIATELY BEFORE SHOOTING!**

Discharge the DPU in the following sequence:

– make sure that the guidance drives and firing circuits are turned off, the control panel is in a locked position;

**ATTENTION:**

**IF THE CARTRIDGE BELT IS NOT COMPLETELY SHOT, THE MACHINE GUN IS COCKED!**

– if the machine gun is cocked (the moving parts are in the rear position), set the safety switch to the “PR” position;

– if the machine gun is not cocked (the moving parts are in the forward position), cock the machine gun by the reloading handle and set the safety switch to the “PR” position;

– open the receiver cover. When opening the lid, it is necessary to hold the moving parts by the reloading handle to prevent spontaneous firing;

– remove the cartridge strip and cartridge from the receiver;

– make sure that there is no cartridge in the chamber or remove the remaining cartridge;

– close the receiver cover;

– move the fuse to the “EG” position and lower the moving parts from the sear;

– perform manual cocking and control descent.

#### 3.2.4.3.2 Shooting from a DPU machine gun

The DPU in battle is served by the tank commander. The commander fires from the DPU.

Aim at the target and fire from the DPU in accordance with paragraph 3.3.5of this manual .

The DPU machine gun should be cocked in anticipation of firing, and the safety catch should be moved to the “OG” position immediately before firing.

To increase efficiency and save ammunition, the tank's fire control system allows firing from the DPU only in short bursts of 5 to 10 rounds, after which the burst automatically stops. To fire the next burst, you need to release and press the fire button again.

To maintain the firing efficiency of a machine gun, the barrel must be protected from overheating. During intense shooting (breaks in shooting are associated only with retargeting), after every 100 shots the machine gun barrel should be cooled .

If you experience a delay in firing from a machine gun, you should reload. If the delay is not eliminated by reloading, the machine gun should be unloaded in the prescribed manner in compliance with safety requirements, and the cause of the delay should be eliminated.

#### 3.2.4.3.3 Preparing DPU ammunition

Before loading cartridge belts, you should inspect the cartridges, belts and magazines.

Inspect the cartridges for the absence of through cracks, deep scratches, dents, protruding nicks on the outer surface, punctures, green deposits or rust on the igniter capsule. Cartridges with these defects must be removed from circulation and destroyed in the prescribed manner.

It is allowed to use cartridges that have minor scratches and dents on the cartridges obtained when loading the cartridge belt. It is allowed to fire cartridges if a small green coating and rust are removed with a dry, clean rag.

The links of the 6L19 cartridge strip must not be broken, bent or cracked. Replace pieces of tape with the indicated defects.

Magazines for cartridge strips should not have significant dents. Magazine covers must be held securely in the closed position.

To store it in the magazine, equip a cartridge belt with 300 rounds of ammunition. For ease of installation in the magazine, the tape can be divided into pieces of the required length. Load the belt manually, or with a 6Ch29 loading machine or a device for loading the belt from a single set of machine gun spare parts. In a correctly equipped belt, the edge of the sleeve should be between the link clamps. The sleeve must be completely enclosed by the link legs. The tape should bend freely. The tape must be equipped without gaps. If the cartridge belt is not fully loaded, leave the first links empty.

**ATTENTION:**

**WHEN RELOADING, IT IS PROHIBITED TO HIT THE CARTRIDGE CASE OR PRIMER WITH ANYTHING!**

Place the cartridge strip in the magazine in accordance with the laying diagram (Figure 9.3), interlocking the pieces of tape with each other as they are laid. A plate with a laying diagram is also located on the inside of the magazine lid. Begin laying the bottom row of tape on the side opposite the magazine exit window, with the tape links being on top and the cartridge bullet pointing away from you when the magazine exit window is located on the left. Lay horizontal rows of cartridge strip evenly along the entire length of the magazine. Place nine rows of tape in the lower part of the magazine, then lower the partition and lay the remaining rows on it.

### 3.2.5 Use of electric triggers of cannons and machine guns

#### 3.2.5.1 Firing a shot

To fire a shot from a cannon from the gunner's position, after the automatic loading cycle, press the fire button under the right index finger on the guidance remote control.

To fire a shot from a coaxial machine gun from the gunner's position, you must press the fire button under the left index finger on the guidance panel.

To fire a shot from a DPU machine gun from the commander's seat, you must press the fire button under the left index finger on the commander's remote control.

To fire a shot from a cannon or coaxial machine gun from the commander’s seat, you must turn on the “DOUBLE” mode, select the type of weapon and press the fire button under the left index finger on the commander’s remote control.

To fire a shot from a cannon after loading manually, you must:

– after charging is complete, the AUTOMATIC-MANUAL switch. on the control panel control system and AZ and PZ, set to the AVT position;

– check AZR EL. DRAIN on the right and left switchboards, they must be turned on;

– The gunner presses the cannon fire button.

To fire a shot when the main firing circuits fail, you must:

– when firing from a cannon, press the duplicate button MO-Kn1 for firing from a cannon on the handle of the lifting mechanism;

– when firing a machine gun from the gunner’s seat, press the duplicate firing button from the MPB-Kn1 machine gun, and from the commander’s seat, press the trigger lever of the mechanical release on the machine gun (in case of complete failure of the electrical circuits).

To fire a shot from a cannon using a mechanical trigger (in the event of a failure of the firing electrical circuits), you must:

– make sure that the frame and the AZ cassette lifting mechanism are in their original position;

– unlock the manual release handle;

– press the manual release handle.

**ATTENTION:**

**THE SHOT WILL FIRE ONLY IF THE FIRING CIRCUITS ARE READY (THE PRESENCE OF THE INSCRIPTION “GOT” ON THE APU OR THE GLOW OF A GREEN INDICATOR IN THE FIELD OF VIEW OF THE OPTICAL CHANNEL)!**

If the supercharger is faulty, the electric triggers can be turned on using the “emergency activation of electric triggers without a supercharger” switch on the left panel under the cover.

**ATTENTION:**

**IT IS PROHIBITED TO TURN ON THE “EMERGENCY ACTIVATION OF ELECTRIC TRIGGERS WITHOUT A SUPERCHARGER” SWITCH UNLESS ABSOLUTELY NECESSARY!**

### 3.2.6 Automatic loader

#### 3.2.6.1 Safety measures when working with AZ

**WHEN WORKING WITH A3, IT IS PROHIBITED:**

**- TURN ON THE NETWORK PROTECTION CIRCUIT BREAKER A3 UPR. ON THE RIGHT DISTRIBUTION PANEL WHEN THE ON-BOARD NETWORK VOLTAGE IS LESS THAN 22 V;**
**- TURN OFF THE CIRCUIT BREAKERS, THE AB SWITCH AND SWITCH THE TYPE SWITCH TO PZ DURING THE CYCLES OF AUTOMATIC CHARGING, LOADING AND UNLOADING;**
**- LEAVE THE GUN BOLT WEDGE OPEN AFTER FINISHING WORK A3;**
**- LEAVE THE AZR A3 UPR SWITCHED ON. ON THE RIGHT AND AZR EL. DESCENT ON THE LEFT SWITCHBOARDS OF THE TOWER AFTER FINISHING WORK WITH A3;**
**- WORK IN MANUAL LOADING MODE WITH THE AZR A3 UPR TURNED ON. AND THE AVT SWITCH IS ON. - MANUAL TO POSITION AVT.;**
**- TROUBLESHOOT AND ADJUST A3 MECHANISMS WHEN THE EL AZR IS TURNED ON. DESCENT AND A3 CONTROL ON THE RIGHT SWITCHBOARD OF THE TOWER, AS WELL AS WITH THE WEAPON STABILIZER TURNED ON;**
**- SWITCH CONTROLS WHEN OPERATING A3 DURING THE AUTOMATIC CHARGING CYCLE;**
**- OPEN THE SHUTTER WEDGE WITHOUT SETTING IT TO THE MANUAL POSITION. AVT SWITCH. - MANUAL AT PU SLA AND AZ AND PZ;**
**- PLACE A GUIDED PROJECTILE AND A CHARGE FROM AN ARTILLERY SHOT INTO ONE CASSETTE.**

**ATTENTION:**

**IT IS NOT ALLOWED TO LET LUBRICANTS AND OPERATING FLUIDS GET ON THE RUBBER OF THE RAMMER CHAIN FLAPS!**

### 3.2.6.2 Preparing the A3 for use

Initial position of the controls AZ:

– AZR SP POD, DOS, L.R.VT, A3 EM, EL. DESCENT included, A3 CONTROL. turned off on the right switchboard and AZR EL. DECLINE is switched off on the left switchboard;

– AVT switch. - MANUAL on the launcher control system and AZ - in the AVT position;

– AVT switch. - MANUAL on PZ - in position AVT.;

– UNLOAD switch - LOADED on PZ - in the UNLOADING position.

Before starting to work with AZ in any mode, including when checking its operation, you must:

– check the initial position of the AZ controls;

– make sure that the MPK stop lever is removed from the clamp, the frame is in the lower position and pressed against the stop;

– make sure by external inspection from the fighting compartment and from the control compartment (in places accessible for inspection) that there are no foreign objects on the flooring and under the rotating conveyor that would prevent its rotation;

– turn on the battery switch.

### 3.2.6.3 Using AZ

#### 3.2.6.3.1 Loading shots into a rotating conveyor

Shots can be loaded either with an empty or with a partially loaded conveyor.

The loading mode is carried out with the battery switch turned on and the AZR “SP” circuit breakers turned on. POD", "DOS", "L.R.VT", "AZ EM", "AZ UPR.", "EL. Descent" on the right and "EL. DESCENT" on the left switchboards of the tower.

To load the gun, give the maximum angle of descent using the “UNLOADING” switch on the loading panel. - LOCKED.” set to the “LOAD” position, and the “AUTO” switch. - HAND.” to the “MANUAL” position After pressing and releasing the ON button. AZ to PZ the empty cassette is lifted onto the loading line. Clean the cassette pipes from dust and dirt . Place a shot in the cassette, sending a projectile (missile) into the lower tube until it stops in the cassette, so that the white arrow on the rocket body coincides with the arrow on the tube), and into the upper tube - a charge (throwing device), while turning the projectile (missile) until its fixation. After laying, make sure that the projectile (missile) and charge (throwing device) are secured against longitudinal movement forward . Set the type switch on the PZ to the position corresponding to the type of loaded shot, press the ON button. A3 on PZ and keep it pressed until the cassette begins to lower. The loaded cassette is lowered to its original position, the conveyor is tucked with the nearest empty cassette to the dispensing window, and the cassette lifting mechanism lifts this empty cassette onto the loading line.

If the type switch is in a position that does not correspond to the type of shot that was loaded into the cartridge, it is necessary to simulate unloading of that type of projectile and repeat the loading.

To stop the cycle when the load is incomplete, you need to turn off and then turn on the AZR UPR on the ShchRP.

### 3.2.6.3.2 Automatic loading of the gun

Before automatically loading the gun, you must turn the “AUTO-MANUAL” switch. to the “MANUAL” position, open the wedge shutter, set the type switch on the control panel of the control system and AZ or PK90 to the position depending on the selected type of shot, switch “AUTO. - HAND.” on the PU control system and AZ - to the “AUTO” position.

On the loading panel and control panel of the control system and AZ, the “AZ READY” signal lights light up, signaling the possibility of automatic loading of the gun.

When you press the "ON" button. AZ" or "AZ. PLATOON" the gun is automatically loaded with the selected type of ammunition.

After the shot, upon a signal from the recoil contact, the CBM hatch briefly opens.

If the AZ circuit receives the “OPA” signal from the WMD protection system, then the CBM hatch does not open.

### 3.2.6.3.3 Manual loading of a cannon with shots from a mechanized stowage

For charging you need:

– turn on the "AUTO" switch - HAND.” on the PZ to the “MANUAL” position - the “MANUAL” signal lamp on the PZ will light up;

– set the “UNGROUND” switch on the PZ. - LOCKED.” to the “UNLOADING” position;

– open the shutter wedge;

– determine by the indicator on the PZ or the LED “THERE IS A TYPE” on the PN what types of shots are available in the VT, and then turn off the A3 APR;

– set the type switch on the PZ to the position corresponding to the selected type of shot;

– with the weapon stabilizer turned off, using the manual mechanism for raising the gun, bring the gun to an angle convenient for loading;

– tilt the footrest 35 (Figure 1.4) with the base away from you, unlock the conveyor by pulling the handle 31 of the manual drive of the VT stopper;

– holding the VT stopper drive lever, turn the VT by raising and lowering handle 37 of the VT manual drive until the STOP VT lamp on the loading panel lights up;

– release the stopper lever and turn the VT manual drive lever until it locks;

– pull lever 18 (Figure 9.10) of the MPK stopper drive until it is installed on the clamp 19 and the cassette lifting mechanism is unlocked;

– by rotating the handle 15 of the manual drive of the MPK with the key pressed, raise the cartridge with the shot to a position convenient for removing the projectile and charge, and lock it by releasing the key on the handle of the manual drive.

– remove the shell from the cassette and send it with a rammer into the gun chamber;

– remove the charge from the cassette and send it with a rammer into the gun chamber until the wedge closes. Use only the standard rammer;

– lower the cassette using the manual drive of the MPK to its original position, press the grip of the MPK as far as it will go and lock it by releasing the key on the handle of the manual drive;

– remove lever 18 of the MPK stopper drive from the clamp;

Return the footrest 35 with the base to its original position (Figure 1.4), having first lowered the handle 37 of the VT manual drive. Switch the AVT switch. - MANUAL on the PZ to the AVT. position, turn on the AZR AZ UPR on the ShchRP.

**ATTENTION:**

**THE ELEMENTS OF THE SHOT MUST BE SENT TO THE GUN CHAMBER ONLY WITH A RAMMER!**

**THE USE OF OTHER MEANS MAY LEAD TO IGNITION OF THE SHOT ELEMENTS INSIDE THE TANK!**

### 3.2.6.3.4 Unloading shots from a rotating conveyor

Unloading shots from a rotating conveyor is carried out similarly to the loading mode. In contrast to loading, set the loading panel type switch to the position corresponding to the type of shot being unloaded, and the UNLOADING switch. - LOADED - to the UNLOADING position.

Turning on the unloading mode and feeding the cartridge with a shot to the loading-unloading line occurs in the same way as the loading mode.

After removing the projectile and charge from the cassette, press the ON button. AZ to PZ. The cassette is lowered. After lowering the cassette, the next cassette with a shot of this type is fed. In the case of unloading the last shot of the selected type, the rotation of the VT and the rise of the MPK does not occur.

To stop the cycle in case of incomplete unloading, it is necessary to turn off and then turn on the ASR UPR at the ShchRP.

#### 3.2.6.3.5 Ejection of the caught pallet

After the shooting is completed, an extracted pallet remains in the CBM trap, which must be removed. This operation is possible both with the weapon stabilizer turned on and off.

The procedure for removing the extracted pan is outlined in paragraph 3.3.7.

#### 3.2.6.3.6 Locking the automatic mode of operation of the weapon stabilizer, automatic loader and firing circuits

Operation of the weapon stabilizer, automatic loading of the cannon and firing of the cannon are possible by installing AVT switches. - MANUAL control panel OMS and AZ and the loading panel in the AVT position. When you turn one of these switches on the corresponding remote control to the MANUAL position. The MANUAL indicator lights up, stabilization and guidance of the turret is disabled, and it is locked by the RMPB on the tank hull. The gun is brought to the automatic loading angle and placed on a hydraulic stop, the firing circuits from the gun and the 7.62 mm machine gun are turned off.

To prevent damage to the CBM and MPK (the stabilizer is turned on), the swinging part of the gun provides hydraulic locking of the gun when these mechanisms are not in their original position.

#### 3.2.6.3.7 Using AZ in conjunction with UVI equipment

Information about the flight time for projectiles of type P or C is transmitted from the UVI using a docking device 24 (Figure 9.8) installed on the VT gearbox.

The charging cycle for types P or C begins by pressing the ON button. AZ on the launcher of the control system and AZ, after measuring the range to the target. In this case, the cassette with the selected type is tucked into the dispensing window, raised onto the information transmission line, where the docking device funnel is extended until it docks with the projectile, and information about the flight time is transmitted. Next, the funnel returns to its original position, and the AZ operation continues as usual.

If the range to the target has not been measured, the loading cycle will stop at the stage of transferring flight time to the projectile (the gun is locked at the loading angle, the cassette is raised to the information transmission line). After measuring the range, the charging cycle will continue automatically.

#### 3.2.6.3.8 Loading rounds into non-mechanized stowage compartments of the fighting compartment

It is recommended to load shots into non-mechanized stowage compartments of the fighting compartment from the gunner's position in the following sequence:

– remove the back and gunner's seat;
– give the gun a maximum elevation angle;
– rotate the tower to the position 14-00 - 16-00 according to the azimuth indicator;
– unfasten and fold up the right and middle protective curtains and secure them in the folded position;
– load five charges into the rack near the MTO partition on the starboard side;
– install and load two racks with four shells at the MTO partition on the starboard side;
– fasten the right and middle protective curtains;
– rotate the tower to the position 20-00 - 22-00 according to the azimuth indicator;
– unfasten and fold up the left and middle protective curtains and secure them in the folded floor ;
– load three charges into the rack at the MTO partition on the left side;
– install and load two racks with four shells at the MTO partition on the left side;
– fasten the middle and left protective curtains
– rotate the tower to position 30-00 according to the azimuth indicator.

After loading shots into the non-mechanized stowage of the fighting compartment, set the gunner's seat and backrest to the working position.

N o t e – Simultaneously with loading rounds into the non-mechanized stowage of the fighting compartment, crew members can load rounds into the non-mechanized stowage of the aft module.

#### 3.2.6.3.9 Loading VT with shots from non-mechanized mountings of the fighting compartment

To load VT with shots from non-mechanized mountings of the fighting compartment, you must:

– stop the tank;
– give the gun a maximum angle of descent;
– remove the back and gunner's seat from the gunner's seat;

– load the VT with shots.

The procedure for removing shots from non-mechanized stowage of the fighting compartment for loading the VT or manually loading the gun is given in Table 8.

In Table 8 and Figure 9.12, shells are designated by the index “c”, charges are designated by the index “z”.

Table 8

| Projectile, charge | Place in installation | Who extracts (charges); approximate position of the tower according to the azimuth indicator | Note |
|---|---|---|---|
| s1, s1 | s1 - in installation near the MTO partition on the right | Gunner; 14-00 - 16-00 | Before removing charges z1 or z2, it is necessary to remove shells c1 and c2 |
| | z1 - in the rack near the MTO partition on the right | | |
| s2, s2 | c2 - in installation near the MTO partition on the right | Gunner; 14-00 - 16-00 | After using c2, remove the mounting rack c1, c2 and place it in the free pipe of the rack near the MTO partition |
| | z2 - in the rack near the MTO partition on the right | | |
| s3, 3 | c3 - in installation near the MTO partition on the right | Gunner; 14-00 - 16-00 | |
| | z3 - in the rack near the MTO partition on the right | | |
| s4, з4 | c4 - installed near the MTO partition on the right | Gunner; 14-00 - 16-00 | After using c4, remove the mounting rack c3, c4 and place it in the free pipe of the rack near the MTO partition |
| | z4 - in the rack near the MTO partition on the right | | |
| s5, з5 | c5 - installed near the MTO partition on the left | Gunner; 20-00 - 22-00 | |
| | z5 - in the rack near the MTO partition on the left | | |
| s6, з6 | c6 - in installation near the MTO partition on the left | Gunner; 20-00 - 22-00 | After using c6, remove the mounting rack c5, c6 and place it in the free pipe of the rack near the MTO partition |
| | z6 - in the rack near the MTO partition on the left | | |
| s7, з7 | c7 - installed near the MTO partition on the left | Gunner; 20-00 - 22-00 | |
| | z7 - in the rack near the MTO partition on the left | | |
| s8, з8 | c8 - installed near the MTO partition on the left | Gunner; 20-00 - 22-00 | After using c8, remove the mounting rack c7, c8 and place it in the free pipe of the rack near the MTO partition |
| | z8 - in the rack near the MTO partition on the left | | |

The sequence of removing shots from non-mechanized stowage of the fighting compartment and the participation of crew members in loading the VT or manually loading the gun can be changed depending on the situation.

When removing rounds from non-mechanized stowage of the fighting compartment, it is recommended to remove the shell mounting racks installed at the MTO partition.

To remove any of the shell mounting racks at the MTO partition, you need to turn the rack handle towards yourself and remove the rack from the brackets.

Removed shell fastening racks may be placed in the free pipes of the rack near the MTO partition.

When working with non-mechanized stowage of the fighting compartment near the MTO partition, it is recommended to turn on the lighting. The switch is located on the lamp located on the roof of the hull on the starboard side.

After loading the VT with rounds from the non-mechanized stowage of the fighting compartment, the removed shell mounting racks, as well as the gunner’s seat and backrest, are placed in the working position.

### 3.2.6.4 Functional test A3

The operation of the A3 in the automatic loading mode of the gun should be checked only with training and mock-up shots.

**ATTENTION:**

**IT IS PROHIBITED TO CHECK THE OPERATION OF THE A3 IF THERE ARE LIVE ROUNDS IN THE A3 CONVEYOR!**

To check the functioning of A3 you must:

– load a dummy charge into the cassette, do not load a dummy projectile;

– carry out a full cycle of loading the gun in automatic mode with the weapon stabilizer turned on;

– turn off AZR EL. DESCENT and A3 CONTROL on the right distribution panel of the turret, as well as the weapon stabilizer, open the bolt wedge and remove the dummy charge from the gun chamber.

Check the work once with each type of shot.

### 3.3 Fire control system

#### 3.3.1 Safety measures when working with OMS

The gunner should turn on the fire control system only at the command of the tank commander.

Before turning on the fire control system, the gunner must:

– make sure that the headband of the PNM is installed correctly and that the eyecup is present (no damage) on the eyepiece of the PNM;

– make sure that the driver's hatch is closed;

– make sure the tower is unlocked;

– make sure that the gun mounting rod is removed “in a traveling manner”;

– make sure that there are no people on the tank or near it at a distance of less than 6 m;

– make sure that the tower can rotate unhindered;

– warn the crew about the activation of the fire control system.

Before turning on the fire control system, the commander must make sure that there are no foreign objects that would interfere with the unhindered deployment of the control panel and control panel. If the tank has fuel barrels installed, they must be removed before turning on the weapon stabilizer.

**DURING THE OPERATION OF THE OMS, IT IS PROHIBITED:**

**- PRESS THE RANGE MEASUREMENT BUTTONS ON THE HANDLES OF THE GUIDANCE CONSOLE AND ON THE COMMANDER’S CONSOLE IN ALL CASES NOT RELATED TO DIRECT RANGE MEASUREMENT;**
**- GET OUT OF THE TANK, CLIMB ONTO THE TANK AND INSIDE IT, BE IN FRONT OF THE ENTRANCE WINDOWS OF THE SIGHTS, REMOVE THE COMMANDER’S AND GUNNER’S GUARDS;**
**- POINT THE CENTRAL RETICLE OF THE PNM AND THE RETICLE OF THE PKP AT THE SUN;**
**- AIM THE CENTRAL RETICLE OF THE PNM AND THE RETICLE OF THE PKP AT PEOPLE, EXCEPT IN CASES OF COMBAT WORK;**
**- ROTATE THE TOWER IF THERE ARE PEOPLE WITHIN A RADIUS OF 6 M;**
**- AIM THE REMOTE CONTROL WHEN THERE ARE PEOPLE ON THE TANK;**
**- MEASURE THE RANGE TO OBJECTS AND STRUCTURES LOCATED IN THE PARKS OF MILITARY UNITS OR MAINTENANCE AREAS (EXCEPT FOR THOSE SPECIFICALLY INTENDED FOR MEASUREMENTS DURING RANGEFINDER CHECKS) AND GLARE OBJECTS.**

#### 3.3.2 Initial position of the control system of the control system

Initial position of the controls on the left distribution panel (hereinafter referred to as SCHRL):

– AZR "PNM" - in the "OFF" position;

– AZR "PREOBR." - in the “ON” position;

– AZR “EL.DOWN” - in the “OFF” position;

– AZR "MAGN.MPB" - in the "ON" position;

– AZR "UP VN" - in the "ON" position;

– AZR "OSV. A LION." - in the “ON” position;

– AZR "OSV. ETC." - in the “ON” position;

– AZR " START" - in the "ON" position;

– AZR " SPZ" - in the "OFF" position;

– AZR "OBOGR.TNP" - in the "ON" position;

– switch EMERGENCY START EL. DESCENT WITHOUT SUPERCHARGER on SCHRL - must be sealed.

N o t e s

1 To comply with safety measures, the “EL.SPUSK” AZR is turned on, if necessary, immediately before firing from a cannon or coaxial machine gun.

2 AZR "SPZ" are included if necessary.

The initial position of the controls on the distribution right panel (hereinafter referred to as SHR):

– AZR "PKP" - in the "ON" position;

– AZR "PKP GN" - in the "ON" position;
– AZR “EL.DOWN” - in the “OFF” position;
– AZR "OBOGR. TNP" - in the "ON" position;
– AZR "AVAR. CHAINS" - in the "ON" position;
– AZR "DOS." - in the “ON” position;
– AZR "SP.POD" - in the "ON" position;
– AZR “L.R.VT” - in the “ON” position;
– AZR "AZ EM" - in the "ON" position;
– AZR "AZ UPR." - in the “OFF” position.

N o t e s

1 To comply with safety measures, the “EL.SPUSK” AZR is turned on, if necessary, immediately before firing from a remote control gun, a cannon or a coaxial machine gun.

2 AZR "AZ UPR." include if necessary.

**ATTENTION:**

**IF THE AZR PNM AND AZR PKP ARE SIMULTANEOUSLY IN THE “OFF” POSITION, THEN WHEN THE TELEVISION DOUBLE SIGHT IS TURNED ON, ITS OPERATION WILL BE DEPENDED FROM THE BATTERY, WHICH REQUIRES REPLACEMENT AFTER IT IS DISCHARGED!**

Initial position of the controls on the distribution panel (hereinafter referred to as ShchR):
– AZR "DPU BU" - in the ON position;
– AZR "DPU VN-GN" - in the ON position;
– AZR "RADIOOB." - in ON position.
Initial position of the controls on the control panel of the OMS and AZ (hereinafter - PU OMS and AZ):
– toggle switch “SUO” - in the “OFF” position;
– toggle switch “STAB” - in the “OFF” position;
– The “AVT-RUCH” toggle switch is in the “AVT” position.
Initial position of controls on the PNM BVD:
– filter handle “ ” - in position “ ”;
– the screw for switching the built-in alignment modes is in the “ ” position.
Initial position of controls on the loading panel (hereinafter referred to as PZ):
– toggle switch “AVT-RUCH” - in the “AVT” position;
– toggle switch "UNGROUND" LOADING" - in the "UNLOADING" position.
Initial position of the controls on the commander's console (hereinafter - PC):
– toggle switch “PKP” - in the “OFF” position;
– toggle switch “DPU” - in the “OFF” position;
– the switch for modes and types of ballistics is in the “NABL” position.
Initial position of the controls on the KVI:
– The “SUO-SNV” toggle switch on the KVI is in the “SUO” position.
The initial position of the controls on the PNM and PKP control panels (hereinafter referred to as Pn-PNM and Pn-PKP, respectively).

The toggle switches for turning on TP channels must be in the “ ” position.
The initial position of the controls on the PDT control panels (hereinafter referred to as Mon-PDT) for the gunner and commander is the “ ” position.

### 3.3.3 Preparing the LMS for inclusion

The driver must:
– turn on the AB switch;
– close and lock the hatch cover;
– Start the engine and set the engine speed to at least 1500 rpm.
The gunner needs:
– remove the cover from the wind sensor and make sure the receiving holes are clean;
– close and lock the hatch cover;
– open the PSM protective covers by turning rods 3 and 8 (Figure 1.5) 90° counterclockwise (if work with the PSM thermal imaging channel is not planned, then it is recommended to open only the right cover, ensuring protection of the protective glass of the PSM thermal imaging channel). When opening both covers, open the right cover first;
– adjust and fix the forehead protector on the PNM;

– by rotating the PSM eyepiece, adjust the diopter setting of the eyepiece until all lines, scales, and service information in the PSM field of view are clearly marked;

– make sure that the handle of the mechanical lift of the gun is installed in the lower position corresponding to manual aiming;

– unlock the tower;

– remove and place the gun locking rod in the socket “in a traveling manner”;

– open the gun bolt wedge;

– make sure that the controls on the ShchRL, PU OMS and AZ, BVD PNM, Pn-PNM, Pn-PDT are set to their original position;

– install the gun guard;

– check the possibility of turning the turret and raising the gun using manual drives.

The commander needs:

– remove the protective cover from the control panel mirror unit protection and insert it into special strips located on the back of the control panel mirror unit protection;

– close and lock the hatch cover;

– make sure that all actuators of the automatic loader (hereinafter referred to as AZ) are in their original position.

– make sure that the controls on ShchRP, ShchR, PC, Pn-PKP, Pn-PDT, PZ, KVI are set to their original position;

– install the gun guard.

### 3.3.4 Enabling the OMS

The fire control system should be turned on only when the engine is running or when the diesel generator set is running or when an external power source with a power of at least 12 kW is connected with a buffer group of at least two batteries or when powered from another tank.

After completing the preparatory operations in accordance with clause 3.3.3of this manual, readiness is ensured for the inclusion of the OMS in one of the following modes:

– for the commander:

- OBSERVATION ” mode (pre-combat work mode);
- “DPU” mode (combat work mode from the commander’s seat);
- DOUBLE ” mode (control mode of a cannon, coaxial machine gun and AZ from the commander’s seat);
- UNDERSTUDY ” mode (emergency mode of operation from the commander’s seat);

– for the gunner:

- OBSERVATION ” mode (pre-combat work mode);
- MAIN ” mode (combat operation mode);
- DOUBLE " mode (emergency mode of operation from the gunner's position).

#### 3.3.4.1 Enabling the fire control system in the “OBSERVATION” mode

In this mode, the control system is preliminarily switched on without turning on the turret weapon guidance drives (for example, on the march) and provides the gunner and commander with the ability to instantly switch to the “MAIN”, “DPU” and “DOUBLE” modes.

After turning on the fire control system in the “OBSERVATION” mode, the commander has the opportunity to:

– work with the BV menu;

– bring the control panel to the selected sighting direction through the commander’s prism observation devices using direction indicators;

– conduct an overview of the terrain and search for targets in the near zone through the surveillance TV channel of the control panel (taking into account the limitations of visibility of a stationary control panel);

– conduct a survey of the area and search for targets through the main TV or TP channel of the control panel (taking into account the limitations of visibility of the fixed control center) or through the strategic offensive weapons;

– measure the range to targets using the LD PKP;

– use functions to improve video quality;

– capture targets for automatic tracking;

– instantly turn on combat mode from the commander's seat.

After turning on the fire control system in this mode, the gunner has the ability to:

– work with the BV menu;

– direct the line of sight of the ISM (due to the ISM tracking the position of the gun) using the manual drives of the gun and turret (with the turret unlocked);

– monitor the area through the PNM TP channel;

– monitor the terrain through the PNM sighting channel;

– measure the range to targets using LD ISM;

– instantly turn the control system into the “MAIN” mode.

To enable the “OBSERVATION” mode at the commander’s workplace, you must perform the following operations:

– make sure that the AZR PKP on the ShchRP is turned on;

– turn on the control panel toggle switch on the PC, after which a television image of the control panel overview TV channel will appear on the commander’s APU screen, and the “ ” and “ ” indicators on the Pn-PKP begin to light up . After an automatic check (no more than 120 s), the “ ” indicator on the Pn-control panel begins to light up .

– if it is necessary to use the main TV channel of the control panel instead of the overview one, by pressing the button “ ” (“UPZ”) on the Pn-PKP set the desired field of view of the TV channel of the control panel (SHPZ, UPZ or UPZ*2);

– if necessary, adjust the brightness, contrast and sharpness of the image on the APU screen by pressing the “+” key to increase the parameter value or by pressing the “-” key to decrease the value. When you press the keys, the numerical value of the adjustable parameter changes and the filling of the graphic bar (graphic interpretation of the numerical value) on the APU screen changes. The selection of an adjustable parameter is carried out by pressing key 3 (Figure 8.20) selecting the adjustable parameter “CONTRAST-BRIGHTNESS-SHARPNESS” until the required symbol appears on the APU screen:

- " " - contrast;
- " " - brightness;
- " " - sharpness;

– after the OCIO reaches the mode, as evidenced by the presence of an image of the azimuth indicator on the commander’s APU screen, achieve an optimal, from the point of view of visual perception, image of the target environment by changing the methods of digital image processing by short-term pressing the OCIO button on the Pn-PKP. After changing the digital processing method, a VI indication with the code of the current method is displayed at the top of the screen for a short time;

**ATTENTION:**
**WHEN DIGITAL PROCESSING IS ENABLED, AUTOMATIC TARGET TRACKING IS BLOCKED!**

To be able to acquire and automatically track a target, you must turn off digital processing (set to “VI-”).

– if it is necessary to use the TP channel of the control panel, turn on the TP channel toggle switch on the PN-control panel, and the “ ” indicator on the PN-control panel begins to blink. After a time of no more than 9 minutes, the control panel TP channel is ready for operation, as evidenced by the absence of blinking of the TP indicator on the PN-control panel when the TV channel is selected or the constant lighting of the TP indicator on the PN-control panel when the TP channel is selected.

N o t e - At low ambient temperatures, there may be a delay (no more than 6 minutes) from the moment the control panel toggle switch is turned on on the PC until the image appears on the commander’s APU screen.

To enable the “OBSERVATION” mode at the gunner’s workplace, you must perform the following operations:

– make sure that the AZR PNM on the ShchRL is enabled;

– turn on the OMS toggle switch on the OMS control panel and AZ. After an automatic check (no more than 70 s) of the computer unit, rangefinder, power circuits and gyroscope rotation speed, the readiness indicators on the front panel of the BVD begin to light up: “ ”, “ ”, “ ”,
if it is necessary to use the TP channel PNM, turn on the TP channel toggle switch to Mon-PNM, after which a test image in the form of horizontal stripes of different brightness and the message COOLING INITIALIZATION is displayed on the screen of the gunner’s APU, and after a time of no more than 11 minutes - the image generated by the TP channel PNM. After entering the thermal imaging channel mode automatically switches to a wide field of view, and a message corresponding to the state of the APU appears on the APU screen (Figure 8.6);

– adjust the contrast, brightness and sharpness of the image on the APU screen (similar to the operations performed by the commander).

When working in high-light conditions, set the FILTER knob to the ON position.

N o t e - At negative ambient temperatures, a delay (no more than 6 minutes) is possible from the moment the toggle switch is turned on Mon-PNM until the image appears on the APU screen.

### 3.3.4.2 Switching the control system to the “DPU” mode

The mode allows the commander to conduct an overview of the terrain, search for targets through the TV and TP channels of the PKP, measure the range to targets using the LD PKP, capture targets for auto tracking and fire at them from the DPU.

Commented [ДДО1]: 188M.48-21

Commented [ДДО2]: 188M.48-21

Switching to the “DPU” mode is carried out only from the commander’s seat from the “OBSERVATION” or “DOUBLE” modes.

To switch the control system to the “DPU” mode, you must:

– make sure that toggle switch 8 (Figure 8.18) of the control panel is turned on on the PC (the “OBSERVATION” or “DOUBLE” modes are turned on);

– set the switch for 4 modes and selecting the type of ballistics on the PC to the “NABL” position;

– on the PC, turn on the toggle switch 6 DPU, while the yellow indicator 5 DPU lights up on the PC, signaling the activation of the electric drives of the vertical and horizontal guidance of the DPU, and on the screen of the commander’s APU in the field of indication of the operating mode of the control system, the inscription “DPU” is displayed, signaling the inclusion of the “DPU” mode DPU".

### 3.3.4.3 Switching the control system to the “DOUBLE” mode

The “DOUBLE” mode is intended for the commander to duplicate the functions of a gunner (firing from a cannon and from a coaxial machine gun with all types of ammunition, except for a guided missile). It is recommended to turn on the “DOUBLE” mode only if it is impossible for the gunner to perform operations in the “MAIN” mode.

The mode provides the commander with the ability to detect and recognize targets when observing through the TV or TP channel of the PKP, measure the range to targets using the LD PKP and fire at them from a cannon and a coaxial machine gun.

Switching to the “DOUBLE” mode is carried out only from the commander’s seat from the “OBSERVATION” or “DPU” modes.

To switch to the “DOUBLE” mode, the commander needs to set the 4 mode switch (Figure 8.18) and select the type of ballistics on the PC to the desired position (B, K, O, P, R, S), after which the gun and turret automatically move at transfer speed to the direction of the PKP line of sight, and the message “DBL” appears on the commander’s and gunner’s APU in window 4 (Figure 8.5) indicating the operating mode of the control system (if a narrow field of view or a narrow field of view with electronic zoom is selected).

N o t e - To ensure the functioning of the “DOUBLE” mode, the gunner must have the “MAIN” mode turned on (the gun and turret must be unlocked).

### 3.3.4.4 Switching the control system to the “MAIN” mode

The mode provides independent operation from the commander and gunner positions.

In combat mode, the gunner detects and recognizes targets when observing through the sighting or TP channel of the PNM, measures the range to targets using the LD PNM and fires at them from a cannon and a coaxial machine gun. At the same time, the commander, regardless of the gunner, has the ability to direct the field of view of the PNM, survey the terrain, search for targets through the TV and TP channels of the PKP, measure the range to targets using the LD PKP and fire at them from the DPU. The commander can perform target designation to the gunner, including target designation with target reacquisition. The commander and gunner have the ability to simultaneously and independently perform automatic target tracking. The commander has the ability to use the functions of digital processing of TV images (visual image enhancement when working with the PKP TV channel).

Switching to the “MAIN” mode is carried out only from the gunner’s position from the “OBSERVATION” mode.

When the gunner is working in the “MAIN” mode, the commander can work in the “OBSERVATION” or “DPU” modes. Operation in the “MAIN” mode is possible when the control panel is turned off.

To switch the control system to the “MAIN” mode, the gunner must:

– set the handle of the mechanical lift of the gun to the upper position corresponding to stabilized pointing;

– make sure the tower is unlocked. If the tower is locked, then it must be unlocked;

– on the fire control and air defense control launchers, turn on the STAB toggle switch, while on the control and air defense control and air defense control launchers the yellow STAB indicator lights up, indicating that the vertical and horizontal gun guidance drives are turned on, and the “ (A) ” indicator on the front panel of the PNM BVD lights up, signaling the possibility of independent guidance of the PNM’s field of view from the guidance console.

### 3.3.4.5 Switching the control system to the “DUBLER” mode

The mode provides emergency operation from the commander's place or from the gunner's place through a backup television sight in the event of failure of the main sights and other equipment of the fire control system, including in the absence of power supply voltage from the tank's on-board network.

In this mode, the commander or gunner detects and recognizes targets, measures the range using the “base-on-target” method, aims the gun using the stabilizer drives, and fires the gun or a coaxial machine gun.

In the event of an emergency lack of power from the on-board network, the gunner is provided with the ability to work with the PDT from an autonomous power source, aiming the gun and turret is carried out by manual drives for aiming and firing through the PDT.

Before turning on the “DUBLER” mode, it is necessary to open the protective cover of the PDT, for which it is necessary to pull rod 11 towards you (Figure 1.5).

Switching to the “DOUBLE” mode from the gunner’s seat or from the commander’s seat is possible both with the control system turned off and on in any mode.

To switch the control system to the “BACKUP” mode from the gunner’s position when the tank’s on-board network is working (when the PDT and STV are operating from the on-board network), you must:

– make sure that the gun lifting mechanism lever is in the upper position (STAB position);

– make sure that the AZR PNM on the ShchRL is turned on;

– turn on the toggle switch on the gunner's Mon-PDT, while in window 7 (Figure 8.17) of the FCS (PDT) operating mode indication the mode - “NAV” (gunner) is displayed.

To switch the control system to the “BACKUP” mode from the gunner’s position when the tank’s on-board network is faulty (when the PDT is operating from an autonomous source and the STV is not working), you must:

– move the lever of the gun lifting mechanism to the lower position (to the RUCH position);

– turn on the toggle switch on the gunner's Mon-PDT, while in window 7 indicating the operation mode of the control system (PDT), the mode is displayed - “NAV RUCH” (gunner, manual control of STV drives), and if there is no power in the on-board network, pictogram 2 is displayed in place 1 of the pictogram display operation of the PDT from the BPR with display of the level of remaining battery charge of the BPR as a percentage;

– unlock the tower.

To switch the control system to the “BACKUP” mode from the commander’s seat (only if there is power in the on-board network), you must:

– make sure that the gun lifting mechanism lever is in the upper position (STAB position);

– make sure the tower is unlocked;

– turn on the toggle switch on the commander’s Mon-PDT, while in window 7 of the indication of the operating mode of the control system (PDT) the mode is displayed - “COM” (commander).

N o t e s

1 The priority for working with the PDT in the presence of on-board network voltage is given to the commander, i.e. when the PDT is turned on simultaneously from both places, the operation mode from the commander’s place will be ensured, while the PDT indicator on the gunner’s Mon-PDT will blink.

2 In the absence of on-board network voltage, only the operating mode from the gunner’s position is provided (even if the PDT is turned on by the commander) with manual aiming of the gun and turret. In this case, the gunner should not move the lever of the gun lifting mechanism to the upper position, to the STAB position (the lever should remain in the lower position, to the RUCH position).

3 When the control system is turned on (the PNM and/or control panel is turned on) and the control system is switched to the “DUBLER” mode, the PNM and/or control panel is automatically turned off, as well as the PT-800 converter and the control system switches to the “BACKUP” mode, and after turning off the “ BACKUP" operation of the control system is restored automatically.

### 3.3.5 Combat use of the fire control system

#### 3.3.5.1 Features of the combat use of the fire control system

Effective combat use of the fire control system is ensured through the integrated interaction of the commander and gunner, through clear and coordinated actions.

During the combat use of the fire control system, the commander solves the following tasks:

– coordinates the actions of the crew;

– surveys the area, detects and recognizes targets;

– measures the range to targets (if necessary);

– determines the degree of danger of detected targets and decides on the need to hit them by the gunner or decides to hit the target through the remote control;

– performs target designation to the gunner;

– if necessary, duplicates the gunner (if it is impossible to fire using the PNM), that is, independently fires from a cannon or coaxial machine gun through the control panel;

– if it is impossible to fire from the gunner's position and if it is impossible to fire using the PKP, if there is an on-board network of the tank and a working STV, fires from a cannon or coaxial machine gun using a PDT.

When using the fire control system in combat, the gunner solves the following tasks:

– receives target designations from the commander or, by the commander’s decision, detects and recognizes targets independently;

– measures the distance to the target;

– selects the type of ammunition that ensures destruction or effective suppression of the target depending on its type;

– conducts aimed fire from a cannon or from a coaxial machine gun.

Effective firing of remotely detonated ammunition requires reliable range measurement (with an error of no more than 10 m). Considering that these ammunition are fired at enemy personnel, including those located in shelters, or at small camouflaged targets, there is a possibility of measuring an unreliable range.

For correct range measurement it is recommended:

– measure the range repeatedly (at least twice), making sure that from measurement to measurement the range differs by no more than 10 m;

– measure range by clearly distinguishable objects located in close proximity to the target.

Remote detonation of a 3OF82 high-explosive fragmentation projectile on a trajectory over a target (type P) is guaranteed to occur if the time from the moment information about the flight time is transmitted to the projectile (after the docking funnel returns to its original position during the loading cycle of type P) until the shot does not exceed 16 With.

It is recommended that type P loading (programming the projectile) be carried out immediately before firing and strive to ensure that the shot is fired within 16 seconds after information about the flight time and speed of the tank is transferred to the projectile. Before firing a shot, it is necessary to ensure a constant speed and direction of movement.

When shooting with type P, it is necessary to take into account that information was transferred to the projectile at the time of programming the projectile. In the event of a significant change in the speed of the tank after programming the projectile (for example, the tank stops or the tank begins to move), ineffective remote detonation of the projectile is possible in advance of the target or far behind the target. In these cases, it is recommended to re-measure the range to the target, move the aiming point 2 m lower relative to the planned hit point and fire a shot, ensuring contact activation of the projectile, while it must be taken into account that in certain situations the projectile may explode on the trajectory in front of the target, without ensuring that the most contact operation and without causing significant damage to the target.

If the target is not hit, it is necessary to fire again, following the recommendations.

To hit a target, if the time exceeds 16 s (for example, when the shot is delayed due to target overlap or when re-aiming at another target, etc.), the BV will automatically generate corrections to ensure that the projectile hits the target directly (at the aiming point) and its contact operation. Immediately before firing, it is recommended to re-measure the range to the target and fire the shot.

The transition from the remote detonation mode to the contact activation mode is signaled by the blinking of indicator 10 (Figure 8.5) of the selected type of ammunition and type of weapon (“P”) in the field of view of the PNM sighting channel and in window 2 (Figure 8.7) indicating the type of ammunition and type of weapon on APU when working in a narrow field of view or narrow field of view with electronic zoom. The contact firing mode is automatically disabled after the gun is fired and recoils. If, after the gun is rolled back, the contact operation mode is not switched off normally, then the switch off will occur when the gun is placed on the stopper at the loading angle during the subsequent automatic loading cycle.

### 3.3.5.2 Features of the combat use of fire control systems in adverse weather conditions

When shooting in difficult weather conditions from a machine gun and a DPU coaxial with the main armament, fire should be performed with an adjustment of the burst, guided visually by bullet tracers and hits, shifting the aiming point in the desired direction to ensure hitting the target.

Due to the low efficiency of firing cumulative projectiles in difficult weather conditions (intermittent wind, variable wind, different wind speeds and directions along the flight path, etc.) at a distance of more than 1600 m, it is recommended to fire armor-piercing sub-caliber projectiles at these ranges, so how their deviation is less dependent on changes in weather conditions.

### 3.3.5.3 Measuring and manually entering target range

Measuring the range to the target from the gunner's position is carried out using a PNM laser range finder, and from the commander's position - a PKP laser range finder. Measuring range using laser rangefinders PNM and PKP is possible after turning on the control system in any modes, except for the “DUBLER” mode.

If it is not possible to use PNM and PKP rangefinders (for example, to exclude unmasking factors of laser radiation), it is possible to enter the range value manually.

To measure the range to the target, the gunner must:

– make sure that the rangefinder readiness indicator “  ” is lit on the front panel of the PNM BVD;

– by deflecting the handles of the guidance console, align the central aiming mark of the sighting channel or the aiming mark of the thermal imaging channel with the center of the target;

– press the range measurement button on the guidance panel (on the right handle under the thumb), after which the measured range value is displayed in the PNM eyepiece, as well as on the APU screen (with the thermal imaging channel turned on).

N o t e - The measured range value is automatically entered into the ballistic computer and taken into account by the fire control system when firing at a target with the selected type of ammunition from the gunner's position.

To measure the range to the target, the commander must:

– make sure that the “  ” indicator on the Pn-control panel is lit;

– by deflecting the guidance control lever on the commander's console, align the sighting symbol of the PKP TV channel or PKP TP channel with the center of the target;

– press the ID button on the commander's remote control (above the left handle), after which the measured range value is displayed on the APU screen.

N o t e - The measured range value is automatically entered into the ballistic computer and taken into account by the fire control system when firing at a target with the selected type of ammunition from the commander's position.

To manually enter the range, the gunner or commander must use the "+" and " –" buttons on the front panel of the PNM BVD.

To reset the range in the ISM, you must simultaneously press the "+" and " –" buttons on the front panel of the ISM BVD, while the "SBR" indication will appear on the target range indicator in the field of view of the sighting channel (in the service line of the TP channel, "SBR" will be displayed) ).

To manually enter the range into the control panel, use the " ⇦ " and " ⇨ " buttons on the Pn-control panel.

To reset the range in the control panel, you must simultaneously press the " ⇦ " and " ⇨ " buttons on the Pn-control panel, and the indication "SBR" ("SBR" for the TP channel) should appear on the APU screen.

### 3.3.5.4 Working in auto-target tracking mode

To capture targets for auto tracking, the commander must:

– detect target;

– select TV or TP channel PKP;

– select the optimal field of view, adjusting the image settings if necessary;

– point the PKP aiming sign at the target, when a frame of readiness to capture is formed, capture the target for automatic tracking by pressing the CAPTURE button on the commander's remote control, located above the left handle;

– If necessary, perform manual retargeting.

To acquire targets for auto tracking, the gunner must:

– detect target;

– select the optimal field of view (UPZ or UPZx2), adjusting the image settings if necessary;

– point the aiming sign of the TP channel of the PNM at the target, when the frame is formed ready for capture, capture the target for auto tracking by pressing the button on the left handle of the guidance console, located under the thumb;

– If necessary, perform manual retargeting.

N o t e s

1 Target acquisition by the gunner is possible only when using the TP channel of the ISM channel.

2 When the PNM TP channel is turned on and the target is automatically tracked through the PKP TP channel, in the process of target designation, automatic target reacquisition is ensured (target acquisition in the PNM thermal imaging channel with automatic setting of the PNM TP channel parameters in accordance with the current parameters of the PNM TP channel).

### 3.3.5.5 Detection and recognition of targets by the commander

In anticipation of the search for targets, depending on the current weather and temperature conditions, adjust the gain of the TP channel, ensuring unambiguous observation of objects and objects on the ground. If necessary, depending on the distance to the intended target, focus the image of the TP or television channels (to achieve a sharp image of the area at a distance to the intended target). Depending on the background target environment and operator preferences, select the polarity of the TP channel image .

To detect targets, the commander must:

– monitor the terrain through the overview TV, main TV and TP channels of the control panel (switch fields of view, direct the field of view of the control panel along the GN and VN so as to ensure scanning of a sector or strip on the terrain in which the target may presumably be located, or conduct a circular view of the area for target detection);

– observe the terrain through the commander's prism observation devices, performing, if necessary, bringing the PKP aiming line to the target area using the direction indicators, observed through the commander's prism observation device(s). If necessary, the commander can quickly determine the prism observation device(s), through which the target currently being observed on the APU should be visible. The prism device(s) through which the target should be visible is determined by the indication on the direction indicator(s);

– monitor the area using an outdoor video surveillance system;

– control your own position and surroundings using an electronic map of the area on the multifunctional panel, performing, if necessary, target designation (automatic coordination of the control panel's field of view with the selected direction or landmark on the electronic map);

– work out targets that appear on the multifunctional panel from a higher commander (carry out target designation for these targets, determine the degree of danger of detected targets, decide on the need to hit them by the gunner or make a decision to hit targets independently through the control center);

– carry out target designation of the control panel to the source of laser radiation (according to commands from the SPS).

After detecting a target, the commander must aim the aiming mark at the target and recognize it. To recognize a target, if necessary, select the optimal field of view, perform additional gain settings for the TP channel, and focus the image. If there is a frame ready for capture, perform target acquisition for auto tracking.

After recognizing the target, the commander must decide on the need to hit the target, carry out target designation to the gunner, or hit the target himself (using the remote control).

N o t e s

1 When working with the PKP overview TV channel, stabilization and guidance of the PKP field of view is provided only in the GN plane; range measurement with a laser range finder and automatic target tracking are not provided.

2 To avoid detection of the tank by the enemy, measuring the range with a laser range finder is recommended only in justified situations.

**ATTENTION:**

**IF SIGNIFICANT DEGRADATION THERMAL IMAGE WHEN WORKING WITH THE TP CHANNEL, INCLUDING THE APPEARANCE OF EXTERNAL NOISE, STRIPES, ETC. CALIBRATION REQUIRED!**

To perform calibration, it is recommended that when the remote control is turned off, using the appropriate direction indicators, rotate the control panel to a position in which the aiming line will be covered by the elements of the remote control or provide a uniform background in the field of view (the best effect is achieved when pointing the field of view at the "sky", while pointing at the sun not allowed), press and hold the " " button  on the PN-PNM for about 2 seconds, select the CALIBRATION item," press the "  " or "  " buttons to activate calibration, after the test pattern disappears and the thermal imaging image appears, the calibration is completed.

### 3.3.5.6 Detection and recognition of targets by the gunner

In anticipation of searching for targets, depending on the current weather and temperature conditions, adjust the diopter setting of the PNM eyepiece, if necessary, turn on the illumination of the aiming mark or turn on the filter, adjust the gain of the TP channel, ensuring unambiguous observation of objects and objects on the ground, if necessary, depending on distance to the intended target, focus the image of the TP channel (to achieve a sharp image of the area at a distance to the intended target). Depending on the background target environment and operator preferences, select the polarity of the TP channel image.

To detect targets, the gunner needs to observe the terrain through the PNM (switch fields of view, direct the field of view of the PNM along the GN and VN so as to ensure scanning of a sector or strip on the terrain in which the target may presumably be located or conduct a 360-degree view of the area to detect the target).

After detecting a target or after target designation from the commander, the gunner must aim the central aiming mark of the ISM or the aiming mark of the thermal imaging channel of the ISM at the center of the target. Holding the central aiming mark with the aiming remote control, select the optimal field of view, if necessary, perform additional gain and focusing adjustments for the TP channel, when working with the PNM TP channel and there is a frame ready for capture, capture the target by pressing the CAPTURE button on the PC and recognize the target.

After recognizing the target, the gunner must engage the target. The procedure for the gunner to fire from a cannon and a coaxial PKT in the "MAIN" mode is set out in paragraph 3.3.5.8of this manual.

N o t e s

1 After successful target designation from the commander and automatic re-acquisition of the target in the TP channel of the PNM, do not perform repeated operations to capture the target.

2 To exclude detection of the tank by the enemy, it is recommended to measure the range with a PNM laser range finder only in justified situations.

3 In the process of target designation from the commander, if the necessary conditions are met, the range measured by the commander is transmitted to the gunner.

4 With the set magnification of the field of view of the sighting channel "4 $^{X}$" (wide field of view) and gun declination angles of more than 3°, it is allowed to darken a small part of the field of view by elements of the tank design.

5 If part of the field of view is significantly obscured by tank design elements, it is recommended to set the field of view increase in the sighting channel to "12 $^{X}$" (narrow field of view) or work through the PNM thermal imaging channel.

**ATTENTION:**

**IN THE EVENT OF SIGNIFICANT DECORATION IN THE THERMAL IMAGE, INCLUDING THE APPEARANCE OF EXTERNAL NOISE, STRIPES, ETC. IT IS NECESSARY TO CALIBRATE TPK-K.**

To perform calibration, it is recommended to close the cover of the entrance window of the ambulance or provide a uniform background in the field of view (the best effect is achieved when pointing the field of view at the "sky", while pointing at the sun is not allowed), press the menu button "  " on the PN-PNM, select the item CALIBRATION", press the "  " or "  " buttons to activate calibration, after the test pattern disappears with the message CALIBRATION and the thermal imaging image appears, the calibration is completed.

### 3.3.5.7 Target designation

The commander has the opportunity to carry out target designation to the gunner, i.e. indicate the direction to the most dangerous target for subsequent immediate destruction from a cannon or coaxial machine gun from the gunner's position.

To carry out target designation, the commander must:

– detect and recognize the target;

– aim the PKP aiming sign at the center of the target;

– while holding the aiming sign, press and hold the control button on the commander's remote control (on the left handle under the index finger). At the same time, the turret and gun begin to move at transfer speed in the direction of coordination with the PKP field of view, the inscription “TsU” appears on the commander’s and gunner’s APU, and indicator 9 (Figure 8.5) of the “DOUBLE” and “TARGET DESIGNATION” modes lights up in the PNM sighting channel;

– after the field of view of the PNM has been coordinated with the field of view of the control panel (at the end of the turn of the turret and the field of view of the PNM in the direction of the target), release the control center button on the commander’s console.

N o t e s

1 After releasing the control center button on the commander’s console, the gunner has the ability to aim, measure the range to the target and fire at it with the selected type of ammunition from a cannon or coaxial machine gun.

2 If the commander has captured the target by pressing the CAPTURE button on the PC, then during target designation the target is re-acquired through the PNM TP channel (with the PNM TP channel turned on).

3 If the commander, after capturing the target for auto tracking, measured the range to the target, then the range measured by the commander is transmitted to the gunner automatically during the target designation process.

### 3.3.5.8 The gunner firing from a cannon and a coaxial PKT in the “MAIN” mode

To prepare and fire a shot from a cannon or PKT in the “MAIN” mode, you must:

– after recognizing the target, depending on its type and range to the target, select the type of ammunition that ensures its destruction, for which switch 7 (Figure 9.5) types of shots and type of weapon on the launcher of the control system and AZ is set to the desired position: B, K, O , R, S, P, U, U-Night;

– make sure (when firing from a cannon) that indicator 6 “THERE IS A TYPE” is illuminated on the launcher of the control system and AZ, which signals the presence of the selected type of projectile in the rotating conveyor;

– load the cannon with the selected type of projectile by pressing button 8 “ON AZ” on the control system launcher and AZ (when firing from a cannon);

– holding the central aiming mark of the sighting channel or the aiming mark of the TP channel on the selected target with the guidance remote control, measure the range to it by pressing the range measurement button on the guidance remote control with the thumb of your right hand (the measured range should be displayed in the field of view of the targeting channel or on the APU);

– holding the central aiming mark of the sighting channel (or the aiming mark of the TP channel) on the aiming point with the aiming remote control for at least 2 s (it is recommended to aim at the center of the target), smoothly press the gun firing button (or PKT) on the aiming remote control and hold it until the shot is fired from a cannon (until the end of the line from the PKT).

**ATTENTION:**

**THE SHOT WILL FIRE ONLY IF THE FIRING CIRCUITS ARE READY (THE GREEN INDICATOR IS GLOWING IN THE FIELD OF VIEW OF THE SIGHTING CHANNEL OR THE PRESENCE OF THE INSCRIPTION “GOT” ON THE APU)!**

The procedure for preparing and firing a shot from a cannon or PKT when working with the sighting and thermal imaging channels of the PNM is similar. In this case, when automatically tracking a target through the PNM thermal imaging channel, the following must be taken into account:

– after locking on a target for auto tracking, if necessary, perform manual re-targeting (point the TP PNM aiming sign at the planned impact point, it is recommended to point at the center of the target) and return the guidance console to the neutral position;

– if the range measurement was not carried out or a significant time has passed after the range measurement, then immediately before the shot it is necessary to measure the range to the target;

– firing from a cannon (machine gun) must be carried out under the condition of automatic target tracking for a duration of at least 2 s.

N o t e s

1 When firing from a coaxial PKT, it is allowed to adjust the aiming point based on the results of hits from the previous burst or along the trajectory of the bullets (when firing tracer bullets).

2 The procedure for combat operation with guided weapons is set out in paragraph 3.3.5.9of this manual.

### 3.3.5.9 Combat work with guided weapons

The use of guided weapons is ensured by the joint operation of the tank's control system and the guided shot. The missile is fired through the cannon barrel by a 9X949 throwing device.

Firing a shot with a guided missile is only possible from the gunner's position in the "MAIN" mode.

The firing procedure for a guided missile is similar to that for other types, but the following must be taken into account:

– To load a cannon with a guided missile, it is necessary to set the switch 7 (Figure 9.5) of types of shots and types of weapons on the launcher of the control system and AZ to the desired position " U " (guided) or " U-Night " (guided - night). When switch 7 is set to the " U " position , the lamp on board the rocket switches on to a bright glow mode, and when set to the " U-NIGHT " position , to a weak glow mode. When firing a guided missile through the PNM thermal imaging channel, it is recommended to set the "U-NIGHT" position. It is permissible to load the cannon with a guided missile from a non-mechanized stowage manually;

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– without the laser control channel being ready (if the " ⚠ " indicator on the front panel of the PNM BVD is not illuminated), do not load the gun with a rocket. Until the laser control channel is ready, automatic loading is blocked by the AZ circuit;

– the throwing device is triggered approximately 1 s after pressing the cannon firing button;

– when firing a guided missile, the guidance speeds of the stabilizer drives are limited;

– hitting a target with a missile during automatic target tracking is carried out similarly to shooting with other types, while after the shot the automatic target tracking does not stop and the possibility of additional targeting is provided using the guidance console in the process of pointing the guided missile at the target;

– when auto-tracking a target after the launch of a guided missile, the BCOI briefly (during the time the video image is illuminated in the field of view of the thermal imaging channel) switches to the "INERTIAL TRACKING" mode, after which it automatically re-acquires the target and continues its auto-tracking;

**ATTENTION:**

**AFTER THE LAUNCH OF A GUIDED MISSILE, UNDER CERTAIN CONDITIONS IT IS POSSIBLE TO CAPTURE THE AUTO TRACKING OF THE GUIDED MISSILE INSTEAD OF THE TARGET!**

In this case, you must immediately reset the auto-tracking and continue pointing and holding the crosshair of the aiming mark at the desired aiming point in manual mode.

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– when auto-tracking a target, after it is hit by type "U", it is necessary to manually reset the auto-tracking of the captured target, for which you need to press button 8 (Figure 8.19) to lock/reset auto-tracking;

– To hit a target with a missile when firing without auto-tracking, it is necessary to use the guidance remote control to hold the central aiming mark of the sighting channel (targeting mark of the TP channel) of the PNM at the aiming point until the missile hits the target. When shooting at small targets, in order to effectively hit targets (to ensure the missile detonates directly under the target) located at distances of up to 2000 m, it is recommended to aim at the lower edge of the target;

– if the measured range to the target is more than 1400 m, the missile flies "in excess", i.e. at a height of 4.5 m above the line of sight; at a range of less than 1400 m - "without exceeding", i.e. the flight path is aligned with the line of sight. The operation of the "without exceeding" mode is indicated by the blinking of indicator 5 (Figure 8.5) when the firing circuits are ready to fire in the field of view of the sighting channel;

– if necessary (for example, to destroy a helicopter), aim the missile in the "NO EXCEEDING" mode to a range of more than 1400 m, before pressing the cannon firing button, measure the range to the target (to assess the possibility of hitting it), then press the PNM button on the front panel " ⮌ " pos. 9 (Figure 8.2). The operation of the "NO EXCEEDING" mode is indicated by the blinking of indicator 5 of the firing circuits being ready (Figure 8.5) for a shot in the field of view of the sighting channel;

– to reduce the preparation time for the next launch of a guided missile, immediately after hitting the target (or detecting a missile malfunction), you must press and release the " ⮌ " button;

– if during the preparation of a shot a malfunction of the range finder or computer is detected, the missile flight mode "NO EXCEEDING" is automatically switched on;

– in cases where it is impossible to reliably measure the range to the target, it is recommended to aim the missile in the "NO EXCEEDING" mode, for which you must perform one of the following actions:

- press the " " button on the front panel of the BVD PNM ⮌ ;
- measure the range to an object less than 1400 m away;
- manually enter a range less than 1400 m;
- reset the range (on the front panel of the PNM BVD, simultaneously press buttons 12 ("+") and 13 ("-") to manually enter the range and change the digital value (Figure 8.2).

When the range is reset, the message "SBR" is displayed in window 3 (Figure 8.7) indicating the range to the target and on indicator 6 (Figure 8.5) of the range to the target in the field of view of the sighting channel.

### 3.3.5.10 Commander firing

The commander can fire from the DPU in the "DPU" mode and from the cannon (coaxial machine gun) in the " DOUBLE " mode (if it is impossible to fire using the PNM).

**ATTENTION:**
**BEFORE STARTING WORK WITH THE REMOTE CONTROL, YOU MUST MAKE SURE THAT THE HATCHES OF THE GUNNER, COMMANDER AND DRIVER ARE CLOSED! WHEN THE HATCHES ARE OPEN, FIRING FROM THE DPU IS BLOCKED!**

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### 3.3.5.10.1 Firing from the DPU

To prepare and fire from the DPU you must:

– make sure that the control panel is turned on (switch 4 (Figure 8.18) of modes and selection of ballistics type on the commander's console is in the NABL position, the control panel toggle switch position 7 is on, the control panel toggle switch position 6 is on) and guidance is provided by the control panel drives;

– after recognizing the target, holding the aiming symbol of the control panel on the selected target with lever 1 of the commander's remote control, measure the range to it by pressing the range measurement button 10 on the commander's remote control (the measured range should be displayed on the APU);

– if necessary, change the rate of fire of the DPU machine gun by pressing button 12 on the commander's console for loading the gun/switching the rate of fire of the DPU. When a high rate is selected (200 shots/min), "P2" is displayed in the window indicating the type of ammunition and type of weapon; when a low rate is selected (100 shots/min), "P1" is displayed.

N o t e - After turning on the DPU, a high rate of fire is set by default. Tempo switching is carried out cyclically (high tempo ("P2") → low tempo ("P1") → high tempo ("P2"), etc.);

– holding down the aiming symbol of the control panel at the aiming point with lever 1 of the commander's remote control for at least 2 s, smoothly press the firing button 11 from the selected weapon on the commander's remote control and hold it until shooting starts and hits targets.

**ATTENTION:**

**BEFORE USING THE DPU IN COMBAT, IT IS NECESSARY TO COCK THE DPU MACHINE GUN;**
**FIRING FROM THE REMOTE CONTROL UNIT WILL OCCUR ONLY IF THE FIRING CHAINS ARE READY (THE PRESENCE OF THE INSCRIPTION "GOT" ON THE APU);**

To minimize the unjustified consumption of DPU ammunition, it is recommended to hit single targets at a low rate of fire!

When automatically tracking a target through the control panel, it is necessary to follow the recommendations set out in clause 2.10.11 188M.RE, Part 1, while manual additional targeting (aiming the control panel aiming mark at the planned impact point) is carried out using the guidance control lever located on the commander's console.

When working with DPU, the following must be considered:

– after turning on the DPU (after the DPU control system enters the mode), the DPU drives are removed from the electromagnetic stoppers and coordinated with the control panel aiming line;

– during the shooting process, if necessary, it is recommended to adjust the battle by observing the trajectory of the bursts;

– If you hold down the fire button for a long time from the selected weapon, the burst will automatically stop (about 3 s after the first shot). If the target is not hit in the first burst, then to continue firing after the cut-off is triggered, you must press and hold the firing button from the selected weapon on the commander's remote control again until the next cut-off;

– lack of firing from the DPU (readiness to fire) can be caused by:

- when fired from one's own cannon;
- location of the aiming line of the control panel along the GN in the installation zone of the mechanical stops of the DPU (the movement of the DPU along the GN is blocked until the aiming line of the control panel leaves the area where the limiters are installed);
- the presence of external structural elements of the tank (antennas, gun, wind sensor, etc.) in the firing zone. In this case, to ensure firing from the control panel (removing the locks), the gunner needs to change the position of the turret or gun, or the commander press and hold the control center button on the commander's console to rotate the turret to a position in which the specified locks will be removed, and then release the control center button;
- The DPU GN drive will resume tracking the control panel's aiming line along the GN when the control panel's aiming line leaves the DPU's GN guidance restriction zone (out of the "dead" zone). If the DPU has reached the stop along the GN, and the PKP aiming line continues to move and enters a certain sector at another stop, then to ensure that the DPU follows the PKP aiming line (with minimal time), the DPU GN drive will start moving at the maximum possible speed to another mechanical to the point. After the turn is completed, the GN DPU drive will remain in the stop area (until the PKP aiming line leaves the "dead" zone);
- lack of firing (in the absence of blocking) may be caused by a cartridge misfire. To continue shooting, it is necessary to cock the machine gun;
- When the ammunition loaded into the control panel is used up, switch 4 (Figure 8.18) of modes and ballistics type selection on the commander's console must be moved to the LOAD position. DPU (DPU

will be brought to the loading position and locked with electromagnetic stoppers), turn off the EL.DOWN AZR on the right distribution panel, open the commander's hatch and load the DPU;

– when the GN DPU is outside the danger zone (outside the front sector between the gunner's and commander's hatches and outside the hatch sectors) and the gunner's or commander's hatch is opened, the DPU is set to a safe vertical position and the DPU's horizontal guidance is blocked;

– when the GN DPU is in a dangerous zone (in the front sector between the gunner's and commander's hatches or in the hatch sectors) and the gunner's or commander's hatch is opened, the DPU is set to a safe position vertically and horizontally (between the gunner's and commander's hatches);

– when the DPU is in the opening sector of the pallet ejection hatch or when the DPU is on the flight path of the pallet, the DPU stops following the line of sight of the control panel along the VN and is brought to an angle of 0° when the gun is placed on the stopper or the fire button is pressed on the PC, while tracking along the GN is not possible is interrupted. Tracking is restored after the gun is removed from the stopper or 1.5 s after the gun is rolled back. If, after pressing the fire button on the PC, a shot did not occur and the gun did not roll back to remove the lock, it is recommended to turn off and turn on the "DPU" toggle switch on the PC.

#### 3.3.5.10.2 Loading DPU

To load the DPU in combat conditions you must:

– make sure that the DPU is working properly;

– move switch 4 (Figure 8.18) of modes and selection of ballistics type on the commander's console to the LOAD position. DPU (DPU will be brought to the loading position and locked with electromagnetic stoppers), while the inscription LOCKING will be displayed in the service line of the control panel (on the APU);

– turn off the AZR EL.PUSK on the right distribution panel;

– open the commander's hatch and, without leaving the tank (standing in the clear space of the commander's hatch), load the DPU.

When conducting training shooting, to ensure operational safety, it is recommended to load the DPU with the control system completely turned off.

**ATTENTION:**

**WHEN LOADING THE CONTROL PANEL WITH THE CONTROL SYSTEM TURNED ON, IT IS NECESSARY TO TURN OFF THE AZR EL.DOWN ON THE DISTRIBUTION PANEL RIGHT!**

#### 3.3.5.10.3 Firing from a cannon and a coaxial PKT in the " DOUBLE " mode

To prepare and fire a shot from a cannon or machine gun in the " TAKE " mode, you must:

– after recognizing the target, depending on its type, turn on the " DOUBLE " mode (select the type of ammunition on the commander's console that ensures its destruction, for which set the mode switch and selecting the type of ballistics on the commander's console to the desired position: B, K, O, R , S, P);

– load the cannon with the selected type of projectile by pressing button 12 (Figure 8.18) for loading the cannon/switching the rate of fire of the DPU on the commander's console to turn on the automatic loader (when firing from the cannon);

– holding down the PKP sighting symbol on the selected target with lever 1 of the commander's remote control, measure the range to it by pressing the range measurement button 10 on the commander's remote control (the measured range should be displayed on the APU);

– holding control lever 1 of the commander's console, the PKP sighting symbol at the aiming point for at least 2 s (it is recommended to aim at the center of the target), smoothly press the firing button 11 from the selected weapon on the commander's console and hold it until the shot is fired.

**ATTENTION:**

**THE SHOT WILL FIRE ONLY IF THE FIRING CHAINS ARE READY (THE PRESENCE OF THE INSCRIPTION "GOT" ON THE APU)!**

In order for the commander to control the presence of the selected type of projectile in the rotating conveyor (when firing from a cannon), it is recommended to set the switch 6 (Figure 9.6) of types of ammunition on the loading panel to the desired position and check the presence of the type of ammunition using indicator 5.

When automatically tracking a target through the control panel, you must be guided by clause 2.10.11 188M.RE, Part 1, while manual additional targeting (aiming the control panel aiming mark at the planned impact point) is performed by the guidance control lever located on the commander's console.

#### 3.3.5.11 Firing by the gunner and commander from a cannon and a coaxial PKT through the PDT (" DOUBLE " mode)

Firing from a cannon and a coaxial PKT through the PDT is an emergency mode and is carried out when it is impossible to fire from the main sights or when other equipment of the fire control system fails, including in the absence of power supply voltage from the tank's on-board network.

If there is power supply from the tank's on-board network, operable STV drives, functioning of the AZ and firing circuits, firing through the PDT is possible from the gunner's position and the commander's position.

In the event of an emergency absence of the on-board network, firing through the PDT is possible only from the gunner's position (when the PDT is operating from an autonomous power source - a backup power supply unit (BPR)).

To prepare and fire a shot from a cannon or machine gun in the " UNDERSTUDY " mode from the gunner's position, in the presence of power supply from the tank's on-board network, it is necessary:

– turn on the PDT from the gunner's position (the inscription "NAV" should be displayed in the service line on the APU);

– unlock the turret and cannon;

– perform target detection by aiming the field of view of the PDT along the GN and VN (deflecting the handles of the guidance panel in the appropriate direction at an angle that provides the required speed);

– after recognizing the target and measuring the range to it, depending on its type, select the type of ammunition that ensures its destruction, for which the switch for the types of shots and the type of weapon on the launcher of the control system and AZ is set to the desired position: "B", "K", " O", "P", "S", "P";

– make sure (when firing from a cannon) that the "THERE IS A TYPE" indicator on the launcher of the control system and AZ is illuminated, which signals the presence of the selected type of projectile in the rotating conveyor;

– load the cannon with the selected type of projectile by pressing the "ON AZ" button on the control system launcher and AZ (when firing from the cannon);

– While holding the PDT sighting sign at the aiming point with the aiming remote control, smoothly press the cannon (machine gun) firing button on the aiming remote control and hold it until the shot is fired.

**ATTENTION:**

**THE SHOT WILL FIRE ONLY IF THE FIRING CHAINS ARE READY (THE PRESENCE OF THE INSCRIPTION "GOT" ON THE APU)!**

N o t e s

1 When shooting from a PKT, after measuring the range, it is necessary to aim at the target the top of the corresponding corner mark 10 (Figure 8.17) for this range (focus on the numbers, in hundreds of meters, near the corner marks, see position 9).

2 If the AZ is inoperative, load the gun manually.

3 When shooting at moving targets, it is recommended to shift the aiming mark of the PDT in the horizontal plane relative to the planned point of impact, compensating for the target's speed (to ensure lateral lead).

Firing from a cannon or machine gun in the " UNDERSTUDY " mode from the commander's seat, in the presence of power supply from the on-board network (the inscription "COM" should be displayed in the service line on the APU), is similar to shooting from the gunner's position. In this case, targeting the field of view of the PDT, loading the gun, selecting the types of shots and the type of weapon are carried out by the relevant authorities on the commander's console.

In order for the commander to control the presence of the selected type of projectile in the rotating conveyor (when firing from a cannon), it is recommended to set the switch 6 (Figure 9.6) of types of ammunition on the loading panel to the desired position and check the presence of the type of ammunition using indicator 5. It is possible not to control the presence of the selected type of projectile; however, if the AZ cycle has not occurred, the commander must select another type of projectile and repeat loading the gun.

When firing a cannon in the " DOUBLE " mode from the gunner's position and there is no power supply from the on-board network (the inscription "NAV RUCH" is displayed in the service line on the APU), the following must be taken into account:

– The operating time of the PDT from the BPR battery is limited. In the absence of power supply from the on-board network, it is necessary to turn on the PDT only to perform combat missions;

– activation of the PDT from the commander is blocked, the commander's APU does not work;

– guidance of the field of view of the PDT is carried out by manual drives of the gun (the lever of the gun lifting mechanism must be in the RUCH position) and the turret;

– The gun is loaded manually;

– before firing, it is necessary to set the switch for the types of shots and the type of weapon on the launcher of the control system and AZ to the position: "B", "K", "O", "P", "C", corresponding to the loaded projectile;

– To fire a shot, the trigger handle located on the gun is used.

### 3.3.5.12 Emergency operation modes of the control system

There are the following emergency operation modes of the control system:

– firing with the weapon stabilizer vertical guidance drive not working;

– shooting with a non-working weapon stabilizer;
– shooting with a non-working PNM rangefinder;
– shooting with a non-working BV;
– shooting with a non-working PMU;
– shooting with a non-functional control panel;
– shooting with non-working PNM, PKP, BV and STV.

#### 3.3.5.12.1 Firing with the weapon stabilizer vertical guidance drive not working

When working with PNM (“MAIN” mode), you must:
– make sure that the guidance panel is aimed at the PNM mirror in the vertical plane;
– turn off the STAB toggle switch on the control system and AZ;
– set the handle of the mechanical lift of the gun to the lower position, ensuring manual aiming of the gun;
– set the switch for the types of shots and the type of weapon on the AZ launcher to the desired position;
– use the HAS TYPE indicator on the launcher of the control system and AZ to make sure that the required type of projectile is present in the rotating conveyor (when firing from a cannon);
– Using a mechanical lift, set the gun to the loading angle, aligning the red mark on the gun with the “LOADING ANGLE” mark. on the gunner's fence;
– load the cannon with the selected type of projectile by pressing the ON.AZ button on the control system launcher and AZ (when firing from the cannon);
– if the gun is not locked at the loading angle, it is necessary to aim the gun up or down with a mechanical lift until it locks at the loading angle;
– make sure that the firing circuits are ready (the green indicator is glowing in the field of view of the sighting channel or the presence of the inscription “GOT” on the APU);
– by rotating the flywheel of the gun's lifting mechanism and turning the guidance console in the horizontal plane, aim the central aiming mark of the sighting channel or the aiming mark of the thermal imaging channel at the center of the target;
– measure the range to the target by pressing the range measurement button on the guidance remote control with the thumb of your right hand, while in the field of view of the target channel or the APU should display the measured range;
– re-aim the central aiming mark of the sighting channel or the aiming mark of the TP channel at the center of the target, holding the central aiming mark of the sighting channel (or the aiming mark of the TP channel) at the aiming point, press the cannon (machine gun) firing button on the aiming panel and hold it until firing shot.

#### 3.3.5.12.2 Shooting with a non-working weapon stabilizer

The firing sequence with an inoperative weapon stabilizer is similar to firing with an inoperative weapon stabilizer vertical guidance drive. In this case, in the horizontal plane, aiming at the target is carried out by rotating the handle of the turret rotation mechanism.

#### 3.3.5.12.3 Shooting with a non-working PNM rangefinder

When the PNM rangefinder is not working, it is recommended to use the “DOUBLE” mode, or perform additional operations for firing from the gunner’s position, including a guided missile.
To ensure shooting from the gunner's position, the following features must be taken into account:
– the range to the target must be entered using the “+” and “–” buttons on the front panel of the BVD ISM (if information about the range to the target is available);
– in the absence of information about the range to the target, the commander needs to measure the range, inform the gunner, or perform automated target designation to transmit the range to the PNM;
– when firing a guided missile, you must use the “+” and “–” buttons on the front panel of the PNM BVD to set the range to less than 1400 m (the “No Exceeding” mode, in which the actual range to the target is not important).

#### 3.3.5.12.4 Shooting with a non-working BV

When the BV is not working, it is necessary to use the “BACKUP” mode.

#### 3.3.5.12.5 Shooting with a non-working PNM

When the PNM is not working, you must use the “DOUBLE” mode.

#### 3.3.5.12.6 Shooting with a non-working control panel

When the control panel is not working, detection, target recognition, range measurement and shooting should be performed from the gunner's position using the PNM ("MAIN" mode).

### 3.3.5.12.7 Shooting with non-working PNM, PKP, BV and STV

When the PNM, PKP, BV and STV are not working, it is necessary to use the “BACKUP” mode from the gunner’s position.

### 3.3.5.13 Working with the calculator block

The computer unit (hereinafter referred to as the BV) is configured and controlled using the BV menu from the gunner's position (using Pn-PNM) or from the commander's position (using Pn-PKP). The menu is displayed on the APU at the gunner's or commander's position, depending on where the menu was entered from.

To enter the main menu of the BV (displaying the image of the main menu of the BV on the APU), it is necessary to simultaneously press the “ ” and “ ” buttons on the Pn-PNM or Pn when the BV is turned on (the control switch is turned on at the launch control system and AZ or the control panel toggle switch is turned on on the commander’s console). -PKP until the main BV menu appears on the gunner’s or commander’s APU.

When displaying the BV menu in a foreign language, you must enter the BV menu “MAIN MENU”, use the “ ”, “ ” buttons to select the line “LANGUAGE” (“ LANGAGE”; “ LANGUAGE”), press the “ ” button and use the “ ” or “ ” button to change language (“RUS” - Russian; “FRA” - French; “ENG” - English).

When loading ammunition into the AZ (after entering the BTsOI and BV mode, when setting the “UNLOADING - LOADING” toggle switch on the loading panel to the “LOADING” position, the AZR PNM (PKP), EL.DOWN on the left distribution panel of the tower and AZR are turned on EL.DOWN on the right switchboard of the turret) the BV submenu “PROJECTILE SUBTYPE/LOADING” automatically appears on the APU.

**ATTENTION:**

**IN ALL CASES NOT RELATED TO LOADING AMMUNITION INTO THE AZ, THE “UNLOADING” TOGGLE SWITCH. - LOCKED.” THE LOADING PANEL MUST BE IN THE “UNLOADED” POSITION!**

To navigate through the menu and change values (modes), use the “ ”, “ ”, “ ”, “ ” buttons on the Pn-PNM or Pn-PKP.

The selection of the required line (submenu) is carried out using the “ ”, “ ” buttons on the Pn-PNM or Pn-PKP; enter the line for editing a parameter by pressing the “ ” or “ ” button , enter the nested submenu by pressing the “ ” button; editing the parameter value and selecting the projectile subtype is carried out using the “ ”, “ ” buttons on the Pn-PNM (Pn-PKP). The selected field is highlighted with the cursor. Changing the state of the AUT/MANUAL, ON/OFF parameter is carried out by pressing the “ ”, “ ” buttons. Transition in the lines BM, BC, OF, R, S(Sh7) of the submenu “PROJECTILE SUBTYPE/LOADING” from the field for selecting the projectile subtype (column with subtypes of ammunition) to the field for the amount of remaining ammunition (column “Pieces”), to the field for the deviation value the initial velocity of projectiles (column “ ΔV0, %”), to the field for adjusting the mass deviation for cumulative and high-explosive fragmentation projectiles (column “ Δm”) and back, by pressing the “ ” or “ ” button. Exiting the editing mode is done by going to the parameter name (left field).

Parameters are written to the BV by pressing and holding the “ ” button (during the process of saving parameters to the BV, the “C” symbol appears in the upper right corner of the menu, which should blink until the saving is completed. The constant lighting of the “C” symbol signals the successful recording of parameters to the BV) .

Writing parameters to the BV must be done after editing the value of a parameter or changing the state of a parameter.

To exit the submenu (go to the higher menu), you must select the “EXIT” line and press the “ ” button.

To exit the BV menu, you must select the “EXIT” line in the BV menu “MAIN MENU” and press the “ ” button.

The BV menu structure is shown in Figure 8.30.

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### 3.3.5.13.1 Entering information into the computer block about ammunition loaded into the VT

During loading of ammunition into the AZ (when setting the “UNLOADING - LOADING” toggle switch on the loading console to the “LOADING” position and the EL.DOWN AZR is turned on on the left and right distribution panels of the tower and when the AZR PNM and/or PKP is turned on on the left and the right switchboards of the tower, respectively, after entering the BCOI and BV modes) it is necessary:

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– enter the subtype of the loaded projectile into the BV (for BM, BK or HE projectile types). To do this you need:

- select the type of projectile (BM, BC or HE);
- go to the projectile subtype selection field, select the desired projectile subtype and save. Repeat the operations for the remaining loaded types of shells;

– insert the remainder of the shells. To do this you need:

- select the type of projectile (BM, BK, OF, U, R or S(Sh7));
- go to the field for the number of remaining shells (column “Pieces”);
- enter the quantity loaded into the VT for the selected projectile type and save. Repeat the operations for the remaining loaded types of shells.

**ATTENTION:**

**THE NUMBER OF PROJECTILES ENTERED FOR EACH TYPE MUST MATCH THE NUMBER OF AMMUNITION LOADED INTO THE ROTATING CONVEYOR. THE TOTAL NUMBER OF PROJECTILES INTRODUCED CANNOT BE MORE THAN 22 PCS. THE POSSIBILITY OF ENTERING MORE QUANTITIES IS BLOCKED!**

If the value “0” is displayed in the “EMPTY CASSETTES” line of the “SUB-TYPE OF PROJECTILE/LOADING” submenu, in order to increase the quantity of one of the projectiles, you must first reduce the incorrectly entered quantity for the other (other) projectiles. The remaining number of empty cassettes (the total number of inserted projectiles minus 22) is displayed in the “EMPTY CASSETTES” line of the “PROJECTILE SUBTYPE/LOADING” submenu.

– enter the deviation values of the initial velocity of the projectiles (column ΔV0, %). To do this you need:

- select the type of projectile (BM, BK, OF, R or S(Sh7));
- go to the field (column) “ ΔV0,%”;
- enter the actual value for the batch and save. The operations must be repeated for all loaded projectiles;

– enter the mass deviation values for cumulative and high-explosive fragmentation projectiles (column “ Δm”). To do this you need:

- select the type of projectile (BK, HE, R or S(Sh7));
- go to field (column) “ Δm”;
- enter the actual value for the batch and save. The operations must be repeated for all loaded cumulative and high-explosive fragmentation shells.

Checking and adjusting the data in the “SUB-TYPE OF PROJECTILE/LOADING” submenu can be done at any time (after the ammunition is loaded into the AZ).

To check and correct the data in the “SUB-TYPE OF PROJECTILE/LOADING” submenu you must:

– enter the BV menu “MAIN MENU”;

– select the line “SUB-TYPE OF PROJECTILE/LOADING”, enter the submenu and, if necessary, change the data according to the above method of this section.

**ATTENTION:**

**AFTER ENTERING THE PROJECTILE SUBTYPES INTO THE CALCULATOR BLOCK, IT IS NECESSARY TO ENTER THE CORRESPONDING PROJECTILE SUBTYPES INTO THE PDT (THE SUBTYPES ENTERED INTO THE PDT MUST CORRESPOND TO THE SUBTYPES ENTERED INTO THE BV)!**

The procedure for entering projectile subtypes into the PDT is set out in paragraph 3.3.5.16.5of this manual.

### 3.3.5.13.2 Adjusting the wear value of the gun bore

The wear value of the gun bore must be entered into the BV after measuring the actual wear of the gun bore. After replacing a gun or gun barrel, it is allowed to enter the wear value from the form into the BV.

To enter the actual wear value of the gun barrel, you must enter the BV menu “MAIN MENU”, then enter the submenu “BARREL WEAR”. Enter the actual wear of the gun barrel and save.

**ATTENTION:**

**WHEN REPLACING A GUN OR GUN BARREL AFTER ENTERING THE ACTUAL WEAR OF THE GUN BORE, YOU MUST SET THE NUMBER OF SHOTS TO ZERO FOR ALL TYPES!**

Zero values for the number of shots are set in the following sequence:
– enter the BV menu “MAIN MENU”, then enter the submenu “BARREL WEAR”;
– select the line “BM SHOT”;
– set to zero values;
– save;
– similarly set zero values in the lines “SHOTS BC”, “SHOTS OF”, “SHOTS U”.

### 3.3.5.13.3 Checking the operating modes of sensors, changing the operating mode of sensors and manually entering values

To check the operating mode of the sensors, as well as to check the current values of parameters from the sensors, you must enter the BV menu “MAIN MENU”, then enter the submenu “SENSOR CONTROL”. Check the parameter of interest.

If there is a justified need (if one of the sensors fails, the sensor readings differ significantly from the actual conditions, etc.), to change the operating mode of the sensor, or to manually enter values, it is necessary:

– select the desired option;

– set the desired operating mode of the sensor and, if the “MANUAL” mode is selected, then according to the weather report, enter the values for this sensor.

In the “AUT” mode, the numerical value of the parameter is supplied to the BV from the corresponding sensor, and in the “MANUAL” mode, a numerical value entered manually is used.

When switching from the “AUTO” sensor operating mode to the “MANUAL” mode, the values that were previously entered manually are displayed. If it is impossible to set the “AUTO” mode or the “ON” state , then this indicates that the sensor is not connected, the cable to the sensor is damaged, or the sensor is out of order .

### 3.3.5.13.4 Setting the alignment range value

To enter the value of the actual alignment range before alignment of the PNM sighting channel (TV channel of the PKP) at a remote point, you must:

– enter the BV menu “MAIN MENU”;

– select the line “ALIGNMENT RANGE” and enter the actual alignment range (measured by the PNM or PKP range finder to the alignment point);

– save.

### 3.3.5.13.5 Setting correction values for individual departure angles

To enter correction values for individual departure angles, you must:
– enter the BV menu “MAIN MENU”, then enter the submenu “CORRECTIONS FOR IPM”;
– select the desired line of the projectile subtype for which individual launch angles are entered;
– enter in the fields for VN and GN (column “VN” - vertical plane, column “GN” - horizontal plane), taking into account the sign, the corresponding correction values for individual departure angles, save.

Enter values for other ammunition in the same way.

**ATTENTION:**

**AFTER ENTERING CORRECTIONS FOR INDIVIDUAL DEPARTURE ANGLES INTO THE COMPUTER BLOCK, IT IS NECESSARY TO ENTER CORRECTIONS FOR INDIVIDUAL DEPARTURE ANGLES INTO THE PDT. AMENDMENTS INTRODUCED INTO THE PDT MUST CORRESPOND TO THE AMENDMENTS INTRODUCED INTO THE BV!**

The procedure for entering corrections for individual departure angles into the DTP is set out in paragraph 3.3.5.16.5of this manual.

### 3.3.5.13.6 Monitoring the operating time of the fuel pump

To control the production of spent fuel, it is necessary:

– turn on the BV (turn on the control system toggle switch on the control system control and AZ or turn on the PKP toggle switch on the commander’s console), using Pn-PKP or Pn-PNM, enter the BV menu “MAIN MENU”, use the “ ⇧ ”, “ ⇩ ” buttons to select the “CONTROL” line, press the button “ ▤ ”, in the line “BV RUN TIME”, check the BV operating time;

– exit the BV menu.

### 3.3.5.14 Procedure for operating the gunner's sight

The gunner's work with the sight is possible after turning on the fire control system in the "MAIN" or "OBSERVATION" modes, while the order of work with the sight is determined by the degree of illumination of the area, weather conditions and the characteristics of the background target environment.

#### 3.3.5.14.1 Working with a gunner's sight in daylight conditions

When working in these conditions, terrain visibility, target search, aiming and firing from the gunner's workplace is ensured by observing the PNM sighting channel through the eyepiece.

To observe and aim through the PNM sighting channel, the gunner must:

– While looking through the eyepiece, set the required magnification ratio by pressing the " " button to switch the viewing channel magnification ratio, pos. 14 (Figure 8.2) on the front panel of the BVD. When you press the " " button, the magnification factor of the viewing channel is successively changed (wide field of view - magnification factor "4 $^{x}$ " or narrow field of view - magnification factor "12 $^{x}$ ");

– when working in adverse weather conditions (for example, in haze, fog, etc.) or when there is a threat of the enemy using laser devices, move handle 8 ("FILTER") for turning the light filter on and off on the front panel of the BVD to the "ON" position, in this case, a special light filter is inserted into the sighting channel of the sight;

– in case of insufficient illumination, turn on the illumination of the aiming mark, for which, on the front panel of the BVD, press button 10 " " to turn on the illumination of the aiming mark and save the value of the parameter being changed.

N o t e - A wide field of view (magnification factor "4X ¨) is recommended to be used only for viewing the terrain, detecting large targets and firing at short ranges.

#### 3.3.5.14.2 Working with a gunner's sight at night and in conditions of limited visibility

When working in these conditions, terrain visibility, target search, aiming and firing from the gunner's workplace are provided using the PNM channel TP. The video image of the TP channel PNM is broadcast to the gunner's APU.

To observe and aim through the TP channel of the PNM, the gunner needs (see Figure 8.21):

– Set the toggle switch for turning on the TP channel PNM on Mon-PNM to the " " position, after which the test table will begin to be displayed on the APU screen, and after a time of no more than 11 minutes a thermal imaging image of the area will appear;

– " or " " buttons on the Pn-PNM, set the required magnification ratio (select a narrow field of view (NFO), a narrow field of view with electronic magnification (UFV×2) or a wide field of view (WFV)). In this case, to increase the multiplicity, press the " " button once or twice , and to decrease the multiplicity, press the " " button once or twice ;

– depending on weather and temperature conditions, adjust the gain of the TP channel, for which press the " " button on the Mon-PNM, while the message "GAIN" and a numerical value in the range from 00 to 08 will appear on the gunner's APU screen, after which press the " " buttons or " " set the optimal gain level of the TP channel;

– depending on the distance to the intended target, focus the image by pressing the " " button on the Mon-PNM, while the "FOCUS" message and a numerical value from 0000 to 0054 appear on the gunner's APU screen, then

press the “ ” or “ ” buttons to achieve sharp and clear image of the terrain at a distance to the intended target;

– Depending on the characteristics of the background target environment, select the color of the aiming mark. To do this, by pressing the “ ” button, select the “BRAND” item and by pressing the “ ” or “ ” buttons , select a color, while the following messages are displayed on the APU screen: “BRAND BLACK”, “BRAND GRAY”, “BRAND WHITE” or “BRAND MISSING”, and the aiming mark changes color (black, gray, white) or is missing;

– by pressing the “ ” buttons on the Mon-PNM, select the normal or inverse image mode, while the message “POLARITY: NORMAL” (warm - white) or the message “POLARITY: INVERSION” (warm - black) is displayed on the gunner’s APU screen, and the image changes polarity depending on the selected mode.

N o t e - A wide field of view (the “ShPZ” message on the APU screen) is recommended to be used only for viewing the area and detecting large targets.

**ATTENTION:**

**IN THE EVENT OF SIGNIFICANT DECORATION IN THE THERMAL IMAGE, INCLUDING THE APPEARANCE OF EXTERNAL NOISE, STRIPES, ETC. IT IS NECESSARY TO CALIBRATE TPK-K.**

To perform calibration, it is recommended to close the protective cover of the thermal imaging channel of the PNM or provide a uniform background in the field of view (the best effect is achieved when pointing the field of view at the “sky”, while pointing at the sun is not allowed), press the menu button “ ” on the PNM-PLM, select “CALIBRATION” item, press the “ ” or “ ” buttons to activate calibration, after the test pattern disappears with the message CALIBRATION and the thermal imaging image appears, the calibration is completed.

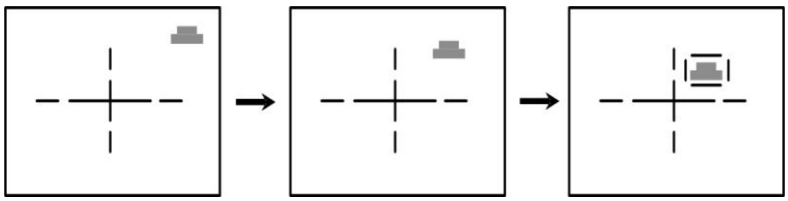
### 3.3.5.14.3 Working with a gunner's sight in low ambient temperatures

When working with the sight in conditions of low ambient temperatures, as well as when the eyepiece fogs up or the outer protective glass of the PNM is frosted, the gunner needs to turn on the heating of the PNM, for which he presses the “ ” button on the Pn-PNM, while on the Pn-PNM the indicator above the button lights up.

### 3.3.5.14.4 Aiming the field of view and aiming mark at the target

To direct the field of view of the sighting or TP channel of the PNM, as well as to hold the sighting mark of the sighting channel or the sighting mark of the TP channel on the target, the gunner needs to deflect the handles of the guidance control panel (hereinafter - PN) in the appropriate direction at an angle that provides the required pointing speed. At the same time, the greater the angle of deviation of the remote control handles from the neutral position, the greater the speed of aiming the field of view and the aiming mark.

When the TP of the ISM channel is operating in the UPZ or UPZ×2, a frame ready for acquisition is formed on the image of a target located in the central part of the APU screen and having sufficient thermal contrast, shape and dimensions that meet the criteria for acquisition for automatic tracking:



N o t e - A frame ready for acquisition can be formed when the field of view of the TP channel of the ISM is pointed in the direction of the target, even if it (the target) is not in the central part of the screen.

### 3.3.5.14.5 Working using automatic target tracking

The use of automatic tracking is possible only when working through the TP channel of the PNM in the UPD or in the UPD × 2 with sufficient thermal contrast of the target.

To acquire a target for auto tracking you must:

– depending on the current weather and temperature conditions, adjust the gain of the TP channel, ensuring unambiguous observation of the area;

– if necessary, depending on the distance to the intended target, focus the image of the thermal imaging channel (to achieve a sharp image of the terrain at a distance to the intended target);

– after detecting a target, select the field of view of the PNM thermal imaging channel that provides target recognition (UPZ or UPZ×2);

– aim the TP channel sighting sign at the center of the target. Moreover, if the target has sufficient thermal contrast, shape and size that meet the criteria for acquisition for automatic tracking, then a frame ready for acquisition is formed on the target image;

– using the PN, hold down the sighting sign of the thermal imaging channel on the selected target to achieve the formation of a frame ready for capture on the target image, then press the CAPTURE-RESET button on the left handle of the PN (under the thumb) to capture the target for automatic tracking;

– if necessary, perform additional targeting. To do this, align the aiming mark of the thermal imaging channel with the required target point (it is recommended to align the aiming mark with the center of the target);

– measure the range to the target by pressing the range measurement button on the PN with the thumb of your right hand (the measured range should be displayed on the APU);

– return the firing point to the neutral position and after 1 to 2 seconds, press and hold the fire button on the firing point until the shot is fired.

**ATTENTION:**

**THE SHOT WILL FIRE ONLY IF THE FIRING CIRCUITS ARE READY (THE PRESENCE OF THE INSCRIPTION “GOT” ON THE APU OR THE GLOW OF A GREEN INDICATOR IN THE FIELD OF VIEW OF THE OPTICAL CHANNEL)!**

N o t e s

1 Detection and recognition of targets can be performed using the ISM sighting channel.

2 If it is impossible to lock onto a target for automatic tracking, it is necessary to ensure smooth holding (without significant deviations from the aiming point, without changing the aiming direction) of the aiming mark of the sighting channel (or the aiming mark of the thermal imaging channel) on the aiming point for at least 2 s, press and hold the shooting button Mon before firing a shot.

3 When firing one of the types B, K, O, R or C, automatic target tracking is reset automatically (at the moment the gun rolls back).

4 When firing types U (U-Night) or P, automatic target tracking is reset only manually (by pressing the CAPTURE-RESET button on the PN) after hitting the target.

5 A more detailed description of the procedure for preparing and firing a guided missile (type U or U-Noch) is given in the paragraph “combat work with guided weapons.”

6 A more detailed description of operating modes using automatic target tracking is given in 188M.RE Part 1.

**ATTENTION:**

**IN THE EVENT OF SIGNIFICANT DECORATION IN THE THERMAL IMAGE, INCLUDING THE APPEARANCE OF EXTERNAL NOISE, STRIPES, ETC. IT IS NECESSARY TO CALIBRATE TPK-K.**

To perform calibration, it is recommended to close the cover of the entrance window of the ambulance or provide a uniform background in the field of view (the best effect is achieved when pointing the field of view at the “sky”, while pointing at the sun is not allowed), press the menu button “  ” on the PN-PNM, select the item “CALIBRATION”, press the “  ” or “  ” buttons to activate calibration, after the test pattern with the message calibration disappears and the thermal imaging image appears, the calibration is completed.

### 3.3.5.15 Procedure for operating the commander's sight

The commander’s work with the sight is possible after turning on the fire control system in the “ OBSERVATION ”, “DPU”, “DOUBLE”, “MAIN” MODES , while the order of work with the sight is determined by the degree of illumination of the area, weather conditions and the characteristics of the background target environment.

#### 3.3.5.15.1 Working with the commander's sight in daylight conditions

When working in daytime conditions, terrain visibility, target search, aiming and firing from the commander’s workplace is provided using an overview TV channel or the main PKP TV channel. The video image of the PKP TV channels is broadcast to the commander’s APU.

To observe and aim through the PKP TV channels, the commander needs (see Figure 8.13):

– select the control panel TV channel, to do this, press the “ ” button to switch between TV and TP channels of the control panel on the Pn-PKP (if the control panel TV channel is selected, then the “ ” indicator lights up on the Pn-PKP );

– " and " " buttons on the Pn-PKP, set the required magnification ratio (select a narrow field of view, narrow field of view with magnification, wide field of view or field of view), while to increase the magnification (to select a narrower field of view) it is necessary press the “ ” button, and to reduce the magnification (to select a wider field of view) - the “ ” button;

– Depending on the distance to the intended target, focus the image by pressing the “ ” button on the Pn-PKP. At the same time, the message “FOCUS” appears on the commander’s APU screen, after which by pressing the “ ” or “ ” buttons , a sharp and clear image of the terrain at a distance to the intended target is achieved;

– depending on the characteristics of the background target environment, select the color of the aiming mark (black, gray, white), to do this, on the Pn-PKP you need to press the “ ” button to select the appropriate item, by pressing the “ ” or “ ” buttons, select the optimal color;

– depending on the observation conditions, select the optimal method of processing the video image (VI1, VI2, VI3 or VI-), for which, by successively pressing the COI button on the Pn-PKP, achieve the optimal image of the background target environment on the APU from the point of view of visual perception.

**ATTENTION:**

**WHEN DIGITAL PROCESSING IS ENABLED, AUTOMATIC TARGET TRACKING IS BLOCKED!**

To be able to acquire and automatically track a target, you must turn off digital processing (set to “VI-”).

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N o t e s

1 When the upper or lower limit of the focusing range is reached, the message “LIMIT” is displayed on the commander’s APU.

2 Field of view (messages “OPZ” on the APU screen) is recommended to be used only for viewing the area and detecting large or closely located targets. Shooting within the field of view is not possible. The wide field of view (the "SHPZ" message on the APU screen) is recommended to be used only for viewing the terrain, detecting large targets and firing at short ranges. Narrow field of view and narrow field of view with magnification (messages “UPZ” and “UPZ×2”, respectively) must be used to detect, recognize and identify targets, aim and fire.

3 A more detailed description of video processing modes is given in clause 2.10.11.11 188M.RE Part 1.

### 3.3.5.15.2 Working with a commander's sight in low visibility conditions

When working in these conditions, terrain visibility, target search, aiming and firing from the commander’s workplace is provided using the PKP channel TP.

To observe and aim through the TP channel of the PKP, the commander needs (see Figure 8.13):

– Set the toggle switch for turning on the TP channel of the control panel on the Pn-PKP to the “ ” position, after which the “TP” indicator on the Pn-PKP begins to blink. After a time of no more than 9 minutes, the TP channel enters mode and the “ ” indicator on the Pn-PKP stops blinking, which indicates that the TP channel is ready for operation.

N o t e – Before the control panel TP channel enters the mode (during the blinking of the “ ” indicator after turning on the control panel TP channel), it is necessary to work with the control panel TV channels;

– select the TP channel of the control panel, to do this, press the “ ” button on the Mon-Repair Control Panel (if the TP channel of the control panel is selected, then the “ ” indicator on the Mon-Repair Control Panel lights up);

– by pressing the " " and " " buttons, set the required magnification magnification (select a narrow field of view, a narrow field of view with magnification or a wide field of view), while to increase the magnification (to

select a narrower field of view) you must press the "  " button, and to decrease magnification (to select a wider field of view) - the "  " button;

– Depending on weather and temperature conditions, adjust the gain of the TP channel, to do this, press the "  " button. In this case, the message "GAIN" and a numerical value in the range from 00 to 08 will appear on the commander's APU screen, after which , by pressing the "  " or "  " buttons , set the optimal gain level of the TP channel;

– Depending on the distance to the intended target, focus the image by pressing the "  " button. In this case, the "FOCUS" message and a numerical value from 0000 to 0054 will appear on the gunner's APU screen, after which by pressing the "  " or "  " buttons , a sharp and clear image of the terrain at a distance to the intended target will be achieved;

– depending on the characteristics of the background target environment, select the color of the aiming mark, to do this, press the "  " button to select the "BRAND" item, press the "  " or "  " buttons to select a color, while the following messages are displayed on the APU screen: "BRAND: BLACK", "BRAND: GRAY", "BRAND: WHITE" or "BRAND: MISSING", and the reticle changes color (black, gray, white) or is missing;

– by pressing the "  " buttons, select the normal or inverse image mode, while the message "POLARITY: NORMAL" (warm - white) or the message "POLARITY: INVERSION" (warm - black) is displayed on the commander's APU screen, and the image changes polarity depending on selected mode.

N o t e - The wide field of view (the "ShPZ" message on the APU screen) is recommended to be used only for viewing the terrain, detecting large-sized targets and firing at short ranges.

**ATTENTION:**

**IN THE EVENT OF SIGNIFICANT DECORATION IN THE THERMAL IMAGE WHEN WORKING WITH THE TP CHANNEL, INCLUDING THE APPEARANCE OF EXTERNAL NOISE, STRIPES, ETC. CALIBRATION REQUIRED!**

To perform calibration, it is recommended that when the remote control is turned off, using the appropriate direction indicators, rotate the control panel to a position in which the aiming line will be covered by the elements of the remote control or provide a uniform background in the field of view (the best effect is achieved when aiming the field of view at the "sky", while aiming at the sun is not allowed), press and hold the menu button "  " on the PN-control panel for about 2 s, select the "CALIBRATION" item, press the "  " or "  " buttons to activate calibration, after the test table disappears and the thermal imaging image appears, the calibration is completed.

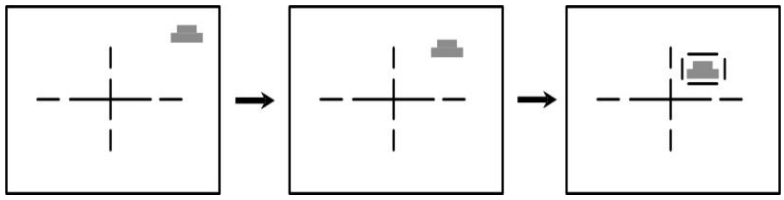
### 3.3.5.15.3 Working with the sight in low ambient temperatures

When working with the sight in conditions of low ambient temperatures, as well as when the outer protective glass of the sight is frosted, the commander needs to turn on the heating of the control panel, to do this, press the "  " button on the Pn-PKP, and the indicator above the button on the Pn-PKP should light up.

### 3.3.5.15.4 Aiming the field of view and aiming mark at the target

To aim the field of view of the TV or TP channel of the PKP, as well as to hold the aiming mark on the target, the commander needs to tilt the lever on the commander's console (hereinafter referred to as PC) with the thumb of his right hand in the appropriate direction at an angle that provides the required guidance speed. In this case, the greater the angle of deviation of the lever from the neutral position, the greater the speed of aiming the field of view.

When working with the main TV channel and the TP channel of the control panel in all fields of view, a frame ready for capture is formed on the image of the target located in the central part of the APU screen and having sufficient thermal contrast, shape and dimensions that meet the criteria for acquisition for automatic tracking:



N o t e s

1 The readiness frame for capture can be formed when the control panel's field of view is pointed in the direction of the target, even if it (the target) is not in the central part of the screen.

2 In the control panel overview TV channel, the frame ready for capture is not formed.

3 When the control panel is operating in the " DOUBLE " mode, the frame ready for capture is formed only in the UPD or in the UPD×2.

### 3.3.5.15.5 Working using automatic target tracking

The use of automatic target tracking is possible if a frame of readiness to capture is formed on the target.

To acquire a target for auto tracking you must:

– in anticipation of the search for targets, depending on current weather and temperature conditions, adjust the gain of the TP channel, ensuring unambiguous observation of elements and objects on the ground;

– if necessary, depending on the distance to the intended target, focus the image (to achieve a sharp image of the terrain at a distance to the intended target);

– after detecting a target, select a field of view that provides target recognition (SHPZ, UPZ or UPZ×2);

– point the PKP aiming sign at the center of the target. Moreover, if the target has sufficient thermal contrast, shape and size that meet the criteria for acquisition for automatic tracking, then a frame ready for acquisition is formed on the target image;

– using a PC, hold down the aiming mark on the selected target until a frame ready for capture is formed on the target image, then press the CAPTURE button on the PC;

– if necessary, perform additional targeting by aligning the aiming mark with the required target point (it is recommended to align the aiming mark with the center of the target);

– measure the range to the target by pressing the range measurement button on the PC with your left thumb (the measured range should be displayed on the APU);

– return the PC to the neutral position and after 1 $^{+1}$ s press and hold the fire button on the PC until the shot is fired.

**ATTENTION:**

**THE SHOT WILL FIRE ONLY IF THE FIRING CHAINS ARE READY (THE PRESENCE OF THE INSCRIPTION "GOT" ON THE APU!)**

N o t e s

1 If it is impossible to lock onto a target for automatic tracking, it is necessary to deflect the guidance control lever on the PC to ensure a smooth hold (without significant deviations from the aiming point, without changing the direction of aiming) of the aiming mark at the aiming point for at least 2 s, press and hold the shooting button on the PC until the shot is fired .

2 When firing one of the types B, K, O, R or C, the automatic target tracking is reset automatically (at the moment the gun rolls back).

3 A more detailed description of operating modes using automatic target tracking is given in 188M.RE Part 1.

**ATTENTION:**

**IN THE EVENT OF SIGNIFICANT DECORATION IN THE THERMAL IMAGE WHEN WORKING WITH THE TP CHANNEL, INCLUDING THE APPEARANCE OF EXTERNAL NOISE, STRIPES, ETC. CALIBRATION REQUIRED!**

To perform calibration, it is recommended that when the remote control is turned off, using the appropriate direction indicators, rotate the control panel to a position in which the aiming line will be covered by the elements of the remote control or provide a uniform background in the field of view (the best effect is achieved when aiming the field of view at the "sky", while aiming at the sun is not allowed), press and hold the menu button " " on the PN-control panel for about 2 seconds, select the "CALIBRATION" item, press the " ⇦ " or " ⇨ " buttons to activate calibration, after the test pattern disappears and the thermal imaging image appears, the calibration is completed.

### 3.3.5.15.6 Viewing thermal imaging images from the PNM at the commander's seat

For prompt decision-making about the “danger” of a target detected by the gunner, as well as for the commander to monitor the correct execution of the gunner’s actions, a function is provided to display a thermal imaging image from the PNM at the commander’s place (on the APU).

To display a thermal imaging image from the PNM on the commander’s APU, you must press and hold the “  ” button on the Pn-PKP (when the “  ” button is released, the image from the PKP is displayed).

### 3.3.5.16 Procedure for working with a television backup sight

The work of a gunner or commander with a PDT is possible after turning on the “DOUBLE” mode from the gunner’s or commander’s seat.

**ATTENTION:**

**IF THERE IS NO ELECTRICITY IN THE ON-BOARD NETWORK OF THE TANK, OPERATION WITH THE PDT IS POSSIBLE ONLY FROM THE GUNNER'S SEAT WHEN USING MANUAL DRIVES OF THE GUN AND TURRE (EVEN IF THE PDT IS ENABLED FROM THE COMMANDER'S SEAT)!**

#### 3.3.5.16.1 Aiming the field of view and aiming mark at the target

If there is an on-board network of the tank, the field of view of the PDT is aimed at the target by STV drives based on signals from the guidance console or the commander's console (guidance is provided due to the mechanical connection of the PDT with the gun and the turret).

In the absence of the tank's on-board network, aiming the PDT's field of view at the target is carried out by manual drives (lifting and turning mechanisms).

#### 3.3.5.16.2 Measuring the range to the target

To measure the range to the target, it is necessary to move (orient the field of view of the PDT) a fixed line 12 (Figure 8.17) under the lower edge of the target, and by pressing the “-” and “+” buttons on the Pn-PDT, bring the movable line 11 to the upper edge of the target . In this case, in window 6 indicating the range to the target, a numerical value corresponding to the measured range will appear.

#### 3.3.5.16.3 Selecting the type of shot and type of weapon

The choice of the type of shot and the type of weapon when working with a PDT from the gunner’s seat is made by setting the switch 7 (Figure 9.5 ) types of shots and the type of weapon on the SLA and AZ launchers to the desired position (B, K, O, R, S, P), Selected type is displayed in window 4 (Figure 8.17 ) indicating the type of ammunition and type of weapon.

The choice of the type of shot and the type of weapon when working with PDT from the commander’s seat is made by setting switch 4 ( Figure 8.18) modes and selecting the type of ballistics on the commander’s console to the desired position (B, K, O, R, S, P).

With the selected types B, K, O, R, C, the prompt display of scale 13 (Figure 8.17 ) is provided for firing from a coaxial machine gun. To turn the scale on/off, you must press the “  ” button on the Mon-PDT. When selecting type P, scale 13 is constantly displayed.

N o t e - The choice of type is ensured even in the absence of the tank’s on-board network.

#### 3.3.5.16.4 Working with the sight in low ambient temperatures

When working with the sight in conditions of low air temperatures, as well as when the outer protective glass of the television backup sight is frosted, it is necessary to turn on the PDT heating. To do this, press the “  ” button on the Mon-PDT (on which the toggle switch is turned on) - on the Mon-PDT the indicator for turning on the heating of the PDT will light up. If there is no power in the tank's on-board network, to turn on the PDT heating, you must press and hold the "  " button on the Mon-PDT until the PDT heating on indicator blinks.

**ATTENTION:**

**USING PDT HEATING IN THE LACK OF POWER IN THE TANK ON-BOARD NETWORK WILL LEAD TO PREMATURE DISCHARGE OF THE BPR BATTERY! TO PRESERVE THE BPR BATTERY CHARGE, IT IS RECOMMENDED TO TURN ON THE PDT HEATING FOR THE MINIMUM REQUIRED TIME!**

### 3.3.5.16.5 Selecting projectile subtypes and entering correction values for IPM

**ATTENTION:**

**OPERATIONS FOR SELECTING PROJECTILE SUBTYPES AND ENTERING CORRECTION VALUES FOR IPM MUST BE PERFORMED IMMEDIATELY AFTER ENTERING (ADJUSTING) PROJECTILE SUBTYPES AND INDIVIDUAL LAUNCH ANGLES INTO THE COMPUTER BLOCK!**

All operations for selecting subtypes of projectiles and entering individual departure angles must be performed on one of the Pn-PDT (gunner or commander) when there is power to the on-board network (with the PNM AZR on the left distribution panel or the PKP AZR on the right distribution panel switched on).

To select (change) projectile subtypes in the PDT, you must:

– turn on the PDT with the Mon-PDT of the gunner or commander;

– enter the PDT menu by pressing and holding the “ ” button on Mon-PDT for at least 3 seconds;

– enter the subtype selection submenu by pressing and holding the “ ” button on Mon-PDT for at least 3 seconds;

– by pressing the “ ” button on the Mon-PDT, select the “Subtype B:” item, by pressing the “+” or “-” buttons, select the desired subtype of armor-piercing projectile (for example, “BM42”);

– by pressing the “ ” button on Mon-PDT, select the “EXIT” item and wait for the automatic exit from the submenu (go to the “SAVE” item);

– When the “SAVE” item is displayed, by pressing the “-”, “+” buttons on Mon-PDT, set the value “YES” in this item and, without performing any actions, wait for the automatic exit from the menu.

The operations must be repeated for all types of projectiles (enter the necessary subtypes), saving with each change.

To enter (change) the values of corrections for IPM into the DTP, you must:

– turn on the PDT with the Mon-PDT of the gunner or commander;

– enter the PDT menu by pressing and holding the “ ” button on Mon-PDT for at least 3 seconds;

– enter the submenu for selecting subtypes (in this submenu the “IIV” item is located), to do this, press and hold the “ ” button on Mon-PDT for at least 3 seconds;

– by pressing the “ ” button on the Mon-PDT, select the “IIV” item, enter the submenu for entering corrections on the IIV, for which press and hold the “ ” button on the Mon-PDT for at least 3 seconds;

– by pressing the “ ” button on the Pn-PDT, select the “BM42 VN” item, by pressing the “-”, “+” buttons on the Pn-PDT, enter the correction value for the individual departure angle in the vertical plane for an armor-piercing projectile.

N o t e – The “BM42 VN” item is displayed if the BM42 subtype was selected in the subtype selection submenu in the “Subtype B:” item. If another subtype was selected, for example, “BM15”, then the item “BM15 VN” will be displayed accordingly;

– by pressing the “ ” button on Mon-PDT, select the “EXIT” item and wait to exit the submenu for entering corrections to the IIV;

– by pressing the “ ” button on Mon-PDT, select the “EXIT” item and wait for the automatic exit from the submenu (go to the “SAVE” item);

– when the “SAVE” item is displayed, by pressing the “-”, “+” buttons on Mon-PDT, set the value “YES” in this item and, without performing any actions, wait for the automatic exit from the PDT menu;

– repeat entering the correction value for the individual angle in the horizontal plane for an armor-piercing projectile.

The operations must be repeated for all types of projectiles (enter the required values), selecting the appropriate items in the “IPM” submenu and saving after entering the values.

### 3.3.5.16.6 Replacing the battery module in the backup power supply of the television backup sight

The battery module in the backup power supply unit (BPR) of the television backup sight (PDT) is replaced when the battery module is completely discharged or when the battery module charge is low.

Before replacing the battery module, you must make sure that the PDT is functioning when operating from the tank's on-board network, for which you must:

– turn on the PNM AZR on the left distribution panel and/or turn on the PKP AZR on the right distribution panel;

– turn on the PDT from the gunner's position;

– make sure that the APU displays the image from the PDT, and in the service line on the APU in window 7 (Figure 8.17) indicating the operating mode of the control system (PDT) the inscription "NAV" is displayed.

To replace the battery module:

– make sure that the PNM AZR is turned off on the left distribution panel and the PKP AZR is turned off on the right distribution panel;

– disconnect the electrical connector from the BPR;

– remove the BPR with bracket from the tank;

– remove the BPR from the bracket;

– unscrew screws 4 (Figure 8.31) securing the cover, remove cover 1;

– unscrew the screws 16 securing the battery module, remove the discharged battery module 5;

– Take a new battery module from the group spare parts for the PDT, unscrew the screws 17 securing the protective cover and dismantle the protective cover 19;

– without allowing distortions, install the new battery module on the guides 7 for installing the battery module and then press on the battery module until the electrical connectors 9 and 18 are aligned;

– secure the battery module with screws 16 for securing the battery module;

– move toggle switch 12 "INSTALLATION" to the "INSTALLATION" position, make sure that indicator 10 "INSTALLATION" lights up (installing the battery module);

– wait until indicator 15 "READY" lights up (the battery module is ready for operation), then move toggle switch 12 "INSTALLATION" to its original (off) position;

– install cover 1 in place and secure it with screws 4 for securing the cover;

– install the BPR on the bracket;

– install a BPR with a bracket into the product;

– connect the electrical connector from the BPR and secure it with wire;

– turn on the PDT from the gunner's position;

– make sure that the image from the PDT is displayed on the APU, and the inscription "NAV RUCH" is displayed in the service line on the APU in window 7 (Figure 8.17) indicating the operating mode of the control system (PDT);

– make sure that inside the icon 2 of the operation of the PDT from the BPR a value of at least 90 is displayed (at least 90% of the rated charge);

– turn off the PDT.

**ATTENTION:**

**TO MINIMIZE THE DISCHARGE OF THE BATTERY MODULE, CHECK THE FUNCTIONING OF THE PDT WITH THE PNM ASD AND THE PCP ASD TURNED OFF FOR NO MORE THAN 1 MIN!**

### 3.3.6 Monitoring the operating time of TP PNM and TP PKP

To check the operating time of the thermal imaging camera (hereinafter referred to as TC) of the PNM, you must:

– turn on the PNM (turn on the SLA toggle switch on the control panel and AZ), turn on the TK switch on the Pn-PNM;

– After the camera's TC enters mode, by pressing the "  " button on Mon-PNM, switch the TC to menu mode and with the same button select the "CAMERA OPERATION" item in it and check the TC's operating hours.

To check the operating time of the PKP thermal imaging camera, you must:

– turn on the control panel (turn on the control panel toggle switch on the commander's console), turn on the TK toggle switch on the Pn-PKP;

– turn on the control panel TP channel (by pressing the channel selection button on the Mon-control panel);

– After the TP camera enters mode, by pressing the "  " button on the Pn-PKP, switch the TC to menu mode and with the same button select the "CAMERA OPERATION" item in it and check the TC operating time.

Checking the operating hours of the micro-refrigeration machine TK is carried out in the same way as checking the operating hours of the TK (the operating hours value is checked in the "REFRIGERATOR OPERATING OPERATIONS" section).

To check the number of ISM range measurement cycles performed, you must:

– turn on the PNM (turn on the OMS toggle switch on the OMS control panel and AZ);

– set the switch for the types of shots and the type of weapon on the control system launcher and AZ to position B;

– using the alignment wrench 17 (Figure 8.2), set the screw for switching the built-in alignment modes on the front panel of the PNM BVD to the “ ” position;

– check the numerical value in the field of view of the sighting channel. The value is displayed in tens of cycles (for example, a value of 22 corresponds to 220 cycles of measuring the ISM range);

– Using an alignment wrench, move the screw for switching the built-in alignment modes on the front panel of the BVD PNM to the “ ” position.

To check the number of cycles of operation of the LCU PNM, you must:

– turn on the PNM (turn on the OMS toggle switch on the OMS control panel and AZ);

– set the switch for the types of shots and the type of weapon on the control system launcher and AZ to the U or
U-Night position;

– using the alignment wrench 17 (Figure 8.2), set the screw for switching the built-in alignment modes on the front panel of the PNM BVD to the “ ” position;

– in the field of view of the sighting channel, check the numerical value that corresponds to the number of cycles of operation of the PSM LCU;

– Using an alignment wrench, move the screw for switching the built-in alignment modes on the front panel of the BVD PNM to the “ ” position.

### 3.3.7 Turning off the fire control system

After finishing firing from the cannon, before turning off the fire control system, remove the remaining tray in the catcher. To do this you need:

– turn off AZR EL.DOWN;

– turn off AZR AZ UPR. on the right switchboard;

– move the AVT-RUCH toggle switch on the control panel of the control system and AZ or on the loading remote control to the MANUAL position. In this case, the gun will move to the loading angle and stop;

– move the FRAME toggle switch on the loading panel to the EMISSION position and hold it in this position until the pallet ejection process is completed, then release the toggle switch;

– after ejecting the pallet, move the FRAME toggle switch to the START position and hold it in this position until the CBM frame takes the original (lower) position, then release the toggle switch;

– enable AZR AZ CONTROL;

– move the AVT-RUCH toggle switch to the AVT position, while the gun will take a position consistent with the sight;

To remove a spent pallet from the CBM when the FCS is not working, you must:

– the gunner must move the gun to a position convenient for removing the pallet and pull out the pallet stopper;

– the commander raises the pallet stop;

– the gunner must release the stopper and hold the pallet stop in the raised position;

– the commander removes the pan from the catcher;

– lower the pallet stop into place.

To turn off the fire control system you must:

– Move the mode switch and shot type selection switch on the PC to the ON position;

– turn off the STAB toggle switch on the control system and AZ;

– set the handle of the mechanical lift of the gun to the lower position;

– set the tower to position 32-00 according to the azimuth indicator;

– turn off the OMS toggle switch on the OMS and AZ launchers and lock the turret;

– close the protective covers of the PMU, to do this, pull out the corresponding rods towards you until they stop and fix them in this position by turning them 90° clockwise, after which return the rods to their original position (away from you until they stop). Close the left cover first, then the right;

– After using the PDT, close its protective cover, for which you must:

- loosen nut 18 (Figure 8.4) and unscrew screw 17 1-2 turns;
- close the protective cover of the PDT and, holding it, turn lever 29 until it stops against the cover. Make sure that the lever is locked in this position; if necessary, unscrew screw 17 an additional 1-2 turns;
- tighten screw 17, ensuring clearance B, and lock it with nut 18;

– stop the gun with a rod;

– On the PC, turn off the DPU and PKP toggle switches in sequence;

– install the protective cover of the control panel mirror unit in place;
– put the cover on the wind sensor.

### 3.3.8 Tank sight alignments

#### 3.3.8.1 Preparing for reconciliations

Alignments to a remote point or to a panel (alignment target), as well as adjustments to the built-in control systems of the PNM and PKP must be carried out with the engine stopped, and the tank must be powered from an external current source (another tank). It is allowed to carry out reconciliations and adjustments when the tank is supplied with power from a diesel generator set.

To eliminate additional operations to point the gun at a remote point (its own sign on the shield), it is recommended to perform alignment of the PNM, PKP, PDT, PKTM and DPU to a remote point or to the shield (alignment target) simultaneously.

Before starting and during adjustments to a remote point or panel, the controls must be in the following positions:

– The STAB toggle switch on the control system and AZ must be turned off (in the OFF position);
– the handle of the mechanical lift of the gun must be in the lower position (manual aiming of the gun);
– The “ ” handle on the front panel of the PNM BVD should be in the “ ” position.

When calibrating and adjusting the built-in PNM control system, a diaphragm from a single set of spare parts for a multi-channel gunner's sight must be installed on the PNM eyepiece.

When aligning against the board (alignment target), the following requirements must be met:
– the distance from the muzzle of the gun to the shield (alignment target) should be (100±0.5) m;
– the target alignment line must be parallel to the horizontal lines in the field of view of the ISM sighting channel (determined visually);
– the elevation angle of the gun relative to the turret control platform when pointing the central aiming mark of the PNM sighting channel at its sign should be 0°±30';
– the target plane must be perpendicular to the axis of the gun barrel (determined visually).

#### 3.3.8.2 Alignment of the gunner's multi-channel sight

##### 3.3.8.2.1 Alignment of the PNM sighting channel relative to the tank gun barrel

It is recommended that the alignment of the PNM sighting channel relative to the tank gun barrel be carried out immediately before firing.

Reconciliation must be carried out in the following sequence:
– open the gun bolt wedge;
– turn on the PNM (turn on the “SLA” toggle switch on the SLA and AZ control panel and wait for the “ ” indication to appear; turn on the STAB toggle switch on the SLA and AZ control panel);
– move the handle of the mechanical lift of the gun to the upper position, ensuring that the HV stabilizer drive is turned on;
– Using an alignment wrench 17 (Figure 8.2), set the screw for switching the built-in alignment modes on the front panel of the PNM BVD to the “ ” position, while the gun is automatically brought to the loading angle and locked with an electromechanical stopper. An image of the alignment superscript on the optical block should appear in the eyepiece. The view of the field of view when aligning the sighting channel is shown in Figure 8.32a.

N o t e - The alignment of the sighting channel relative to the barrel of a tank gun can be carried out with the HV stabilizer drive turned off, for which it is necessary to bring the gun with a mechanical lift until it locks at the loading angle, rotating the handle of the mechanical lift, determine the play of the handle and set the handle to approximately the middle position of the play;

– remove the eyecup from the PNM eyepiece and install the diaphragm from the single spare parts of the multi-channel gunner's sight;
– if necessary, rotate the tower so that the superscript on the optical block is visible against a light background;
– by pressing the “ ” button on the front panel of the ISM, set a narrow field of view of the ISM sighting channel;
– by pressing the “ ”, “+” buttons on the front panel of the BVD PNM –and observing through the eyepiece the vertical movement of the central aiming mark 1, achieve alignment of the top of the CPM (horizontal strokes 3) with the upper slice of index 2;

– press the “  ” button to remember the vertical relative position of the central aiming mark and the index on the optical block;

– By pressing and holding the “  ” button, make the message “V_GN” appear in the field of view of the eyepiece. By pressing the “ ”, “+” buttons on the front panel of the BVD PNM –and observing through the eyepiece the horizontal movement of the central aiming mark, achieve alignment of the top of the CPM with the middle of the index groove on the optical block;

– press the “  ” button to remember the horizontal relative position of the central aiming mark and the index on the optical block.

N o t e - Before pressing the “  ” button, the numerical value of the alignment in the field of view of the sighting channel will blink;

– Using an alignment wrench, set  the screw for switching the built-in alignment modes on the front panel of the BVD PNM to the “ ” position.

### 3.3.8.2.2 Alignment of the ISM sighting channel to a remote point

Alignment of the ISM sighting channel to a remote point must be carried out only in the following cases:

– in case of a faulty built-in control system (IMC) for reconciliation of the INM;

– after replacing the PNM blocks, gun, gun barrel, electromechanical gun stopper, BO DI, BI DI;

– in case of systematic misses after alignment using the built-in control system for the alignment of the PNM (alignment of the sighting channel of the PNM relative to the tank gun barrel), etc.

Alignment should be carried out when the barrel is not exposed to direct sunlight or precipitation, when the gun barrel is cold or when there is weakly noticeable heating (after firing) in the muzzle area.

**ATTENTION:**

**IN ALL CASES OF ALIGNMENT OF THE ISM SIGHTING CHANNEL AT A REMOTE POINT, EXCEPT FOR THE CASE OF ALIGNMENT ASSOCIATED WITH A MALFUNCTION OF THE ISM CONTROL SYSTEM, DURING THE ALIGNMENT PROCESS IT IS NECESSARY TO ADDITIONALLY PERFORM OPERATIONS TO ZERO THE BEND SENSOR!**

To reset the bend sensor:

– make sure that the bend sensor is turned on (the state is set to “ON” in the lines “DI of the HV barrel” and “DI of the GN barrel” of the BV submenu “SENSOR CONTROL”);

– perform zeroing of the bend sensor, for which you need to enter the BV menu “MAIN MENU” using the “  ”, “  ” buttons on Pn-PNM (Pn-PKP) , select the line “ZERO DI”, press and hold the “ ” button  until the DI is reset and save the operation in the BV (press and hold the “  ” button);

– check the correctness of the DI zeroing operation, for which enter the SENSOR CONTROL submenu and make sure that the values of no more than 12" are displayed in the HV BARREL DI and GN BARREL DI items.

After zeroing the bend sensor, you must:

– perform alignment of the ISM sighting channel at a remote point using the method described below;

– perform alignment of the control panel TV channel in the “DOUBLE” mode at a remote point according to the method described in paragraph 3.3.8.3.2of this manual.

To align the ISM sighting channel to a remote point, you must:

– install the tank horizontally (visually);

– set the switch for the types of shots and the type of weapon on the launcher of the control system and AZ to position “B”;

– open the gun bolt wedge;

– turn on the PNM (turn on the OMS toggle switch on the OMS control panel and AZ and wait for the “  ” indication to appear). Do not turn on the STAB toggle switch on the SLA and AZ launchers (for aiming the gun and turret using manual drives);

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– after the “ ” indication appears on the front panel of the ISM BVD, reset the range by simultaneously pressing the “+” and “ –” buttons on the front panel of the ISM BVD, while the “SBR” indication appears on the digital indicator in the field of view;

– select an object on the ground with a clearly visible aiming point and located at a distance of at least 1600 m (remote point);

– in the BV menu “MAIN MENU”, check whether the alignment range in the line “ALIGNMENT RANGE” corresponds to the actual value according to the method described in paragraph 3.3.5.13.4of this manual. If necessary, adjust the alignment range value in the “ALIGNMENT RANGE” line.

– remove the eyecup from the PNM eyepiece and install the diaphragm from the single spare parts of the multi-channel gunner's sight;

– remove grease and dirt from the barrel bore in the area of its muzzle;

– assemble the UPV alignment device, for which you need to screw two handles 5 (Figure 8.36) into the body 4 of the device and secure a red flag 9 in one of the handles;

– install the UPV device with shanks 6 and 7 into the barrel bore until stop 8 touches the muzzle of the barrel (place the stop horizontally, handles vertically);

– by rotating the diopter ring 1 of eyepiece 2, achieve a sharp image of the crosshair of the UPV device;

– using the gun lifting mechanism and the turret rotating mechanism, aim the gun so that the crosshair of the UPV device aligns with the aiming point on the ground;

– turn the UPV device 180° (with the eyepiece to the left), determine in this position the horizontal and vertical displacement of the UPV crosshair relative to the aiming point on the ground;

– to achieve a gun position in which the displacement of the UPV crosshair in the initial and 180° rotated positions would be equal in numerical value and opposite in sign (separately horizontally and vertically).

N o t e s

1 Rotate the UPV device 180° without removing it from the barrel and without disrupting the gun’s aiming (control by the displacement of the central aiming mark relative to the aiming point on the ground).

2 Point the gun with the UPV device at a remote point using the lifting and turning mechanisms in the same way: from bottom to top and from left to right.

3 If the difference in readings of the UPV device in the initial and rotated 180° positions in absolute value is more than 600 mm, adjust the UPV device in accordance with Appendix B;

– by pressing the “ ” button on the front panel of the ISM, set a narrow field of view of the ISM sighting channel;

– by pressing and holding the “ ” button on the front panel of the BVD PNM, make the item “V_VN” appear in the field of view of the eyepiece;

– by pressing the “-”, “+” buttons and observing through the PNM eyepiece the vertical movement of the central aiming mark relative to the aiming point on the ground, achieve alignment of the top of the central aiming mark with the vertical aiming point on the ground;

– press the “ ” button on the front panel of the BVD PNM to memorize the vertical position of the central aiming mark;

– by pressing the “ ” button, select the “V_GN” item in the field of view of the eyepiece and using the “-”, “+” buttons, observing through the PNM eyepiece the horizontal movement of the central aiming mark relative to the aiming point on the ground, achieve alignment of the top of the central aiming mark with the aiming point on terrain horizontally;

– press the “ ” button on the front panel of the BVD PNM to memorize the horizontal position of the central aiming mark.

N o t e - Until the “ ” button is pressed, the numerical alignment value will flash;

– To complete the alignment, you need to press the “ ” button on the front panel of the ISM BVD until the “OUT” item appears in the field of view of the eyepiece, and then press the “ ” button.

After completing the alignment, remove the UPV device from the gun.

### 3.3.8.2.3 Alignment of the ISM sighting channel with the shield (target)

Alignment to the shield (target) is carried out if it is impossible to align the ISM sighting channel to a remote point.

Before carrying out the alignment, it is necessary to install the alignment target (Figure 8.35) at a distance of (100±0.5) m from the muzzle of the gun.

Alignment of the ISM sighting channel to the target is carried out similarly to the alignment of the ISM sighting channel to a remote point, while in the line “ALIGNMENT RANGE” in the BV menu, enter the value of 1600 m in accordance with clause 3.3.5.13.4of this manual, the gun is aimed at its sign on targets, and then combine the central reticle of the PNM (using the BVD menu of the PNM) with their mark on the shield (target).

#### 3.3.8.2.4 Adjustment of the built-in ISM control system

The adjustment of the built-in ISM control system is carried out immediately after the alignment of the ISM sighting channel to a remote point or shield (target).

**ATTENTION:**

**OPERATIONS TO ALIGN THE ISM CONTROL SYSTEM SHOULD NOT BE PERFORMED IF THE ALIGNMENT OF THE ISM SIGHTING CHANNEL TO A REMOTE POINT OR SHIELD (TARGET) IS CARRIED OUT DUE TO A MALFUNCTION OF THE CONTROL SYSTEM!**

Adjustment should be carried out when the barrel is not exposed to direct sunlight or precipitation, when the gun barrel is cold or when there is weakly noticeable heating (after firing) in the muzzle area.

Adjustment should be carried out in the following sequence:

– install the technological plug 7600.0136.610 from the single set of spare parts and accessories for the multi-channel gunner's sight on the control electrical connector of the BVD PNM;

– turn on the PNM (turn on the OMS toggle switch on the OMS and AZ control panel and wait for the “ ” indication to appear), do not turn on the STAB toggle switch on the OMS and AZ control panel;

– remove the eyecup from the PNM eyepiece and install the diaphragm from the single spare parts of the multi-channel gunner's sight;

– Using an alignment wrench, set the screw for switching the built-in alignment modes on the front panel of the BVD PNM to the “ ” position;

– install the gun on the stop at the loading angle manually using the gun's lifting mechanism, for which, with the wedge open and the handle of the mechanical lift of the gun in the lower position, aim the gun with the lifting mechanism until it locks at the loading angle. Then, by rotating the handle of the lifting mechanism, determine the play of the handle and set the handle to approximately the middle position of the play. After locking the gun at the loading angle, an image of a superscript on the optical block should appear in the eyepiece. The view of the field of view when adjusting the viewing channel is shown in Figure 8.32a;

– if necessary, rotate the tower so that the superscript on the optical block is visible against a light background;

– by pressing the “ ” button on the front panel of the ISM, set a narrow field of view of the ISM sighting channel;

– by pressing the “ –”, “+” buttons and observing through the eyepiece the vertical movement of the central aiming mark 1, achieve alignment of the top of the digital center (alignment horizontal strokes 3) with the upper cut of the superscript 2 on the optical block;

– press the “ ” button to remember the vertical relative position of the central aiming mark and the superscript on the optical block;

– By pressing and holding the “ ” button, make the message “YU_GN” appear in the field of view of the eyepiece. By pressing the “ ”, “+” buttons –, observing through the eyepiece the horizontal movement of the central aiming mark, achieve alignment of the top of the CPM with the middle of the index groove on the optical block;

– press the “ ” button to remember the horizontal relative position of the central aiming mark and the superscript on the optical block.

N o t e - Until the “ ” button is pressed, the numerical alignment value will flash;

– Using an alignment wrench, set the screw for switching the built-in alignment modes on the front panel of the BVD PNM to the “ ” position.

**ATTENTION:**

**AFTER TURNING OFF THE CONTROL SYSTEM, IT IS NECESSARY TO REMOVE THE TECHNOLOGICAL PLUG 7600.0136.610 FROM THE CONTROL ELECTRICAL CONNECTOR OF THE BVD PNM!**

### 3.3.8.2.5 Alignment of the ISM sighting channel relative to the control panel TV channel

The alignment of the ISM sighting channel relative to the control panel TV channel is intended to ensure the accuracy of coordination of the ISM with the control panel in the "TARGET DESIGNATION WITH AUTOMATIC TARGET RECOVERY" and "TARGET DESIGNATION" modes.

The alignment of the PNM sighting channel relative to the PKP TV channel is carried out at a remote point on the ground or at a shield (alignment target) (Figure 8.35) installed at a distance of (100±0.5) m from the gun muzzle.

Alignment of the ISM sighting channel with respect to the control panel TV channel must be carried out in the following cases:

– after alignment of the ISM sighting channel against a remote point on the ground or against a board (alignment target);

– after calibrating the PNM TV channel in the " DOUBLE " mode against a remote point on the ground or against a board (alignment target);

– in the event of a systematic lack of reacquisition in the "TARGET DESIGNATION WITH AUTOMATIC TARGET RECOVERY" mode or a significant misalignment of the crosshair of the PNM reticle (the top of the central reticle of the PNM) with the target after the end of target designation.

To align the ISM sighting channel relative to the control panel TV channel at a remote point on the ground or a shield (target) installed at a distance of (100±0.5) m, it is necessary:

– install the tank horizontally (check visually);

– set the switch for the types of shots and the type of weapon on the launcher of the control system and AZ to position "B";

– open the gun bolt wedge;

– turn on the PNM (turn on the OMS toggle switch on the OMS control panel and AZ and wait for the "  " indication to appear). Do not turn on the STAB toggle switch on the SLA and AZ launchers (for aiming the gun and turret using manual drives);

– after the "  " indication appears on the front panel of the ISM BVD, reset the range by simultaneously pressing the "+" and " –" buttons on the front panel of the ISM BVD, while the "SBR" indication appears on the digital indicator in the field of view;

– by pressing the "  " button on the front panel of the ISM, set a narrow field of view of the ISM sighting channel;

– using the lifting mechanism of the gun and the rotating mechanism of the turret, aim the top of the central aiming mark of the PNM sighting channel at the selected aiming point and distant at a distance of at least 1600 m (at your mark on the shield);

– turn on the control panel (turn on the control panel toggle switch on the commander's console and wait for the "  " indication to appear on the Pn-PKP);

– turn on the " DOUBLE " mode (switch the mode switch and select the type of ballistics on the PC to position "B");

– make sure that the control panel TV channel is selected (there should be an indication "  " on the Mon-control panel);

– by pressing the "  " button on the Pn-PKP, install UPZx2;

– reset the range by simultaneously pressing the "  " and "  " buttons on the Pn-PKP, while the "SBR" indication should appear on the APU screen;

– if necessary, using Pn-PKP, focus the TV channel;

– using the gun's lifting mechanism and the turret's rotating mechanism, the gunner aims the crosshair of the PKP TV channel's sighting mark with the aiming point on the ground (with his sign on the shield);

– by pressing and holding the “ ” button on the front panel of the BVD PNM, make the item “V_VN” appear in the field of view of the eyepiece;

– by pressing the “-”, “+” buttons and observing through the PNM eyepiece the movement of the central aiming mark vertically relative to the aiming point on the ground (your mark on the shield), achieve alignment of the top of the central aiming mark with the aiming point on the ground (with your mark on the shield ) vertically;

– press the “ ” button on the front panel of the BVD PNM to memorize the vertical position of the central aiming mark;

– by pressing the “ ” button, select the “V_GN” item in the field of view of the eyepiece and using the “-”, “+” buttons, observing through the PNM eyepiece the horizontal movement of the central aiming mark relative to the aiming point on the ground (your mark on the shield), achieve alignment of the top of the central an aiming mark with an aiming point on the ground (with its own sign on the shield) horizontally;

– press the “ ” button on the front panel of the BVD PNM to memorize the horizontal position of the central aiming mark.

N o t e - Until the “ ” button is pressed, the numerical alignment value will flash;

– To complete the alignment, you need to press the “ ” button on the front panel of the ISM BVD until the “OUT” item appears in the field of view of the eyepiece, and then press the “ ” button.

#### 3.3.8.2.6 Alignment of the thermal imaging channel of the PNM

Alignment of the thermal imaging channel of the PNM relative to the sighting channel is carried out at a remote point on the ground or at a shield (alignment target) (Figure 8.35) installed at a distance of (100±0.5) m from the muzzle of the gun.

Before starting the alignment, make sure that the controls are in the following positions:

– The “STAB” toggle switch on the control system and AZ is turned off (in the “OFF” position);

– the handle of the mechanical lift of the gun is in the lower position (manual aiming of the gun);

– the tower is unlocked.

#### 3.3.8.2.7 Alignment of the ISM thermal imaging channel against the shield (target)

Alignment of the PNM thermal imaging channel against a shield (target) installed at a distance of (100±0.5) m from the gun muzzle is carried out similarly to the alignment of the PNM thermal imaging channel at a remote point on the ground according to the method given in clause 3.3.8.2.8 of this manuals. In this case, the central aiming mark of the sighting channel is aimed by lifting and rotating mechanisms at its mark on the target, and then the sighting mark of the thermal imaging channel (using Pn-PNM) is combined with its mark and the alignment values are stored in the TC memory.

#### 3.3.8.2.8 Alignment of the ISM thermal imaging channel to a remote point on the ground

To align the ISM thermal imaging channel to a remote point, you must:

– install the tank horizontally (visually);

– set the switch for the types of shots and the type of weapon on the launcher of the control system and AZ to position “B”;

– turn on the PNM (turn on the “SLA” toggle switch on the control panel and the AZ and wait for the “ ” indication to appear on the front panel of the PNM BVD);

– turn on the PNM thermal imaging channel, for which set the toggle switch on Pn-PNM to the “ ” position (on);

– after turning on the “ ” indicator on the front panel of the ISM BVD, reset the range by simultaneously pressing the “+” and “ –” buttons on the front panel of the ISM BVD, while the indication “SBR” (“0000” should appear in the field of view of the sighting channel and on the APU screen );

– remove the eyecup from the PNM eyepiece and install the aperture from a single set of spare parts for the multi-channel gunner's sight;

– by pressing the “ ” button on Pn-PNM, install UPZx2 TP of the PNM channel;

– by pressing the “ ” button on the front panel of the ISM BVD, set a narrow field of view of the ISM sighting channel;

– by rotating the PSM eyepiece, adjust the diopter setting of the eyepiece until all lines, scales and service information in the PSM field of view are clearly marked;

– after the TP channel enters mode, select a point on the ground that is no less than 1600 m away and can be clearly observed in both the sighting and thermal imaging channels of the ISM;

– if necessary, using Pn-PNM, make TC settings (gain, focus), select normal or inverse image display;

– Using the lifting mechanism of the gun and the rotating mechanism of the turret, aim the central aiming mark of the sighting channel at the selected point (at your mark on the shield).

N o t e - When the STAB toggle switch is turned off on the SLA and AZ launchers, the field of view of the PNM monitors the gun and turret, thereby ensuring the guidance of the central aiming mark of the sighting channel when aiming the gun and turret using manual drives;

– By pressing the “ ” button on the Pn-PNM, switch the TC to menu mode and with the same button select the “ALIGNMENT OF VN GUNNER” item in it. At the same time, to be able to change the value when selecting this item, you must hold down the menu button “ ” for at least 3 seconds ;

– using the “ ” and “ ” buttons , align the sighting sign of the thermal imaging channel vertically with the selected point on the ground (with your sign on the shield);

– By pressing the “ ” button on the Pn-PNM, switch the TC to menu mode and, with the same button, select the “ALIGNMENT OF GN GUNNER” item in it. In this case, to be able to change the value when selecting this item, you must hold down the menu button “ ” for at least 3 seconds;

– using the “ ” and “ ” buttons , align the sighting sign of the thermal imaging channel horizontally with the selected point on the ground (with your sign on the shield);

– save the reconciliation values in the TC memory, for which by pressing the “ ” button on Mon-PNM you must select the parameter saving mode in the TC menu - the “SAVE” item, and then by pressing the “ ” and “ ” buttons select the “SAVE: IN PROGRESS” item and wait the message “SAVING: COMPLETED” is displayed.

### 3.3.8.2.9 Alignment of the rangefinder channel of the ISM relative to the sighting channel

The alignment of the rangefinder channel of the PNM is carried out when there is a mismatch between the rangefinder channel of the PNM and the sighting channel (with the top of the central aiming mark), which leads to systematic misses of the rangefinder or a discrepancy between the measured range and the actual range to targets (objects on the ground). For example, after measuring the range along the edge of a building, the range is not displayed (the ISM sighting channel displays “- - - -”) or the range differs significantly from the range to the building, which indicates that the ISM rangefinder channel is mismatched with the ISM sighting channel.

It is recommended to check the alignment of the rangefinder channel of the ISM and, if necessary, adjust it in anticipation of the combat use of the ISM (in anticipation of firing through the ISM).

To check and, if necessary, adjust the alignment of the ISM rangefinder channel, you must:

– remove the eyecup from the PNM eyepiece and install the aperture from a single set of spare parts for the multi-channel gunner's sight;

– ” and “ ” indications to appear on the front panel of the PNM BVD);

– set the switch for the types of shots and the type of weapon on the control system launcher and AZ to position B;

– by pressing the “ ” button on the front panel of the ISM, set a narrow field of view of the ISM sighting channel;

– using the alignment key 17 (Figure 8.32), the screw 20 for switching the built-in alignment modes on the front panel of the PNM BVD must be set to the “ ” position;

– in the field of view of the sighting channel, check the relative position of the central sighting mark 1 (Figure 8.32), horizontal line 3, vertical line 4 with the alignment mark 5 that appears (the top of the central sighting mark must coincide with the center of the point of the alignment mark 5);

– if there is a discrepancy (if the top of the central aiming mark does not coincide with the center of the point of the alignment mark 5), it is necessary to rotate the alignment screw 3 of the laser rangefinder horizontally (" ") and the alignment screw 4 of the laser rangefinder vertically ("  ") with an alignment wrench 17 (Figure 8.2)  on the front panel of the PNM BVD, align the center of the alignment mark point 5 (Figure 8.32) of the PNM rangefinder channel with the top of the central sighting mark;

– Using an alignment wrench 17 (Figure 8.32), turn the screw 20 for switching the built-in alignment modes on the front panel of the PNM BVD to the “  ” position.

N o t e - If there is excessive illumination of the field of view and low contrast of the image of the alignment mark, it is recommended to cover the entrance window of the PNM with a tarpaulin, shield, etc.

### 3.3.8.2.10 Alignment of the laser control channel of the ISM relative to the sighting channel

Alignment of the laser control channel (hereinafter referred to as the LCU) of the PNM is carried out in case of systematic misses when firing a guided missile.

It is recommended to check the alignment of the laser control channel of the IMS and, if necessary, adjust it in anticipation of the combat use of the IMS (in anticipation of firing a guided missile through the IMS).

To check and, if necessary, adjust the reconciliation of the LCU INM it is necessary:

– remove the eyecup from the PNM eyepiece and install the aperture from a single set of spare parts for the multi-channel gunner's sight;

– turn on the PNM (it is enough to turn on the FMS toggle switch on the control panel and the AZ and wait for the “  ” indication to appear on the front panel of the PNM BVD);

– on the launcher of the control system and AZ there is a switch for the types of shots and the type of weapon must be set to the “U” or “U-Night” position;

– using an alignment wrench 17 (Figure 8.2), set the screw 20 for switching the built-in alignment modes on the front panel of the BVD PNM to the “  ” position;

– no earlier than 15 s after setting the built-in alignment mode switch to the “  ” position in the field of view of the eyepiece of the sighting channel, it is necessary to check the relative position of the appeared alignment square 6 (Figure 8.32c) relative to the vertical 7 and horizontal 8 lines of the laser control channel.

N o t e - If there is excessive illumination of the field of view and low contrast of the image of the alignment mark (square), it is recommended to cover the entrance window of the PNM with a tarpaulin, shield, etc. If necessary, adjust the brightness of the alignment mark (square). The brightness changes in steps by pressing the “  ” button on the front panel of the BVD PNM.

The top of the vertical alignment mark 7 of the laser control channel should be in the middle of the vertical alignment mark stroke, and the right end of the horizontal alignment mark 8 of the laser control channel should be in the middle of the horizontal alignment mark stroke;

– if there is a mismatch, it is necessary, by rotating the alignment wrench 17 (Figure 8.2) of the alignment screws of the laser control channel located at the bottom of the PNM (see pos. 15), to align the alignment mark (square) with the top of the vertical alignment mark 7 (Figure 8.32c) of the laser control channel and with the right end of the horizontal alignment stroke 8 of the laser control channel;

– Using an alignment wrench 17 (Figure 8.2), move the screw for switching the built-in alignment modes on the front panel of the PNM BVD to the “  ” position;

– switch types of shots and type of weapon on the control panel, return the control system and AZ to the initial position (any except “U” and “U-Night”).

### 3.3.8.2.11 Setting up the PNM aiming line shifts

Adjustment of the deviation of the aiming lines of the PNM is carried out in the presence of spontaneous movement of the central aiming mark of the PNM when the guidance remote control is released, which interferes with the aiming and holding of the central aiming mark of the PNM on the target.

Adjustment of the PNM aiming line deviation must be carried out in the following sequence:

– turn on the PNM (turn on the OMS toggle switch on the OMS control panel and AZ and wait for the “ ” indication to appear). To select an object on the ground along which you plan to navigate when setting up the drift, you need to turn on the STAB toggle switch on the SLA and AZ launcher and turn on the STV drive (with the driver's hatch closed, unlock the turret, ensuring that the STV GN drive is turned on and move the handle of the gun lifting mechanism to the upper position, ensuring that the HV STV drive is turned on);

– by pressing and holding the “ ” button on the front panel of the BVD INM, make the BVD menu appear in the field of view of the eyepiece (item “U_VN”);

– by pressing the “+”, “-” buttons and observing through the eyepiece, achieve a minimum deviation of the ISM aiming line in the VN plane;

– remember the entered values by pressing the “ ” button;

– select the “U_GN” item in the BVD menu;

– by pressing the “+”, “-” buttons and observing through the eyepiece, achieve a minimum deviation of the aiming line of the ISM in the GN plane;

– remember the entered values by pressing the “ ” button;

– By pressing the “ ” button on the front panel of the PNM BVD, the message “EXIT” appears in the field of view of the eyepiece, and then press the “ ” button.

N o t e - Until the “ ” button is pressed, the numeric value will flash.

### 3.3.8.2.12 Alignment of a coaxial machine gun with a cannon (with PNM sighting channel)

Alignment of a coaxial machine gun with a cannon (with a PNM sighting channel) must be carried out in the following cases:

– when installing a new machine gun in a tank;

– with a significant deterioration in shooting accuracy;

– when repairing a machine gun, replacing machine gun components and installations, as a result of which the firing of the machine gun may change;

– when repairing and replacing elements of the fire control system, as a result of which the firing of the machine gun may change.

Before carrying out the alignment, it is necessary to install the shield (alignment target) (Figure 8.35) at a distance of (100±0.5) m from the muzzle of the gun.

To align a coaxial machine gun with a cannon (with a PNM sighting channel), you must:

– install the tank horizontally (visually);

– dismantle the casing of the gun armored mask;

– install a cold sighting tube (hereinafter referred to as the TCP) into the machine gun barrel;

– set the switch for the types of shots and the type of weapon on the launcher of the control system and AZ to position “B”;

– remove the eyecup from the PNM eyepiece and install the aperture from a single set of spare parts for the multi-channel gunner's sight;

– turn on the PNM (turn on the OMS toggle switch on the OMS control panel and AZ and wait for the “ ” indication to appear). Do not turn on the “STAB” toggle switch on the fire control system and AZ (for aiming the gun and turret using manual drives);

– after the “ ” indication appears on the front panel of the ISM BVD, reset the range by simultaneously pressing the “+” and “ –” buttons on the front panel of the ISM BVD, while the “SBR” indication appears on the digital indicator in the field of view;

– by pressing the “ ” button on the front panel of the ISM, set a narrow field of view of the ISM sighting channel;

– Using the lifting mechanism of the gun and the rotating mechanism of the turret, aim the central aiming mark of the PNM sighting channel at your mark on the target.

N o t e - The gun and turret are aimed in the same way: from bottom to top and from left to right;

– observing the TKhP eyepiece, use the machine gun’s alignment mechanism to combine the TKhP crosshair with the PKTM sign on the target.

To move the machine gun barrel to the right or left, it is necessary to unscrew the right or left bushing of the machine gun alignment mechanism, respectively, and screw the opposite bushing in until it stops. To move the machine gun barrel up or down, you need to unscrew the upper or lower bushing of the alignment mechanism, respectively, and screw the opposite bushing in until it stops. Rotating the bushing by one large division corresponds to moving the point of impact by one thousandth of the distance, which at a distance of 100 m is 10 cm.

To turn the horizontal screw bushings, use a special 22 mm wrench placed in the driver’s tool box.

After completing the alignment, remove the TCP from the machine gun.

After completing the alignment of the coaxial machine gun, it is necessary to perform operations to bring it to normal combat in accordance with instruction 188M I.PNB “Bringing the DPU and coaxial PKTM to normal combat.”

### 3.3.8.3 Alignment of the commander's panoramic sight

#### 3.3.8.3.1 Alignment of the PKP TV channel relative to the tank gun barrel

It is recommended that the PKP TV channel be aligned with the tank gun barrel immediately before firing.

Reconciliation must be carried out in the following sequence:

– open the gun bolt wedge;

– turn on the control system in the “DOUBLE” mode (the switch for modes and selection of ballistics type must be in position “B”);

– make sure that the control panel TV channel is selected (there should be an indication “ ” on the Mon-control panel);

– reset the range by simultaneously pressing the “ ” and “ ” buttons on the Pn-PKP, while the “SBR” indication should appear on the APU screen;

– enter the control panel menu “Main Menu” (press the “ ” button on the Pn-control panel);

– ”, “ ” buttons on the Pn-PKP, select the “SVK” item, press the “ ” button on the Pn-PKP, a flashing “SVK” indication should appear on the APU screen, the gun is automatically brought to the loading angle and locked with an electromechanical stopper. The image of the alignment superscript 2 (Figure 8.34) on the optical block should appear in the field of view, and the “SVK” indication should stop blinking.

N o t e - Alignment of the PKP TV channel relative to the barrel of a tank gun can be carried out with the HV stabilizer drive turned off, for which the gunner needs to bring the gun with a mechanical lift until it locks at the loading angle, rotating the handle of the mechanical lift, determine the play of the handle and set the handle to approximately the middle position of the play;

– if necessary, rotate the tower so that the superscript on the optical block is visible against a light background;

– by pressing the buttons " ", " ", " ", " " on the Pn-PKP, align the crosshair of the aiming mark of the TV channel of the PKP with the center of the superscript groove on the BO at the level of its upper cut;

– save the adjusted position (alignment values) by pressing and holding the “ ” button on the Pn-control panel.

During the saving process, until it is completed, the saved value flashes. Stopping blinking indicates successful recording of the stored value;

– by pressing the “ ” button on the Pn-PKP, exit the PKP SVK mode (the gun should be released from the lock, and the index in the PKP’s field of view should disappear);

– ", " " buttons on the Pn-control panel, select the "EXIT" item and by pressing the " " button on the Pn-control panel, exit the control panel menu.

**3.3.8.3.2 Alignment of the control panel TV channel in the " DOUBLE " mode**

Alignment of the PKP TV channel in the " DOUBLE " mode is carried out at a remote point on the ground or at a shield (alignment target) (Figure 8.35) installed at a distance of (100±0.5) m from the muzzle of the gun.

Alignment of the control panel TV channel in the " DOUBLE " mode must be carried out only in the following cases:

– in case of a faulty built-in control system (IMC) for control panel alignment;

– after replacing the control panel blocks, gun, gun barrel, electromechanical gun stopper, BO DI, BI DI;

– in case of systematic errors after alignment using the built-in PKP alignment control system (alignment of the PKP TV channel relative to the tank gun barrel), etc.

Alignment should be carried out when the barrel is not exposed to direct sunlight or precipitation, when the gun barrel is cold or when there is weakly noticeable heating (after firing) in the muzzle area.

**ATTENTION:**

**IN ALL CASES OF CALIBRATION OF THE CONTROL PANEL TV CHANNEL AT A REMOTE POINT, EXCEPT FOR THE CASE OF VERIFICATION DUE TO A MALFUNCTION OF THE CONTROL PANEL INTERNAL CONTROL SYSTEM, BEFORE CALIBRATING THE CONTROL PANEL TV CHANNEL IN THE "DOUBLE" MODE, IT IS NECESSARY TO ALIGN THE PSM SIGHTING CHANNEL AT A REMOTE POINT WITH ADDITIONAL OPERATIONS TO ZERO THE BEND SENSOR!**

**3.3.8.3.3 Alignment of the control panel TV channel in the " DOUBLE " mode at a remote point on the ground**

To align the control panel TV channel in the " DOUBLE " mode at a remote point on the ground, you must:

– install the tank horizontally (visually);

– set the switch for the types of shots and the type of weapon on the control system launcher and AZ to position B;

– open the gun bolt wedge;

– turn on the PNM (turn on the OMS toggle switch on the OMS control panel and AZ and wait for the " " indication to appear). Do not turn on the STAB toggle switch on the SLA and AZ launchers (for aiming the gun and turret using manual drives);

– after the " " indication appears on the front panel of the ISM BVD, reset the range by simultaneously pressing the "+" and " –" buttons on the front panel of the ISM BVD, while the "SBR" indication appears on the digital indicator in the field of view;

– using the lifting mechanism of the gun and the rotating mechanism of the turret, aim the top of the central sighting mark of the PNM sighting channel at the selected aiming point and remote at a distance of at least 1600 m (to the remote point at which the alignment of the PNM sighting channel was previously carried out);

– in the BV menu "MAIN MENU", check whether the alignment range in the line "ALIGNMENT RANGE" corresponds to the actual value according to the method described in paragraph 3.3.5.13.4of this manual.

N o t e - The alignment range in the line "ALIGNMENT RANGE" when aligning the ISM sighting channel and aligning the control panel TV channel in the "DOUBLE" mode should be the same, because alignments must be performed at one remote point, and the range must correspond to the actual range to the remote point;

– turn on the control panel (turn on the control panel toggle switch on the commander's console and wait for the " " indication to appear on the Pn-PKP);

– turn on the " DOUBLE " mode (switch the mode switch and select the type of ballistics on the PC to position B);

– make sure that the control panel TV channel is selected (there should be an indication " " on the Mon-control panel);

– by pressing the “  ” button on the Pn-PKP, install UPZx2;

– reset the range by simultaneously pressing the “  ” and “  ” buttons on the Pn-PKP, while the “SBR” indication should appear on the APU screen;

– if necessary, use the Pn-PKP to focus the TV channel;

– remove grease and dirt from the barrel bore in the area of its muzzle;

– assemble the UPV alignment device, for which you need to screw two handles 5 (Figure 8.36) into the body 4 of the device and secure a red flag 9 in one of the handles;

– install the UPV device with shanks 6 and 7 in the barrel bore until stop 8 touches the muzzle of the barrel (place the stop horizontally, handles vertically);

– by rotating the diopter ring 1 of eyepiece 2, achieve a sharp image of the crosshair of the UPV device;

– using the gun lifting mechanism and the turret rotating mechanism, aim the gun so that the crosshair of the UPV device aligns with the aiming point on the ground;

– turn the UPV device 180° (with the eyepiece to the left), determine in this position the horizontal and vertical displacement of the UPV crosshair relative to the aiming point on the ground;

– to achieve a gun position in which the displacement of the UPV crosshair in the initial and 180° rotated positions would be equal in numerical value and opposite in sign (separately horizontally and vertically).

N o t e s

1 Rotate the UPV device 180° without removing it from the barrel and without disrupting the gun’s aiming (control by the displacement of the central aiming mark relative to the aiming point on the ground).

2 Point the gun with the UPV device at a remote point using the lifting and turning mechanisms in the same way: from bottom to top and from left to right.

3 If the difference in readings of the UPV device in the initial and rotated 180° positions in absolute value is more than 600 mm, adjust the UPV device in accordance with Appendix B;

– enter the control panel menu “Main Menu” (press the “  ” button on the Pn-control panel);

– by pressing the “  ”, “  ” buttons on the Mon-PKP, select the “0”-STV” item;

– activate the adjustment (press the “  ” button on the Pn-PKP);

– by pressing the buttons "  ", "  ", "  ", "  " on the Pn-PKP and observing the field of view, achieve alignment of the crosshair of the aiming symbol of the PKP TV channel with the selected point on the ground (with its own sign) vertically and horizontally;

– save the adjusted position (alignment values) by pressing and holding the “  ” button on the Pn-control panel. During the saving process, until it is completed, the saved value flashes. Stopping blinking indicates successful recording of the stored value;

– ”, “ ”  buttons  on the Pn-control panel, select the “EXIT” item and by pressing the “  ” button on the Pn-control panel, exit the control panel menu.

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After completing the alignment, remove the UPV device from the gun.

### 3.3.8.3.4 Alignment of the control panel TV channel in the “ DOUBLE ” mode using the panel

Alignment to the shield (target) should be carried out if it is impossible to align the TV channel of the control panel at a remote point.

Alignment of the PKP TV channel against a shield (target) installed at a distance of (100±0.5) m from the muzzle of the gun is carried out in the same way as the alignment of the PKP TV channel at a remote point, while in the line “ALIGNMENT RANGE” in the BV menu must be entered value 1600 m (as when aligning the PNM sighting channel), the gun is aimed at its sign on the target, and then the sighting sign of the PKP TV channel (crosshair of the sighting mark) is combined with its sign.

### 3.3.8.3.5 Adjustment of the control panel built-in control system

The adjustment of the control panel built-in control system is carried out immediately after the control panel TV channel is aligned to a remote point or panel (target).

**ATTENTION:**

**DO NOT PERFORM OPERATIONS TO ADJUST THE ALARM CONTROL PANEL'S CONTROL PANEL'S TV CHANNEL IF THE ADJUSTMENT OF THE CONTROL PANEL'S TV CHANNEL**

**TO A REMOTE POINT OR PANEL (TARGET) IS CARRIED OUT DUE TO A MALFUNCTION OF THE CONTROL PANEL'S CONTROL PANEL!**

Adjustment should be carried out when the barrel is not exposed to direct sunlight or precipitation, when the gun barrel is cold or when there is weakly noticeable heating (after firing) in the muzzle area.

Adjustment should be carried out in the following sequence:

– open the gun bolt wedge;

– turn on the control panel (turn on the control panel toggle switch on the commander's console and wait for the

“  ” indication to appear on the Pn-PKP);

– turn on the “ DOUBLE ” mode (move the mode switch and select the type of ballistics on the PC to position “B”), while not turning on the “STAB” toggle switch on the control system and AZ launchers, and leave the mechanical lift lever in the lower position (to ensure manual aiming of the gun );

– make sure that the control panel TV channel is selected (there should be an indication “  ” on the Mon-control panel);

– by pressing the “  ” button on the Pn-PKP, install UPZx2;

– reset the range by simultaneously pressing the “  ” and “  ” buttons on the Pn-PKP, while the “SBR” indication should appear on the APU screen;

– enter the control panel menu “Service Menu” (simultaneously press the “  ” button and the “  ” button on the Pn-control panel);

– ”, “  ” buttons  on the Pn-PKP, select the “Adjusting SVK” item, press the “  ” button on the Pn-PKP, a flashing indication “Adjusting SVK” should appear on the APU screen;

– install the gun on the stop at the loading angle manually using the gun's lifting mechanism, for which the gunner, with the wedge open and the handle of the mechanical gun lift in the lower position, aim the gun with the lifting mechanism until it locks at the loading angle. Then, by rotating the handle of the lifting mechanism, determine the play of the handle and set the handle to approximately the middle position of the play. After the gun is locked at the loading angle, the image of superscript 2 (Figure 8.34) on the optical block should appear in the control panel's field of view, and the “Adjusting SVK” indication should stop blinking;

– if necessary, rotate the tower so that the superscript on the optical block is visible against a light background;

– ", "  ", "  ", " "  buttons  on the Pn-PKP and observing the field of view, achieve the crosshair of the PKP aiming mark 1 with the center of the superscript groove 2 on the optical block at the level of its upper cut;

– save the adjustment by pressing and holding the “  ” button on the Pn-control panel. During the saving process, until it is completed, the saved value flashes. Stopping blinking indicates successful recording of the stored value;

– by pressing the “ ” button  on the Pn-PKP, exit the PKP adjustment mode, the gun should be removed from the stopper, and the alignment superscript should disappear from the PKP's field of view;

– ”, “ ”  buttons  on the Pn-control panel, select the “EXIT” item and by pressing the “  ” button on the Pn-control panel, exit the control panel menu.

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### 3.3.8.3.6 Alignment of the thermal imaging channel of the control panel

Alignment of the PKP thermal imaging channel relative to the TV channel is carried out at a remote point on the ground or at a shield (alignment target) (Figure 8.35) installed at a distance of (100±0.5) m from the gun muzzle.

Before starting the alignment, make sure that the controls are in the following positions :

– The “STAB” toggle switch on the control system and AZ is turned off (in the “OFF” position);

– the handle of the mechanical lift of the gun is in the lower position (manual aiming of the gun);

– the tower is unlocked.

### 3.3.8.3.7 Alignment of the thermal imaging channel of the control panel at a remote point on the ground

To align the thermal imaging channel of the control panel at a remote point, you must:

– install the tank horizontally (visually);

– turn on the control panel (turn on the “PKP” toggle switch on the commander’s console and wait for the “  ” indication to appear on the Mon-PKP);

– turn on the thermal imaging channel of the control panel, for which set the toggle switch on the Pn-control panel to the “  ” position (on);

– select the TP channel of the control panel (there should be an indication “ ” on the Pn-control panel  );

– move the mode switch and selection of ballistics type on the PC to position “B”;

– by pressing the “  ” button on the Pn-PKP, install UPZx2;

– after the TP channel enters mode, select a point on the ground that is no less than 1600 m away and can be clearly observed in a narrow field of view with electronic magnification (UPZx2) in both the television and thermal imaging channels of the PKP;

– if necessary, using Pn-PKP, perform TC settings (gain, focus), select normal or inverse image display;

– select the TV channel of the control panel (there should be an indication “  ” on the Pn-control panel) and, if necessary, focus the TV channel;

– reset the range by simultaneously pressing the “  ” and “  ” buttons on the Pn-PKP, while the “SBR” indication should appear on the APU screen;

– The gunner, using the lifting mechanism of the gun and the rotating mechanism of the turret, aim the sighting sign of the PKP TV channel at the selected point.

N o t e - When the “STAB” toggle switch is turned off on the SLA and AZ control panel, the PKP’s field of view monitors the gun and turret, thereby ensuring the targeting of the PKP TV channel when aiming the gun and turret using manual drives;

– select the TP channel of the control panel (there should be an indication “ ” on the Pn-control panel  );

– By pressing the button “  ” on the Pn-PKP, switch the TC to menu mode and with the same button select the item “ALIGNMENT OF VN GUNNER”. At the same time, to be able to change the value when selecting this item, you must hold down the menu button “ ” for at least 3 seconds  ;

– using the “  ” and “  ” buttons , align the sighting sign of the thermal imaging channel vertically with the selected point on the ground (with your sign on the shield);

– By pressing the “ ” button  on the Pn-PKP, switch the TC to menu mode and with the same button select the “GN GUNNER ALIGNMENT” item in it. At the same time, to be able to change the value when selecting this item, you must hold down the menu button “ ” for at least 3 seconds  ;

– the “  ” and “  ” buttons to align the sighting mark of the thermal imaging channel horizontally with the selected point on the ground;

– save the reconciliation values in the TC memory, for which by pressing the “ ” button on the Pn-PKP, you must select the parameter saving mode in the TC menu - the “SAVE” item, and then by pressing the “  ” and “  ” buttons,  select the “SAVE: IN PROGRESS” item and wait the message “SAVING: COMPLETED” is displayed.

### 3.3.8.3.8 Alignment of the thermal imaging channel of the control panel against the shield (target)

Alignment of the thermal imaging channel of the control panel against a shield (target) installed at a distance of (100±0.5) m from the muzzle of the gun is carried out similarly to the alignment of the thermal imaging channel of the control panel at a remote point. In this case, the aiming sign of the PKP TV channel is aimed by lifting and rotating

mechanisms at its sign on the target, and then the sighting sign of the thermal imaging channel (using Pn-PKP) is combined with its sign and the alignment values are stored in the TC memory.

### 3.3.8.3.9 Alignment of the rangefinder channel of the control panel relative to the main TV channel

Alignment of the rangefinder channel of the control panel is carried out when there is a mismatch between the rangefinder channel of the control panel and the main TV channel (with a crosshair), which leads to systematic misses of the rangefinder or a discrepancy between the measured range and the actual range to targets (objects on the ground). For example, after measuring the range along the edge of a building, the range is not displayed ("- - - -" or zero range is displayed) or the range differs significantly from the range to the building, which indicates that the rangefinder channel of the control panel is mismatched with the TV channel of the control panel.

It is recommended to check the alignment of the rangefinder channel of the PKP and, if necessary, adjust it in anticipation of the combat use of the PKP.

To check and, if necessary, correct the alignment of the rangefinder channel of the control panel, you must:

– turn on the control panel (just turn on the control panel toggle switch on the commander's console and wait for the " " and " " indication to appear on the Pn-PKP);

– make sure that the control panel TV channel is selected (there should be an indication " " on the Mon-control panel);

– by pressing the " " button on the Pn-PKP, install UPZx2;

– enter the control panel menu "Main Menu" (press the " " button on the Pn-control panel);

– by pressing the " ", " " buttons on the Pn-PKP, select the "Range Finder" item, press the " " button on the Pn-PKP, a flashing "Range Finder" indication should appear on the APU screen, and after a while (no more than 60 s), on the APU screen the alignment spot LD PKP pos. should appear. 1 (Figure 8.33), and the "Rangefinder" indication should stop blinking;

– make sure that the center of the alignment spot LD PKP pos. 1 coincides with the crosshair of the aiming mark 2;

– if there is a discrepancy, using the navigation buttons on the Pn-PKP (" ", " ", " ", " "), align the center of the alignment spot 1 with the crosshair of the aiming mark 2 of the PKP in the vertical and horizontal planes;

– exit the LD alignment adjustment by pressing the " " button on the Pn-PKP;

– by pressing the " ", " " buttons on the Pn-control panel, select the "EXIT" item and exit the "Alignment" control panel menu (press the " " button on the Pn-control panel).

### 3.3.8.3.10 Configuring PKP aiming line offsets

The adjustment of the PKP aiming line shift is carried out in the presence of spontaneous movement of the PKP aiming symbol when the guidance control lever on the commander's console is released, which interferes with the aiming and holding of the PKP aiming symbol on the target.

Setting up the aiming line of the control panel must be carried out in the following sequence:

– turn on the control panel (turn on the control panel toggle switch on the commander's console and wait for the " " indication to appear on the Pn-PKP);

– make sure that the control panel TV channel is selected (there should be an indication " " on the Mon-control panel);

– enter the control panel menu (press the “ ” button on the Pn-PKP), by pressing the “ ” , “ ” buttons, if necessary, select the “DEVOD” item on the Pn-PKP;

– activate the adjustment (press the “ ” button on the Pn-PKP);

– by pressing the “ ”, “ ”, “ ”, “ ” buttons on the Pn-PKP and observing the field of view, achieve a minimum deviation of the PKP’s aiming line in the VN and GN planes;

– save the adjustment by pressing and holding the “ ” button on the Pn-control panel. During the saving process, until it is completed, the saved value flashes. Stopping blinking indicates successful recording of the stored value;

– exit parameter adjustment by pressing the “ ” button on the Pn-control panel;

– By pressing the “ ” , “ ” buttons on the Pn-control panel, select the “EXIT” item and exit the control panel menu (press the “ ” button on the Pn-control panel).

### 3.3.8.4 Alignment of the sight - television backup

#### 3.3.8.4.1 Alignment of PDT at a remote point using an alignment device

Alignment should be carried out when the barrel is not exposed to direct sunlight or precipitation, when the gun barrel is cold or when there is weakly noticeable heating (after firing) in the muzzle area.

To align to a remote point you must:

– turn on the PNM AZR on the left distribution panel and/or turn on the PKP AZR on the right distribution panel;

– install the tank horizontally (visually);

– set the switch for the types of shots and the type of weapon on the control system launcher and AZ to position B;

– open the gun bolt wedge;

– turn on the PDT from the gunner's position (set the toggle switch on the Mon-PDT to the on position “I”), do not turn on the STAB toggle switch on the control system and AZ launcher, while the driver’s hatch must be open, or the MAG AZR must be turned off. MPB on the left distribution panel (to block the turret GN drive and ensure turret guidance using the turret rotation mechanism handle);

– after the image appears on the APU, reset the range by simultaneously pressing the “+” and “ –” buttons on the gunner’s Mon-PDT, while the “SBR” indication should appear on the APU screen;

– select an object on the ground with a clearly visible aiming point and located at a distance of at least 1600 m (remote point);

– remove grease and dirt from the barrel bore in the area of its muzzle;

– assemble the UPV alignment device, for which you need to screw two handles 5 (Figure 8.36) into the body 4 of the device and secure a red flag 9 in one of the handles;

– install the UPV device with shanks 6 and 7 into the bore until stop 8 touches the muzzle of the barrel (place the stop horizontally, handles vertically);

– by rotating the diopter ring 1 of eyepiece 2, achieve a sharp image of the crosshair of the UPV device;

– using the cannon lifting mechanism and the turret rotating mechanism, aim the cannon so that the crosshair of the UPV device aligns with the aiming point on the ground;

– turn the UPV device 180° (with the eyepiece to the left), determine in this position the horizontal and vertical displacement of the UPV crosshair relative to the aiming point on the ground;

– to achieve a gun position in which the displacement of the UPV crosshair in the initial and 180° rotated positions would be equal in numerical value and opposite in sign (separately horizontally and vertically).

–

N o t e s

1 Rotate the UPV device 180° without removing it from the barrel and without disrupting the gun's aiming (control by the displacement of the central aiming mark relative to the aiming point on the ground).

2 Point the gun with the UPV device at a remote point using the lifting and turning mechanisms in the same way: from bottom to top and from left to right.

3 If the difference in readings of the UPV device in the initial and rotated 180° positions in absolute value is more than 600 mm, adjust the UPV device in accordance with Appendix B;

– by pressing and holding the “ ” button on the gunner's Mon-PDT, enter the PDT menu;

– by pressing the “ ” button on the gunner's Mon-PDT, select the “VN ALIGNMENT” item;

– by pressing the “-”, “+” buttons on the gunner's Mon-PDT and observing the movement of the aiming mark vertically, relative to the aiming point on the ground, achieve vertical alignment;

– by pressing the “ ” button on the gunner's Mon-PDT, select the “SAVE” item, by pressing the “-”, “+” buttons on the gunner's Mon-PDT, set the value “YES” in this item and without performing any actions with the gunner's Mon-PDT, wait for automatic exit from the PDT menu;

– by pressing and holding the “ ” button on the gunner's Mon-PDT, enter the PDT menu;

– by pressing the “ ” button on the gunner's Mon-PDT, select the “GN ALIGNMENT” item;

– by pressing the “-”, “+” buttons on the gunner's Mon-PDT and observing the horizontal movement of the aiming mark relative to the aiming point on the ground, achieve horizontal alignment;

– by pressing the “ ” button on the gunner's Mon-PDT, select the “SAVE” item, by pressing the “-”, “+” buttons on the gunner's Mon-PDT, set the value “YES” in this item and without performing any actions with the gunner's Mon-PDT, wait for automatic exit from the PDT menu.

After completing the alignment, remove the UPV device from the gun.

#### 3.3.8.4.2 Alignment of the PDT against the board (target) using an alignment device

Alignment to the shield (target) should be carried out if it is impossible to align the PDT to a remote point.

Before carrying out the alignment, it is necessary to install the alignment target (Figure 8.35) at a distance of (100±0.5) m from the muzzle of the gun.

Alignment of the PDT to the target is carried out similarly to the alignment of the PDT to a remote point, in this case the gun is aimed at its mark on the target, and then the aiming mark of the PDT (crosshair of the aiming mark) is combined with its mark on the shield (target).

#### 3.3.8.4.3 Alignment of PDT without using an alignment device

It is possible to calibrate the PDT without using the UPV device, but it should be taken into account that this method is less accurate and, at the first opportunity, it is necessary to perform the alignment using the UPV device.

The PDT alignment, without using an alignment device, should be carried out in the following sequence:

– make sure that the PNM sighting channel has been aligned relative to the tank gun barrel;

– install the tank horizontally (visually);

– set the switch for the types of shots and the type of weapon on the launcher of the control system and AZ to position “B”;

– turn on the PNM (turn on the OMS toggle switch on the OMS and AZ control units and wait for the “ ” indication to appear), do not turn on the STAB toggle switch on the OMS and AZ PUs, while the driver's hatch must be open, or the MAG AZR must be turned off. MPB on the left distribution panel (to block the turret GN drive and ensure turret guidance using the turret rotation mechanism handle);

– after the “ ” indication appears on the front panel of the ISM BVD, reset the range by simultaneously pressing the “+” and “ –” buttons on the front panel of the ISM BVD, while the “SBR” indication appears on the digital indicator in the field of view;

– when aligning to a distant point, select an object on the ground with a clearly visible aiming point and located at a distance of at least 1600 m (remote point);

– observing through the PNM eyepiece, aim the gun so that the top of the central aiming mark of the PNM sighting channel aligns with the aiming point on the ground (with its mark on the shield). Point the gun in the same way: from bottom to top and from left to right;

– without disrupting the gun's aiming, turn off the PNM (turn off the control switch on the launch control and AZ) and turn on the PDT from the gunner's position (set the toggle switch on the Pn-PDT to the on position "I");

– After the image appears on the APU, reset the range by pressing the "+" and "-" buttons simultaneously on the gunner's Mon-PDT, while the "SBR" indication should appear on the APU screen;

– by pressing and holding the "  " button on the gunner's Mon-PDT, enter the PDT menu;

– by pressing the "  " button on the gunner's Mon-PDT, select the "VN ALIGNMENT" item;

– by pressing the "-", "+" buttons on the gunner's Mon-PDT and observing the movement of the aiming mark vertically, relative to the aiming point on the ground, achieve vertical alignment;

– by pressing the "  " button on the gunner's Mon-PDT, select the "SAVE" item; by pressing the "-", "+" buttons
on the gunner's Mon-PDT, set the value "YES" in this item and, without performing any actions with the gunner's Mon-PDT, wait for the automatic exit from the PDT menu;

– by pressing and holding the "  " button on the gunner's Mon-PDT, enter the PDT menu;

– by pressing the "  " button on the gunner's Mon-PDT, select the "GN ALIGNMENT" item;

– by pressing the "-", "+" buttons on the gunner's Mon-PDT and observing the horizontal movement of the aiming mark relative to the aiming point on the ground, achieve horizontal alignment;

– by pressing the "  " button on the gunner's Mon-PDT, select the "SAVE" item; By pressing the "-", "+" buttons
on the gunner's Mon-PDT, set the value "YES" in this item and, without performing any actions with the gunner's Mon-PDT, wait for the automatic exit from the PDT menu.

Alignment to a shield (target) installed at a distance of (100±0.5) m from the muzzle of the gun is carried out similarly to alignment to a remote point according to the method given above. In this case, the central aiming mark of the PNM sighting channel is aimed by lifting and rotating mechanisms at its mark on the target, and then the PDT sighting mark (crosshair of the sighting mark) is combined with its mark on the shield (target).

### 3.4 Remote machine gun control system

#### 3.4.1 Alignment of the control panel with the PKP TV channel

Alignment of the control panel with the control panel TV channel must be carried out in the following cases:

– when installing a new machine gun on the control center;

– with a significant deterioration in the accuracy of shooting from the DPU;

– when repairing a DPU machine gun, replacing components of a DPU and DPU machine gun, as a result of which the combat of the machine gun may change;

– when repairing and replacing elements of the fire control system and remote control system, as a result of which the firing of the machine gun may change.

Before carrying out the alignment, it is necessary to install the shield (alignment target) (Figure 8.35) at a distance of (100±0.5) m from the muzzle of the gun. The requirements that must be observed when aligning against the panel are set out in paragraph 3.3.8.1of this manual.

To align the control panel with the control panel TV channel, you must:

– install the tank horizontally (visually);

– turn on the control panel (turn on the control panel toggle switch on the commander's console and wait for the
"  " indication to appear on the Pn-PKP);

– turn on the " DOUBLE " mode (move the switch for modes and selecting the type of ballistics on the PC to position B), while not turning on the STAB toggle switch on the launch control system and AZ, and leave the mechanical lift lever in the lower position (to ensure manual aiming of the gun and DPU);

– make sure that the control panel TV channel is selected (there should be an indication “  ” on the Mon-control panel);

– turn on the remote control (turn on the remote control switch on the commander’s console and wait for the indication to appear).

N o t e – When the control system is operating in the “DOUBLE” mode and the STAB toggle switch is turned off, the control panel monitors the control panel and the control panel monitors the gun on the fire control control and AZ controls;

– install a cold zeroing tube THP-12-150 (hereinafter referred to as THP) for a 12.7 mm machine gun into the bore of the DPU machine gun;

– by pressing the “  ” button on the Pn-PKP, install UPZx2;

– reset the range by simultaneously pressing the “  ” and “  ” buttons on the Pn-PKP, while the “SBR” indication should appear on the APU screen;

– if necessary, using Pn-PKP, focus the TV channel;

– using the lifting mechanism of the gun and the rotating mechanism of the turret, aim the sighting mark of the PKP TV channel at your mark on the shield (alignment target);

– enter the control panel menu “Main Menu” (press the “  ” button on the Pn-control panel);

– by pressing the “  ”, “  ” buttons on the Pn-PKP, select the “0”-DPU” item;

– activate the adjustment (press the “  ” button on the Pn-PKP);

– ", "  ", "  ", " "  buttons  on the Pn-PKP and observing through the THP eyepiece, align the THP crosshair vertically and horizontally with your sign on the shield (alignment target);

– save the adjustment by pressing and holding the “  ” button on the Pn-control panel. During the saving process, until it is completed, the saved value flashes. Stopping blinking indicates successful recording of the stored value;;

– exit parameter adjustment by pressing the “  ” button on the Pn-control panel;

– By pressing the “  ”, “  ” buttons on the Mon-control panel, select the “EXIT” item and exit the control panel menu (press the “  ” button on the Mon-control panel).

After completing the alignment, remove the THP from the DPU machine gun.

After completing the alignment of the DPU machine gun, it is necessary to perform operations to bring it to normal combat in accordance with instruction 188M I.PNB “Bringing the DPU and coaxial PKTM to normal combat.”

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### 3.5 Software and hardware complex

The procedure for using the software and hardware complex PTK (hereinafter referred to as PTK) is given below in the relevant sections describing the use of its components. When using the PTK, you should additionally be guided by the operational documentation for the PTK and its components included in the ED for the tank. When working with the PTC, you must also be guided by the “Rules for using the product 450B RIVU.465632.018-02” and the “Rules for using the product 450A RIVU.465632.018-01 as part of the subscriber communicator (AK-3.5) IT-NYa.468367.117” (as part of the tank’s operational documentation not included).

Before use, the initial data is entered into the PTC:

– in the PTK - an electronic map of the area, the operational tactical situation, telecommunication configuration data and other data necessary for working in the automated control system network;

– in product 450B - key information;

– in a radio station – radio data.

The input of the initial data is carried out by automated control system specialists using the special equipment they have.

The inclusion of the PTC can be complete (hereinafter the term “PTK Enablement” will be used), when the PTC, CO and KSS are turned on, or partial, when it is not necessary to work in the ACS network, and only the KSS is turned on.

The control of the PTC when it is turned on and in use is carried out from the UARMk. Therefore, all control actions when using the PTC are given in paragraph 3.5.2of this manual.

PTK operates in the following modes:

– combat, when all the functions of the PTK are performed;

– duty officer, when data transmission to the automated control system network is blocked, but data reception is ensured;

– educational and training, when working with training databases or crew training.

The required mode is set when the PTC is turned on; in addition, the mode can be changed automatically based on a command from the senior commander received through the ACS network.

### 3.5.1 Checking the functionality of the PTK

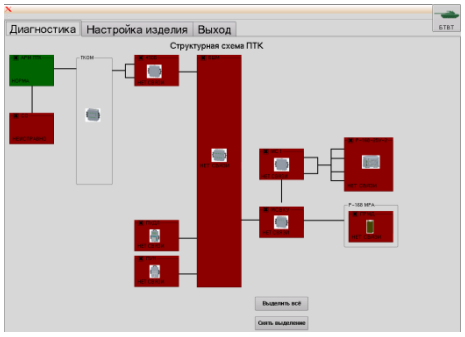
The functionality of the PTC is checked as follows:

– enable the PTK (including the KSS), the description of inclusion is given in paragraph 3.5.2.5of this manual, and the DKMV must be included;

– By successively pressing the “F4” or “F5” button on the PMF, display the “UPTK Test Software” window;

– go to the “Diagnostics” tab, and a window will be displayed, an example of which is given below. Click the “Select All” button and after testing is completed, the image of all tested blocks should be green. Red color indicates a malfunction of the unit or lack of communication with it, yellow color indicates limited performance, gray color indicates incomplete testing. The absence of an “ **x** ” sign on the block image indicates that this block is not being tested;

– press the PMF buttons 3 – 6 (Figure 11.2) or 8, 9 to display the window required for work.




### 3.5.2 Unified commander's workplace

#### 3.5.2.1 Safety Precautions and Operating Limitations

**WHEN WORKING WITH UARMK IT IS PROHIBITED:**

**OPEN UARMK BLOCKS;**
**TURN ON THE UARMK WITH THE NEGATIVE JUMPERS OF THE UARMK BLOCKS DISCONNECTED;**
**CONNECT (DISCONNECT) HARNESSES AND NEGATIVE JUMPERS WHEN THE UARMK IS TURNED ON;**
**TURN OFF THE AZR PTK OR THE TANK BATTERY SWITCH, AND ALSO START THE MAIN ENGINE OF THE TANK WITH THE STARTER WHILE TURNING ON THE UARMK;**
**VIOLATE THE INTEGRITY OF SEALS INSTALLED AT MANUFACTURING PLANTS ON UARMK UNITS.**

#### 3.5.2.2 Actions in case of threat of enemy capture of a tank

If there is a threat of the tank being captured by the enemy, it is necessary to destroy the key information stored in the 450B product, for which the tank commander must:

– unscrew the cap of the plug installed on the front side of the 450B product, destroying the paper seal, while the button pressed by the lid will work and the key information will be destroyed;

– report to a higher commander about the destruction of key information.

#### 3.5.2.3 Preparing UARMk for work

When preparing for the work of UARMk, ACS specialists, using their existing equipment, enter the following initial data:

– electronic maps of the area;

– operational-tactical situation;

– telecommunications setup data;

– other service information necessary for the operation of the hardware control system in the automated control system network.

#### 3.5.2.4 Working with UARMk

In the process of working with UARMk, the following functions are performed:

– enabling PTC and registering the operator;

– conducting combat operations, while performing the following functions:

- maintaining situational data;
- actions during the battle;
- target reconnaissance;
- remote target designation;

– interaction with SPO KBO;

– control of the curtain installation system;

– management of a complex of communications equipment;

– orientation system control;

– turning off the PTC.

For the orientation system to work (to receive information from the speed sensor), DCM must be turned on.

#### 3.5.2.5 Enabling the PTC and registering the operator

To enable the software and operator registration you must:

– turn on AZR RADIOOB, while AVSKU and radio stations are turned on;

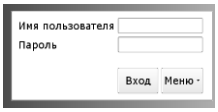
– turn on the AZR PTK and AZR CO on the driver's panel, and the on-board power supply will be supplied to the PTK and CO. The ON indicator on the PMF should glow yellow;

– press the “ ⏻ ” key on the PMF, at the same time, the ON indicator on the PMF will change the color of the glow to green and the loading of the operating system will be activated and service messages will be displayed on the screen during its loading.

**ATTENTION:**

**IN THE PROCESS OF ACTIVATING THE PTC, IT IS IMPOSSIBLE TO DISCONNECT THE POWER TO THE PTC OR START THE MAIN ENGINE WITH THE STARTER, AS THIS CAN RESULT IN DAMAGE TO THE FILE SYSTEM!**

After loading the operating system, a dialog box for entering the username and password will appear on the screen, an example of which is given below:



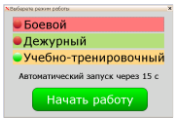

– Enter the user name by clicking on the user name input field, after which a virtual keyboard is displayed on the screen, an example of which is given below:

– using the keyboard, type the user name (determined by the ACS specialist), the typed name is displayed in the top line of the keyboard window, and press the “ENTER” key, the keyboard will disappear from the screen;

– enter a password by clicking on the password entry field, after which a virtual keyboard will be displayed on the screen;

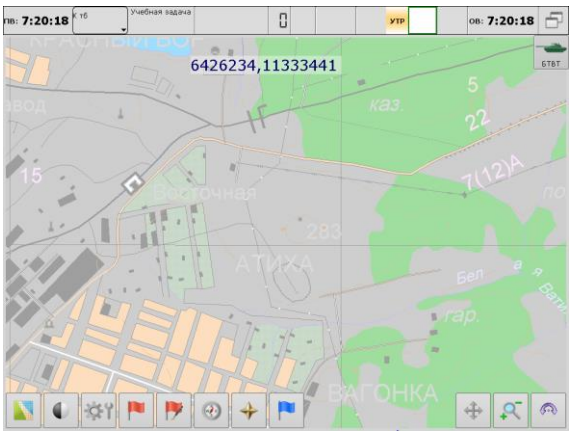
– using the keyboard, type the password (determined by the ACS specialist), the typed password is displayed in the top line of the keyboard window in the form of the “*” symbols, and press the “ENTER” key, the keyboard will disappear from the screen. If data is entered incorrectly more than three times in a row, the work of this user is blocked, and a corresponding message is displayed. To unlock, you should contact an automated control system specialist;

– In the dialog box for entering the user name and password, click the “Login” button, after which the window for selecting the operating mode will appear on the screen, an example of which is given below:




To the left of the mode name there is a mode enable indicator (red – mode off, green – mode on);

– select the required mode, the indicator of the selected mode will change color from red to green and click the “Get Started” button, after which the loading of the system-wide software will begin. If you do not click the “Get Started” button, the download of system-wide software will begin automatically, after the time specified in the window in the message. In this case, service messages are automatically displayed on the screen. After the download is complete, the main window with an electronic map of the area appears on the screen, an example of which is given below:




The top panel of the main window appears at the top of the screen, an example of which is given below:


The information displayed in it contains:

– standard time received from the orientation system;

– a button with the name of the official registered in the PTC;

– the currently running task;

– tank coordinates, m;

– tank speed, km/h;

– directional angle of the tank hull;

– PTC operating mode;
– button to open the “Document Flow Information” window;
– operational time set by the operator;
– menu button for running applications.

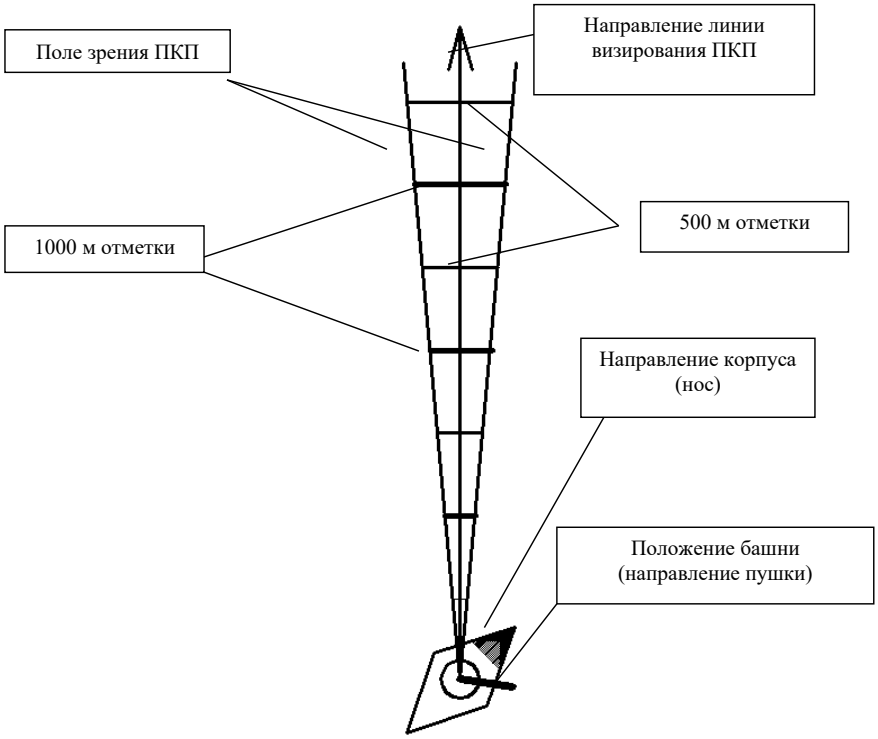
At the top of the screen, on the ECM field, the coordinates of the point to which the marker points are displayed.

There are menu buttons at the corners of the screen. In the upper right corner there is a button “ 

” to enable the interaction of the PTK with the tank systems, in the lower left corner there is the main menu “ 
”, and in the lower right there is a menu for working with the map “ 
”.

On the EKM field there is a sign of your own tank with a field of view of the PKP with marks every 500 m. The hull and turret of the tank will be oriented relative to the EKM grid.

An example image of a tank sign is shown below:




N o t e – The control panel's field of view and turret position will only be displayed when the fire control system is turned on.

### 3.5.2.6 Conduct of hostilities

Combat operations are carried out by a group of military equipment equipped with a hardware system and interconnected via radio channels and integrated into an automated control system.

During the conduct of hostilities, the following main functions are performed:
– maintaining situational data;
– actions during the battle;
– target reconnaissance;
– remote target designation.

A detailed description of the functions “Maintaining situational data” and “Actions during combat” is given in the operator’s manual VMKTS.00013-02 34 01 from the operational documentation for the tank.

### 3.5.2.7 Target reconnaissance

The tank must have the fire control system enabled.

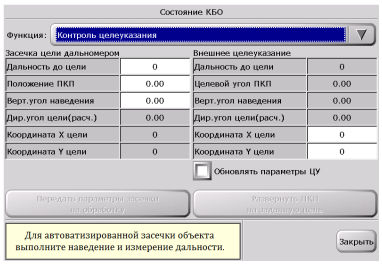
Perform target reconnaissance as follows:

– press the “ 

” button, and an additional menu will open at the top of the screen, in which press the “ 

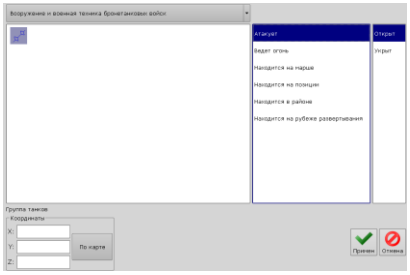
” button, and the following menu will open, in which in the “Technical” tab. state" press the " 

" button, in the "OBE status" window that appears, select the "Target designation control" function from the drop-down list, and the target designation control window will be displayed on the screen, an example of which is given below:




– the tank commander should aim the PKP sighting sign at the center of the target and measure the range to it, while in the left part of the window there will be data on the reconnaissance target;

– press the “Submit the notch parameters for processing” button, and then the “Close” button, this will close the “BEC Status” window and open the enemy object selection window, an example of which is given below. If necessary, or if the window for selecting an enemy object is hidden behind the “UPTC Status” window, close the “UPTC Status” window;

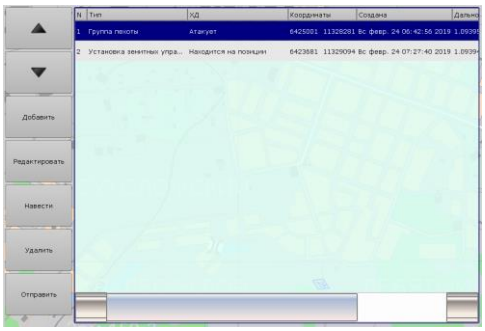


– select the type of target, the nature of the target’s action and the degree of target concealment and click the “Apply” button, while the enemy object selection window will disappear and the enemy object manager window will open, in which you can select a scouted target and click the “Submit” button. The “Send target” window will appear, in which you need to select the recipient and click the “Select” button, and the data on the target will go online.

### 3.5.2.8 Remote targeting

To perform a remote instruction you must:

– In the main window, press the “ 
” button (blue icon), and the enemy object manager window will be displayed, an example of which is given below:



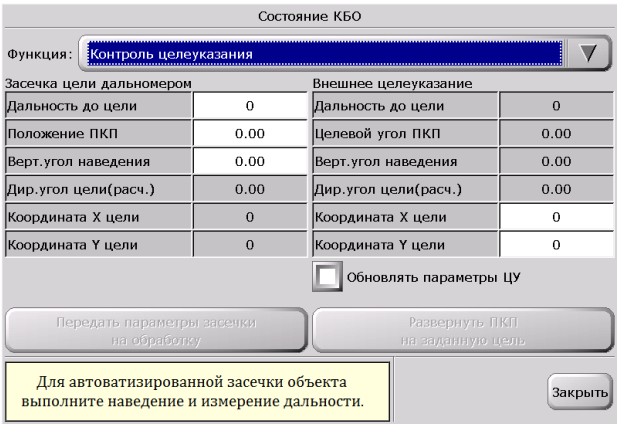

– Select the required goal from the list of goals, and the selected line will be highlighted in color;

– press the “  ” button (blue icon), this will open the main window, where the received target will be plotted against the background of the ECM;

– Select on the ECM the area in which the target is located, outlining it with a rectangle, and a window with a list of targets will appear on the right side of the screen, an example of which is given below:


– Click on the line with the received goal, and it will be highlighted in color;

– Press the “  ” button, and a window will be displayed on the screen, an example of which is given below:




– press the “Deploy the control panel to a specified target” button, this will start the rotation of the control panel, and a message about the rotation of the control panel to the target will be displayed on the screen. After completion of the control panel rotation, a message indicating the completion of the control panel rotation will be displayed. To take into account changes in the position of the hull and BM of the tank over time, it is recommended to set the flag in the line “Update control center parameters”;

– the target must be within the PCP's field of view.

It is possible to carry out target designation in another way, for which in the “Enemy Objects Manager” window you need to select a target and press the “Aim” button, this will open the SPO KBO window “UPTK Status”, the “Target Designation Control” function, in which you need to press the “Expand” key PKP for a given target.”

### 3.5.2.9 Interaction with open source software KBO

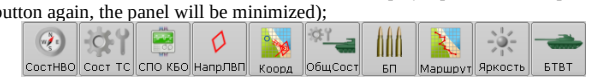
When interacting with open source software KBO, the following functions are available:

a) viewing the technical condition of the hardware and software.

To view the technical condition of the hardware and software, you must:

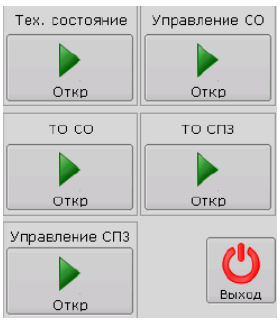
1) in the main window, click the “ 

” button, which will display a panel, an example of which is given below (if you click this button again, the panel will be minimized);




2) press the “ 

” button, which displays the open source software KBO taskbar, an example of which is given below:



3) click the “ 

” button in the “Technical” group. status”, and the “OBE Status” window will be displayed;

4) in the “Function” drop-down list, select “Technical condition of equipment and control systems”, this will display a window, an example of which is given below:


This window provides information about the performance and readiness for operation of the tank subsystems and the hardware system.

At the top of the window there is a drop-down list “Function”, consisting of the following lines: “Technical condition of equipment and hardware”, “Availability of power supply and fuel”, “Information from DKMV”, “Target designation control”, “SPZ management”;

5) to exit the “KBO Status” window you must:

– Click the “Close” button in the “KBO Status” window;

– In the KBO open source software taskbar, click the “ 

” button.

–

N o t e – If necessary, collapse the armored vehicle panel by pressing the “ 

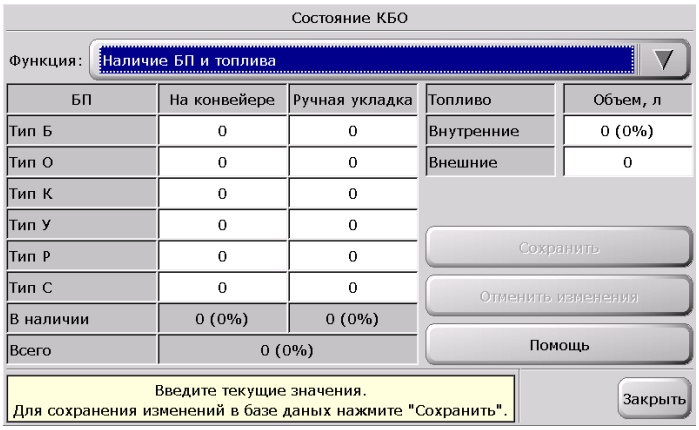
” button;

b) viewing and updating (entering) data on the availability of fuel and ammunition.

To view and correct (enter) data on the availability of fuel and ammunition, you must:

1) perform actions according to items 1 – 3 of subclause 3.5.2.9a;

2) in the “Function” drop-down list, select “Availability of power supply and fuel”, and a window will appear, an example of which is given below:



3) enter data manually (by clicking on the corresponding input field, a keyboard is displayed on the screen) for the number of shells, for the amount of fuel in external tanks, the remaining data is set automatically according to the data received from the DCMV, press the “Save” button, if necessary, press the “ button Cancel changes";

4) to return to the main window, perform the actions in accordance with listing 5 of subparagraph “a”;

c) viewing information received from DCMV.

To view information received from DCMV, you must:

1) perform actions according to lists 1 – 3 of subparagraph “a”;

2) in the “Function” drop-down list, select “Information from DKMV”, and a window will be displayed, an example of which is given below:

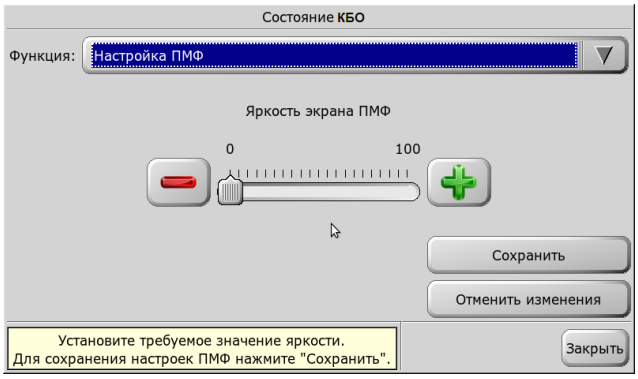

4) to return to the main window, perform the actions in accordance with listing 5 of subparagraph “a”;

d) adjusting the brightness of the PMF screen

To adjust the brightness of the PMF-PTK screen you need to:

1) perform actions according to lists 1 – 3 of subparagraph “a”;

2) in the “KBO Status” window, in the “Function” drop-down list, select “PMF Settings”, and a window will be displayed, an example of which is given below:




3) by pressing the “+” or “-” buttons, set the required level of illumination of the PMF-PTK screen and press the “Save” button;

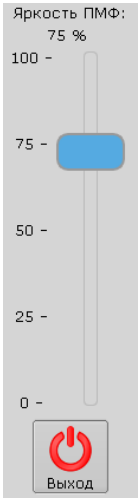
4) to return to the main window, perform the actions in accordance with listing 5 of subparagraph “a”.

It is possible to adjust the brightness of the PMF in another way; for this you need to:

1) perform the action listed in subparagraph 1 “a”;

2) press the “ 

” button, this will display the brightness adjustment panel, an example of which is given below:




Working with other buttons of the "Armored Vehicle" menu is described in detail in the operator's manual VMKTS.00013-02 34 01, attached to the tank and in paragraph 3.5.2.10of this manual.

### 3.5.2.10 Orientation system control

The management of the CO is carried out in accordance with clause 3.5.2.10of this manual.

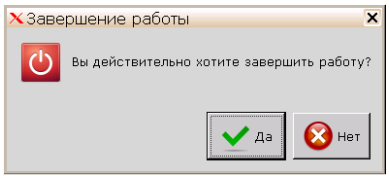
### 3.5.2.11 Curtain setting system control

The SPZ is managed with the PMF. The procedure for working with the SPZ is given in the PTK operating manual (ITNYa.469679.004-02RE), attached to the tank and in paragraph 3.18.3of this manual.

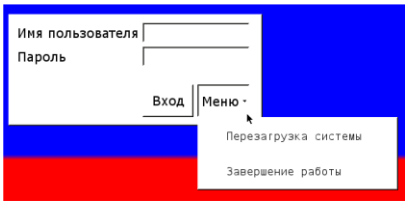
### 3.5.2.12 Turning off the PTC

The PTC is turned off as follows:

– Click the button with the name of the registered official in the top panel of the main window and select the “Shutdown” function in the menu that opens, and a window will appear on the screen, an example of which is given below:




– press the YES button, and a window for entering the user name and password will be displayed on the screen, in which press the “Menu” button, and a submenu will be displayed, an example of which is given below:




– select the “Shutdown” function, this will unload the software and the screen will go dark;

– press the “ ⏻ ” button on the PMF, and the power indicator on the PMF will change color from green to yellow;

– turn off the AZR PTK and AZR SO, while the ON indicator on the PMF goes out;

– turn off AZR RADIOOB., while AVSKU and radio stations will turn off.

In exceptional cases, including when leaving a tank when it is flooded, it is allowed to turn off the PTC only with the “ ⏻ ” button on the PMF.

### 3.5.3 Communications complex

#### 3.5.3.1 Safety Precautions and Operating Limitations

**ATTENTION:**

**TO AVOID THE FAILURE OF RADIO STATIONS AND AVSKU FROM THE INFLUENCE OF STATIC ELECTRIC CHARGES ACCUMULATED ON A PERSON, IT IS PROHIBITED TO LEAVE THE CONNECTORS OF THE AVSKU UNITS UNUSED DURING OPERATION UNLOCKED OR TOUCH WITH HAND THEIR CONTACTS!**

**PROHIBITED:**

**OPERATION OF THE COMMUNICATIONS COMPLEX (HEREINAFTER REFERRED TO AS THE CSS) AT AN AMBIENT TEMPERATURE INSIDE THE TANK BELOW MINUS 40 ºC OR ABOVE PLUS 60 ºC;**
**TURN ON THE KSS WITHOUT BATTERIES INSTALLED ON THE TANK. WHEN THE AZR RADIOOB BATTERIES ARE REMOVED, THE POWER TOGGLE SWITCH ON THE R-168-25U-2 RADIO STATION, THE PIT TOGGLE SWITCH ON THE VKU UNIT OF THE R-168MRA RADIO STATION MUST BE TURNED OFF;**
**TURN ON THE KSS WHEN THE ON-BOARD NETWORK VOLTAGE IS LESS THAN 22 V OR MORE THAN 30 V. THE VOLTAGE IS CONTROLLED FROM THE DRIVER'S APU;**
**WORK WITH RADIO STATIONS WITH HIGH-FREQUENCY CABLES DISCONNECTED FROM THEM;**
**WORK WITH RADIO STATIONS WHEN THE TANK IS LOCATED AT A DISTANCE CLOSER THAN 150 M FROM OTHER RADIO STATIONS WITH A EMITTING POWER OF MORE THAN 100 W;**
**CONNECT AND DISCONNECT CONNECTING CABLES WHEN THE KSS POWER IS TURNED ON;**
**TURN OFF THE POWER SUPPLY TO THE KSS WHEN PREPARING AND ENTERING RADIO DATA (HEREINAFTER REFERRED TO AS RD) INTO THE RADIO STATION, SETTING DATA INTO THE MSVKU INTERFACE UNIT AND KEY INFORMATION INTO THE 450B PRODUCT;**
**START THE TANK ENGINE WHEN ENTERING THE RD, KEY INFORMATION AND CONFIGURATION DATA INTO THE KSS;**
**TOUCH THE CURRENT-CARRYING PARTS OF ANTENNA DEVICES WHEN TRANSMITTING;**
**INSTALL AND REMOVE THE ANTENNA PINS OF THE R-168BSHPA ANTENNA WHILE THE R-168-25U-2 RADIO STATION IS SWITCHED ON FOR TRANSMISSION;**
**TROUBLESHOOT THE CSS WHEN THE ON-BOARD NETWORK IS CONNECTED;**
**PRESS SIMULTANEOUSLY TWO OR MORE BUTTONS ON THE FRONT PANELS OF THE RADIO STATION R-168-25U-2 TRANSCEIVERS AND ON THE PUDL AND PUN UNITS FROM THE AVSKU COMPLEX;**
**WIPE OR WASH THE SHOCK ABSORBERS OF THE R-168BSHPA AND SK-B ANTENNAS WITH KEROSENE, GASOLINE, DIESEL FUEL OR OIL;**
**OPEN KSS BLOCKS;**
**UNAUTHORIZED TO BREAK THE PAPER SEAL AND UNSCREW THE CAP FROM THE PLUG CONNECTED TO THE PU CONNECTOR OF PRODUCT 450B!**

**ATTENTION:**

**IT MUST BE REMEMBERED THAT WHEN UNSCROPPING THE CAP FROM THE PLUG, THE KEY INFORMATION IS ERASED FROM THE MEMORY OF THE 450B PRODUCT, AFTER WHICH WORK IN THE ACS NETWORK IS IMPOSSIBLE!**

When moving the tank, take measures to prevent the antennas from touching power lines.

When working with the radio station R-168-25U-2, it is necessary to strictly observe the requirement for a reception/transmission ratio of 5/1 with continuous transmission operation for no more than 3 minutes. Failure to comply with these requirements may result in failure of the radio or disruption of radio communications.

**ATTENTION:**

**IT IS PROHIBITED TO OPERATE THE TRANSCEIVERS OF THE RADIO STATION R-168-25U-2 ON THE SELF-DEFEATING FREQUENCIES SPECIFIED IN THE ITNYA OPERATING MANUAL 464511.245-04 RE!**

### 3.5.3.2 Radio communication rules

Discipline must be observed when conducting radio communications. The shorter and clearer the transmission, the more reliable the connection and the more difficult it is for the enemy to detect the location of the radio station.

**WARNING:**

**THE ENEMY IS LISTENING!**

The R-168-25U-2 radio station operates in simplex mode, so after transmitting a radio message you should immediately switch to receiving. Otherwise, you can completely disrupt communication in this radio network.

When a tank moves on sandy soil, dry snow and dry dusty paved roads at a speed of more than 20 km/h, impulse noise of electrostatic origin occurs, which can reduce the communication range.

When working in receive mode for a long time, to reduce operator fatigue, it is recommended to use a noise suppressor.

**ATTENTION:**

**WHEN THE NOISE SUPPRESSOR IS TURNED ON, THE SENSITIVITY OF THE RADIO STATION RECEIVER DECREASES, SO IT IS NOT RECOMMENDED TO USE IT WHEN WORKING AT EXTREME RANGES;**
**THE NOISE SUPPRESSOR OPERATES AT A SIGNAL LEVEL AT THE RECEIVER INPUT OF NO MORE THAN 1.5 μV, WHICH CORRESPONDS TO THE VALUE "0" ON THE APO FAMILIARIZATION POINT FOR PP2! IF THERE IS INTERFERENCE AT THE RECEIVER INPUT AND THE INPUT SIGNAL (USEFUL SIGNAL PLUS INTERFERENCE) IS MORE THAN 2 μV, THEN THE NOISE SUPPRESSOR MAY NOT SUPPRESS SUCH A SIGNAL!**

When organizing radio communications, you should take into account the possibility of interference from other radio stations, as well as from industrial facilities. The interfering effect in a given period of time manifests itself differently at different frequencies, therefore, when working, it is advisable to choose a frequency at which there is no radio interference - in this case, on the PUDL block, when displaying the current state of the radio station transceiver in the "advanced menu", the APO display column is highlighted number "0".

The interfering effect manifests itself differently at different frequencies, therefore, when conducting radio communications, you should choose spare frequencies in different parts of the operating range.

You should avoid placing the tank in the lowlands during communications; it is better to place it on a hill.

When working at close distances, it is recommended to set the radio stations to reduced output power levels, because Too strong a transmitting signal can lead to a decrease in the quality of radio communications, and in some cases to a complete breakdown.

When the R -16825U-2 radio station is operating, as well as when the driver receives voice messages from the DKMV, the rest of the crew may have weak listening to voice messages received/transmitted via the radio station and received by the driver from the DKMV.

**ATTENTION:**

**WHEN CHOOSING AN OPERATING MODE WHEN WORKING WITH THE RADIO STATION R-168-25U-2, YOU MUST REMEMBER THAT IN ORDER TO INCREASE THE RECONNAISSANCE PROTECTION OF RADIO COMMUNICATIONS, IT IS PREFERABLE TO WORK IN THE "FCHS-TM", "PPRF" AND "AS" MODES FOR THE PP2 RADIO STATION AND "KFCH-TS" ", "PPRF" FOR PP1 RADIO STATION, IF THE CORRESPONDENT HAS SUCH OPERATING MODES!**

When conducting radio communications through PP1 of the R-168-25U-2 radio station in the frequency range from 390 to 440 MHz, it is necessary to take into account that the radio station provides radio communications with a radio station of the same type at specified communication ranges, provided that this communication is carried out in open areas.

N o t e - Open terrain refers to terrain that is a flat treeless area, up to 75% of the area of which is clearly visible in all directions from commanding heights. Open areas are characterized by the absence of pronounced unevenness of the earth's surface, small relative elevations (no more than 25 m) and relatively low slopes (no more than 2°).

When conducting radio communications through PP2 of the R-168-25U-2 radio station in the frequency range from 30 to 108 MHz, it is necessary to take into account that the radio station provides radio communications with a radio station of the same type at specified communication ranges, provided that this communication is carried out in moderately rugged terrain.

N o t e – Moderately rough terrain refers to terrain where approximately 20% of it is occupied by natural obstacles. Moderately rugged terrain is characterized by the undulating nature of the earth's surface, forming unevenness (hills) with relative elevations from 25 to 200 m with a predominant slope slope of no more than 3°.

When working using the R-168MRA radio station, it is necessary to take into account that high-quality radio communication, providing maximum channel data transfer speed, is possible only when subscribers are in the line of optical visibility zone.

### 3.5.3.3 Preparing a set of communications equipment for operation

The preparation of the CSS for work is determined by the nature of the task. To ensure internal communication between crew members, it is enough to use the AVSKU complex; to provide voice external radio communication, the R-168-25U-2 radio station is used in addition to the AVSKU; to ensure the operation of the automated control system, the R-168MRA radio station is used in addition to the AVSKU.

Before preparing the communication equipment complex for operation, it is necessary that the controls are in their original position:

– AZR RADIOOB. must be turned off;

– The POWER toggle switch on the R-168-25U-2 radio station must be turned on. The position of other controls located on the radio station is not regulated;

– The PIT toggle switch on the VKU unit of the R-168MRA radio station must be in the OFF position.

When preparing a set of communications equipment for operation, it is necessary to:

– install the R-168BShPA antenna rods. To install the rods you need:

- remove the rods from the case (located in a single set of spare parts for the tank);
- remove the plug from the antenna base shank;
- connect the rod and the emitter stand to each other and check the reliability of the joint. The rod with the stand and base are connected to each other by threaded connections;
- connect the articulated rod and stand to the shank of the antenna base and check the reliability of its fixation;

– if it is necessary to use the R-168MRA radio station, turn on the PIT toggle switch on the VKU unit;

– the crew put on headsets and connect them to the MT10M devices, which are connected to the PUDL (commander), PUN (gunner), MSNC (driver) units;

**ATTENTION:**

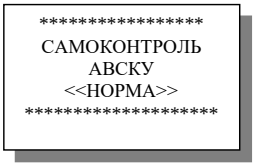
**TO AVOID DAMAGE TO THE CORDS OF THE MT10M DEVICES, IT IS NECESSARY TO SECURE THE DEVICE ON THE OPERATOR'S TORS DURING OPERATION BY HANGING IT ON A BUTTON LOCATED ON THE EQUIPMENT!**

If there is no button on the operator’s equipment, it must be sewn on. Upon completion of work with the AVSKU complex, MT10M devices must hang on bolt buttons, which are located in the crew’s working areas.

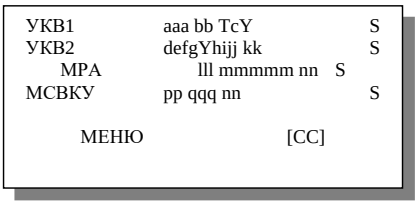
– turn on the KSS equipment by setting the AZR RADIOOB toggle switch. to the on position (the distribution panel ShchR with AZR RADIOOB. is located on the side of the tower in front of the commander). When you turn on the AZR RADIOOB, the process of self-monitoring of the switched-on KSS equipment begins. During self-monitoring, a message is displayed on the alphanumeric indicator of the PUDL block of the AVSKU complex (the “>” symbol moves from left to right):

```
**********
САМОКОНТРОЛЬ
АВСКУ
ЖДИТЕ >
**********
```

After self-testing for 2 s, in the absence of failures, the following message should be displayed on the alpha-numeric indicator of the PUDL:




After which a message should appear with the current state of the channel-forming means (hereinafter referred to as the “main screen”):




Where:
VHF1 - line displaying the status of PP1 of the radio station R-168-25U-2;
VHF2 - line displaying the status of PP2 of the radio station R-168-25U-2;
MPA - line displaying the status of the R-168MRA radio station;
MSVKU - line displaying the state of the MSVKU block.
– check that the 450B product is turned on by flashing the POWER indicator on it in green;
A description of the “main screen” message indication fields is given in Table 9

Table 9

| Designation | Description | Possible display values |
|---|---|---|
| **VHF1** | | |
| aaa | Channel number installed on PP1 of the radio station R-168-25U-2 | "001" - "100" |
| bb | Operating mode set on PP1 of the radio station R-168-25U-2 | “_A” - KFC-A mode<br>“KD” - KFC-C mode<br>“PP” - PPFC mode |
| T | PTT/Repeater | “T” - without relay<br>“P” - through a repeater |
| c | PTT channel | “O” - main channel,<br>“K” - command channel |
| Y | Sign of entry into transmission | " " - reception<br>" " - transmission |
| **VHF2** | | |
| d | Channel number installed on PP2 of the radio station R-168-25U-2 | "18" |
| e | Operating mode set on PP2 radio station R-168-25U-2 | “F” - FES mode<br>“D” - FChDS mode<br>“A” - AC mode<br>“C” - SP mode<br>“P” - frequency converter mode |
| f | For the FChDS, SP mode - the number of the reception charger<br>For the FES mode - the number of the reception and transmission RF | “1” - “8” - in FChS, FChDS modes<br>“_” - in AC, PDFC modes |
| g | For the FChDS mode - the number of the transmission RF<br>For AC mode - a sign of manual or automatic adaptation | “1” - “8” - in FChDS mode<br>“A” - automatic adaptation in AC mode<br>“P” - manual adaptation in AC mode<br>“_” - in FES, PDFR modes |

| Designation | Description | Possible display values |
|---|---|---|
| Y | Sign of entry into transmission | " " - reception<br>" " - transfer |
| h | For FChS, FChDS, SP modes - APO level code | “1” - “F” - in FChS, FChDS, SP modes<br>“ ” - in AC, PDFC modes |
| i | Gain path used | "U" - VUFUS<br>P" - PP |
| jj | Multichannel attribute | “OK” - single-channel mode<br>"MK" - multi-channel mode |
| kk | For FChS, FChDS modes - a sign of the noise suppressor being turned on | “__” - PN is disabled in FChS, FChDS modes<br>“PSh” - PS is turned on in the FChS, FChDS modes |
| | For AC and frequency converter modes - a sign of the presence or absence of network synchronization | “DR” - lack of network synchronization (standby mode) in the operating modes AC, PDFR<br>“SV” - synchronization was carried out in the operating modes AC, PDFC |
| **MRA** | | |
| lll | Channel number installed on the MPA radio station | "001" - "251" |
| mmmmm | Power installed on the MPA radio station | "0.008", "0.020", "0.050", "0.130", "0.320", "0.800", "2.000", "5.000" |
| nn | Number of “visible” subscribers | "00" - "99" |
| **MSVKU** | | |
| pp | Channel number installed on the MSVKU block | "01" - "11" |
| qqq | Power installed on the MSVKU unit | "001", "005", "020", "030", "050", "100" |
| **For all channel-forming agents** | | |
| S | State | “-” - presence of an accident<br>“+” - normal<br>“?” - state is not defined |

If there are no "-" or "?" in the “S” field for switched on channel-forming means on the main screen - the KSS equipment is ready for operation.

If for some reason there is no connection between the AVSKU and the channel-forming device, the symbols “XXXXXXXXX” will be displayed in the current status line of this channel-forming device.

It must be taken into account that the connection of the R-168MRA radio station to the KSS information network occurs in no more than 3 minutes.

**ATTENTION:**

**SUCCESSFUL CONNECTION OF THE R -168MRA RADIO STATION TO THE INFORMATION NETWORK OF THE COMMUNICATIONS COMPLEX IS POSSIBLE ONLY IF THE NETWORK PARAMETERS ARE CORRECTLY RECORDED IN THE RADIO STATION’S MEMORY!**

– if necessary, prepare and enter (correct) radio data into the KSS equipment (into the R-168-25U-2 and R-168MRA radio transceivers), configuration data (into the MSVKU block) and key information (into the 450B product). Preparation and input are carried out by ACS specialists using the equipment they have. In exceptional cases, the radio and configuration data can be entered or corrected by the tank commander.

Entering radio data (hereinafter referred to as RD) into the memory of the R-168-25U-2 radio transceivers can be done in several ways:

– manually, from the PUDL unit of the AVSKU complex. The procedure for manually entering the RD into the transceivers of the R-168-25U-2 radio station from the PUDL unit is described in detail in the operating manual for the software and hardware complex AVSKU ITNYA.468369.048-36 RE, attached to the tank;

– automated, using the AK-3.5 subscriber communicator (hereinafter referred to as AK), which is part of a single set of spare parts for the tank. The procedure for automated input of RD into radio transceivers using an AK is described in detail in the operating manual on PTK ITNYA.469679.004-02 RE, attached to the tank.

**ATTENTION:**

**IT IS ALLOWED TO RECORD RD ON A SEPARATELY TAKEN CHANNEL ONLY FOR SEPARATE OPERATING MODES OF THE R-168-25U-2 RADIO STATION IN ACCORDANCE WITH TABLE 10 FOR PP2 AND TABLE 11 FOR PP1!**

Table 10

| Possible operating modes of the PP2 radio station on a separate channel | The required set of radio data to operate on the selected channel |
|---|---|
| "FES", "SP", "DP" | eight HRAs |
| “FChS”, “FChS-TM”, “SP”, “DP” | eight HRAs; key; SA; target audience; GA |
| "AS" | eight HRAs; HRA of the old park; key; SA; target audience; GA |
| "PPRCH" | PPP, n PPP; HRA of the old park; key; SA; target audience; GA |
| N o t e - n is the number of PPCs equal to the PPP. | |

Table 11

| Possible operating modes of the PP1 radio station on a separate channel | The required set of radio data to operate on the selected channel |
|---|---|
| KFC-A | PRM/PRD frequency; operating mode; power; restriction of work on transmission; economizer |
| KFC-C | PRM/PRD frequency; operating mode; masker; target audience; GA; IA; SA; power; limitation of transmission time; channel interception priority; call type, commander channel; masker key |
| PPRF | nHRA; bias; operating mode; masker; target audience; GA; IA; SA; power; limitation of transmission time; channel interception priority; commander channel; masker key; PPRF key |
| N o t e - n - number of RF units | |

Entering the RD into the R-168MRA radio station can be done in several ways:

– manually, from the PUDL unit of the AVSKU complex. The procedure for preparing and entering radio data and configuration data into the R-168MRA radio station from the PUDL unit is described in the operating manuals for PTK ITNYA.469679.004-02 RE and for the software and hardware complex AVSKU ITNYA.468369.048-36 RE, attached to the tank;

– automated, using AK . The procedure for automated input of radio data and configuration data into the R-168MRA radio station using the AK is described in the operating manual on PTK ITNYA.469679.004-02 RE, attached to the tank.

You can enter setup data into the MSVKU in several ways:

– manually, from the PUDL unit of the AVSKU complex. The procedure for preparing and entering configuration data into the MSVKU block is described in the operating manuals for the hardware and software complex AVSKU ITNYA.468369.048-36 RE, supplied with the tank;

– automated, using AK. The procedure for automated input of setting data into the MSVKU unit using the AK is described in the operating manual for PTK ITNYA.469679.004-02 RE, attached to the tank.

The procedure for entering key information into 450B products using AK is described in detail in the operating manual on PTK ITNYA.469679.004-02 RE, attached to the tank.

#### 3.5.3.4 Radio station R-168-25U-2

The radio station R-168-25U-2 can be controlled by:

– from the front panels of the radio transceivers (access is difficult);

– from the control and indication unit PUDL of the AVSKU complex;

– from the PMF-PTK panel.

Considering that the control and indication unit PUDL (hereinafter referred to as PUDL) is intended, among other things, to control the radio station, and control from it is more convenient, the operation of the radio station when controlled from the PUDL unit of the AVSKU complex will be described below.

The procedure for controlling the radio station from the PMF-PTK panel is set out in the software for support and decision making VMKTS.00013-02, attached to the tank.

If necessary, the operating procedure of the R-168-25U-2 radio station when controlled from the front panels of the transceivers can be found in the operating manual for the R-168-25U-2 radio station ITNYA.464511.245-04 RE, attached to the tank.

##### 3.5.3.4.1 Checking the functionality of the radio station R-168-25U-2

To check the functionality of the radio transceivers, you must:

– prepare the radio station for operation in accordance with clause 3.5.3.3of this manual;

– check the functionality of the PP1 radio station in the following sequence:

- on the PUDL block, press the PC1 button, while the indicator of the same name above the button should light up green, and the “advanced menu” for controlling the PP1 radio station will be displayed on the indicator of the PUDL block.

N o t e – Explanation of the “extended menu” indication and the procedure for controlling radio transceivers from the “extended menu” are set out in the operating manuals for PTK ITNYA.469679.004-02 RE and for the hardware and software complex AVSKU ITNYA.468369.048-36 RE, attached to the tank ;

- from the PUDL block, set on PP1 the number of the channel on which RDs are entered for operation in the “KFCH-C” mode, guided by clause 3.5.3.4.3of this manual;
- check the functionality of the receiving path PP1 of the radio station. The receiving path PP1 of the radio station R-168-25U-2 is considered to be in good working order if the PC1 indicator is lit on the PUDL block, there is a sign of reception on the indicator of the PUDL block - the “ ” symbol, the operation of other radio stations (if any) is heard in the headset phones and the effect is not heard “self-excitation”, characterized by whistling;
- check the functioning of the transmitting path PP1 of the radio station when working through the main channel , to do this, press the TRD button on the MT10M device and pronounce loudly the sound “a” or the count “one”, “two”, “three”. The presence of a self-listening headset in the phones and the appearance of the symbol “ ” on the indicator of the PUDL block in the “main screen” or in the “extended menu” indicate the serviceability of the transmitting path PP1 of the radio station R-168-25U-2, when operating through the main channel;
- check the functioning of the transmitting path PP1 of the radio station when working through the commander’s channel , to do this, press the CALL button on the MT10M device and pronounce loudly the sound “a” or the count “one”, “two”, “three”. The presence of a self-listening headset in the phones and the appearance of the symbol “ ” on the indicator of the PUDL block in the “main screen” or in the “extended menu” indicate the serviceability of the transmitting path PP1 of the R-168-25U-2 radio station, when operating through the commander’s channel;

– check the functionality of the PP2 radio station when operating through a power amplifier (hereinafter referred to as PA) of the VUFUS unit in the following sequence:

- on the PUDL block, press the PC2 button, while the indicator of the same name above the button should light up green, and the “advanced menu” for controlling the PP2 radio station will be displayed on the indicator of the PUDL block;
- from the PUDL block, set on PP2 the number of the channel on which the RDs are entered for operation in the “PFS” mode, guided by clause 3.5.3.4.3of this manual;
- connect PP2 through the PA of the radio station (in the “advanced menu” on the PUDL block, the indication “U” should be displayed in the seventh column of the second line) with setting the average or full output power, guided by paragraph 3.5.3.4.3of this manual;
- if the noise suppressor is turned on, turn it off, following paragraph 3.5.3.4.3of this manual;
- check the functionality of the receiving path PP2 of the radio station connected through the PA of the radio station. The receiving path PP2 of the radio station R-168-25U-2 is considered to be in good working order if the RS2 indicator is lit on the PUDL block, there is a sign of reception on the indicator of the PUDL block - the “ ” symbol, in the headset phones the own noise of the PP2 receiver or the operation of other radio stations (if any) can be heard ) and the “self-excitation” effect, characterized by a whistle, is not heard. When adjusting the volume on the MT10M device, the level of its own noise should change;
- check the functionality of the transmitting path PP2 of the radio station, to do this, press the PRD button on the MT10M device (their own noise should disappear), and pronounce loudly the sound “a” or the count “one”, “two”, “three”. The presence of a self-listening headset in the phones and the appearance of the symbol “ ” on the indicator of the PUDL block in the “main screen” or in the “extended menu” indicate the serviceability of the transmitting path PP2 of the R-168-25U-2 radio station.

#### 3.5.3.4.2 Initial settings of the radio station R-168-25U-2

The radio's initial settings include the radio's transceiver settings. A complete list of initial settings and the procedure for working with the initial settings of the radio transceivers are described in detail in the operating manuals on PTK ITNYA.469679.004-02 RE and on AVSKU ITNYA.468369.048-36 RE, supplied with the tank .

**ATTENTION:**

**WHEN WORKING WITH PP2 RADIO STATIONS IN THE INITIAL SETTINGS, THE TYPE OF ANTENNA USED WITH A WAVE IMPEDANCE OF 50 OHMS MUST BE SET!**

To set the type of antenna used with a characteristic impedance of 50 ohms, you need to select the line “50 ohms” in the “SETTINGS\ANTENNA” submenu on PUDL.

**ATTENTION:**

**WHEN WORKING WITH PP2 RADIO STATIONS IN THE INITIAL SETTINGS, THE REPEAT MODE MUST BE DISABLED!**

To disable the relay mode, you need to select the “OFF” line on PUDL in the “SETTINGS\RTR” submenu.

#### 3.5.3.4.3 Operating procedure for radio station R-168-25U-2

The radio station can operate in the following operating modes through the PP2 transceiver in the MV frequency range:

– fixed frequency - simplex (“PSF”). When operating in a given mode, reception and transmission are carried out on one AFB;

– fixed frequency - dual-frequency simplex (“DFDS”). When operating in a given mode, reception is carried out on one AFB, and transmission is carried out on another AFB;

– scanning reception (“SP”) in the “PSF” mode. This mode is used to sequentially bypass up to eight RFBs with automatic scanning stop when receiving a tone call from a correspondent, the connection with which was interrupted for any reason;

– fixed frequency – simplex with technical masking of transmitted information (“FChS-TM”);

– duty reception (“DP”). Used when working for a long time on reception, while preventing unauthorized switching of the radio station to transmit mode;

– pseudo-random tuning of the operating frequency (“PRFC”) according to group 8, 16, 32, 64, 128 or 256 AF with a speed of 100 jumps per second and the ability to receive a tone call from radio stations operating on a fixed AF;

– adaptive communication (“AC”). When working in this mode, there is an automatic selection of one or two AFBs, the best according to the results of the analysis of the interference situation, from a group of up to eight AFBs and the ability to receive a call from a radio station operating on a fixed AFB.

The radio station can operate in the following operating modes through the PP1 transceiver in the UHF1 frequency range:

– analogue at a fixed frequency (“KFCh-A”). In the “KFCh-A” mode, open analog speech information is received and transmitted;

– digital cryptographically secure on a fixed frequency (“KFC-Ts”). In the “KFC-Ts” mode, the radio station provides operational communication on two frequencies (the main channel and the commander’s channel) without switching the channel;

– digital with software tuning of the operating frequency (“PRFC”). In the frequency converter mode, digital information and data are received and transmitted in digital form with software frequency tuning in a group of up to 256 frequency converters at a speed of 240 jumps per second;

– scanning at pre-prepared frequencies (up to 10 RF frequencies).

**ATTENTION:**

**WHEN OPERATING THE RADIO STATION R-168-25U-2 IN THE FREQUENCY RANGE FROM 80 TO 108 MHZ, A POSSIBLE REDUCTION IN THE COMMUNICATION RANGE DUE TO THE FEATURES OF OPERATING THE RADIO STATION WITH THE R-168BSHPA ANTENNA!**

The procedure for operating the radio station in various operating modes, when controlled from the PUDL unit, is described in detail in the operating manuals for PTK ITNYA.469679.004-02 RE and for the software and hardware complex AVSKU ITNYA.468369.048-36 RE, supplied with the tank.

It is prohibited to operate radio stations at frequencies affected by internal radiation specified in the operating manual for the radio station R-168-25U-2 ITNYA.464511.245-04 RE!

### 3.5.3.5 Radio station R-168MRA

The R-168MRA radio station operates in an automated mode. The radio station settings are controlled from the PUDL unit of the AVSKU complex or from the PMF-PTK panel.

The procedure for controlling the radio station from the PUDL unit is set out in the operating manuals for PTK ITNYA.469679.004-02 RE and for the software and hardware complex AVSKU ITNYA.468369.048-36 RE, supplied with the tank.

The procedure for controlling the radio station from the PMF-PTK panel is set out in the support and decision-making software VMKTs.00013-02, attached to the tank.

#### 3.5.3.5.1 Checking the functionality of the R-168MRA radio station

To check the functionality of the R-168MRA radio station, you must:

– prepare the radio station for operation and turn it on in accordance with clause 3.5.3.3of this manual;

– check on the indicator of the PUDL block in the third line of the “main screen” the display of information about the current state of the radio station.

The display of information about the current state of the radio station on the indicator of the PUDL block indicates the operability of this radio station.

#### 3.5.3.5.2 Operating procedure for the R-168MRA radio station

The operation of the R-168MRA radio station (search for a radio network, registration in a radio network, reception and transmission of information) is carried out automatically without operator intervention.

### 3.5.3.6 AVSKU complex

#### 3.5.3.6.1 Checking the functionality of the AVSKU complex

To check the functionality of the AVSKU complex, you must:

– put on the TSh-4M headsets for the crew members and adjust them to the size of their heads using adjustment straps, while adjusting the laryngophones so that they fit snugly to the larynx on both sides;

– connect the headset connectors to MT10M devices, which, in order to avoid contamination and damage to the contacts of the electrical connectors, must be permanently connected to the AVSKU units. The commander's MT10M device is connected to the PUDL unit, the gunner's MT10M device is connected to the PUN unit, the driver's MT10M device is connected to the MSNC unit.

N o t e – If necessary, an additional subscriber can connect to the intercom network, for which it is necessary to remove the MT10M device and the TSh-4M headset from the spare parts stowage of the tank and connect them to the additional subscriber block, which is located under the cover, on the wind sensor stand, welded externally turrets, behind the gunner's hatch;

– prepare the AVSKU complex for operation and turn it on, guided by the instructions in paragraph 3.5.3.3of this manual;

– crew members switch to working via the intercom network, following the instructions in clause 3.5.3.6.4;

– Set each crew member to the required intercom volume level using the VOLUME buttons on their MT10M device. It is recommended to set the volume with the engine running, i.e. in the presence of ambient acoustic noise. The tank crew and the additional subscriber must hear each other over the intercom network when the buttons on the MT10M devices are released;

– check the operation of the AVSKU complex in terms of access to external communication via both communication channels of the radio station, guided by the instructions in paragraph 3.5.3.4.1of this manual;

– check the operation of the circular call, following the instructions in paragraph 3.5.3.6.2of this manual.

#### 3.5.3.6.2 Procedure for working with AVSKU

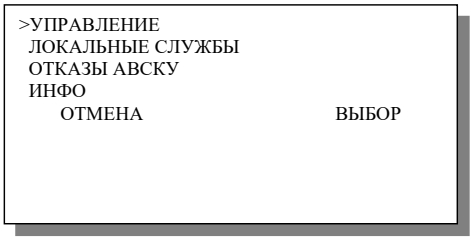
**ATTENTION:**

**- HIGH-QUALITY TWO-WAY COMMUNICATION IS POSSIBLE ONLY WHEN ALL CREW MEMBERS HAVE LARYNGOPHONES TIGHTLY PRESSED TO THE LARYNX;**
**- IN ORDER TO AVOID DAMAGE TO THE CORDS OF MT10M DEVICES, IT IS NECESSARY TO SECURE THE DEVICE DURING OPERATION BY HANGING IT ON A BUTTON LOCATED ON THE CHEST OF THE EQUIPMENT. IF THERE ARE NO BUTTONS ON THE OPERATOR'S EQUIPMENT, THE BUTTON MUST BE SEWN ON. MT10M DEVICES, UPON COMPLETION OF WORK WITH THE AVSKU COMPLEX, MUST HANG ON BUTTON BOLTS LOCATED IN THE EQUIPMENT AREAS OF THE CREW MEMBERS;**
**- WHEN WORKING WITH THE R-168-25U-2 RADIO STATION, THE PUDL BLOCK SUBSCRIBER (COMMANDER) HAS PRIORITY OVER THE PUN BLOCK SUBSCRIBER (GUNNER)!**

#### 3.5.3.6.3 Working with the PUDL block menu

The menu of the PUDL block is entered by pressing the K1 button, which, when the "main screen" is displayed, is located under the "MENU" banner. To move through menu items, use the " ∇" and " Δ" buttons until the ">" marker on the alphanumeric indicator aligns with the required menu item. The alphanumeric PUDL indicator has four lines. If all menu commands are not displayed on the alphanumeric indicator, then the next command will appear after pressing the " ∇" button when the marker is positioned on the last displayed item or the " Δ" button when the marker is positioned on the first displayed item. To go up a level in the menu structure, press the K1 button. To select a menu item, press the K2 button. On the digital indicator of the PUDL block, a hint of the operation that will be performed after pressing the K1 button is displayed in the lower left corner, and a hint that will be performed after pressing the K2 button is displayed in the lower right corner.

For example, when the following message is displayed on the indicator of the PUDL block:




Pressing the K1 (CANCEL) button will move up the menu items, and pressing the K2 (SELECT) button will select the selected menu item.

In the following text, the path to the desired menu item will be indicated as follows: “MENU/CONTROL/PC SETTINGS”.

#### 3.5.3.6.4 Working in an intercom network

To organize internal communication, it is necessary for all crew members to switch to working via the internal communication network.

The green glow of the aircraft indicators on the PUDL and PUN blocks indicates that the commander and gunner are in the internal communication network. If for some reason the BC indicators do not light up, you must press the BC button on the corresponding unit.

N o t e – Some buttons on the PUDL control panel have dual purposes. On such buttons, the inscriptions are located in two rows. It must be taken into account that by default, pressing the buttons leads to the execution of commands in accordance with the inscriptions located in the top row, while the RZh indicator on the control panel of the PUDL unit does not light up. When you press the RZh button, the indicator of the same name will light up, and when you press buttons with double designations, commands will be executed in accordance with the inscriptions located in the bottom row. Pressing the P3 button again will cause the indicator of the same name to go out. In some justified cases (for the convenience of the operator), the RZh indicator will light up automatically. Pressing buttons that have a single purpose (for example, the BC button) will lead to the execution of the command assigned to this button, regardless of the lighting of the RZh indicator;

Switching the driver to the internal or external communication network is carried out by the commander from the PUDL unit. The connection procedure is set out in the operating manual for the software and hardware complex AVSKU ITNYA.468369.048-36 RE, supplied with the tank.

**ATTENTION:**

**NEGOTIATIONS OVER THE INTERCOM NETWORK ARE CONDUCTED WITHOUT PRESSING BUTTONS ON THE MT10M DEVICES!**

If one or more crew members are in the external radio communication network, then by double pressing for 1 s and then holding the CALL button on their MT10M device by any crew member, except the additional subscriber, all crew members are forcibly disconnected from external radio networks and transferred to the network internal circular communication (hereinafter referred to as CC). In this case, the CV indicators on the PUDL and PUN blocks will light up green, and the message “ CIRCULAR COMMUNICATION” will be displayed on the alphanumeric indicator of the PUDL block .

Subscribers of the PUDL (commander) and PUN (gunner) blocks can organize a CA by pressing the CV button on their blocks.

**ATTENTION:**

**WHEN IN THE CA NETWORK, THE ORGANIZER OF THE CA MODE MUST HOLD THE CALL BUTTON ON HIS MT10M DEVICE OR THE CV BUTTON ON HIS UNIT FOR THE DURATION OF THE NEGOTIATIONS!**

After releasing the CALL button on the MT10M device or the CV button on the PUDL and PUN blocks, the CA organizer restores the previous modes of communication between crew members and indications on the PUDL and PUN blocks.

The operating procedure in internal communication networks is described in more detail in the operating manual for the hardware and software complex AVSKU ITNYA.468369.048-36 RE, supplied with the tank.

#### 3.5.3.6.5 Working in an external radio communication network

To connect to the external radio communication network, the commander needs to press the RS1 button on the PUDL unit (to work through PP1 of the R-168-25U-2 radio station) or RS2 (to work through PP2 of the R-168-25U-2 radio station). A green indicator above the button indicates that the commander is connected to the external radio communication network through the selected radio transceiver.

If the commander is in the external radio communication network, then the indicator of the same name will glow red on the gunner's console (GRC), which notifies the gunner that work on the radio communication channel through the transceiver selected by the commander is prohibited.

To connect to the external radio communication network, the gunner needs to press the PC1 button on the PUN unit (to work through PP1 of the R-168-25U-2 radio station) or RS2 (to work through PP2 of the R-168-25U-2 radio station). A green indicator above the button indicates that the gunner is connected to the external radio communication network through the selected radio transceiver.

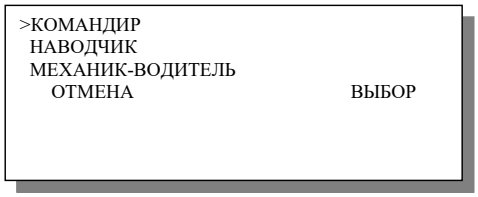
If the gunner is in the external radio communication network, then the indicator of the same name will light up in red on the commander's console (CUDL), which notifies the commander that the radio communication channel is busy through the transceiver selected by the gunner.

It should be noted that the commander has priority in choosing one or another radio communication channel. If necessary, the commander can at any time break the external radio communication channel organized by the gunner by pressing the indicator button of the same name on the PUDL unit, glowing red. The gunner does not have such an opportunity.

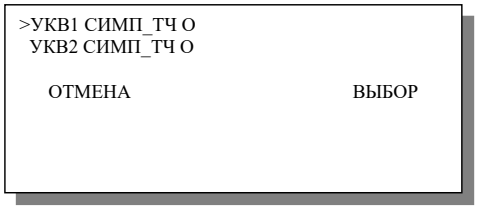
To connect the driver to the external radio communication network through PP1 or PP2 of the R-168-25U-2 radio station, the commander from the PUDL unit needs to connect the driver from the menu item "AB CONNECTION" to work with one or another transceiver of the radio station.

To connect the driver to external communications via the R-168-25U-2 radio station, the commander at the PUDL unit must:

– select the menu item "MENU/CONTROL/AB CONNECTION" or press the "RS AB" button. In this case, the alphanumeric indicator of the PUDL block will display a menu with a list of subscribers who can be connected to the external radio communication network, for example:



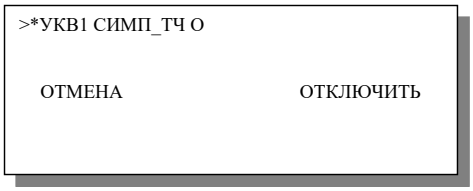

– Using the " ∇", " Δ" buttons, select the "DRIVER MECHANIC" menu item and press the "K2" (SELECT) button. In this case, a message with a list of possible connections will be displayed on the alphanumeric indicator of the PUDL block, for example:




– using the " ∇", " Δ" buttons, select the menu item " VHF1 SIMP_TCH O" , when connecting the R-168-25U-2 radio station to PP1 or " VHF2 SIMP_TCH O" , when connecting the R-168-25U-2 radio station to PP2 and press button "K2" (SELECT). In this case, a menu will be briefly displayed on the alphanumeric indicator of the PUDL block, in one of the lines of which the message "CHANNEL IS BEING CREATED" will be displayed.

If the radio communication channel is successfully created, a menu will be briefly displayed, in one of the lines of which the message "CHANNEL CREATED" will be displayed.

After which a message will be displayed indicating that the driver is connected to the selected transceiver of the R-168-25U-2 radio station, for example:




Disconnecting the driver from the R-168-25U-2 radio station is done by pressing the “K2 (DISABLE)” button in this menu.

There is no provision for connecting an additional subscriber to external radio communications.

**3.5.3.6.6 The procedure for conducting radio communications through PP1 of the radio station R -16825U2**

When a crew member is in the external radio communication network through PP1 of the radio station R-168-25U-2 in the “KFCh-A” or “PPRF” mode, to transmit a voice message, press and hold the PRD button on the MT10M device; to receive a voice message, you must release the button PRD.

When a crew member is in the external radio communication network through PP1 of the R-168-25U-2 radio station in the “KFC-Ts” mode, it is possible to conduct radio exchange on two channels - the main and the commander’s channel (set when entering the RD in PP1 of the R-168-25U radio station -2). To transmit a voice message on the main channel, press and hold the PRD button on the MT10M device until the message is transmitted. To transmit a voice message on the commander’s channel, press and hold the CALL button on the MT10M device until the message is transmitted. Voice messages are received simultaneously on two channels without pressing buttons on the MT10M device.

**3.5.3.6.7 The procedure for conducting radio communications through PP2 of the radio station R -16825U2**

When the subscriber is in the external radio communication network through PP2 of the radio station R-168-25U-2, to transmit a voice message, press and hold the PRD button on the MT10M device; to receive a voice message, you must release the PRD button.

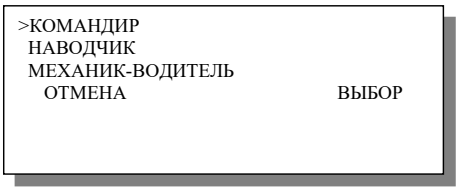
**3.5.3.6.8 Working in listening mode**

The commander, gunner and driver have the ability to listen to the R-168-25U-2 radio station while simultaneously being on the intercom network.

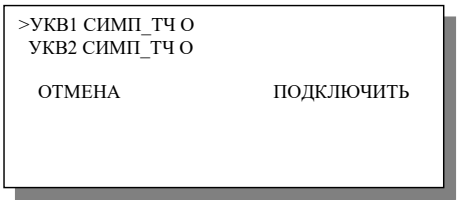
The commander has access to enable/disable this function. To do this, the commander on the PUDL unit must press one of the buttons PR RS1 (to listen to PP1 of the radio station R-168-25U-2) or PR RS2 (to listen to PP2 of the radio station R-168-25U-2). The indicator of the same name will glow green above the pressed button, indicating that it is possible to listen to the selected radio transceiver. Pressing these buttons again will turn off the listening mode and the indicator above the button will go out.

The commander also has the opportunity from the PUDL unit to connect the gunner and driver to listening mode for the R-168-25U-2 radio station. To connect, the commander at the PUDL unit must:

– select the menu item “MENU/CONTROL/WATCH SETTINGS”. In this case, a menu will be displayed on the alphanumeric indicator with a list of subscribers who can be connected to the listening mode of a particular transceiver of the R-168-25U-2 radio station;

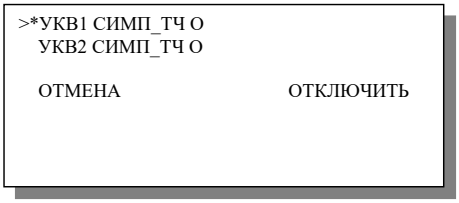



– Using the “ ∇”, “ Δ” buttons, select the menu item “DRIVER” or “GUANER” and press the “K2” (SELECT) button. In this case, a message with a list of possible connections will be displayed on the alphanumeric indicator of the PUDL block;




– using the " ∇", " Δ" buttons, select the menu item "VHF1 SIMP_TC", when connecting the R-168-25U-2 radio station to PP1 or "VHF2 SIMP_TC", when connecting the R-168-25U-2 radio station to PP2 and press the " K2" (CONNECT). In this case, a menu will be briefly displayed on the alphanumeric indicator of the PUDL block, in one of the lines of which the message “CHANNEL IS BEING CREATED” will be displayed ;

– If the radio communication channel is successfully created in the listening mode, a menu will be briefly displayed, in one of the lines of which the message “CHANNEL CREATED” will be displayed. After which a message will be displayed indicating that the driver or gunner is connected to the selected transceiver of the R-168-25U-2 radio station in listening mode.




Disabling the listening mode PP1 or PP2 of the radio station R-168-25U-2 of the driver or gunner is done by pressing the “K2” (DISABLE) button in this menu.

### 3.5.3.6.9 Quickly enable/disable PN

The commander has the ability, when working with PP2 of the R-168-25U-2 radio station in the “FChS” or “FChS-TM” modes, to quickly turn on/off the noise suppressor from the PUDL control panel.

To quickly turn on the PN, press the PN button, and the indicator of the same name will light up in green above the pressed button. To turn off the noise suppressor, press the PSH button again, and the corresponding indicator will go out.

**ATTENTION:**

**THE NOISE SUPPRESSOR OF THE RADIO STATION R-168-25U-2 WORKS ONLY UP TO A CERTAIN SIGNAL LEVEL AT THE RECEIVER INPUT!**

If the total input signal (useful signal plus interference) is more than a certain value, then the noise suppressor will not be able to suppress such interference. Therefore, when working with PN, it is necessary to take into account the possibility of interference from powerful radio stations operating in the range of the R-168-25U-2 radio station, as well as from industrial facilities. The interfering effect in a given period of time manifests itself differently at different frequencies, therefore, when working, it is advisable to choose a frequency at which there is no radio interference - on the PUDL block, when displaying the current state of the radio transceiver in the “advanced menu”, the number “0” is displayed in the APO display column .

N o t e – Explanation of the “extended menu” indication and the procedure for controlling radio transceivers from the “extended menu” are described in detail in the operating manuals for PTK ITNYA.469679.004-02 RE and for the software and hardware complex AVSKU ITNYA.468369.048-36 RE, attached to tank.

### 3.5.3.6.10 Quickly enable/disable TM mode

The commander has the ability, when working with PP2 of the R-168-25U-2 radio station, on a channel on which the RDs are prepared for operation in the FChS and FChS-TM modes, to quickly enable/disable the TM mode from the PUDL control panel.

To quickly turn on the TM mode, you need to press the TM button on the PUDL unit, and the indicator of the same name will light up in green above the pressed button - a sign that the TM mode has been turned on. To turn off the TM mode, press the TM button again, and the indicator of the same name above the TM button will go out - a sign that the TM mode has been turned off.

#### 3.5.3.6.11 Promptly sending a tone call

The commander, gunner and driver, when working through PP2 of the radio station R-168-25U-2 in the FChS and FChS-TM modes and through PP1 and in the KFC-A mode, have the ability to promptly send a tone call.

To send a tone call to a subscriber who is in the external radio communication network, you must press the (PRD) key twice on your MT10M device within 1 second, after which a tone call signal lasting from 4 to 8 seconds is sent to the external network. When you press and hold the key twice, a ring tone will be sent for as long as the key is held.

In addition, the commander has the ability to send a tone call to the external network by pressing the "CALL" button on the PUDL block. The ring tone will be sent for as long as it is held CALL button.

The procedure for working in external communication networks is described in more detail in the operating manual for the hardware and software complex AVSKU ITNYA.468369.048-36 RE, supplied with the tank.

#### 3.5.3.6.12 Operation of the MSVKU block

The operation of the MSVKU block (network search, registration in the network, reception and transmission of information) is carried out automatically without operator intervention.

### 3.5.3.7 Peculiarities of operation of the communication equipment complex as part of the software and hardware complex

The features of the work of the CSS as part of the PTC include the following factors:

– the first (upper) transceiver (TP1) of the radio station provides reception/transmission of only voice information;

– the second (lower) transceiver (PP2) of the radio station provides reception/transmission of both voice and digital information. Moreover, the reception/transmission of digital information has priority over the reception/transmission of voice information. Those. When receiving/transmitting digital information, the speech channel is disabled. But due to the fact that the reception/transmission of digital information is carried out in short bursts with a duration of less than 0.5 s, this transmission does not have a significant impact on the quality of voice radio traffic;

– When receiving/transmitting digital information, priority is given to the high-speed radio station R-168MRA. If for some reason (for example, the subscriber is at a distance exceeding the range of the R-168MRA radio station) it is impossible to transmit data via a high-speed data transmission channel, digital information is delivered automatically (without operator participation) through PP2 of the R-168-25U radio station -2, but with a lower data transfer rate;

– The KSS equipment as part of the PTC allows the reception/transmission of digital information through the MSVKU unit via the IEEE 802.11b (Wi-Fi) radio interface. This transfer is carried out automatically, without operator participation;

– KSS equipment can operate in autonomous mode, i.e. when UARMk is disabled or faulty. When working in offline mode, only transmission/reception of voice information is provided.

### 3.5.3.8 Product 450B

#### 3.5.3.8.1 Checking the functionality of the 450B product

To check the functionality of the 450B product you must:

– prepare the 450B product for operation and turn it on in accordance with clause 3.5.3.3of this manual.

**ATTENTION:**

**BEFORE CHECKING THE OPERATION OF THE 450B PRODUCT, YOU MUST ENTER KEY INFORMATION INTO IT!**

– Check the connection of the 450B product to the tank's PTK information network using the VVS1 indicator on the TKOM unit. The presence of intermittent lighting of the POWER indicators on the 450B unit and VSV1 on the TKOM unit indicate the operability of the 450B product.

#### 3.5.3.8.2 Procedure for working with product 450B

The operation of the 450B product (encryption and decryption of digital information coming from the UARMk or to the UARMk) is carried out automatically without operator intervention.

## 3.5.4 Orientation system

### 3.5.4.1 Security measures

**PROHIBITED:**

**- CARRY OUT ANY INSTALLATION, DISMANTLING OR REPAIR WORK WITH THE PTK AZR SWITCHED ON AT THE SHCHV;**
**- ELIMINATE PROBLEMS WITH THE ORIENTATION SYSTEM ON;**
**- INSTALLATION, DISASSEMBLY AND SOLDERING OF CONDUCTORS AND CONDUCTORS OF LIVE CABLES;**
**- DISCONNECT AND CONNECT CONNECTORS WITH VOLTAGE ON!**

### 3.5.4.2 Working with the orientation system

Work with the orientation system is carried out jointly with UARMk.

#### 3.5.4.2.1 Preparing for work

Preparation for working with the orientation system consists of preparing the initial data, turning on the equipment and initial orientation.

Preparation of initial data for the orientation system is carried out before its use and consists in drawing up a route for the upcoming movement and determining the coordinates of the destination $X_{pn}$ and $Y_{pn}$.

The route of the upcoming movement to a given destination is selected based on the assigned task of carrying out the march.

When the orientation system operates autonomously, in addition to the specified initial data, it is necessary to determine the coordinates of the starting point of the route $X_{ref.}$ and $Y_{ref.}$, directional angle $\alpha_{op}$. to a landmark that is indicated on the electronic map and visible from the starting point (if there is one).

If possible, it is advisable to select several control points along the route of the upcoming movement, determine their coordinates, prepare data on directional angles to visible landmarks, to the destination in order to control your location during the march and, if possible, clarify the current coordinates of the tank and current directional angle of the tank. Landmarks visible from the starting and control points must be located at a distance of at least 1 km from them.

As the starting and control points for the route of the upcoming movement, it is recommended to choose points of the state geodetic network that can be approached closely.

Coordinates of points and directional angles to landmarks are taken from the catalog of coordinates of geodetic points. In catalogs of geodetic points, the values of directional angles to landmarks are given in degrees.

**ATTENTION:**

**TURN ON THE ORIENTATION SYSTEM ONLY WHEN THE TANK IS STOPPED! IT IS PROHIBITED TO START DRIVING AFTER THE ORIENTATION SYSTEM IS TURNED ON AND BEFORE THE MESSAGE "THIS IS PRELIMINARY READY" APPEARS!**
**TURN ON THE ORIENTATION SYSTEM ONLY WHEN THE SUPPLY VOLTAGE IN THE ON-BOARD NETWORK IS FROM 22 TO 29 V!**

The initial orientation of the tank starts automatically every time the orientation system is turned on.

Initial orientation consists of determining the initial directional angle of the tank $\alpha_{ref}$., the initial coordinates of the tank $X_{ref}$., $Y_{ref}$. and entering this data into the orientation system.

Determination of the initial coordinates of the tank can be done automatically (from ASN), or the initial coordinates can be entered manually. Determination of the initial directional angle of the tank can be done automatically (during the process of gyrocompassing), or the initial directional angle of the tank can be entered manually.

#### 3.5.4.2.2 Turning on the orientation system and initial orientation in automatic mode

To turn on the orientation system and initial orientation in automatic mode, you must:

– place the tank at the starting point with known coordinates (if possible);

– turn on the UARMk, and the characteristic noise of the SSGKKU operation may be heard. After turning on the system, the built-in functional control of the orientation system begins, data is automatically read from the storage device, coordinates are set from the ASN and the directional angle of the tank is determined;

– check for the message "There are coordinates from ASN" to appear, meaning automatic installation of coordinates from ASN. The message "There are coordinates from the ASN" is displayed on the PMF if the number of received satellites is at least four and the quality of reception from the ASN is not higher than "1", while it should be remembered that at the nearest control point with known coordinates it is necessary to correct the coordinates. The ASN operating mode is achieved within no more than 5 minutes after the orientation system is turned on. If there is no data from the ASN, the message "No coordinates from the ASN" will appear on the PMF;

– in the dialog box, check the values of the X, Y coordinates, which must correspond to the coordinates of the tank's location with a deviation of no more than 500 m;

– check the display of operational messages on the PMF screen: 3 to 8 minutes after switching on – the message "Gyrocompassing in progress" and "There is preliminary readiness" and 14 minutes after switching on – the message "Gyrocompassing is completed", meaning the successful completion of determining the initial directional angle.

Within 15 minutes after turning on the orientation system, a red cross will be displayed in the top line on the PMF on the navigation equipment sign, which will disappear when the built-in CO monitoring is completed with a positive result and orientation is completed.

When you turn on the orientation system, the following modes are set by default:

– integrated mode of operation of the orientation system;

– operating mode of ASN “GLONASS VT+GPS”.

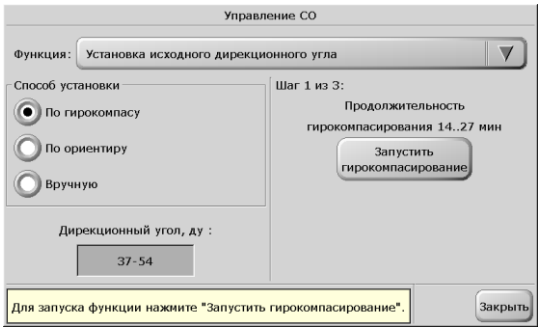
N o t e s

1 When a message about ASN failure appears, it is allowed to work with the system in the “Standalone” navigation mode.

2 When the operational message “No data from RPZU” appears, enter into the system from the UARMk panel the formulaic values of the coefficients and corrections, in accordance with paragraph 3.5.4.5of this manual.

To reduce the error, if there is time, it is recommended to restart the gyrocompass mode (six-minute cycle), for which:

– select the function “Setting the initial directional angle”, the method of setting “By gyrocompass” of the “CO Control” mode, and a window will be displayed, an example of which is given below:




– press the “Start gyrocompassing” key, and a countdown of the gyrocompassing time is generated on the PMF screen. At the end of the time, the value of the directional angle is displayed, while the initial value of the directional angle is written to the RAM of the system computer;

– press the “Close” key.

If the tank has not moved since the last time the equipment was turned off, and the initial orientation was completed in full, you can use the values of the initial coordinates and the initial directional angle from the storage device. To do this, after turning on the orientation system, it is necessary to cancel gyrocompassing using the “Setting the initial directional angle” function, the “By gyrocompass” method of setting the “CO Control” mode. In this case, you can start moving after the operational message “Final readiness is available.”

### 3.5.4.2.3 Initial orientation in semi-automatic mode

This mode is used when it is impossible to use automatic initial orientation.

### 3.5.4.2.4 Entering origin coordinates

Entering the initial coordinates (if any) must be completed before the message “Gyrocompassing in progress” appears. If this condition is not met, turn off the orientation system and turn it on again after 15 seconds. To enter initial coordinates manually you must:

– select the “Setting initial coordinates” function and set the installation method to “Manual”, and the window will display fields for entering the initial coordinates of the tank ;

– enter the values of the original coordinates. If the starting point is on the map, you can press the “Indicate on map” button to enter the starting coordinates into the equipment and indicate the location of the starting point on the electronic map. Return to the “CO Management” mode in the “Setting initial coordinates” function, where the coordinates of the specified initial point will be displayed in the X, Y coordinate input fields;

– press the “Set initial coordinates” button;

– wait for the message “Gyrocompassing completed” to appear, meaning the determination of the initial directional angle has been successfully completed.

### 3.5.4.2.5 Entering the initial directional angle of the tank

In the case when there is no time to perform gyrocompassing and if a landmark with a known directional angle or is visible from the starting point $\alpha$, then determining the initial directional angle $\alpha_{ref.}$ can be done according to the guideline.

To do this you need:

– install the tank at the starting point, directly driving over it or driving close to it. In the latter case, the tank must be installed in an alignment with a landmark, i.e. on the line from the starting point to the landmark;

– enable UARMk;

– check in the top line of the PMF screen the values of the X, Y coordinates, which must correspond to the coordinates of the tank's location with a deviation of no more than 500 m, if necessary, enter the original coordinates manually;

– cancel gyrocompassing by selecting the "Setting the initial directional angle" function, the "By gyrocompass" method of setting the "CO Control" mode and pressing the "Cancel gyrocompassing" key;

– select the installation method "By landmark";

– turn on the control system in the "OBSERVATION" mode and aim the PKP aiming mark at a landmark with a known directional angle $\alpha_{op.}$ Place the aiming reticle towards the landmark image from left to right;

– remove the numerical value of the sighting angle from the azimuth indicator of the turret rotation $\alpha_{mechanism}$ ;

– enter the values of the angle of the reference direction, the angle of sight to the reference point and press the "Set initial directional angle" button, and the value of the initial directional angle $\alpha_{ref\ appears\ on\ the\ PMF\ screen.}$ tank, and the initial value of the directional angle will be written into the RAM of the system computer.

If the landmark is displayed on the electronic map:

– in the "CO Control" mode, select the "Setting the initial directional angle" function;

– press the "Indicate landmark on map" button;

– indicate a landmark on the electronic map;

– remove the numerical value of the sighting angle from the azimuth indicator of the turret rotation mechanism $\alpha_{.}$ ;

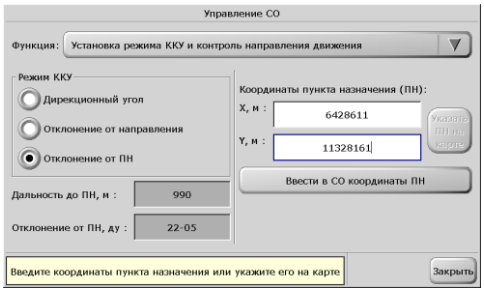
– enter the values of the sighting angle at the reference point and press the "Set initial directional angle" button, and the value of the initial directional angle $\alpha_{ref\ appears\ on\ the\ PMF\ screen.}$ tank.

When the message "Directional angle is not defined" is displayed, you must repeat the procedure for determining the directional angle.

### 3.5.4.2.6 Entering destination coordinates

Entering the coordinates of the destination $X_{a.n.}$ , $Y_{a.n.}$ into the orientation system after entering the initial coordinates $X_{ref.}$ , $Y_{ref.}$ , as well as determining and entering the initial directional angle of the tank $\alpha_{ref}$ .

To enter the coordinates of the destination, in the "CO Control" mode, select the function "Setting the KU mode and controlling the direction of movement" and the KKU mode "Deviation from the PN", and a window will be displayed, an example of which is given below:




Enter the values of the coordinates of the destination and press the "Enter PN coordinates into the CO" button, in which case the value of the distance to the destination and the value of the deviation from the direction towards it will appear on the PMF, and the values of the specified coordinates will be written to the RAM of the system computer.

If your destination is shown on the electronic map:

– press the button "Indicate PN on the map";

– indicate your destination on the electronic map;

– return to the "CO Control" mode, select the "Setting the CO mode and controlling the direction of movement" function, where the values of the destination coordinates will be displayed in the field for the set of coordinates of the destination.

After successfully entering the initial coordinates of the tank, the initial directional angle and the coordinates of the destination, the orientation system is ready for operation.

### 3.5.4.2.7 Setting (changing) operating modes of the orientation system

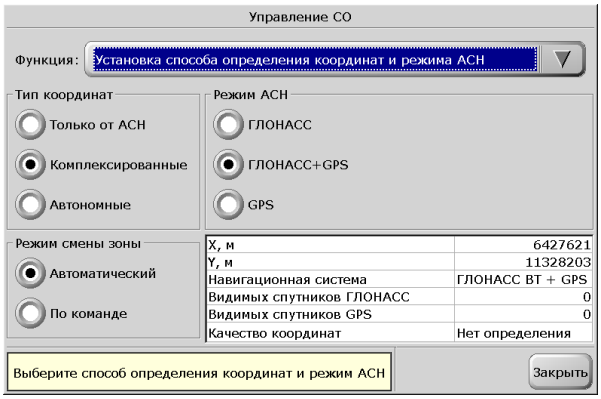
When you turn on the orientation system, the following modes are set by default:

– integrated mode of operation of the orientation system;

– operating mode of ASN “GLONASS VT+GPS”;

To set (change) the operating modes of the orientation system, you must:

– in the “CO Management” mode, select the “Setting the method for determining coordinates and ACH mode” function, and a window will be displayed, an example of which is given below:

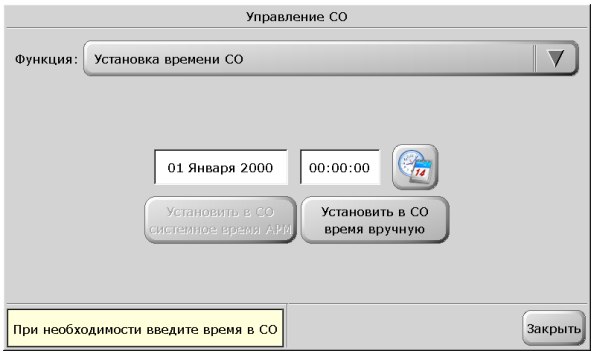



– set the required method for determining coordinates: “Only from ASN”, “Integrated”, “Autonomous”;

– set the ASN operating mode. To select the ASN mode, you need to check the number of visible satellites and the quality of coordinate determination. The selected mode is determined to be working if the number of visible satellites is at least four, in mixed modes - at least five;

– set the zone change mode to “Automatic”;

– set the time according to ASN data by selecting the appropriate function of the “CO Management” mode, and a window will be displayed, an example of which is given below:




– “press” the key with the image of a clock and calendar, and the window will display the current date and Greenwich time ;

– select the “Time synchronization according to ASN data” function;

– “Press” the “Set system time according to ASN” button, and the current date and Greenwich time will be displayed in the window.

This completes the entry of initial data. After the orientation system is ready for operation and receives the operational message “Gyrocompassing is complete” (“Final readiness is available” when the gyrocompassing mode is

cancelled), the tank can begin moving. It is allowed to start moving after the message “Preliminary readiness is available”, but the operation of the orientation system with the specified accuracy is not guaranteed.

### 3.5.4.2.8 Initial orientation in low visibility conditions

If the tank begins to move using the orientation system at night, the initial orientation should be carried out using the gyrocompass mode or all the necessary initial data must be entered into the orientation system in advance during the day. After completing the initial orientation, the tank can return to its location, and the orientation system must work during the return movement. Upon arrival at the location, turn off the orientation system. Navigation data will be automatically written to the computer's memory at the time the system is turned off. Once the system is turned off, the tank cannot be moved.

At night before departure, it is necessary to turn on the orientation system, cancel gyrocompassing using the “Setting the initial directional angle” function, the “By gyrocompass” method of setting the “CO Control” mode and start moving after the operational message “Final readiness is available.”

In poor visibility conditions, perform orientation using the gyrocompass mode. Enter the initial directional angle of the tank $\alpha_{ref}$, entered into the equipment along with other initial data, as in night conditions.

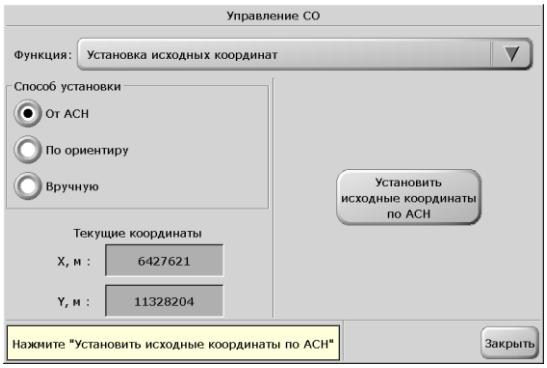
### 3.5.4.2.9 Initial orientation in the absence of coordinates of the starting point

If there is no point with known coordinates at the tank’s location that can be used as a starting point, then its coordinates can be determined using satellite navigation equipment.

To do this you need:

– set the ACH operating mode by selecting the “Setting the method for determining coordinates and ACH mode” function in the “CO Control” mode;

– select the “Set initial coordinates” function and a window will be displayed, an example of which is given below:




– check the method for setting the initial coordinates. It must be “from ASN”;

– press the “Set initial coordinates using ASN” button, and if after 5 minutes from the moment the system is turned on, the operational message “No coordinates from ASN” does not appear, the orientation system will set the coordinate values received from ASN as initial ones;

– select the function “Setting the method for determining coordinates and ASN mode” and check the quality of determining ASN coordinates. If it has a “1” sign, consider the installation of the initial coordinates to be satisfactory. Otherwise, change the location of the tank to ensure maximum “visibility” of the celestial hemisphere and repeat entering the initial coordinates from the ASN.

### 3.5.4.2.10 Initial orientation in the absence of coordinates of the starting point and the absence of coordinates from the ASN

If at the location of the tank there is no point with known coordinates and there are no coordinates from the ASN due to lack of communication with the NKV or failure of the ASN, but it is possible to reach such a point while the tank is moving along the route, then the initial directional angle of the tank $\alpha_{ref.}$ can be determined and entered into the equipment at the location of the tank, and the initial coordinates $X_{out}$, $Y_{out}$ and the coordinates of the destination $X_{pn}$, $Y_{pn}$ when passing a point with known coordinates.

the initial directional angle αmust be determined using the gyrocompass mode or, if there is a directional angle value, enter it into the system by selecting the “Initial directional angle setting” function, the “Manual” setting method for the “CO Control” mode.

To do this you need:

– select the installation method “Manual”;

– enter the value of the initial directional angle;

– press the “Set initial directional angle” key.

The reverse action is not allowed, that is, it is impossible to first set the coordinates of one point, and then at another point determine and enter into the system the initial directional angle of the tank.

### 3.5.4.2.11 Determining initial coordinates from a remote point with known coordinates

In cases where the tank is installed away from the starting point of the route and the directional angle of the tank has been set, the initial coordinates must be set using the “Set initial coordinates” function, the “By Landmark” setting method of the “CO Control” mode.

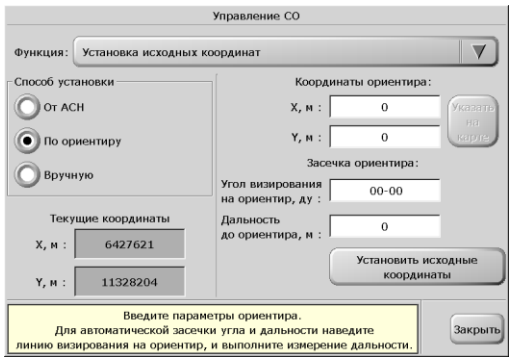
To do this you need:

– turn on the control system in the “OBSERVATION” mode and aim the PCP aiming mark at the reference point of the starting point. When aiming, move the central mark of the sight to the landmark image from left to right;

– remove the numerical value of the sighting angle from the azimuth indicator of the turret rotation $\alpha_{mechanism}$;

– determine the distance using a rangefinder to the starting point landmark;

– select the “Setting initial coordinates” function, the “By landmark” installation method, an example of the “Setting initial coordinates” function window is shown below:




– enter the X, Y coordinates of the starting point.

If the starting point is shown on the electronic map:

– press the “Point to map” button;

– indicate the starting point on the electronic map;

– return to the “CO Management” mode, select the “Setting initial coordinates” function, where the coordinates of the starting point will be displayed in the landmark coordinates;

– enter the values of the sighting angle, the distance to the reference point of the starting point and press the “Set initial coordinates” button, in which case the values of the tank’s coordinates will appear on the display of the UARMk panel, and the initial values of the coordinates of the tank’s location will be written into the RAM of the system computer.

### 3.5.4.2.12 Working with the orientation system while the tank is moving

While the tank is moving, the commander, observing on the PMF screen (in the “CO Control” window) the values of the X, Y coordinates, the directional angle of the $\alpha_{axis}$, the direction to the destination, the distance to the destination, estimates the relative position of the destination and the tank on the map and, taking this information into account, gives the driver instructions to ensure the tank moves along the chosen route.

The driver has the opportunity to observe on the APU the current directional angle of the tank or the angle of deviation from the destination. In cases where it is possible for the tank to move to its destination in a straight line, the driver drives the tank so that on the APU display in the “Deviation from PN” frame the index is kept near the zero mark of the heading indicator.

While the tank is moving, it is necessary to monitor the correct functioning of the orientation system by changing the current coordinate values, the current directional angle, the directional angle to the destination and the distance to the destination, and to monitor the current state of the system using operational messages and failure messages.

During normal operation of the orientation system:

– the location of the tank on the topographic map does not differ significantly from the location of the tank determined by the X and Y coordinates generated by the orientation system;

– the values of the tank's directional angle on the PMF screen coincide with the readings on the driver's APU;

– when the tank turns to the right, the directional angle on the PMF screen and on the APU increases, when the tank turns to the left it decreases;

– when moving along a course close to any coordinate axis, the corresponding coordinate is predominantly calculated;

– when the movement begins, the message “Movement” appears on the PMF screen;

– when the tank is moving, there should be no failure messages on the PMF screen;

– During stops, the message “Stop” appears on the PMF screen.

To increase the accuracy of the orientation system, it is recommended:

– clarify the values of the tank's directional angle every 2 to 3 hours of movement;

– carry out correction of the current coordinates of the tank’s location at points with known coordinates lying on the route of movement every 2 to 3 hours of movement;

– replace the coordinates of the destination when changing the route;

– carry out reorientation and redefinition of coordinates if unauthorized movement is allowed with the system turned on when the tank is tilted more than 30°, or its operation is stopped if there is an unacceptable decrease in voltage in the on-board network.

**WHEN WORKING WITH THE ORIENTATION SYSTEM, IT IS PROHIBITED:**
**- TURN OFF THE POWER TO THE TANK. IF THE POWER IS TURNED OFF, THE INITIAL ORIENTATION MUST BE PERFORMED AGAIN;**
**- CONTINUE DRIVING WITH THE ORIENTATION SYSTEM TURNED ON AT TILT ANGLES OF MORE THAN 30º;**
**- USE THE RESULT OF GYROCOMPASSING IF THE FULL VALUE OF THE X COORDINATE AND THE FULL VALUE OF THE Y COORDINATE ARE NOT ENTERED INTO THE SYSTEM;**
**- USE THE VALUE OF THE CURRENT DIRECTIONAL ANGLE IF THE FULL VALUE OF THE X COORDINATE IS NOT ENTERED INTO THE SYSTEM;**
**- DRIVING WITH THE SYSTEM TURNED ON IF THERE IS A MESSAGE ABOUT ANY FAILURE, EXCEPT FOR A MESSAGE ABOUT ASN FAILURE!**

When the message “No coordinates from ASN” appears, you can work with the orientation system in offline mode. To do this, you need to select the function “Setting the method for determining coordinates and the ASN mode”, the type of coordinates is “Offline”.

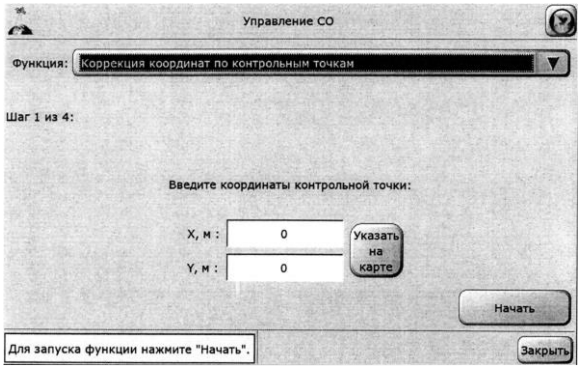
When messages appear, “SSGKKU failure”, “No exchange with SSGKKU”, “No frame rotation”, “DSMU power failure” or DSMU malfunction, it is allowed to work with the orientation system in the mode of determining coordinates from satellite navigation equipment. To do this, you need to select the function “Setting the method for determining coordinates and ASN mode”, the type of coordinates “Only from ASN”.

### 3.5.4.2.13 Correction of tank coordinates

If during the movement of the tank, when passing landmarks indicated on the map and identified by the commander (bridge, road intersection, crossings, etc.), the location of the tank indicated on the map does not coincide with the actual location of the tank on the ground, it is recommended to correct the values current coordinates X, Y with control from the PMF. The coordinate correction function can be launched and the control point coordinate values can be set both while the tank is parked and while the tank is moving.

Correct the coordinates of the tank according to the coordinates of the control point lying on the route of movement in the following sequence:

– launch in advance, before approaching the control point, the “Coordinate correction by control points” function of the “CO Management” mode; an example of the “Coordinate correction by control points” window is given below:




– enter the coordinates of the control point.

If the control point is displayed on the electronic map, you must:

– press the “Point to map” button;

– indicate a control point on the electronic map;

– return to the “CO Management” mode, select the “Coordinate correction by control points” function, where the values of its coordinates will be displayed in the control point coordinate set field;

– press the “Start” key, and the message “Coordinate Correction” will be generated on the PMF screen;

– press the “Continue” button;

– at the moment of passing the control point, simultaneously visually evaluate the distance S, and a message about the distance D to the control point will appear on the screen;

– if the distance to the control point is more than 30 m, correction of coordinates is necessary, to do this, press the “Perform correction” button, and an image with corrected coordinates will be formed on the PMF screen;

– press the “Close” key to exit to the “CO Management” menu. In the computer's RAM, instead of the current coordinates, the coordinates of the control point are entered, taking into account the increments obtained during the movement of the tank from the moment the comparison command was issued;

– if the distance to the control point is less than 30 m, it is necessary to cancel the coordinate correction, to do this, press the “Abort”, “Close” keys, which will exit to the “CO Management” menu. The current coordinate values are stored in the computer's RAM.

#### 3.5.4.2.14 Correction of tank directional angle

It is recommended to correct the tank's directional angle at control points along the route in gyrocompass mode.

To do this you need:

– stop the tank at a control point;

– determine the directional angle of the tank by selecting the “Setting the initial directional angle” function, the “By gyrocompass” method of setting the “CO Control” mode and press the “Start gyrocompassing” button, while a timer is formed on the PMF screen with the gyrocompassing time counting down;

– check the appearance of the operational message “Gyrocompassing completed”, indicating the completion of the gyrocompassing mode. After the mode is completed, the new value of the tank's directional angle is automatically written to the computer's RAM.

#### 3.5.4.2.15 Changing the destination

If it is necessary to change the final destination during movement, you must enter the full coordinates of the changed destination by selecting the “Setting the CG mode and controlling the direction of movement” function, the CG mode “Deviation from the PN” of the “CO Control” mode. Coordinates can be entered both while stationary and while moving. It is allowed to enter the coordinates of the destination in the coordinate system of the zone adjacent to the zone in which the coordinates of the tank are determined. In this case, select the function “Setting the method for determining coordinates and the ASN mode”, the mode of changing the zone “Adjacent zone”, the orientation system calculates the distance to the destination and the directional angle to it for the coordinate zone in which the coordinates of the tank are determined.

#### 3.5.4.2.16 Working with the orientation system when crossing the junction of topographic map zones

When a tank moves from one topographic zone to another, it is necessary to activate the flag for forced recalculation of coordinates by selecting the function “Setting the method for determining coordinates and the ACH mode”,

the zone change mode “Adjacent zone”. The orientation system automatically recalculates the coordinates when the zone boundary is reached.

### 3.5.4.2.17 Working with the orientation system when the tank gets stuck and when the power is accidentally turned off.

To eliminate increased path measurement errors in the process of overcoming swampy terrain, crossing water obstacles and getting the tank stuck, it is necessary to use the “Locate near water obstacles” mode, which ensures that coordinates are redefined after overcoming an obstacle.

To do this you need:

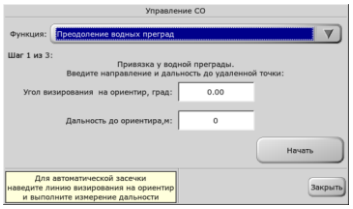
– place the tank in front of the obstacle and select as a reference a local object visible from both sides of the obstacle. In the absence of such a landmark, install the tank in a place visible from the opposite bank;

– turn on the control system in the “OBSERVATION” mode and aim the PCP reticle at a landmark. When aiming, move the central mark of the sight to the landmark image from left to right;

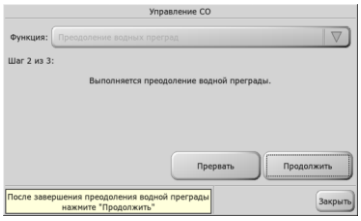
– remove the numerical value of the sighting angle of the $\alpha_{turret1}$ from the azimuth indicator of the turret rotation mechanism ;

– determine the distance D1 using a rangefinder to a landmark;

– select the “Overcoming Water Obstacles” function of the “CO Control” mode, while the PMF generates a request for the viewing angle of a landmark and the distance to it, an example of the “Overcoming Water Obstacles” function window is given below:



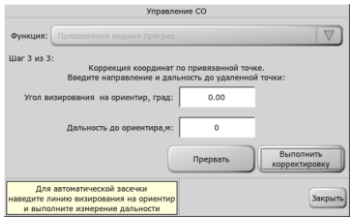

– Enter the values of the landmark and press the “Start” button. If there is no reference point, enter the values $\alpha_{vis1} = 0$, D1 = 0. In this case, the message “Overcoming a water obstacle in progress” is generated on the PMF - evidence of the readiness of the system to move the tank, as shown below:




– in the case where there is no landmark, move the tank before overcoming the obstacle in such a way that in the place where it was located, set a landmark that will be visible from the opposite bank;

– force the obstacle and stop the tank in a place from which a landmark is visible;

– press the “Continue” button, while the PMF generates a request for the viewing angle and distance to the landmark:




– sight the landmark using the control panel. When sighting, move the central mark of the sight to the image of the landmark from left to right;

– $_{viz2}$ from the azimuth indicator of the turret rotation mechanism $\alpha$;

– determine the distance D2 using a rangefinder to a landmark;

– enter the values of the viewing angle, the distance to the landmark and press the “Make adjustment” button;

– press the “Close” key. In this case, the “CO Management” mode menu will be exited and the new location of the tank will be written to the RAM of the coordinate computer;

– start moving to complete the task.

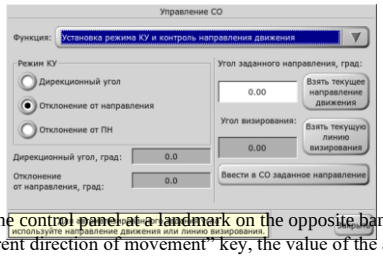
If the power is accidentally turned off while driving or parked, reorient the tank.

### 3.5.4.2.18 Using the orientation system for underwater driving

If a tank has to overcome a water obstacle while marching with the orientation system turned on, then in this case it is necessary:

– position the tank in the direction of the water obstacle to be overcome (along a landmark on the opposite bank);

– select the function “Setting the KU mode and controlling the direction of movement”, the KU mode “Deviation from direction” of the “CO Control” mode, and a window will be displayed, an example of which is given below:




– make a sighting using the control panel at a landmark on the opposite bank;

– press the “Take the current direction of movement” key, the value of the angle of the given direction will be displayed, and the “PN” indicator will light up on the driver’s APU in the “Deviation from PN” frame;

– press the button “Enter the specified direction in the CO”, in which case the value of the deviation from the specified direction is displayed in the dialog box, and the value of the deviation from the specified direction is displayed on the driver’s APU.

Start overcoming the obstacle, while driving the tank so that the zero deviation value is displayed in the dialog box, and the deviation value on the driver’s APU remains at zero.

If a tank that reached a water obstacle was moving with the orientation system turned off, then to overcome the water obstacle it is necessary:

– stop the tank before the water line;

– enable UARMk;

– perform orientation, checking for the appearance of the operational message “Gyrocompassing completed”;

– position the tank in the direction of the water obstacle to be overcome (along a landmark on the opposite bank);

– select the function “Setting the KU mode and controlling the direction of movement”, the KU mode “Deviation from the direction” of the “CO Control” mode, while on the driver’s APU in the frame “Deviation from the PN” the “PN” indicator will light up;

– make a sighting using the control panel at a landmark on the opposite bank;

– press the “Take the current direction of movement” key, and the value of the angle of the specified direction will be displayed;

– press the “Enter the given direction in the CO” key, while the PMF displays the value of the deviation from the given direction, and the driver’s APU displays the value of the deviation from the given direction.

After the system enters a state of readiness for operation, start moving and drive the tank so that the zero deviation value is displayed on the PMF, and the deviation value on the driver’s APU remains at zero.

N o t e – It is allowed for the tank to start moving after the operational message “Preliminary readiness is available”, however, the accuracy of maintaining the given direction will be lower.

More detailed questions of preparation for work and work with the orientation system, setting up the system, checking parameters and technical condition, maintenance, safety precautions, troubleshooting, storage and some others are described in the operating manual for the orientation system AYUIZH.462414.059RE.

### 3.5.4.2.19 Turning off the orientation system

Turn off the system only when parked. It is not recommended to start moving within 3 to 5 minutes after turning off the orientation system.

To turn off the orientation system, you need to turn off the UARMk.

### 3.5.4.3 CO calibration

### 3.5.4.3.1 Measurement of correction Δω for own care of SSGKKU

Measure the correction for the SSGKKU's own maintenance on a site with an inclination angle of no more than 3° in the following sequence:

– install the tank on the site;

– enable UARMk;

– to enter the orientation system control mode, successively press the "BTVT" and "SPO OBE" keys on the PMF, controlling the appearance of the "OBE Control" dialog box;

– until the message "There is preliminary readiness" appears, press the "CO Control" key;

– select the "Setting initial coordinates" function and enter into the equipment with the PMF the value of the X coordinate of the tank's location with a deviation of ± 500 м;

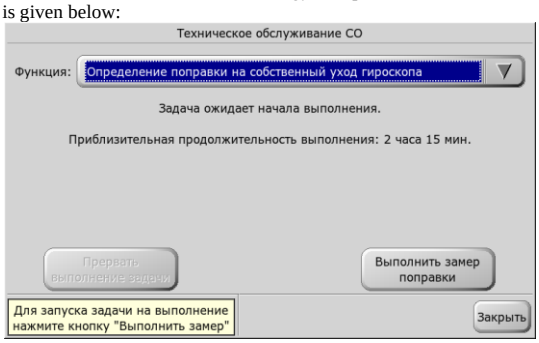
– after the message "Gyrocompassing is completed" appears on the PMF, select the "Operational review data" function and monitor the messages on the panel about the angles of inclination β, Ψ, which should be no more than 3°. At tilt angles greater than 3°, move the tank;

– exit to the "OBC Management" dialog box by pressing the "Close" button;

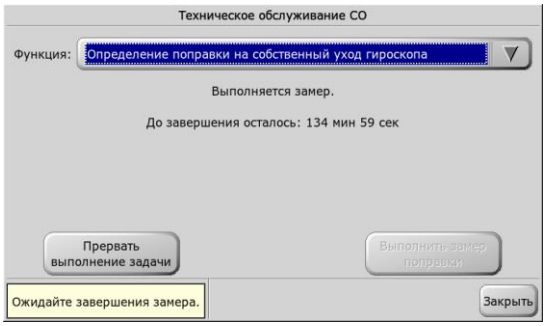
– withstand a tank with a working orientation system for 1 hour;

– press the "TO CO" key;

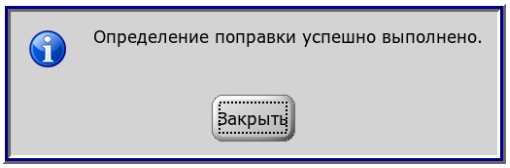
– select the function "Determination of correction for the gyroscope's own drift", and a window will be displayed, an example of which is given below:




– Press the "Perform correction measurement" button, and a window will be displayed, an example of which is given below:




A message will appear on the PMF with the time remaining until the end of the measurement. At the end of the measurement, a window is formed on the PMF, an example of which is presented below:



– press the “Close” button, and the new correction value Δω will be written into the equipment RAM;

– select the “Formular corrections and coefficients” function, press the “Read from CO” key, check the value of the new amendment to the escape rate Δω and press the “Save to CO” key;

– write down the new amendment value in the tank log;

– press the “Close” button to exit to the “CO Maintenance” mode window;

– turn off UARMk.

When the message “Δω is more than 3.0 º/h” appears on the PMF, check that the X coordinate is entered correctly; if the X coordinate is entered correctly, the SSGKKU is faulty.

#### 3.5.4.3.2 Measuring corrections to longitudinal $\Delta\beta_v$ and transverse $\Delta\psi_v$ slopes

Measurement of corrections to the longitudinal $\Delta\beta_v$ and transverse $\Delta\psi_v$ slopes is carried out when performing maintenance.

Before measuring the corrections to the longitudinal $\Delta\beta_v$ and transverse $\Delta\psi_v$ slopes, determine the correction for the own drift Δω.

Measurement of corrections to the longitudinal and transverse inclinations of the tank should be carried out in the parking lot, on a level area with a hard surface in the following sequence:

– install the tank on the site;

– enable UARMk;

– enter the “TO SO” submenu of the “SPO KBO” menu;

– expect the appearance of operational messages “Gyrocompassing in progress”, “Preliminary readiness”, “Gyrocompassing completed”;

– enter the item “Determination of corrections $\Delta\beta_v$, $\Delta\psi_v$”, in the submenu “TO CO”;

– perform the measurement in accordance with the instructions appearing on the PMF screen before the message about the tank turning appears;

– turn the tank 180°. When turning the tank, install it in such a way that the right caterpillar is in the place where the left caterpillar was located before the turn, and the edge of the clearance of the bow of the tank is located in the place where the edge of the clearance of the rear part of the tank hull was located before the turn;

– carry out the measurement in accordance with the instructions appearing on the PMF screen;

– after carrying out the work, enter the item “Formular amendments and coefficients (part 1)” of the submenu “TO CO”;

– press the “Read from CO” button;

– observe the values of the received corrections and record new values in the tank log;

– enter and save the correction values Δβ, Δψ equal to the values $\Delta\beta_v$, $\Delta\psi_v$ respectively;

– turn off UARMk.

#### 3.5.4.3.3 Measurement of azimuthal correction ΔA for SSGKKU

The azimuthal correction ΔA is determined when performing maintenance.

Before measuring the azimuthal correction, determine the correction for its own drift Δω and align the sighting device.

Measure the azimuthal correction ΔA on a flat area with a known reference direction and coordinates in the following sequence:

– place the tank at a control point;

– enable UARMk;

– to enter the orientation system control mode, successively press the “BTVT” and “SPO OBE” keys on the PMF while controlling the appearance of the “OBE Control” dialog box;

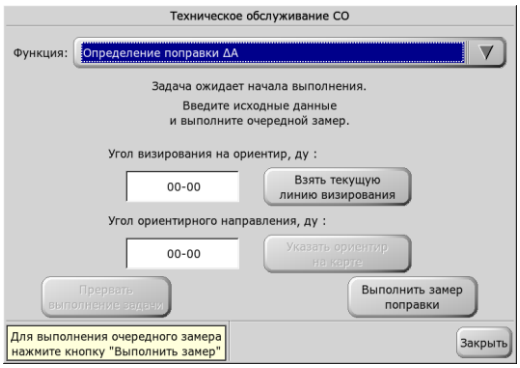
– until the message “There is preliminary readiness” appears on the PMF, press the “CO Control” key;

– adjust the coordinate values in accordance with the coordinates of the control point of the work site by selecting the “Setting initial coordinates” function of the “CO Management” mode;

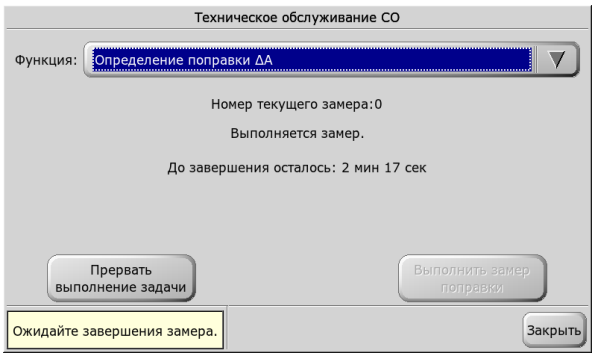
– press the “Close” key;

– press the “TO CO” key, select the “Formular corrections and coefficients” function, press the “Read from CO” key and enter the correction value ΔA= 0 until the message “Preliminary readiness is available” appears. Press the “Save to CO” button. The values of the remaining amendments and the coefficient $K_{dm}$ must correspond to the values from the tank’s registration form;

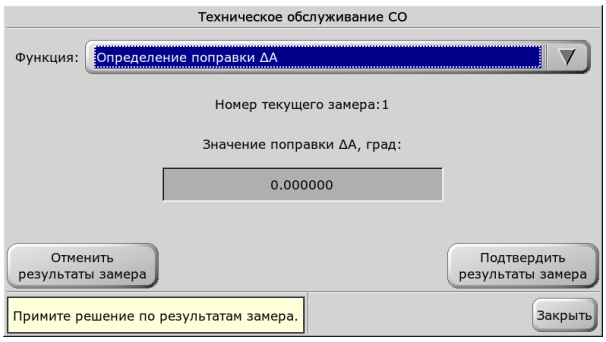
– select the “Determination of correction ΔA” function, monitoring the appearance of the message “Gyrocompassing is completed”, and windows will be displayed, an example of which is given below:



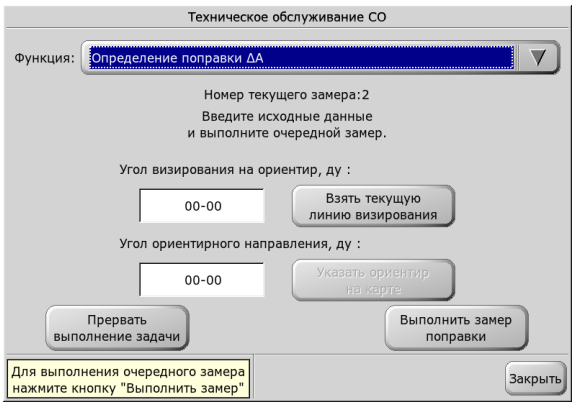

– sight at a landmark whose directional angle is known and take the sighting angle values from the azimuth indicator;
– enter the value of the viewing angle;
– enter the value of the reference direction angle;
– Press the “Perform correction measurement” button, and the dialog box shown below will be displayed:



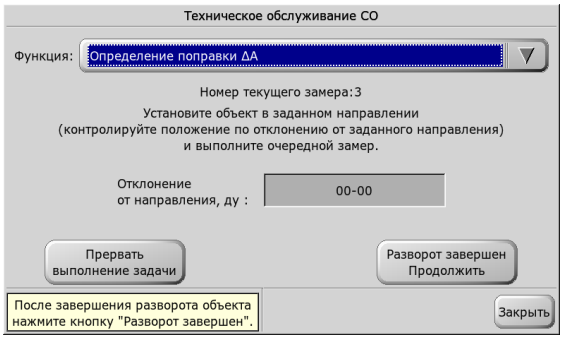

Once the countdown is complete, the dialog box shown below will be displayed:




– Press the “Confirm measurement results” button, and the dialog box shown below will be displayed:




– Press the “Take correction measurement” button and carry out two measurements in the same way. After the third measurement, the transition is performed and the dialog box shown below will be displayed:




– turn the tank around and position it in such a way that the deviation value from the direction differs by 180° from the original value;

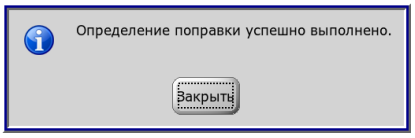
– Press the “Rotation complete” key. Continue”, a dialog box will be displayed prompting you to enter the initial data;

– sight at a landmark whose directional angle is known and take the sighting angle values from the azimuth indicator;

– enter the value of the viewing angle;

– enter the value of the reference direction angle;

– Press the “Take correction measurement” button and carry out three measurements in the same way. After the third measurement, if the task completes successfully, the transition is performed and the dialog box shown below will be displayed:




– press the “Close” button, and the new correction value ΔA will be written into the equipment RAM;

– select the “Formular corrections and coefficients” function, press the “Read from CO” key, check the value of the new azimuthal correction ΔA and press the “Save to CO” key;

– write down the new amendment value in the tank log;

– press the “Close” key to exit to the “TO CO” mode window;

– turn off UARMk.

### 3.5.4.3.4 Determination of the correction Δα for the dynamic displacement of the longitudinal axis of the tank and the path correction coefficient Km

The path correction coefficient is determined when performing maintenance, as well as after changing caterpillar tracks or changing their tension.

Determination of corrections should be carried out on a certified measured straight section with a length of (1000±0.5) m or (2000±1) m, with road conditions similar to the route of the upcoming movement, excluding slipping and skidding during movement and equipped in accordance with the operating instructions for the orientation system AYUIZH.462414.059RE.

The coordinates of the beginning (end) of the section must be determined with a deviation of ± 10 м, while the coordinates of the end (beginning) of the section relative to the beginning (end) must be determined with an error of ± 1 м. The longitudinal angle of inclination of the site should not be more than 1°.

The measuring section must have tank turning points located no more than 500 m from the beginning and end of the section.

Before determining the corrections Δα and the Km coefficient, the correction Δω for the own departure of the SSGKKU must be determined and work must be done to measure the azimuthal correction ΔA.

Determine the corrections Δα and the path correction coefficient Km in the following sequence:

– place the tank at mark 4 in alignment with milestones 1, 2;

– enable UARMk;

– to enter the control mode of the orientation system on the PMF, press the “BTVT”, “SPO KBO” keys successively while monitoring the appearance of the “UPTC Control and Status” dialog box;

– press the “CO Control” key;

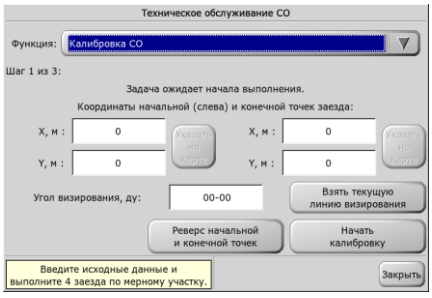
– select the “Set initial coordinates” function, the “Manual” installation method and enter the coordinates of the starting point by pressing the “Set initial coordinates” button;

– press the “Close” key;

– press the “TO CO” key, select the “Formular corrections and coefficients” function, press the “Read from CO” key, set the correction and coefficient values Δα= 0 °, Km = 1, press the “Save in CO” key. The form values of the remaining amendments and coefficients must correspond to the values from the tank form;

– press the “Close” key;

– after receiving the message “Gyrocompassing is completed”, select the “CO Calibration” function in the “CO Maintenance” submenu, and a window will be displayed, an example of which is given below:



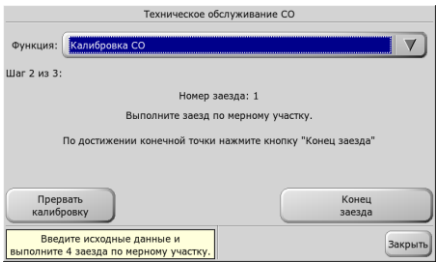

– enter the coordinates of the starting point of the measuring section $X_n = X_k$ ($X_k$ is the full value of the coordinate of any point of the measuring section, determined with a deviation of no more than ±500 m), $U_n = 0$ м;

– enter the coordinates of the end point of the measuring section $X_k = X_n$, $Y_k = S_{uch}$ ($S_{uch}$ – length of the measuring section);

– sight at pole 8 (landmark) located at the opposite end of the measuring section and read off the sighting angle value from the azimuth indicator;

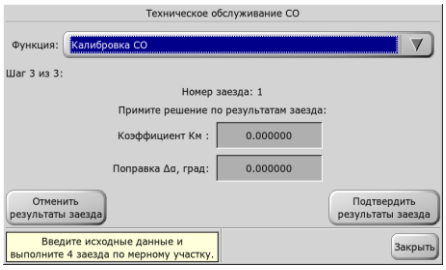
– manually enter the viewing angle value;

– Press the “Start calibration” button, and a window will appear on the PMF, an example of which is given below:

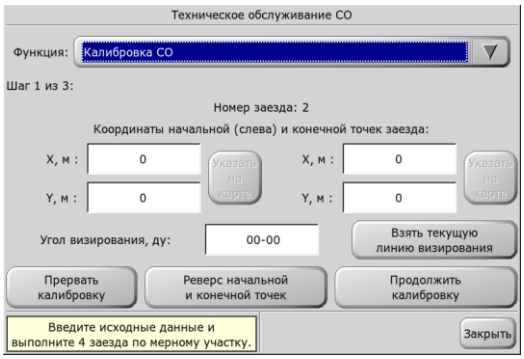



– drive along the measuring section, stopping the tank at the end point of measuring section 7 on the line with milestones 5 and 6;

– press the “End race” button, and a window will appear on the PMF, an example of which is given below:




– Press the “Confirm race results” button if the race result is accepted, and a window will be displayed, an example of which is given below:




– turn the tank around for the ride in the opposite direction and place it at mark 7 on the line with milestones 5 and 6;

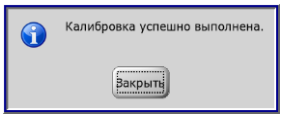
– make sighting similarly to the previous point with the only difference being to sight at milestone 3;

– press the “Continue calibration” button, and a message with the number of the next run will appear on the PMF;

– drive along the measuring section, stopping the tank at the end point of measuring section 4 on the line with milestones 1 and 2;

– perform two more runs in the same way;

– Press the “End race” button and the “Confirm race results” button, after which the average values of the corrections Δα and the Km coefficient for four races will be installed in the equipment RAM, and a window will appear on the PMF, an example of which is given below:




– press the “Close” key;

– turn the tank around to perform control runs in the forward and reverse directions;

– press the “CO Control” button, select the “Setting initial coordinates” function, the “Manual” installation method and enter the X coordinate values equal to the X coordinate of any point of the measuring section, determined with an error of no more than 500 m and the Y = 0 coordinate and press the “Set” button original coordinates";

– press the “Close” key;

– select the function “Setting the initial directional angle”, the installation method “By landmark”;

– sight at a pole located at the opposite end of the measuring section and read off the sighting angle value from the azimuth indicator;

– manually enter the value of the sighting angle and the reference direction angle equal to $\alpha_{op}$ = 90 °(15-00 d.u.);

– press the “Set initial directional angle” key, and the value of the directional angle will appear on the PMF;

– drive along the measuring section, stopping the tank at the end point of the measuring section on the line of the side milestones;

– select the “Operational review data” function and check the coordinates of the end point $X = X_m$, $Y = S_{uch}$;

– deploy the tank and perform operations similar to the previous race;

– at the end of the race, check the coordinates of the end point. The deviation in determining the coordinates in each control run should be no more than ± 10 м;

– press the “TO CO” key, select the “Form amendments and coefficients” function and write down the values of the amendment Δαand coefficient $K_m$ in the tank form;

– turn off UARMk.

### 3.5.4.4 Checking the functionality of the orientation system

To check the functionality of the orientation system, you must:

– turn on the orientation system and wait until the initial orientation is completed (the message “Gyrocompassing completed” appears);

– press the “BTVT” key and select the “SPO KBO” key in the expanded key bar;

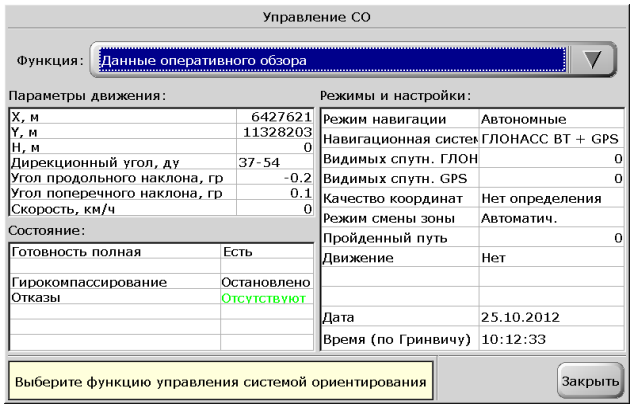
– display the “OBE Status” dialog box on the PMF screen by pressing the “Tech. State";

– expand the drop-down list and select the line of the function “Technical condition of the UPTK”, in the dialog box that appears, in the line “Orientation system”, the result of monitoring the technical condition of the CO will be displayed;

– close the “UPTC Status” window by pressing the “Close” button;

– display the “CO Management” dialog box by pressing the “CO Management” button;

– Expand the “Function” drop-down list and select the “Operational review data” line, and a window will be displayed, an example of which is given below:




The orientation system is considered to be in working order if, after 15 minutes, a message about the readiness of the system is displayed on the PMF in the “Technical condition of the UPTK” mode, and a message about the ab-

sence of failures is displayed in the “Operational review data” function. If the orientation system is faulty, a message about missing data is displayed in the “OBE Status/Technical Status of UPTK” dialog box. In the “CO Management/Operational Review Data” mode, a list of inoperative units is displayed. A failure of the SSGKKU can be recorded no earlier than 8 minutes after the system is turned on.

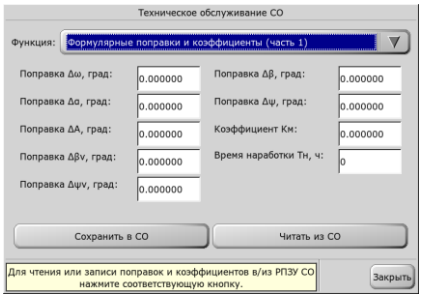
### 3.5.4.5 Checking the value of corrections and coefficients for compliance with the tank registration form

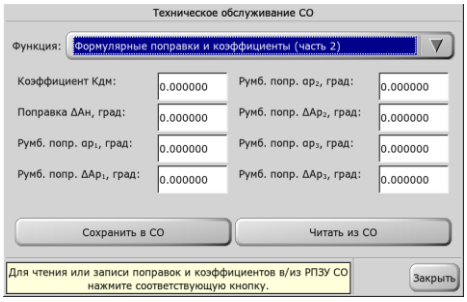
If necessary, you can check the values of corrections and coefficients for compliance with the tank registration form; for this you need to:

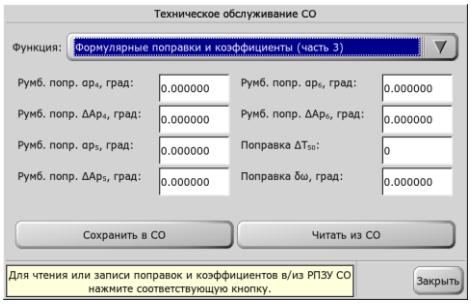
– exit the “Manage CO” dialog box by pressing the “Close” button;

– to display the “CO Maintenance” window in the “UPTC Control and Status” dialog box, press the “CO Maintenance” key;

– Expand the “Function” drop-down list and select the line “Formular amendments and coefficients”, and windows will be displayed, an example of which is given below:




Check the values of corrections and coefficients for compliance with the tank registration form. Monitor the corrections Δω and Kdm until the message “Gyrocompassing in progress” appears (displayed 3 to 8 minutes after turn-

ing on the orientation system), control the values of the remaining corrections and the coefficient Km until the message "Gyrocompassing is completed" appears (displayed 15 minutes after turning on orientation systems). Time is for reference only and is not controlled.

### 3.6 Power point

#### 3.6.1 Using the heater

##### 3.6.1.1 General instructions

The heater is used to warm up the power plant before starting the engine at an ambient temperature below plus 5 °C.

There should be no dust, dirt, foreign objects or fuels and lubricants on the heater and in the area where it is located. The wires must be secured and not damaged, the tips on the spark plug terminals must be tightly tightened.

The heater can operate in the following modes:

– one-time engine warm-up;

– maintaining the thermal state of the engine (with periodic starts of the heater).

Operation of the heater in the specified modes is possible with a delay in the start time.

##### 3.6.1.2 Preparing the heater for start-up

Before starting the heater in any mode, you must:

– open the cover of hatch 3 (Figure 2.8) for the release of combustion products on the right side of the tank;

– install a visor 5 from a single set of spare parts for the tank in the exhaust tract of the heater, which protects the rubber of the road wheels from the effects of exhaust gases;

– set the fuel distribution valve of the fuel system to the TANK ON position;

– turn on the battery switch and DCMV;

In case of unstable operation of the heater, it is necessary to pump up the fuel at the main pump or pump.

During normal operation of the heater, the exhaust gases should be light gray or colorless .

**ATTENTION:**

**IT IS PROHIBITED TO TURN ON THE HEATER WHEN THE FUEL DISTRIBUTION VALVE IS IN THE "TANK CLOSED" POSITION, AS THIS WILL LEAD TO THE FAILURE OF THE FUEL PUMP OF THE HEATER!**

If there is no coolant in the cooling system, the start of the heater is blocked by the DCMV.

If there is no coolant circulation or when the coolant temperature is above plus 105 °C during the heater operation, the fuel valve automatically turns off and the heater stops working.

When you try to start the heater with the exhaust flap closed, the DKMV blocks the start of the heater. When starting the tank engine with the hatch open, a warning message is displayed on the driver's APU about the need to close hatch 3.

##### 3.6.1.3 Starting the heater to warm up the engine once

To start the heater to warm up the engine once, you must:

– prepare the heater for start-up in accordance with clause 3.6.1.2;

– select the HEATER item in the DCM menu;

– in the HEATER submenu, select the operating mode – SINGLE;

– select START and confirm the selection with the SELECT button.

##### 3.6.1.4 Starting the heater in the mode of maintaining the thermal state of the engine

To start the heater in the mode of maintaining the thermal state of the engine, you must:

– prepare the heater for start-up in accordance with clause 3.6.1.2;

– in the DCM menu, select the HEATER item;

– in the HEATER submenu, select the HEATING OD operating mode;

– select START and confirm the selection with the SELECT button.

In this mode, the heater will automatically start and stop, keeping the engine warm for 24 hours.

##### 3.6.1.5 Delaying the start time of the heater

To perform a delayed start of the heater (single or in the mode of maintaining the thermal state of the engine), you must:

– prepare the heater for start-up in accordance with clause 3.6.1.2;

– In the DKMV menu, set a delayed start of the heater, for which:

- select the HEATER item in the menu;
- in the HEATER submenu select DELAY 00H 00M and press the SELECT button;
- use the UP, DOWN and SELECT buttons to set the time interval after which the heater should start, select the EXIT item and confirm the choice with the SELECT button;

– in the HEATER submenu, select the required operating mode: SINGLE OR HEATING OD, select the START item and confirm the choice with the SELECT button.

#### 3.6.1.6 Stopping the heater

To stop the heater operation, you must select the HEATER item in the DCMV menu, select STOP in the HEATER submenu and confirm the selection with the SELECT button.

After the heater has finished operating, remove the visor and place it in the tank spare parts kit. Replace cover 3 of the combustion products release hatch and tighten the bolts.

#### 3.6.1.7 Purge the heater

To turn on the heater purge mode (in order to remove unburnt fuel or condensate from the combustion chamber), you must select the HEATER item in the DCMV menu, select the PURGE operating mode in the HEATER submenu, select the START item and confirm the selection with the SELECT button. Also, purge is carried out automatically after each stop of the heater operation.

### 3.6.2 Engine fuel supply system

When pumping fuel from tank tanks into any container or into the fuel system of another tank, set the handle of the fuel distribution valve to the PUMPING position.

The handle for shutting off the external tanks must be in the ON position. To OFF position. turn the valve off when driving underwater or when removing external tanks. If the external tank or connected barrel is broken, immediately turn the tap to the OFF position.

Bleeding the fuel supply system is carried out by the BCN or RNM while the air release valve button is pressed. The presence of fuel pumping is indicated by an increase in force on the handle of the PNM pump when the electric drive pump is turned on; in the absence of effort, achieve its increase by vigorously working the handle. A short-term pumping is necessary before starting the engine after the tank has been parked for a long time.

#### 3.6.2.1 Installation and inclusion of barrels in the fuel system

Barrels with a capacity of 200 liters with a G2 or M72x4 filler neck thread are suitable for installation on a tank.

Install and connect barrels to the fuel supply system in the following order:

– install the upper sections of the aft lattice screens in the lower position, to do this, unlock and remove the axles 45 (188M.06.002IS, Figure 1, sheet 5) at the junction of the sections with the ties 50, install the removed axes back into the holes of the ties and lock them with spring cotter pins. After moving the sections to the lower position, fix them with the axles, lock the axes with spring cotter pins;

– install brackets 14 for fastening barrels (Figure 2.24), located in a single set of spare parts for the tank, on top of the brackets of the aft lattice screens and secure them using bolts 48 (188M.06.002IS, Figure 1, sheet 5) with nuts 46;

– install brackets 188M.91.017sb and 188M.91.017sb-01 for fastening the third barrel onto the lid of the diesel generator compartment, removing them from the rear plate of the hull. The supports of the brackets should be directed towards the nose of the tank;

– install barrels 1 (Figure 2.24) on the brackets and pre-fix them with tapes 5, bolts 15, pins 33 and cotter pins 34. Secure the fastening tapes of the third barrel with rods 199.91.034сб, located in a single set of spare parts for the tank. The filler necks of the barrels must be in the up position. The gap between the middle barrel and the diesel generator compartment must be at least 5 mm;

– remove the plugs from the filler necks of the barrels;

– screw fittings 24 into the necks of the barrels, first making sure that the sealing rings 26 are intact;

– connect the necks 29 to the fittings through gaskets 27 and secure with clamps 28;

– remove the cover from the barrel activation adapter 22 located on the fifth external fuel tank 10, connect the flange 20 to it and secure it with bolts 19;

– secure the hose connections as indicated in Figure 2.24, while avoiding pinches and breaks of the connecting hoses;

– finally secure the barrels.

If two barrels are installed, it is necessary to disconnect the union connections of the neck of the left barrel with the neck of the middle barrel by unscrewing the union nuts 2 and 4. Connect the drainage hose 3 to the fuel hose 6 using adapter 35 (188M.33.060sb), located in a single set of spare parts for the tank. If necessary, to avoid fractures of the

drainage sleeve, loosen the bolt 17 securing the bracket 16 of the drainage sleeve, move the drainage sleeve to a position that prevents its fractures, and re-fasten the sleeve with the bolt and bracket.

**ATTENTION:**

**BARRELS MUST BE REMOVED IN ANTICIPATION OF WORK WITH THE INCLUSION OF A WEAPON STABILIZER!**

Place the removed barrel plugs and adapter cover in the spare parts box.

### 3.6.3 Intake air heating system

#### 3.6.3.1 Checking the functioning of the air intake system without starting the engine

To check the functioning of the air intake system without starting the engine, you must:

– turn on the BCN switch;

– turn on the COMBINATION switch;

– on the DCMV in dialogue mode, select START WITH PVV, after which the number of remaining allowed starts is displayed on the driver's APU (the total number of allowed starts is 20). When the allowed starts are exhausted, the number of emergency starts used will be displayed (the total number of emergency starts is 10), with a warning being issued: ENGINE SAFETY IS NOT GUARANTEED. When the emergency starts are exhausted, the start mode with PVV will be blocked with the display of the message ENGINE LIFE FOR STARTS WITH PVV EXHAUSTED;

– after the message CONFIRM START WITH PVV KN appears. SELECT press and release the SELECT button - the driver's APU displays the engine oil pressure scale and the engine start cycle timer with PVV. After 1 minute, the engine MZ turns on. After 2 minutes, the driver's APU displays the message PRESS THE STARTER BUTTON, which should go out after about 15 seconds;

– turn off the BCN switch;

– turn off the COMBINATION switch.

Check by touch the heating of the PVV spark plugs with the roof open above the power compartment.

## 3.7 Tank body

### 3.7.1 Tank hull hatches

#### 3.7.1.1 Opening and closing the driver's hatch from outside the hull

To open the hatch cover you must:

– lift the hatch cover 6 (Figure 4.6) until it stops, rotating screw 17 through key 9 clockwise, using a key for hatch cover locks from a single set of spare parts for the tank;

– turn the lid until it stops, clockwise;

– lower the hatch cover until it stops on support bracket 1 and bracket 2, turning the screw counterclockwise through the key;

– lock the hatch cover with the stopper 40 of the handle 39 of the lever. To do this, you need to pull the lever handle and, turning it around its axis counterclockwise (all the way), release it;

– fix the screw handle 27 by turning the lock 25 until it engages the button 26 around its axis.

To close the hatch cover you must:

– remove the screw handle 27 from the latch 25, to do this, pull the latch by the button 26 and turn it half a turn around its axis;

– lift the hatch cover 6 as far as it will go, turning the screw clockwise through the key;

– remove the hatch cover from the stopper 40. To do this, it is necessary to pull the handle 39 of the lever until the stopper disengages with the outer glass 15 and, turning it around its axis clockwise (all the way), lower it;

– turn the lid all the way, counterclockwise;

– lower the hatch cover all the way, turning screw 17 through key 9 counterclockwise.

#### 3.7.1.2 Closing and opening the driver's hatch from inside the hull

To close the hatch cover you must:

– remove the handle 27 of the screw from the clamp 25. To do this, pull the latch by button 26 and turn it half a turn around its axis;

– lift the hatch cover 6 by rotating the screw 17 by the handle 27 of the screw until it stops, clockwise;

– turn the hatch cover 6. To do this, remove the hatch cover from the stopper 40, pulling the lever handle 39 until the stopper disengages from the outer glass 15, and turn the lever handle all the way, counterclockwise;

– release the handle 39 of the lever - the cover will lock in position above the hatch;

– lower the hatch cover 6, rotating the screw 17 by the handle 27 of the screw until it stops, counterclockwise;

– fix the handle 27 of the screw by turning the lock 25 around its axis until it engages the button 26.

To open the hatch cover you must:

– remove the handle 27 of the screw from the clamp 25. To do this, pull the latch by button 26 and turn it half a turn around its axis;

– lift the hatch cover 6 by rotating the screw 17 by the handle 27 of the screw until it stops, clockwise;

– turn the hatch cover 6. To do this, remove the hatch cover from the stopper 40, pulling the lever handle 39 until the stopper disengages from the outer glass 15, and turn the lever handle all the way, clockwise;

– lower the lever handle - the lid will lock in the open, rotated position;

– lower the hatch cover until it stops on support bracket 1 and bracket 2, rotating the screw by the screw handle until it stops, counterclockwise;

– fix the handle 27 of the screw by turning the lock around its axis until it engages the button.

#### 3.7.1.3 Emergency opening of the driver's hatch

**ATTENTION:**

**WHEN EMERGENCY OPENING THE HATCH, THE COVER RAISE SHARPLY!**

To open the hatch cover in an emergency, do the following:

– remove lever 29 from the fixed position (Figure 4.6) by turning handle 28 all the way from its original position (see B);

– sharply press handle 28 down until it stops and the emergency lifting mode is activated (see E) - under the action of spring 16, the hatch cover 6 will rise sharply up until it stops. It is allowed to squeeze the lid with your hands;

– turn the hatch cover 6. To do this, remove the hatch cover from the stopper 40, pulling the lever handle 39 until the stopper disengages from the outer glass 15, and turn the lever handle all the way, clockwise.

– release the lever handle - the cover will lock in the open, rotated position.

It is allowed to turn the hatch cover 6 by hand by removing the hatch cover from the stopper 40. To do this, it is necessary to pull the handle 39 of the lever until the stopper disengages from the outer glass 15 and, turning it around its axis clockwise (all the way), lower it.

#### 3.7.1.4 Restoring the original state of the closing (opening) mechanism after emergency opening of the driver's hatch

To restore the original state of the closing (opening) mechanism after an emergency lifting of the hatch cover, you must:

– fix lever 29 by turning handle 28 all the way to its original position;

– remove the handle 27 of the screw from the clamp 25. To do this, pull the latch by button 26 and turn it half a turn around its axis;

– connect the nut 24 with the rod 13. To do this, by rotating the screw 17 by the handle 27 of the screw clockwise, lift the hatch cover 6 until it stops - the nut 24 with balls 46 will move upward, compressing the spring 16. When the balls are aligned with the groove of the rod 13 under the action springs 47 sleeve 45 with the conical surface of the groove squeezes the balls into the groove of the rod and locks them, connecting the nut to the rod;

– lower the hatch cover until it stops on support bracket 1 and bracket 2, rotating the screw by the handle 27 of the screw until it stops, counterclockwise;

– fix the screw handle by turning the lock around its axis until it engages button 26.

#### 3.7.1.5 Using the emergency exit hatch

To open the hatch cover you must:

– remove the driver's seat backrest and bracket and spare parts from the hatch cover;

– open the hatch. To do this, unfasten the retainers 5 (Figure 4.7) left and 17 right and turn them with hammer blows until they stop at the angles 6 - the retainers will be blown out of engagement with the flange, the hatch cover 20 will open under its own weight.

If it is necessary to separate the hatch cover 20 from the flange 23 in the bottom, unlock and unscrew the clamps 11 located on the cover mounting axles 9.

To close the hatch cover you must:

– install the axles 9 of the hatch cover with the sealing rings 8 installed on them into the holes of the flange 23 and screw the clamps 11 with spring washers 10;

– close the hatch. To do this, lift the hatch cover 20 by the handle 2, place the bolts 5 left and 17 right behind the flange 23. Slide them with hammer blows until they stop at the angles 6. Secure the 3 clamps 11 and the bolts 5 left and 17 right with wire;

– install the removed assembly units and put the spare parts in their original places.

### 3.7.2 Using the driver's seat

**ATTENTION:**

**WORK IN THE CONTROL DEPARTMENT WITH THE SEAT IN THE LOWER POSITION ONLY BE ENSURED THAT THE SEAT IS RELIABLE!**

To adjust the seat height you need to:

– with your left hand, unlock the handle 8 (Figure 4.8) of the locking mechanism by pressing it towards the pillow and moving it back;

– set the seat to the required height;

– lock the seat in the desired position by moving handle 8 to its original position.

To move the seat along the tank body you must:

– move the locking lever 17, located on the right under the seat cushion, to the left;

– move the seat forward or backward;

– lock the seat by releasing lever 17.

If it is difficult to lock the seat height, it is necessary to clean the toothed racks 10 and the clamps 11 of the locking mechanism from dirt.

If it is difficult to move the seat along the tank body, you must:

– raise the seat to the top position and lock it;

– remove the bow by moving the bushings 19 along the axis of the bow;

– remove the backrest 1 by tilting it back and removing it from the brackets 5 of the pillow frame 18;

– go behind the seat to the emergency exit hatch;

– use lever 17 to move the cushion as far forward as possible and remove it;

– clean the guide strips of the cushion frame 18 and the grooves of the seat base 6 from dirt.

An additional cushion can be installed on the seat, which is available in a single spare parts kit for the tank.

### 3.7.3 Opening and closing roofs over the transmission and power plant

To prevent lever 2 (Figure 4.10) from touching the gear shift drive lever when opening and closing the roof over the transmission, the gear shift lever on the selector must be in the neutral position.

During operation of the tank, the roof must be secured to all bolts, with the exception of the bolts above the outlet pipe, instead of which plugs 14 are installed (Figure 4.9).

Install spring washers under all roof fastening bolts, with the exception of the bolts securing the rods.

Before installation, lubricate the roof fastening bolts with graphite grease, and clean the holes for the bolts from dust and dirt.

#### 3.7.3.1 Opening and closing the roof over the power plant

To open the roof over the power plant you must:

– turn the turret in such a position that it does not overlap the roof, while the roof passes between the lower mounting bracket of the leftmost frontal container of the remote control and the lower edge of the side of the turret stern (approximately 18-39 according to the azimuth index);

– remove pin 22 from the upper and lower axle 23 (Figure 4.9) ;

– turn the lattice screen 15 to the folded position, as shown in the figure;

– unscrew bolt 17 from axis 18;

– unscrew eye bolt 21 and install it in place of bolt 17 in axis 18;

– remove pin 19 from axle 18;

– dismantle axle 18 (to avoid losing the pin, insert it into the axle);

– unscrew bolt 17 from axis 20;

– unscrew the eye bolt 21 and replace the bolt 17 in the axis 20;

– remove pin 19 from axis 20;

– dismantle axle 20 (to avoid losing the pin, insert it into the axle);

– turn the frame with screens 16 to the folded position, as shown in the figure;

– fix the frame 16 with the screens and the lattice screen 15 together with the upper pin 22 on the chain, installing it in the holes of the slats, as shown in the figure;

– open the basket lid located on the frame 16 with screens;

– Unscrew bolts 2 securing the roof above the power plant;

– stand with your feet on the roof and turn the bolt 1 until it disengages with the roof. Holding the roof with your foot (to prevent the roof from hitting the elements of the tower), let it rise under the action of the torsion bar;

– raise the roof 3 until it is secured with stopper 5; if necessary, additionally tighten the tower to remove the roof from contact with the tower structural elements.

Close the roof over the power unit in reverse order.

#### 3.7.3.2 Opening and closing the transmission roof

To open the roof over the transmission you must:

– Unscrew bolts 2 (Figure 4.9) securing the roof above the transmission;

– turn lock 1;

– insert rod 4 into the left or right eye to anchor the roof and lift the roof to the support point of lever 2 (Figure 4.10) with latch 10;

– To ensure safe work in the power compartment, install rod 4 (Figure 4.9) between the roof and the tank hull as shown in Figure 4.10.

To close the roof over the transmission you must:

– clean the mating surfaces of the sides of the tank body under the rubber roof seals from dirt and foreign objects (especially in the area of the front corners of the roof);

– remove rod 4 (Figure 4.9);

– supporting the roof by the rod 4 inserted into the left or right eye for mooring the roof, by hitting the latch 10 (Figure 4.10) from below with another rod, disengage the lever 2 from the engagement with the latch 10;

– lower the roof smoothly, without impact;

– secure the roof with bolt 1 (Figure 4.9) and tighten all bolts 2 tightly.

To open the roof over the transmission without radiators, you must:

– to gain access to plug 8, to do this, unscrew and remove the axle connecting lever 13 and the OPVT rod, pos. 11. Move the OPVT rod to the left until it stops relative to the longitudinal axis of the tank and disengage it from the right eye. Move the freed end of the OPVT rod to the side, providing access to plug 8;

– unscrew plug 8;

– unscrew any bolt 9 securing the radiator rack to the roof and screw it through the hole for plug 8 into the threaded hole of the beam of the exit shutters;

– unscrew the pressure bolt 12;

– unscrew the remaining bolts 9;

– Unscrew bolts 2 securing the roof above the transmission;

– turn lock 1;

– Insert rod 4 into the left or right eye to anchor the roof and lift the roof until it is secured with stopper 5.

To close the roof over the transmission with the radiators removed, you must:

– clean the mating surfaces of the sides of the tank body under the rubber roof seals from dirt and foreign objects (especially in the area of the front corners of the roof);

– supporting the roof by the rod 4 inserted into the left or right eye for mooring the roof, remove it from the stopper 5 and lower it smoothly, without impact;

– secure the roof with bolt 1 and tighten all bolts 2 tightly;

– tighten the bolts 9, while the bolt used to fasten the radiator rack to the beam of the exit blinds through the hole in the plug 8 must be unscrewed and screwed into place;

– screw in plug 8;

– install the OPVT rod in place and connect the axle to lever 13. Cotter the axle;

– screw bolt 12 all the way.

#### 3.7.3.3 Simultaneous opening of the roofs over the power plant and transmission

If both roofs are opened simultaneously, you must:

– open the roof over the transmission;

– open the roof over the power plant;

– To ensure safe operation, install rods 4 between the roofs and the tank body.

### 3.8 Tank tower

#### 3.8.1 Using the Tower Stopper

To lock the turret, it is necessary to pull off cap 1 (Figure 6.4) on handle 9 and turn it so that the letter “Z” printed on it faces the fighting compartment. Then, using handle 9, turn sprocket 10 clockwise to lock the tower.

To avoid sticking the teeth of the stopper comb 7 into the teeth of the lower shoulder strap, when locking, it is recommended to move the turret in both directions by turning the handle of the manual rotation mechanism.

When the tower is locked, pointer 14 should be opposite the letter “Z” printed on panel 15.

After locking the tower, it is recommended to lower handle 9 down.

To unlock the turret, it is necessary to pull off cap 1 on handle 9 and turn it so that the letter “O” printed on it faces towards the fighting compartment. Then, using handle 9, turn sprocket 10 counterclockwise to unlock the tower.

When the tower is unlocked, pointer 14 should be opposite the letter “O” printed on panel 15.

#### 3.8.2 Opening and closing the commander's hatch cover

To open the hatch cover you must:

– remove the lock 21 (Figure 6.5) from the hole in the hatch cover 7 by pulling the button 23 down and turning it 180°;

– remove lock 8 from engagement with the base of the hatch using handle 20, turning it 90°;

– turn button 23 by 180°, ensuring that the lock is secured with lock 21;

– lift the hatch cover 7 until it is automatically locked by stopper 17 in the open position.

To close the hatch cover you must:

– remove the stopper 17 from engagement with the tooth on the left eye of the hatch cover 7 by turning the stopper handle 1 down;

– holding the hatch cover 7, pull it down;

– remove the lock 21 from the hole in the hatch cover 7 by pulling the button 23 down and turning it 180°;

– engage lock 8 with the base of the hatch using handle 20, turning it 90°, ensuring complete closure of the hatch;

– turn button 23 180°, ensuring that the lock is secured with lock 21.

#### 3.8.3 Crew seats in turret

##### 3.8.3.1 Using the commander's seat

To adjust the seat cushion 9 (Figure 6.9) in height, press lever 38, move bracket 24 with the carriage in a vertical plane to the desired position and lock the seat by releasing lever 38.

To adjust the tilt of the backrest 6, press down the lever 14, tilt the backrest 6 to the desired position and lock it by releasing the lever 14. If necessary, the backrest 6 can be removed. To do this, press lever 14 down and pull the backrest up until the bolster 20 comes out of the seat cushion 9 brackets. To install the backrest 6 on the seat cushion 9, press down the lever 14, insert the bolster 20 into the grooves of the seat cushion 9 brackets, select the backrest tilt position and lock the backrest by releasing the lever 14.

If necessary, the seat cushion 9 can be removed. To do this, move the seat cushion 9 to the lowest height position, remove the backrest 6, fold the upper guard panel 8, use the handle 7 to unlock the guard 8, place the guard 8 on the seat cushion 9, turn the seat cushion 9 on the bracket 24 with the carriage approximately 40° upwards and remove the seat cushion from bracket 24 with the carriage. Install the seat cushion 9 in the reverse order.

##### 3.8.3.2 Using the gunner's seat

To adjust the tilt of backrest 5 (Figure 6.10), press lever 20 down, tilt backrest 5 to the desired position and lock it by releasing lever 20. If necessary, backrest 5 can be removed. To do this, press lever 20 down and pull the backrest up until the bolster 28 comes out of the seat cushion 9 brackets. To install the backrest 5 on the seat cushion 9, press lever 20 down, insert the bolster 28 into the grooves of the seat cushion 9 brackets, select the backrest tilt position and lock the backrest by releasing lever 20.

If necessary, the seat cushion 9 can be removed. To do this, remove the backrest 5, turn the seat cushion 9 on the bracket 7 approximately 40° upwards and remove the seat cushion from the bracket 7. Install the seat cushion 9 in the reverse order.

### 3.9 Dynamic protection complex

#### 3.9.1 Security measures

Dynamic protection elements (hereinafter referred to as EDS) are safe during storage, transportation, maintenance and operation if the requirements of these instructions are met.

**ATTENTION:**

**DURING STORAGE, TRANSPORTATION, MAINTENANCE AND OPERATION OF ELECTRONIC DEVICES, IT IS PROHIBITED:**
**- CARRY OUT WORK NOT PROVIDED FOR IN THESE INSTRUCTIONS;**
**- STRIKE THE EDZ, THE CONTAINER IN WHICH THE EDZ IS STORED;**
**- TURN OVER AND THROW CONTAINERS WITH EDZ;**
**- CARRY AND TRANSPORT ELECTRONIC DEVICES IN FAULTY CONTAINERS;**
**- MOVE BOXES WITH EDZ DRAGGING;**
**- RAISE EDS TO A HEIGHT OF MORE THAN 3 M FROM THE FLOOR, STACK BOXES WITH EDZ IN STACKS MORE THAN 3 M HIGH;**
**- STACK BOXES WITH EDS ON VEHICLES SO THAT THE TOP ROW OF BOXES IS HIGHER THAN THE SIDE OF THE BODY BY MORE THAN 1/3 OF THE HEIGHT OF THE BOX;**
**- SUBJECT TO EDS DISASSEMBLY;**
**- PLACE EDZ NEAR A SOURCE OF HIGH TEMPERATURE;**
**- CARRY OUT WORK DURING A THUNDERSTORM AND IN THE SECURITY ZONE OF THE HIGH-VOLTAGE TRANSMISSION LINE;**
**- CARRY OUT ANY FIRE-CUTTING AND ELECTRIC WELDING WORK ON THE EDS, AS WELL AS DIRECTLY ON SECTIONS OF EDS CONTAINERS IN WHICH EDS ARE INSTALLED;**
**- USE EDS WITH PARTIAL OR COMPLETE OPENING OF THE CASE, DEFORMATION OF THE CASE IN THE FORM OF CRACKS, THROUGH HOLES AND DENTS OF MORE THAN 3 MM ON THE CASE. PRODUCTS WITH SUCH DEFECTS ARE SUBJECT TO DESTRUCTION IN ACCORDANCE WITH THE ESTABLISHED PROCEDURE;**
**- STORE ELECTRONIC DATA TOGETHER WITH DETONATING CORDS, BLACK POWDER, SMOKELESS POWDER CHARGES, IN BOXES WITH INCENDIARY AND ILLUMINATING SHELLS (MINES), PYROTECHNICS!**

When handling EDS Fire safety requirements must be observed. Workplaces and storage areas for electronic data must be provided with fire extinguishing means.

When handling EDS, you must additionally be guided by the operational documentation for EDS supplied with the tank.

#### 3.9.2 The procedure for equipping the dynamic protection complex for the hull and turret

Each tank is equipped with dynamic protection elements (hereinafter referred to as EPD) of only one batch. Before installation on a tank , EDS are subject to a 100% control inspection. The tank is not equipped with remote sensing elements at the manufacturer's factory.

When receiving boxes with EDS from the warehouse, you must check:
– integrity of seals, integrity of boxes;
– presence of markings on the boxes;
– availability of accompanying documentation.

After opening the boxes, check:
– number of EDS in boxes;
– the state of the markings on the EDS , its correspondence with the markings on the boxes;
– condition of the paintwork;
– the condition of the ceresin or other sealing filler in the gap between the body parts of the products;
– no damage to parts of the E- DZ body (cracks, dents) or irregularities in rolling.

EDS that have malfunctions and defects are not allowed to be installed on a tank.

##### 3.9.2.1 The order of equipping the KDZ on the upper frontal part of the hull

The total number of EDS installed in the dynamic protection module on the upper frontal part of the hull is 80 pcs.

To equip the dynamic protection module on the upper frontal part of the EDS body, you must:

– remove end caps 4 (figure) from each section of the bottom row and two side sections of the top row;

– remove covers 7 from the upper middle sections;

– Unscrew the upper bolts 8 securing the module;

– Remove trays 1 from each section of the bottom row and the side sections of the top row. Do not remove pallets 6 from the upper middle sections;

– place 1 eight E DZ pos. in each pallet. 2 in two layers, and put four EDS pos. in the pallets of 6 upper middle sections. 2 in one layer. EDZ should be laid parallel to the longitudinal axis of the VLD;

– install pallets 1 with EDS pos. 2 in the bottom row of sections and two side sections of the top row;

– install covers 7, 4 in place, securing them with bolts 3, 5 with washers;

– install the upper bolts 8 of the module mounting.

#### 3.9.2.2 Procedure for equipping side screens

The total number of EDS installed in the side screens is 196 pcs.

Equipping the side screens with EDS is done before installing them on the tank.

To equip the side screens you need:

– lay the screen face down on a flat surface;

– remove the back covers 10 (Figure 6.12) and 8, unscrewing the bolts 9 holding the front and back covers together;

– place four EDS pos. in each opening of the rubber plates. 7 in two layers, except for the first screens.

– in the first screen, place six EDS pos. in the lower opening of the rubber plates. 7 in two layers, and six EDS in the upper opening of the rubber plates.

#### 3.9.2.3 The procedure for equipping the KDZ on the tower

The total number of EDZ on the tower is 204 pieces. Of these, 4S23 elements are installed on the frontal part of the turret (114 pcs.) and on the sides (58 pcs.); 4C22 elements are installed on the roof (32 pcs.).

To equip vertically located side containers 41 (Figure 6.13) on the left and right sides of the tower, you must:

– unscrew bolts 46, 48 and remove covers 47,66,67,68;

– remove pallets 45;

– install EDS pos. 11 in pallets 45 in two layers: bottom layer - two EDZ along the pallet, one EDZ across the pallet; top layer - two EDZ along the pallet (above two EDZ located lengthwise), one EDZ across the pallet;

– install pallets 45 with EDS pos. 11 into place, pressing the pallets with elements against the back plates of the onboard containers. To do this, if necessary, you need to bend the elements of the Y pallets;

– install covers 47,66,67,68 in place and secure them with bolts 46,48.

To equip a vertically located side container 55 on the left side of the tower, you must:

– unscrew bolts 46 and remove cover 52;

– remove tray 51;

– install EDS pos. 11 per pallet 51 in two layers: bottom layer - two EDZ along the pallet; top layer - two EDZ across the pallet;

– install pallet 51 with EDS pos. 11 into place, pressing the tray with elements against the back plate of the onboard container. To do this, if necessary, you need to bend the elements of the Y pallet;

– install cover 52 in place and secure it with bolts 46.

To equip the vertically located side container 56 on the left side of the tower, you must:

– unscrew bolts 46 and remove cover 50;

– remove pallet 49;

– install EDS pos. 11 per pallet 49 in two layers: bottom and top layer - three EDS each, located across the pallet;

– install pallet 49 with EDS pos. 11 into place, pressing the tray with elements against the back plate of the onboard container. To do this, if necessary, you need to bend the elements of the Y pallet;

– install cover 50 in place and secure it with bolts 46.

To equip a vertically located side container 42 on the right side of the tower, you must:

– remove the on-board container 42, for which it is necessary to loosen the bolts 48 securing it to the frame;

– unscrew bolts 46 and remove cover 53;

– remove pallet 54;

– install EDS pos. 11 per pallet 54 in two layers;

– install pallet 54 with EDS pos. 11 into place, pressing the tray with elements against the back plate of the onboard container. To do this, if necessary, you need to bend the Y element of the pallet;

– install cover 53 in place and secure it with bolts 46;

– install the onboard container 42 in place and tighten the bolts 48.

To equip vertically located side containers 43 on the right side of the tower, you need:

– unscrew bolts 46 and remove covers 53;

– remove pallets 54;

– install EDS pos. 11 in pallets 54 in two layers;

– install pallets 54 with EDS pos. 11 into place, pressing the pallets with elements against the back plates of the onboard containers. To do this, if necessary, you need to bend the Y element of the pallets;

– install covers 53 in place and secure them with bolts 46.

To equip container 5 with a roof you need:

– unscrew bolts 23 and remove cover 24;

– get gaskets 60, 61;

– place one EDS pos. on the bottom of the container body 25. 59;

– lay plates 60, 61;

– install cover 24 in place and secure it with bolts 23.

To equip roof containers 6 you need:

– unscrew bolts 23 and remove covers 26;

– get plates 62, 63;

– place the EDS pos. 59 in housing 27 in one layer in places limited by partitions;

– lay plates 62, 63;

– install covers 26 in place and secure them with bolts 23.

To equip roof containers 7 you need:

– unscrew bolts 23 and remove covers 37;

– get plates 64, 65;

– place one EDS pos. on the bottom of housings 38. 59;

– place the second EDS pos. 59 with a turn relative to the lower EDS;

– lay plates 64, 65;

– install covers 37 in place and secure them with bolts 23.

To equip frontal containers 1 (upper cassette) and 4 you need:

– unscrew bolts 9, 14 and remove covers 10, 13;

– remove pallets 12 from the upper and lower sections of the containers;

– install EDS pos. 11 in pallets 12 in two layers: bottom layer - two EDZ along the pallet, one EDZ across the pallet; top layer - one EDZ across the pallet (above two EDZ located lengthwise), two EDZ along the pallet;

– install pallets 12 with EDS pos. 11 into place, pressing the pallets 12 with the elements to the back plates of the frontal containers. To do this, if necessary, you need to bend the element III of the pallet;

– install covers 10, 13 in place and secure them with bolts 9, 14.

To equip frontal containers 3 you need:

– unscrew bolts 9 and remove covers 28;

– remove pallets 30;

– install four EDS pos. 11 in pallets 30 in two layers, perpendicular to each other;

– install pallets 30 with EDS pos. 11 into place, pressing the pallets with elements against the back plates of the front containers. To do this, if necessary, you need to bend the elements of the pallet;

– install covers 28 in place and secure them with bolts 9.

To equip frontal container 2 you need:

– unscrew bolts 9, 14 and remove covers 19, 21;

– remove pallets 20;

– install in pallets 20 two EDS pos. 11, moving them to opposite sides of the pallet;

– install pallets 20 with EDS pos. 11 into place, pressing them against the rear plates of the frontal container. To do this, if necessary, you need to bend the elements of the pallets;

– install covers 19, 21 in place and secure them with bolts 9, 14.

To equip frontal container 2 you need:

– unscrew bolts 9, 14 and remove covers 19, 21;

– remove pallets 20;

– install in pallets 20 two EDS pos. 11, moving them to opposite sides of the pallet;

– install pallets 20 with EDS pos. 11 into place, pressing them against the rear plates of the frontal container. To do this, if necessary, you need to bend the elements of the pallets;

– install covers 19, 21 in place and secure them with bolts 9, 14.

### 3.9.3 Installation of side and lattice screens

The procedure for installing side, lattice screens and shields is set out in document 188M.06.002IS “Side, lattice screens and shields. Installation and location” attached to the tank.

### 3.9.4 Installing additional protection

#### 3.9.4.1 Installing additional housing protection

The additional dynamic protection screen of the body is a fabric cover 1 (Figure 6.14), or 2, or 3, equipped with front 14 and side 13 inserts placed in the internal pockets, into which, starting from the dynamic protection ele-

ment, EDS pos. 7 and inserts 6. From above, the additional screen is covered successively with the front, side and back walls of the cover, which are secured with paired ties 12, 10 and a textile fastener 11.

Cases 1 contain seven EDS and twelve inserts; in cases 2 – eight EDS and fourteen inserts each; in cases 3 - nine EDS and sixteen inserts.

The total number of EDZ installed in additional housing screens is 224 pcs.

A set of equipped additional hull screens is installed on the brackets 4 of the side screens of the DZ using straps with buckle 5 sewn to the cover, and secured using straps 9 and buckles 8.

#### 3.9.4.2 Installation of additional tower protection

Containers for additional turret protection are secured to brackets located along the perimeter of the turret using straps and buckles sewn to the containers.

**ATTENTION:**

**WHEN INSTALLING ADDITIONAL PROTECTION TOWERS ON THE RIGHT ARE EXCLUDED FROM THE WORK RIGHT ROUGH HEAD SPZ AND START CAMERA, LOCATED ON THE RIGHT SIDE OF THE TOWER.**

The total number of electronic protection devices installed in additional tower protection containers is 162 pcs.

Before installation, equip each tower container as follows: place plywood inserts 2 (Figure 6.15, sheet 2) in the side pockets of the fabric cover 1 (Figure 6.15), place the bottom insert 5 on the bottom of the cover, then install the side inserts 3, then the front and rear inserts 7 should be placed between the side inserts with the 3 grooves facing up. After this, one by one, starting with the dynamic protection element, lay down the DZ 4S24 elements, pos. 6 with the markings facing down and gaskets 4. Secure the laid elements with ties sewn in the middle of the front and back walls of the cover from the inside. Close the top of the container sequentially with the side, front and back walls of the cover, which are secured with paired ties and a textile fastener.

First of all, you should fasten the containers with the upper straps, to adjust the position of the containers in height, buckles III, sewn on the upper straps, are used, then press the containers with the lower straps, to adjust the final position of the containers, buckles III and E, sewn on the front side of the containers, are used.

Install the additional protection containers on the left in the following order:

– fasten container P (Figure 6.15, sheet 1) so that the rear belt fastening seam is at the level of surface C (Figure 6.15 sheet 2);

– the remaining containers must be installed at the same level C in height with the container P.

Install the additional protection containers on the right in the following order:

– secure container H (Figure 6.15) so that the lower part Y of the container is at the level of surface T;

– the remaining containers must be installed at the same height F as container H.

Mesh screens (Figure 6.15, sheet 3) are networks woven from polyamide cord, the nodes of which contain metal elements. The upper parts of the net are placed on the mounting strips. Mesh screens are installed around the perimeter of the tower and are attached to the frontal containers of the remote control, the left radar shield, brackets 15 and 23 and mesh screens.

Install mesh screens 8 and 9 on the frontal DZ containers, screwing the screen strips with bolts Y from the frontal DZ containers. The mesh screen 9 is mounted on the bracket 23 with bolts 10 and washers 11 and 12; bolts 19 with washers 18, 20 and 21; screws 22 and nuts 17 with washers 11, 12. The mesh screen 13 is attached to the left of the tower on the radar shield with a bolt 14 with washers 11 and 12; onto the bracket 15 with bolts 10 with washers 11 and 12. The mesh screen 16 is attached through the slats to the mesh screens with bolts 19 and nuts 17 with washers 11 and 12. If necessary, before installing the mesh screens, remove the transport wire securing the nets to the mounting bars in the screens.

To ensure the convenience of the mechanic-driver when driving the tank in the “stowed” position, it is necessary to secure the mesh screen 8 in the upper position with belts $\Phi_1$ as shown in Figure 6.15, sheet 3 (sections C1 and T1). To move the mesh screen 8 to its original position, it is necessary to pull down the ends of the belts $\Phi_1$.

### 3.10 A set of visibility reduction means

The "Cape" visibility reduction system is installed, operated, stored and maintained in accordance with the IMZHV.169.500.000RE manual supplied with the tank. The “Cape” set is located in a single tank spare parts kit that cannot be transported. It is installed only during combat operations in anticipation of the enemy’s use of high-tech reconnaissance and destruction weapons.

Installation of the kit on the tank is carried out using belts and buckles using special brackets available on the tank, as well as elements of external equipment. If the brackets are deformed, straighten them with a tool from a single set of spare parts for the tank.

### 3.11 Chassis

#### 3.11.1 Checking and adjusting track tension

To check the track tension:

– install the tank on a horizontal (visually), if possible, level and solid platform;

– release the brakes on the drive wheels by removing the parking brake pedal from the latch and releasing it;

– Place thread 2 (Figure 5.9) of the device for measuring track sag on the connecting brackets located above the second and third support rollers. The thread should lie on the heads of the staples behind the fastening bolts;

– Using a metal ruler 1, measure the distance from the thread to the connecting bracket of the caterpillar, approximately in the middle between the second and third support rollers;

– move the tank forward a distance of at least half its length and measure the sag again. If necessary, tighten the tracks.

The track sag should be between 12 and 14 mm.

Operation of the new tracks for the first 300 km (according to the speedometer) is allowed with a sag of 10 to 14 mm, while the difference in sag of the left and right tracks is no more than 3 mm.

To tension (loosen) the caterpillar it is necessary:

– remove the cover from the hole to access the tension mechanism worm shank, remove the casing to protect the tension mechanism shank from dirt and ice;

– unlock the tensioning mechanism worm with a socket wrench and crowbar by turning the hexagonal head of the locking screw at an angle from 180° to 360° counterclockwise;

– install a double-head socket wrench on the heads of the screw and worm, and jointly rotate the worm and screw clockwise to tighten the track.

After tensioning the caterpillar, lock the tensioning mechanism worm with a screw with a tightening torque of 800 to 1000 N m (80 to 100 kgf ·m) (approximately corresponding to the force of one person on the shoulder of 1.5 m).

To loosen the track, you must jointly rotate the worm and screw counterclockwise.

If it is impossible to tension the track, with the guide wheels fully extended forward, it is necessary to remove one track from each track, and the number of remaining tracks in the left and right tracks should be the same.

In the event of a tank being pulled away, which interferes with its normal movement, it is allowed to equalize the lengths of the tracks by mutually rearranging the required number of tracks from one track to another.

#### 3.11.2 Installation of asphalt shoes

##### 3.11.2.1 Installation of ACB with dismantling of the caterpillar

To install ACB you need:

– install the product on a horizontal (visually) level, as flat and solid area as possible;

– disconnect the caterpillar according to paragraph 7.9.2of this manual and spread it on the ground in front of the tank;

– divide the caterpillar into approximately two equal parts and disconnect them;

– use crowbars to install the disconnected part of the caterpillar on the edge, placing it along a circular arc;

– clean the track track links and places for fasteners from dirt;

– insert into the AKhB track links pos. 5 (Figure 5.17) and tighten with bolts 4. The tightening torque of the bolts with wrench 2 with torque attachment 1 should be from 450 to 500 N·m (from 45 to 50 kgf·m);

– spread a part of the caterpillar with installed ACB in front of the tank and dock it with the part of the caterpillar located under the product;

– move the tank to a part of the track with installed ACB;

– install the ACB on the second part of the track in the same way as installing it on the first part of the track;

– connect the parts of the track and install the track on the product in accordance with paragraph 7.9.2of this manual;

– install the ACB on the second track in the same way as installing it on the first track;

– adjust the track tension in accordance with paragraph 3.11.1of this manual.

##### 3.11.2.2 Installation of ACB without dismantling the track

To install ACB into track links, it is necessary to install the product on a horizontal (visually) level, as flat and solid area as possible.

In the area of the drive wheels on inclined sections of the caterpillar it is necessary to:

– clean the track track links and places for fasteners from dirt;

– insert AKhB pos. 5 into the track links (Figure 5.17), tighten with bolts 4. The tightening torque of the bolts with wrench 2 with torque attachment 1 should be from 450 to 500 N·m (from 45 to 50 kgf·m).

Moving the tank (back or forward) in separate batches, install all the ACBs into the track.

### 3.11.3 Removing the ACB without dismantling the track

To remove the ACB from the track, you must:

– on the inclined section of the caterpillar in the area of the drive wheel, clean the counterbore of the ACB bolts from dirt (if necessary) using a punch 3 and a hammer;

– Unscrew bolt 4, remove the ACB from the track links;

By moving the product (back or forward), in separate batches, remove all hazardous chemicals from the track.

### 3.11.4 Removing the ACB with dismantling the caterpillar

To remove ACB from track track links, you must:

– install the product on a horizontal (visually) level, as flat and solid area as possible;

– disconnect the caterpillar according to paragraph 7.9.2of this manual and spread it on the ground in front of the tank;

– divide the caterpillar into approximately two equal parts and disconnect them;

– install the disconnected part of the caterpillar on the edge using crowbars, placing it along a circular arc;

– clean the counterbore of the ACB bolts from dirt (if necessary) using a punch 3 and a hammer;

– Unscrew bolts 4, remove the ACB from the tracks;

– spread a part of the caterpillar with the removed ACB in front of the tank and dock it with the part of the caterpillar located under the tank;

– move the tank onto a part of the track with the ACB removed;

– remove the ACB from the second part of the track in the same way as removing it from the first part of the track;

– connect the parts of the track and install the track chain on the product in accordance with paragraph 7.9.2of this manual;

– remove the ACB from the second track in the same way as removing it from the first track;

– adjust the track tension in accordance with paragraph 3.11.1of this manual.

## 3.12 Tank electrical equipment

### 3.12.1 General instructions for operating tank electrical equipment

The tank is equipped with batteries of the type 12ST-85RM with a rated voltage of 24 V. Connect the batteries in accordance with the diagram located on the battery casing.

**ATTENTION!**

**IT IS PROHIBITED TO OPERATE BATTERIES WITHOUT PROTECTIVE TERMINAL COVERS AND WITHOUT BASKET LOCKS INSTALLED!**

When operating the tank you must:

– Do not allow water, radiofrequency, fuel and oil to get on electrical wires and electrical equipment. Wipe contaminated areas dry with a clean cloth without using solvents;

– after using an emergency socket or microcharging electrical connector, screw their covers tightly; when preparing to overcome a water obstacle under water, tighten the lids with a wrench;

– When connecting electrical connectors, ensure that the guide wrench is in the correct position. Tighten the union nuts of electrical connectors by alternately pressing the moving part and tightly screwing the union nut;

– turn on the weapon stabilizer only when the engine is running with a crankshaft speed of at least 1500 rpm;

– if the screen braid of the wire is damaged, apply a bandage made of galvanized or tinned wire with a diameter of 0.2 to 0.5 mm to the damaged area;

– If the wire insulation is broken, wrap the damaged area with insulating tape or replace the wire.

N o t e - Replace the faulty wire with a wire of the same or larger cross-section.

#### 3.12.1.1 Connecting an external power source

To charge rechargeable batteries (hereinafter referred to as batteries) and power the tank equipment, an external current source can be used, similar in characteristics to the tank generator set with a voltage of (27.5 ±1.0) V DC with a load of up to 18 kW, or serviceable batteries connected in group with a voltage of 24 V and a nominal capacity of at least 280 Ah (Figure 10.6). Connecting more than one tank to such a current source is not allowed.

An external current source must be connected using plus and minus wires included in the tank's group spare parts kit, in compliance with the following rules:

– turn off the battery switch and all tank consumers;

– insert the tip of the "minus" wire into the " –" socket of the external tank start socket, and connect the second tip of this wire to the negative terminal of the external source;

– insert the tip of the “plus” wire into the “BS+” socket of the external power socket, and then connect the second tip of this wire to the positive terminal of the external source;

– turn on the AB switch.

**ATTENTION:**

**VIOLATION OF THE CONNECTION ORDER AND REVERSAL OF VOLTAGE POLARITY IS NOT ACCEPTABLE!**
**AFTER DISCONNECTING FROM AN EXTERNAL SOURCE, THE FIRST START OF THE ENGINE MUST BE CARRIED OUT WITH THE STARTER ONLY!**

#### 3.12.1.2 Checking the operation of lighting and traffic alarms

Set the circuit breakers (AMB) on the driver's panel (under the covers) and in the tower (AMB LIGHTING LEFT AND LIGHTING RIGHT in the left distribution panel) to the ON position. If the AZR is not fixed in the on position, it is necessary to bring the AZR handle to the extreme off position, and then repeat the switching on.

Turn on the battery switch and measure the rated voltage on the corresponding scale on the driver’s APU.

Check the serviceability of the lighting and alarm circuits by turning on the corresponding lamps, lampshades, headlights, side lights, signal lamps and indicators as follows:

– lighting fixtures for the driver's panel and gear selector - by turning on the LIGHTING switch on the driver's panel to the M. LIGHT (low light) or B. LIGHT (bright light) position;

– instrument complex lighting lamp PKUZ-1A - by turning on the switch located next to the lamp;

– stowage lighting lamps - by turning on a switch located on the same bracket with the right lamp at the rear right on the commander's hull roof;

– left headlight of the housing - by turning on the LIGHT HEADLIGHTS switch. on the driver's panel to position B. LIGHT or M. LIGHT. When installing the LIGHT HEADLIGHT switch. in position B. LIGHT the left headlight lights up with a bright glow, in position M. LIGHT - with a weak glow;

– right headlight of the housing - by turning on the RIGHT HEADLAMP switch. on the driver's panel. Control the switching on of the right headlight by touch by checking the heating of the headlight glass;

– rear light on the turret - by turning on the switch behind the commander on the roof of the turret;

– emergency lighting lamps located in the housing on the roof behind the driver, in the turret behind the gunner and behind the commander - by turning on the toggle switches on the lamps with the battery switch on or off, with the engine not running;

– tower lighting lamps left front and left rear - by turning on the switch at the left rear lamp;

– left tower lighting fixture - by turning on the switch near the lamp;

– illumination of the azimuth indicator - by turning on the switch located on the tower rotation mechanism under the azimuth indicator;

– lighting lamp for a coaxial machine gun - by turning on the switch near the lamp;

– rear tower lighting lamp - by turning on the switch at the lamp;

– upper tower lighting fixture - by turning on the switch at the lamp;

– sound signal - by pressing the SOUND SIGNAL button on the driver's panel.

The performance of the sound signal is assessed by ear, the performance of the lamps is assessed visually.

To check the operability of the road alarm:

– with the engine not running:

- set the ALL-REAR switch on the driver's panel to the REAR position, this will cause the lamps in the rear marker lights and the marker light on the tower to light up, and the marker light indicator on the remote TV display will light up;
- set the ALL-REAR switch on the driver's panel to the ALL position, this will cause the lamps in the rear, front, side and tower side lights to light up;
- install switch B. SVET-M. LIGHT on the driver's panel in the M position. LIGHT, while the lamps in the side lights of the rear, front, side and on the tower light up with a faint glow;

– with the engine running:

- set the ALL-REAR switch to the ALL position, while the lamps in the rear, front, side marker lamps and in the marker lamp on the tower should be constantly on;
- Set the turn switch on the dashboard to the left of the driver's observation device to the neutral position. When you press the stopping brake pedal or the button in the left turn lever, the lamps in the rear left and right marker lamps and in the marker lamp on the tower should light up in the “ blinking ” mode (the lamps in the front and side marker lamps must be on continuously). When the tank speed is less than 5 km/h, the brake indicator on the remote TV display should also light up;
- set the TURN switch to the position corresponding to a right turn, while the lamps in the right rear, right front and right side marker lights and the right turn indicator on the remote TV display light up in the “ blinking ” mode. The lamps in the left rear, left front, left side and tower side marker lamps are constantly on;

- set the TURN switch to the position corresponding to a left turn, while the lamps in the left rear, left front and left side marker lights and the left turn indicator on the remote TV display light up in the " blinking " mode. The lamps in the side lamps in the right rear, right front, right side and on the tower are constantly on;
- set the TURN switch to the position corresponding to turning left or right, and press the stop brake pedal or the button in the left turn lever, while the lamps in the rear marker lights and on the tower light up in the " blinking " mode (the lamps in the front and side marker lights should be on constantly); The brake indicator on the remote TV display lights up.

#### 3.12.1.3 Headlights and traffic alarms

To install the numbers in the FG 126 headlight cassette, you need to unscrew the two upper screws securing the frame to the headlight, unscrew the upper wing nut of the head three or four turns, install the numbers and tighten the screws and wing nut. The red light filter of the headlight can be removed along with the digital attachment.

The tank braking signal is given by flashing rear parking lights when the parking brake pedal is pressed or the braking device is turned on.

To signal the upcoming turn of the tank, you must set the turn switch to the appropriate position (right or left). In this case, the right or left group of side lights switches on to flashing mode. At the end of the turn, set the switch to the neutral position.

#### 3.12.1.4 Network protection circuit breakers type AZR

To turn on the AZR machine after it has turned itself off, you must move the handle in the off direction all the way and set it to the on position. If the AZR switches itself off again, eliminate the fault in the electrical circuit.

### 3.12.2 Electrical equipment of the case

#### 3.12.2.1 Removing batteries

The procedure for removing the battery is as follows:

– remove the frontal explosive reactive armor container (hereinafter referred to as DZ) from the tower, pos. 1 (Figure 6.13);

– turn off the battery switch;

– lower the driver's seat and lock it securely in the lower position, remove the backrest and cushion;

– remove the removable equipment from the AB casing and the rack of the spare device TNPO -168V;

– remove the manual fire extinguisher from the VT fence;

– remove the left seat suspension strut;

– remove the upper and then the lower casing of the battery;

– remove the protective boxes from the AB terminals;

– disconnect the wires and jumpers from the battery, insulate the ends of the disconnected wires;

– install protective boxes on the battery;

– remove the locks securing the baskets with batteries in the racks;

– remove the batteries with baskets one by one from the tank through the driver's hatch, having first set the turret in position 31-35 according to the azimuth indicator, or through the emergency exit hatch.

#### 3.12.2.2 Battery Installation

The procedure for installing the battery is as follows:

– install in AB racks with baskets;

– secure the baskets with AB locks;

– remove the protective boxes from the AB terminals;

– connect the wires and jumpers to the battery according to the diagram on the battery casing (Figure 10.12), tighten the nuts and bolts securing the wires and jumpers tightly;

– install protective boxes on the AB terminals;

– install the lower and upper AB casings;

– install the left seat suspension post, while inserting a crowbar into the holes of the post and bracket;

– install a manual fire extinguisher on the VT fence;

– reinstall the removed equipment and rack TNPO-168V;

– Reinstall the driver's seat cushion and backrest;

– install the frontal container DZ pos. 1 (Figure 6.13).

### 3.12.3 Auxiliary diesel generator set

#### 3.12.3.1 Security measures

Before you start operating the diesel generator set, you must carefully study this manual.

When carrying out maintenance and repairs, use only serviceable tools.

All maintenance work on the diesel generator set should be carried out with the tank's battery switch turned off.
Do not operate the diesel generator set in a closed, unventilated area.
Do not work near rotating generator drive pulleys.
Do not work while the cooling system electric fan is rotating.
To avoid burns from heated parts, service the diesel generator set approximately 30 minutes after stopping the diesel generator set.

**PROHIBITED:**

**- OPERATE THE DIESEL GENERATOR SET WHEN FUEL OR OIL IS LEAKING;**
**- OPERATE THE DIESEL GENERATOR SET WITH HATCHES 7 (FIGURE 4.4), 10, 13 CLOSED;**
**- OPERATE THE DIESEL GENERATOR SET WHEN FLAMMABLE SUBSTANCES COME INTO CONTACT WITH THE MUFFLER;**
**- OPERATE DIESEL GENERATOR SETS WITH DAMAGED INSULATION AND FAULTY CONTACTS IN ELECTRICAL EQUIPMENT;**
**- TOUCH THE HOUSING AND LIVE PARTS OF THE DIESEL GENERATOR SET DURING ITS OPERATION;**
**- TURN ON THE DIESEL GENERATOR SET WITH ANY UNCONNECTED CONNECTORS;**
**- USE AN OPEN FLAME TO HEAT THE DIESEL ENGINE CRANKCASE;**
**- OPEN THE FILLER CAP OF THE EXPANSION TANK OF THE COOLING SYSTEM WHEN THE ENGINE IS NOT COOLED DOWN;**
**- CUT OFF ACCESS OF COOLING AIR TO THE FAN!**

### 3.12.3.2 Preparing to use a diesel generator set

Before starting operation of the diesel generator set, you must:
– turn on the AB switch;
– open and lock in the open position the covers of hatches 7 (Figure 4.4), 10, 13 for air entry into the compartment and air and exhaust gases out of the diesel generator compartment. It is recommended to also open hatch 9 for better air exit from the compartment;
– set the fuel distribution valve handle to the TANK ON position;
– perform a control inspection of the diesel generator set.

### 3.12.3.3 Starting the diesel generator engine

Starting and stopping the diesel generator set is carried out from the control panel using AZR 13 (Figure 10.11) and the START button pos. 58.
The sequence of actions to start the diesel generator set engine depends on the ambient temperature. It is necessary to take into account the ambient temperature not only at the current moment, but also the temperature at which the diesel generator set was not operating in the previous day.
For example, if at the time of start-up the ambient air temperature is in the range from 0 to minus 20 °C, and in the previous day the diesel generator set was inoperative at an ambient air temperature in the range from minus 20 to minus 40 °C, then when starting the diesel generator set you should use heating the oil in the engine crankcase and coolant.

#### 3.12.3.3.1 Starting the diesel generator set at an ambient temperature above minus 20 °C.

To start a diesel generator set at an ambient temperature above minus 20 °C, you must:
– on the diesel generator control panel, move AZR pos. 13 to ON position. In this case, indicators 53, 54, 55, 56, 59 light up. These indicators continue to light for 2 s. Then indicators 54, 55, 59 go out. Automatically, depending on the ambient temperature, the glow plugs are turned on for the required time, as evidenced by the glow of the glow plug indicator 56;
– wait until the indicator 56 of the glow plugs goes out, then press and hold the START button pos. 58. After the engine begins to operate steadily, release the START button . Turning on the starter while the engine is running is not allowed. After a successful start of the engine, all indicators on the diesel generator control panel should go out and indicator 52 should light up. The duration of continuous operation of the starter is no more than 20 s;
– if the engine does not start on the first try, repeat the above steps after at least 1 minute ;
– warm up the engine at minimum idle speed for at least 2 minutes;
– After warming up, increase the engine crankshaft speed by smoothly moving the accelerator control lever 11 to the lower position.
The diesel generator set is ready to receive the load.
If the engine does not start after two attempts, then it is necessary to eliminate the malfunctions in accordance with paragraph 7.10.3 of this manual.

**3.12.3.3.2 Starting the diesel generator set at an ambient temperature of minus 20 °C and below.**

Before starting the diesel generator set at an ambient temperature of minus 20 °C and below, it is necessary to warm up the oil in the engine crankcase and the coolant in the system for 30-40 minutes. To do this, turn on the " HEATING " toggle switch on the diesel generator set remote control , and the indicator above the toggle switch should start flashing. .

N o t e – The heating of the diesel generator set will be switched off automatically when the required coolant temperature is reached or when the diesel generator starts to start. It is possible to turn off heating manually by turning off the " HEATING UP " toggle switch on the diesel generator set remote control.

The diesel generator set is started in the following sequence:

– on the diesel generator control panel, move AZR pos. 13 to ON position. In this case, indicators 53, 54, 55, 56, 59 light up. These indicators continue to light for 2 s. Then indicators 54, 55, 59 go out. Automatically, depending on the ambient temperature, the glow plugs are turned on for the required time, as evidenced by the glow of the glow plug indicator 56;

– wait until the indicator 56 of the glow plugs goes out, then press and hold the START button, pos. 58 to turn on the starter. After the engine begins to operate steadily, release the START button. Turning on the starter while the engine is running is not allowed. After a successful start of the engine, all indicators on the diesel generator control panel should go out and indicator 52 should light up. The duration of continuous operation of the starter is no more than 20 s;

– if the engine does not start on the first try, repeat the above sequence after at least 1 minute ;

– warm up the engine by running at minimum idle speed for at least 2 minutes;

– After warming up, increase the engine crankshaft speed by smoothly moving the accelerator control handle 11 to the lower position.

The diesel generator set is ready to receive the load.

If the engine does not start after two attempts, then it is necessary to eliminate the malfunctions in accordance with paragraph 7.10.3 of this manual.

**3.12.3.4 Operation of diesel generator set**

During normal operation of the diesel generator set, the engine operation indicator 52 should light green on the control panel. The lighting of other indicators during operation of the diesel generator indicates a malfunction. If there are malfunctions, measures must be taken to eliminate them. Troubleshooting should be carried out with the diesel generator set turned off, the electrical load removed and the battery switch turned off.

If the maximum permissible coolant or oil temperature is exceeded, the diesel generator set will automatically turn off the electrical load and continue idling.

**ATTENTION!**

**IF THE HIGH COOLANT TEMPERATURE INDICATOR LIGHTS UP, IT IS NECESSARY TO OPERATE THE DIESEL GENERATOR SET FOR 1 MINUTE WITH THE ELECTRICAL LOAD REMOVED AT MAXIMUM ENGINE SPEED, AND THEN STOP THE DIESEL GENERATOR SET!**

The diesel generator set ensures simultaneous operation of:

– software systems;

– commander and gunner sights;

– radio stations and ABCU;

– interior lighting;

– filter-ventilation unit, instrument complex PKUZ-1A;

– laser radiation indication systems;

– air conditioner;

– battery charging (turns on automatically).

The operation of the tank weapon stabilizer and automatic loader is possible when some of the above consumers, for example, the air conditioner, are turned off.

To avoid overloading the diesel generator set, it is recommended that powerful consumers (weapons stabilizer, air conditioner) be turned on no earlier than 10 minutes after the diesel generator set is started.

The total long-term load on the diesel generator set can be up to 10 kW. If the diesel generator set is overloaded, the diesel generator set will automatically turn off (determined by the absence of battery charging current and the voltage in the on-board network below 26.5 V at the driver's APU). To restore the operation of DGU10, it is necessary to reduce the electrical load by disconnecting some consumers.

When operating on fuel grades TS-1, T-2, RT, the reduction in the rated electrical power of the diesel generator set can be up to 20%.

To prevent oil leakage from the engine cylinders into the exhaust system with its subsequent burnout or leakage through the exhaust system connections, when operating a diesel generator set, long-term (more than 30 minutes) operation of the diesel generator set without an electrical load or with a low load (up to 50 A) is not recommended.

#### 3.12.3.5 Diesel generator stop

To stop the diesel generator set you must:

– remove the electrical load (turn off electricity consumers);

– reduce the engine crankshaft speed to the minimum, to do this, smoothly move the accelerator control lever 4 to the upper position;

– let the engine run at minimum crankshaft speed for 1 to 2 minutes;

– turn the AZR to the OFF position, after which the diesel generator set will stop.

### 3.13 Surveillance equipment

#### 3.13.1 Using an outdoor video surveillance system

In order to prevent damage to the components of the strategic offensive weapons, deterioration of the optical characteristics of television cameras.

**PROHIBITED:**

**- CONNECT AND DISCONNECT ENVIRONMENT CABLES WITH THE POWER SOURCE ON;**
**- APPLY STRIKES TO COMPONENT PARTS OF STRATEGIC OFFENSIVE WEAPONS;**
**- TOUCH THE SURFACES OF THE PROTECTIVE GLASS OF THE TV CAMERAS WITH YOUR HANDS;**
**- TRANSPORT START SPARE PARTS OUTSIDE OF THE SPECIALLY PROVIDED PACKAGING (THE AVAILABILITY OF A SINGLE START SPAST DEPENDS ON THE TYPE OF CAMERA SUPPLIED AS PART OF THE SYSTEM)!**

N o t e - During operation, clean the protective glass (hereinafter referred to as the glass in the frame) of the television camera with a flannel cloth, having previously soaked any dirt adhering to the glass in the frame with water.

#### 3.13.1.1 Turning START on and off

To enable START you must:

– make sure that the START AZR on the left switchboard of the tower is turned on;

– switch SUO-SNV on KVI pos. 5 (Figure 12.1) move to the START position, while on the KVI the indicator with the inscription START will light up, indicating that power is supplied to the cameras.

Checking the operability of the strategic offensive weapons is carried out visually. When the START is turned on for the first time, the commander's APU screen should display a panoramic image of the surrounding environment from four television cameras simultaneously (Figure 12.2).

Alternately pressing the buttons on the front panel of the CVI "1↑", "2→", "3↓", "4←" with the viewing direction arrow symbols displays images from each of the four cameras in turn. When you press the button on the KVI "PAN ┼" of a panoramic image, a panoramic image is displayed on the APU screen. A black and white image from the corresponding television camera is displayed on the APU screen, and an arrow symbol corresponding to the viewing direction is displayed in the upper left corner of the APU screen: forward, right, backward, left. At the same time, for the 1st, 2nd, 4th television cameras there is a direct image, and for the 3rd television camera - a mirror image. During panoramic images, the symbols (arrows and ┼ icon) are not displayed in frames from the corresponding cameras. Indication of viewing directions in various modes is presented in Figure 12.3.

During the operation of the SNV, the electric heating of the glass in the frame of the television cameras is automatically turned on and off if the ambient temperature is below plus 20 °C.

After finishing work with the SNV, it should be turned off by turning the switch on the KVI to the SLA position. In this case, the light indicator on the KVI goes out, and video information from the control system is displayed on the APU (if the control system is turned on).

#### 3.13.2 Using the rear view camera

#### 3.13.2.1 Turning the rear view camera on and off

**ATTENTION:**

**WHEN TURNING THE TV CAMERA ON AND OFF, IT IS PROHIBITED TO BE IN THE AREA OF THE PROTECTIVE COVER OF THE TV CAMERA!**
**CONTINUOUS TIME OF TURNING ON THE TV CAMERA - NO MORE THAN 2 HOURS TO AVOID OVERHEATING AND FAILURE OF THE ELECTRONIC VALVE SUPPLYING COMPRESSED AIR TO THE PNEUMATIC CYLINDER OF THE DRIVE OF THE PROTECTIVE COVER OF THE TV CAMERA!**
**REMEMBER! WHEN THE CAMERA OPERATES FOR MORE THAN 30 MINUTES, THE SHUTTER CLOSES AUTOMATICALLY.**

To turn on the television camera, you must press the VIDEO button on the driver's panel - the image of the terrain is displayed on the driver's APU screen (Figure 12.6). Additionally, the conventional gauge lines are displayed on the APU screen.

The image of a conventional track allows the driver to compare the distance between natural obstacles on the ground with the dimensions of the tank when reversing.

The lines start from the edge of the camera's field of view, at a distance of approximately 4.5 m from the axis of the drive wheel, their length corresponds to a distance of 5 m on the ground.

The extreme left and right lines of the conditional gauge are built according to the largest dimensions of the tank hull, the middle lines correspond to the ground clearance between the tracks.

To turn off the camera, you must press the VIDEO button again.

When you turn on the camera, the protective cover 28 (Figure 12.4) automatically opens - dust and dirt may get on the outer glass of the lens, so you should turn on the camera only when necessary, taking into account road conditions.

#### 3.13.2.2 Checking the functionality of the rear view camera heating

The heating of the rear view camera turns on automatically when the camera is turned on. The time it takes for the camera's outer glass to reach a temperature sufficient to remove fog or frost depends on the ambient temperature. In this case, if fogging or frost (ice) coating on the outer glass is not eliminated within 10 minutes or more, then the electrical heating of the television camera is inoperative.

### 3.13.3 Use of surveillance devices installed in the tower

To prepare the commander and gunner for use of observation devices, it is necessary to clean the optical surfaces of the observation devices from dust and dirt. Pre-soften dried dirt on protective glass with water and remove it, then wipe the surface of the glass with a clean flannel cloth.

When installing observation devices TNP4E-06, TNP-165A (hereinafter referred to as the device) in the shafts of the commander's and gunner's workplaces, it is necessary to check the presence of rubber gasket 1 on the device (Figures 12.8, 12.16), the cleanliness of the device and the seat. If necessary, clean the devices and internal cavities of the shafts from dust, dirt, and ice.

When fastening the TNPE4E-06 surveillance devices, tightening screws 6 (Figure 12.8) should be done with a 13 mm wrench, and when fastening the TNP-165A surveillance device, tightening screw 3 (Figure 12.16) with hand force; the use of the tool is not permitted.

To prevent fatigue of the observer's eyes in a brightly lit area, it is necessary to install light filters 7, which are part of the devices, which are located in the rack behind the gunner's seat, under the springs 8 on the output windows of the TNPE4E-06 devices.

Electric heating of both windows of TNPE4E-06 devices must be turned on during rain, sleet, frost and icing. At ambient temperatures below minus 10 °C, it is not recommended to turn on the electric heating of both windows in order to avoid freezing of the devices in the shafts. If an ice roller appears in front of the device, it is necessary to remove the observation device and chip off the ice roller.

It is necessary to turn on the electrical heating of TNPE4E-06 devices in the following sequence:

– check the connection of the electrical connector of the electric heating cable to the device;

– On the amplifier body 4 of the glass temperature regulator, built into the body 2 of the device, set the toggle switch to one of two positions - BOTH (towards you) or OUT. (in the direction away from you), based on the operating conditions of the tank;

– turn on the AZR OBOGR.TNP on the left and right distribution boards of the tower. At the same time, when the glass temperature is below plus 25 °C, its electric heating should turn on. When the glass heats up to the set temperature (from plus 25 to plus 45 °C), the electric heating should automatically turn off. There is no light indication of electric heating operation on the device.

After eliminating fogging or icing of the device, turn off the AZR OBOGR.TNP on the left and right distribution boards of the tower.

The TNP-165A device does not have electrical heating.

In order to keep the optical surfaces of surveillance devices in good condition for a long time, care must be taken when installing and removing devices and not subjecting the protective glass to impacts.

### 3.13.4 Using a driver's night monitoring device

The image of the terrain when observed through a TVN-5 night vision device (hereinafter referred to as the TVN-5 device) is monochrome, yellow-green in color and has worse clarity than when observed through a daytime device. Therefore, the driver must acquire certain skills in recognizing objects and terrain when observing through the TVN-5 device.

It is recommended to use the blind when observing terrain objects against a bright horizon and to eliminate the interfering effects of light (fires, glow).

By blocking the upper part of the field of view with a shutter and decreasing the aperture, you can increase the contrast of the terrain image.

In case of increased illumination of the area (at dusk, at dawn, on a moonlit night), it is necessary to use the device's diaphragm: DIAPHRAGM handle pos. 2 (Figure 2.10) is installed in such a position that the image of the terrain is the most contrasting.

In case of poor visibility due to low light (on a moonless night, in forest clearings, gorges, tunnels, etc.), it is recommended to turn on the FG 125 infrared headlight (IR headlight), taking into account that the IR headlight unmasks the tank .

When maintaining the tank, it is necessary to wash off dried dirt from the optical parts of the TVN-5 device with water, having previously softened it with water, using a canvas stitching cloth from the spare parts for the tank, and wipe clean with a flannel napkin (from a single set of spare parts for the TVN-5 device).

In order to prevent damage to the TVN-5 device and deterioration of its characteristics

**PROHIBITED:**

**- CONNECT OR DISCONNECT THE ELECTRICAL CONNECTOR OF THE POWER SUPPLY CABLE WHEN THE TVN-5 DEVICE IS TURNED ON;**
**- TOUCH THE OPTICAL PARTS OF THE TVN-5 DEVICE WITH YOUR HANDS AND DIRTY CANVAS;**
**- TRANSPORT THE DEVICE, INCLUDING WHEN STOWING A TANK, WITHOUT A PLUG ON THE EYEPIECE AND A COVER ON THE ELECTRICAL CONNECTOR OF THE DEVICE!**

### 3.13.4.1 Preparing the TVN-5 device for operation

To install the TVN-5 device in the "combat" position, you must:

– disconnect the power cable from the TNPO-168V surveillance device, put a cover on the cable socket, removing it from the cable socket of the TVN-5 device, and place the cable in the clips. Install the plug located in the TVN box on the plug of the TNPO-168V surveillance device;

– remove the TNPO-168V monitoring device from the shaft and remove spacer 9 from it (Figure 12.9);

– remove the rollers 4 (Figure 12.11) securing the eccentric clamp 5;

– install the eccentric clamp 5 into the lower holes of the forks 3, using the rollers 4;

– remove the TVN-5 device from the TVN storage box and make sure that the shutter and diaphragm of the TVN-5 device are closed. The curtain is closed when the CURTAIN handle pos. 11 (Figure 12.10) is turned to the right all the way and the inscription CLOSED is visible to the observer, when examining the TVN-5 device from above. The diaphragm is closed when the DIAPHRAGM handle pos. 2 is turned to the left all the way and the inscription CLOSED is visible to the observer when examining the TVN-5 device from above;

– place the TNPO-168V surveillance device in the TVN box in place of the TVN-5 device;

– put the shock-absorbing-sealing spacer 2 (Figure 12.11), removed from the TNPO-168V device, onto the clip 1 on the TVN-5 device;

– install the TVN-5 device together with the holder and spacer into the tank shaft and secure it with clamp 5 in the same way as the TNPO-168V surveillance device was secured;

– remove the cover from the plug of the TVN-5 device and place it in the TVN box;

– Release the power cable of the TVN-5 device from the clips, connect it to the TVN-5 device, tightly screwing the socket union nut onto the plug. Place the cable in clips, but do not allow the cable to sag.

To install the device in the "stowed" position, you must:

– fasten bracket 2 (Figure 2.12) to axis 4 and secure with stopper 3;

– install the TVN-5 device using the housing sockets on two sides of the bracket 2, secure with screw 1;

– Release the power cable of the TVN-5 device from the clips, pass it through the window in bracket 2, remove the cover from the plug of the TVN-5 device and the plug from the cable socket, put them in the TVN box. Connect the cable to the TVN-5 device and place it in the clips inside the tank, ensuring that the cable does not sag.

Removing the TVN-5 device from the bracket is done by disconnecting the cable from the plug, screwing the cover onto the plug, putting a cover on the socket, and placing the cable in the clips. Place the TVN-5 device in the TVN box to replace the TNPO-168V surveillance device. Remove bracket 2 and place it in the spare parts for the tank.

### 3.13.4.2 the TVN-5 device

The procedure for turning on the TVN-5 device is as follows:

– turn off the lamp in the control compartment and cover the lamps with curtains;

– remove the rubber plug from the eyepiece of the TVN-5 device and place it in the TVN box;

– turn on the TVN-5 device by minimally turning the DIAPHRAGM handle pos. 2 (Figure 12.10) clockwise;

– Looking through the eyepiece, open the shutter using the BLIND handle pos. 11, and the DIAPHRAGM handle pos. 2 smoothly turn to the right until a contrasting image of the terrain is obtained.

If there is insufficient illumination of the area, turn on the IR headlight of the FG 125 headlight.

If it is necessary to electrically heat the head prism of the TVN-5 device, install the PRISM HEATING toggle switch pos. 6 to the top position. When the ambient temperature is below minus 10 °C, it is not recommended to turn on the heating of the head prism.

Turn off the TVN-5 device by returning the PRISM HEATING toggle switch pos. 6 (if it was turned on), CURTAIN handles pos. 11, DIAPHRAGM handles pos. 2 to the original position. Install a rubber plug into the eyepiece of the TVN-5 device.

### 3.13.4.3 Checking the functionality of the TVN-5 device

The operation of the TVN-5 device is checked at any time of the day. The procedure for turning on the TVN-5 device for testing during the day is as follows:

– set the TVN-5 device to the “combat” or “travel” position;

– make sure that the shutter and aperture are closed;

– put the outer diaphragm 13 from the TVN-5 device kit on the body 1 of the upper prism, while the diaphragm disk must be set to the SOLAR position;

– position the TVN-5 device so that bright or direct sunlight does not fall on the entrance window and the eyepiece;

– remove the plug from the eyepiece;

– turn on the TVN-5 device by minimally turning the DIAPHRAGM knob pos. 2 clockwise and, looking through the eyepiece, open the aperture and shutter. If, with the diaphragm of the TVN-5 device fully open, visibility when observing through the eyepiece is insufficient, then it is necessary to set the disk in the outer diaphragm to the following position CLOUDY, etc.

At high brightness, immediately close the shutter and go to the previous position of the aperture dial. When changing the position of the diaphragm disk, the shutter and the diaphragm of the device should be closed.

**IT IS PROHIBITED TO VIOLATE THE RULES FOR TURNING ON THE TVN-5 DEVICE DURING DAYTIME, BECAUSE IF BRIGHT LIGHT ENTERS THE TVN-5 DEVICE THROUGH THE PRISM OR EYE CAR, THE DEVICE MAY FAIL OPERATION!**

The TVN-5 device must operate stably, without flashes or blinking 30 seconds after switching on, and provide sufficient visibility of objects on the ground. After turning off the TVN-5 device, a glow can be observed in the eyepiece for approximately 5 minutes.

Stroke of handles DIAPHRAGM pos. 2 and CURTAIN pos. 11 should be smooth. In extreme positions, the curtain should completely open or close the field of view. In the extreme left position of the DIAPHRAGM handle pos. 2 the device should turn off.

When checking the TVN-5 device, shadows from the diaphragm and uneven brightness of the field of view may be observed in the field of view.

The operation of the TVN-5 device in the dark is checked without using the external diaphragm 13 in the same sequence as in the daytime.

### 3.13.4.4 Checking the operation of electrical heating of the TVN-5 device

The test should be carried out in a darkened room or in the dark at a temperature not exceeding plus 20 °C as follows:

– make sure that the shutter and aperture are closed;

– connect the power cable to the TVN-5 device;

– turn on the TVN-5 device;

– turn on the PRISM HEATING toggle switch pos. 6 (Figure 12.10);

– determine the temperature increase along the edges of the eyepiece lens and the head prism by hand through a flannel cloth (from a single set of spare parts for the TVN-5 device).

### 3.13.5 Using the driver's protective cap

To install the protective cap you need:

– remove the rear part 2 (Figure 12.13) of the cap from the cover, put the cover in place according to the list of a single set of spare parts for the tank;

– turn the cover frame to a vertical position, straighten the cover, unscrew the wing nuts 6;

– install the driver's shield 1 on the studs of the cover frame and secure it with wing nuts 6;

– secure the cap with four locks 3 to the brackets welded to the roof from inside the housing.

Connect the shield to the GPO system of the driver's observation device according to the diagram in Figure 12.14, for which:

– using a 17x19 wrench from a single set of spare parts for the tank, unscrew the union nut at the end of the GPO nozzle hose of the TNPO-168V device from the fitting attached to the lower inclined nose sheet;

– connect the shield hose to the same fitting, tightly screwing the union nut on the hose with a 17x19 wrench.

Turning on the front window 8 GPO (Figure 12.13) is done in the same way as turning on the GPO of the driver's device TNPO-168V.

If the front window 8 is heavily soiled, it is necessary to use a mechanical cleaner 7.

If it is difficult to rotate the wiper handle 7 using an 8x10 wrench from a single set of spare parts for the tank, remove the wiper handle 7 and lubricate the rubbing surfaces of the handle axis and the bushing on the driver's shield 1 with lubricant, followed by assembling the mechanism.

Turn on electric glass heating only when the glass is frosted or during heavy snowfall, when manual cleaning is not enough.

To turn on the electric heating of the front window, you need to connect the shield wire with a plug to plug socket 22 (Figure 1.3), located next to the emergency lighting lamp behind the hatch, and place the slack part of the wire in a clip located on the roof to the right of the driver.

After disconnecting the wire from the emergency power socket, it must be placed in the clip on the panel.

Under favorable meteorological conditions, it is recommended to install only the driver's shield 1 (Figure 12.13), for which it is necessary:

– Unscrew with a 17x19 wrench from a single set of spare parts for the tank two bolts on the roof in front of the driver's hatch to a length that allows free installation of the shield;

– insert the shield angles with the slots under the bolt heads and tighten the bolts with the same wrench.

After use, the rear part 2 of the cap is placed in a special case in its regular place according to the list of a single set of spare parts for the tank; the driver's shield 1 is also placed in its regular place according to the list of a single set of spare parts for the tank.

If the glass installed on the driver's panel 1 fails, it must be replaced with a new one from a single set of spare parts for the tank.

### 3.13.6 Hydropneumatic cleaning system for observation and aiming devices

#### 3.13.6.1 General instructions for using GPO systems

During summer operation, GPO systems are filled with clean fresh water without mechanical impurities through a funnel with a filter and a tip. When transferring the tank to winter operation, it is necessary to drain the water from the tanks, blow out the systems with compressed air by switching on from each workplace, each observation and aiming device in WATER mode. In the future, for the entire period of winter operation, turn on the GPO systems only in AIR mode.

#### 3.13.6.2 Using the GPO system of the surveillance device in the housing

To clean the monitoring device from dirt, you need to turn handle 8 (Figure 12.14) of the valve clockwise until it stops and briefly press lever 4 until it stops. It is recommended to restart cleaning after 2 to 3 seconds to ensure that dispenser 5 is filled with the next portion of water.

To clean the observation device from dust or snow, you must turn handle 8 counterclockwise until it stops. and briefly press lever 4.

If you constantly use cleaning in the AIR mode in sandy areas, you need to turn on the cleaning in the WATER mode two or three times a day (handle 8 install horizontally) to remove accumulated sand from the pipeline.

The GPO system can be used to clean the glass of the driver's protective cap. The operation of the GPO system, in this case, is similar to its operation when cleaning the surveillance device. To connect the driver's protective cap to the GPO system, it is necessary to disconnect the sprayer hose 1 from fitting 9 and connect the protective cap hose to fitting 9.

#### 3.13.6.3 Using the GPO system of observation and aiming devices in the turret

To clean the protective glass of observation and aiming devices, you must:

– open the air bleed valve 40 (Figure 1.3), located in the control compartment, while the air bleed fitting plug 33 must be screwed in all the way;

– open cylinder valves 39;

– The gunner should turn the handle of crane 5 (Figure 12.17) to the vertical position all the way to clean the protective glass of the PNM, or to the horizontal position all the way to clean the protective glasses of the left and right observation devices and briefly press the toggle switch of the GPO switch pos. 6 up, to the AIR position, to remove dust or snow, or down, to the WATER position, to remove dirt;

– the commander, by turning the crane handle 16 (Figure 12.15), select which prism observation devices will be cleaned:

- vertically upward, for cleaning observation devices No. 1, 2 and 7;
- to the left, to clean devices No. 5 and 6;
- to the right, to clean devices No. 3 and 4;
- down to clean the PKP sight.

Before cleaning the control panel entrance window, the commander must move the sight mirror unit to an angular position corresponding to 45° relative to the longitudinal axis of the turret to the left. To do this, you need to use the button of the corresponding direction indicator, or a PC, guided by the electronic azimuth indicator.

Briefly press the GPO switch pos. 21 (Figure 1.4) up, to the AIR position, to remove dust or snow, or down, to the WATER position, to remove dirt.

It is recommended to restart dirt cleaning after 2 to 3 seconds to ensure that the dispensers are filled with the next portion of water.

### 3.14 Habitability facilities

#### 3.14.1 Habitat heater

The heater operation is controlled by the HEATING B. COMPARTMENT switch located on the driver's panel.

To automatically turn on or turn off the crew compartment heater while the heater is operating, you must select the HEATER item in the DCM menu, select HEATER ON (OFF) in the HEATER submenu and confirm the selection with the SELECT button.

#### 3.14.2 Thermoelectric air conditioner

##### 3.14.2.1 Security measures

CHP is an electrical device using semiconductor power devices. The operator must carefully study the purpose, design and operation of each component of the CHP.

**PROHIBITED:**

**- TURN ON THE CHP WHEN THE COOLANT IS NOT FILLED;**
**- BLOCK THE INLET OF THE ELECTRIC FAN AND DEFLECTORS FOR THE EXIT OF AIR FROM THE COOLING UNITS (CU);**
**- BLOCK THE HEAT RELEASE RADIATOR WITH THE BLOWER FANS;**
**- MAINTENANCE WHEN THE CHP IS RUNNING;**
**- TURN ON THE CHP WHEN FILLING AND DRAINING COOLANT;**
**- OPERATE THE KHP WHEN THE SIGNAL LEDS 12 (FIGURE 13.2) "EMERGENCY STATE" AND 10 "MINIMUM COOLANT LEVEL" LIGHT UP!**
**IT IS NOT ALLOWED FOR COOLANT TO ENTER THE COOLING UNITS THROUGH THE FAN GRILLE AND DEFLECTORS WHEN REPLACING THE COOLANT!**

##### 3.14.2.2 Preparing KHP for operation

Before starting work, check the following:

– the inlet opening of the electric fan and BO deflectors should not be blocked by foreign objects;

– The coolant level in the expansion tank should be between the MAX and MIN marks. If necessary, add coolant according to the recommendations of paragraph 5.8.20.1of this manual.

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##### 3.14.2.3 Air conditioner operation

Operation of the CHP in the "Air Conditioning" mode is possible only with the engine running.

Each BO can operate in autonomous mode.

Long-term operation of the CHP (more than 4 hours) in ventilation mode with the engine not running leads to discharge of the batteries.

###### 3.14.2.3.1 Air conditioning mode

To turn on the "Air conditioning" mode you must:

– turn on the battery switch;

– turn on AZR COND. on the left side of the tower under the ShchRL;

– turn on BO.

The BO is turned on by switch 8 ( Figure 13.2 ) on the front panel of the BO. At the same time, the green signal LED 9 lights up and the BO electric fan starts working. The air supply speed can be smoothly changed using the fan speed controller 7. The direction of the flow of cooled air can be changed using deflectors 2 located on the front panel of the air cooler. When any BO is turned on, the heat removal radiator fans and the coolant pump are turned on.

The BO is turned off by switch 8, and the signal LED 9 goes out.

During the operation of KHP, condensation may appear on the BO deflectors and fall out from the deflectors, which does not affect the BO performance. If necessary, in this case it is possible to stop the release of water by reducing the fan speed.

If there is no or insufficient coolant level, the red signal LED 10 lights up on the front panel of the coolant.

In an emergency, when the temperature in the BO reaches plus 85 °C, the thermal relay is activated, the BO control system automatically turns off and the red signal LED 12 on the front panel lights up.

**3.14.2.3.2 ” mode**

To enable the “Ventilation” mode:

– turn on the battery switch;

– turn on AZR COND.;

– turn on BO.

The BO is turned on in the “Ventilation” mode by switch 1 (Figure 13.2 ) on the front panel of the BO. At the same time, electric fan 13 BO starts working. The heat removal radiator fans and pump do not work. The air supply speed can be smoothly changed using the fan speed controller 7.

## 3.15 Air system

### 3.15.1 Using the air system

Normal air pressure in the system should be from 120 to 160 кгс/см$^2$. To ensure reliable engine starting in winter, the pressure in the system must be at least 75 кгс/см$^2$. To check, it is necessary to open the valves of the air cylinders, while the pressure gauge will contain information about the air pressure in the air system.

If an air leak is detected from the system, the location of the leak should be determined by hearing or by wetting the fitting connections with soap foam. If necessary, tighten the fitting connections. The permissible decrease in air pressure in the system when the compressor is not working, the cylinder valves are open and the pressure in the system is from 130 to 160 кгс/см$^2$should be no more than 5 кгс/см$^2$in 30 minutes.

If the pressure automatic switch turns on the compressor idle mode when the pressure in the system is more than 165, кгс/см$^2$it is necessary to close the cylinder valves and, with the engine running, ensure that this mode is turned on three to five times, each time bleeding the air to a pressure of 120 кгс/см$^2$through the GPO system in the “AIR” mode.

If the pressure in the system does not increase above 120 кгс/см$^2$or at a pressure from 120 to 160 кгс/см$^2$the compressor idle mode does not turn on and no leaks are found when checking the system, it is necessary to blow out the pressure switch.

To do this you need :

– open the roof over the transmission;

– unfasten and tighten plug 4 (Figure 14.5) on the casing of the pressure switch until it stops;

– start the engine, close the cylinder valves and run at minimum idle speed for 3 to 5 minutes;

– stop the engine;

– unscrew plug 4 on the casing of the pressure switch and check the operation of the system for filling; if necessary, repeat the operation two to three times;

– Unscrew plug 4 until it stops and secure with wire.

If after the completed operations the pressure in the system does not rise above 120 кгс/см$^2$or at a pressure from 120 to 160 кгс/см$^2$the idle mode of the compressor does not turn on, it is necessary to flush the pressure switch, following the instructions in the section “Use of accessories and tools” of the list of the group spare parts kit for the tank.

When the tank is parked for more than 2 hours, the air cylinder valves should be closed to prevent air leakage from the system. Do not use too much force to close the valve.

### 3.15.2 Refilling air cylinders

Refueling of the air system and gas cylinders is carried out automatically from the AK150SV-Yu compressor with the engine running, the cylinder valves and the air bleed valve open.

If there is no air in the air cylinders and the engine is not started by the starter-generator, the cylinders can be filled with compressed air from another tank.

To do this you need:

– connect two hoses 175.86.016sb with adapter fitting 172.60.172 for refilling air cylinders from single sets of spare parts for tanks;

– close the air bleed valves;

– connect the ends of the hoses to the air bleed fittings of the tanks;

– on a tank being filled with air, open the cylinder valves and the air bleed valve;

– on the air source tank, start the engine, close the cylinder valves and open the air bleed valve;

– fill the cylinders with air at a pressure of at least 75 кгс/см$^2$;

– close the air bleed valves, disconnect the hoses, tightly screw the plugs onto the air bleed fittings;

– Place the hoses and adapter fitting in place.

### 3.16 Fire protection system

#### 3.16.1 Security measures

**ATTENTION:**

**TO AVOID THE RELEASE OF THE FIRE EXTINGUISHING AGENT FROM THE CYLINDERS, IT IS PROHIBITED TO USE OPEN HEATING DEVICES, MATCHES, INCANDESCENT LAMPS WITH A POWER OF MORE THAN 10 W IN THE PRODUCT IN PLACES WHERE OPTICAL SENSORS ARE LOCATED AT A DISTANCE OF LESS THAN 100 MM FROM THE RECEIVING WINDOW OF THE SENSOR, AND ALSO PORTABLE RADIO STATIONS IN TRANSMISSION MODE!**

Connecting connectors, replacing squibs, fire extinguishing agent cylinders, GOA-19 fire extinguishing aerosol generators, fuses, and lamps must be done only with the battery switch turned off.

#### 3.16.2 Preparing fire-fighting equipment for work

The tank is equipped with a PPO system with automatic or forced activation. The PPO system is ready for operation when the battery switch is turned on (on the P13 control panel the inscriptions 1B, 2B, 3B, 4B light up) and when the OPV-PPO switch on the P13 remote control is in the PPO position.

#### 3.16.3 Checking the functionality of the software system using the CHECK button

In the initial state, on the P13 remote control, the OPV-PPO switch should be in the PPO position.

Turn on the battery switch - on the P13 control panel the inscriptions 1B, 2B, 3B, 4B light up fully, which indicates the serviceability of the electric igniter circuits of the GOA -19 fire extinguishing aerosol generators, squibs and the presence of pressure in the cylinders.

To check, you need to start the FVU supercharger, press and release the CHECK button on the P13 remote control, while doing this:

– the inscriptions PO, 3O and the inscription F light up on the P13 remote control for a period of time from 0.5 to 3 s;

– the light alarm lamps light up: the FIRE indicator on the remote display in a flashing mode and the PPO lamp at the commander;

– the blower stops;

– the MOD is triggered, and the inscription 3B on the P13 remote control lights up with full heat;

– after a time of 15 to 25 s from the moment the CHECK button is pressed, the PO inscription goes out and the supercharger turns on, and after a time of 30 to 50 s, the 3B inscription on the P13 remote control goes out, the 3B inscription lights up at full strength and the alarm light goes out.

At the end of the test, you must press the RESET button on the P13 remote control, turn off the supercharger, cock the MOD, turn off the battery switch.

N o t e - The passage of the “CHECK” command is blocked when the “FIRE” command is passed in the habitable or engine compartment.

#### 3.16.4 Checking the functionality of the software system using manual buttons

Set the OPVT-PPO switch on the P13 remote control (Figure 15.5) to the OPVT position. Turn on the battery switch - on the P13 remote control the inscriptions 1B, 2B, 3B, 4B and the inscription OPVT light up in a flashing mode.

**ATTENTION:**

**IT IS PROHIBITED TO PERFORM THE CHECK WHEN THE PPO-OPVT SWITCH IS IN THE PPO POSITION!**

To check the functionality of the fire alarm system from the manual activation buttons, you must:

– press the software button on the P13 remote control, and the software inscription lights up;

– press the RESET button on the P13 remote control, and the software sign goes out;
– similarly check the operability of the system from the PPO buttons on the left and right distribution panels;
– press the ZO button on the P13 remote control, the sign ZO lights up;
– press the RESET button on the P13 remote control, the inscription ZO goes out.
When the test is complete, turn off the battery switch.

### 3.16.5 Crew actions in case of fire

Crew actions in case of fire are described in section 4.

## 3.17 Defense system against weapons of mass destruction

The system provides protection for the crew from weapons of mass destruction only in the presence of excess pressure (pressure) in the habitable compartment of the tank. During the operation of the tank, the PKUZ-1A and FVU instrument complex should be turned on only in anticipation of the use of nuclear weapons or crossing a contaminated area and to carry out the necessary checks. In other cases, the instrument complex PKUZ-1A and FVU must be turned off, and rubber caps and a shield must be installed on the fittings of the VZU complex.

Turn on the FVU supercharger when firing.

### 3.17.1 Security measures

When operating and servicing the protection system, the following safety precautions must be observed:

– after passing through the contaminated area, cock the mechanism for controlling the position of the FVU valve, i.e., turn off the absorbent filter only after special treatment of the internal cavities of the FVU. Replace the absorbent filter while wearing a gas mask, rubber apron and rubber gloves;

– degassing and decontamination of the external surfaces of the tank should be carried out with the supercharger turned off, while rubber caps and a shield covering them must be installed on the fittings of the VZU cover of the PKUZ-1A instrument complex;

– before replacing the PDF or cleaning the PDF heater and heating tube from dust after the tank has been in the zone of contamination of the agent, pump clean air through the B-2 sensor of the PKUZ-1A instrument complex for at least 2 hours;

– remove used PDF from the tank using tweezers and destroy by burning;

– Work on cleaning the PDF heater from dust should be carried out using a brush;

– After performing any maintenance work on the sensor, or after being in a contaminated area, wash your hands with soap and water.

### 3.17.2 Preparing the protection system for operation

To prepare the protection system for operation, you must:
– turn on and configure the PKUZ-1A instrument complex;
– check the pressure in the habitable compartment.

### 3.17.3 Switching on and setting up the PKUZ-1A instrument complex

Before turning on the PKUZ 1A instrument complex, -you must:
– remove the cap shield from the armored cover of the VZU and place it in the spare parts box;
– remove the caps from the fittings of the VZU armor cover;
– install on the measuring panel (Figure 16.1) the OPERATING MODE switch pos. 4 to OFF position;
– switch the THRESHOLD toggle switch O pos. 9 to the COARSE position;
– turn the SET knob. ZERO pos. 8 counterclockwise until it stops;
– check on the sensor (Figure 16.4) the presence of unused PDF frames on the frame counter scale. When using all frames, replace the smoke filter;
– turn the air flow regulator 2 in the direction indicated by the letter M from eight to ten turns;
– set handle 11 of the input rotameter valve to the SET position. ZERO (horizontal position) and unscrew the plug 8 of the silica gel cartridge.

To turn on and configure the PKUZ -1A instrument complex, you must:
– set the LOW switch. pos. 7 (Figure 16.1) on the measuring panel to position “1”;
– set the NETWORK-OFF toggle switch pos. 6 on the measuring panel to the NETWORK position. In this case, the indicators O, P, A, HEATING, OFF will turn on. K. and the illumination lamp of the input rotameter on the sensor, after a time of 1 to 3 s the O, P, A, HEATING indicators will turn off and an automatic test of the complex’s

functionality will begin (with a countdown from 40 s on the digital indicator 11 of the measuring console). At the end of the test, the numbers “8.8.8.” are turned on and off. on the digital indicator, all segments of the linear LED indicator, indicators O, P, A, HEATING. After the automatic performance test is completed, “0” should light up on the digital indicator of the measuring console, and one green segment should light up on the linear LED indicator 10. The glow of the HEATING indicator signals the automatic activation of the heating control circuit, the frequency of which depends on the ambient temperature;

– adjust regulator 2 (Figure 16.4) on the sensor the flow of pumped air through the input rotameter, the float of which should be between the marks;

– 10 minutes after turning on the SET knob. ZERO pos. 8 (Figure 16.1) on the measuring panel, set the three green segments of the LED indicator 10 to glow, then make the third segment go off;

– set handle 11 (Figure 16.4) of the sensor rotameter valve to the OPERATION position and adjust the air flow;

– screw the plug onto the silica gel cartridge;

– set the OPERATING MODE switch on the measuring panel to the PA or OPA position. The OPVT - PPO switch on the P13 console (Figure 15.5) should be in the PPO position.

N o t e – For a better overview of the controls when setting up the PKUZ -1A instrument complex, it is necessary to lower the driver’s seat and recline the backrest.

### 3.17.4 Creating and checking support in the habitable compartment

Support is provided when the hatches, hatches and plugs of the hull and turret are closed, the OPVT cover is placed on the muzzle of the gun, or a pallet is inserted into the gun chamber.

To create backwater, you need to turn on the FVU in filter ventilation mode.

Check the pressure using the pressure gauge with the cap removed from the outer tube of the pressure gauge and with the engine running at a crankshaft speed of approximately 1800 rpm. The ball in the sub-pressure meter tube should move and be in the upper position.

### 3.17.5 Crew actions under conditions of use of weapons of mass destruction

In anticipation of a nuclear strike, the crew needs to prepare the defense system for operation.

After the shock wave has passed and the supercharger has automatically turned on, you must:

– cock the cooling system blind drive mechanism by moving the blind drive handle down until the mechanism locks;

– cock the engine stopping mechanism, for which move the manual fuel supply handle to the rearmost position and push the fuel pedal toward you until it locks;

– start the engine.

Before the tank overcomes terrain contaminated with radioactive, toxic substances or bacterial agents, it is necessary to prepare the protection system for operation, turn on the FVU in filter ventilation mode by pressing the ORB button on the P13 remote control (at the same time, the “F” lamp on the P13 remote control is lit) and make sure that there is backup.

When crossing contaminated terrain, move at the maximum possible speed, constantly monitor the backwater, the presence of toxic substances outside the tank and the level of radiation inside the tank using sound and light alarms issued by the PKUZ-1A instrument complex. If there is no pressure, put on gas masks.

When shooting in contaminated areas, you must:

– turn on the driver's mechanic's individual blower and the commander's and gunner's cooling units;

– when firing a machine gun, load the cannon with a shot from a non-mechanized ammunition rack;

– When firing from a cannon, make sure that the cannon bore is open for as short a time as possible.

After crossing an area contaminated with radioactive, toxic substances or bacterial agents, it is necessary:

– turn off the PKUZ-1A instrument complex;

– turn off the FVU. Before turning off, press the RESET button on the P13 remote control, if you turned it on using the ORB button;

– install the sub-porometer cap, caps and shield of the VSU cover;

– carry out partial or complete decontamination, degassing or disinfection of the tank and the cavities of the air defense unit in accordance with current military instructions;

– cock the FVU valve to its original position - corresponding to the FVU ventilation mode (Figure 16.2).

Partial degassing of the tank is carried out using TDP devices, one of which is located in the outer third box of spare parts, and the second is located inside the tank, on the VT fence, to the left of the rack with charges. During partial degassing, treat only those parts of the tank that the crew touches when performing the necessary work.

The degassing solution used in the device has a polydegassing effect against OM type Vx, soman and mustard gas.

When working with the device, remember that the degassing solution is flammable.

The procedure for partial degassing is as follows:

– remove the safety cap from the spray bottle;

– wear personal protective equipment;

– open the hatch;

– point the spray bottle at the surface to be treated, holding the bottle with the valve up;

– open the cylinder valve and, from a distance of 20 to 50 cm, treat these surfaces so that a visible film of liquid is removed from them. Degassing of individual surfaces is carried out with a rag moistened with a solution of TDP;

– After degassing is completed, close the valve of the device.

### 3.17.6 Features of the protection system operation

When operating the PKUZ -1A instrument complex, the following features must be taken into account:

– if there are exhaust gases and fuel vapors in the surrounding atmosphere, when handle 11 (Figure 16.4) of the input rotameter valve is in the OPERATION position, several red segments of the linear LED indicator of the measuring console are allowed to glow without issuing a signal;

– There may be cases where the PKUZ -1A complex is triggered by command “O” from the exhaust gases of its engine in parks, parking lots, during sharp turns, dense placement of tanks, moving in a convoy or during towing, when exhaust gases in high concentrations can enter the sensor of the PKUZ instrument complex -1A. A characteristic sign of such a response is the lighting of the “O” indicator on the measuring panel with an audible alarm. If in this case the OPERATING MODE switch was in the OPA position, the actuators are activated by the “O” command. If the OPERATING MODE switch was in the RA position, the 3ETs13-1 equipment does not receive the “O” command, and the PKUZ -1A instrument complex will operate in the OB indication mode with an alarm;

– it is necessary to change PDF frames in the sensor when operating a tank with the PKUZ -1A complex turned on during ETO, and in the presence of snow cover - after 500 km;

– It is recommended that every 4 hours of continuous operation of the PKUZ --1A instrument complex , a performance check be carried out without issuing commands;

– When checking the instrument complex, every 20 minutes the “O” circuit is automatically checked, and a sound signal is issued in the form of one or two sound bursts with a duration of 0.3 to 2 s.

### 3.17.7 Checking the functionality of the protection system

#### 3.17.7.1 Checking the functionality of the PKUZ 1A instrument complex-

To check the functionality of the PKUZ -1A instrument complex, you need to turn it on, unscrew the cap of the “HEATING CONTROL, OPA” button and check the functionality of the heating tube and cyclone, as well as the issuance of an alarm on the commands “O”, “P” and “A”. Why set the “OPERATION MODE” switch on the measuring console to the “OFF” position; in this case, the “OFF” indicator should light up. TO".

Press and release the “HEATING CONTROL, OPA” button. Within 20 seconds, the “HEATING”, “O”, “P”, “A” indicators should turn on and off sequentially. Next, the numbers “8.8.8.” should turn on and off. on the digital indicator, all segments on the linear LED indicator, indicators “O”, “P”, “A”, “HEATING”. During the inspection, an intermittent audio alarm is issued via ABCC to the entire crew.

#### 3.17.7.2 Checking the functionality of 3ETs13-1 equipment using the ORB button

To check the signal passage in the “ORB” mode, press and hold the ORB button on the P13 remote control, and the following happens:

– the FVU valve is moved to the position of the supercharger through the absorber filter and the inscription F on the P13 remote control lights up;

– the driver's APU displays the message TOXIC SUBSTANCES, the OPA indicator starts flashing on the remote TV display for the entire time the OPA button is held on the P13 remote control;

– The blower starts automatically.

To remove the “ORB” mode, release the ORB button, press and release the RESET button on the P13 remote control. Turn off the supercharger by setting the SUPERCHARGER-EL switch. DESCENT on the left switchboard of the tower to the PUMP.OFF position, and manually cock the FVU valve to its original position; At the same time, the inscription F on the P13 remote control goes out.

#### 3.17.7.3 Checking the electrical circuits of the protection system using commands from the PKUZ -1A complex

Set the OPERATING MODE switch on remote control B -1 to position RA, with the indicator OFF. K should go out.

Turn on the blower, press and release the HEATING CONTROL, OPA button on the measuring panel, and the following happens:

– on the measuring panel within 20 s the HEATING, O, P, A indicators should turn on and off in sequence;

– after the O indicator is turned on, an intermittent sound signal begins to be issued to the AVSKU to the entire crew;

– after the P indicator turns on, the electromagnet of the FVU valve is activated - the inscription F on the P13 remote control lights up;

– the driver's APU displays the message TOXIC SUBSTANCES, and the OPA indicator starts flashing on the remote TV display;

– after indicator A turns on, the blower stops, the MOD electromagnets and the blinds are activated;

– the driver's APU displays the inscription RADIATION, the OPA indicator flashes on the remote TV display;

– The numbers “8.8.8.” should turn on and off. on the digital indicator, all segments on the linear LED indicator, indicators O, P, A, HEATING, OFF. TO;

– after the digital indicator readings reach a zero value, the intermittent sound signal in the ABCD stops;

– after a time of 30 to 50 s from the moment indicator A turns on, the supercharger automatically starts and its valves open.

Press and release the RESET button on the P13 remote control. Turn off the supercharger by setting the SUPERCHARGER-EL switch. DESCENT on the left switchboard of the tower to the PUMP.OFF position, and manually cock the FVU valve to its original position, cock the MOD and install the seal on its body, cock the cooling system shutter drive mechanism.

Set the OPERATING MODE switch on remote control B -1 to the OPA position, with the indicator OFF. K should not burn.

Press and release the HEATING CONTROL, OPA button on the measuring panel, and the following happens:

– on the measuring panel within 20 s the HEATING, O, P, A indicators should turn on and off in sequence;

– after the O indicator is turned on, an intermittent sound signal begins to be issued to the AVSKU for the entire crew, the supercharger automatically starts, the electromagnet of the FVU valve is activated - the inscription F on the P13 remote control lights up;

– the driver's APU displays the message TOXIC SUBSTANCES, and the OPA indicator starts flashing on the remote TV display;

– after indicator A turns on, the blower stops, the MOD electromagnets and the blinds are activated;

– the driver's APU displays the inscription RADIATION, the OPA indicator flashes on the remote TV display;

– The numbers “8.8.8.” should turn on and off. on the digital indicator, all segments on the linear LED indicator, indicators O, P, A, HEATING, OFF. TO;

– after the digital indicator readings reach a zero value, the intermittent sound signal in the AVSKU stops;

– after a time of 30 to 50 s from the moment indicator A turns on, the supercharger automatically starts and its valves open.

To cancel the mode, press and release the RESET button on the P13 remote control. Turn off the supercharger and manually cock the FVU valve to its original position, cock the MOD and install the seal on its body, cock the cooling system shutter drive mechanism.

### 3.17.7.4 Checking the functionality of the filter-absorber and the tightness of the air routes of the FVU

To check the functionality of the filter-absorber and the tightness of the air routes of the FVU, it is necessary to:

– prepare the tank to check the pressure in the filter ventilation mode;

– the crew take their places in the tank and close the hatches;

– switch the FVU to filter ventilation mode, to do this, pull rod 24 (Figure 16.2) of the electromagnet until valve 19 of the FVU operates;

– turn on the supercharger;

– Place a rag moistened with ethyl mercaptan near the armor protection of the supercharger valves for 1 minute.

If the filter-absorber is in working order and the FVU routes are sealed, the smell of ethyl mercaptan in the tank should not be felt. If there is an odor, you should determine the location of the leaks and eliminate the leaks; if the absorbent filter is faulty, replace it.

When checking, the total time of pumping air through the filter should not be more than 10 minutes. Testing should not be carried out during precipitation.

Persons working with ethyl mercaptan (except for the crew in the tank) must use gas masks.

If it is impossible to use ethyl mercaptan, or for a more detailed search for leaks in the FVU routes, check the tightness by pressure testing, using devices 188M.87.003sb and 188M.87.004sb from the group spare parts kit for the tank.

To do this you need:

– dismantle the supercharger protection 7 and the reed valve 28, remove the springs 6, 8, remove the air intake valve 5 and the dust emission valve 9;

– instead of protecting the supercharger 7 and the petal valve 28, install plugs 188M.87.004sb and 188M.87.003sb from the group spare parts kit for the tank;

– switch the FVU to filter ventilation mode, for which pull the rod 24 of the electromagnet until the valve 19 of the FVU operates;

– install the air supply hose of the PPGU universal device located in the maintenance workshop onto the fitting of the technological plug 188M.87.004sb;

– Working with the pump from the PPGU kit, create a pressure in the system of at least 400 mm of water. Art., monitoring its value using a pressure and vacuum gauge. The pressure drop according to the pressure and vacuum gauge should not be more than 25 mm of water. Art. in 15 minutes

– in case of air leakage exceeding the permissible limits, the leakage locations should be determined (by ear or using a soap solution) and the leaks should be eliminated.

After completing the check you must:

– turn off the blower and switch the air pump to ventilation mode, to do this, pull the lever 17 by the ring 18 until the air pump valve 19 locks in the closed state;

– install air intake valve 5 and dust emission valve 9, springs 6, 8, supercharger protection 7 and reed valve 28 into place. When installing springs and valves, it is necessary to take into account that a long spring must be installed on the air intake valve.

### 3.17.8 Switching off the PKUZ-1A instrument complex

Upon completion of the protection system operation, it is necessary to turn off the PKUZ-1A instrument complex and return the controls and actuators of the protection system to their original position, for which:

– set the NETWORK - OFF toggle switch on the measuring panel to the OFF position;

– set the OPERATING MODE switch to the OFF position;

– turn the SET knob. ZERO to the far left position;

– turn the air flow regulator on the sensor to side B until it stops;

– make sure that there are plugs on the silica gel cartridge of the sensor and on the HEATING CONTROL, OPA button of the measuring console;

– turn off the filter-absorber by cocking the FVU valve switching mechanism by moving the valve handle up until it locks;

– install caps on the VZU fittings of the PKUZ-1A instrument complex and install the cap shield;

– Place the cap on the outer tube of the pressure gauge.

### 3.17.9 Starting and stopping the FVU supercharger in non-automatic mode

To start the supercharger you must:

– make sure that all AZR machines located on the driver's panel under the covers and AZR EL. DESCENT on the tower switchboards are included;

– open the valves of the air cylinders and make sure that the pressure in the air system is at least 40 $кгс/см^2$;

– set the switch SUPERCHARGER - EL. REDUCER on the left tower switchboard to the ON position. This starts the supercharger and opens its valves.

If the supercharger does not start (no air flow from the FVU valve box) and there is no time to eliminate the malfunction, it is necessary to start the supercharger using a manual backup drive, and make sure that there is air flow from the FVU valve box.

To start the supercharger using a backup drive, you must:

– turn the turret to a position convenient for access to the handle with the ring (to the right along the course approximately up to the 34-00 mark on the azimuth indicator for launching from the commander's position or to the left approximately to the 10-00 mark according to the azimuth indicator for launching from the gunner's position);

– turn on the battery switch if it was turned off;

– Move the handle with the ring towards the fighting compartment as far as it will go, this will start the supercharger and open its valves. Make sure there is air flow from the valve box of the FVU.

To stop the supercharger, you must set the SUPERCHARGER - EL switch. DELETE on the left tower switchboard to the PRESSURE position. OFF

### 3.17.10 Safety valve position

When storing a tank and operating it in uncontaminated areas:

– the FVU supercharger valves must be closed when the supercharger is stopped;

– the FVU valve must be in the supercharger operating position, bypassing the absorber filter (the inscription "F" on the P13 remote control should not be lit).

When operating a tank in contaminated areas:

– the FVU valve must be in the position where the supercharger operates through the absorber filter (the inscription "F" on the P13 remote control must be lit);

– The supercharger valves must be open and the supercharger must be running.

## 3.18 Curtain setting system

### 3.18.1 Security measures

When the SPZ is operating, the safe removal zone is at least 400 meters when using 3D6 and 3D6M grenades and at least 300 meters when using 3D17 grenades.

The protective covers of the OR heads should only be opened when using or servicing the SDR, otherwise the covers should be closed.

When driving a tank with the SPD turned on in conditions where sudden changes in illumination are observed (for example, driving through a forest on a sunny day), in order to avoid false alarms, it is recommended to turn on the SPD in the "Semi-automatic" mode.

Do not allow grenades to fall, hit or fall into water or snow.

If there are dents, damage to the hinge, clogged nozzle holes, or after getting into water, grenades are not allowed for use.

When working with grenades, there should be no open electrical heating devices, exposed wires or faulty electrical equipment on the tank.

Laser irradiation of a tank when checking the SPZ from a rangefinder must be carried out only upon command from the tank being tested, for which communication must be ensured between the tank being tested and the emitter. During work, it is necessary to take measures to prevent laser radiation from entering the eyes of workers, including through optical instruments.

**IT IS PROHIBITED TO CHARGE AND DISCHARGE SYSTEM 902 LAUNCHERS WITH AZR SDR ENABLED!**
**IT IS PROHIBITED TO DISCONNECT THE CABLES AND REPAIR THE UNITS WITH THE SDR ON!**

When the SPZ is turned on in the "Automatic" or "Semi-automatic" modes and the launchers of the 902 system are loaded, pressing the DZ START button on the commander's console will cause the turret to rotate and the grenade to fire.

When the SPZ is turned on and the 902 system launchers are loaded, simultaneously pressing the TsU-LI and DZ START buttons on the commander's console will lead to the shooting of grenades from all charged launchers.

### 3.18.2 Preparing SDR for work

When preparing the SDS for work, you must:

– make sure that the AZR SPZ is turned off on the ShchRL;

– remove the plugs from the launchers and place them in the spare parts box;

– clean the launcher barrels;

– check the mobility of the locking ring and the electric striker of the launchers;

– load the launchers with 3D17 grenades (a 3D6 grenade can be used, and the operation of the SDS will be effective only when using the "LAUNCH BY LVP" and "GROUP LAUNCH" functions). Send the grenade into the barrel using hand force, while making sure that the locking ring fits into the groove of the grenade by pulling the grenade loop;

– put the plug supplied with the grenades onto the launcher all the way (launches are carried out without removing the plug);

– enable AZR SDR;

– close the driver's hatch;

– turn on AZR RADIOOB. in the tower;

– the inspector should put on a headset and connect it to the AVSKU;

– turn on the PTC (it is not necessary to turn on the radio stations and the orientation system);

– turn on the OMS in the "Observation" mode.

There should be no emergency messages from the SPZ at the PMF. Check the charge of the launchers in the "Control" mode.

**ATTENTION:**

**WHEN CHECKING, IN ORDER TO AVOID UNAUTHORIZED SHOOTING OF GRENADES, DO NOT PRESS THE DZ START BUTTON ON THE COMMANDER'S REMOTE CONTROL OR SIMULTANEOUSLY THE DZ START AND TSU-LI BUTTONS!**

### 3.18.3 Use of SDRs for their intended purpose

SDR operates in the following modes:

– automatic;

– semi-automatic;

– control

In addition, in the “AUTOMATIC” and “SEMI-AUTOMATIC” modes, the following functions are performed :

– “TARGETING TO THE SOURCE OF LASER RADIATION” (TSU-II);
– “START ON LVP”;
– “SHOT WITH DOOR”;
– "GROUP START".

The SPS is turned on automatically when the OMS is turned on, and the ARMk (from the PTK) must be turned on.

After switching on, the control unit carries out self-monitoring, monitoring of the OR heads and communication lines with them, as well as monitoring the charge of the launchers and the “Automatic mode” is set, after which the SPS goes into a standby state. If the control results are positive, then the PMF does not display information about the state of the SPS; if they are negative, then a list of faults and a warning about the operation of the SPD with restrictions are displayed on the PMF. Switching the SPZ into “Semi-automatic” or “Control” modes is done from the PMF ARMk using the menu.

### 3.18.3.1 Working with SDR in “AUTOMATIC” mode

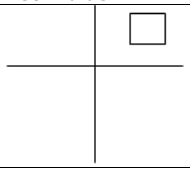
“AUTOMATIC” mode is the main operating mode of the SDR. To work in this mode you need:

– prepare the SDR for work;
– open the protective head covers OR.

After switching on, the SZ goes into a standby state and does not require attention until it receives laser radiation.

When a tank is irradiated by a laser emitter, a sound alarm will appear in the AVSKU in the form of four or five sound signals, and a message will appear on the PMF with information about the direction of irradiation (to the head) and the type of attacking weapon. When the precise heads of the OR are illuminated, the grenade will be fired in the direction of the irradiation. In addition, the PMF will provide recommendations to the operator on further actions depending on the specific situation. Information displayed on the PMF, comments and recommendations on the commander’s actions are given in Table 12.

Table 12

| Information displayed on the PMF | Comments and recommended actions |
|---|---|
| SDR | The PMF displays information regarding the SDR |
| SPZ-AVT | SDR is included in “Automatic” mode |
| SPZ-PA | SDR is included in the “Semi-automatic” mode |
| SPZ-Control | SDR is included in the “Control” mode |
|  | A mnemonic diagram showing the charge of the 902 system launchers. The left group of numbers corresponds to the left group of launchers. The presence of the “X” symbol instead of the image of a grenade indicates that the corresponding launchers are discharged or there is a lack of contact in the corresponding circuit. The mnemonic diagram is displayed in the “monitoring” mode, as well as in the frames “Maintenance and control of the sanitary protection system” and “Management of the sanitary protection system” |
| Sound in AVSKU | A control sound signal is issued to the AVSKU |
| START GROUP<br>Hold down the keys<br>TSU-LI and START DZ | The SPZ operates in the “Group Start” submode. Until the end of shooting, you must hold down the TSU-LI and START DZ buttons |
| START GROUP<br>Completed<br>Release the keys<br>TSU-LI and START DZ | Firing grenades in the “Start group” submode is completed. It is necessary to release the TSU-LI and DZ START buttons |
|  | A mnemonic diagram indicating the direction of attack (in the “automatic” and “semi-automatic” modes) or the faulty OR channel (in the “control” mode). A flickering marker indicates the head from which the signal came (or the faulty channel). The top right quadrant corresponds to the right fine head, the top left quadrant corresponds to the left fine head, the bottom right quadrant corresponds to the right coarse head, and the bottom left quadrant corresponds to the left coarse head |
| NO SHOOTING<br>For the tower, press and hold START DZ | The launchers in the direction of irradiation are discharged. To shoot with additional rotation of the turret (sub-mode “Start with additional rotation”), press and hold the START button |
| Tower reversal<br>Hold START DZ | The tower is rotated in the “Launch on LVP” submode or in the “Start with additional rotation” submode. Hold down the START button |
| Release START DZ | The shooting of grenades in the “Launch on a high-altitude road” or “Launch with a twist” submode is completed. Release the START button |

| Information displayed on the PMF | Comments and recommended actions |
|---|---|
| SHOOTING IS LOCKED<br>To shoot, press START DZ | The range is measured by its own rangefinder or by a guided projectile. To remove the lock, press the START button |
| SPZ-PA To shoot, press START DZ | The SPZ operates in “Semi-automatic mode”. To shoot a grenade during laser irradiation, press the START button |
| For control center on AI, press and hold the control center-li button | It is possible to implement the “TsU-II” submode; to do this, you need to press and hold the TsU-LI button |
| Panorama reversal on AI Hold the TSU-LI button | The “TsU-AI” submode is running. Keep the TSU-LI button pressed |
| Reversing the tower and panorama using AI. Hold the TSU-LI button | The “CU-AI” submode is performed on rough heads. Keep the TSU-LI button pressed |
| Release the TSU-LI button | Panorama reversal in the “TsU-II” submode is completed. Release the TSU-LI button |
| MANEUVER UNLOADED | All launchers are discharged. Give a command to the driver to perform the maneuver |
| SHOOTING IS LOCKED CLOSE THE HATCHES | The driver's hatch is open, close the hatch |
| ATTACK-RANGE FINDER MANEUVER | The range to the tank was measured with a laser range finder in the viewing area of the rough heads. Give a command to the driver to perform the maneuver |
| ATTACK-ATGM MANEUVER<br>For control center on AI, press and hold the control center-li button | Attack with an anti-tank weapon with a laser designator in the field of view of the rough heads. Give a command to the driver to perform the maneuver or to perform the “TsU-II” submode, press and hold the TsU-LI button |

### 3.18.3.2 Working with SDR in “SEMI-AUTOMATIC” mode

“SEMI-AUTOMATIC” mode is an auxiliary mode of operation of the fire protection system and is used for training or in cases where automatic grenade firing is not needed.

To work in “SEMI-AUTOMATIC” mode you must:

– prepare the SDR for work;

– open the protective covers of the OR heads;

– switch the SPZ to the “SEMI-AUTOMATIC” mode with the PMF using the menu in the sequence: Armored Vehicles - SPO KBO - SPZ Control - SPZ operating mode - Semi-automatic.

After this, the SDR goes into a standby state until it receives laser radiation.

When a tank is irradiated by a laser emitter, a sound alarm will appear in the AVSKU in the form of four or five short-term sound signals, and a message will appear on the PMF about the direction of irradiation (accurate to the head) and the type of attacking weapon, as well as recommendations for operator actions depending on the situation. To shoot a grenade in the direction of irradiation (when the precise heads OR are illuminated), you must press the START DZ button on the commander’s remote control.

Switching the SPZ to the “AUTOMATIC” mode is performed from the PMF using the menu in the sequence: BTVT - SPO KBO - SPZ Control - SPZ operating mode - Automatic.

### 3.18.3.3 Working with SDR in the “Control” mode

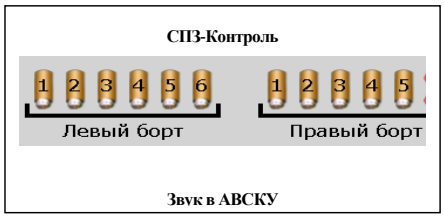
The test can be performed with both loaded and unloaded System 902 launchers.

Check the SDS with loaded launchers as follows:

– turn on the control system in the “MAIN” or “DOUBLE” mode;

– prepare the SDR for work;

– set the “control” mode with the PMF in the sequence: BTVT - SPO KBO - TO SPZ - TO and control SPZ - Control, while the following message should appear on the PMF:




– By listening, make sure that there is a continuous sound signal in AVSKU while the line “Sound in AVSKU” is illuminated (approximately for 3 s).

The presence of the “X” symbol instead of the image of a grenade indicates that the corresponding launcher is discharged or the corresponding electrical circuit is faulty; in this case, it is necessary to turn off the SDS AZR and recharge this launcher. Unloading is carried out with a banner from a single spare parts system of the 902 system, for which you insert the nose of the banner into the grenade loop, rest the handle of the banner against the cut of the barrel and, using the banner as a lever, remove the grenade from the launcher. If the electrical circuit is faulty, it is necessary to eliminate the fault and repeat the test using the above method.

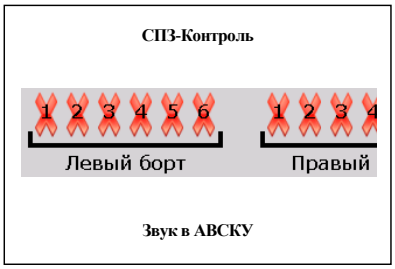
**ATTENTION:**

**WHEN CHECKING, IN ORDER TO AVOID UNAUTHORIZED SHOOTING OF GRENADES, DO NOT PRESS THE START DZ BUTTON ON THE COMMANDER’S REMOTE CONTROL OR SIMULTANEOUSLY THE START DZ AND TSU-LI BUTTONS!**

the test with discharged launchers as follows:

– prepare the SPZ for work (except for loading grenade launchers);

– set the “Control” mode with the PMF using the menu in the sequence: Armored Vehicles - SPO KBO - TO SPZ - TO and control SPZ - Control, in this case a message should appear on the PMF with the symbols “X” instead of the image of grenades:




– close one by one with key 902.03.001 (from the spare parts system 902) the electrical strikers of the launchers onto the barrel body of the launcher, while on the PMF in the message in the cells corresponding to the launchers being checked, instead of the symbol “X”, an image of a grenade with its serial number should be displayed, which indicates serviceability of the electrical circuit being tested.

**ATTENTION:**

**WHEN CHECKING, IN ORDER TO AVOID A SHORT CIRCUIT, DO NOT PRESS THE DZ START BUTTON ON THE COMMANDER’S REMOTE CONTROL OR SIMULTANEOUSLY THE DZ START AND TSU-LI BUTTONS!**

At the end of the scan, turn off the systems included in the scan.

### 3.18.3.4 Working with SDR in the “TsU-II” submode

The specified sub-mode is implemented by the decision of the commander when the SPS is operating in the “Automatic” or “Semi-automatic” modes. When laser irradiation of a tank occurs and appropriate recommendations appear on the PMF, the commander must:

– press and hold the TSU-LI button on the commander’s remote control, while:

- if laser radiation is registered by precise heads, then the control panel will turn towards the laser emitter and stop;
- if laser radiation (only the target designator type) is registered by coarse heads, then first the turret will rotate until the radiation is captured by the fine head and the grenade will be fired (if the SDS is operating in the “ Automatic ” mode) in the direction of the emitter, and then the control panel will rotate until it is directed to the laser emitter;

– After stopping the control panel, release the TSU-LI button.

N o t e s

1 The rotation of the turret or control panel will stop when the TSU-LI button is released or when the target designator stops irradiating the coarse heads until it is captured by the fine heads.

2 Target designation of the laser emitter is recommended to be carried out immediately after the start of irradiation, since when the tank moves, and especially when the turret is rotated, the accuracy of target designation decreases and it may be ineffective.

#### 3.18.3.5 Working with SPZ in the “Launch on LVP ” submode

This sub-mode is implemented by the decision of the commander when the SPS is operating in the “Automatic” or “Semi-automatic” modes only in the absence of laser irradiation, as follows:

– point the central aiming mark of the control panel in the direction of setting the curtain;

– press and hold the DZ START button on the commander’s remote control, the turret will rotate until the axis of the loaded launcher aligns with the direction of the PKP line of sight and the grenade will be fired;

– release the START button;

– To fire a grenade again, you must repeat the previous operations, adjusting the position of the control panel if necessary.

N o t e – When the DZ START button is released before the grenade is fired, work in this submode stops.

#### 3.18.3.6 Working with SPZ in the “Group Start ” submode

This sub-mode is implemented by the decision of the commander when the SPS is operating in “Automatic” or “Semi-automatic” modes; for its implementation it is necessary:

– turn the turret with the cannon in the direction of placing the curtain;

– Simultaneously press and hold the TSU-LI and DZ START buttons on the commander’s remote control, which will result in sequential firing from all loaded launchers;

– After shooting the grenades, release the TSU-LI and START DZ buttons.

N o t e - When the TSU-LI and DZ START buttons or one of them are released, work in this submode stops.

After finishing work with the SDR, it is necessary to clean the protective glass of the OR heads from dirt and dust and close the covers.

## 3.19 Smoke exhaust system

### 3.19.1 Preparing the system for use and using the system

To set up a smoke screen, you must turn on the AZR TDA and set the
BCN-TDA switch on the driver's panel to the TDA position. To stop setting up a smoke screen, turn off the BCN-TDA and AZR TDA switches.

Exhaust the smoke only when the engine is well warmed up (the coolant temperature must be at least plus 80 °C).

When operating on T-2 and TS-1 fuels, it is not recommended to turn on the TDA system, since the smoke screen is not effective enough.

Fuel consumption during TDA operation is approximately 5 l/min. The maximum permissible duration of each smoke exhaust is no more than 5 minutes. After stopping the smoke outlet, the engine must run under load for 3 to 5 minutes to remove unevaporated fuel.

When a smoke screen ignites, it is necessary to turn off the TDA AZR for a period of 2 to 3 s, after which it can be turned on again.

**ATTENTION:**

**DO NOT STOP THE ENGINE WHEN THE SMOKE SCREEN IS BURNING!**

## 3.20 Equipment for underwater tank driving

### 3.20.1 Security measures

The basis for safe driving of a tank under water is careful and high-quality work on installing removable equipment and sealing the tank, the technical serviceability of the tank systems and strict compliance with the require-

ments and current guidelines for overcoming water obstacles with tanks, infantry fighting vehicles and armored personnel carriers (RPVP).

Crews who have undergone special training for underwater driving are allowed to overcome water obstacles along the bottom.

Communication with the crew of a tank stopped under water, in the event of a radio communication failure, is maintained via an internal communication network using the MT10M-05 device, the cord of which (cord length L = 10 m) is lowered into the air supply pipe and connected to the MTG2 connector of the PUDL control and indication unit, having previously disconnected the connector of the standard cable.

Overcoming a water obstacle along the bottom is allowed only in a explored crossing area, and in this case:

– the angle of entry into the water should not be more than 25°, and the angle of exit from the water should not be more than 15°;

– the current speed should not be more than 1.5 m/s;

– the surface of the water barrier must be free of ice.

### 3.20.2 Preparing a tank to overcome a water obstacle

#### 3.20.2.1 Preliminary preparation

In anticipation of overcoming a water barrier, it is necessary to dismantle the protection installed above the outer armor protection cover of the gun and check the condition and fastening of the outer armor protection cover and the coaxial machine gun cover. Apply a layer of ZZK-3U putty taken from the OPVT container to the detected damage. If it is impossible to repair the covers, replace them with spare ones taken from the group (gun armor protection cover) and single (machine gun cover) sets of spare parts for the tank, respectively.

Replace the gun armor protection cover in the following order:

– unscrew the four casing mounting bolts;

– dismantle the casing, for which you need to move it forward and lift it up;

– disconnect the cable from measuring block 2 (Figure 8.26) of the barrel bend sensor;

– Unscrew one of the nuts 10 and loosen the adjusting screw 12, then unscrew the bolts 4 and remove the measuring unit 2. At the same time, remember the number of washers 5 under each sensor support.

**ATTENTION:**

**INTERFERING THE WASHERS UNDER EACH SENSOR SUPPORT IS NOT ALLOWED, AS THIS CAN LEAD TO A SIGNIFICANT INTERFERENCE IN THE BARREL BEND SENSOR ADJUSTMENT!**

– unscrew nuts 11 and remove plate 3;

– install a new armor protection cover;

– install the plate and measuring block in the reverse order of removal;

– check the values of the Z and Y coordinates using Appendix D;

– install the casing in its original place and secure it with bolts.

When preparing a tank for overcoming a water obstacle, it is necessary to perform the following work:

– take from the OPVT container an air supply pipe, a box of ZZK-3U putty, a signal cord, life jackets, gas masks, a rubber cover for the muzzle of the gun barrel;

– crew members remove body armor if they were wearing them;

– check the serviceability and readiness for operation of insulating gas masks.

On the turret and in the fighting compartment:

– install the R-168BShPA antenna stand and pin;

– make sure that the pressure gauge fitting is securely closed with the cap;

– check the closure of the supercharger valves. A sign of valve closure is a dull slam of the valves on the seat when the supercharger is turned off;

– check the ease of unlocking and removing the gunner’s left rear observation device from the shaft;

– it is recommended to remove the covering tarpaulin;

– close the covers and plugs on the aft module.

In the management department:

– check the reliability of closing and locking the latches and clamps of the emergency exit hatch;

– check the ease of unlocking and removing the driver's observation device from the shaft.

From the outside and inside the case:

– unscrew three plugs 14 (Figure 4.9) in the roof above the engine in the area of the exhaust pipe and install instead of them bolts 16 (Figure 18.4) with washers taken from a single set of spare parts for the tank;

– check the tightness of the bolts securing the roofs above the power compartment;

– check the presence and reliability of fastening of covers, hatches and plugs of the housing and tower (screw the cover of the external socket with a key);

– remove the shield and make sure that the caps of the VZU fittings of the PKUZ-1A instrument complex are securely closed; install the shield in place.

Seal the following places with ZZK-3u putty:

– the outer contour of the outer perimeter armor protection cover, having previously dismantled the protection installed above the cover. Install the protection in place;

– butt connections of the gun receiver with the barrel and bolts of the front

– receiver flange;

– cover and hatches of the diesel generator compartment around the perimeter;

– bolt heads for fastening the R-168BShPA antenna shock absorber to the antenna housing and the antenna housing to the tank turret, as well as the joints of these fastenings;

– the joint of the “KDA” electrical connector cover (on the wind sensor pipe) and the joint of the “SR-GShS” electrical connector cover (on the tower under the R-168BShPA antenna).

When the KMT-8 trawl is installed on the tank, it is necessary to additionally seal the following places with ZZK-3u putty:

– sealing the cable and the axis of the gripping mechanisms on the cranks of the knife sections;

– places where the pneumatic system pipelines exit from the tank and the crank of the knife sections;

– places where electrical wires exit from the tank to the trawl and their connections.

### 3.20.2.2 Preparing the air conditioner for underwater driving

When preparing for underwater driving, install lids 1 (Figure 13.3) and 2 containers in the position shown in Figure 13.3a. In this case, the OPV sensor 8 is triggered, which turns off the BO if they were turned on. The red signal LED 11 (Figure 13.2) on the BO lights up, the fans for blowing the heat release radiator and the liquid pump are turned off. CHP operation is possible only in the “Ventilation” mode.

After overcoming the water barrier, install covers 1 (Figure 13.3) and 2 in the position indicated in Figure 13.3b, ensuring that sensor 8 OPVT is activated (bar 3 of cover 2 is installed on the rod of sensor 8 OPVT) - the BO and signal LED 11 begin to work (Figure 13. 2) goes out, the heat removal radiator fans and the liquid pump turn on.

When washing the tank, to prevent moisture from entering the container, place lids 1 (Figure 13.3) and 2 in the position shown in Figure 13.3b.

### 3.20.2.3 Equipment installation and sealing quality check

When installing the equipment, perform the following work:

– carry out the preliminary work necessary to open the roof over the engine, following the instructions in paragraph 3.7.3of this manual;

– remove cover 2 (Figure 18.4) of the OPVT;

– install covers over the air inlets of the power compartment roof;

– install removable rod 12;

– move the supporting brackets 7 for the covers above the exit blinds to a vertical position if fuel barrels are not installed;

– set the torsion bars of the covers above the entrance blinds to the working position, turn lever 14 to a position that ensures closing of the left cover 6 (parallel to the board);

– secure the stoppers 32 on the covers 6 and the roof of the MTO with cotter pins 33 taken from a single set of spare parts;

– cock the drive to the covers and close all the covers, turn the lever 14 to the working position, when closing the covers 6, release the stoppers 32;

– remove lever 1 (Figure 18.3) and set it to working position;

– Install cover 2 (Figure 18.4) in its original place;

– install exhaust valves with a gasket on the flange of the exhaust pipe, having previously cleaned it of dirt and carbon deposits, check the fit of the valve plates to the seats;

– open the hatch for installing the air supply pipe in the gunner's hatch cover;

– install the lower elbow of the air supply pipe into the hole in the hatch on the gunner's hatch cover and tighten the pipe fastening nut using a crowbar from a single set of spare parts;

– install a seal on the muzzle of the gun barrel;

– make sure that the rubber plugs are tightly placed on the barrels of the launchers of the air curtain stopping system;

– disconnect external fuel tanks.

To check the quality of sealing you must:

– unscrew one of the bolts securing the filler neck cover of the internal tanks and install the air exhaust hose from the PPGU universal device located in the maintenance workshop into the hole;

– seal the hole with putty;

– start the engine and set the minimum stable idle speed;

– make sure that there is no one inside the tank and close all hatch covers from the outside;

– cover the opening of the air supply pipe with shield 15 (Figure 18.1);

**ATTENTION:**

**CLOSE THE HOLE SO THAT THE VACUUM INSIDE THE TANK IS NO MORE THAN 300 MM HG. ST. WHEN THE CURRENCE INCREASES MORE THAN 300 MM HG. ST. MOVE THE SHIELD COVERING THE PIPE HOLE USING A SPECIAL CROWBAR!**

– identify leaks by the sound of air being sucked into the tank and seal them with putty.

### 3.20.2.4 Final preparation

Final preparation is carried out after checking the quality of sealing and eliminating all identified leaks.
To do this you need:
– remove the shield covering the opening of the air supply pipe;
– open hatch covers for crew members;
– stop the engine;
– remove the PPGU hose and screw the bolt into the hole;
– open the sealing covers by turning the tower and cock the drives to the covers again, set lever 1 (Figure 18.3) to the working position;
– assemble all three elbows of the air supply pipe and install a removable stage 54.83.131sb from a single set of spare parts for the tank on the middle elbow;
– install a signal light in the pipe (when overcoming a water obstacle at night) and plug it into the plug socket located on the bottom sheet of the turret to the left of the gunner's seat. At the same time, install the upper elbow of the pipe so that the lantern shines backward (against the direction of the tank).

**ATTENTION:**

**WHEN THE AIR SUPPLY PIPE IS INSTALLED ON THE GUNNER'S HATCH COVER, THE HATCH COVER IS NOT FIXED TO THE STOPPER IN THE OPEN POSITION. TO AVOID INJURY WHEN OPENING AND CLOSING A COVER WITH AN AIR SUPPLY PIPE INSTALLED, BE CAUTIONARY!**

– unscrew the plug from the water discharge hole of the pump and place it in the spare parts box;
– secure the exhaust valves with a pin in the open position and install a safety shield on them;
– close all spare parts and accessories boxes;
– stop the tower;
– turn off the remote control if it was turned on ;
– turn off the KAZ/GShS AZR (on the roof of the tower behind the commander), if it was turned on;
– lay tow ropes in accordance with the depth and width of the crossing, as well as in accordance with the location of the evacuation team and the availability of evacuation means;
– apply a layer of putty 3 to 4 mm thick on the rubber rings of the crew hatch covers if they are damaged;
– crew members put on life jackets and insulating gas masks. Move insulating gas masks to the "ready" position;
– the gunner takes his place, gives the gun an elevation angle of 10° (according to the risk on the fence);
– close the gunner's hatch;
– the commander and driver take their places.

**ATTENTION:**

**IF, WHEN THE TANK IS MOVING TOWARDS A WATER OBSTACLE DUE TO TERRAIN CONDITIONS (MOVING THROUGH A FOREST, ETC.), INSTALLING THE AIR SUPPLY PIPE IN A VERTICAL POSITION CAN LEAD TO ITS DAMAGE, INSTALL THE PIPE IN A HORIZONTAL POSITION BY OPENING THE GUNNER'S HATCH COVER AND SECURING THE PIPE USING STOP 17 (FIGURE 18.1 ) ON THE TOWER BRACKET. AT THE SAME TIME, THE GUNNER'S HATCH COVER REMAINS OPEN!**

– It is prohibited for crew members to be in the light of the gunner's hatch when the tank is moving with the air supply pipe installed in a horizontal position.

When preparing to overcome a water obstacle in anticipation of the use of chemical agents, it is additionally necessary:
– remove the shield from the protective cover of the VZU instrument complex PKUZ -1A and place it in the spare parts box;
– remove the standard caps from the fittings of the protective cover of the VSU;
– put caps with an extended cable on the VZU fittings, having previously secured the end of the cable with a loop to the lower mounting bracket of the remote control container on the right side of the gun.

### 3.20.3 Approach to a water obstacle and crew actions before entering the water

When the tank approaches a water obstacle, it is necessary to carefully monitor the operation of the engine, trying not to overload it. The coolant temperature before entering the water should not be more than plus 90 °C for water and plus 80 °C for antifreeze. The speed of movement with installed OPVT should not be more than 25 km/h.

Perform orientation operations, guided by the instructions in paragraph 3.5.4.2.18of this manual.

Before entering the water you must:

– close the covers over the air inlets of the power compartment roofs and make sure that they are securely held by the locks, additionally press the left cover 6 (Figure 18.4) to the frame with lever 14, when closing the covers 6, release the stoppers 32;

– remove flap 22 from the exhaust valves (Figure 18.3), and remove the valves from the pin;

– turn on the sump pump;

– set the OPVT - PPO switch on the P13 remote control to the OPVT position and make sure the OPVT lamp lights up;

– in anticipation of the use of OV, it is necessary to turn on and configure the PKUZ -1A instrument complex;

– the commander from the control and display unit PUDL of the AVSKU complex switches the driver to work via the radio station R-168-25U-2. When crossing a water obstacle, it is recommended to conduct radio communication through the first transceiver (PP1) of the R-168-25U-2 radio station in low power mode or through the second transceiver (PP2) in the “bypass” mode;

– make sure there is radio communication;

– use the handle of the manual fuel supply drive to set the engine crankshaft rotation speed from 1300 to 1500 rpm;

– close the commander's hatch cover;

– close the driver's hatch cover, unlock the hatch cover rotation handle and lock it in the pulled position;

– engage 1st gear and start driving.

### 3.20.4 Crew actions when overcoming a water obstacle

Overcome a water obstacle in first gear at an engine speed in the range from 1300 to 1500 rpm. Entry into the water, movement under water and exit from the water should be carried out smoothly, without a sharp change in the engine crankshaft speed.

Commands are given and the movement of the tank under water is adjusted from the shore via radio. All commands from the shore are received directly by the driver mechanic and listened to by the tank commander.

If radio communication with the shore is disrupted, the commander must restore communication via the R-168-25U-2 radio station. If it is impossible to restore communication, you must immediately stop the tank without stopping the engine and wait for instructions on further actions, taking measures to eliminate the radio communication fault.

When stopping the tank, using the stopping brake is not recommended.

To avoid stopping the engine under water, operation at an engine crankshaft speed of less than 1200 rpm is not allowed.

### 3.20.5 Crew actions after overcoming a water obstacle

Immediately after the tank leaves the water, the crew, without leaving the tank, must do the following:

– the commander from the control and indication unit PUDL of the AVSKU complex switches the driver to work via the intercom network;

– unlock the tower;

– open the sealing covers by turning the turret manually to the left to position 27-33 according to the azimuth indicator; open the covers while moving, at an engine speed of no more than 1800 rpm;

– set the OPVT - PPO switch on the P13 remote control to the PPO position;

After carrying out the above work, the tank is ready to fire from a cannon and coaxial machine gun.

**ATTENTION:**

**IT IS PROHIBITED TO ROTATE THE TURRET AT GUN DESCENT ANGLES IN THE AREA OF OPEN SEALING COVERS. ROTATION OF THE TURRET IN THE AREA OF OPEN SEALING COVERS IS ONLY POSSIBLE AT ELEVATION ANGLES OF THE GUN NOT LESS THAN 6 °!**

The first shot from a cannon with the muzzle seal of the cannon barrel not removed can be fired with any projectile.

**ATTENTION:**

**IN THIS CASE, A CAP MUST BE INSTALLED ON THE FUSE OF A HIGH-EXPLOSIVE FRAGMENTATION PROJECTILE!**

When subsequently moving by land, you must:

– turn off the signal light, if installed;

– Unscrew the nut securing the air supply pipe, push the pipe out of the hatch in the gunner's hatch cover and close the hatch cover;

– If there is no water in the tank, turn off the sump pump.

If it is necessary to fire from a remote machine gun mount, cock the machine gun and pump the control unit vertically to drain water from the barrel and receiver.

If, after overcoming a water obstacle, it is possible for the crew to exit the tank, the following must be done:

– depressurize the tank completely;

– drain the water from the housing;

– remove water from electrical equipment, surveillance and aiming devices in accessible places. Drain the water from the cavity of the outer cover of the gun's armor protection;

– remove water from the hull and turret gas flow systems (at an ambient temperature of less than plus 5 °C);

– clean the check valve of the water discharge pipe of the pump out pump from dirt and silt;

– remove water from the gun receiver and clean the gun if water gets into it;

– drain the water from the DPU magazines, wipe the ammunition dry;

– clean and lubricate the DPU machine gun;

– check the condition of the gaskets on the plates of the exhaust valves of the FVU, if necessary, replace the plates;

– install -standard caps and a shield on the VZU cover of the PKUZ 1A instrument complex. Place the caps with an extended cable in the spare parts box;

– check the condition and fastening of the armor protection seals of the gun and coaxial machine gun;

– check the possibility of dismantling the observation devices of the driver, commander and gunner from the mines;

– place removable equipment in standard places;

– inspect the external fuel tanks and, if there are no damages, include them in the fuel system;

– at an ambient temperature below plus 5 °C, drain the water from the tower's gas purification tank and blow through the housing and tower gas purification systems with compressed air, turning on five to ten times from each workplace;

– drain the water from the diesel generator compartment

– open plug 15 (Figure 6.2) on the aft module.

### 3.20.6 Crew exiting the tank onto the surface of the water

The crew's exit to the surface of the water is described in section 4.

### 3.20.7 Overcoming the ford

The ford is overcome in low gears, which are chosen depending on the steepness of the banks, the depth of the ford and the condition of the bottom soil. Entry into the water, movement under water and exit from the water are carried out smoothly, without a sharp change in the engine crankshaft speed. Changing gears and stopping the engine while wading is not allowed.

A ford with a depth of no more than 1.2 m can be overcome without special tank preparation.

To overcome a deeper ford (from 1.2 to 1.8 m), the following work must be done:

– make sure that the supercharger valves are closed;

– remove the shield, make sure that the caps are closed on the VZU fittings of the PKUZ-1A complex and install the shield in place;

– unscrew the plug from the water discharge hole using the pump;

– install exhaust valves with gasket;

– remove cover 2 (Figure 18.4 OPVT;

– install covers over the air inlets of the power compartment roofs;

– install removable rod 12;

– move the supporting brackets 7 for the covers above the exit blinds to a vertical position if fuel barrels are not installed;

– set the torsion bars of the covers above the entrance blinds to the working position, turn lever 14 to a position that ensures closing of the left cover 6 (parallel to the board);

– secure the stoppers 32 on the covers 6 and the roof of the MTO with cotter pins 33 taken from a single set of spare parts;

– cock the drive to the covers and close all the covers, turn lever 14 to the working position;

– remove lever 1 (Figure 18.3) and set it to working position;

– Install cover 2 (Figure 18.4) in its original place;

– open the tower hatch covers. If fording is carried out with the turret hatch covers closed, it is necessary to open the hatch in the gunner's hatch cover.

**ATTENTION:**

**IT IS PROHIBITED TO CLOSE THE TURRET HATCHES WITH THE CLOSED HATCH IN THE GUNNER'S HATCH COVER WHILE THE ENGINE IS RUNNING AND WHEN THE ENTRANCE AND EXIT WINDOWS OF THE MTO ROOF ARE SEALED!**

– close the upper window of the driver's observation device with the shutter in the presence of ice cover;
– close the driver's hatch;
– turn on the sump pump.

The driver controls the tank according to the commander's instructions.

After crossing the ford, open the sealing covers by turning the turret manually to the left to position 27-33 according to the azimuth indicator.

### 3.20.8 Training pipe-hole

To install a manhole pipe you need:
– lock the turret, give the gun an elevation angle of 10°;
– unscrew the two bolts securing the DZ containers;
– install adapter angles 6 (Figure 18.2), and instead of unscrewed bolts, fasten the angles with bolts taken from the group spare parts kit;
– install rubber cords 11 and 12 at the joints of the lower and upper pipes;
– install the lower pipe 7 on the open commander's hatch with brackets towards the rear of the tank;
– fasten the pipe with four ties 4 to the brackets 5 welded on the tower and the angles 6 so that the cups 8 are on the upper parts of the ties, while tightening the couplings 10 so that the direction of the faces of the nuts 9 of the ties coincides with the direction of the faces of the hexagons of the couplings, then slide the cups onto nuts and hexagons of the coupling, thereby preventing the couplers from unscrewing;
– extend and lock handrail 1 in the upper pipe 2;
– install the upper pipe 2 and tighten it with the lower pipe 7 with ties 3 until the joint is tight;
– seal the joints between the upper 2 and lower 7 pipes, as well as between the lower pipe and the commander’s hatch, with ZZK-3U putty.

The manhole pipe with fastening parts is included in the group spare parts kit for the tank, and the rubber cords are placed in a box in accordance with the list of the group spare parts kit.

## 3.21 Equipment for self-digging

### 3.21.1 Security measures

**PROHIBITED:**

**- WHEN TEARING OUT A TRENCH, BE CLOSER THAN 5 M FROM ITS EDGE;**
**- HOLD THE CROWBAR BY THE END WHEN MOVING THE BLADE TO THE WORKING POSITION (TO AVOID PRESSING YOUR HAND WITH THE CROWBAR TO THE GROUND)!**

### 3.21.2 Preparing equipment for self-digging

To carry out work using the equipment you must:
– lock the turret and give the cannon the maximum elevation angle;
– to avoid damage, remove the front folding flaps with the mud flaps installed on them, the axles of the flaps and place them near the intended trench, so that they do not interfere with the self-digging of the product;
– install the tank along the axis of the proposed trench and lower the blade into the working position on the ground.

Bringing the blade into working position is done manually by two people using a crowbar and a special crowbar available on the tank.

To move the blade to the working position you must:
– using the key 172.90.008сб (from a single set of spare parts for the tank), loosen the clamp bolts, while the blade will be held on the latch, turn the clamps 90° and screw the bolts in until they stop;
– insert a crowbar into the blade bracket, and holding the blade with a crowbar, press the latch down with a special crowbar and lower the blade to the ground;
– insert a special crowbar into the hole of the blade, lift the blade with it and remove the crowbar, then lower the blade to the ground and remove the special crowbar.

### 3.21.3 Rules and procedures for using equipment for self-digging

The total operating time of the tank in self-entrenchment mode should not be more than 25 hours.

On loose and soft soils (sand, peat, etc.), tear off the trench with the shuttle movement of the tank, track after track.

On dense soils that do not collapse under the tracks, tear out a trench 5 to 5.5 m wide along the surface of the soil, gradually narrowing as it deepens to approximately the width of the tank. Tear off the trench using a shuttle movement with shifts to the right and left and diagonal passes at small angles relative to the longitudinal axis of the trench. Move backwards with small turns.

When breaking out of a trench, move only in first gear and reverse gear.

The initial length of the trench is from 8 to 10 m. By gradually moving the tank back from its original position, as the depth of the trench increases, bring its length to a size of 10 to 14 m. After removing approximately half (in depth) of the trench, remove the tank from it and on command The commander reverses it and installs it on the opposite side of the trench, and then continues to dig it out to the specified depth.

When excavating a trench, do not allow an earthen parapet more than 1 m high to accumulate in front of it. Remove the parapet during subsequent passes by shifting the soil with a blade to a distance of 8 to 12 m.

**IT IS PROHIBITED TO TURN THE TANK AROUND WHEN MOVING FORWARD WITH A BURIED BLADE, OR TO DIG A TRENCH ON FROZEN AND ROCKY SOILS!**

Stop digging the trench if there are large boulders, brickwork, stumps, metal structures and other objects in the ground that could cause damage to the blade.

If the tank does not move during the process of breaking out of the trench with the gear engaged and the engine running for 3 to 4 seconds, immediately depress the clutch pedal and turn off the gear. Repeat the excerpt from the trench. If after two or three attempts the tank does not move, it is necessary to take it back and stop digging the trench.

To install the blade in the stowed position, you must:

– clear the soil from the blade, the lower nose sheet of the tank and the mounting parts of the blade in the stowed position;

– insert a special crowbar into the hole of the blade, lift the blade with it and insert the crowbar into the bracket;

– lift the blade with a crowbar and install it on the latch, to do this, press the blade against the lower nose sheet of the tank;

– secure the blade with clamps and bolts;

– Install the previously removed front flaps with mud flaps and fastening axles onto the product and secure with bolts.

## 3.22 Stowing a set of spare parts and service equipment

The stowage of a set of spare parts outside and inside the tank, as well as the stowage of service equipment, should be carried out in accordance with the list of a single set of spare parts, 188M.ZI-O, attached to the tank.

### 3.22.1 Laying a covering tarpaulin

Before laying, fold the covering tarpaulin along its larger side (10 m) into six panels, each approximately 0.9 m wide, and roll tightly on both sides into two rolls. The diameters of the rolls should be approximately the same. When rolling into a tarpaulin, roll up two ropes, folded along a length of approximately 1 m.

After rolling, tie the tarpaulin together with two straps and place it on the turret in a basket on the rear aft module.

### 3.22.2 Laying tow ropes

Towing ropes should be laid at the stern of the tank hull.

Lay the first tow rope as follows. Install one thimble into the bracket on the rear right flap of the fender and secure with a rod. Then place the cable on the support above the right rear marker light, place it under the brackets on the stern beam, place it in the left bracket on the stern beam and secure with a rod. Hook the other thimble onto the left rear towing hook.

Lay the second tow rope as follows. Install one thimble into the bracket on the rear left flap of the fender and secure with a rod. Then place the cable on the support above the left rear marker light, place it under the brackets on the stern beam, place it in the bracket on the bracket for fuel barrels and secure it with a rod. Hook the other thimble onto the right rear towing hook.

### 3.23 Separate operating and maintenance instructions

#### 3.23.1 The condition of the tank is "on the move"

In the “stowed” position, the fighting compartment and armament of the tank must be in the following state:

– the tower is stuck;

– the gun is unloaded and locked with a “travelling” rod, the bolt wedge is closed, the muzzle and breech parts are covered;

– the machine gun, coaxial with the cannon, is unloaded and sheathed;

– the machine gun from the DPU is unloaded;

– hatches for the commander, gunner and driver can be opened or closed depending on the situation;

– the wind sensor is covered;

– the FVU supercharger can be turned off or on depending on the situation;

– The control system is turned off;

– The AZR on the distribution boards of the tower are included, except for the AZ UPR., PKP GN, and the PKP on the right and EL. DESCENT, PNM and SPZ on the left distribution panels;

– The AZR on the driver's control panel is turned on, except for the AZR TDA and VODOPUMP;

– The AZR on the battery protection unit is turned on;

– AZ controls are in their original position;

– PTC is enabled (if necessary).

#### 3.23.2 Transferring a tank from traveling to combat position

To transfer the fighting compartment and armament of a tank from a traveling position to a combat position, you must:

– remove the covers from the muzzle and breech of the gun, from the wind sensor, from the coaxial machine gun, from the embrasure of the coaxial machine gun and place them in the basket on the aft module on the left;

– charge the DPU;

– close and lock the hatch covers from the inside;

– remove the gun mounting rod “in a traveling manner”, install the rod in the rack on the left bracket of the cassette lifting mechanism;

– unlock the tower;

– set the rollback indicator to the forward position;

– check the position of the guard (the gunner's side guard must be in the rearmost position, the commander's side guard must be raised and secured, the commander's footrest must be raised to the highest position);

– load the coaxial machine gun;

– check the position of the FVU valve (in uncontaminated areas it should be in the supercharger position, bypassing the absorber filter);

– turn on the FVU supercharger and make sure that there is pressure in the habitable compartments;

– open the gun bolt wedge;

– turn on the control system in the “MAIN” mode for the gunner and the “OBSERVATION” mode for the commander, if necessary, turn on the remote control;

– if necessary, turn on START;

– enable AZR SDR;

– turn on the PTC (if necessary).

In conditions of insufficient visibility, it is necessary to switch the aiming and observation devices to the appropriate modes.

In anticipation of hostilities, it is recommended to remove the fuel drums and drain the fuel from the external tanks, or remove the external fuel tanks.

#### 3.23.3 Rules for operating a tank in summer conditions

Summer operating conditions are characterized by a stable ambient temperature of plus 5 °C and above.

In summer, the MZN DV button. hold for no more than 1 minute.

Monitor the good condition of the mud and dust shields over the tracks, since if they are damaged, the amount of dust entering the air cleaner and inside the tank increases, and the conditions for observing the road worsen.

When the engine is idling for more than 30 minutes, it is necessary to briefly increase the rotation speed to 2000 rpm for a period of 3 to 5 minutes.

After driving through stubble or dry grass, clean the screens over the blinds, air cleaner screens and radiators.

Before the march, in anticipation of firing, it is necessary to seal the sections of the cannon and machine gun barrels with thick paper, tying the edges of the paper with thread or twine.

After sandstorms that caught tanks parked in open spaces or field conditions, it is necessary to carry out inspection and maintenance to the extent of ETO before starting operation.

Systematically check the electrolyte level in the batteries and, if necessary, add distilled water to the required level.

Prevent dust from entering components and mechanisms by observing the following refueling procedure and rules:

– before opening the filler caps and filling holes, clean the areas around the caps from dirt and dust and wipe them with a rag;

– check the cleanliness of refueling equipment (tools) before using it and, if necessary, thoroughly clean it of dust and dirt, rinse it in diesel fuel and wipe with a clean rag;

– For refueling, use clean fuel and lubricants from tightly closed containers to prevent dust from getting into it.

### 3.23.4 Rules for operating a tank in winter conditions

Winter operating conditions are characterized by a stable ambient temperature below plus 5 °C.

In winter conditions, fill the fuel system with diesel winter, arctic or TS-1, T-2 and RT fuels (see table 5 ) .

In winter conditions, fill the cooling system with low-freezing liquid brands “40” or “65” and “Tosol-A40M” or “Tosol-A65M”, while on the DKMV display in the DKMV menu in the SETTINGS submenu in the COOLANT TYPE item, set the type of coolant - antifreeze .

At positive or close to positive ambient temperatures, if, when filling the engine cooling system with low-freezing coolant, movement is limited by its temperature, it is allowed to turn on an increased stage in the fan drive.

Before parking the tank for a long time (more than 2 hours), pump out the oil from the transmission unit units.

In winter, keep the MZN pump on for no more than 2 minutes.

Long-term operation (more than 30 minutes) at idle or under load at oil and coolant temperatures below plus 65 ºC is not allowed.

At ambient temperatures below minus 20 °C, start the engine only using a combined method.

At ambient temperatures of minus 30 °C and below, it is recommended to install the left OPVT cover on the output blinds.

Drain any water that has accumulated on the bottom immediately after stopping the tank.

Before firing the cannon, remove the grease from the barrel and bolt, and then wipe them with a cloth soaked in grease, avoiding excessive lubrication, especially the firing mechanism and the working surfaces of the bolt.

To maintain performance and prevent defrosting of batteries installed on the tank, do not allow discharge to more than 25% of their capacity.

### 3.23.5 Operating a tank with a cooling system filled with water

Keep the tank heated or drain the water immediately after stopping the engine; the water temperature before draining should not be lower than plus 60 °C. Immediately after draining the water, fill the cooling system with low-freezing coolant. If there is not enough low-freezing coolant in the cooling system, pour 6 to 8 liters of low-freezing coolant through the radiator neck.

**ATTENTION:**

**WHEN DRAINING WATER, DO NOT INSTALL THE TANK WITH A LIST ON THE STARBOARD SIDE AND AN INCLINATION TOWARD THE BOW!**

To avoid the formation of ice jams, refill with hot water (from 80 to 90 °C) without interruptions, in the shortest possible time, in compliance with the following additional requirements:

– Before adding water, open the coolant drain valve by screwing the drain tip into it;

– As soon as a continuous stream of hot water flows from the drain valve, unscrew the tip and continue filling until normal;

– make sure there are no air pockets in the cooling system based on fluctuations in the water level when turning the heater on and off in the purge mode;

– start the heater.

## 4 Actions in extreme conditions

### 4.1 Crew actions in case of fire

If a fire is detected, it is necessary, without waiting for the system to automatically operate, to turn it on manually; to do this, you must perform the following steps:

– press the PO button on the P13 remote control or the PPO button on the left or right switchboard in the event of a fire in the habitable compartment;

– press the ZO button on the P13 remote control in case of a fire in the MTO;

– press and release the PO and 3O buttons on the P13 remote control during a simultaneous fire in the habitable compartment and the logistics department.

If the inscription PO or 3O on the P13 remote control continues to light, this means that the fire has not been extinguished and it is necessary to repeat the fire extinguishing operation. The disappearance of the inscriptions 1B, 2B, 3B, 4B on the P13 remote control indicates that the corresponding cylinder has worked.

When extinguishing a fire in the crew compartment, crew members must hold their breath as much as possible, open their hatch covers and breathe only through them. If the situation allows, the crew must leave the tank and stay outside the tank until it is completely ventilated from the fire extinguishing agent and combustion products. When extinguishing a fire in the MTO, the crew remains in place and continues to perform the task.

Extinguishing fires inside and outside the tank, including napalm-type fire mixtures, can be done with a manual halon fire extinguisher. To do this, point the fire extinguisher with the nozzle in the direction of the fire and open the shut-off valve. When extinguishing a fire externally, if the situation allows, the crew must stop the engine and extinguish the fire. If the situation does not allow leaving the tank, the crew can continue to carry out the combat mission, but to prevent combustion products from entering the tank, it is necessary to stop the engine.

If fire mixture gets on aiming and observation devices, it is necessary to remove the burning fire mixture from the glass of the devices using the GPO system.

After extinguishing the fire, if the situation allows, it is necessary to carry out a control inspection and repair the damage caused by the fire. As soon as possible, replace expired fire extinguishing cylinders, fire extinguishers and fire extinguishing aerosol generators.

### 4.2 Crew exiting the tank onto the surface of the water

The crew's exit to the surface of the water is possible only after the tank is flooded, and all crew members are required to wear insulating gas masks and life jackets.

The tank is flooded only at the command of the crossing director. If there is no communication with the shore and the crew is wearing insulating gas masks in the “combat” position for more than 30 minutes, as well as if there is a threat of flooding, the tank commander independently makes a decision for the crew to leave.

Each crew member comes to the surface from the flooded tank through his own hatch. If necessary, the driver and gunner can exit through the commander's hatch, and the commander through the gunner's hatch.

The transition of the driver to the commander's seat should be done on his back, head first, while avoiding squeezing the breathing bag of the insulating gas mask.

The exit of crew members and transitions are possible in IP-5 gas masks and life jackets worn over summer uniforms. When overcoming a water obstacle in winter clothing, winter jackets must be removed and placed inside the tank.

Commander actions:

– give a command to the crew members to begin preparing the tank for flooding;

– hand over the signal cord (previously taken from the spare parts kit) to the driver;

– remove the headset;

– turn on emergency lighting;

– fold down the top part of your seat rail;

– lower the seat all the way down;

– remove the magazine with the belt for the coaxial machine gun;

– remove the sleeve catcher and move the sleeve catcher bracket aside, removing it from the latch;

– remove the magazine with the belt for the coaxial machine gun from the VT deck under the PRMD unit, fold back the grips of its fastening on the VT deck;

– remove the footrest;

– open the hatch cover lock, lock the lock handle in the open position;

– upon receipt of reports from crew members about readiness for flooding, give the command to the crew to transfer the IP-5 gas masks from the “ready” to the “combat” position and check the serviceability of their operation;

– after receiving reports about the proper operation of gas masks, give the command to flood the tank;

– After the tank is completely flooded, open the hatch cover and float to the surface.

Gunner actions:

– remove the headset;

– move the seat guard panel forward all the way;

– at the command of the tank commander, transfer the IP-5 gas mask from the “ready” position to the “combat” position, check the serviceability of its operation;

– open the hatch cover lock, lock the lock handle in the open position, and then report to the commander about your readiness for flooding;

– after receiving a command about flooding, remove the left rear observation device;

– After the tank is completely flooded, open the hatch cover and float to the surface.

Actions of the driver:

– remove the headset;

– turn on the emergency lighting and turn off the battery switch;

– remove the parking brake pedal from the latch;

– make sure that the handles for closing and turning the hatch cover are in the unlocked position;

– tilt the seat back;

– at the command of the tank commander, transfer the gas mask from the “ready” to the “combat” position and check that it is working properly, and then report to the commander about readiness for flooding;

– after receiving a command about flooding, remove the monitoring device;

– after the tank is completely flooded, open the hatch cover, turn your back forward for ease of exit and float to the surface.

The tank flooding time through the gunner's and driver's observation device shafts is approximately 1.5 minutes at a depth of 5 m. A sign of complete tank flooding is the spontaneous opening of the turret hatch covers.

During flooding, communication between the commander and the gunner is maintained visually, by voice and by touching the hand, and between the driver and the commander by transmitting conventional signals using a signal cord or striking the tank with a metal object.

### 4.3 Transfer of crew members from the control compartment to the fighting compartment and back

The tank provides places for crew members to move from the fighting compartment to the control compartment and back - when they are replaced at work or evacuated from the tank.

The commander and gunner move from their places to the driver's workplace and back through the opening between the turret ring and the rotating conveyor deck when the turret is positioned according to the azimuth indicator in the zones indicated in Figure 19.1.

In this case, the transition is ensured at any position of the tower, except for the zones according to the azimuth indicator from 11-00 to 20-00 (the transition point is covered by the mechanism for raising the commander’s seat, a rack for stowing and mounting the commander’s AKS-74U assault rifle), from 32-00 to 37- 00 (the transition point is covered by the front part of the gunner's seat mounting bracket) and from 52-00 to 1-18 (the transition point is covered by the cassette lifting mechanism, a rack for stowing and mounting the gunner's AKS-74U assault rifle).

If elements of the tank structure overlap the transition area, it is necessary to rotate the turret to a position that allows the transition.

The commander's transition to the driver's seat and back is carried out at the turret position, respectively, from 32-00 to 20-00 and from 11-00 to 1-18 according to the azimuth indicator. Lowering the gun makes the transition easier.

The transfer of the gunner to the driver's place and back is carried out at a turret position from 37-00 to 52-00 according to the azimuth indicator.

The transition of the commander to the gunner's place and vice versa is carried out above the breech and the frame of the pallet removal mechanism - with the gun raised to the maximum elevation angle, the commander's seat guard folded forward and the movable guard of the gunner's seat moved forward.

When evacuating from a tank through the driver's hatch or emergency exit hatch, the driver opens the corresponding hatch and leaves the tank, the gunner and commander alternately move to the driver's place and leave the tank.

To open the emergency exit hatch, it is necessary to remove the backrest 2 of the driver’s seat 1, the fire extinguisher 14, the “AB” first aid kit case 4 and the infantry shovel 3.

The dependence of the removed assembly units, a single set of spare parts, ammunition and other equipment on the position of the turret during transitions is given in Table 13.

Table 13

| Tower position according to the azimuth indicator | What's being filmed | Who's filming |
|---|---|---|
| 1-18...11-00 | Backrest 10 and seat 9 commander.<br>Two magazines 7 with a belt for a coaxial machine gun, mounted on the VT flooring (behind the commander’s seat 9) | Commander or driver |

| Tower position according to the azimuth indicator | What's being filmed | Who's filming |
|---|---|---|
| 20-00…32-00 | Magazine 7 with a belt for the coaxial machine gun and a commander's footrest 8, mounted on the VT flooring (in front of the commander's seat 9). Shell catcher 6 and magazine 7 with a belt for the coaxial machine gun (in the cartridge tray), mounted on the gun | Commander or driver |
| 37-00…43-00 | Turn the gunner's footrest 13 towards the gun to a fixed position | Gunner or driver |
| 43-00…52-00 | Back 11 and seat 12 of the gunner.<br>Magazine 7 with a belt for a coaxial machine gun, mounted on the VT flooring (behind the gunner's seat 12) | Gunner or driver |

removed during transitions are placed in free places in the tank:

– driver in the bow of the control compartment;

– commander and gunner under the cannon and MUP frame.

## 5 Maintenance

### 5.1 General instructions

Maintenance is understood as a set of works to maintain the functionality or serviceability of the tank when used for its intended purpose.

Maintenance prevents premature wear of components and the tank as a whole and maintains it in constant combat readiness.

Before maintenance, the tank must be cleared of dirt, snow and dust.

Maintenance of the tank must be carried out by personnel familiar with this operating manual.

The oils and lubricants used must be clean and meet the requirements of relevant standards and specifications.

Lubricant filling points are shown in Figure 21.1.

In winter, before refueling, heat the lubricant to a temperature of plus 60 to plus 70 ° C. Heating with an open flame is not allowed.

Replace the lubricant in the mechanisms immediately after running, while the mechanisms are still warm.

**ATTENTION:**

**IT IS PROHIBITED TO REFILL MECHANISMS LESS FREQUENTLY THAN INDICATED IN THIS MANUAL, AND ALSO TO EXCEED THE SPECIFIED AMOUNT OF LUBRICANT TO BE REFILLED!**
**WHEN WASHING THE TANK FROM THE OUTSIDE, WATER ENTERING THE ENGINE THROUGH THE OUTLET PIPE AND INTO THE VZU OF THE PKUZ-1A COMPLEX IS NOT ALLOWED!**

### 5.2 Security measures

Work related to maintenance and troubleshooting must be carried out only with serviceable tools and accessories with the engine not running and the battery switch turned off. In this case, it is necessary to take into account the possibility of hot coolant and oils in the pipelines and assemblies of the tank, as well as the presence of high pressure.

**ATTENTION:**

**IT IS PROHIBITED TO CARRY OUT WELDING WORK ON A TANK LOADED WITH AMMUNITION, AS WELL AS DIRECTLY ON THE KDZ SECTION EQUIPPED WITH EDS!**

It is allowed to carry out welding work without dismantling the EDZ if the heating of the sections does not exceed the temperature withstandable by the palm of the hand. Work in the immediate vicinity of the section with EDS should be carried out for no more than 7 minutes, while ensuring protection from flames or splashes of molten metal. Continue work after the section has cooled to ambient temperature.

When carrying out electric welding work on the tank hull, connect the “negative” wire from the welding machine only to the mounting bolts for spare tracks on the stern or to the guide brackets of the front flaps, using their fastening bolts.

When welding on the tower, use any bolts on the outer surface of the tower. The contact point between the negative wire of the welding machine and the tank body must be cleared of paint and grease. Sparking at the point of contact is not allowed.

Work on the installation and dismantling of high-pressure pipelines should be carried out with the valves of the air cylinders closed and there is no pressure in the pipelines.

Remove used anti-smoke filters of weapons of mass destruction equipment from the tank using tweezers, avoiding touching them with unprotected hands.

Do not use open fire when inspecting batteries, fuel tanks, and ammunition.

When carrying out work in the engine compartment, the roof above it must be supported with rods. When checking the functioning of the EPS from the rangefinder, it is necessary to take measures to prevent laser radiation from entering the eyes, including through optical instruments.

### 5.3 Types and frequency of maintenance

To maintain the tank in technically sound condition during its operation before major repairs, the following types of maintenance are provided:

– maintenance when used as intended, including:

- daily maintenance (ETM) - after any use of the tank, regardless of operating hours;
- maintenance No. 1 (TO-1) - every $2500^{+200}$km, but not less than after 150 hours of engine operation;
- maintenance No. 2 (TO-2) - every $5000^{+200}$ km, but not less than after 300 hours of engine operation;
- seasonal maintenance - when preparing the tank for operation in summer or winter conditions.

– maintenance during storage.

Regardless of the tank's operating time in kilometers, the following tank maintenance operations are performed depending on the engine's operating hours, or depending on the elapsed period of time, with a note in the tank's log-book:

– changing the oil in the engine lubrication system, servicing the MAF oil filter, MC-1 oil purifier, fine fuel filters, in accordance with Table 14. After replacing the filter bags, the seals on the fuel filter must be restored with a seal from the operating facility with a mark in the engine passport;

– tightening the engine injector mounting nuts using a torque wrench with a force of 30 to 35 N ·m (3 to 3.5 kgf ·m) from the engine spare parts group kit - every 350 hours;

– replacing the compressor filter every 500 hours of engine operation;

– replacing the coolant in the air conditioner - once every 2 years;

– re-examination of air system cylinders and PPO system cylinders - once every 5 years with the replacement of squibs with new ones (for PPO cylinders);

– replacing the battery of the electronic unit PI of satellite navigation equipment - once every 5 years;

– changing PDF frames when operating a tank with the PKUZ-1A instrument system turned on and in the presence of snow cover - every 500 km;

– changing the oil in the hydraulic system of the HV stabilizer drive - once every 6.5 years or every 425 hours of operation of the stabilizer;

– gun maintenance is combined with regular tank maintenance and is performed in accordance with the technical description and operating instructions for the 2A46M-5 gun:

- TO-1 - after 150 shots, but at least once a year;
- TO-2 - after 450 shots, but at least once every 3 years.

Table 14

| Oil brand | Oil change frequency, h | Maintenance frequency, h | | | |
|---|---|---|---|---|---|
| | | MC-1 | | MAF | Fine fuel filters |
| | | Normal conditions | Particularly dusty conditions | | |
| ВНИИНП М – $5_э/16Д_2$ | 350 | 50 | 25 | 150 | 350 |
| М – $14Г_2$(к) | 150 | 50 | 25 | 50 | |
| Mobil1 | 300 | 125 | 50 | 150 | |
| М – $12Г_2$ | 300 | 125 | 25 | 150 | |
| N o t e - It is allowed to remove the seal on the nuts securing the cups of the cover of fine fuel filters | | | | | |

For the gun, seasonal, regulated maintenance during storage and current repairs must be carried out in accordance with the technical description and operating instructions 2A46M-5.

Once a year or based on the results of a control and technical (current) inspection, remove and send the PKUZ-1A instrument complex for maintenance No. 3 (checking the “P” circuit) to a specialized enterprise.

All types of radio maintenance are performed within the tank maintenance period.

Malfunctions identified during operation should be eliminated during technical maintenance, except in cases where the malfunction does not allow the task to be continued or continued operation leads to an emergency condition.

If necessary, replenish a spent single set of spare parts during maintenance.

Upon completion of maintenance, the tank must be technically sound and fully filled with fuel and lubricants and special liquids. The presence and quantity of ammunition in the tank is determined by the decision of the operating organization.

Maintenance of the diesel generator set is carried out according to the operating time meter of the diesel generator set with the frequency indicated in Table 15. The fact of technical maintenance of the diesel generator set must be recorded on the tank’s form.

Table 15

| Type of maintenance | Frequency or duration |
|---|---|
| Control inspection (CR) | Before each use |
| Daily Maintenance (DTO) | Once a day after finishing work, regardless of operating hours |
| First maintenance (TO-1) | 250 hours |
| Second maintenance (TO-2) | 500 operating hours |

| Type of maintenance | Frequency or duration |
|---|---|
| Seasonal Maintenance (MS) | When preparing a tank for operation in summer or winter conditions |

### 5.4 Daily Maintenance

The scope of daily maintenance work is outlined in Table 16.

Table 16

| Operations Performed Maintenance | Directions on implementation | Tools used , accessories and materials |
|---|---|---|
| **Operations performed after any use** | | |
| Refill the tank with fuel | Carry out, guided by the instructions of paragraph 2.3.8of this manual | Handle wrench 27 mm , s t r e n for measuring oil and fuel levels V tank x , rags |
| Refill the engine lubrication system oil | Carry out, guided by the instructions of paragraph 2.3.6of this manual | |
| Check for the absence of water and condensate in the diesel generator compartment; if there is any, drain it | The diesel generator compartment must be dry and clean. Drain the condensate by unscrewing plugs 11 (Figure 4.4) or removing hatch 17 | Keys 17, 19mm, rags |
| Refill the GPO systems with water (when operating in the summer ) | Carry out, guided by the instructions of paragraphs. 5.8.19.1, 5.8.19.2of this manual | Key 22 mm , funnel with filter and tip , clean water |
| Make sure absence leaks from systems power installations, hydraulic systems of transmission units | Check the condition of the grids output blinds. At absence mesh leaks weekend blinds must be dry and h pure | |
| Check charge PPO balls | The charge of the corresponding cylinders is indicated by the inscriptions 1B, 2B, 3B and 4B na remote control P13, fully lit when turned on battery switch | - |
| Check pressure air x a in cylinders air systems | The air pressure in the cylinders should be 120-160 кгс/см$^2$. After checking, close the air cylinder valves | - |
| Check tension tracked tapes (fulfill through every 300 – 400 km mileage) | Check, following the instructions in paragraph 3.11.1of this manual | Device for measurements track sagging , key For track tension, crowbar, ruler 300d GOST 427-75 |
| In accessible places, visually check the condition of the components and bolted connections of the chassis elements and flanges of the final drives | If the fastening is loosened, tighten the bolts . To loosen a bolt , check the situation by hammering it . Check the chassis components in accordance with clause 5.8.13.1. If necessary, perform a full check in accordance with clause 5.8.13.2of this manual. | Hammer , track maintenance wrench, keys 27, 36, 41 mm, crowbar, ruler 300d GOST 427-75 |
| Clean optical surfaces of prisms surveillance devices, optical surfaces of TSN, TV cameras SN V, rear view cameras, input windows of OR heads | Metal parts rub vet about sewing, optical surfaces - napkin from single sets of spare parts TSN and CH B (from a single set of spare parts for the tank). S o p tic surfaces first remove dust and grains of sand , soak the dirt with water , then wipe with a clean napkin , doing circular movement from the center to the edges | Rags, napkins made from single Spare parts TSN and START |
| After use tank with included PKUZ-1A change PDF frame in block B - 2 | - | - |
| Check the secure fastening of the ammunition in the racks and the spare parts kit inside and outside the tank | Ammunition And kit Spare parts must be securely fastened | Handle wrench 27 mm , keys 19 and 22 mm , pliers , cotter pins |
| If necessary, make adjustments or enter radio data, setup data and key information into the KSS equipment | Carry out, guided by the instructions of paragraph 3.5.3.3of this manual | |
| **- shooting operations** | | |
| Perform operations in the scope of ETO guns | Execute immediately after the shooting, hands on, guided by the instructions of the operational documentation for the gun supplied with tank | According with operational documentation on the cannon attached to tank |
| Clean out And lubricate coaxial machine gun And machine gun DPU | Execute immediately after the shooting, hands on instructions 6P7K.00.000 TO and 6P49 00 000 08RE attached to tank | According with 6P7K.00.000 TO and 6P49 00 000 08RE attached to tank |
| Clean out And lubricate system launchers setting the curtain | Execute immediately after the shooting, manually , guided by the instructions of clause 5.8.23.2 | Set Spare parts s and systems 902, portable lamp, diesel fuel, lubricant , rags |

| Operations Performed Maintenance | Directions on implementation | Tools used , accessories and materials |
|---|---|---|
| **Operations after use DGU** | | |
| Check the oil level in the diesel engine crankcase, top up if necessary | Check, guided by clause 5.8.15.1of this manual | 19 mm wrench, rag |
| Check the coolant level in the expansion tank of the diesel generator set, top up if necessary | The liquid should be at a level between the lower edge of the expansion tank neck and the bottom under the neck | Wrench 19 mm , wrench 27 mm |
| When indicator 55 lights up (Figure 10.11), replace the filter element of the diesel generator air filter | Replace according to clause 5.8.15.4of this manual | 19 mm wrench, rag |
| **Operations performed after overcoming contaminated area of the nose** | | |
| Carry out complete decontamination, degassing or disinfection of the tank and cavities of the FVU | Carry out in accordance with current job descriptions | TDP (if necessary) |
| **Operations performed on the wrong side of the gun** | | |
| Clean the channels of the gun barrels, coaxial machine guns, DPU machine guns, launchers installations SDR from lubrication | Carry out in accordance with the operating instructions. document on the cannon and machine guns attached To tank | According with operational documentation on the cannon and machine guns attached to tank |
| Perform operations within the scope of the gun's KO | Carry out in accordance with the operating instructions. document on the cannon attached To tank | - |
| Check the condition of the cassettes AZ and at necessity clear cassette, bottom under VT and capture of the IPC | Carry out following the instructions in paragraphs. 5.8.4.1, 5.8.4.2of this manual | - |
| Check the functionality of the AZ | Carry out in accordance with the instructions in paragraph 3.2.6.4of this manual | - |
| Check that the entries are correct values IPM for compliance with the tank registration form. Check the functioning of the sensors Calculator block menu | Values IPM should correspond to the tank form. D a tchi-k i v BV menu should to be in position ON or AVT , indications should correspond to reality (visual) | - |
| Check operation OMS in MAIN and DOUBLE modes, with verification functioning TC PNM And T K PKP | Check by switching on, following the instructions in paragraph 3.3.4of this manual | - |
| Check excess pressure (backup) in habitable department | Check, guided by the instructions in paragraph 3.17.4of this manual | - |

### 5.5 Maintenance No. 1 and No. 2

The scope of maintenance work No. 1 and No. 2 is outlined in Table 17.

Table 17

| Job title | Type of maintenance | | Implementation instructions | Tools and operating materials |
|---|---|---|---|---|
| | TO-1 | TO-2 | | |
| **Department of Management** | | | | |
| Service AB | + | + | Maintain AB in accordance with the ED for batteries attached to the tank | - |
| Check the functionality of the software system using the CHECK button | + | + | Check, guided by the instructions in paragraph 3.16.3of this manual | - |
| Check the operation of the fire alarm system from the manual fire alarm buttons | - | + | Check, guided by the instructions in paragraph 3.16.4of this manual | - |
| Check the serviceability of the PPO system circuits using the KPK13 device | - | + | Check, guided by the instructions in paragraph 5.8.21of this manual | Device KPK13 from a group kit of spare parts for a tank |

| Job title | Type of maintenance | | Implementation instructions | Tools and operating materials |
|---|---|---|---|---|
| | TO-1 | TO-2 | | |
| Clean the glass of the optical sensors of the PPO system from dirt | + | + | Wipe the glass with a flannel cloth | Flannel napkin |
| Check the functionality of the PKUZ-1A instrument complex (without issuing commands to the actuators) | + | + | Check, guided by the instructions in paragraph 3.17.7of this manual | - |
| Check the functionality of the 3ETs13-1 equipment using the ORB button | + | + | Check, guided by the instructions in paragraph 3.17.7.2of this manual | - |
| Replace the silica gel cartridge on the B-2 sensor of the PKUZ-1A instrument complex | - | + | Replace according to the instructions in paragraph 5.8.22.5of this manual. | - |
| Replace the filter elements of sensor B-2 | - | + | Replace according to the instructions in paragraph 5.8.22.4of this manual | - |
| Clean the heater and filter compartment from dust | - | + | Replace according to the instructions in paragraph 5.8.22.3of this manual | - |
| Remove the driver's mechanic's observation device, clean the device and the device shaft from dust and dirt. | + | + | Remove the device without using a tool | Rags, napkins |
| TVN-5 device: | | | Check, guided by the instructions in paragraph 3.13.4of this manual | External diaphragm from the spare parts kit, head S 19 mm GOST R 57977-2017 with extension, flannel cloth |
| - check functionality; | + | + | | |
| - check the consistency of the optical axes of the FG 125 headlights with the optical axis of the device; | - | + | | |
| - check the operation of electric heating | + | + | | |
| TV rear view camera: | | | | - |
| - check the functionality of the television camera; | + | + | Check switching on according to clause 3.13.2.1of this manual | |
| - check the operation of the electrical heating of the protective glass of the television camera; | + | + | | |
| - check the functionality of the pneumatic drive of the camera protection damper | + | + | | |
| Drain the sediment from the air system sump | - | + | Place a rag under the sump and unscrew the drain plug 2-3 turns (do not drain the sludge at subzero temperatures) | Socket wrench 17 mm, rags |
| **Engine - transmission compartment** | | | | |
| Blow out the starter-generator with compressed air | - | + | Blow, guided by the instructions in paragraph 5.8.14.1of this manual | Head S 19 mm GOST R 57977-2017 with extension, MTO compressor, hose |
| Flush the hole in the float valve of the fuel supply system | - | + | Rinse only when operating in very dusty conditions.<br>The washing procedure is as follows:<br>- unscrew the fitting from the hexagon of the plug;<br>- wash the fitting and the hole in the plug with diesel fuel;<br>- install the fitting in place, replacing the rings if necessary and secure with wire | Head S 27 mm GOST R 57977-2017 with extension, pliers, wire KO-1.2x200 Diesel fuel, rags, ring 18x24, TU 4753-022-03965181-2004 |
| Flush the centrifugal oil purifier MC-1 | + | + | Rinse according to the instructions in paragraph 5.8.6.3of this manual | Device for disassembling the MTs-1 filter (includes engine spare parts), head S 24 mm GOST R 57977-2017 with extension, wrench 36 ммGOST 2841-80, bucket, diesel fuel, rags |
| Clean the MAF oil filter | - | + | Rinse according to the instructions in paragraph 5.8.6.4 | Socket wrench 54.28.116sb-A, rags, diesel fuel, syringe press |

| Job title | Type of maintenance | | Implementation instructions | Tools and operating materials |
|---|---|---|---|---|
| | TO-1 | TO-2 | | |
| Check the tightness of the clamps in the connections of the air supply pipe with the air cleaner and the connection between the air intake and the compressor | + | + | Shakiness and movement of clamps is not allowed. If necessary, tighten the clamps | - |
| Check (without disassembling) the condition of the connections of the engine exhaust manifolds with gas lines, the turbocharger with gas lines and the exhaust pipe | - | + | Pay attention to the reliability of locking the bolts and nuts, to the absence of leaks and penetration of exhaust gases from under the clamps, to the integrity of the sealing gasket on board | - |
| Clean the inertial grid entrance grid from dust and dirt | + | + | - | Brush |
| Check the operation of the TDA system | + | + | Check switching on before placing the tank for maintenance | - |
| Wash the filter of the pump-out line of the hydraulic system of the transmission unit | + | + | Check, guided by the instructions in clause 5.8.10.3of this manual | Head S 14 mm GOST R 57977-2017 with extension, syringe, bucket, diesel fuel, rags, oil |
| Change the oil in the hydraulic system of the transmission unit | - | + | Check, guided by the instructions in clause 5.8.10.2of this manual | Keys for plugs in the bottom and chassis components, head S 14 mm GOST R 57977-2017 with extension, handle wrench 27 mm, rod, bucket, syringe, funnel, oil drain tip, oil, rags |
| Check that the hydraulic system of the transmission unit is completely filled | + | - | Check, guided by the instructions in paragraph 2.3.10of this manual | Handle wrench 27 mm, rod |
| **DGS compartment** | | | | |
| Clean the external surfaces of the diesel generator set and the radiator of the cooling system from dust and dirt | + | + | Carry out, guided by the instructions of paragraphs. 5.8.15.6, 5.8.15.7of this manual | 19 mm wrench, compressed air, rags |
| Replace the engine oil and oil filter | + | + | Carry out, guided by the instructions of clause 5.8.15.2of this manual | 19 mm wrench, oil filter remover from a single set of spare parts DGU10, engine oil, oil filter, rags |
| Check the performance of the diesel generator set | + | + | Check by starting the engine and listening to the operation of the diesel generator set. Extraneous noise is not allowed | - |
| Replace the fuel filter | - | + | Replace according to clause 5.8.15.5of this manual | 14 mm wrench, rag, fuel filter |
| Replace coolant in the cooling system | - | + | Perform at every second maintenance-2, guided by clause 5.8.15.3of this manual | Wrench 27 mm, 19 mm, coolant, bucket, rags |
| **Combat compartment** | | | | |
| Inspect and, if necessary, clean the bottom under the rotating conveyor and VCU from dust, dirt and foreign objects | + | + | Clean according to the instructions in clause 5.8.4.1of this manual | - |
| Clean the glass of the optical sensors of the PPO system from dirt | + | + | Wipe the glass with a flannel cloth | Flannel napkin |
| Check the slipping torque of the rammer clutch | - | + | Check, guided by the instructions in paragraph 5.8.4.3of this manual | Device for measuring torque, head S 24 mm GOST R 57977-2017 with extension, screwdriver, dynamometer from tank group spare parts |
| Check the operation of the stoppers and hatch cover locks | - | + | The mechanisms must work freely, without jamming and reliably perform their functions. If necessary, wash and lubricate the mechanisms | Head S 14 mm GOST R 57977-2017 with extension, screwdriver, syringe, diesel fuel, rags, compressed air, lubricant |

| Job title | Type of maintenance | | Implementation instructions | Tools and operating materials |
|---|---|---|---|---|
| | TO-1 | TO-2 | | |
| Check the cotter pins for securing the upper and lower turret straps | - | + | If the cotter pin is broken, tighten and tighten the bolts securing the shoulder strap | Key for the shoulder strap fastening bolts, socket wrench 32x36 54.28.116sb-A, crowbar, wrench 36 mm GOST 2841-80, wire KO-1.6 |
| Lubricate the sector on the gun cradle and the lifting mechanism gear | + | + | - | Rags, lubricant |
| Tighten armor mask bolts | - | + | Bolt tightening torque: (400 ±30) N ·m ((40 ±3) kgf m) | Socket wrench 32x36 54.28.116sb-A |
| Tighten the gun trunnion wedge bolts | + | + | Bolt tightening torque: (400 ±50) N ((40 ±5) kgf) at shoulder (0.425 ±0.025) m | Socket wrench 172.90.004sb |
| Check the serviceability and reliability of fastening of the installation parts of the coaxial machine gun and the DPU machine gun | + | + | If the bolts are loosened and the cotter pins are broken, tighten and tighten the bolts | Heads S 10, 12, 14 mm GOST R 57977-2017 with extension |
| Perform maintenance of the PKTM machine gun and 6P49 machine gun | + | + | Carry out in accordance with 6P7K.00.000 TO and 6P49 00 000 08 RE | Sets of single spare parts for machine guns, rags, lubricant |
| Check the appearance, cleanliness and fastening of the components of UARMK, SO, KSS | + | + | Remove dirt with a rag, and from the screens with a clean calico napkin. Check the reliability of fastening of all blocks, if necessary, tighten the fastening parts | Rags, calico napkin |
| Check the functionality of the automated control system | + | + | Check by switching on, following the instructions in paragraph 3.5.2.5of this manual | - |
| Check the functionality of the system | + | + | Check by switching on, following the instructions in paragraph 3.5.4.4of this manual | - |
| Perform CO calibration | - | + | Carry out, guided by the instructions of paragraph 3.5.4.3of this manual | - |
| Check the functionality of the radio station R-168-25U-2 | + | + | Carry out, guided by the instructions of clause 3.5.3.4.1of this manual | - |
| Check the functionality of the R-168MRA radio station | + | + | Carry out, guided by the instructions of paragraph 3.5.3.3of this manual | - |
| Check the functionality of the 450B product | + | + | Carry out, guided by the instructions of clause 3.5.3.8.1of this manual | - |
| Check the functionality of the AVSKU complex | + | + | Carry out, guided by the instructions of paragraph 3.5.3.6.1of this manual | - |
| Check the condition of silica gel in the desiccant absorbers on the BSMP PNM, BZ PKP, PDT module and in the drying indicators BOE PKP, BVD PNM and BI DI | + | + | Having provided access to the desiccant and drying indicators, make sure through the protective glass that the silica gel has a bluish-blue color. If the silica gel turns white or pink, replace the desiccant or drying indicator on the appropriate unit. | Head S 12 mm GOST R 57977-2017 with an extension, a key for removing the desiccant (drying indicator) from a single set of spare parts for a multi-channel gunner's sight (PKP or PDT) |
| Check the condition of silica gel in the TPK-K desiccant | + | + | Make sure through the protective glass that the silica gel is light blue to blue in color. If the silica gel turns gray-pink, replace the TPK-K desiccant | Key for removing the TPK-K desiccant from a single set of spare parts for a multi-channel gunner's sight (TPK-K spare parts) |
| Check the alignment of the ISM sighting channel against a remote point or against an alignment target at 100 m, followed by adjustment of the built-in control system | + | + | Check the reconciliation, guided by paragraphs. 3.3.8.2.2, 3.3.8.2.4of this manual | Technological plug 7600.0136.610 from a single set of spare parts for a multi-channel gunner's sight, calibration target at 100 m |
| Check the alignment of the control panel TV channel in the “double” mode | + | + | Carry out, guided by the instructions of paragraph 3.3.8.3.2of this manual | 100 m calibration target |
| Check the DPU reconciliation | + | + | Carry out, guided by the instructions of paragraph 3.4.1of this manual | 100 m calibration target |
| Check the DTP reconciliation | + | + | Carry out, guided by the instructions of paragraph 3.3.8.4.3of this manual | 100 m calibration target |

| Job title | Type of maintenance | | Implementation instructions | Tools and operating materials |
|---|---|---|---|---|
| | TO-1 | TO-2 | | |
| Check the alignment of the ISM rangefinder channel and the laser control channel relative to the ISM sighting channel | + | + | Carry out, guided by the instructions of paragraphs. 3.3.8.2.9, 3.3.8.2.10of this manual | - |
| Check the alignment of the rangefinder channel of the control panel relative to the TV channel of the control panel | + | + | Carry out, guided by the instructions of clause 3.3.8.3.9of this manual | - |
| Check the alignment of the PNM thermal imaging channel | + | + | Carry out, guided by the instructions of paragraph 3.3.8.2.6of this manual | 100 m calibration target |
| Check the alignment of the thermal imaging channel of the control panel | + | + | Carry out, guided by the instructions of paragraph 3.3.8.3.6of this manual | 100 m calibration target |
| Check the functioning of the BCOI | + | + | Check the possibility of acquisition, auto-tracking, re-targeting, resetting target acquisition, target designation with automatic re-acquisition, guided by clause 2.10.11 188M.RE Part 1 | - |
| Check the correctness of the entered values of the sensor parameters in the calculator unit menu while simultaneously checking the functioning of the Pn-PNM and Pn-PKP | + | + | Carry out in accordance with clause 3.3.5.13.3of this manual | - |
| Check the functioning of the PNM | + | + | Check that the ISM is turned on, the mirror is pointed, the displayed indication is correct, the range can be measured, the reticle illumination is turned on | - |
| Check the operation of the control panel | + | + | Check that the control panel is turned on, VN and GN guidance, the correctness of the displayed service information, the ability to measure range, switching between TV and TP channels, switching fields of view | - |
| Check the functioning of the PDT in the presence of the tank's on-board network | + | + | Check the activation of the PDT from the gunner's and commander's positions, the correctness of the displayed service information, and the ability to measure range | - |
| Check the charge level of the backup power supply unit PDT | + | + | Check by turning on the PDT from the gunner's position when the PDT is powered from the BPR (AZR PNM and PKP are turned off). The test should be carried out in the shortest possible time to avoid discharge of the battery in the BPR.<br>When the battery charge is less than 60%, replace the battery in the BPR or replace the BPR | - |
| Check the functioning of the heating of the protective glass PNM | + | + | Make sure that the switch for the types of shells and the type of weapon on the launcher of the control system and AZ is not in the U or UN position. Press the<br>“ ↑↑↑ ” button on the Mon-PnM and make sure that the indicator above the button lights up | - |
| Check the functioning of the heating control panel protective glass | + | + | Press the HEATING button on the Mon-alarm control panel and make sure that the HEATING indicator Mon-alarm control panel lights up | - |
| Check the functioning of the heating of the protective glass PDT | + | + | Press the “ ↑↑↑ ” button on Mon-PDT and make sure that the indicator above the button lights up | - |

| Job title | Type of maintenance | | Implementation instructions | Tools and operating materials |
|---|---|---|---|---|
| | TO-1 | TO-2 | | |
| Check the functioning of the PNM rangefinder | + | + | Checks are carried out on two shields, with visual visibility of the shields. The first shield is located at a range from 50 to 400 м, the second shield is located at the maximum possible range (based on the conditions of the training ground, but no more 7550 м). Carry out range measurements for each of the shields and make sure that the measured ISM range corresponds to the actual one | - |
| Check the operation of the control panel rangefinder | + | + | Checks are carried out on two shields, with visual visibility of the shields. The first shield is located at a range from 100 to 400 м, the second shield is located at the maximum possible range (based on the conditions of the training ground, but not more than 5500 m). Carry out range measurements for each of the shields and make sure that the range measured by the control panel corresponds to the actual one | - |
| Check parameters of LKU PNM | - | + | Check, guided by the instructions in the operating manual for PNM 7197.00.00.000 RE | - |
| Check the functioning of the TP channel of the PNM | + | + | Check the output to the TP mode of the PNM channel after turning on the toggle switch on the Pn-PNM, check the control using the controls on the Pn-PNM | - |
| Check the functioning of the control panel TP channel | + | + | Check the access to the TP channel mode of the control panel after turning on the toggle switch on the Pn-control panel, check the control using the controls on the Pn-control panel | - |
| Check the possibility of image adjustments on the APU | + | + | All keys on the APU must be pressed without jamming and must provide adjustment of the brightness, contrast and sharpness of the APU image | - |
| Check the functioning of the weapon stabilizer | + | + | Check by turning on the control system in the “MAIN”, “DOUBLE” and “DOUBLE” modes | - |
| Make sure there is no oil leakage from the hydraulic system of the weapon stabilizer | + | + | Oil leakage through fixed joints is not allowed. Formation of oil films on the actuator cylinder rod is allowed | Portable lamp, rags, filter paper |
| Check the oil level in the weapon stabilizer supply unit | + | + | The oil level indicator bar should be opposite the ambient temperature mark with a deviation of ±25 °C. If the bar goes beyond the minus tolerance, refill the power supply unit, following the instructions in paragraph 5.8.3.2of this manual | Single set of spare parts for weapon stabilizer, oil, rags |
| Check the rigidity and degree of damping of the weapon stabilizer | - | + | Carry out, guided by the instructions of clause 5.8.3.1of this manual | Clamp with pencil, 70 kgf dynamometer, shield, screwdriver |
| Check the functioning of the DPU | + | + | Check the functioning of the DPU by turning on the control system in the “DPU” mode | - |
| Replace the filter-absorber of the FVU, check the functionality of the filter and the tightness of the air routes of the FVU | + | - | Replace the filter at the second maintenance No. 1 | Filter, heads S 12 and 14 mm GOST R 57977-2017 with extension, wire, pliers GOST R 53925-2010 |
| Check the condition of the silica gel in the desiccant heads OR | + | + | The silica gel should be a bluish blue color. Otherwise, replace the desiccant. | Head S 22 mm GOST R 57977-2017 with extension |

| Job title | Type of maintenance | | Implementation instructions | Tools and operating materials |
|---|---|---|---|---|
| | TO-1 | TO-2 | | |
| Check the functioning of the SDR in the “CONTROL” mode | + | + | Carry out, guided by the instructions of clause 3.18.3.3of this manual | Banner and key 902.03.001 from spare parts system 902 |
| Check the functioning of the SDR from the rangefinder | - | + | Carry out, guided by the instructions of clause 5.8.23.1of this manual | Shield 184M.59.046, tank with laser rangefinder |
| Clean and lubricate System 902 launchers | + | + | Carry out, guided by the instructions of clause 5.8.23.2of this manual | Bannik, rags, lubricant GOI-54p GOST 3276-89 |
| Check the condition and performance of the CHP | + | + | Clean all components of the CHP from dust and dirt and check the reliability of their fastening.<br>Wipe the OB housings dry.<br>If necessary, add coolant to the expansion tank | Brush, rags |
| Check the functionality of the START | + | + | Check by switching on, guided by clause **Error! Reference source not found.**of this manual | - |
| Check the functioning of the GPO system of observation and aiming devices | + | + | Check by switching on | - |
| **Chassis** | | | | |
| Check the condition of the chassis components | + | + | Check in accordance with clause 5.8.13.2 | Hammer, wrench for caterpillar maintenance, wrenches 27, 36, 41 mm, crowbar, ruler 300d GOST 427-75 |
| Check the oil level in the support rollers | - | + | Check, guided by the instructions in paragraph 5.8.13.8of this manual | Head S 19 mm GOST R 57977-2017 with extension, oil, syringe |
| Refill with lubricant: | | | Refuel, guided by the instructions in paragraph 5.8.13of this manual | Syringe press or filling unit, heads S 17, 27 mm GOST R 57977-2017 with extension, 172.95.102sb, adapter fitting 54.28.1499 from tank group spare parts, pliers, scrap wire, crowbar, lubricant |
| - bearings of road wheels; | - | + | | |
| - guide wheel bearings; | - | + | | |
| - bearings of balancer bushings; | - | + | | |
| - internal cavity of the BR carrier | + | + | | |
| Tighten the drive wheel plugs | - | + | Plug tightening torque from 4000 to 5000 N ·m (from 400 to 500 кгс · м) | Head S 17 mm GOST R 57977-2017 with extension, key 172.95.118sb to the drive wheel hub plug (from the tank spare parts group kit) |
| **Frame** | | | | |
| Lubricate the roof mounting bolts above the power compartment | + | + | Before lubricating, clean the bolts from dirt and dust. | Rags, diesel fuel, graphite grease |
| Check the fastening of the flange connections of the barrel brackets | – | + | If necessary, tighten the bolts | Heads S 24, 27 mm GOST R 57977-2017 with extension |
| Carry out a random inspection of the electronic parts by dismantling them from the section at the rate of 2% of the number of products installed on the turret, the right and left sides of the hull and on the removable nose module of the hull | + | + | If an EDS is detected that has a malfunction or defects specified in paragraph 7.8 of this manual, then all EDS installed on this armored unit are subject to inspection. EDS that have defects that cannot be repaired must be replaced | Heads S 17, 22, 24 mm GOST R 57977-2017 with extension, screwdriver GOST 17199-88 |
| Notes<br>1 “+” - maintenance is carried out.<br>2 “-” - technical is not carried out. | | | | |

### 5.6 Seasonal service

The scope of seasonal maintenance work is given in Table 18. When performing work, it is necessary to use tools and devices from the single and group spare parts kits of the tank.

Table 18

| Job title | Implementation instructions | Tools and operating materials |
|---|---|---|
| Service the control system | Perform work in the scope of TO-1 | - |
| Dynamic protection complex | Perform work in the scope of TO-1 | - |
| **Operations performed in preparation for spring-summer operation** | | |
| Check gun recoil devices | Check, guided by the instructions of 2A46M.TO "125-mm tank guns 2A46M, 2A46M-1, 2A46M-4, 2A46M-5. Technical description and operating instructions" supplied with the tank | In accordance with the instructions of 2A46M.TO |
| Drain the low-freeze coolant, flush the cooling system and fill it with clean fresh water with a three-component additive | After filling the cooling system with water, change the value of the WATER - ANTIFREEZE setting in DCMV to WATER | Bucket, 27 mm handle wrench, drain nozzle connected to a hose used in the MZA-3 unit, water with a three-component additive |
| Remove sediment from the internal fuel tanks, replace winter diesel fuel with summer diesel fuel (refueling is allowed after the winter fuel has been completely exhausted during operation) | Carry out in accordance with clause 5.8.8.1of this manual | MZA-3 refueling unit, bucket, funnel with mesh, fuel |
| Drain condensate sludge from the engine venting system tank | Remove the hatch cover to drain the oil from the input gearbox. To drain condensate sludge, turn the handle of the plug valve 90° (the handle is located along the drain tube). After draining the condensate, return the tap handle to its original position (across the drain tube). Install the hatch cover | Handle wrench 27 mm |
| Check by weighing the amount of fire extinguishing mixture in the cylinders of the PPO system and manual freon fire extinguishers | Check, guided by the instructions in paragraph 5.8.21.2of this manual | Wrench 14 mm, wire KO-0.5 and KO-1.2, pliers |
| Check the serviceability of the electrical circuits of the PPO system using the KPK13 device | Check, guided by the instructions in paragraph 5.8.21of this manual | Wrench 32x36 mm, device KPK13 from the tank spare parts group kit |
| Fill the tanks of the hydropneumatic cleaning systems of observation devices and sights with water and check the operation of the system | Carry out, guided by paragraphs. 5.8.19.1, 5.8.19.2of this manual | 22 mm wrench, funnel with filter and tip |
| Lubricate all leather straps | - | Castor oil |
| Check the condition and performance of the CHP | Clean all components of the CHP from dust and dirt. Wipe the OB housings dry.<br>Check the operation of the CHP by turning it on in the "AIR CONDITIONER" mode, guided by clause 3.14.2.3of this manual | Brush, rags |
| **Operations performed in preparation for autumn-winter operation** | | |
| Drain the water from the engine cooling system, flush the cooling system and fill it with low-freezing coolant of the appropriate brand (depending on the conditions of the upcoming operation) with checking the density of the low-freezing liquid in accordance with paragraph 5.8.7.5of this manual | After filling the cooling system with low-freezing coolant, change the value of the WATER - ANTIFREEZE setting in DKMV to ANTIFREEZE | Bucket, 27 mm handle wrench, drain nozzle connected to the hose used in the MZA-3 unit, low-freezing coolant |
| Replace summer diesel fuel with winter or arctic fuel (depending on the conditions of upcoming operation) | To remove any remaining fuel from the lines after refilling the fuel system, run the engine for 10 $^{+5}$ minutes. | MZA-3 refueling unit, bucket, funnel with mesh, fuel |

| Job title | Implementation instructions | Tools and operating materials |
|---|---|---|
| Fill the PVV fuel line with winter (arctic) fuel | Turn off the cooling system fan drive by loosening nut 11 (Figure 3.7) and rotating stop 10 counter-clockwise to move it to the extreme right position. Start and warm up the engine, set the idle speed, the valves of the air cylinders must be open. ATTENTION: OPERATION WITH THE FAN DRIVE NOT DISCONNECTED IS PROHIBITED! Press the lever of the electric air valve for supplying air to the air supply and hold it for 1.5 to 2 minutes to remove the remaining summer fuel from the fuel line of the air supply, then close the valves of the air cylinders, stop the engine and connect the cooling system fan drive | |
| Check the serviceability of the engine heating system | Start the heater in single heating mode in accord-ance with clause 3.6.1 and let it operate for 3 to 5 minutes. During normal operation of the heater, an increase in coolant temperature should be observed, exhaust gases should be light gray or colorless, and the driver's APU should not display any images indicating a malfunction of the heater. | - |
| Drain condensate sludge from the venting system tank | Remove the cover of the input gearbox oil drain hatch. To drain the condensate sludge, turn the han-dle of the plug valve 90 °(the handle is located along the drain tube). After draining the condensate, return the tap handle to its original position (across the drain tube). Reinstall the hatch cover | Handle wrench 27 mm |
| Service the air purifier and check the SDU warning light | Carry out, guided by the instructions of paragraphs. 5.8.9.1, 5.8.9.4 | Keys 14 and 22 mm, socket wrench 17 mm, wrench 175.90.004, hook 175.90.013, special crowbar, screwdriver, rul-er, pliers, lubricant, wire KO-1.2, rubber tube 4c6x1.3 L=500 mm from a single tank spare parts kit |
| Check gun recoil devices | Check, guided by the instructions of 2A46M.TO "125-mm tank guns 2A46M, 2A46M-1, 2A46M-4, 2A46M-5. Technical description and operating in-structions" supplied with the tank | In accordance with the instructions of 2A46M.TO |
| Drain water from tanks of hydropneumatic cleaning systems | Carry out according to the instructions in para-graphs. 5.8.19.3and 5.8.19.4of this manual | Keys 17, 22, 27 mm; bucket |
| Drain the sediment from the air system sump | Place a rag under the sump and unscrew the drain plug 2-3 turns (do not drain the sludge at sub-zero temperatures | Socket wrench 17 mm, rags |
| Check that the hydraulic system of the transmission unit is completely filled with oil. | If necessary, refill the oil tank to mark level "42" on the rod | Handle wrench 27 mm, rod for measuring fuel and oil levels, bucket, funnel with filter, trans-mission oil |
| Check the condition of the tarpaulin and insulation mat | Repair if necessary | - |
| Start the diesel generator set and operate for 10 to 15 minutes to completely exhaust the summer fuel | Carry out in accordance with the instructions of paragraph 3.12.3of this manual | - |

### 5.7 Tank maintenance during storage

Maintenance during long-term storage of the tank is carried out in accordance with the "Manual (instructions) for the storage of armored weapons and equipment" in force in the region of operation.

Maintenance during short-term storage of the tank is described in paragraph 8.3of this manual.

### 5.8 Maintenance Techniques

#### 5.8.1 A gun

##### 5.8.1.1 Adjusting backlash selecting devices

After firing from 100 to 150 shots, it is necessary to adjust four backlash selecting devices (two each on the cradle and on the neck) in accordance with the technical description and operating instructions for the tank gun (2A46M.TO and 2A46M.TO1).

To access the backlash selecting devices on the neck of the cradle, you must:

– disconnect the cable from measuring block 2 (Figure 8.26) of the bend sensor;

– Unscrew the nuts securing the tie rods 6 (Figure 18.5) and remove the cover 3 from shells 2 and 4, then move the cover forward to gain access to bolts 6 and 14 (Figure 9.13);

– unpin the wire on one of the bolts 14 and loosen it;

– unscrew the bolts 6 and move the armored mask 2 forward to gain access to the gun play selecting devices;

– tighten the gun play selecting devices in accordance with the technical description and operating instructions for the tank gun (2A46M.TO and 2A46M.TO1);

– install armored mask 2 in place. Evenly tighten bolts 6 until they stop, then release half a turn;

– tighten the weakened bolt 14 with a force from 67 to 100 N (from 6.7 to 10 kgf) on a 150 mm shoulder, using a replaceable head 1-12.5-24-A-1-Ts9 (24 mm) and a key 6910-0324 Ts9khr from a single set of spare parts for a tank, as well as a dynamometer from a group set of spare parts for a tank (group set of spare parts for a weapon stabilizer). Then secure the bolt 14 with wire.

**ATTENTION:**

**INCREASING THE TIGHTENING FORCE OF BOLTS 14 IS NOT ALLOWED, AS IT MAY RESULT IN ABNORMAL OPERATION OF THE GUNS!**

– tighten bolts 6, then secure with washers 12 and wire 13. To ensure installation of washers, it is possible to additionally tighten bolts 6 to an angle of 15°;

– install cover 3 (Figure 18.5) and secure the cover fastening cable;

– install the armor protection casing on the armored mask and tighten the fastening bolts;

– connect the cable to measuring block 2 (Figure 8.26) of the bend sensor.

#### 5.8.1.2 Cleaning and lubricating the gun

After each firing, clean the gun in accordance with the technical description and operating instructions for the tank gun (2A46M.TO and 2A46M.TO1). It is necessary to clean the bore on the day of shooting after the barrel has cooled.

If there are no necessary conditions for cleaning the bore, wipe the bore and chamber with a bath cloth soaked in diesel fuel or kerosene. Clean and lubricate as soon as possible.

**ATTENTION:**

**DO NOT DAMAGE THE COMPLETENESS OF THE PARTS OF THE BLOWING MECHANISM INCLUDED IN THE GUN!**
**IN THE CASE OF INSTALLING ON A 2A46M-5 GUN PIPE 2A46MSB01-1 OF A 2A46M GUN, WHICH IS INTERCHANGEABLE IN TERMS OF FASTENING (SUPPLIED ASSEMBLY WITH A BLEEDING MECHANISM), IT MUST BE BORNE IN MIND THAT ON SOME OF THESE PIPES, THE FRONT NECK OF THE RECEIVER AND THE RECEIVER FASTENING PARTS MAY CHECK OUT!**
**INSTALLING PARTS OF THE BLOWING MECHANISM THAT DO NOT CORRESPOND TO THE COMPLETE SET MAY LEAD TO BREAKDOWN OF THE RECEIVER SEAL AND GAS CONTAMINATION OF THE TANK'S CABIN COMPARTMENT, WHICH IS DANGEROUS TO THE LIFE OF THE CREW!**

When cleaning and lubricating the blowing mechanism, it is necessary to remove the clamp with the reflector of the barrel bend sensor, to do this, unscrew two bolts 9 (Figure ) and remove the clamp 7 with gaskets 8, body 6 with the reflector.

After cleaning the blowing mechanism, install the optical unit 1, while housing 6 with a reflector and visor L is installed between two annular collars D on the barrel. When tightening clamp 7, install spacers 8 as shown in Figure 8.26, then tighten bolts 9 to size K, tapping clamp 7 with a hammer, and tie them with wire.

#### 5.8.1.3 Checking the moment of gun imbalance

The moment of unbalance of the gun should be no more than 30 N m (3 kgf m) with an excess on the barrel.

Before starting work, install the tank horizontally (visually), load the gun with a mock-up of a high-explosive fragmentation round (from the group kit of spare parts for the tank) and install a box with full ammunition or with loads with a total weight of 8.5 kg on the cartridge case catcher of the 7.62 mm machine gun.

To determine the moment of imbalance it is necessary:

– turn off the battery switch;

– install the lever “MANUAL - STAB.” to the “STAB” position;

– make sure there are no jams when the gun is smoothly moved by the barrel from stop to stop (remove any jams found);

– install a clamp with loops for a dynamometer (from the STV spare parts kit, group spare parts kit for the tank) at a distance of 10 to 15 mm from the muzzle of the barrel;

– measure with a dynamometer (from the STV spare parts kit, group spare parts kit for the tank) the forces required to slowly move the gun from the horizontal position up and from the horizontal position down in the range of approximately 100 mm (do not take into account the starting force).

Calculate the moment of imbalance $M_н$, N m (kgf m), using the formula:

$$M_н = \frac{(P_1 - P_2)}{2} \cdot l, \quad (1)$$

where $P_1$ and $P_2$ are the forces obtained when moving up and down, respectively, N (kgf);

l is the distance from the muzzle to the axis of the gun trunnion, equal to 5.1 m.

Perform these measurements three times and calculate the arithmetic mean value of the moment of imbalance.

If the moment of imbalance does not correspond to the permissible level, balance the gun using weights installed on the bottom sheet of the gun guard. When these weights are used up, balance the gun by installing ring weights from the tank's group spare parts kit on the front end of the receiver. To ensure the installation of ring weights, it is allowed to trim a section of the thermal protective casing. The maximum number of specified cargoes in the presence of a casing is 12 pcs., in the absence of a casing - 18 pcs.

### 5.8.2 Machine guns

#### 5.8.2.1 Bringing machine guns to normal combat

Machine guns that come into service as part of a tank are brought into normal combat by firing at the tank's manufacturing plant. Corrections for individual departure angles ( IAF) were introduced into the fire control system ( FCS) and entered into the tank's normal combat registration card.

Bringing a machine gun to normal combat is carried out in the following cases:

– when installing a new machine gun in a tank;

– with a significant deterioration in shooting accuracy;

– when repairing a machine gun, replacing machine gun components and installations, as a result of which the firing of the machine gun may change;

– when repairing and replacing elements of the sighting system and fire control system, as a result of which the firing of the machine gun may change.

Bringing machine guns to normal combat involves the following work:

– control of alignment of machine guns with sights;

– firing in bursts with assessment of compliance of the accuracy and accuracy of fire with the specified criteria;

– determining the values of corrections for machine guns' IDM and introducing these corrections into the tank's control system;

– entering data on the results of shooting and amendments entered into the control system into the tank log.

The procedure and rules for bringing a coaxial machine gun PKTM and a remote machine gun mount (DPU) with a machine gun into normal combat 6P49MT included in the tank are outlined in the instructions 188M I.PNB-1, attached to the tank.

#### 5.8.2.2 Machine gun maintenance

Maintenance of machine guns is carried out to ensure their maintenance in a technically sound combat-ready condition, timely identification and elimination of malfunctions.

Maintenance of machine guns consists of periodic inspection, disassembly, cleaning, lubrication and replacement of faulty parts.

Routine maintenance, which consists of inspecting the machine gun in assembled and disassembled form, cleaning and lubrication, is carried out in the following cases:

– in preparation for shooting and after shooting;

– after classes without shooting - upon returning from classes;

– if the machine gun was not used in training or shooting - at least once a week;

– in a combat situation, during maneuvers or exercises - daily, taking advantage of lulls in combat or breaks in exercises.

**ATTENTION:**

**BEFORE PERFORMING MAINTENANCE, MAKE SURE THAT THE MACHINE GUN IS UNLOADED!**

The volume, procedure and frequency of maintenance of the 7.62 mm coaxial machine gun and the 12.7 mm DPU machine gun are described in detail in 6P7K.00.000 TO and 6P49 00 000-08 RE, attached to the tank.

#### 5.8.2.3 Maintenance of flexible cable DPU

Remove the two shields on the DPU machine support that cover the flexible cable.

Clean the flexible cable and the rim with rollers from dirt, lubricate the roller axes with Litol-24 or Litol-24RK GOST 21150-2017 grease.

Reinstall the shields.

### 5.8.3 Weapon stabilizer

#### 5.8.3.1 Methodology for checking the parameters of a tank weapon stabilizer

**ATTENTION:**

**PARAMETERS ARE MEASURED NO EARLIER THAN 10 MINUTES AFTER TURNING ON THE STABILIZER!**

##### 5.8.3.1.1 Checking the rigidity of the weapon stabilizer HV drive

Check the rigidity of the STV in the vertical plane in the operating modes of the control system "MAIN" and "DOUBLE" in the following sequence:

– remove the standard plug from the control electrical connector of the STV control unit and connect the configuration and testing panel;

– turn on the "MAIN" mode, do not remove the turret from the stopper;

– using the setting and testing console, reset the HV drive integrators;

– attach a clamp with a pencil to the end of the cannon barrel, and install a shield with graph paper in front of the cannon;

– Using a dynamometer, apply a force of (157±2) N [(16.0±0.2) kgf] to the clamp and use a pencil to make the first mark on the position of the gun barrel. Then sharply remove the force and make a second mark corresponding to the position of the gun after the force was removed.

– measure up and down twice;

– using the setting and testing console, switch the HV drive integrators to operating condition (disable integrator reset);

– determine the rigidity of the STV vertical guidance drive G, (Nm)/mrad, using the formula

$$G = \frac{4100}{a}, \quad (2)$$

where 4100 is the conversion factor;

a - the distance between two marks on the shield, mm.

The arithmetic mean of the stiffness, determined from two measurements in each direction, is taken as the numerical value of stiffness.

– turn on the "DOUBLE" mode;

– determine the hardness of the STV in the "DOUBLE" mode using the above method;

– turn on the "DOUBLE" mode from the gunner's position;

– determine the hardness of the STV in the "DOUBLE" mode using the above method.

The rigidity value of the HV drive must be at least 700 N m/mrad (71 kgf m/mrad).

##### 5.8.3.1.2 Checking the damping of the HV drive of the weapon stabilizer

Checking the damping of the HV drive of the weapon stabilizer is carried out in the following sequence:

– turn on the OMS mode in the "MAIN" mode;

– set (by deflecting the handles of the guidance panel or the PC lever) the gun at an elevation angle of about 10º according to the mark on the gun guard;

– bring the gun to the loading angle by setting the AVT-RUCH toggle switch on the control panel of the control system and AZ to the RUCH position;

– remove the gun from the loading angle by setting the AVT-RUCH toggle switch to its original position. The gun must be brought into a coordinated position with the line of sight of the PNM (PKP). Visually determine the number of overtravels when matching the gun with the line of sight and the magnitude of the first overtravel. During the first overrun, the breech of the gun should not go beyond the 13º mark on the gunner's fence, the number of overruns should be from one to four;

– turn on the "DOUBLE" mode;

– determine damping (the number of overtravels and the value of the first overtravel) in the "DOUBLE" mode using the above method.

#### 5.8.3.1.3 Checking the damping of the weapon stabilizer GN drive

STV damping in the horizontal plane should ensure braking of the tower from the transfer speed with a number of overtravels from one to three, while the first overtravel should not be more than 100 d.u. (100 divisions of the accurate azimuth indicator scale).

An overtravel is considered to be when the azimuth indicator needle goes beyond the steady (agreed) position with the oscillatory nature of the tower braking.

The value of the first overtravel is taken to be the difference between the position of the pointer of the precision scale at the maximum deviation of the tower from the steady position and the position of the pointer at the steady position of the tower.

N o t e – It is allowed that the GN drive does not overtravel.

Check damping in the GN plane in the "MAIN" and "DOUBLE" modes in the following sequence:

– make sure that there are no people and foreign objects (trees, walls, pillars, etc.) at a distance of less than 6 m from the axis of rotation of the tower;

– turn on the "BASIC" mode;

– tilt the guidance console to the right all the way (control lever of the commander's console to the right all the way);

– release the handles of the guidance console (PC control lever) after the turret reaches a steady transfer speed;

– mark on the precise scale of the azimuth indicator the extreme position of the arrow during the first overtravel of the tower and at a steady position, and also count the number of overtravels of the tower relative to the steady position;

– repeat the measurement when pointing the turret with the transfer speed to the left;

– turn on the "DOUBLE" mode;

– determine damping in the "DOUBLE" mode in the sequence indicated above.

Checking the damping in the GN plane in the "DUBLER" mode is carried out in the same way; the control system is turned on in the "DUBLER" mode, and the check is performed from the gunner's position.

### 5.8.3.2 Refilling the HV hydraulic drive of a tank weapon stabilizer with oil and replacing the oil in the HV hydraulic drive

Before filling with oil (changing oil) in the HV hydraulic drive, it is necessary to take measures to prevent dust and dirt from getting into the HV hydraulic drive and into the working fluid (clean off dust and dirt from the blocks in the area of the supply unit and the actuator cylinder, wipe the connection points of the plugs and nuts with a clean rag, wetted with diesel fuel or gasoline). During work, do not allow oil to come into contact with the tank equipment and electrical cables.

Filling the HV hydraulic drive (changing the oil in the HV hydraulic drive) should only be done with hydraulic oil MGE -10A in accordance with TU 38.401-58-337-2003, which has a manufacturer's passport. The amount of oil required to fill the HV hydraulic drive is no more than 2.8 kg. The oil must be in a sealed container. Refueling is carried out using a hand pump PB2.962.006, taken from the STV spare parts group kit.

**ATTENTION:**

**IT IS PROHIBITED TO USE OTHER OILS TO FILL THE HYDRAULIC DRIVE EXCEPT HYDRAULIC OIL MGE-10A ACCORDING TO TU 38.401-58-337-2003, OR MIX IT WITH OTHER OILS OF RUSSIAN OR FOREIGN PRODUCTION!**

Before refueling the VN STV hydraulic drive, the following operations must be performed:

– install the tank horizontally (visually);

– lock the gun in the "stowed" position;

– connect the hose of the hand pump PB2.962.006 from the STV spare parts group kit to the filling valve 8 (Figure 8.37) of the supply unit;

– Using a 14 mm wrench, unscrew (from three to four turns) plug 2 of the executive cylinder (hereinafter referred to as CI) and plug 15 of the supply unit (hereinafter referred to as UP);

– Using a 12 mm wrench, loosen nut 4 in the CI and unscrew bolt 3 (three to four turns);

– remove cover 5 CI with a screwdriver;

– Using special socket wrenches with external hexagons 8 and 10 mm, unscrew (two to three turns) limiter 6 and valve 7.

To refill the VN STV hydraulic drive with oil, you must perform the following operations:

– make sure that preparatory operations have been completed before refueling the VN STV hydraulic drive;

– Using a hand pump, pump oil into the supply unit. When oil appears without air bubbles from under plug 18, screw in the plug. When oil appears without air bubbles from under plug 2, screw in the plug;

– when oil appears without air bubbles from under bolt 7, tighten the bolt and secure it with nut 4;

– when oil appears from under valve 7, close the valve and limiter 6;

– pump oil into the supply unit until the movable bar 13 aligns with the "+25" mark on scale 12 of the oil indicator;

– unlock the gun and turn on the HV drive for a period of 8 to 10 minutes;
– turn off the HV drive and let the oil settle for 5 to 10 minutes;
– set the gun in a horizontal position (visually);
– release air from the supply unit through plug 15 UP;
– lock the gun in the “stowed” position;
– release air from the cylinder head through plug 2;
– release air from the cavities of the power cylinder through bolt 3 and valve 7;
– pump oil into the supply unit until bar 13 aligns with the mark “+90” at an ambient temperature of 0 to plus 50 °C or with the mark “+50” at a temperature from 0 to minus 50 °C;
– disconnect the filling hose of the hand pump PB2.962.006;
– screw union nut 9 with cover 10 PU and tie with wire;
– keep the HV drive switched off for 2 hours;
– install the movable bar 13 at the risk of the oil indicator corresponding to the ambient temperature, draining the oil through plug 15 UP;
– wipe oil stains and oil leaks with a clean rag;
– check the rigidity and damping of the HV drive.

The hydraulic drive is considered to be correctly charged if the temperature on the oil gauge scale differs from the ambient temperature by no more than 25 °C. If the hydraulic drive is overfilled with oil, it may be released during STV operation through the hole in piston 14.

#### 5.8.3.3 Changing the oil in the hydraulic drive of the stabilizer of tank weapons

The oil in the STV hydraulic drive must be replaced once every 10.5 years or after 500 hours of STV operation.

It is recommended to change the oil immediately after turning off the STV.

To change the oil in the VN STV hydraulic drive, you must:
– install the tank horizontally (visually);
– turn on the control system in the “MAIN” mode (the turret may not be unlocked), and aim the gun several times at the VN. No earlier than after 10 minutes of operation, turn off the control system;
– lock the gun in the “stowed” position;
– place a container under the supply unit and the actuator cylinder to collect the drained oil;
– from the filling valve 8 (Figure 8.37), unscrew the union nut 9 with cover 10;
– unscrew the hose from the hand pump PB2.962.006 from the stabilizer spare parts group kit. Connect the hose (from the needle side) to the filling valve 8;
– drain the oil;
– Using a 14 mm wrench, unscrew (from three to four turns) plug 2 CI and plug 15 PU;
– Using a 12 mm wrench, loosen nut 8 in the CI and unscrew bolt 7 (three to four turns);
– use a screwdriver to remove the cover 5 CI;
– Using special socket wrenches with external hexagons 8 and 10 mm, unscrew (two to three turns) limiter 6 and valve 7;
– remove the gun from the “stowed” position and slowly manually pump from stop to stop several times to drain the remaining oil;
– connect the hose to the hand pump PB2.962.006;
– perform the operations provided for refilling the VN STV hydraulic drive with oil, guided by clause 5.8.3.2of this manual.

### 5.8.4 Automatic loader

#### 5.8.4.1 Cleaning the bottom under the VT and removing the cassettes

To remove the cassettes and clean the bottom you must:
– turn off AZR AZ UPR. On the right switchboard of the tower;
– use the manual lifting mechanism to give the gun a maximum angle of descent;
– turn the VT by hand so that the gripper hooks are between the hooks of two adjacent cassettes;
– raise the gripper with the manual drive of the MPK to a position convenient for work and fix it;
– turn the VT with a manual drive so that the cassette to be removed is in the dispensing window, lock the VT and remove the cassette through the dispensing window. To ensure ease of operation, it is necessary to remove two or three cassettes;
– after removing the cassettes, remove the protective shields from the VT frame and place them on the VT flooring along with the fastening parts;
– turning the turret using the manual turning mechanism, clean the bottom through the dispensing window and remove foreign objects;

– after cleaning the bottom, install protective shields on the VT frame and cassettes in the VT sockets, turn and lock the VT using a manual drive in the position where one of the cassettes is in the dispensing window;

– Use the manual drive of the MPK to lower the gripper to its original position.

#### 5.8.4.2 Checking the condition of AZ cassettes

To check the condition of the cassettes you must:

– switch off AZR AZ UPR. On the right switchboard of the tower;

– pull the MPC stopper drive lever until the MPC is unlocked and install it on the lock;

– lift the cassette manually onto the loading line and lock it;

– clean the cassette, gripper and gripper clamp support pads from dirt;

– Check the condition of the stops on the lifting mechanism and the latches on the cassette, and make sure that there are no visible deformations of the cassette pipes. If the cassette has dents on the tube that prevent the passage of a charge or projectile, replace the cassette;

– lower the cassette manually to its original position, pressing the grip all the way, and lock it;

– turn the VT by hand one step;

– lift the next cassette and repeat the inspection and cleaning operations;

– repeat inspection operations for each cassette;

– After lowering the last cassette to its original position, remove the MPK stopper drive lever from the clamp and press it against the gearbox.

#### 5.8.4.3 Adjusting the slipping torque of the rammer clutch

If, in the process of chambering a shot, the rammer chain stops, or the shot element is not loaded intensively (the projectile is not fixed in the gun), adjust the slipping moment, for which:

– install a device for measuring the slipping torque of the rammer clutch (located in the group spare parts kit for the tank);

– set the rammer chain to its original position (on the latch), wind the cable around the device pulley and make ten turns of the pulley clockwise, pulling the cable by the loop;

– push the rammer chain all the way to the pallet stop, wind the cable around the pulley and make ten turns of the pulley counterclockwise;

– Gently pull the cable loop with a dynamometer and, at the beginning of turning the pulley counterclockwise, note the dynamometer reading.

Perform measurements five times. The arithmetic mean value of the force should be from 380 to 520 N (from 38 to 52 kgf).

Adjust the slipping torque by tightening or loosening the castle nut under the cover. After adjusting the torque, tighten the castle nut, install the cover and remove the device.

### 5.8.5 Heater

#### 5.8.5.1 Cleaning the injector and bypass valve

It is necessary to flush nozzle 23 (Figure 2.5) and bypass valve 2 if they fail to operate. A clogged injector or bypass valve causes the heater to stop working or operate abnormally, which is indicated by the appearance of white smoke or fuel from the outlet pipe, as well as an increase in the time it takes to warm up the coolant.

The procedure for flushing the nozzle is as follows:

– remove the front guard 17 (Figure 9.8);

– remove three panels 1 (Figure 2.44) and two removable brackets 4 on the VT frame from the control compartment of the tank;

– remove three cassettes 3 from the VT sockets with the shields removed;

– remove removable sheet 2;

– rotate the tank turret so that the opening from the removable VT sheet is in the heater area;

– Turn the VT frame with the sockets with the cassettes and shields removed towards the heater area.

– unscrew the nuts securing the fuel supply tube to the injector and unscrew injector 23 (Figure 2.5);

– loosen nut 7 (Figure 2.7) on the nozzle and, unscrewing union nut 10, remove nozzle 9 and swirler 8 with filter;

– unscrew valve 1;

– rinse all parts in clean gasoline, paying attention to the cleanliness of the 0.5 mm diameter holes in the nozzle and swirler, and assemble the injector. Cleaning holes with steel wire is not allowed.

Reinstalling the nozzle is carried out in the reverse order, replacing, if necessary, sealing gasket 2.

The procedure for flushing the bypass valve is as follows:

– carry out work to prepare for removing the valve, similar to the preparatory work for removing the injector;

– disconnect the hose clamps on the drain tube 25 (Figure 2.5);

– unscrew nut 3 securing the drain tube to the valve and remove drain tube 25;
– plug the drain pipe hose;
– unscrew bypass valve 2;
– measure the protrusion (recession) of the adjusting screw relative to the end of the housing;
– disassemble the valve from the adjusting screw side;
– wash the valve parts in clean gasoline;
– Assemble the valve by setting the adjusting screw to the previous position according to the marks from the core and the value of the protrusion (recession) of the adjusting screw relative to the end of the body.

Reinstall the valve in reverse order.

Install the fencing sheets, VT shields with brackets and cassettes in the reverse order.

#### 5.8.5.2 Bleeding air from the fuel pump

Upon completion of work related to depressurization of the fuel system, or after complete exhaustion of fuel from the fuel system, before starting the heater, it is necessary to bleed air from fuel pump 1 of the heater in the following order:

– turn on the “BCN – TDA” switch to the “BCN” position;
– start the heater in purge mode in accordance with clause 3.6.1.7;
– hold the air release valve lever 21 in the on position for 10 to 15 s;
– release the valve lever and turn off the BCP switch, wait for the purge to complete.

If the heater operates unstable, release air from the pump again.

#### 5.8.5.3 Cleaning the boiler heater

If the operation of the heater is accompanied by the appearance of black smoke or the heating of the power plant is slow, it is necessary to clean the walls of the heat exchanger from carbon deposits.

To clean the heater boiler, it is necessary to assemble and install instead of plug 19 (Figure 2.5) a device from the tank’s group spare parts kit, open the air source valve and briefly press (0.5 s) on the valve lever to clean the boiler, changing the direction of the air stream by turning the device.

Once the soot has flown out of the heater outlet pipe, stop the air supply, remove the device from the heater head and replace plug 19.

Start the heater. After the heater operates, the deposit becomes dry, easily flakes off and is finally removed by secondary cleaning according to the above method. After cleaning the heater, screw the plug 19 and secure it with wire.

### 5.8.6 Engine lubrication system

#### 5.8.6.1 Oil drain

It is recommended to drain the oil from the system immediately after stopping the engine.

The procedure for draining the oil is as follows:

– remove the hatch cover above the filler neck of the additional tank, clean the plug and the flange of the additional oil tank from dust and dirt and unscrew the plug;
– remove the hatch covers under the engine and the main engine oil tank;
– unscrew the drain valve plug of the main oil tank;
– prepare a container with a capacity of approximately 70 liters for the drained oil;
– Screw the tip into the drain valve of the main oil tank until oil begins to flow out;
– drain the oil from the lubrication system;
– drain the oil from the engine crankcase by unscrewing the drain plug located in the lower crankcase;
– When the oil is drained, unscrew the drain plug, tightly tighten the drain plugs of the main oil tank and the engine crankcase, and secure the crankcase plug with wire;
– install the filler cap of the additional oil tank, making sure that the gasket is intact;
– install the manhole covers in their places.

#### 5.8.6.2 Change of oil

When changing the oil you must:

– Completely drain the oil from the engine crankcase and oil tank. The temperature of the drained oil should not be lower than plus 60 °C;
– fill the system with fresh oil of the same brand as the drained one;
– start the engine and let it run at minimum idle speed for 1 to 2 minutes;
– stop the engine and check the oil level in the additional oil tank, if necessary, top up to the level of 65 liters along the rod.

When switching from oil M-14 $Г_2$(k) to oil M- $5_з$/16 $Д_2$, M-12 $Г_2$or Mobil1, you must:

– drain the oil from the oil tank and engine crankcase;
– fill the lubrication system with oil of a different brand;
– change the oil in the external oil tank;

– Carry out extraordinary flushes of the MTs-1 centrifugal oil purifier at the time of refueling and after 50 hours of engine operation (500 km of tank mileage).

#### 5.8.6.3 Flushing the centrifugal oil purifier MTs-1

To provide access to the oil purifier, the roof over the engine must be opened.

The procedure for flushing the oil purifier is as follows:

– unscrew bolt 1 (Figure 2.16), remove cover 3;

– remove the rotor and allow the oil to drain from it;

– install the rotor into the device included in the spare parts kit for the engine, located in the group spare parts kit for the tank;

– unscrew the coupling nut 5, remove the rotor cover 16;

– clean deposits from the internal surfaces of the cover 16 and the rotor housing 14, and then rinse the rotor parts with clean diesel fuel;

– If compressed air is available, blow off the parts. It is necessary to pay special attention to the cleanliness of nozzles 22; if the nozzle holes are clogged, carefully clean them with soft (copper or aluminum) wire with a diameter of no more than 1.8 mm and blow with compressed air.

**IT IS PROHIBITED TO CLEAN THE HOLES IN THE NOZZLES WITH SHARP METAL OBJECTS AND STEEL WIRE!**

– rinse body 8 and cover 3 of the oil purifier with diesel fuel, wetting wipes and wiping the parts with them;

– check the condition of the rubber gasket 15 between the cover and the rotor housing. If the gasket is swollen or severely crushed, it must be replaced with a new one from a single engine spare parts kit;

– install the rotor body into the fixture, install the rotor cover and tighten the coupling nut 5 with a wrench so as not to destroy the rotor cover. Remove the device from the rotor;

– Install the rotor into the oil purifier housing. The rotor should be lowered onto the rod carefully so as not to damage the rotor bearing;

– check the condition of the rubber ring 18 between cover 3 and body 8 of the oil purifier and, if necessary, replace it by taking it from a single engine spare parts kit;

– Reinstall the oil purifier cover, then tighten bolt 1;

– check the fastening of the oil purifier with tapes and, if necessary, tighten them;

– start the engine and, after warming it up at idle speed, make sure that there are no oil leaks in the oil purifier connections;

– close the roof over the engine.

#### 5.8.6.4 Flushing the MAF oil filter

To provide access to the MAF oil filter (hereinafter referred to as the filter), it is necessary to open the roof over the engine.

Rinse the filter in the following order:

– Unscrew the coupling bolt 1 (Figure 2.15) and remove it together with cover 2;

– remove filter sections 5, 6 and 7 from housing 4 one by one;

– inspect filter sections 5, 6 and 7 and, placing them in a vessel with clean diesel fuel, rinse thoroughly; To better clean the sections from deposits and dirt, the sections should be washed twice and, if compressed air is available, blow them off;

– pump out all the oil from filter housing 4 using a manual syringe, taking it from a single set of spare parts;

– wash the inner surface of the filter housing 4 with wipes soaked in diesel fuel, followed by wiping the housing with dry, clean wipes;

– wash cover 2;

– install filter sections 7, 6 and 5 on rod 8, turning them around rod 8 when installing them;

– check the presence of rubber ring 3 and its correct position in the annular groove of cover 2;

– install the filter cover 2 so that the end of the filter housing 4 fits into the annular groove of the cover 2, then tighten the coupling bolt 1 securing the cover 2 with a wrench until it is tight. If rubber ring 3 is swollen or severely crushed, replace it with a new one taken from a single engine spare parts kit;

– check the fastening of the filter with tapes, the fastening and connection of pipelines to the filter and, if necessary, tighten the corresponding connections;

– start the engine and, after warming it up at idle speed, make sure that there are no oil leaks in the oil filter connections;

– close the roof over the engine.

If, after washing filter sections 5, 6 and 7, the filter oil pressure in the engine lubrication system does not correspond to the recommended values, replace filter sections 5, 6 and 7 with new ones, taking them from the group spare parts kit of the tank.

#### 5.8.6.5 Cleaning the oil intake filter

Wash the oil intake filter in the main oil tank when storing the tank, in case of oil change.

To wash the oil intake filter:

– open cover 17 (Figure 2.11) of the access hatch to the drain valve of the engine lubrication system tank on the bottom of the tank;

– drain the oil from the main oil tank, following paragraph 5.8.6.1of this manual;

– unpin and disconnect the electrical connector from the temperature receiver and unscrew the temperature receiver from hole B (Figure 2.10);

– Unscrew and unscrew the intake filter from the main oil tank;

– wash the filter in diesel fuel and blow with compressed air;

– screw the intake filter into the main oil tank, checking the integrity of the sealing gasket, and secure it with a cotter pin;

– Screw in the temperature receiver, checking the integrity of the sealing gasket, and secure it;

– connect the electrical connector to the temperature receiver and secure it ;

– close cover 17 (Figure 2.11) of the access hatch to the drain valve of the engine lubrication system tank on the bottom of the tank.

### 5.8.7 Engine cooling system

#### 5.8.7.1 Coolant drain

To drain the coolant you must:

– install the tank horizontally (visually) or with a roll to the left side;

– unscrew the filling plugs in the expansion tank and radiator;

– unscrew the drain valve plug;

– Screw the drain nozzle connected to the hose (from the MZA-3 unit kit) into the drain valve and drain the coolant into a previously prepared container with a capacity of approximately 90 liters.

To more completely remove fluid from the system, it is necessary at the end of the draining process (no jet leakage) to open the roof with radiators, create a MZN DV in the engine lubrication system by pressing the MZN DV button. pressure of at least 2 кгс/см$^2$and turn the engine crankshaft with the starter for 3 to 5 s without fuel supply.

After draining, unscrew the drain plug and reinstall the filler caps and drain valve.

To reuse the coolant, drain it into a clean container.

**ATTENTION:**

**TO AVOID CORROSION OF ALUMINUM PARTS OF THE ENGINE AND COOLING SYSTEM, AFTER DRAINING THE LOW-FREEZING COOLANT, THE COOLING SYSTEM IS ALLOWED TO BE KEEPED UNFILLED FOR NO MORE THAN ONE MONTH WITH THE RADIATOR CAP CLOSED, FULL TANK AND DRAIN VALVE!**

If the system is filled with water, then after draining the water, the tank can be kept without filling coolant for up to one month, in which case the system must be filled with low-freezing coolant, left for 15 to 20 minutes and then drained.

After draining, close the radiator filler necks, expansion tank and drain valve with plugs.

#### 5.8.7.2 Flushing the cooling system

It is necessary to flush the cooling system when replacing one type of coolant with another.

For washing you need:

– drain the coolant;

– Fill the cooling system with water without additives to the level of the filler necks;

– start the engine and run for 50 to 10 minutes;

– drain the water from the cooling system (do not reuse the water);

– Fill the cooling system with coolant depending on the operating temperature conditions.

#### 5.8.7.3 Cleaning radiators in a rack

To clean the radiator cores, it is necessary to open the roof with radiators over the transmission and blow out the radiator cores with compressed air from the inside. Clean the outside of the oil radiators with a hair brush with the roof above the radiators open.

#### 5.8.7.4 Cleaning the hinge joints of the shutter axes and the drive of the exit blinds

The axes of the hinge joints are cleaned by increasing the force on the blind drive handle.

The procedure for cleaning the hinge joints is as follows:

– open the roof over the transmission with radiators;

– disconnect rod 14 (Figure 2.22) from double-arm lever 12;

– check the mobility of the shutters 17 of the exit blinds by moving the rod 14 by hand.

If rod 14 moves with jamming, it is necessary to wash the hinge joints of the blinds in accessible places with diesel fuel; If the rod moves easily, then the following must be done:

– connect rod 14 to lever 12, rinse with diesel fuel and lubricate the hinge joints of the blinds drive;

– close the roof with radiators.

#### 5.8.7.5 Checking the density of low-freezing coolant

To check the density of low-freezing coolant, it is necessary to draw such an amount of coolant into the hydrometer pipette so that the hydrometer floats freely in it in a vertical position.

The density value on the hydrometer scale along the line of contact of the liquid with the instrument rod corresponds to the coolant density value. The standard coolant density values are specified in the engine operating manual.

### 5.8.8 Engine fuel supply system

#### 5.8.8.1 Draining fuel

Pump fuel out of the system using the BCP. In addition, drain the fuel from the internal tanks through the drain valves, and pump out the MZA from the external tanks from each tank separately.

To pump out fuel with a pump you must:

– unscrew the plug from the drain fitting located on the bracket with fuel devices;

– screw in the drain nozzle connected to the hose used in the MZA;

– lower the second end of the hose into a previously prepared container for draining fuel or into one of the filling necks of the fuel system of another tank;

– turn on the pump;

– set the handle of the fuel distribution valve to the PUMP-OUT position;

– open the filling neck of the fifth outer tank or the left barrel (with the barrels connected), do not open the necks of the remaining tanks;

– pump out fuel;

– set the fuel distribution valve handle to the TANK ON position;

– turn off the pump;

– lower the free end of the hose into the control compartment so that it is slightly above the fitting;

– unscrew the hose tip from the fitting;

– remove the hose from the control compartment at both ends and drain the remaining fuel from it;

– screw the plug into the fitting;

– close the filling neck of the fifth outer tank or the left barrel (with barrels connected).

To drain fuel through tank drain valves, you must:

– unscrew the armored plug in the bottom of the tank hull and the drain valve plug of the right tank;

– screw the fuel drain nozzle connected to the MZA hose into the drain valve until it stops;

– lower the second end of the hose into a previously prepared container for draining fuel;

– open the filling neck of the fifth outer tank or the left barrel (with barrels connected);

– drain fuel from external tanks and barrels;

– open the filler neck of the right tank and continue draining fuel from the right tank and the bow group of tanks;

– unscrew the nozzle with the hose from the drain valve of the right tank;

– unscrew the armor plug in the bottom of the tank hull and the drain valve plug of the left bow tank;

– screw the fuel drain nozzle connected to the MZA hose into the drain valve until it stops;

– drain the fuel (remaining 90 to 100 liters) from the left bow tank;

– unscrew the nozzle with the hose from the valve of the left bow tank;

– close the filler necks;

– install the tank valve plugs and holes in the bottom in place.

#### 5.8.8.2 Fuel filter maintenance

To wash the coarse fuel filter, you must:

– set the fuel distribution valve handle to the TANK CLOSED position;

– loosen nut 2 (Figure 2.27) in the center of the filter cover (key 27) and hold it from turning;

– Rotating filter cup 9, remove it together with filter sections 10, 11, 12;

– remove the filter sections from the glass, rinse them and the glass thoroughly in fuel;

– install the filter sections in the glass;

– put the glass in place;

– Set the fuel distribution valve handle to the TANK ON position.

When assembling the filter, pay special attention to the serviceability and correct installation of filter sections 10, 11, 12, spring 6, ring 7, felt 4 and paronite gaskets 13.

Bleed the fuel system of the BCN or PLM with the air release valve open and make sure that there is no fuel leakage through the filter connections.

The procedure for servicing fine filters is set out in the operating manual for the 92S2F RE1 engine (part 2) .

#### 5.8.8.3 Procedure for removing water when filling the fuel system with water-soaked fuel

When the message “Water in fuel” appears on the driver’s APU screen, you must:

– pump out all fuel from tanks and barrels;

– drain the remaining fuel and water from the left bow tank, the right group of tanks (right bow and right tanks) through the drain valves;

– remove remaining fuel from the external tanks through their filling necks using a filling syringe;

– Unfasten the fifth external fuel tank and lift its rear part to ensure fuel flows to the filler neck;

– disconnect the necks of the equipment for connecting barrels from the fittings screwed into the barrels;

– loosen the straps securing the barrels and turn the barrels on the brackets with their necks down;

– remove remaining fuel and water from the barrels;

– install and secure the fifth external tank, barrels and equipment for connecting them;

– wash the sections and glass of the coarse fuel filter;

– replace the filter bags of the fine fuel filter and wash its glasses in accordance with 92S2F RE1 (part 2);

– fill the fuel system tanks with clean dehydrated fuel;

– turn on the BCP and open the air release valve for 2 to 3 minutes to fill the pipelines and coarse and fine filters with fuel, then, with the pump turned on, make sure that there are no leaks in the connections disassembled during the work.

The absence of sludge drainage at subzero temperatures indicates the presence of frozen water in the tanks. To remove water, it is necessary to thaw the frozen water in the tanks by placing the tank in a heated box and perform the work described above.

### 5.8.9 Air purification system

#### 5.8.9.1 Air purifier maintenance

It is necessary to service the air purifier after it reaches the maximum resistance, a sign of which is the display of the inscription “SERVICE IN” on the DKMV display.

After the “SERVICE IN” message is displayed, provided the air is dusty, the tank may be allowed to move for 2 to 5 hours.

The short-term lighting of the “SERVICE IN” sign when shifting gears and a sudden change in fuel supply is not a sign of the need to service the air cleaner.

The air purifier can be serviced using workshop or personal tools.

The procedure for servicing the VO using individual means is as follows:

– retrofit the MZA filling unit pos. 1 (Figure 2.42) and bath 4 (use a group kit of spare parts for the tank) with intake filter 8, nut 9, nozzle 7;

– pour 40 liters of clean diesel fuel into the bath, install the MZA unit pos. 1 and connect it to the tank’s on-board network;

– remove the air cleaner cover;

– unfasten and remove the cassette beams;

– remove the cassettes;

– remove the felt pads from the cassettes and the air cleaner cover and thoroughly clean them of dust and dirt;

– Clean the internal surfaces of the air cleaner housing and cover from dust with a dry rag, and clean the internal surfaces of the cyclones from dirt with a brush. Rags and other foreign objects are not allowed to enter the air purifier;

– thoroughly rinse each cassette 5 (Figure 2.42, b) on both sides, directing a stream of diesel fuel from the dispensing valve RK-25 pos. 6 onto the surface of the cassette placed on fingers 3.

Wash the cassettes according to the inscription on the cassettes in the following sequence:

– top, bottom;

– then replace the fuel and repeat the flushing in the same sequence.

To speed up the washing of the cassettes, it is recommended to remove dust from the lower cassette before washing by lightly tapping it on a wooden object.

After washing, soak the upper cassette with engine oil by dipping. The oil temperature should be from plus 60 to plus 100 °C.

After impregnation, allow excess fuel to drain from the lower cassette and oil from the upper cassette 2 (see Figure 2.42,a), placing them in the bath at an angle of 60° to 75°.

The duration of oil drainage at ambient temperatures from plus 15 to plus 20 ° C, depending on its temperature, is given in table 19 .

Table 19

| Temperature, °C | 60 | 80 | 100 |
|---|---|---|---|
| Duration of oil drainage, h, not less | 2 | 1.5 | 0.5 |

When using the installation for washing and oiling VO cassettes, follow the instructions set out in the technical description of the maintenance workshop.

Place felt pads in the shells of the heads, covers and cassettes. Before installing the gasket, lubricate it with Litol-24 grease GOST 21150-2017.

Install the cassettes with the inscriptions “LOWER”, “UPPER” towards the air cleaner pipe and secure them with beams. Tighten the beam bolts evenly, ensuring reliable compression of the cassettes by all beams.

Install the cover and tighten the tie nuts tightly. Tighten the nuts evenly, avoiding deformation of the lugs on the cover. The cover should fit all the centering strips on the head and provide a good seal around the entire perimeter of the felt gasket.

Start the engine and run for 3 to 5 minutes at a crankshaft speed of 1800 to 1900 rpm.

#### 5.8.9.2 Air Purifier Maintenance Guidelines

Premature air purifier reaching its maximum resistance may be caused by contamination of the protective meshes around the cyclone apparatus. In this case, it is necessary to remove the air cleaner, remove the protective nets, clean them of dirt and blow them with compressed air. At the same time, inspect and, if necessary, clean the inlet pipes of the cyclones from dirt in accessible places.

It is recommended to clean the protective grids and the air cleaner housing (outside) from dirt each time you remove the air cleaner.

When removing the air purifier, protect the air supply pipe from foreign objects, dirt and dust by wrapping the pipe in plastic film and tying it.

It is not recommended to remove the air cleaner unless absolutely necessary. In exceptional cases (combat use), if it is impossible to timely service the VO, it is allowed, in order to delay maintenance, to tap each dismantled cassette on both sides of a wooden object, take measures to prevent contamination of the cassettes and the internal surface of the VO, install the cassettes in the VO and continue exploitation.

#### 5.8.9.3 Procedure for removing and installing the air cleaner

The procedure for removing the air cleaner is as follows:

– open the roof over the engine;

– loosen the bolts securing the air cleaner legs and fold back the clamping bars;

– unscrew the union nuts connecting the dust extraction pipes to the dust collector pipes of the air cleaner;

– remove the clamps from the cuff connecting the air cleaner pipe to the air supply pipe and move the cuff towards the pipe;

– disconnect the cable from the electrical connector SDU1A-0.12;

– remove the air cleaner. To reduce the weight of the air cleaner, it is possible to remove the cassettes from it before removing it.

The procedure for installing the air purifier is as follows:

– connect the connecting cord from the electrical connector SDU1A-0.12;

– install the air cleaner paws under the mounting clamps and secure with ties;

– connect the union nuts connecting the dust extraction pipes to the dust collector pipes of the air cleaner;

– install clamps on the cuff connecting the air cleaner pipe to the air supply pipe;

– move the cuff with your hands onto the air cleaner pipe, if necessary, adjusting it with a special hook available in a single set of spare parts;

– tighten the clamps.

Before installing the air cleaner, lubricate the internal surfaces of all air cleaner pipes with a thin layer of grease used on the tank.

If the cuff between the air intake and the air supply pipe or between the air supply pipe and the compressor is damaged, replace the cuffs. Secure the cuffs with clamps.

#### 5.8.9.4 Checking the SDU1A-0.12 air cleaner limit resistance indicator

Check the limit resistance indicator every time the air cleaner is serviced.

The procedure for checking the alarm is as follows:

– Place the rubber tube included in a single set of spare parts onto the pipe of the plug securing the alarm to the bracket, so that it covers the radial holes in the pipe. The inner surface of the tube must be clean, without traces of fuels and lubricants, moisture and dust;

– create pressure by blowing into the tube.

The display of the inscription “SERVICE IN” on the DKMV display will indicate the serviceability of the signaling device. If the inscription is missing, and the electrical circuit is in good condition, replace the signaling device and repeat the test.

### 5.8.10 Transmission hydraulic system

#### 5.8.10.1 Pumping oil from transmission units

Oil must be pumped out when refueling and replacing oil in the hydraulic system of the transmission unit, as well as before putting the tank into storage. In winter conditions, oil should be pumped out during ETO and in anticipation of long-term parking (more than 2 hours).

**WARNING:**

**IN THE EVENT OF IMPROPER PREVIOUS FILLING (REFILLING) OF OIL INTO THE TRANSMISSION TANK, WHEN PUMPING OIL FROM THE TRANSMISSION UNITS, THE TRANSMISSION TANK POSSIBLE OVERFLOW AND DESTRUCTION!**

In the absence of information about the correctness of the previous filling (refilling) of oil into the transmission tank, it is recommended that instead of pumping oil from the transmission units, drain the oil from both gearboxes and the input gearbox. The total volume of oil drained from transmission units and oil remaining in the transmission tank should not exceed 42 liters.

Pump out the oil only with the batteries installed and the battery switch on.

The values of these quantities should be monitored using DCMV.

To pump out you need:

– start the engine, set the crankshaft speed from 1400 to 1500 rpm;

– display information on the oil pressure in the transmission unit to the driver’s APU;

– make sure there is pressure from 1.5 to 3 $кгс/см^2$; after a period of 2 to 3 minutes has elapsed after starting the engine, turn on the OIL PUMPING FROM Gearbox switch and hold it in the on position for 1 minute, while the oil pressure in the transmission unit should be 0 $кгс/см^2$;

– without releasing the OIL PUMPING FROM GEARBOX switch, stop the engine;

– after the engine has completely stopped, release the OIL PUMPING FROM Gearbox switch;

– pause for 5 minutes to allow the oil to drain from the walls of the crankcases and parts;

– turn on the OIL PUMPING FROM Gearbox switch and, without releasing the switch, start the engine;

– set the crankshaft speed in the range from 1400 to 1500 rpm) and operate for 1 minute, while the oil pressure in the transmission unit should be 0 $кгс/см^2$;

– stop the engine;

– after 10 to 15 seconds have elapsed after stopping the engine, release the OIL PUMPING FROM GEARBOX switch;

– open the roof over the transmission;

– Clean the filler neck of the transmission oil tank from dust and dirt and remove the plug.

Check the completeness of oil pumping out 10 to 15 minutes after stopping the engine, allowing the oil to settle from the foam, by measuring the oil level in the transmission tank. The level should be between the marks “40” and “42” on the rod (from 40 to 42 liters of oil, respectively).

If necessary, for more accurate control of pumping completeness, additionally drain the remaining oil from both gearboxes and the input gearbox. The amount of oil drained should be no more than 3 liters from each gearbox and no more than 2 liters from the input gearbox.

After checking the completeness of pumping with drains, you must:

– start the engine and set the crankshaft speed from 1400 to 1500 rpm, run for 5 to 6 minutes to fill the oil lines;

– Refill the transmission tank with an amount of oil equal to that drained from the gearbox and input gearbox.

#### 5.8.10.2 Changing the oil in the hydraulic system of the transmission unit

It is recommended to change the oil in the hydraulic system of the transmission unit while it is hot, immediately after stopping the engine.

The oil change procedure is as follows:

– install the tank so that the cavities of the teeth of the drive wheel rims are opposite the gearbox intake filters;

– pump out the oil from the units, following the instructions in paragraph 5.8.10.1of this manual;

– prepare the necessary tools, devices and containers for the drained oil;

– clean from dust and dirt and unscrew the oil tank filler plug;

– unscrew the plugs in the bottom of the tank under the drain valve of the oil tank and under the drain plug of the input gearbox housing;

– clean off dirt and unscrew the oil tank drain valve plug;

– Screw the tip for draining fuel, oil and coolant, connected to the MZA hose, into the drain valve of the oil tank and drain the oil;

– Unscrew the drain plug of the input gearbox housing and the gearbox intake filters and drain the oil;
– wash the filter of the pump-out line and intake filters of the gearbox in diesel fuel;
– install the filters in their places and screw in the drain plugs;
– pour 37 to 42 liters of oil into the oil tank (in winter it is necessary to fill in hot oil);
– after filling the oil tank, start the engine with air, run for 2 to 3 minutes, then pump out the oil from the units;
– Check the oil level in the tank and top it up to mark “42” on the rod.

The total amount of oil required for refueling during replacement is approximately from 50 to 57 liters.

Only clean oil approved for use may be poured into the hydraulic system of the transmission unit. Pour oil from a clean container through a funnel with a mesh.

**5.8.10.3 Flushing the hydraulic system of the transmission unit**

In all cases, after washing the filters, make sure that there is no oil leakage from their installation locations while the engine is running.

The hydraulic system of the transmission unit is flushed if an unauthorized type of oil is used or different types of oils are mixed together, as well as if foreign inclusions are detected in the filters.

To flush the hydraulic system of the transmission unit, you must:

– drain the previously filled oil from the tank, both gearboxes, and the input gearbox, rinse the filters of the oil tank and gearbox;
– pour 42 liters of clean oil into the tank, approved for use in the transmission unit;
– start the engine and run for 10 minutes;
– pump out the oil from the units, guided by clause 5.8.10.1of this manual;
– Drain the oil from the tank, both gearboxes, and the input gearbox and refill the tank with 42 liters of clean oil approved for use in the transmission unit.
– start the engine and run for 1 minute;
– pump out the oil from the units, guided by clause 5.8.10.1of this manual;
– top up the oil in the tank to a level of 40 to 42 liters along the rod.

**5.8.10.4 Cleaning the oil tank filter**

Before washing the oil tank filter, it is recommended to pump out the oil from the units.

To wash the filter you need to:

– Unscrew the nuts securing the filter element to the filter housing on the oil tank and remove the filter element;
– Unlock and unscrew the nut securing the filter sections on the rod, and then remove the filter sections;
– wash all filter parts in clean diesel fuel;
– inspect the filter sections, replace defective ones with new ones from the group spare parts kit for the tank;
– check the condition of the rubber sealing rings on the filter element cover; if there are tears or delaminations of the rings, replace them;
– assemble the filter element; after tightening the filter sections with a nut, their free movement on the rod is not allowed; if it is impossible to tighten the filter sections tightly, you need to add one or two sections to the bag;
– blow out the filter with compressed air or allow excess diesel fuel to drain;
– remove sediment from the cavity of the filter housing on the tank with a syringe and wipe this cavity with a rag;
– lubricate the rubber sealing rings with oil approved for use in the transmission unit;
– install the filter element in place.

**5.8.10.5 Washing the intake filters of the gearbox**

Before removing the filters, install the tank so that the cavities of the gear rims of the drive wheels are opposite the filters.

To wash the intake filters you need to:

– unscrew the intake filter from each gearbox housing;
– wash the filters in clean diesel fuel;
– blow out the filters with compressed air or allow excess fuel to drain;
– check the condition of the aluminum gasket and rubber sealing ring, replace them if necessary;
– check the condition of the filter mesh; if damage is detected, solder the mesh or replace the filter;
– Lubricate the rubber rings with oil before installing the filter;
– install the filters in place.

**5.8.10.6 Cleaning compressor and bevel gear filters**

The compressor filters and fan drive gear are washed during the second maintenance service No. 1, or when changing the oil and flushing the hydraulic system of the transmission unit.

To wash the compressor filter, you need to unscrew the filter housing located on the compressor drive and unscrew the filter from the housing.

To wash the bevel gear filter of the fan drive, it is necessary to unscrew the oil supply fitting from the gearbox housing and unscrew the filter from the fitting.

Wash the filter housing, fitting and filters in clean diesel fuel, dry and reassemble.

When installing fittings with filters, replace the copper-asbestos rings.

### 5.8.10.7 Checking and regulating oil pressure in the hydraulic system of the transmission unit

Monitor pressure values using a device for measuring oil pressure in the hydraulic system of the transmission unit (from the group spare parts kit for the tank).

Check and adjust the pressure in the following cases:

– when replacing gearboxes;

– when replacing a valve device;

– when replacing distribution mechanisms;

– when the tank is withdrawn while moving or when starting off;

– if the oil pressure values on the corresponding DCMV scale do not correspond to the values specified in paragraph 3.1.5 of this manual.

Checking and adjusting the pressure is carried out at an engine crankshaft speed of 1700 to 1800 rpm and at an engine oil and coolant temperature of plus 70 to plus 90 °C.

To check and adjust the pressure in the hydraulic system of the transmission unit, you must:

– stop the engine;

– install a device for measuring oil pressure in the hydraulic system of the transmission unit on the grille of the exit shutters;

– open the roof over the transmission;

– turn off the fan by loosening the nut and tightening the stop on the fan control spool box;

– disconnect the tracks and release the drive wheels;

– connect the device to the right and left MR;

– start the engine and set the crankshaft speed from 1700 to 1800 rpm.

With the engine running, check the hydraulic control pressure of the right and left gearbox using the pressure gauges of the device.

When the selector lever is in the neutral position or when any gear is engaged, except for 1st gear and reverse gear, the pressure should be from 10 to 11.5 кгс/см$^2$, the pressure difference in the left and right gearbox is no more than 1 кгс/см$^2$.

Adjust the pressure by rotating the adjusting sleeve 28 (Figure 3.13, sheet 2) of the distribution mechanism **;** in this case, you must first unscrew the cap 27 and remove the lock washer 46. After adjustment, install the lock washer 46 on the sealant.

When engaging 1st gear and reverse gear, as well as when the turn lever is in the rearmost position, the pressure on the leading side (when engaging any gear) should be from 16.5 to 18 кгс/см$^2$. Adjustment is carried out with screw 42, for which it is necessary to unscrew the cap 43 and loosen the lock nut 44. After adjustment, tighten the lock nut, put the cap in place and secure it with a cotter pin.

If the specified adjustment fails to establish the pressure in the gearbox within the specified limits, as well as when replacing the valve device, it is necessary to check the pressure in the oil supply line to the distribution mechanisms. To do this, remove cover 12 from one of the distribution mechanisms and use a screwdriver to push in spool 34 (with the engine running); in this case, the corresponding pressure gauge should show a pressure from 17 to 18.5 кгс/см$^2$; Adjust the pressure using screw 4 (Figure 3.14).

After adjustment, replace cover 12 (Figure 3.13, sheet 2) of the inspection hatch of the distribution mechanism, replacing gasket 45 under this cover. Before installation, lubricate the gasket on both sides with sealant.

After making these adjustments, check the pressure difference in the left and right gearbox. When installing the clutch pedal in any intermediate position, the pressure difference in the left and right gearbox throughout the entire range of oil pressure changes from 2 to 7 кгс/см$^2$should be no more than 1 кгс/см$^2$. Adjustment of pressure equality is carried out guided by clause 5.8.11.3 of this manual.

Adjust the lubricant pressure in the hydraulic system of the transmission unit using screw 7 (Figure 3.14) of the valve device when the selector lever is in the neutral position.

The lubricant pressure should be in the range from 1.5 to 3 кгс/см$^2$at an engine speed in the range from 1600 to 1900 rpm.

After adjusting the hydraulic pressure:

– turn off the engine;

– disconnect the device for measuring pressure from the left and right MR;

– close the roof over the MTO;

– remove the pressure measuring device.

### 5.8.11 Control drives

### 5.8.11.1 Checking and adjusting control drives

The adjustment parameters of control drives, except for the stopping brake drive, as a rule, remain unchanged over the period of operation. Control drives are adjusted after replacing gearboxes, distribution mechanisms, or after other work that violates the adjustment parameters of the drives. In this case, the rotation drive is adjusted after adjusting the clutch drive.

When removing the rear transverse shaft 33 (Figure 3.21) of the gear shift drive for repair work, do not disconnect the clutch 28 from the right and left distribution mechanisms. It is necessary to unfasten and loosen the nuts 30 on the adapter shafts 35 and slide them along the splines towards the shaft 33, disconnecting the shafts 35 from the couplings 28.

When installing shaft 33, it is necessary to align the pins of the adapter shafts 35 with the groove of the coupling 28. In this case, adjustment of the gear shift drive is not required.

### 5.8.11.2 Operational and adjustment parameters of tank units and mechanisms

Operational adjustment parameters are given in Table 20.

Table 20

| Parameter name | The adjusted drive must correspond |
|---|---|
| **Fuel pump control drive** | |
| When you press pedal 2 (Figure 3.22) to supply fuel until the stop of adjusting bolt 1 into the bonnet welded on the bottom, the relative elongation of the elastic link of the rod 13 of the fuel pump is: | |
| - with a 2.5 mm thick probe installed under the adjusting bolt | absent |
| - with the dipstick removed | available (determined visually) |
| **Gear shift drive** | |
| Discrepancy between arrow 16 (Figure 3.21) and marks on dial 17 of the left and right distribution mechanisms, in gears, mm, no more | 3 |
| **Clutch drive** | |
| In the initial position of clutch pedal 23 (Figure 3.21), the arrow does not align with the lower edge “0” of plate 24: | |
| - non-income, mm, no more | 1.5 |
| - transition, mm, no more | 0.5 |
| When the clutch pedal 23 is depressed all the way to the adjusting bolt 22, the position of the arrow relative to the upper edge “1” of the plate 24 is: | |
| - non-income, mm, no more | 1.5 |
| - transition, mm, no more | 2.5 |
| **Steering drive** | |
| Clearances between the shanks of levers 14 (Figure 3.21) and limiting bolts 26 and 27 on the right and left distribution mechanisms in the initial and final positions of control levers 1, mm | from 0.3 to 0.7 |
| **Stopping brake drive** | |
| In the initial position of the drive, pointer arrow 17 (Figure 3.17) of servomechanism 4 | matches the risk “0” |
| When installing the stopping brake pedal 13 on the second tooth of the latch 14: | |
| - pointer arrow 17 of servo mechanism 4 | is between risks “I” and “2” |
| - arrow 16 of the servomechanism equalizer 4 | located between the marks on the bar welded to the balancer 7 |
| When trying to press the pedal further than the second tooth of the latch, movement of the right and left rods 8 and 11, mm | from 0 to 1 |

### 5.8.11.3 Checking and adjusting the gearbox release drive (clutch drive)

In the initial position of the drive, the arrow edge of the bushing of the distribution mechanism must coincide with the lower edge “0” of plate 24 (Figure 3.21) of the dial of both distribution mechanisms. The permissible shortfall is no more than 1.5 mm, the transition is no more than 0.5 mm. Measurement error ± 0.1mm. Ensure that bolts 25 are screwed in on the clutch shaft bushings.

When the clutch pedal 23 is pressed all the way to the adjusting bolt 22, the arrow edge of the distribution mechanism bushing should coincide with the upper edge “1” of the dial plate 24. The permissible shortfall is no more than 1.5 mm, the transition is no more than 2.5 mm. Ensure that bolts 22 are screwed in.

The adjustment is preliminary. Precise adjustment is made using pressure gauges when adjusting the synchronization of changes in oil pressure in the boosters in the left and right gearbox, guided by the instructions in the paragraph “Checking and adjusting oil pressure in the hydraulic control and lubrication system of the transmission.”

**ATTENTION:**

**BEFORE ADJUSTING THE CLUTCH DRIVE, IT IS PROHIBITED TO MOVE THE LEVER 14 DISTRIBUTION MECHANISMS!**

### 5.8.11.4 Checking and adjusting the stopping brake drive

The stopping brake drive is adjusted correctly if, when the stopping brake pedal 13 (Figure 3.17) is positioned on the second tooth of the latch 14, the arrow 16 of the equalizer is between the risks, the pointer arrow 17 of the servomechanism is between the risks “1” and “2” (Figure 3.24 a), and when the pedal moves forward from the second tooth of the latch to the stop, the movement of the left 11 (Figure 3.17) and right 8 gearbox rods is no more than 1 mm (Figure 3.24e). When the pedal is removed from the latch, the drive must return to its original position, with the pointer arrow facing the “0” mark, and the gearbox rods must move towards the rear of the tank by at least 28 mm, which guarantees that the brake clutches in the gearboxes are disconnected .

The stopping brake drive should be adjusted if the tank is braking insufficiently or unevenly. To access the adjustment points, it is necessary to remove the covers of the hatch under the engine and the access hatch to the servomechanism of the parking brake drive.

To regulate the drive it is necessary:

– install pedal 13 (Figure 3.17) of the stopping brake on the second tooth of latch 14 and check the position of arrow 16 of the equalizer (see Figure 3.24a). When the arrow leaves the zone between the risks towards the tank's nose, lengthen the right rod 8 (Figure 3.17) and shorten the left rod 11 by the same length until the arrow reaches the middle of the zone between the risks (Figure 3.24 b). When the arrow leaves the zone between the risks toward the stern, lengthen the left rod and shorten the right rod by the same length until the arrow reaches the middle of the zone between the risks (Figure 3.24 c);

– check the travel of the left and right gearbox rods when pressing the pedal from the second latch tooth all the way (Figure 3.24d). If the rods move more than 1 mm, return the pedal to its original position, shorten the rods by half a turn of the ties and check their movement again. Shorten the rods by half a turn until their movement is less than 1 mm;

– check the position of the arrow-pointer 17 (Figure 3.17) of the servomechanism when installing the pedal on the second tooth of the latch. If the pointer arrow does not reach mark “1” (Figure 3.24 e), lengthen both rods until the arrow returns to the area between marks “1” and “2” and repeat the drive adjustment;

– check the travel of the gearbox rods when the pedal returns from the second tooth of the latch to its original position and that the arrow-pointer of the servomechanism aligns with the mark “0”. If the arrow does not reach the mark or if it is difficult to move the pedal, the bottom under the brake drive should be cleaned of dirt and dust in the following places:

- under the left thrust lever (through the hatch under the engine);
- under the equalizer (through the access hatch to the parking brake servo mechanism);
- under the servo mechanism lever (with the air cleaner removed).

Upon completion of the adjustment, it is necessary to tighten the locknuts of the gearbox rods and install the covers of the hatch under the engine and the access hatch to the servomechanism of the parking brake drive.

When replacing the gearbox, it is necessary to lengthen the gearbox rods by the same amount (from three to five turns of the ties) to facilitate subsequent adjustment.

**ATTENTION:**

**FAILURE TO COMPLY WITH THE PROCEDURE FOR ADJUSTING THE STOPPING BRAKE DRIVE CAN RESULT IN THE FAILURE OF TRANSMISSIONS AND THE CREATION OF EMERGENCIES DUE TO THE IMPOSSIBILITY OF BRAKING!**

### 5.8.11.5 Checking and adjusting the drive by controlling the fuel pump

When you press the fuel pedal 2 (Figure 3.21) all the way:

– with a 2.5 mm thick probe installed between the adjusting bolt 1 and the side welded on the bottom, there should be no relative elongation of the elastic link of the fuel pump rod 13;

– with the probe removed, there should be a relative elongation of the elastic link (determined visually).

If necessary, adjust by screwing bolt 1 into pedal 2.

Under these conditions, the engine will develop the maximum possible speed and stop at the initial (rearmost) position of the manual fuel supply handle 20 and pedal 2 released.

On the product, with a warm engine, with the shutters open, and the manual fuel supply handle 20, fixed after bringing it all the way to the lever 19, the engine crankshaft rotation speed should reach from 800 to 950 rpm.

If necessary, adjust the tie rod 15. In the initial position of the drive (the rearmost position of the handle 20 and the released pedal 2), the gap between the pin 18 of the handle 20 and the lever 17 must be at least 1 mm.

**IT IS PROHIBITED TO ADJUST THE DRIVE WITH THE LIMIT SCREWS ON THE FUEL PUMP!**

### 5.8.11.6 Checking and adjusting the gear shift drive

For an adjusted drive, in all gears, arrows 16 (Figure 3.21) should coincide with the marks of the same name on the dials 17 of the right and left distribution mechanisms. A discrepancy of no more than 3 mm is allowed. If the arrows do not coincide with marks of more than 3 mm, the drive should be adjusted.

If the arrows do not coincide with the marks on the dials of both distribution mechanisms by the same amount and in the same direction, it is necessary to align the arrows 16 with the marks on the dials by screwing in or unscrewing the tie 11.

If the arrows do not coincide with the marks on the dials of both distribution mechanisms by different amounts or in different directions, you must:

– Use tie 11 to align arrow 16 with the marks on dial 17 of the right distribution mechanism;

– disconnect the inclined rod 18 with a quick-release tip from the lever of the left bushing 29 of the clutch shaft, for which it is necessary to press the spring-loaded bushing 31 along the axis of the rod and remove the axis of the driver 32 from the inner race of the lever bearing;

– Unscrew the adjusting bolts 25 and nuts 34 of the clutch shaft bushings 29 from 2 to 3 turns and move the bushings 29 to the middle of the clutch shaft 15;

– determine the magnitude (in millimeters) and direction of the maximum shift of the arrow relative to the mark on the dial of the left distribution mechanism;

– set gear shift lever 3 to third gear position;

– disconnect coupling 28 from the right distribution mechanism, to do this, unfasten and loosen the nuts 30 on coupling 28 on the side of the distribution mechanism and on the shaft coupling 33, holding shaft 33 from turning by the hexagon on the adapter shaft 35, and move shaft 35 with coupling 28 along the splines inward rear cross shaft 33;

– manually turn the rear transverse shaft 33 until arrow 16 aligns with the mark “3” on the dial of the left distribution mechanism;

– disconnect coupling 28 with adapter shaft 35 from the left distribution mechanism, first making marks on the coupling and the shaft of the left distribution mechanism opposite any spline;

– turn the rear transverse shaft 33 disconnected from the distribution mechanisms in the direction of the arrow's displacement from the mark by the number of splines obtained by dividing the maximum numerical value of the misalignment by 0.6, and connect the couplings 28 to the distribution mechanisms, while the dimension B between the couplings and the distribution mechanisms should be from 1 to 3 mm, and the difference in dimensions D should be no more than 2 mm;

– connect the clutch shaft 15 with the bushings 29 of both distribution mechanisms and tighten the nuts 34, while maintaining the difference in dimensions D of no more than 2 mm and the gap between the end of the bushings 29 and the covers of the distribution mechanisms of at least 0.5 mm;

– connect the lever of the left bushing 29 of the clutch shaft with the quick-release tip of the inclined rod 18;

– Screw in the adjusting bolts 25 and check the synchronization of changes in oil pressure in the boosters of the left and right gearboxes, following the instructions in paragraph “Checking and adjusting the oil pressure in the hydraulic control and lubrication system of the transmission.”

### 5.8.11.7 Checking and adjusting the gear selector lock from the parking brake latch

Installation of pedal 13 (Figure 3.17) of the stopping brake on latch 14 is possible only after setting the gear shift lever to the neutral position. In this case, engaging 1st gear or reverse gear becomes impossible.

If 1st gear or reverse gear is engaged when the brake pedal is locked, it is necessary to shorten the gear selector locking cable 15 using the adjusting fork 2.

### 5.8.11.8 Checking and adjusting the tank rotation drive

In the initial position of the control levers 1 (Figure 3.21), the stops 8 on the longitudinal composite rods 6 must rest against the limiting bolts 7 of the initial position, while in the left and right distribution mechanisms there must be a gap between the shank of the lever 14 of the distribution mechanism and the upper limiting bolt 26 of the initial position $0{,}3^{+0{,}4}$mm. Ensure the gap with tie 10.

In the final position (pull) of the control levers, the stops 8 on the longitudinal composite rods 6 should rest against the final position adjusting bolts 9, while in the left and right distribution mechanisms the gap between the shank of the lever 14 of the distribution mechanism and the lower limit bolt 27 should be $0{,}3^{+0{,}4}$mm. Ensure the clear-

ance by screwing in or unscrewing the adjusting bolt 9 of the final position. The position of the limiting bolts 26 of the initial position and 27 of the final position on the distribution mechanisms and the limiting bolt 7 of the initial position cannot be adjusted in operation.

### 5.8.12 Tank tower

#### 5.8.12.1 Washing and lubricating the turret ring

The ball bearing and the rubber seal of the turret shoulder strap need to be lubricated only in the event of a significant increase in the force on the handle of the manual rotation mechanism when the turret rotates on a horizontal section.

Grease CIATIM-201 GOST 6267-74 in an amount of 300 to 400 g is filled with a syringe press through the threaded hole of the barrel located in the right rear part of the bottom sheet of the tower, having first unscrewed the plug.

When refueling, it is necessary to rotate the tower so that the lubricant is introduced in one or two full revolutions of the tower. Once filling is complete, replace the plug and tighten it tightly.

#### 5.8.12.2 Flushing and lubricating the tower stopper

When moving the turret stopper tightly in the housing, it is necessary to rinse it with the diesel fuel used in the product through the hole in the stopper body, having previously unscrewed the bolt securing the shield. After flushing through this hole, lubricate the stopper with CIATIM-201 GOST 6267-74 grease, then install the bolt in place and screw it in tightly.

To avoid the flushing liquid getting on the electrical equipment components, it is necessary to cover them with a rag, and, if possible, place a container to collect the draining flushing liquid.

#### 5.8.12.3 Washing and lubricating stops and locks of tower hatches

In case of tight closing or opening of the covers, wash the hinges of the commander's and gunner's hatches by pouring diesel fuel used in the product between the hinges, opening and closing the hatch cover.

Wash the locks and stoppers of hatch covers if their handles rotate too tightly.

The procedure for washing locks (stoppers) is as follows:

– unscrew the lock (stopper) and disassemble it;

– Wash the lock (stopper) parts in diesel fuel and wipe them dry with a rag.

After washing, assemble the lock (stopper), having previously lubricated its parts and sockets with CIATIM-201 lubricant.

### 5.8.13 Chassis

#### 5.8.13.1 Criteria (signs) of the need to check the limit state of chassis components

The criteria for the need to check the limit state of chassis components are:

– for caterpillar:

- impossibility of tensioning the track when the guide wheels are fully extended forward;
- deterioration of adhesion of tracks to the road surface;
- cracks on the tracks;
- tank operating time 6000 km or more;

– for the drive wheel and rings:

- significant wear of the tooth profile of the ring gear;

– for road wheels:

- jamming (lack of rotation) of the roller;
- significant difference in wear of road wheels;
- The tank's operating time is 6000 km or more.

If the listed criteria (signs) are detected, it is necessary to check the limit state of the chassis components in accordance with paragraph 5.8.13.2of this manual. Assembly units and parts of the chassis that have reached their limit state must be replaced or rearranged during the next maintenance (ETO, MOT No. 1 or MOT No. 2).

#### 5.8.13.2 Determination of the limit state of chassis components

##### 5.8.13.2.1 Drive wheels and crowns

When operating the tank, replace the drive wheels with extreme wear on one side of the profile of the teeth of the rims, when the size from the worn profile to the edge of the casting recess of the tooth is 4 mm or less (Figure 5.10). Check wear on the outer rims.

If the tooth profile on both sides is extremely worn, replace the rims with new ones. If the ridges of the tracks touch the hub of the drive wheel, replace the rims with new ones regardless of the wear of the teeth.

#### 5.8.13.2.2 Track tracks

Replace track tracks in the following cases:

– when the rubber rings of the hinges are completely destroyed (the dimensions in the places indicated in Figure 5.10 are 73 mm or more);

– if there is a crack on at least one of the ribs;

– if there is a crack on the tile more than 20 mm long;

– when the lugs are completely worn out.

#### 5.8.13.2.3 Caterpillar

Replace the track when more than one third of the tracks fail (increasing in size by more than 73 mm on a weakened track).

#### 5.8.13.2.4 Track rollers

Replace the support roller if the following malfunctions occur:

– wear of rubber tires to a thickness of less than 30 mm around the entire circumference;

– wear of rubber tires across the entire width to the metal, preventing the roller from rotating;

– tears and chips across the entire surface of the tire with a depth to the metal and a total area of more than half the surface of the tire tread;

– complete detachment and displacement of the tire from the bandage.

If there is a significant difference in wear or damage to the rubber tires, swap the 6th support rollers with the 1st ones, and the 5th ones with the 2nd or 3rd ones.

#### 5.8.13.2.5 Hydraulic shock absorber arm joints

Replace the bushings of the hydraulic shock absorber levers with new ones if the play in the hinges is more than 25 mm. For replacement, use the parts included in a single spare parts kit for the tank.

Measure the total play in the hinges with a ruler in the following order:

– using a crowbar from a single set of spare parts for the tank, move the shock absorber lever up to the stop;

– install the ruler, resting it on the upper finger;

– measure dimension A (Figure 5.15) from the upper shock absorber pin or from the upper hinge cover to any sharp edge at the end of the balancer pin;

– move the shock absorber lever down until it stops;

– measure size $A_1$.

Difference between sizes A and$A_1$ equal to the total play of the shock absorber hinges. If the play is more than 25 mm, replace the worn bushings (available in the group spare parts kit for the tank).

### 5.8.13.3 Refilling the track rollers with lubricant

To refuel the track rollers and idler wheels, you must:

– clean the bolt heads of the filling holes and the covers around the bolt heads from dirt and dust;

– Using an S17 mm socket wrench, unscrew the bolts installed in the filling holes of the support rollers and idler wheels. The two track roller filling holes are located on the same axis with distinctive spherical protrusions on the roller disk. The filling holes for the idler wheels are located in two diametrically located distinctive thickenings of the hub;

– refill lubricant through the lower filling hole until fresh lubricant comes out of the upper hole. Refueling of track rollers and idler wheels is carried out using an A3-1 refueling unit or a syringe press;

– install the bolts into the filling holes;

– Install spring washers under the bolt heads.

### 5.8.13.4 Refilling the bearings of the balancer bushings with grease

To refuel the bearings of the balancer bushings you must:

– clean the plug heads of the filling holes and the recesses for the plugs in the balancer brackets from dirt and dust;

– Using a socket wrench S=17 mm, unscrew the filling plugs in the balancer brackets;

– refill each bearing with grease using a syringe press in an amount of 120 to 200 g;

– screw the filler plugs into place;

– Install aluminum gaskets under the plug heads.

### 5.8.13.5 Refilling the bearings of the front balancer bushings with grease

To refuel the bearings of the front balancer bushings, it is necessary to move the blade of the self-digging equipment into the working position, after which the filling plugs are unscrewed with the key 172.95.102сб, available in the group spare parts kit for the tank.

#### 5.8.13.6 Refilling the internal cavity of the final drive with lubricant

To refuel the internal cavity of the final drive carrier, you must:

– clean the plug head (as well as the surface around the plug head) of the filling hole in the drive wheel mounting plug from dirt and remove the wire;

– Using a socket wrench S=27 mm, unscrew the plug installed in the filling hole and instead screw in the adapter fitting 54.28.1499, available in the group spare parts kit for the tank;

– connect the syringe press hose to the fitting and fill the carrier cavity with lubricant (approximate amount of lubricant 500 g);

– unscrew the adapter fitting;

– Screw the plug into the filling hole and secure with wire.

#### 5.8.13.7 Checking and refilling support rollers with oil

To check and refill oil in the support rollers, you must:

– install the tank on a level surface;

– clean the filler plug and the bore for the plug in the hub from dirt and dust;

– Using a socket wrench S=19 mm, unscrew the plug installed in the filling hole. If it is impossible to unscrew the plug due to the ridge of the caterpillar, move the tank;

– Check the oil level in the support roller. When the carrier roller is fully filled, the oil level should be up to the bottom edge of the filler hole;

– if necessary, refill the support roller with oil using a syringe press and allow excess oil to drain;

– install the plug in the filling hole and tighten it to a torque of 100 to 120 N ·m (10 to 12 kgf m) (approximately 0.2 m of one person's shoulder force).

#### 5.8.13.8 Changing the oil in support rollers

Change the oil in the following order:

– unscrew the filler plug;

– use a syringe press with a rubber tube placed on the sock to suck out the possible amount of oil;

– fill the support roller to normal using a syringe press;

– install the plug in the filling hole and tighten it to a torque of 100 to 120 N ·m (10 to 12 kgf m) (approximately 0.2 m of one person's shoulder force), after allowing excess oil to drain.

### 5.8.14 Electrical equipment MTO

#### 5.8.14.1 Blowing the starter-generator

To remove dust from the cavities of the starter-generator, it is necessary to blow it with compressed air in the following sequence:

– release the starter-generator hose attached to the transmission bevel gear pipeline;

– unscrew the plug on the tip of the starter-generator hose;

– connect the hose from the compressor of the maintenance vehicle to the tip of the starter-generator hose through the adapter for purging the SG from the group spare parts kit;

– start the tank engine and set the rotation speed from 1500 to 1600 rpm;

– turn on the compressor and vent the starter-generator for 5 minutes with the tank engine running;

– stop the engine and stop the compressed air supply;

– disconnect the compressor hose with the adapter from the tip of the starter-generator hose;

– screw the plug onto the starter-generator hose;

– secure the starter-generator hose to the bevel gear pipeline.

#### 5.8.14.2 Checking the functionality of the starter-generator

To check the functionality of the starter-generator, you must:

– make sure that the SG armature shaft rotates when the engine is running;

– stop the engine and turn off the battery switch;

– remove the 600 A fuse from the battery protection unit;

– disconnect wire 43 from terminal "P" of the relay regulator;

– disconnect the electrical connector SR-14 installed on the roof of the building next to the BCS;

– connect the “P” terminal of the relay-regulator with a wire to contacts 3 and 4 of the SR-14 electrical connector socket and turn on the AB switch;

– start the engine and set the crankshaft speed from 800 to 1000 rpm;

– Check the voltage generated by the starter-generator at the “P” terminal of the relay-regulator, which, if the starter-generator is working properly, should be from 70 to 120 V. If the voltage is less than permissible, measure the resistance of the starter-generator excitation circuit.

#### 5.8.14.3 The procedure for measuring the resistance of the excitation circuit

The procedure for measuring the resistance of the excitation circuit is as follows:

– stop the engine and turn off the battery switch;

– disconnect the electrical connector SR-14 installed on the roof of the building next to the BCS;

– measure the resistance between pins 3-4 of the SR-14 electrical connector socket and the tank body.

With a resistance of 1.25 to 1.34 Ohms, the excitation circuits are operational.

If the resistance value does not fall within the range from 1.25 to 1.34 Ohms, then this indicates an open or short circuit in the excitation circuit. In this case, measure the resistance of the field windings with the wire disconnected from the electrical connector SG-SH between the connector contact and the starter-generator housing.

If the resistance value does not fall within the range of 1.25 to 1.34 Ohms, the starter generator must be replaced.

#### 5.8.14.4 Battery Maintenance

Maintain the battery in accordance with the operating instructions for lead-acid starter batteries IRFB.563423.009RE supplied with the tank.

Do not allow the battery to discharge more than 25% in winter and more than 50% in summer. The degree of charge of batteries installed in the tank is determined by the voltage drop when starting the engine with the starter and by the charging current .

When the engine is running from 10 to 15 minutes and the crankshaft speed is from 1500 to 2000 rpm, in fully charged batteries the charging current should not be more than 20 A. The permissible charging current is from 50 to 130 A. If the charging current is greater than the permissible voltage or The battery when starting the engine with a starter is less than 18 V, it is necessary to charge the battery.

To restore the electrolyte level in the battery, add only distilled water, after which it is necessary to charge the battery for 10 to 15 minutes from an external current source or from the tank generator.

When the ambient temperature is below minus 25 °C, it is recommended to store batteries in a heated room.

#### 5.8.14.5 Recharging batteries with low currents

To recharge the battery with low currents, the tank has an electrical connector located on the housing of the left front parking light. The cables for connecting the tank to the charging unit are included in the group spare parts kit.

### 5.8.15 Diesel generator service

**ATTENTION:**

**SERVICING THE ENGINE IS PERFORMED ONLY WITH THE ENGINE NOT RUNNING!**

#### 5.8.15.1 Checking the oil level in the diesel generator set engine

To check the oil level:

– install the tank on a horizontal platform;

– check the level on a cold diesel generator engine; if the engine has been warmed up, allow it to cool for at least 15 minutes;

– open hatch 9 (Figure 4.4);

– remove oil dipstick 15 (Figure 10.11);

– wipe the dipstick with a non-fibrous, clean cloth;

– insert the dipstick all the way and remove it again;

– check the oil level on the dipstick; it should be between the upper and lower marks;

– close hatch 9 (Figure 4.4).

**ATTENTION:**

**THE ENGINE OIL LEVEL SHOULD NEVER BE BELOW THE LOW MARK ON THE DIPSTICK OR ABOVE THE UPPER MARK ON THE DIPSTICK!**

#### 5.8.15.2 Replacing the engine oil and oil filter

Fill the diesel generator engine lubrication system with oil in accordance with Table 5. System capacity is from 2.3 to 2.5 liters of oil.

**ATTENTION:**

**IT IS PROHIBITED TO USE OTHER GRADES OF OILS, AS WELL AS MIXING THE GRADES OF OILS USED WHEN FILLING AND REFILLING THE SYSTEM!**

Filling the DGU engine with oil should be done from a bucket through a watering can with a filter from a single set of spare parts for the tank. Flushing the lubrication system is not required.

To change the oil in a diesel generator set engine you must:
– install the tank on a horizontal platform;
– start up the diesel generator set and warm up the engine for at least 10 minutes;
– stop the diesel generator set;
– open hatches 9 (Figure 4.4) and 17;
– install a container to collect oil under plug 47 (Figure 10.11) for draining oil from the engine;
– Unscrew plug 47, plug 7 for filling engine oil and drain the oil. Duration of oil draining is at least 20 minutes;
– tighten the oil drain plug, checking the condition of the sealing gasket, if necessary, replace it with a gasket from a single set of spare parts DGU10;
– place a rag under the oil filter 12 to prevent oil spillage;
– Unscrew oil filter 12 counterclockwise, avoiding oil spillage. If necessary, use an oil filter puller from a single set of spare parts DGU10;
– remove a rag with leaked oil, wipe the place where the oil filter is connected to the engine;
– lubricate the O-ring of the new oil filter with fresh engine oil;
– screw the oil filter clockwise until the sealing ring comes into contact with the supporting surface, then tighten it at an angle from 180° to 270°;
– Fill the engine to the level of the top mark on oil dipstick 15. Check the oil level with the dipstick fully inserted;
– screw in the oil filler plug;
– start the diesel generator set engine and let it run for at least 5 minutes;
– stop the diesel generator set and, after waiting at least 10 minutes after stopping the diesel generator set, check the oil level, if necessary, add oil to the upper mark on the dipstick;
– close hatches 9 (Figure 4.4) and 17;

**ATTENTION:**

**IT IS PROHIBITED TO OPERATE THE ENGINE GENERATOR WITH THE OIL LEVEL BELOW THE LOWER MARK ON THE DIPSTICK OR ABOVE THE UPPER MARK ON THE DIPSTICK!**

#### 5.8.15.3 Replacing coolant in the diesel generator cooling system

Fill the diesel generator engine cooling system in accordance with Table 5. System capacity is from 4 to 4.5 liters of coolant.

**DO NOT USE WATER AS COOLANT**

Filling the diesel generator set engine with coolant should be done from a bucket through a funnel with a mesh from a single set of spare parts for the tank. Flushing the cooling system is not required.

To replace the coolant in the diesel generator cooling system, you must:
– open hatch cover 17 (Figure 4.4) in the bottom of the diesel generator compartment, cover 8 of the diesel generator compartment;
– unscrew plug 48 (Figure 10.11) to drain the coolant and drain it into a bucket (to make draining easier, unscrew plug 24 of the expansion tank filler neck);
– After draining the coolant, tighten the drain plug;
– unscrew fitting 34 of drainage pipeline 37 on expansion tank 29;
– Fill the engine cooling system until the neck is cut or until coolant appears from the drain pipe;
– screw in plug 24 of the filler neck of the expansion tank;
– screw in fitting 34;
– start the diesel generator set engine and let it run for at least 2 minutes at idle speed, then stop the diesel generator set;
– Allow the engine to cool, unscrew the filler cap of the expansion tank, check the coolant level, and top up if necessary. The coolant level should be at the level of the lower edge of the filler neck. If necessary, repeat the topping procedure until the coolant level stabilizes;

– start the diesel generator set, after warming up the coolant and turning on the electric fan of the diesel generator set, stop and allow it to cool;
– Unscrew the filler cap of the expansion tank, check the coolant level, and top up if necessary;
– check for coolant leakage;
– close hatch cover 17 (Figure 4.4) in the bottom of the diesel generator compartment, cover 8 of the diesel generator compartment.

During operation of the diesel generator set, the permissible coolant level must be between the lower edge of the expansion tank neck and the bottom under the neck.

**ATTENTION:**

**IT IS PROHIBITED TO FILL THE DGS WITH COOLANT THROUGH THE NECK OF THE STEAM-AIR VALVE!**
**DO NOT OPEN THE COOLANT FILL CAP WHEN THE ENGINE IS WARM!**

#### 5.8.15.4 Replacing the diesel generator air filter

The air filter filter element is replaced when lamp 55 (Figure 10.11) of the air filter clogged indicator on the control panel lights up.

To replace the air filter element you must:
– remove cover 8 (Figure 4.4) of the diesel generator compartment;
– unclip two latches 26 (Figure 10.11) on the air filter housing 3 and carefully move the housing to the side;
– remove the filter element from the air filter housing;
– remove dust and dirt from the air filter housing using a damp rag or a vacuum cleaner from the tank's group spare parts kit;
– insert a new filter element from a single set of spare parts for the tank into the air filter housings;
– close the filter cover and secure the latches.

#### 5.8.15.5 Replacing the fuel filter

To replace the fuel filter you must:
– open hatch 10 (Figure 4.4) ;
– place a container for collecting fuel under the bleed screw 43 (Figure 10.11) of the filter;
– unscrew screw 43 two or three turns and drain the fuel from the filter;
– holding ring 42 with your hand, unscrew bolt 17 and remove glass 16 with the filter element;
– replace the filter element in the glass;
– install the glass on the filter housing and, holding ring 42 with your hand, screw in bolt 17;
– screw in bleeder screw 43;
– Run the diesel generator set for 2-3 minutes and make sure there are no fuel leaks.

#### 5.8.15.6 Cleaning the diesel generator set

Clean the diesel generator set and the diesel generator compartment using compressed air and rags.

#### 5.8.15.7 Cleaning the radiator of the cooling system

To remove dust, dirt and foreign objects from the radiator core, it is necessary to open hatches 7 (Figure 4.4) and 13 and blow out the radiator with compressed air from the inside and outside.

### 5.8.16 Outdoor video surveillance system

#### 5.8.16.1 General instructions for servicing START

Depending on the type of television cameras supplied as part of the system, they are equipped or not equipped with a single spare parts. If you have a single spare parts kit, it is possible to replace the protective glass and drying cartridge.

Wipe the optical surfaces of the protective glass of START television cameras with wipes provided in a single set of START spare parts.

When cleaning the optical surface, first remove grains of sand and dust, then, after moistening the glass, wipe with a clean cloth, making circular movements from the center to the edges.

The optical surface must be cleaned carefully to avoid damaging the seal where the optics meets the metal frame.

Do not touch the optical surface with your fingers or oily or dirty rags: even the slightest grease stains will degrade the image quality of the system.

#### 5.8.16.2 Replacement of framed glass and drying cartridge

During operation of the SNV, damage to the protective glass 22 (Figure 12.1) is possible: matting (clouding caused by numerous small scratches of an abrasive material, such as sand), chips, cracks that impair visibility through television cameras.

Damaged protective glass (glass in a frame) of a television camera should be replaced with a new one from the single START spare parts kit (if available). Replacing the glass in the camera frame should be done in a dry room.

The glass in the camera frame is replaced with the power supply turned off in the following order:

– unscrew bolts 11 securing bracket 6 or 21;

– unlock and disconnect the electrical connector of harness 8 or harness 15 from camera 7 or 14 or 16 or 17;

– remove the locking wire of bolt 18;

– unscrew bolt 18 from rod 19 of bracket 6 or 21;

– remove the television camera from bracket 6 or 21;

– remove the damaged glass 22 in the frame from the body of the television camera using a single SPTA key for START;

– Move the sealing ring from the damaged glass removed from the television camera to the new glass from the single START spare parts kit. If the ring has tears, cracks or other integrity problems, replace it with a new one from the single START spare parts kit;

– install new glass 22 into the camera body;

– check the color of the silica gel in the window of the drying cartridge: the color is bluish-blue - the silica gel is working, not saturated with moisture, the color is pale pink or off-white - the silica gel is moistened and requires restoration.

The drying cartridge with moistened silica gel should be replaced with a new one from the single START spare parts kit.

The new drying cartridge may be kept open from the moment the cover is removed from it until it is screwed into the body of the television camera for no more than 2 minutes.

After replacing the glass in the frame, install the television camera in bracket 6 or 21, checking the presence of a rubber gasket between the camera and the bracket, tighten bolt 18 through rod 19, secure bolt 18 with wire, connect and secure with wire the electrical connector of harness 8 or harness 15.

Moisture-saturated silica gel from the drying cartridge is restored by heating at a temperature from plus 90 to plus 120 °C, guided by color, to bluish-blue. The restored silica gel is placed in the drying cartridge body, closed with a lid with an o-ring and placed in a single START spare parts kit.

### 5.8.17 TV rear view camera

During KO, it is necessary to check the condition of the outer glass of the camera lens and, if necessary, clean it of dust, dirt, moisture or frost with a flannel cloth from a single set of spare parts for the tank.

To clean the outer glass, open the protective cover 29 by pressing the VIDEO button or manually.

**ATTENTION:**

**WHEN TURNING THE TV CAMERA ON AND OFF, IT IS PROHIBITED TO BE IN THE AREA OF THE PROTECTIVE COVER OF THE TV CAMERA!**
**CONTINUOUS TIME OF TURNING ON THE TV CAMERA - NO MORE THAN 2 HOURS TO AVOID OVERHEATING AND FAILURE OF THE ELECTRONIC VALVE SUPPLYING COMPRESSED AIR TO THE PNEUMATIC CYLINDER OF THE DRIVE OF THE PROTECTIVE COVER OF THE TV CAMERA!**

To replace the outer glass of the TVKT-65N camera or check the condition of the silica gel in the drying cartridge of the TVKT-65N camera, as well as to replace a damaged TVKT-65N or TKV-1-65 camera with a new one from the group spare parts kit for the tank, you must first:

– Using an 8x10 wrench from a single set of spare parts for the tank, unscrew bolts 14 (Figure 12.4) and remove cover 18;

– Using a 5.5x7 wrench from a single set of spare parts for the tank, unscrew the set screw 20 and remove the rod 19;

– Unscrew the nut of the electrical connector of the camera harness 2 and remove the camera 16 from the protection housing 30.

If the outer glass of the TVKT-65N camera lens is damaged, replace it with a new one from a single set of spare parts for the tank.

To do this you need:

– Unscrew the framed glass from the camera body using a key from a single set of spare parts;

– remove remaining sealant from the threaded surface of the camera body;

– apply a bead of sealant from a single set of spare parts for the camera to the frame;

– apply a bead of sealant to the last turn of the threaded surface of the frame;

– Screw the framed glass into the camera body using a key.

If necessary (if there is a layer of moisture on the inner surface of the protective glass that cannot be removed when the electric heating is operating), after replacing the glass in the frame, replace the drying cartridge.

To do this you need:

– prepare a spare drying cartridge from a single set of spare parts for the tank;

– unscrew the drying cartridge from the camera body;

– unscrew the cap and immediately screw a new drying cartridge into the camera body.

It is advisable to replace the drying cartridge in a dry room. Keep the new drying cartridge open for no more than 2 minutes.

After replacing the outer glass of the TVKT-65N camera, replacing the drying cartridge of the TVKT-65N camera, or replacing a damaged TVKT-65N or TKV-1-65 camera with a new one, connect camera harness 2 to camera 16, install camera 16 in the protection housing 30, rod 19, Set screw 20, cover 18 and bolts 14 are also put in place.

Secure the nut of the electrical connector of the harness 2 of the television camera with KO 0.5 wire, secure the set screw 20 and bolts 14 with KO 1.2 wire.

When replacing a failed driver's APU module with a new one, it is necessary to link the conventional gauge lines to the dimensions of the tank in the following order:

– install the tank on a flat horizontal platform;

– turn on the APU and, using a tape measure at least 15 m long, place the poles according to Figure 12.7;

– Simultaneously press the “ ” and “+” buttons on the front panel of the APU and hold them for at least 5 s to enter the conditional gauge lines editing mode, when turned on, the left conventional gauge line turns green and an information line appears on the screen according to Figure 12.6, containing the number lines from 1 to 4 (1 is the number of the leftmost line on the APU screen), followed by the designation of the edited coordinate (“X1” or “Y1” is the horizontal and vertical coordinates of the top point of the line, “X2” or “Y2” is the horizontal and vertical coordinates of the bottom point of the line) and the numerical value of the edited coordinate;

– using the “+” and “-” buttons on the front panel of the APU, it is necessary to align the end of the green line with the base of the desired pole in the direction of the coordinate indicated in the information line;

– to move to the next coordinate, press the “ ” button;

– after the fourth click on the “ ” button (alignment along the Y2 coordinate), the green color goes to the next line of the conditional track, the ends of which must also be aligned with the base of the corresponding poles;

– after aligning the ends of the fourth line of the conditional track with the bases of the corresponding poles, when you press the “ ” button, the editing mode automatically ends and the specified coordinates are saved in the non-volatile memory of the APU module.

### 5.8.18 Driver's night monitoring device

#### 5.8.18.1 Checking the consistency of the optical axes of the IR headlight and the TVN-5 device

Coordination of the optical axes of the headlight and the TVN-5 device should be carried out at night in the absence of extraneous lighting.

To do this you need:

– install the tank on a level surface;

– turn on the TVN-5 device installed in the shaft and the FG 125 IR headlight located on the bow plate of the tank hull;

– loosen the headlight mounting nut on the bracket to allow easy turning by hand;

– install a clearly visible rectangular object with side dimensions from 0.3 to 0.5 m at a distance 45 мfrom the nose of the tank along its longitudinal axis;

– observing the object through the eyepiece of the TVN-5 device and, turning the headlight, achieve the best visibility of the base of the object;

– Without disturbing the adjusted position of the headlight, tighten the fastening nut;

– turn off the TVN-5 device and the headlight.

### 5.8.19 Hydropneumatic cleaning system for observation and aiming devices

#### 5.8.19.1 Filling water into the tank of the GPO system in the housing

The capacity of tank 7 (Figure 12.14) is 8 liters.

To refill the tank you need:

– unscrew plug 3 of the filler pipeline;

– fill tank 7 with water through a funnel with a filter and a tip;

– Tightly tighten plug 3 of the filler pipe.

To prevent overflow, it is recommended to control the water level in the tank using a drain hose. To do this, remove the hose from the clip, lift the plug 6 of the drain hose slightly above the tank 7 and unscrew it one turn. The appearance of water from the plug 6 of the drain hose signals the filling of the tank 7 (the principle of communicating vessels).

#### 5.8.19.2 Filling water into the tank of the GPO system in the tower

The capacity of the GPO system tank in the tower is 7 liters.

To fill the tank with water you need:

– unscrew plug 1 (Figure 12.17) from the filling hole located behind the PDT sight head protection;

– pour water into the filling hole through a funnel with a filter and a tip;

– screw plug 1 into the filling hole.

#### 5.8.19.3 Draining water from the GPO system tank in the housing

The capacity of the GPO system tank in the housing is 8 liters.

To drain water from the tank you must:

– unscrew the plug in the emergency exit hatch cover;

– unscrew plug 3 (Figure 12.14) of the filler pipeline by one to two turns;

– remove the drain hose from the clips, unscrew plug 6 two to three turns and drain the water into the hole in the emergency exit hatch cover;

– upon completion of draining, screw in plug 6 and install the drain hose into the clip, screw in plug 3 of the filler pipeline and the plug in the emergency exit hatch cover;

– turn the handle 8 of valve 2 with the tap to the horizontal position (WATER mode) and blow out the system by pressing the GPO button five times;

– At the end of the purge, turn handle 8 of valve 2 with tap to the vertical position (AIR mode).

#### 5.8.19.4 Draining water from the GPO system tank in the tower

The capacity of the GPO system tank in the tower is 7 liters.

To drain water from the tank you must:

– remove the drain hose from the clips and, unscrewing plug 3 (Figure 12.17) on drain hose 4 two to three turns, drain the water into the prepared container (bucket);

– Screw in plug 3 after draining and install the drain hose into the clips;

– the commander presses the toggle switch of the GPO switch down to the WATER position, once or twice in each position of the valve handle 16 (Figure 12.15);

– The gunner must press the toggle switch of the gas pressure switch down to the WATER position, twice in each position of the tap handle 28.

After draining the water, pressing the toggle switches of the GPO switches is only allowed upwards, to the AIR position.

### 5.8.20 Thermoelectric air conditioner

#### 5.8.20.1 Refilling the coolant air conditioner

Refill coolant in the following sequence:

– unscrew the two bolts securing the protective casing 7 (Figure 13.1) and remove the protective casing;

– open the cover 8 of the expansion tank 6;

– unscrew six bolts 15 (Figure 13.3 a) and remove covers 1 and 2;

– unscrew plug 16 of heat release radiator 9;

– unscrew the eight bolts 6, remove the protective mesh 7 and check that valve 5 is closed;

– check the tightness of coolant drain fitting 15 (Figure 13.2) in each coolant unit;

– Fill coolant through the neck of the expansion tank to a level between the MAX and MIN marks marked on the expansion tank;

– screw plug 16 into radiator 9 to release heat when coolant appears in the hole;

– check for coolant leaks in the connections;

– if the coolant level in the expansion tank decreases, add coolant;

– install covers 1 and 2 in place; strip 3 of cover 2 should close the OPVT sensor pos. 8;

– install the protective grid 7 in place.

To fully fill the KHE with coolant, press and hold button 9 (Figure 13.1) for pumping coolant for 5 to 15 s. If necessary, add coolant and press the pump button again. Repeat the operation several times until the coolant level in the expansion tank stops decreasing and the release of air bubbles stops, which means there is no air in the KHP cooling system. The coolant level in the expansion tank is monitored visually through transparent glass;

– close the cover 8 of the expansion tank 6;

– Reinstall the protective cover 7.

#### 5.8.20.2 Coolant replacement

Replace the coolant once every two years.

Replace the coolant in the following sequence:

– unscrew the two bolts securing the protective casing 7 (Figure 13.1) and remove the protective casing;

– open the cover 8 of the expansion tank 6;

– unscrew eight bolts 6 (Figure 13.3 a), remove the protective mesh 7, remove valve 5 from the clip, open it and drain the coolant through sleeve 4 into a pre-prepared container (approximately 10 l);

– loosen fitting 15 (Figure 3.2) in each coolant and drain the remaining coolant into a previously prepared container;

– tighten fitting 15 to drain the coolant in each coolant compartment;

– close tap 5, secure it in the clip and replace the protective mesh 7;

– unscrew six bolts 15 and remove covers 1 and 2;

– unscrew plug 16 of heat release radiator 9;

– Fill coolant through the neck of the expansion tank to a level between the MAX and MIN marks marked on the expansion tank;

– screw plug 16 into the heat release radiator when coolant appears in the hole;

– check for coolant leaks in the connections;

– if the coolant level in the expansion tank decreases, add coolant;

– install covers 1 and 2 in place; strip 3 of cover 2 should close the OPVT sensor pos. 8.

To fully fill the KHE with coolant, press and hold button 9 (Figure 13.1) for pumping coolant for 5 to 15 s. If necessary, add coolant and press the pump button again. Repeat the operation several times until the coolant level in the expansion tank stops decreasing and the release of air bubbles stops, which means there is no air in the KHP cooling system. The coolant level in the expansion tank is monitored visually through transparent glass;

– close the cover 8 of the expansion tank 6;

– Reinstall the protective cover 7.

### 5.8.21 Fire-fighting equipment

#### 5.8.21.1 Checking the serviceability of the PPO system circuits using the KPK13 device

In the case of a complete check of all circuits of the fire extinguishing aerosol system (optical sensor circuits, temperature sensor circuits, pressure alarm circuits and cylinder squibs, igniter circuits of fire extinguishing aerosol generators) self-testing procedures, connect the KPK13 device once at the beginning of the test.

##### 5.8.21.1.1 Self-monitoring procedure for the KPK13 device

When the device operates in accordance with the self-test procedure, consider the KPK13 device to be in good working order.

Install on the KPK13 device:

– toggle switch “1-10” - “11-20” on the THERMAL SENSORS panel to position “1-10”;

– toggle switches PRESENCE 1B, INPUT 1B, 2B, 3B, NETWORK to OFF position;

– switches on the THERMAL SENSORS and OPTICAL SENSORS panels to position “0”;

– turn off the battery switch;

– connect the KPK13 device (Figure 15.6) to the B13-1S block;

– set the OPVT - PPO toggle switch on the P13 control panel to the OPVT position;

– turn on the battery switch - the inscriptions 1B, 2B, 3B, 4B light up with a faint glow, the inscription OPVT of the remote control P13 flashes;

– turn on the NETWORK toggle switch on the KPK13 device - the NETWORK indicator of the device lights up;

– press and release the CONTROL button on the front panel of THERMAL SENSORS. - the AVAILABLE indicator lights up, the CONTROL indicator lights up and after (12±2) s goes out, after which the ERROR indicator lights up. on this panel;

– press and release the RESET button on the front panel of THERMAL SENSORS - the IPR indicators go out. and AVAILABILITY on this panel;

– press and release the CONTROL button on the front panel OPTICAL SENSORS. - the indicators CONTROL, CORRECT, on this panel light up;

– press and release the RESET button on the OPTICAL SENSORS front panel - the CONTROL, CORRECT indicators on this panel go out.

–

##### 5.8.21.1.2 Checking optical sensor circuits using the KPK13 device in the “OPVT ” mode

Check the optical sensor circuits using the KPK13 device in the “OPVT” mode in the following sequence:

– turn off the battery switch;

– connect the KPK13 device (Figure 15.6) to the B13-1S block;

– set the OPVT - PPO toggle switch on the P13 control panel to the OPVT position;

– turn on the battery switch;

– Carry out the self-testing procedure for the KPK13 device.

To check the first optical sensor you need to:

– set the switch on the OPTICAL SENSORS panel of the KPK13 device to position “1”;

– press and release the CONTROL button on the OPTICAL SENSORS panel of the KPK13 device. - the CONTROL, CORRECTION indicators light up. on this panel, on the P13 remote control, the software inscription lights up for a period of 15 to 25 s, and a speech sound signal is sent to the driver’s head phones once.

To check the following optical sensors, repeat the test, sequentially setting the OPTICAL SENSORS switch of the KPK13 device on the panel to positions “2” to “10”.

Set the switch on the OPTICAL SENSORS panel of the KPK13 device to position “0”, press and release the RESET button - the CORRECT, CONTROL indicators go out. on this panel;

– turn off the battery switch;

– disconnect the KPK13 device from the B13-1S unit;

– set the OPVT - PPO toggle switch on the P13 control panel to the PPO position;

– turn on the battery switch - on the P13 remote control the inscriptions 1B, 2B, 3B, 4B are lit.

#### 5.8.21.1.3 Checking thermal sensor circuits using the KPK13 device in the “OPVT ” mode

Check the temperature sensor circuits using the KPK13 device in the “OPVT” mode in the following sequence:

– turn off the battery switch;

– connect the KPK13 device (Figure 15.6) to the B13-1S block;

– set the OPVT - PPO toggle switch on the P13 control panel to the OPVT position;

– turn on the battery switch;

– Carry out the self-testing procedure for the KPK13 device.

To check the first temperature sensor you need to:

– on the THERMAL SENSORS panel of the KPK13 device, set the toggle switch “1-10” - “11-20” to position “11-20”, the switch to position “1”;

– press and release the CONTROL button. - the AVAILABILITY indicator lights up, the CONTROL indicator lights up and after no more than 14 s goes out, after which the IRR. indicator lights up, the inscription 30 lights up on the P13 remote control for a period of 30 to 50 s, a voice sound signal is sent to the driver’s head phones once .

To check the remaining temperature sensors, repeat the test, sequentially setting the switch on the THERMAL SENSORS panel to positions “2” to “5”;

– set the controls of the KPK13 device to their original position - all indicators on the device go out;

– turn off the battery breaker

– disconnect the KPK13 device from the B13-1S unit;

– on the P13 remote control, set the OPVT - PPO toggle switch to the PPO position;

– turn on the battery switch - on the P13 remote control the inscriptions 1B, 2B, 3B, 4B are lit.

#### 5.8.21.1.4 Checking optical sensor circuits using the KPK13 device in the “PPO” mode

To check the optical sensor circuits using the KPK13 device in the “PPO” mode, you must:

– turn off the battery switch and disconnect the cable parts of the contact devices of the squibs of the PPO cylinders;

– connect the KPK13 device (Figure 15.6) to the B13-1S block;

– set the OPVT - PPO toggle switch on the P13 control panel to the PPO position;

– on the KPK13 device, turn on the AVAILABILITY 1B toggle switch;

– turn on the battery switch;

– carry out the self-testing procedure for the KPK13 device;

– On the KPK13 device, turn on the toggle switches INPUT 1B, INPUT 2B, 3B.

To check the first optical sensor you need to:

– set the switch on the OPTICAL SENSORS panel of the KPK13 device to position “1”;

– press and release the CONTROL button. - the CONTROL, CORRECTION indicators light up. on this panel and the 1BPO indicator on the middle panel of the KPK13 device, on the P13 control panel the inscription 1B goes out, for a period of 15 to 25 s the inscription PO lights up, the FIRE indicator lights up on the remote TV display in a flashing mode, the signal light at the commander's side lights up, on the head phones The driver is given a voice signal once. After the software sign on the P13 control panel goes out, the supercharger starts.

Check the remaining optical sensors by sequentially setting the switch on the OPTICAL SENSORS panel of the KPK13 device to positions “2” to “10”.

When checking the second optical sensor, the 2BPO indicator on the middle panel of the KPK13 device lights up and the inscription 2B on the P13 remote control goes out. When checking the third to tenth optical sensors, the indicators 1BPO, 2BPO on the middle panel of the KPK13 device are lit, the inscriptions 1B, 2B on the P13 remote control are not lit. While the software inscription on the P13 control panel is on, the supercharger is turned off and a sound and light alarm is issued. When the software inscription on the P13 control panel goes out, the supercharger starts and the

light alarm stops; turn off the supercharger and set the controls of the KPK13 device to their original position - all indicators on the device go out.

Connect the cable parts of the contact devices of the squib cartridges of the PPO cylinders.

#### 5.8.21.1.5 Checking the temperature sensor circuits using the KPK13 device in the "PPO" mode

To check the temperature sensor circuits using the KPK13 device in the "PPO" mode, you must:

– turn off the battery switch and disconnect the cable parts of the contact devices of the electric igniters of the fire extinguishing aerosol generators;

– connect the KPK13 device (Figure 15.6) to the B13-1S block;

– set the OPVT - PPO toggle switch on the P13 control panel to the PPO position;

– turn on the battery switch;

– carry out the self-testing procedure for the KPK13 device;

– On the KPK13 device, set the switch on the OPTICAL SENSORS panel to position "0", the toggle switch "1-10" - "11-20" on the THERMAL SENSORS panel to position "11-20";

– turn on the NETWORK toggle switch on the KPK13 device, the NETWORK indicator lights up, the inscriptions 2B, 4B on the P13 remote control light up faintly;

– turn on the AVAILABILITY 1B toggle switch on the middle panel of the KPK13 device - the inscriptions 1B, 3B on the P13 remote control light up with a weak glow;

– turn on the toggle switches INPUT 1B, INPUT 2B, 3B on the middle panel of the KPK13 device.

To check the first temperature sensor you need to:

– set the switch on the THERMAL SENSORS panel of the KPK13 device to position "1";

– press and release the CONTROL button. on the THERMAL SENSORS panel - the PRESENT indicator lights up, the CONTROL indicator lights up and after no more than 14 s goes out, after which the ERROR indicators light up. on the THERMAL SENSORS panel, 1BZO on the middle panel of the KPK13 device, on the P13 control panel the lamp 3B goes out, the inscription 3B lights up, the MOD is triggered, a light alarm is issued for a period of 30 to 50 s;

– cock MOD.

To check the second temperature sensor you must:

– set the switch on the THERMAL SENSORS panel of the KPK13 device to position "2";

– press the CONTROL button. on the THERMAL SENSORS panel - the AVAILABILITY, FIXED indicators go out;

– release the CONTROL button. on the THERMAL SENSORS panel, –the PRESENT indicator lights up, the CONTROL indicator lights up and after no more than 14 s goes out, after which the ERROR indicators light up. on the THERMAL SENSORS panel, 2BZO, 1 BZO on the middle panel of the KPK13 device, on the P13 control panel the inscription 4B goes out, the inscription ZO lights up, the MOD is triggered, a light alarm is issued for a period of 30 to 50 s;

– cock MOD;

– turn off and turn on the toggle switches INPUT 1B, INPUT 2B, 3B on the middle panel of the KPK13 device, the indicators 1BZO, 2BZO on the middle panel of the KPK13 device go out, the inscriptions 3B, 4B on the P13 control panel light up with a weak glow;

– press and release the RESET button on the THERMAL SENSORS panel of the KPK13 device - the AVAILABLE, IRR. indicators go out. on the THERMAL SENSORS panel of the KPK13 device.

Check the third and fourth temperature sensors of the protection zone by sequentially setting the switch on the THERMAL SENSORS panel to positions "3", "4";

turn off and turn on the toggle switches INPUT 1B, INPUT 2B, 3B on the middle panel of the KPK13 device, the indicators 1BZO, 2BZO on the middle panel of the KPK13 device go out, the inscriptions 3B, 4B on the P13 remote control light up with a weak glow;

Check the fifth temperature sensor ZO in the same way as the first, setting the switch on the THERMAL SENSORS panel to position "5".

Upon completion of the check you must:

– install on the KPK13 device:

- toggle switch "1-10" –"11-20" on the THERMAL SENSORS panel to position "1-10";
- toggle switches PRESENCE 1B, INPUT 1B, 2B, 3B, NETWORK to OFF position;
- switches on the THERMAL SENSORS and OPTICAL SENSORS panels to position "0";

– turn off the battery switch;

– disconnect the KPK13 device from the B13-1S unit;

– connect the cable parts of the contact devices of the electric igniters of the fire extinguishing aerosol generators.

### 5.8.21.2 Checking the charge of fire protection cylinders and manual fire extinguishers

Once a year, it is necessary to check the charge of PPO cylinders and manual halon fire extinguishers by control weighing. PPO cylinders are weighed without squibs. When weighing, the difference with the mass indicated on the stencil is allowed to be no more than 10 g, with the error of the mass measuring instrument not exceeding ±5 g. If the mass of the fire extinguisher cylinder does not correspond to that indicated on the stencil, it should be replaced. The weighing results or the fact of replacing fire extinguisher cylinders should be entered into the tank's log.

### 5.8.21.3 Replacement of fire extinguishing aerosol cylinders, fire extinguishing aerosol generators and a box with assembly

After the fire extinguishing aerosol cylinders, fire extinguishing aerosol generators and the launch unit have been triggered, the cylinders should be replaced with charged ones, and the fire extinguishing aerosol generators and the box with the launch unit should be replaced with new ones.

To replace the cylinder in the control department you must:

– turn off the battery switch;

– tuck the turret (to provide access to the crew compartment cylinders);

– Unlock and disconnect the electrical connector 3 (Figure 15.7) from the cylinder pressure indicator and the union nut 4 with the electrical wire from the cylinder head and remove the squib;

– unfasten and unscrew bolt 1 of clamp 2 securing the cylinder and remove the cylinder;

– install a charged cylinder;

– screw in bolt 1 of clamp 2 securing the cylinder and secure with wire;

– install a new squib into the cylinder head;

– connect the electrical connector 3 of the pressure alarm, the union nut 4 with the electrical wire and secure with wire.

To replace the GOA-19 fire extinguishing aerosol generators in the MTO, you must:

– turn off the battery switch;

– open the roof over the transmission;

– Unlock and disconnect union nuts 5 (Figure 15.9) with electrical wires from fire extinguishing aerosol generators GOA-19 pos. 2;

– Unfasten and unscrew fastening bolt 4, remove bracket 3 and fire extinguishing aerosol generators GOA-19 pos. 2;

– remove the plug from the new fire extinguishing aerosol generator GOA-19 and install thermal start unit 1 (supplied with the generator), securing it with wire;

– install new fire extinguishing aerosol generators GOA-19 pos. 2, securing them with bracket 3, screwing in bolt 4;

– close the roof over the transmission.

To replace the box with the launch unit:

– turn off the battery switch;

– Unscrew bolts 1 (Figure 15.11), remove spring washers 2 securing the box under the launch unit;

– remove the rubber seal pos. 3;

– remove electrical connectors 4, 5 from the launcher box;

– displace the 13 PVC tube and unwind the 9 PVC tape;

– disconnect the wires of electrical connectors 4, 5, unscrewing screws 8, nuts 10, remove washers 11, 12, dismantle box 6 of the starting unit;

– install electrical connectors 4, 5 with a new box of the starting unit, using screws 8, nuts 10, washers 11, 12. To prevent the wires from getting tangled up, when connecting them, follow the markings of the wires;

– Insulate the connection point with 9 PVC tape. Wrap the PVC tape until the 13 PVC tube fits tightly;

– Place the 13 PVC tube on the tape pos. 9;

– place electrical connectors 4.5 in a box pos. 6;

– install rubber seal pos. 3;

– install box 6 of the launch unit in its normal place, securing it with bolts 1 and spring washers 2.

At least once a year, and also when dismantling the cylinder, inspect the squib cartridge of the PPO system for the absence of mechanical damage, contamination, corrosion, and oxidation. If defects are detected, as well as during a technical inspection of the cylinder (once every 5 years), the squib must be replaced with a new one.

#### 5.8.21.4 Replacing the cooling system fan squib

Replacing and cleaning parts of the fan support should be carried out after the fire protection system is activated when extinguishing a fire in the mechanical equipment in the following order:

- loosen one of the lower bolts 7 (Figure 15.12) securing the cover 8 of the fan support, unscrew the other four bolts;
- turn the cover down around the loosened bolt;
- Unscrew bolt 2 securing contact device 3;
- loosen the three screws on the front cover of the contact device;
- remove the contact device by moving it along the grooves on piston 6;
- Unscrew bolts 1, remove piston 6;
- remove squib 4 from the piston;
- clean the outer working surface of the piston until powder deposits are completely removed; Clean with a rag soaked in liquid gun lubricant, then wipe dry;
- clean the inner surface of cylinder 5 with a rag wrapped around a screwdriver and soaked in liquid gun lubricant; Continue cleaning until the rag comes out of the cylinder clean; After cleaning, wipe the surface dry;
- reinstall the parts in reverse order; replace the PPS GOST V 19430-80 squib cartridges with new ones, tighten the three screws on the front cover of the contact device.

### 5.8.22 Defense system against weapons of mass destruction

#### 5.8.22.1 Replacing the filter absorber

The absorbent filter must be replaced during the second maintenance No. 1, and also after:

– a single stay in an area contaminated with unstable toxic substances;

– five times of stay in an area contaminated with organic phosphorus or other persistent agents;

– degassing or decontamination of internal cavities of the FVU;

– during the operation of the filter, holes in the housing or dents with a depth of more than 8 мм.

To replace the absorber filter you must:

– remove the commander's seat;

– disconnect the electrical wires from the electromagnet of the actuator switching mechanism of the FVU valve;

– disconnect the wire of the negative contact of the FVU branch pipe;

– loosen the lower clamp securing the cuff connecting the upper and lower pipes;

– unscrew the bolts of the filter-absorber fastening tapes;

– remove the filter-absorber with the pipe;

– Disconnect the pipe, reed valve and flange from the absorber filter.

Installation of a new filter-absorber (located in the group kit of spare parts for the tank) is carried out in the reverse order, after first removing the plugs with gaskets from the air inlet and outlet holes.

After installing a new filter-absorber, check its functionality.

#### 5.8.22.2 Replacing the smoke filter of the sensor

The smoke filter must be replaced when all frames are used.

To replace the smoke filter you must:

– Unscrew the wing nut securing the filter compartment cover;

– turn the cover down and remove it from the axles;

– remove the used PDF using tweezers, avoiding touching the filter to exposed skin areas;

– turn the movable system 2 (Figure 16.7), remove the cassette 1 and open its cover;

– take the PDF from the ZIP-01A kit of the PKUZ-1A instrument complex (located in a single spare parts kit for the tank), place it in a cassette and remove the free upper end of the filter;

– install the cassette in place and return the moving system to its original position;

– Turn the frame change handle 4 until it stops 6 and tuck the extended end under the stops, bracket and pusher so that no more than 5 mm of the filter tape extends beyond the pusher teeth. This can be done by lifting the pusher teeth;

– return the frame transfer knob to its original position, after making sure that the filter tape is moving normally;

– turn the movable system and set the number “40” on the scale 3 against the marks on the movable system;

– turn the frame change handle 4 until it stops 6, return the moving system to its original position;

– Replace the cover and secure the frame change handle with the latch in the upper position.

#### 5.8.22.3 Cleaning the heater and sensor filter compartment from dust

To clean you need:

– Unscrew the wing nut securing the filter compartment cover;

– turn the cover down and remove it from the axles;

– using the brush and cambric contained in ZIP-01A, clean the heater body, the clamp body and the inner surface of the compartment body from dust;

– Replace the filter compartment cover and secure it with the wing nut.

#### 5.8.22.4 Replacing sensor filter elements

Replace filter elements as they become dusty, determined by the impossibility of adjusting the air flow through the rotameter.

To replace filter elements you must:

– press the spring latch, open the cover 3 (Figure 16.4) of the compartment and remove the filter elements from the housing;

– take clean elements made of filter fabric and polyurethane foam from the ZIP-01A kit of the PKUZ-1A instrument complex and insert first the first and then the second elements into the nozzle body;

– place the cover in its original position.

The used filter fabric element is not suitable for secondary use.

The used polyurethane foam filter element must be washed with water or gasoline B-70 TU 38.101913-82, wrung out without twisting, dried and placed in the ZIP-01A kit of the PKUZ-1A instrument complex. The polyurethane foam filter element can be washed three times.

#### 5.8.22.5 Replacing the silica gel cartridge in the sensor

To replace the cartridge you must:

– unscrew cartridge 9 (Figure 16.4);

– take a loaded cartridge from the ZIP-01A kit of the PKUZ-1A complex, unscrew the plugs on both sides and install it in place of the removed one;

– screw the plug connected by a chain to the sensor body onto the installed cartridge;

– unscrew the nut on the used cartridge with the key from the ZIP-01A set of the PKUZ-1A complex;
– remove the washer, spring and mesh;
– pour silica gel out of the cartridge;
– remove the mesh and filter (the filter and silica gel are not suitable for reuse);
– insert two grids, a spring and a washer into the cartridge, screw in the nut;
– screw into the cartridge two plugs removed from the cartridge taken for replacement from the ZIP-01A kit of the PKUZ-1A complex;
– put the cartridge in the ZIP-01A kit of the PKUZ-1A complex.

To replace silica gel in cartridges you must:
– take a container with silica gel from the ZIP-01A kit of the PKUZ-1A complex;
– unscrew the three wing nuts in the container and remove the lid;
– take the used cartridge from the ZIP-01A set of the PKUZ-1A complex, unscrew the plug, nut and remove two grids, a spring and a washer from the cartridge;
– take a filter glued to a metal washer from the container and insert it into the cartridge with the convex side down, after straightening it with tweezers;
– insert grid;
– pour silica gel from the bag in the container into the cartridge;
– insert the mesh with the sealed side to the silica gel;
– insert the spring and washer;
– screw in the nut until it stops and screw in the plugs;
– install the lid on the container, securing it with wing nuts;
– place the loaded cartridges and container in the ZIP-01A set of the PKUZ-1A instrument complex.

#### 5.8.22.6 Cleaning the air intake device

If, while the tank is moving with the PKUZ-1A instrument system turned on, water and dirt are thrown onto the VZU, it is necessary to clean the VZU or drain the water from it.

To clean the inlet and outlet channels of the armored protective cover and the internal cavity of the VZU glass under this cover, it is necessary to unscrew the bolts securing the cover, remove cover 3 (Figure 16.5), wipe the cavities of the glass 2 with a napkin from the ZIP-01A kit of the PKUZ-1A instrument complex and clean the channels of the cover 3. Traces of diesel fuel, oil and paint in the cavities of the glass and lid are not allowed. If necessary, rinse these surfaces with distilled water and blow with compressed air.

When installing the protective cover, pay attention to the presence and cleanliness of the surfaces of the spacer and gaskets on the cyclone and cup.

To drain water from the cavity of the VZU glass, unscrew the drain plug 4 from the lower end of the glass, after draining the water, screw the plug until it stops.

If the drain plug is turned out, the normal operation of the device is disrupted.

#### 5.8.22.7 Cleaning the cyclone air path and heated inlet tube

In case of significant contamination in cases where, after setting the “zero” of the “O” circuit, when switching handle 11 ( Figure 16.4 ) of the block B-2 valve from the “SET” position. ZERO" to the "WORK" position, the red segments on the linear LED indicator light up, the channels of the cyclone air path and the heated inlet tube must be cleaned.

Cleaning should be carried out in the absence of exhaust gases, fuel vapors and fumes in the air.

### 5.8.23 Curtain setting system

#### 5.8.23.1 Checking the functioning of the SPZ from the rangefinder

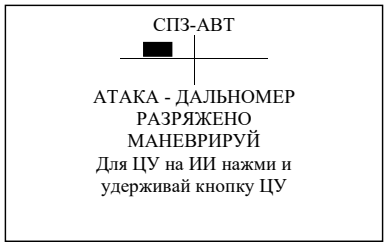
Checking the functioning of the SDS from the rangefinder must be performed as follows:
– install the tank being tested, the shield 184M.59.046 (from the group spare parts kit) and the emitter product on a horizontal (visual) platform, and install the shield according to Figure 17.6 so that the center of the circle is at a height of (2000-100 ±) mm relative to the ground, and the front the plane of the shield is perpendicular (visually) to the platform and the longitudinal axis of the tank being tested;
– turn on the PTK (without turning on the CO), including the R-168-25-U2E radio station, and ensure radio communication between the tank being tested and the emitter product;
– point the aiming mark of the rangefinder of the emitter tank at the center of the circle on the shield;
– on the tank being tested:
- check the discharge of system 902 launchers;
- open the protective covers of the fine and coarse heads OR;
- turn on all AZR in the tower;
- close the driver's hatch;
- turn the OMS into the “Main” mode;

- install a PKP in the TV channel, a wide field of view;
- set the tower to position “1” according to Table 21, and move the PKP mirror block to the position agreed with the tower;

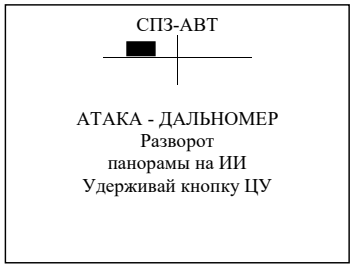
Table 21

| **Angular position of the tower according to the azimuth indicator** | **Irradiated head OR** |
|---|---|
| 1 (36-20) | Left accurate |
| 2 ( 49-00 ) | Left rough |
| 3 ( 59-00 ) | |
| 4 ( 11-30 ) | Right rough |
| 5 ( 22-00 ) | |
| 6 ( --26-00 ) | Right exact |

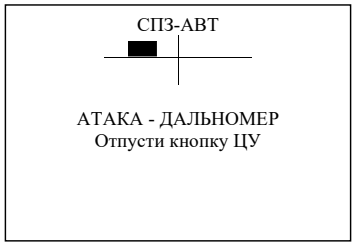
– upon command from the tank being tested, press the range measurement button on the emitter product, while on the tank being tested an audible alarm should appear in the AVSKU, and the following message should appear on the PMF:




– To the commander of the tank being tested, while the message is illuminated (for about 8 s), press and hold the TsU-LI button on the commander’s remote control, while the PKP mirror unit should begin to rotate to the left, and the message should change to the message shown below:




– after turning, the control panel mirror block should stop and the message should change to the message shown below, while the shield should be in the control panel’s field of view;



– release the TSU-LI button and the message should go out;

– after the message goes out, set the tower to position “2” according to Table 21, and move the control panel mirror unit to the position agreed with the tower;

– Upon command from the tank being tested, the emitter operator presses the range measurement button, while on the tank being tested an audible alarm should appear in the AVSKU, and the following message should appear on the PMF:


– after the message goes out, set the tower to position “3” according to Table 21 and repeat the previous check;

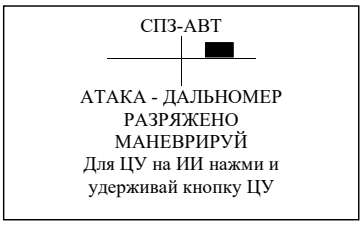
– after the message goes out, set the tower to position “4” according to Table 21;

– Upon command from the tank being tested, the emitter operator presses the range measurement button, while on the tank being tested an audible alarm should appear in the AVSKU, and the message should appear on the PMF:

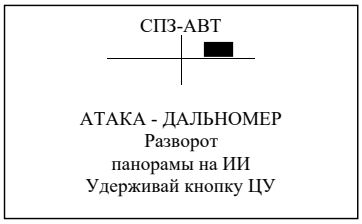

– after the message goes out, set the tower to position “5” according to table 21 and repeat the previous check;

– after the message goes out, set the tower to position “6” according to Table 21, and move the control panel mirror unit to the position agreed with the tower;

– Upon command from the tank being tested, the emitter operator presses the range measurement button, while on the tank being tested an audible alarm should appear in the AVSKU, and the message should appear on the PMF:




– press and hold the TSU-LI button on the commander’s remote control, while the PKP mirror unit should begin to rotate to the right, and the following message should appear on the PMF:




– after turning the control panel mirror block to the required angle, it should stop, and the message shown below should appear on the PMF, while the shield should be in the control panel’s field of view;


– release the TSU-LI button, and the message should go out.

After completing the test, turn off all previously turned on systems and close the covers of the fine and coarse OR heads.

#### 5.8.23.2 Cleaning and Lubricating System 902 Launchers

Cleaning of launchers in preparation for firing must be done as follows:

– clean the external surfaces of the launcher from dust and dirt;

– Remove grease from the launcher using a banner and a rag. To remove grease from the bottom of the launcher, fix the banner block with screw grooves on the banner axis with long grooves, insert the banner all the way into the bottom of the launcher and, rotating it, remove the grease. To remove grease from the walls of the launcher barrel, fix the banner block on the axis with short grooves. Wrap a clean rag around the banner block so that the banner fits into the launcher with little effort. Remove grease completely, changing rags if necessary.

After firing from the 902 system, it is necessary to check the movement of the electric striker 11 (Figure 17.3) and the locking ring 8 in each launcher. If there are no jams of the specified parts, the launcher is cleaned and lubricated without disassembling; if the electric striker and locking ring lose mobility, the launcher is cleaned and lubricated with disassembly.

##### 5.8.23.2.1 Cleaning and lubricating the launcher without disassembling

Clean and lubricate the launcher without disassembling in the following order:

– clean the external surfaces of the launcher from dust and dirt;

– wrap a rag soaked in diesel fuel and wrung out on the banner (excessive amount of fuel can lead to a short circuit);

– Use a banner to completely clean the launcher from carbon deposits;

– wipe the walls of the launcher and the bottom of the breech dry;

– lubricate the walls of the launcher and the bottom of the breech with a thin layer of GOI-54p lubricant using a banner and a rag soaked in lubricant;

– put the plug on the launcher.

##### 5.8.23.2.2 Cleaning and lubricating the launcher with disassembly

Clean and lubricate the launcher with disassembly in the following order:

– bend stopper 4 and unscrew barrel 2 from breech 6 using key 902.03.001 from a single set of spare parts for system 902;

– remove retaining ring 8 from the breech groove;

– unscrew contact 10 with the insulator using a socket wrench S=27 mm, remove the electric striker 11 and the electric striker spring 13;

– wash the removed parts in diesel fuel and wipe dry (do not screw the lock washer from contact 10 with the insulator);

– clean the breech and barrel from carbon deposits;

– lubricate the groove of the locking ring 8, gasket 5, the bottom of the breech 6 and the barrel bore with GOI-54p lubricant;

– assemble the launcher by performing sequential operations, for which:

- screw in contact 10 with the insulator using a socket wrench S=27 mm, remove the electric striker 11 and spring 13 of the electric striker;
- insert retaining ring 8 from the breech groove;
- screw barrel 2 into breech 6 with key 902.03.001 and bend stopper 4;

– press the electric striker and make sure that it vigorously returns to its original position;

– put the plug on the launcher.

## 6 Technical condition monitoring

Technical condition monitoring (hereinafter referred to as TCM) is carried out to assess the technical condition of the tank and its readiness for use. CTS can be carried out during scheduled inspections of the technical condition of the tank, as well as during the transfer of the tank from one operating organization to another.

The frequency of CTS performance is established by the regulatory documentation of the operating organization.

The scope of work to monitor technical condition is set out in Table 22.

**ATTENTION:**

**- WHEN CHECKING THE OPERABILITY OF THE CONTROL SYSTEM, OBSERVE THE SAFETY MEASURES SPECIFIED IN CLAUSE 3.3.1;**
**- AT USING A STABILIZER WEAPONS AND AZ MAKE SURE IN ABSENCE FOREIGN OBJECTS INTERFERING ROTATION OF THE TOWER AND VT!**

The operation of the control system is checked when power supply is provided using one of the following methods:

– prepare and launch the diesel generator set in accordance with paragraphs. 3.12.3.2and 3.12.3.3;
– prepare and start the engine in accordance with clause 3.1.2;
– connect an external source of electricity to the tank in accordance with clause 3.12.1.1.

Table 22

| Operations Performed | Directions on implementation | Operating Condition Criteria |
|---|---|---|
| **Fire control system** | | |
| Enable the control system in the "MAIN" mode | Carry out in accordance with clause 3.3.4.4. Before turning on the control system, perform the operations listed in clause 3.3.3, including checking the functionality of the drives of the protective covers of the PMU | Protective covers should open and close without jamming.<br>When the FCS is turned on and operating, there should be no malfunction messages on the commander's and gunner's APUs |
| Check the provision of guidance of the visual fields of the IMU and weapons | While operating the guidance console, check the guidance of the PNM's fields of view, as well as the guidance of the gun in the vertical and horizontal planes (monitoring the PSM's field of view) | Guidance of the PNM and weapon fields of view must be carried out smoothly throughout the entire range of turret speeds |
| Check the functioning of the control system in the "DPU" mode | Carry out in accordance with clause 3.3.4.2 | In accordance with clause 3.3.4.2 |
| Check the operation of the DPU guidance drives | When the "DPU" mode is turned on, by controlling the lever of the commander's guidance console, check the guidance of the control panel's field of view, as well as the DPU | Guidance of the field of view of the control panel and control panel should be carried out smoothly, over the entire speed range |
| Check the presence of the auto tracking readiness frame in the field of view of the TP channels PNM and PKP | Carry out in accordance with paragraphs. 3.3.5.14.5and 3.3.5.15.5 | The frame ready for auto-tracking must be present (if there is the necessary thermal contrast of the background target environment) |
| Check the functioning of the PNM and PKP rangefinders | Measure the distance to a separate object standing on the ground, located at least 100 m away from the tank | The measured range should be displayed in the field of view of the target and TP and TV channels |
| Check the switching of the magnification factor and fields of view of the PNM and PCP | Consistently switch the magnification ratios of the sighting channel and TP channel PNM, TV and TP channel PKP | When each field of view of the ISM and PKP channels is turned on, there must be an image of the observed area with the corresponding magnification factor |
| Check the functioning of guided weapons | At the control center and AZ, select type "U" or "U-Night" | The LCU readiness indicator<br>" ⚠ " should light up on the front panel of the PNM |
| Check the functioning of the AZ | Carry out in accordance with clause 3.2.6.4 | The charging cycle should complete without delay. When the EL.SPUK AZR is turned on on the right and left distribution panels, the firing circuit readiness indicator should light up in the field of view of the PNM sighting channel, and the inscription "GOT" should appear in the field of view of the TP channel |
| Check the functioning of the control system in the "DUBLER" mode | Carry out in accordance with clause 3.3.4.5 | In accordance with clause 3.3.4.5 |

| Operations Performed | Directions on implementation | Operating Condition Criteria |
|---|---|---|
| **ATTENTION:**<br>**BEFORE CHECKING THE FUNCTIONING OF THE FIRING CIRCUITS, MAKE SURE THAT THERE IS NO AMMUNITION IN THE GUN CHAMBER AND IN THE MACHINE GUNS!** | | |
| Check the functioning of the cannon firing circuits | Enable the control system in the "MAIN" mode in accordance with clause 3.3.4.4. At the control center and AZ, select type "B", or "K", or "O".<br>Close the gun bolt wedge.<br>Turn on AZR EL.PUSK on the left and right distribution panels.<br>If there is an indicator of the readiness of the firing circuits in the field of view of the PNM sighting channel, press the gun firing button | The trigger mechanism of the gun must fire (detect by sound) |
| Check the functioning of the coaxial machine gun firing circuits | Enable the control system in the "MAIN" mode in accordance with clause 3.3.4.4.<br>Select type "P" at the control center and AZ.<br>Move the safety lock of the coaxial machine gun to the "OG" position and cock the machine gun.<br>Turn on AZR EL.PUSK on the left and right distribution panels.<br>If there is an indicator of the readiness of the firing circuits in the field of view of the PNM sighting channel, press the firing button from the coaxial machine gun | The moving parts of the coaxial machine gun must vigorously return to the forward position |
| Check the functioning of the DPU machine gun firing circuits | Enable the control system in the "DPU" mode in accordance with clause 3.3.4.2.<br>Move the safety lock of the DPU machine gun to the "OG" position and cock the machine gun.<br>Turn on AZR EL.PUSK on the left and right distribution panels.<br>If there is an inscription "GOT" in the field of view of the TV or TP channels of the control panel, press the fire button on the PK-90 | The moving parts of the DPU machine gun must vigorously return to the forward position |
| **Armament** | | |
| Carry out a control inspection of the cannon and machine gun weapons | Carry out in accordance with the operational documentation for weapons supplied with the tank | In accordance with the ED for armament attached to the tank |
| **Curtain setting system** | | |
| Check the functionality of the SDR in the "CONTROL" mode | Carry out in accordance with clause 3.18.3.3 | In accordance with clause 3.18.3.3 |
| **Power and transmission units** | | |
| Perform a control inspection of the tank in accordance with the subsection " Operations Performed Before Any Use " | Carry out in accordance with table 3 | According to table 3 |
| Check the performance of the heater | Carry out in accordance with clause 3.6.1.3 | The heater should start up confidently and work without interruption. Exhaust gases should be colorless or light gray. There should be no messages on the driver's APU about malfunctions or exceeding parameter values |
| Prepare for starting and start the engine | Carry out in accordance with clause 3.1.2.<br>Start the engine with air and the starter once each | The engine should start confidently and run without interruption. There should be no messages about malfunctions or parameter values leaving operating ranges on the driver's APU |
| Perform a test run of 10 to 15 km | While driving, check the operation of the engine and transmission in all gears (if possible), in turns and when moving forward and in reverse. | While driving, the driver's APU should not display any malfunction messages or parameter values leaving their operating ranges. |

| Operations Performed | Directions on implementation | Operating Condition Criteria |
|---|---|---|
| Check the tightness of the power plant systems and the hydraulic system of the transmission unit | After the test run, check the condition of the grids of the exit blinds | Exit blinds must be dry and clean |
| Check the functioning of the air systems | After the test run, check the air pressure in the cylinders. After checking, close the air cylinder valves | The air pressure in the cylinders should be from 120 to 160кгс/см$^2$ |
| **Communications complex** | | |
| Check the functionality of AVSKU | Carry out in accordance with clause 3.5.3.6.1 | The tank crew must hear each other over the intercom network when the buttons on the MT10M devices are released |
| Check the functionality of the radio station R-168-25U-2 | Carry out in accordance with clause 3.5.3.4.1 | In accordance with clause 3.5.3.4.1 |
| Check the functionality of the R-168MRA radio station | Carry out in accordance with clause 3.5.3.5.1 | In accordance with clause 3.5.3.5.1 |
| Check the functionality of the 450B product | Carry out in accordance with clause 3.5.3.8.1 | In accordance with clause 3.5.3.8.1 |
| **Software and hardware complex** | | |
| Check the functionality of the PTK | Carry out in accordance with clause 3.5.1 | In accordance with clause 3.5.1 |
| **Diesel generator set** | | |
| Prepare for start-up and start up the diesel generator set | Carry out in accordance with paragraphs. 3.12.3.2and 3.12.3.3. It is recommended to check the operation of the diesel generator set in conjunction with checking the operability of the control system | The diesel generator set engine should start confidently and run smoothly, without interruptions. When the diesel generator set is operating, only indicator 52 should be lit on the control panel (Figure 10.11), the battery charging current (according to the indications on the driver's APU) should be positive |
| **Chassis** | | |
| Check the condition of the chassis components | Carry out in accordance with clause 5.8.13.2 | In accordance with clause 5.8.13.2 |
| **Fire-fighting equipment** | | |
| Check the functionality of the software | Carry out in accordance with clause 3.16.3 | In accordance with clause 3.16.3 |
| **Defense system against weapons of mass destruction** | | |
| Check the functionality of the PKUZ-1A instrument complex | Carry out in accordance with clause 3.17.7.1 | In accordance with clause 3.17.7.1 |
| Check the functionality of the 3ETs13-1 equipment | Carry out in accordance with clause 3.17.7.2 | In accordance with clause 3.17.7.2 |
| Check the electrical circuits of the protection system using commands from the PKUZ-1A complex | Carry out in accordance with clause 3.17.7.3 | In accordance with clause 3.17.7.3 |
| **Surveillance equipment** | | |
| Check the functionality of the outdoor video surveillance system | Carry out in accordance with clause 3.13.1.1 | In accordance with clause 3.13.1.1 |
| Check the functionality of the rear view camera | Turn on DCMV.<br>Press the VIDEO button on the driver's panel | The driver's APU screen should display an image of the terrain with the lines of the tank's conventional gauge |
| Check the functionality of the TVN-5 device | Carry out in accordance with clause 3.13.4.3 | In accordance with clause 3.13.4.3 |

| Operations Performed | Directions on implementation | Operating Condition Criteria |
|---|---|---|
| **Hydropneumatic cleaning system** | | |
| Check the functionality of the hull hydropneumatic cleaning system | Fill the tank of the housing's gas flow system with clean water.<br>Open the air cylinder valve.<br>Turn the tap handle on valve 18 ( Figure 1.3 ) clockwise until it stops and briefly press the valve lever until it stops.<br>If the ambient temperature is below freezing, do not fill the tank of the gas purification system; turn the valve handle on the valve counterclockwise until it stops and briefly press the valve lever until it stops. | A stream of air or a stream of air with a portion of water must be supplied to the protective glass of the driver's mechanic's device |
| Check the functionality of the hydropneumatic cleaning system in the tower | Fill the tower's GPO system tank with clean water.<br>Open the air cylinder valve.<br>Open the air bleed valve 40 (Figure 1.3), and the plug of the air bleed fitting 33 must be screwed in until it stops.<br>Turn the AB switch ON.<br>Briefly move toggle switch 21 ( Figure 1.4) and toggle switch 48 ( Figure 1.5) to the WATER position.<br>If the ambient temperature is below zero, do not refill the gas flow system tank; briefly switch the toggle switches to the AIR position. | The protective glass of observation or aiming devices (depending on the position of the distribution valves) must receive an air flow or an air flow with a portion of water |
| **Air conditioner** | | |
| Check the operation of the air conditioner | To prevent battery discharge, it is recommended to check the performance of the air conditioner with the diesel generator set or engine running.<br>Turn on the AB toggle switch ON.<br>Turn on switch 8<br>(Figure 13.2) on the commander and gunner cooling units | On the commander's and gunner's cooling units, LED 9 should light up green, and cooled air should start flowing from the deflectors.<br>LEDs 10 and 12 should not be lit |

## 7 Maintenance

### 7.1 General instructions

All repair work must be carried out in compliance with the following requirements:

– before starting work, the workplace must be provided with the necessary tools, devices, stands, materials, spare assembly units and parts;

– when replacing a unit, it is necessary to carefully check the technical condition of adjacent units and assembly units;

– All parts and assembly units, after removal from the tank, must be washed, wiped dry, after which their technical condition must be checked;

– Removed usable fasteners should be temporarily installed in their places, and where they interfere with further dismantling, collected in a separate box. Replace bolts and nuts with more than two threads stripped or edges crumpled with new ones;

– All cotter pins, wire used to lock bolts and nuts, lock washers, spring washers and gaskets must not be reinstalled;

– units opened during dismantling or disassembly, as well as the ends of disconnected pipes of cooling, lubrication and fuel supply systems, must be temporarily closed with covers, plugs, plugs or plastic film;

– Before installing the unit you should check:

- presence and correct locking of nuts and bolts;
- no damage to the housing and electrical connectors (if any);

– installed units, assembly units and parts must be free of corrosion. Clean and touch up painted areas of the surface affected by corrosion. Clean all nicks and burrs on the seating surfaces and edges of parts;

– bolts, nuts, fittings and other parts of threaded connections must be tightened evenly and tightly, except in cases specifically specified in the technical requirements;

– threads and rubbing parts of plug connectors, before direct joining, must be lubricated with grease such as GOI-54p or CIATIM-201, or equivalent. Contact of grease on the contact field of connectors and equipment is not allowed. Tighten the union nuts of plug connectors by alternating pressing the moving part of the connector and screwing in the union nut;

– rubber shock absorber washers must be inspected and, if necessary, replaced;

– All paronite sealing gaskets and connecting hoses of the fuel supply system tubes must be placed on thickly ground zinc white, except in cases specifically specified in the technical requirements.

### 7.2 Security measures

**WARNING:**

**WHEN ALL TYPES OF WORK ARE WORKED ON THE MACHINE, A SIGN MUST BE DISPLAYED: “CAUTION! WORK IS UNDERGOING!”**

When carrying out work, you should be guided by the safety measures set out in the operating instructions for the machine, as well as the safety requirements in force in organizations carrying out repairs. When carrying out repairs of components and assemblies, it is necessary to comply with the safety measures given in the relevant sections of this manual.

All types of work should be carried out under the guidance of a responsible person who has studied the design and operating rules of the machine as a whole, as well as the design of components and assemblies being repaired.

Persons who have completed a training course and knowledge testing in labor safety, fire safety and first aid are allowed to carry out repair work on components and assemblies.

When towing the machine with a tractor to repair stations, strictly follow the requirements of the machine’s operating instructions. When towing a vehicle using tow ropes, the driver of the towed vehicle must be in the control compartment, and the driver's hatch must be closed.

**ATTENTION:**

**NO PEOPLE ARE ALLOWED BETWEEN THE TRACTOR AND THE TOWED VEHICLE, OR WITHIN THE LENGTH OF THE TOWING ROPES!**

When in a suspended position, the machine body must be supported by special stands. When working under the machine, it is necessary to use roll-out carts, benches or mats.

**ATTENTION:**

**WHEN WORKING WITH HANGING THE MACHINE, IT IS NOT ALLOWED:**

– finding people under the car while lifting or lowering it with jacks;

– leaving a car raised on jacks without stands;

– carrying out any work on a machine raised on jacks without stands.

Cranes and lifting mechanisms (hoists, winches, crampons, blocks, pulleys, etc.) used for lifting and moving must be clearly marked with the registration (inventory) number, lifting capacity and date of the next test.

Removable load-handling devices (slings, pliers, traverses, etc.) must be equipped with stamps or firmly attached metal tags indicating the number, load capacity and test date.

Only specially trained and certified persons are allowed to operate lifting mechanisms, sling loads and perform rigging work when repairing a machine.

The weight of the load to be lifted must be determined before lifting. The load on lifting mechanisms and removable load-handling devices should not exceed their lifting capacity.

Loads may be lowered to pre-prepared places where the loads cannot fall, tip over or slide down. To make it easier to remove the slings from under the load, it is necessary to lay strong pads at the place where it is installed.

**WHEN CARRYING OUT WORK RELATED TO LIFTING AND SHIFTING LOAD, IT IS PROHIBITED:**

– use uncertified lifting mechanisms and removable load-handling devices;
– lift and move loads in insufficient lighting;
– be under a raised load or under a crane boom;
– pull back the load while lifting, moving and lowering it;
– level the load with the worker's own weight. To level the load, it is necessary to use special guys (ropes, hooks) of the appropriate length;
– leave the load hanging;
– correct the harness or allow any work to be carried out on the lifted load;
– check with your hands the coincidence of the fastening holes and mating planes of the lowered load with the mating parts.

When carrying out lifting, machining and assembly work, use certified equipment and follow the safety measures in force at the place of work.

Workstations for repairing units and assemblies dismantled from the machine must be equipped with special stands or workbenches covered with steel or aluminum sheets.

The plumbing tool used during repairs must be in good working order and checked by the person responsible for the serviceability of the tool.

The heads of hammers and sledgehammers must have a smooth, slightly convex surface without warps, chips, gouges, cracks and burrs. Hammers, sledgehammers and other impact tools must be tightly fitted to the handles. Handles of hammers, chisels, etc. must have an oval cross-section along the entire length, be smooth and free of cracks. The axis of the hammer handle must be perpendicular to the longitudinal axis of the tool. The tool on the handle must be wedged (except for the sledgehammer).

**IT IS PROHIBITED TO WORK WITH TOOLS THE HANDLES OF WHICH ARE SET ON SHARP ENDS (FILES, SCRAPS, ETC.) WITHOUT METAL BANDAGE RINGS!**

Impact tools (chisels, bits, notches, cores, etc.) must have a smooth back part without cracks, burrs, hardening or bevels. There should be no damage to the working end.

It is not allowed to use wrenches with a jaw size (grip) that is more than 0.3 mm larger than the turnkey dimensions of the bolts and nuts.

The working surfaces of the wrenches should not have knocked down bevels, and the handles should not have burrs.

**IT IS PROHIBITED TO EXTEND THE WRENCHES WITH ADDITIONAL LEVERS, OTHER WRENCHES OR PIPES WHEN REMOVING (DROPING) NUTS OR BOLTS!**

Tools should only be carried in tool boxes. When carrying or transporting a tool, its sharp parts must be protected.

**WHEN USING POWER TOOLS IT IS PROHIBITED:**

– start work without making sure that the tool is in working order;
– disassemble the power tool without disconnecting the cable from the power supply;
– leave a power tool connected to the network unattended;
– grasp the rotating parts of the tool or the spindle with your hands during operation;
– allow tension or twisting of the cable;
– operate electric tools from ladders.

**WHEN WORKING WITH PNEUMATIC TOOLS IT IS PROHIBITED:**

– fasten the hoses by twisting them with wire, change the working inserts while the pneumatic tool is working, and also leave the working tip in the pneumatic tool during long breaks in work;
– stop the air supply by "breaking" the hoses;

– operate pneumatic tools from ladders.

### 7.3 Weapon complex

#### 7.3.1 Possible gun malfunctions and ways to eliminate them

Possible malfunctions of the gun and methods for eliminating them are given in the technical description and operating instructions for the tank gun (2A46M.TO).

If systematic deviations of projectiles from the aiming point are detected during firing, as well as in cases where there is an assumption of a possible change in the deviation from the straightness of the barrel bore axis (for example, when the barrel is “stuck”, side impacts of the barrel on obstacles, etc.), it is necessary bring the weapons complex to normal combat in accordance with Appendix A.

#### 7.3.2 Possible malfunctions of machine guns and ways to eliminate them

If there is a delay when firing, you must first reload the machine gun. If the delay is not eliminated by reloading, you should unload the machine gun, determine the cause of the delay and eliminate it in accordance with the instructions in Tables 23 and 24.

Possible malfunctions of the coaxial machine gun and methods for eliminating them are given in Table 23.

Table 23

| Malfunction | Probable Cause | Elimination method |
|---|---|---|
| No shot when pressing the fire button | The machine gun is not cocked | Cock the machine gun |
| | The machine gun safety is in the PR position | Set the safety switch to the FIRE position |
| | The electrical connector to the machine gun's electric trigger is not connected | Connect the electrical connector |
| Lack of movement of the bolt frame to the forward position.<br>The bolt frame stopped before reaching the forward position, another cartridge was in the chamber, the extractor hooks did not capture the cartridge in the receiver | Contamination of the receiver or chamber, carbon deposits in the gas chamber pipe | Without disassembling the machine gun, lubricate the chamber, rubbing parts, and gas chamber pipe. Clean the machine gun or replace the barrel as soon as possible |
| | Wrinkled or dirty cartridges or tape | Replace cartridges or tape |
| Misfire.<br>Bolt carrier in forward position, cartridge in chamber, no shot fired | Cartridge malfunction.<br>Drummer malfunction.<br>Contamination of the machine gun or hardening of the lubricant | Reload the machine gun and fire a shot. If the misfire occurs again, inspect the cartridge removed from the chamber and, if there is no deep dent on the capsule, clean the bolt, chamber and rubbing parts, and if the firing pin breaks or wears out, send the machine gun to a workshop |
| Failure to remove the cartridge case. The bolt frame stopped in an intermediate position, the cartridge case remained in the chamber and the next cartridge buried a bullet in it | Malfunction of the ejector or its spring | If the cartridge case cannot be removed from the chamber during reloading, knock it out with a cleaning rod or replace the barrel.<br>If the ejector or its spring malfunctions, send the machine gun to a repair shop |
| | Contamination of the chamber or cartridge, failure of the rim of the sleeve | If the rim of the case breaks, clean the chamber, lubricate the cartridges in the tape and move the gas regulator to a lower setting |
| Incomplete retraction of the bolt frame. The bolt frame stopped in an intermediate position, the cartridge removed from the receiver remained in the extractor hooks | Contamination of rubbing parts | Cock the bolt frame and continue firing. Clean and lubricate the machine gun as soon as possible. |
| | Tape jammed in receiver | When repeating the delay, after unloading the machine gun, inspect the placement and correctness of the tape. |
| | The effort to retract the bolt frame to the cocked position is low | If the tape is laid and equipped correctly, move the gas regulator to a larger division. Clean and lubricate the machine gun as soon as possible |

Possible malfunctions of the DPU machine gun and methods for eliminating them are given in Table 24.

Table 24

| Malfunction | Probable Cause | Elimination method |
|---|---|---|
| No shot when pressing the fire button | The machine gun is not cocked | Cock the machine gun |
| | The machine gun safety is in the PR position | Set the safety switch to the FIRE position |

| Malfunction | Probable Cause | Elimination method |
|---|---|---|
| | The electrical connector to the machine gun's electric trigger is not connected | Connect the electrical connector |
| When the reloading handle is withdrawn, the recoil parts are not cocked | The machine gun safety is in the PR position | Set the safety switch to the FIRE position |
| | Simultaneous placement of two cartridges into a machine gun | Open the receiver cover and place one cartridge behind the locking fingers of the tray |
| | Incorrect tape padding | Open the receiver cover and check the tape packing |
| Misfire.<br>The cartridge is in the chamber, the moving parts are in the extreme forward position, no shot occurred | Cartridge malfunction.<br>Contamination of moving parts | Remove the cartridge from the chamber and inspect it. If there is no deep dent on the capsule, wipe and lubricate the moving parts |
| | Breakage of the striker, sediment or breakage of the return spring | Inspect the firing pin and return spring; if faulty, replace |
| Lack of movement of the bolt frame to the forward position | Contamination of the chamber, carbon deposits in the piston cavity | Pull the bolt frame back and continue shooting. When repeating the delay, clean the internal cavity of the piston and chamber |
| | The cartridge is dented, corroded or dirty. | Remove the faulty cartridge |
| Lack of moving parts back | Incomplete displacement of the sleeve in the bolt grooves. When the bolt frame moves to the extreme forward position, the sleeve rests against the liner.<br>Contamination of the machine gun, especially gas paths | Reload to deflect the cartridge case. Move the gas regulator from position “1” to position “2”.<br>If the delay is repeated, clean the gas paths and rubbing surfaces and move the gas regulator back to position “1” |
| Jamming of moving parts | A foreign object entering the machine gun or machine gun parts breaking | Remove any foreign object or broken part. Inspect the machine gun, replace the broken part from the spare parts; if there is no replacement part, send the machine gun to the workshop. Clean out nicks and bruises in the metal |
| Non-reflection of the sleeve.<br>The sleeve is wedged in the grooves of the bolt cylinder, and the moving parts are in an intermediate position | Malfunction of the bolt hooks or broken hook spring | Move the sleeve in the grooves of the bolt all the way to the right, holding the moving parts, reflect the sleeve. If the delay recurs, replace the hooks. |
| Loss of cartridge case.<br>When moving parts come to the forward position, they stick into the sleeve | Broken toe tooth or toe spring | Remove the sleeve and replace the broken spring.<br>If one of the hooks breaks, replace both hooks |
| Cartridge sticking.<br>The cartridge being sent into the chamber is pinched between the bolt and the receiver tray | Incomplete removal of the cartridge by the link remover due to incomplete removal of the moving parts | Move the moving parts to the sear, open the cover, remove the tape, remove the jammed cartridge, load the machine gun and continue shooting. When the delay is repeated, move the gas regulator from position “1” to position “2” |
| Missed feed.<br>Another cartridge missed the receiving window | Broken or weakened feed finger spring or locking finger spring | Replace springs (in the workshop) |
| | Link malfunction (bent or dented link legs) | Remove sections of the tape (ten links) with defective links |
| An empty link falling under the link remover | Incorrect equipment of the belts, cartridge falling out of the belt when shooting | Open the receiver cover, release the tape, load the machine gun. Continue shooting |

### 7.3.3 Possible malfunctions in firing circuits and ways to eliminate them

Possible malfunctions in firing circuits and methods for eliminating them are given in Table 25.

Table 25

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| There is no message in the service line on the APU and there is no “READY” light signal in the field of view of the PMU after loading | The automatic charging cycle is not complete | Check the condition of the AZ mechanisms in their original state. Check the condition of the gun wedge. If necessary, return the mechanisms to their original position and close the gun bolt wedge |
| Galvanic circuit does not work | The electrical circuit to the bolt wedge striker is broken | Check the cleanliness of the contact plate and the lower contact of the wedge (remove grease) |
| | | Check the contact between the leaf spring and the striker and the wires with the leaf spring. |

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| The electric trigger of the machine gun does not work | There is no electrical contact in the electrical connector of the machine gun's electric trigger | Check the connection of the electrical connector to the machine gun |
| The electric triggers of the cannon and machine gun do not work | The AZR on the driver's panel is turned off | Enable AZR on the driver's panel |

### 7.3.4 Possible AZ malfunctions and ways to eliminate them

Possible AZ malfunctions and methods for eliminating them are presented in Table 26.

Table 26

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| AZ does not work - automatic shutdown of AZR SP. UNDER., on the right distribution panel | The MPC locking lever is not removed from the clamp | Remove the stopper lever from the clamp. Make sure that the lever is removed from the clamp by pressing it against the gearbox |
| There is no locking at the loading angle (multiple slipping of the electric machine stopper) | Large contamination of the conical surfaces of the stopper and bushing in the gun | - with the wedge open and the weapon stabilizer turned off, give the gun a maximum elevation angle;<br>- the commander turns off the AZR AZ UPR. on the right switchboard;<br>- set the AVT switch. - MANUAL on the loading panel to the MANUAL position, and the FRAME switch to the EMISSION position; |
| | | - the gunner slowly move the gun to the loading angle until the gun stopper is released (monitor by the sound of the running electric motor);<br>- holding the FRAME switch in the EMISSION position, turn off the EL. DRAIN on the right switchboard;<br>- release the FRAME switch;<br>- give the gun a maximum elevation angle;<br>- wipe dry the conical surface of the stopper and bushing in the gun;<br>- return the gun stopper to its original position, turning on the EL AZR. Descent and AZ CONTROL. |
| There is no information about switching on the AZ in automatic mode (AZ READY for PO and PN); | Lamp burned out | If, after completing all the required preparatory operations, the AZ READY indicators on the control panel and launcher do not light up, and the gun and turret are aimed from the remote control, then to load, you must press the MZ button on the launcher. If charging is normal, continue working and replace the lamp as soon as possible. |
| There is no information for turning on the AZ in manual mode (MANUAL on PZ and PN); | Lamp burned out | If when installing AVT switches. - MANUAL on PU or PZ to MANUAL position. MANUAL indicators do not light up. on the PU or PZ, and the gun on the command RUCH. is brought to the loading angle, and the gun and turret are not controlled from the guidance console, continue work and replace the lamp as soon as possible |
| The ejection hatch lid does not open | Freezing of water in the gaps of the manhole cover | Destroy the ice by hitting the hatch cover from the inside or outside with the L.R.VT AZR switched off |
| The charge does not enter the cassette tube | The cassette is dented | Tap the cassette pipe with a hammer on the mandrel located in the group spare parts kit for the tank |
| In loading and unloading modes, the cassette rises to the projectile dispensing line | The CBM frame is not pressed against the stop | Turn on the AVT switch. - MANUAL on the PZ to the MANUAL position.<br>Turn off AZR AZ UPR. Lower the cassette using the manual drive. Press the frame against the stop, setting the FRAME switch to the OUT position on the PZ |

## 7.4 Fire control system

### 7.4.1 Possible malfunctions of the PMU and ways to eliminate them

**ATTENTION:**

**THE PNM AND BSMP CONTROL UNITS MUST ONLY BE REPLACED AS A COMPLETE SET!**

Possible malfunctions of the PMU, probable causes and methods for eliminating them are given in Table 27.

Table 27

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| There is no " " indication  on the front panel of the ISM BVD; on the APU screens in a wide field of view (WFO) the inscription "SSU OFF" is displayed when the ISM is turned on | The 10 A fuse-link has burned out (the on-board network voltage is not supplied to the PSM control unit).<br>Malfunction in the control unit of the PNM, BSMP or in the tank equipment | Check the "+27 V" indication on the PNM control unit:<br>1) if there is an indication, replace the "+27 V" 10 A fuse-link from a single set of spare parts for the multi-channel gunner's sight;<br>2) in the absence of the "+27 V" indication, perform the following checks: turn off the "SUO" toggle switch on the control panel of the control system and the AZ, turn off the AZR PNM on the left distribution panel, disconnect the cable from the electrical connector X3 BU PNM, turn on the AZR PNM on the left distribution panel after what:<br>a) check the presence of on-board network voltage at the electrical connector of the disconnected cable on pins 3, 4 relative to the tank body;<br>b) check the electrical connection between contacts 43 and 44 of the disconnected cable with the tank body;<br>c) turn on the "OMS" toggle switch on the OMS and AZ control panel, check the presence of on-board network voltage at the electrical connector of the disconnected cable at pin 26 relative to the tank body.<br>If the results of checks according to the lists a) – c) are positive, replace the PNM and BSMP control unit<br>If there is no voltage or contact with the body, check the tank equipment (cable set) and eliminate the malfunction |
| There is no indication "  " on the front panel of the BVD PNM, on the screens of the APU in a wide field of view (SFV) the inscription "SSU OSH 1" is displayed, on the line of indicators of the control unit the red "  " indicator lights up | No three-phase AC voltage is supplied to the PNM control unit | Check the indication on the protection unit. If there is an indication, replace the corresponding fuse-link.<br>If there is no indication, do the following: turn off the OMS toggle switch on the OMS control panel and the AZ, turn off the PNM AZR on the left distribution panel; disconnect the cable from the electrical connector X3 BU PNM, turn on the AZR PNM on the left distribution panel; turn on the OMS toggle switch on the OMS control unit and AZ; Check the presence of AC voltage at the electrical connector of the disconnected cable between pins 33 and 34, between pins 33 and 41, between pins 34 and 41. The nominal voltage should be 36 V. |
| | Malfunction in the control unit of the PNM, BSMP or tank equipment | If there is voltage, replace the PNM and BSMP control unit.<br>If there is no voltage, check the tank equipment (cable set) and eliminate the malfunction |
| There is no indication "  " on the front panel of the PNM BVD, on the APU screens in a wide field of view (FOV) the inscription "SSU OSH 2" is displayed, on the line of indicators of the PNM BU the  red " " indicator is lit | One or more 2 A fuse links (1~, 2~, 3~) in the PNM control unit have burned out | Check the indication on the protection unit. If there is an indication, replace the corresponding fuse-link.<br>Check the indications "1~", "2~", "3~" on the PNM control unit.<br>If there is an indication, replace the corresponding 2 A fuse-link from a single set of spare parts for a multi-channel gunner's sight |
| | Cable No. 1 is damaged (between the PNM X1 control unit and the PNM X1 BVD). | Fix the cable fault or replace the cable |
| | Malfunction in control unit PNM, BSMP | If there is no burnout of the 2 A fuse links (1~, 2~, 3~) and the cable No. 1 PNM is in good condition, replace the PNM and BSMP control unit |
| There is no indication "  " on the front panel of the PNM BVD, on the | Cable No. 1 PNM is damaged (between the PNM X1 control unit and the PNM X1 BVD). | Fix the cable fault or replace the cable |

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| screens of the APU in a wide field of view (SFV) the inscription “SSU OSH 3” is displayed, on the line of indicators of the PNM BU the red “ ” indicator is lit  | Malfunction in control unit PNM, BSMP | If there is no damage to cable No. 1 of the PNM, it is necessary to replace the CU of the PNM and BSMP |
| There is no indication “  ” on the front panel of the PNM BVD, on the screens of the APU in a wide field of view (SFV) the inscription “SSU OSH 4” is displayed, on the line of indicators of the PNM BU the red “ ” indicator lights up  | The tank's on-board voltage is less than 22 V | Disconnect the electrical connector X3 BU, measure the voltage at pins 3 and 4 of the electrical connector of the cable relative to the tank body. If the voltage is from 22 to 29 V, replace the PNM and BSMP control unit. If the voltage is less than 22 V, it is necessary to eliminate the cause of the low voltage of the tank’s on-board network (should be from 22 to 29 V) |
| There is no “ ” indication  on the front panel of the PNM BVD, on the APU screens in a wide field of view (FOV) the inscription “SSU OSH 5” is displayed, on the line of indicators of the PNM BU the red “ ” indicator is lit  | Refusal of the arrester in the emergency hospital | Replace control unit PNM and BSMP |
| There is no indication “  ” on the front panel of the PNM BVD, on the screens of the APU in a wide field of view (SFV) the inscription “SSU OSH 6” is displayed, on the line of indicators of the PNM BU the red “ ” indicator lights up.  | The fuse-link “~” 0.25 A on the PNM control unit has burned out. | Check the indication on the PMU control unit. If there is an indication “~” and there is no indication “↕”, “↔”, replace the 0.25 A fuse-link from a single set of spare parts for a multi-channel gunner’s sight |
| | Cable No. 1 PNM is damaged (between the PNM X1 control unit and the PNM X1 BVD). | Fix the cable fault or replace the cable |
| | Malfunction in control unit PNM, BSMP | If there is no damage to cable No. 1, it is necessary to replace the PNM and BSMP control unit |
| There is no indication of “  ” or “  ” on the front panel of the PNM BVD (the range is not measured by a laser range finder or there is no missile control field) | The laser control channel and the rangefinder channel are blocked by the installed technological plug 7600.0136.610 | Make sure that the control electrical connector PNM (BVD PNM -X5) is not equipped with a technological plug 7600.0136.610 from a single set of spare parts for a multi-channel gunner’s sight |
| | Failure of the laser missile control channel or the rangefinder channel PNM (BVD PNM) | Replace the BVD PNM |
| Silica gel in desiccant absorbers on the BSMP body or drying indicators on the BVD PNM body has acquired a pink-white color | Silica gel is saturated with moisture | Replace desiccant absorbers or drying indicators from a single set of spare parts for a multi-channel gunner's sight |
| The silica gel in the TPK-K desiccant has acquired a gray-pink or lilac color | Silica gel is saturated with moisture | Replace the TPK-K desiccant from a single set of spare parts for a multi-channel gunner's sight (TPK-K spare parts) |

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| Burnout of fuse links on the PNM unit immediately after their replacement | Short circuit or overload in electrical circuits | Make sure the cable harnesses are intact.<br>Check the tank equipment (cable set) and eliminate the malfunction.<br>If the cable harnesses are not damaged and the tank equipment is functioning normally, then it is necessary to replace the PNM and BSMP control unit |
| When the toggle switch is turned on on Mon-PNM, there is no image from the TP channel of the PNM | Failure of the TP channel of the PNM | Replace the PNM thermal imaging camera |

### 7.4.2 Possible malfunctions of the control panel, probable causes and ways to eliminate them

Possible malfunctions of the control panel, probable causes and methods for eliminating them are given in Table 28.

Table 28

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| “  ” indication on the Pn-PKP; on the APU screens in a wide field of view (WFO) the inscription “SSU OSH 1” is displayed | The control panel control unit does not receive three-phase AC voltage | Check the indication on the protection unit. If there is an indication, replace the corresponding fuse link.<br>If there is no indication, do the following: turn off the “OMS” toggle switch on the OMS control panel and AZ; turn off the AZR control panel on the right switchboard; disconnect the cable from the electrical connector X3 BU PKP, turn on the AZR PKP on the right distribution panel; turn on the OMS toggle switch on the OMS control unit and AZ; Check the presence of AC voltage at the electrical connector of the disconnected cable between pins 26 and 27, between pins 27 and 28, between pins 26 and 28. The nominal voltage should be 36 V. |
| | Malfunction in the PKP control unit, BOE or tank equipment | If there is voltage, replace the PKP control unit and BOE control unit one by one.<br>If there is no voltage, check the tank equipment (cable set) and eliminate the malfunction |
| “  ” indication on the Pn-PKP; on the APU screens in a wide field of view (WFO) the inscription “SSU OSH 2” is displayed | Cable No. 2 of the control panel is damaged (between control panel control unit X2 and control panel control unit X4). | Fix the problem or replace the cable |
| | Malfunction in PKP control unit, BOE | Replace the PKP control unit and BOE control unit one by one. |
| “  ” indication on the Pn-PKP; on the APU screens in a wide field of view (WFO) the inscription “SSU OSH 3” is displayed | Cable No. 2 of the control panel is damaged (between control panel control unit X2 and control panel control unit X4). | Fix the problem or replace the cable |
| | Malfunction in PKP control unit, BOE | If there is no damage to cable No. 2 of the control panel, it is necessary to replace the control panel control unit and the BOE one by one. |
| “  ” indication on the Pn-PKP; on the APU screens in a wide field of view (SFV) the inscription “SSU OSH 4”, or “SSU OSH 5”, or “SSU OSH 6” is displayed | The control panel cables are damaged (connected to the BOE and control panel control unit) | Repair or replace the corresponding cable |
| | Malfunction of the PKP control unit or BOE | If there is no damage to the control panel cables, it is necessary to replace the control panel control unit and BOE one by one |
| “  ” indication on the Pn-PKP; on | The control panel cables are damaged (connected to the BOE and control panel control unit) | Repair or replace the corresponding cable |

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| the APU screens in a wide field of view (WFO) the inscription “SSU OSH 7” is displayed | Damaged cable No. 3AC (connected to BV-X6 and BUPKP-X3) | Fix the cable fault or replace the cable |
| | Malfunction of PKP control unit or BV or BOE BV | If there is no damage to the control panel cables, it is necessary to replace the control panel control unit, BV and BOE one by one |
| There is no “ ” indication  on the Pn-PKP (the range is not measured by a laser rangefinder) | Failure of the PKP rangefinder channel (BOE PKP) | Make sure that the rangefinder channel of the control panel is not blocked in the control panel menu.<br>Replace the BOE PKP |
| There is no “ ” indication  on the Pn-control panel, there is no image from the control panel TV channel | Failure of the TV channel PKP (BOE PKP) | Replace the BOE PKP |
| There is no “ ” indication  on the Pn-PKP (when the toggle switch on the Pn-PKP is turned on and the thermal imaging channel is selected), there is no image from the TP channel of the PKP | Failure of the TP channel of the PKP (BOE PKP) | Replace the BOE PKP |
| There is no PKP guidance on GN | The 30 A fuse-link in the ECU has burned out | Check the integrity of the fusible insert in the ECU. In case of burnout, replace the 30 A fuse-link from the set of single spare parts for the control panel |
| | The control panel cables are damaged (connected to the control unit PKP-X2 and BUD-X2, 4 and BOE-4, 5) | Repair or replace the corresponding cable |
| | Malfunction of the PKP control unit or ECU or PVKU (BOE PKP) | Replace the control panel control unit, ECU and control panel control unit one by one |
| The silica gel in the desiccant located in the lower part of the BOE or the drying indicator on the BZ body has acquired a pink-white color | Silica gel is saturated with moisture | Replace the desiccant or drying indicator from a single set of spare parts for the control panel |

### 7.4.3 Possible malfunctions of AS VP, probable causes and ways to eliminate them

Possible malfunctions of the AC and VP, probable causes and methods for eliminating them are given in Table 29.

Table 29

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| There is no “ ” indication  on the front panel of the PMU BVD, it is impossible to enter the BV menu, abnormal operation of the PMU and control panel, etc. | The fuel tank does not receive voltage from the tank's on-board network | Check the supply of on-board network voltage to the fuel supply unit in the following sequence:<br>- turn off the “MSO” toggle switch on the control panel and AZ, turn off the PNM AZR on the left distribution panel, the PKP AZR on the right distribution panel, disconnect the cable from the electrical connector BV-X2;<br>- turn on the AZR PNM on the left distribution panel, the AZR PKP on the right distribution panel;<br>- check the presence of +27 V voltage on the electrical connector of the disconnected cable on contacts 20-23 and check the presence of electrical connection of contacts 35, 36 on the electrical connector of the disconnected cable with the tank body.<br>If there is no voltage or contact with the body, check the tank equipment (cable set) and eliminate the malfunction |
| | BV malfunction | If there is voltage at the input to the BV, it is necessary to replace the BV |
| One or more buttons on the Pn-PNM and Pn-PKP do not work, the thermal imaging channel of the PNM or PKP does not turn on | Malfunction of the cable harness connected to BV, Pn-PNM and Pn-PKP | Fix the problem or replace the cable |
| | Malfunction of Pn-PNM or Pn-PKP | Replace Pn-PNM or Pn-PKP |
| Not possible in the submenu “SENSORS CONTROL” in the lines “TEMP. CHARGE", or "PRESSURE", or "TEMP. AIR" set the AVT mode or there are no readiness for DTZ, DTV, DBP in the "READINESS" submenu or the readings from one of the sensors differ significantly from real weather conditions | Faulty cables connected to the corresponding sensors | Repair or replace the corresponding cable |
| | Failure of DM or DTV | If there is no damage to the cables, replace the failed sensor |
| It is impossible to set the ON mode in the “SENSOR CONTROL” submenu in the lines “VN BARREL DI” and “GN BARREL DI”; there are no readings from the DI when the cursor is on these lines | The BI DI exhibition was not produced after dismantling | Install and exhibit BI DI in accordance with Appendix D of this manual |
| | Malfunction of cables inside the tank (from BV-X10 to SR-DI) and outside the tank (from SR-DI to BI) | Repair or replace the corresponding cable |
| | BO failure | Make sure the integrity of the optical element in the BO, if necessary, replace the BO |
| | BI failure | Replace BI |
| Target designation from one of the control points is not provided or the indicator is not illuminated on one of the control points when the GN control panel is located in the control station sector | Failure of the UN or damage to the cable harness from the corresponding UN to the AUN | Replace UN |
| Target designation from any of the launchers is not provided or the indicators are not illuminated on all launchers or the AUN is not ready in the “READINESS” submenu | Malfunction of the cable harness from BV-X10 to AUN-X1 | Make sure the cable harness is intact; if a fault is detected, replace the harness |
| | Failure of AUN | Replace AUN |

### 7.4.4 Possible malfunctions of the PDT, probable causes and ways to eliminate them

Possible malfunctions of the PDT, probable causes and methods for eliminating them are given in Table 30.

Table 30

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| There is no indication “ ” on Mon-PDT when the PDT is turned on (PDT is functioning) | Mon-PDT faulty | Replace faulty Mon-PDT |
| “ ” indication on the Mon-PDT when the PDT heating is turned on (the PDT heating is functioning) | Mon-PDT faulty | Replace faulty Mon-PDT |
| “ ” indication on the Mon-PDT when the PDT heating is turned on (the PDT heating does not function) | PDT module is faulty | Replace the PDT module |
| The PDT does not switch to battery mode (there is no “ ” (“BATTERY”) indication on the BPR) | The fuse in the power supply unit has blown | Replace fuse |
| | BPR battery is low | Replace the battery, following paragraph 3.3.5.16.6of this manual |
| | BPR faulty | Replace BPR |
| There is no vertical guidance of the PDT field of view | The drive and alignment mechanism are faulty | Replace the drive and alignment mechanism |

### 7.4.5 Possible malfunctions of the video path equipment (BKVS, BTsOI, VSU, SNV), probable causes and ways to eliminate them

Possible malfunctions of the BKVS, BTsOI, APU, SNV, probable causes and methods for eliminating them are given in Table 31.

Table 31

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| The BCOI does not enter the mode (intermittent lighting of the “V6” indicator on the BCOI) | BCOI is faulty | Replace BCOI |
| There is no image on one or two APUs in all operating modes of the APU | Malfunction of cables from BKVS to APU | Check the integrity of the cables, if a fault is detected, repair the damage or replace the corresponding cable |
| | APU faulty | Replace APU |
| | BKVS faulty | Replace BKVS |
| | KVI is faulty | Replace KVI |
| There is no reception of TV or TV images from the corresponding channel (there is an image of a “chess board” on the screen) | BCOI is faulty | Replace BCOI |
| | BKVS faulty | Replace BKVS |
| | Malfunction of cables from BKVS to APU | Check the integrity of the cables, if a fault is detected, repair the damage or replace the corresponding cable |
| Flashing of the PNM and/or PKP sighting mark | BV is faulty | Replace BV |
| | BCOI is faulty | Replace BCOI |
| | Damage to the cable from the BV to the BCOI | Check the integrity of the cable, if a fault is detected, repair the damage or replace the cable |
| There is no video image from the START and PKP on the commander’s APU | Malfunction of the cable from the KVI to the APU | Check the integrity of the cable, if a fault is detected, repair the damage or replace the cable |
| | KVI is faulty | Replace KVI |

### 7.4.6 Possible malfunctions of the STV, probable causes and ways to eliminate them

Possible malfunctions of the ETS, probable causes and methods for eliminating them are given in Table 32.

Table 32

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| When the STAB toggle switch is turned on at the SLA and AZ launchers, the turret cannot be aimed from the guidance panel | The driver's hatch is not closed | Close the driver's hatch |
| | The tower is not unlocked | Unlock the tower |
| | AZR MPB -EM is turned off | Turn on AZR MAGN. MPB on ShchRL |
| | AZR CONVERTER is switched off | Enable AZR CONVERT SCHRL |
| No vertical guidance | AZR UP VN is turned off | Enable AZR UP VN ShchRL |
| | The “AVT.-RUCH” toggle switch on the control system control system and AZ (or PZ) is set to the “RUCH” position | Switch the toggle switch to the “AVT” position |
| | Switch types of shots and type of weapon on the PU control system and AZ is set to the “LOADING” position | Set the switch to any position except “LOAD” |
| | After the shot, the pallet did not fall into the catcher | Set the “AUTO-MANUAL” toggle switch to the “MANUAL” position, remove the tray, set the switch to the AUTOMATIC position |
| | The automatic loader mechanisms are not returned to their original position | Return the mechanisms to their original position |
| Full or partial functioning of STS is not ensured | Malfunction of STV units | Replace a failed unit |

### 7.4.7 Possible malfunctions of the control system, probable causes and ways to eliminate them

Possible malfunctions of the control system, probable causes and methods for eliminating them are given in Table 33.

Table 33

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| There is no tracking of the control panel drives by the control panel, although the control panel indication is present on the PC | AZR DPU VN-GN is switched off | Enable AZR DPU VN-GN on ShchR |
| | The commander's hatch is not closed | Close the commander's hatch |
| | Foreign objects in the control panel leading to jamming of the control panel drives | With the remote control switched off, perform an inspection and remove foreign objects |
| There is no tracking of the control panel drives by the control panel, and there is no indication of the control panel on the PC | AZR DPU BU is switched off | Enable AZR DPU BU on ShchR |
| There is no electric trigger for the DPU machine gun | The commander's hatch, or the gunner's hatch, or the driver's hatch is not closed | Close the hatches of the commander, gunner and driver |
| | AZR EL.PUSK on ShchRP is switched off | Enable AZR EL.PUSK on ShchRP |
| | The cable from the electromagnet of the DPU machine gun is not connected | Connect the cable from the electromagnet of the DPU machine gun |
| Full or partial functioning of the control system is not ensured | Malfunction of DPU units | Replace a failed unit |

### 7.4.8 Possible malfunctions of other equipment included in the control system, probable causes and ways to eliminate them

Possible malfunctions of other equipment included in the control system, probable causes and methods for eliminating them are given in Table 34.

Table 34

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| In the “SENSOR CONTROL” submenu in the “Roll” or “Pitch” lines, the readings are not displayed or the readings change spontaneously over a wide range of angles in the absence of influences on the DCT | Three-phase AC voltage is not supplied to the VCT | Check the indication on the protection unit. If there is an indication, replace the corresponding fuse-link<br>If there is no indication on the protection unit, check the tank equipment (cable set) and eliminate the malfunction |
| | VCT malfunction | If there is alternating current voltage between contacts 1 and 2, 2 and 3, 1 and 3 of the DCT (when the control system is operating in all modes except the “BACKUP” mode), replace the DCT |
| The indication on the protection unit lights up, while the normal operation of the stabilization and control systems PNM and PKP is disrupted | One or more fuse links in the protection unit have burned out | Replace the corresponding fuse link in the protection unit |
| The indication on the protection unit lights up, and the normal operation of the safety protection system is disrupted | One or more fuse links in the protection unit have burned out | Replace the corresponding fuse link in the protection unit |
| The indication on the protection unit lights up, and the normal operation of the STV is disrupted | One or more fuse links in the protection unit have burned out | Replace the corresponding fuse link in the protection unit |
| The indication on the protection unit lights up, and the normal operation of the DPU control system is disrupted | One or more fuse links in the protection unit have burned out | Replace the corresponding fuse link in the protection unit |
| There is no indication on the protection unit, and the normal operation of the DCT, stabilization and control systems PNM, PKP, SPZ, STV and SU DPU is disrupted | There is no AC voltage from PT-800 and RCHN-3/3 | Check the tank equipment (cable set) and eliminate the malfunction |
| | | If there is no damage to the cables, replace PT-800 or RCHN-3/3 |
| The control system does not take into account the wind from the wind sensor, and there are no readings from the wind sensor when the cursor is on the “WIND SPEED” line of the “SENSOR CONTROL” submenu | The cable between the BV-X3 and the wind sensor is damaged | Check the integrity of the cable harness; if a fault is detected, repair the damage or replace the cable |
| | Wind sensor malfunction | Replace wind sensor |
| | BV malfunction | Replace BV |
| The readings of the electronic azimuth indicator are missing or do not correspond to the actual position of the tower relative to the hull, while there are no readings (spontaneously changing when the tower is stationary) from the tower position sensor in the “TOWER DP” line of the “POSITION SENSORS” submenu | The cable to the tower position sensor is damaged | Check the integrity of the cable harness; if a fault is detected, repair the damage or replace the cable |
| | Turret position sensor malfunction | Replace turret position sensor |
| | BV malfunction | Replace BV |
| There is no guidance of the VN STV drive when working with PNM and PKP, while guidance of the VN STV drive is provided when working with PDT, there are no readings (spontaneously changing when the gun is stationary) from the gun position sensor in the line “GUN DP” of the “POSITION SENSORS” submenu | The cable between the BV-X3 and the gun position sensor is damaged | Check the integrity of the cable harness; if a fault is detected, repair the damage or replace the cable |
| | Gun position sensor malfunction | Replace gun position sensor |
| | BV malfunction | Replace BV |
| There is no guidance of the PNM and guidance of the STV drives when working with the PDT from the gunner's position, there is no reaction to pressing buttons on the guidance remote control | The cable between the BV-X2 and the guidance console is damaged | Check the integrity of the cable harness; if a fault is detected, repair the damage or replace the cable |
| | Pointing remote control malfunction | Replace the pointing remote control |
| | BV malfunction | Replace BV |
| There is no guidance of the control panel and guidance of the STV drives when working with the PDT from the commander’s seat, there is no reaction to pressing buttons on the commander’s remote control | The cable between the BV-X1 and the commander’s console is damaged | Check the integrity of the cable harness; if a fault is detected, repair the damage or replace the cable |
| | Commander's console malfunction | Replace the commander's console |
| | BV malfunction | Replace BV |

## 7.5 Software and hardware complex

### 7.5.1 Possible malfunctions of UARMk and ways to eliminate them

Possible malfunctions of the UARMk and methods for eliminating them are given in Table 35.

Table 35

| Malfunction | Probable Cause | Elimination method |
|---|---|---|
| The ON indicator on the PMF is missing | Harness No. 24 is faulty (Figure 11.1, sheet 2) | Replace harness |
| | The BV-PMF cable is faulty | Replace the cable (from the group spare parts kit for the tank) |
| | BV is faulty | Replace the BV (from the group kit of spare parts for the tank) |
| | PMF faulty | Replace the PMF (from the group kit of spare parts for the tank) |
| There is no glow on the PMF screen | PMF faulty | Replace the PMF (from the group kit of spare parts for the tank) |
| There is no reaction of graphical interface elements to the corresponding keystrokes on the PMF | Software failure | Turn off the -PTK automated workstation and turn it on again. If the problem persists, contact an automated control system specialist (system administrator) |
| | PMF faulty | Replace the PMF -PTK (from the group spare parts kit for the tank) |
| | The BV-PMF cable is faulty | Replace cable |
| When checking the functionality of the PTC, a malfunction of the UARMk is indicated | Harness No. 24 is faulty | Replace harness |
| | BV is faulty | Replace the BV (from the group kit of spare parts for the tank) |

### 7.5.2 Possible malfunctions of KSS equipment and ways to eliminate them

KSS equipment must be repaired in specialized workshops by qualified specialists.
Crew members are only permitted to perform the following operations:
– replace blocks of components of KSS equipment;
– replace faulty laryngophones of headset headsets;
– replace damaged harnesses, cables, grounding and negative jumpers.

#### 7.5.2.1 Possible malfunctions of the radio station R-168-25U-2

Possible malfunctions of the R-168-25U-2 radio station and instructions for eliminating them are given in Table 36.

Table 36

| Malfunction | Probable Cause | Elimination method |
|---|---|---|
| The radio station does not turn on, indicator 7 (Figure 11.3) of the presence of BS on the VUFUS -25 unit does not light up, there is no noise in the headset phones | Battery switch is turned off (when the tank engine is not running) | Turn on the battery breaker |
| | AZR RADIOOB is switched off. | Enable AZR RADIOOB. |
| | Poor contact in the BS connector on the VUFUS -25 block | Restore contact in connector |
| | Damage to harness 6 (Figure 11.1, sheet 1) | Replace harness 6 |
| | Open circuit of the power switch on the VUFUS -25 unit | Replace radio station |
| | The BLS-25 unit in the VUFUS -25 unit is faulty | Replace radio station |
| When entering transmission via PP2, there are 25 pos. on the IP indicator panel. -10 (Figure 11.3) of the VUFUS -25 block lights up and the AV.U indicator | 168BShPA antenna are knocked down or not installed- | Install the R -168BShPA antenna stand and pin |
| | There is no contact in connector ANT1 pos. 1 (Figure 11.3) on the VUFUS -25 block or in the ANT1 and OUTPUT connectors of the UCHR device or the R -168BShPA antenna connector | Restore contact in connector |

| Malfunction | Probable Cause | Elimination method |
|---|---|---|
| | Break in cable connections 1 or 2 (Figure 11.1, sheet 1) | Replace faulty cable connection |
| | PP2 of the radio station is faulty | Replace radio station |
| | The UM 25 block -in the VUFUS25 block is faulty | Replace radio station |
| When entering transmission via PP2, there are -25 pos. on the IP indicator panel. 10 (Figure 11.3) of the VUFUS -25 block lights up and the AV.T indicator | Overheating of the UM -25 block in the VUFUS25 block | Take measures to cool the radio:<br>- do not work for transmission;<br>- switch to working in “low” power mode or in “bypass” mode;<br>- turn off the radio station |
| When entering transmission via PP2, there are -25 pos. on the IP indicator panel. 10 of the VUFUS25 block the indicator AV.P lights up | Overload of the UM -25 block (input) in the VUFUS25 block | On PP2 set the “average” output power |
| | PP2 of the radio station is faulty | Replace radio station |
| There is no radio communication when working with the radio station. At the same time, on the indicator panel IP -25, pos. 10 of the VUFUS25 block, the “+5V” or “+12V” indicators do not light up | The IVE 10 unit -in the VUFUS25 unit is faulty | Replace radio station |
| When working with PP2 radio stations in the frequency range from 30.0 to 45.975 MHz, there is no radio communication, and there are -25 pos. 10 of the VUFUS25 block indicator D1 does not light up | PP2 is faulty | Replace radio station |
| | The BUK 25 block -in the VUFUS25 block is faulty | Replace radio station |
| When working with PP2 radio stations in the frequency range from 46.0 to 69.975 MHz, there is no radio communication, and there are -25 pos. on the PP indicator panel. 10 of the VUFUS25 block indicator D2 does not light up | PP2 is faulty | Replace radio station |
| | The BUK 25 block -in the VUFUS25 block is faulty | Replace radio station |
| When working with PP2 radio stations in the frequency range from 70.0 to 107.975 MHz, there is no radio communication, and there are -25 pos. on the PP indicator panel. 10 of the VUFUS25 block indicator D3 does not light up | PP2 is faulty | Replace radio station |
| | The BUK 25 block -in the VUFUS25 block is faulty | Replace radio station |
| When entering transmission through PP2 of the radio station in “full” power mode, the correspondent does not perceive the transmitted information, while there -are 25 positions on the IP indicator panel. 10 of the VUFUS25 block the MSCH.P indicator does not light up; in the extended menu PP2, the symbol “U” is displayed on the alphanumeric indicator of the PUDL block in the power sign. | The UM 25 block -in the VUFUS25 block is faulty | Replace radio station |

| Malfunction | Probable Cause | Elimination method |
|---|---|---|
| When entering transmission through PP2 of the radio station in the “medium” power mode, the respondent does not perceive the transmitted information, while -there are 25 positions on the IP indicator panel. 10 of the VUFUS25 block the MSCH.S indicator does not light up; in the extended menu PP2, the symbol “U” is displayed on the alphanumeric indicator of the PUDL block in the power symbol. | The UM 25 block -in the VUFUS25 block is faulty | Replace radio station |
| When entering transmission through PP2, the correspondent does not perceive the transmitted information, while -there are 25 positions on the IP indicator panel. 10 of the VUFUS25 block the FDS1 indicator does not light up | The FDS 20 block -in the VUFUS25 block is faulty | Replace radio station |
| There is no control of PP2, while the message “FAILURE” is displayed on the LCD indicator of PP2, pos. 6, or service information is not displayed on the indicator | PP2 is faulty | Replace radio station |
| The radio station is turned on, the BS, “+5V” and “+12V” indicators on the VUFUS -25 unit are lit , PP1 does not turn on | PP1 is faulty | Replace radio station |
| There is no radio communication when working with PP1 | There is no contact in connector ANT2 pos. 4 (Figure 11.3) on the VUFUS -25 block or in the ANT2 and OUTPUT connectors of the UCHR device or the R -168BShPA antenna connector | Restore contact in connector |
| | Break in cable connections 2 or 3 (Figure 11.1, sheet 1) | Replace faulty cable connection |
| | PP1 is faulty | Replace radio station |
| When entering a transmission through PP1, the correspondent does not perceive the transmitted information | Insufficient output power level of PP1 | Set the appropriate output power level of PP1 |
| | PP1 is faulty | Replace radio station |
| There is no control of PP1 from the front panel | PP1 is faulty | Replace radio station |
| When working with PP1, there is no radio communication in the “KFCh-Ts” and “PPRF” modes | System clock failure | Re-enter the RD into PP1 |
| | Battery CR 2025 3 V (Panasonic) in PP1 is discharged | Replace the battery CR 2025 3 V (Panasonic) in PP1* |
| * The replacement procedure is set out in the operating manual for the radio station R-168-25U-2 ITNYA.464511.245-04 RE. | | |

**7.5.2.2 Possible malfunctions of the R-168MRA radio station**

Possible malfunctions of the R-168MRA radio station and instructions for eliminating them are given in Table 37.

Table 37

| Malfunction | Probable Cause | Elimination method |
|---|---|---|
| When the radio is turned on, the PIT indicator on the VKU unit does not light up | AZR RADIOOB is switched off. on ShchR | Enable AZR RADIOOB. on ShchR |
| | VKU fuse blown | Replace the VKU unit |
| | Poor contact in the BS connector on the VKU block, in the SR-RO connector, in the X2 connector on ShchR | Restore contact in connector |
| | Damage to harness 6 (Figure 11.1, sheet 1) | Replace harness 6 |
| | Damage to a branch of the tower electrical system harness from connector X2 ShchR to connector SR-RO | Replace harness |
| There is no connection with the AVSKU complex | Poor contact in connectors:<br>- LAN or POWER on the PRMD unit;<br>- PIT, LAN1 or LAN2 on the VKU unit of the radio station;<br>- LAN1 on the MSVKU block | Restore contact |
| | Damage to harness 9 (Figure 11.1, sheet 1) | Replace harness 9 |
| | Damage to harness 14 (Figure 11.1, sheet 1) | Replace harness 14 |
| | Damage to harness 15 (Figure 11.1, sheet 1) | Replace harness 15 |
| | The PRMD unit is faulty | Replace the PRMD unit |
| | VKU unit is faulty | Replace the VKU unit |
| The radio station is not registered in the radio network | The radio is set to a reduced output power level | Set the output power to a higher level |
| | The radio station is out of range of the radio network | Change the location of the tank on the ground |
| | Poor contact in connector X1 of the SK-B antenna, in the ANT connector of the PRMD unit | Restore contact in connector |
| | Damage to HF cable 4 (Figure 11.1, sheet 1) | Replace RF cable 4 |
| | The PRMD unit is faulty | Replace the PRMD unit |

### 7.5.2.3 Possible malfunctions of the AVSKU software and hardware complex, MT10M devices and TSh-4M headsets

Possible malfunctions of the hardware and software complex AVSKU, MT10M devices, TSh-4M headsets and instructions for eliminating them are given in table 38.

Table 38

| Malfunction | Probable Cause | Elimination method |
|---|---|---|
| The complex does not turn on. There is no indication on the complex blocks | Battery switch is turned off (when the tank engine is not running) | Turn on the battery breaker |
| | AZR RADIOOB is switched off. | Enable AZR RADIOOB. |

| Malfunction | Probable Cause | Elimination method |
|---|---|---|
| The complex does not turn on. There is no indication on the blocks BShM, MSVKU, PUDL, PUN, MS1, MSnch(1), MSnch(2). On the power supply unit (2) the PIT and “12V” indicators do not light up | Poor contact in the 27V connector on the power supply (2) | Restore contact in connector |
| | Harness 6 is faulty (Figure 11.1) | Replace harness 6 |
| | PSU is faulty(2) | Replace power supply(2) |
| The complex does not turn on. There is no indication on the blocks BShM, MSVKU, PUDL, PUN, MS1, MSnch(1), MSnch(2). The “12V” indicator on the power supply unit (2) does not light up. PIT indicator lights up | PSU is faulty(2) | Replace power supply(2) |
| The complex does not turn on. There is no indication on the blocks MSVKU, PUDL, PUN, MS1, MSNC(1), MSNC(2). The PIT indicator on the BShM unit does not light up | Poor contact in the PIT connector on the BShM unit or in the 12V connector on the power supply unit (2) | Restore contact in connector |
| | Harness 10 is faulty (Figure 11.1) | Replace harness 10 |
| | BShM unit is faulty | Replace the BShM block |
| When the complex is turned on, the message “FAILURE” is displayed on the indicator of the PUDL block. After testing* by the subscriber of the complex equipment, information about the failure of the TKOM unit and the 450B product is displayed on the PUDL indicator. On the power supply unit (1) the PIT and “12V” indicators do not light up | Poor contact in the 27V connector on the power supply unit (1) or in the PIT connector on the TKOM | Restore contact in connectors |
| | Harness 6 is faulty (Figure 11.1) | Replace harness 6 |
| | PSU is faulty(1) | Replace power supply(1) |
| When the complex is turned on, the message “FAILURE” is displayed on the indicator of the PUDL block. After testing* by the subscriber of the complex equipment, information about the failure of the TKOM unit and the 450B product is displayed on the PUDL indicator. On the power supply unit (1) the “12V” indicator does not light up, the PIT indicator lights up | PSU is faulty(1) | Replace power supply(1) |
| When the complex is turned on, the message “FAILURE” is displayed on the indicator of the PUDL block. After testing* by the subscriber of the complex equipment, information about the failure of the TKOM unit and the 450B product is displayed on the PUDL indicator. The PIT indicator on the TKOM unit does not light up | Poor contact in the PIT connector on the TKOM unit or in the 12V connector on the PSU unit (1) | Restore contact in connector |
| | Harness 16 is faulty (Figure 11.1) | Replace harness 16 |
| | The TCOM unit is faulty | Replace the TCOM unit |
| When the complex is turned on, the message “FAILURE” is displayed on the indicator of the PUDL block. After testing* by the subscriber of the complex equipment, information about the failure of the MSVKU and MS1 blocks is displayed on the PUDL indicator. The PIT indicator on the MSVKU unit does not light up | Poor contact in the PIT connector on the MSVKU block or LAN1 on the BShM block | Restore contact in connector |
| | Harness 7 is faulty (Figure 11.1) | Replace harness |
| | MSVKU unit is faulty | Replace the MSVKU unit |
| When the complex is turned on, the message “FAILURE” is displayed on the indicator of the PUDL block. After the subscriber has tested* the complex equipment, the PUDL indicator also displays information about the failure of the MS1 unit. The PIT indicator on the MC1 unit does not light up | Poor contact in the LAN connector on the MC1 block or in the LAN2 connector on the MSVKU block | Restore contact in connector |
| | Harness 8 is faulty (Figure 11.1) | Replace harness 8 |
| | Block MC1 is faulty | Replace block MC1 |

| Malfunction | Probable Cause | Elimination method |
|---|---|---|
| When the complex is turned on, the message “FAILURE” is displayed on the indicator of the PUDL block. After testing* by the subscriber of the complex equipment, information about the failure of the MS1 unit is displayed on the PUDL indicator. The LAN2 indicator on the MSVKU unit does not blink. Subscribers do not have radio communication through the radio station R -16825U2 | Software failure | Turn off the complex by setting AZR RADIOOB. to the off position and turn it on again after a time of at least 5 s, setting the AZR RADIOOB. to the on position |
| | Poor contact in the LAN connector on the MS1 block or in the LAN2 connector on the MSVKU block | Restore contact in connector |
| | Harness 8 is faulty (Figure 11.1) | Replace harness 8 |
| | Block MC1 is faulty | Replace block MC1 |
| | MSVKU unit is faulty | Replace the MSVKU unit |
| When the complex is turned on, the message “FAILURE” is displayed on the indicator of the PUDL block. After testing* by the subscriber of the complex equipment, the PUDL indicator displays information about the failure of the MS1, TKOM, BShM, PUN, MSVKU, and 450B units. The LAN2 indicator on the BShM unit does not blink. The commander lacks all types of communications | Software failure | Turn off the complex by setting AZR RADIOOB. to the off position and turn it on again after a time of at least 5 s, setting the AZR RADIOOB. to the on position |
| | Poor contact in the LAN2 connector on the BShM unit or in the LAN connector on the PUDL | Restore contact in connector |
| | Harness 12 is faulty (Figure 11.1) | Replace harness 12 |
| | PUDL unit is faulty | Replace PUDL block |
| | BShM unit is faulty | Replace the BShM block |
| When the complex is turned on, the message “FAILURE” is displayed on the indicator of the PUDL block. After testing* by the subscriber of the complex equipment, information about the failure of the PUN unit is displayed on the PUDL indicator. The LAN4 indicator on the BShM unit does not blink. The gunner lacks all types of communications | Software failure | Turn off the complex by setting AZR RADIOOB. to the off position and turn it on again after a time of at least 5 s, setting the AZR RADIOOB. to the on position |
| | Poor contact in the LAN connector on the PUN block or in the LAN4 connector on the BShM block | Restore contact in connector |
| | Harness 13 is faulty (Figure 11.1) | Replace harness 13 |
| | PUN unit is faulty | Replace the PUN block |
| | BShM unit is faulty | Replace the BShM block |
| When the complex is turned on, the message “FAILURE” is displayed on the indicator of the PUDL block. After testing* by the subscriber of the complex equipment, information about the failure of the MSVKU and MS1 blocks is displayed on the PUDL indicator. The LAN1 indicator on the BShM unit does not blink. The LAN3 indicators on the MSVKU unit do not blink. All subscribers have no radio communication via radio station R -16825U2 | Software failure | Turn off the complex by setting AZR RADIOOB. to the off position and turn it on again after a time of at least 5 s, setting the AZR RADIOOB. to the on position |
| | Poor contact in the LAN1 connector on the BShM block or in the LAN3 connector on the MSVKU block | Restore contact in connector |
| | Harness 7 is faulty (Figure 11.1) | Replace harness 7 |
| | BShM unit is faulty | Replace the BShM block |
| | MSVKU unit is faulty | Replace the MSVKU unit |
| When the complex is turned on, the message “FAILURE” is displayed on the indicator of the PUDL block. After testing* by the subscriber of the complex equipment, information about the failure of the MSVKU and MS1 blocks is displayed on the PUDL indicator. The LAN2 indicator on the MSVKU unit does not blink. All subscribers have no radio communication via radio station R -16825U2 | Software failure | Turn off the complex by setting AZR RADIOOB. to the off position and turn it on again after a time of at least 5 s, setting the AZR RADIOOB. to the on position |
| | Poor contact in the LAN2 connector on the MSVKU block or in the LAN connector on the MS1 block | Restore contact in connector |
| | Harness 8 is faulty (Figure 11.1) | Replace harness 8 |
| | MSVKU unit is faulty | Replace the MSVKU unit |
| | Block MC1 is faulty | Replace block MC1 |
| The PUDL unit does not respond to button presses or there is no indication corresponding to the operating mode | Software failure | Turn off the complex by setting AZR RADIOOB. to the off position and turn it on again after a time of at least 5 s, setting the AZR RADIOOB. to the on position |
| | PUDL unit is faulty | Replace PUDL block |
| The PUN unit does not respond to button presses or there is no indication corresponding to the operating mode | Software failure | Turn off the complex by setting AZR RADIOOB. to the off position and turn it on again after a time of at least 5 s, setting the AZR RADIOOB. to the on position |
| | PUN unit is faulty | Replace the PUN block |

| Malfunction | Probable Cause | Elimination method |
|---|---|---|
| The message “SOFTWARE ERROR” is displayed on the indicator of the PUDL block | Software failure | Turn off the complex by setting AZR RADIOOB. to the off position and turn it on again after a time of at least 5 s, setting the AZR RADIOOB. to the on position |
| 16825U2 radio station from the PUDL unit- | Software failure | Turn off the complex by setting AZR RADIOOB. to the off position and turn it on again after a time of at least 5 s, setting the AZR RADIOOB. to the on position |
| | Poor contact in connector PC1 (not controlled by PP1 of the radio station), or in connector RS2 (not controlled by PP2 of the radio station) on the MS1 block, or in connector C2 on the VUFUS -25 block of the radio station | Restore contact in connector |
| | Harness 5 is faulty (Figure 11.1) | Replace harness 5 |
| | Block MC1 is faulty | Replace block MC1 |
| | Radio station is faulty | Replace radio station |
| 168MRA radio station from the PUDL unit- | Software failure | Turn off the complex by setting AZR RADIOOB. to the off position and turn it on again after a time of at least 5 s, setting the AZR RADIOOB. to the on position |
| | Poor contact in the LAN1 connector on the MSVKU block, or in the LAN1, LAN2 connectors on the VKU block of the radio station, or in the LAN connector on the PRMD block of the radio station | Restore contact in connector |
| | Harness 9 is faulty (Figure 11.1) | Replace harness 9 |
| | Harness 15 is faulty (Figure 11.1) | Replace harness 15 |
| | MSVKU unit is faulty | Replace the MSVKU unit |
| | Radio station is faulty | Replace radio station |
| The commander completely or partially (subscribers hear him, he does not, or vice versa) lacks internal and external communication | Poor contact in the MTG1 connector on the PUDL block | Restore contact in connector |
| | The commander's MT10M device is faulty | Replace the MT10M device) |
| | The commander's headset is faulty | Replace the headset |
| | PUDL unit is faulty | Replace PUDL block |
| The gunner completely or partially (subscribers hear him, he doesn’t, or vice versa) lacks internal and external communication | Poor contact in the MTG1 connector on the PUN block | Restore contact in connector |
| | Gunner's MT10M device is faulty | Replace the MT10M device |
| | Gunner's headset is faulty | Replace the headset |
| | PUN unit is faulty | Replace the PUN block |
| The driver has no internal or external communication at all; the PIT indicator on the MSNC(2) unit does not light up | Poor contact in the MTG2 connector on the PUN block or in the Sh2, Sh6 connectors on VKU-1 or in the LF connector on the MSNCh(2) block | Restore contact in connector |
| | Harness 18 is faulty (Figure 11.1) | Replace harness 18 |
| | Harness 22 is faulty (Figure 11.1) | Replace harness 22 |
| | MSNC unit(2) is faulty | Replace MSNC unit(2) |
| | PUN unit is faulty | Replace the PUN block |
| The driver completely or partially (subscribers hear him, he doesn’t, or vice versa) has no internal or external communication; the PIT indicator on the MSNC(2) unit lights up | Poor contact in the MTG1 connector on the MSNC unit (2) | Restore contact in connector |
| | The driver's MT10M device is faulty | Replace the MT10M device |
| | The driver's headset is faulty | Replace the headset |
| | Poor contact in the MTG2 connector on the PUN block or in the Sh2, Sh6 connectors on VKU-1 or in the LF connector on the MSNCh(2) block | Restore contact in connector |
| | Harness 18 is faulty (Figure 11.1) | Replace harness 18 |
| | Harness 22 is faulty (Figure 11.1) | Replace harness 22 |
| | MSNC unit(2) is faulty | Replace MSNC unit(2) |
| | PUN unit is faulty | Replace the PUN block |

| Malfunction | Probable Cause | Elimination method |
|---|---|---|
| A subscriber organizing external radio communication using the radio station R -16825U2 does not have the ability to access transmission | The subscriber's MT10M device is faulty | Replace the MT10M device |
| The subscriber (except for the subscriber connected to the KDA) using his MT10M device does not have the ability to organize internal circular communication | The subscriber's MT10M device is faulty | Replace the MT10M device |
| The subscriber connected to the KDA does not have an internal connection | Poor contact in the KDA connector or in the MTG3 connector on the MSNCh unit (1) | Restore contact in connector |
| | Harness 21 is faulty (Figure 11.1) | Replace harness 21 |
| | MSNC unit(1) is faulty | Replace MSNC unit(1) |
| The quality of the crew's internal communications has deteriorated (subscribers hear interference, crackling, "breaking" of speech, unauthorized changes in volume) | Presence of moisture and dirt in the KDA connector of harness 21 (Figure 11.1) | Clean connector |
| * The procedure for testing the equipment of the complex is set out in the operating manual for AVSKU ITNYA.468369.048-36 RE, attached to the tank.<br>** The procedure for replacing units of the AVSKU complex (PUDL, PUN, MS1, TKOM, BShM and MSVKU) is set out in the operating manual at AVSKU ITNYA.468369.048-36 RE, attached to the tank. | | |

### 7.5.2.4 Possible malfunctions of the 450B product

Possible malfunctions of the 450B product and instructions for eliminating them are given in Table 39.

Table 39

| Malfunction | Probable Cause | Elimination method |
|---|---|---|
| When AZR RADIOOB is turned on. the POWER and EMERGENCY indicators on the 450B product do not light up | There is no contact in the PIT connector on the 450B product or in the VS1 connector on the TKOM unit | Restore contact in connector |
| | Harness 17 is damaged (Figure 11.1, sheet 1) | Replace harness 17 |
| There is no connection between the 450B product and the AVSKU complex; the VS1 indicators on the TKOM unit and LAN3 on the BShM unit do not blink. | No contact in connectors:<br>- VVS1 on the TKOM unit;<br>- OOD or APD on product 450B;<br>- LAN3 on the BShM block | Restore contact in connector |
| | Harness 17 is damaged (Figure 11.1, sheet 1) | Replace harness 17 |
| | Harness 11 is damaged (Figure 11.1 sheet 1) | Replace harness 11 |
| | Product 450B is faulty | Replace product 450B |
| No data is transmitted through the 450B product, while the EMERGENCY indicator is not lit, and the POWER indicator is blinking green (standard indication) | Key information has not been entered into the memory of the 450B product | Enter key information into the memory of the 450B product |
| | Product 450B is faulty | Replace product 450B |
| On the 450B product the EMERGENCY indicator is constantly lit red | Product 450B is faulty | Replace product 450B |

### 7.5.3 Possible malfunctions of the orientation system

Possible CO malfunctions and methods for eliminating them are given in Table 40.

Table 40

| Malfunction | Possible reasons | Instructions for identifying faults and damage | Instructions for eliminating faults and damage |
|---|---|---|---|
| The orientation system does not turn on | Harness 25 is faulty<br>Harness 28 faulty | Ring harness 25<br>Ring harness 28 | Replace harness 25<br>Replace harness 28 |

| Malfunction | Possible reasons | Instructions for identifying faults and damage | Instructions for eliminating faults and damage |
|---|---|---|---|
| Computer failure | The computer is faulty | Check the failure message in the “CO Management/Operational Review Data/Status” mode | Replace the computer. After replacement, check the equipment according to clause 2.4.3.3 AYUIZH.462414.059 RE |
| No exchange with SSGKKU | The computer is faulty | Check the failure message in the “CO Management/Operational Review Data/Status” mode | Replace the computer.<br>After replacement, check the equipment according to clause 2.4.3.3 AYUIZH.462414.059 RE |
| | SSGKKU faulty | Check the failure message in the “CO Management/Operational Review Data/Status” mode | Replace SSGKKU<br>After replacement, check the equipment according to clause 2.4.3.1 AYUIZh.462414.059 RE |
| SSGKKU refusal | Harness 25 faulty | Ring harness 25 | Replace harness 25 |
| | Harness 27 faulty | Ring harness 27 | Replace harness 27 |
| | SSGKKU faulty | Check the failure message in the “CO Management/Operational Review Data/Status” mode | Replace SSGKKU.<br>After replacement, check the equipment according to clause 2.4.3.1 AYUIZh.462414.059 RE |
| No frame rotation | SSGKKU faulty | Check the failure message in the “CO Management/Operational Review Data/Status” mode | Replace SSGKKU.<br>After replacement, check the equipment according to clause 2.4.3.1 AYUIZh.462414.059 RE |
| ASN failure | ASN is faulty | Check the failure message in the “CO Management/Operational Review Data/Status” mode | Replace ASN.<br>Check the equipment according to clause 2.4.3.4 AYUIZH.462414.059 RE |
| | Harness 23 faulty | Ring harness 23 | Replace harness 23 |
| | RF cable 30 faulty | Ring HF cable 30 | Replace HF cable 30 |
| | HF cable 31 is faulty | Ring HF cable 31 | Replace HF cable 31 |
| No exchange with ASN | The computer is faulty | Check the failure message in the “CO Management/Operational Review Data/Status” mode | Replace the computer.<br>After replacement, check the equipment according to clause 2.4.3.3 AYUIZH.462414.059 RE |
| | ASN is faulty | Check the failure message in the “CO Management/Operational Review Data/Status” mode | Replace ASN.<br>Check the equipment according to clause 2.4.3.4 AYUIZH.462414.059 RE |
| When moving, the current coordinates do not change | Harness 28 faulty | Ring harness 28 | Replace harness 28 |
| | DSMU faulty | Check the DSMU fastening | Replace DSMU.<br>After replacement, check the equipment according to clause 2.4.3.2 AYUIZh.462414.059 RE |
| | Harness 25 faulty | Ring harness 25 | Replace harness 25 |

## 7.6 Power point

### 7.6.1 Possible malfunctions of the power plant and ways to eliminate them

Possible malfunctions of the power plant and methods for eliminating them are given in Table 41.

Table 41

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| Engine won't start | Fuel does not enter the engine cylinders: | |
| | - presence of air in the fuel supply system; | Bleed air from the system.<br>If after this the engine does not start, it is necessary to remove air from the high-pressure pump and fine filters, to do this, unscrew the plugs on the fuel flow pipe from the high-pressure pump and filters, pump the fuel through the BCP or RPM |

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| | - fuel filters or pipelines are clogged (ice may form in winter); | Wash the fuel filters, replacing the filter packs of the fine filters and blow out the pipelines (if plugs form, warm up the pipelines or filters without using an open flame) |
| | - the float valve of the fuel supply system is clogged | Check the valve for cleanliness. If it is clogged, disassemble it, wash it and blow it out |
| | The engine does not develop a starting speed of the crankshaft: | |
| | - the starter-generator develops insufficient rotation speed; | Check the charge level of the batteries and recharge if necessary. |
| | - insufficient compressed air pressure in the air system; | Check the air pressure in the cylinders. If the pressure is less than 75 $кгс/см^2$, start the engine using the starter or a combined method. |
| | - oil has not been pumped out from the transmission units | Warm up the engine with a heater |
| The engine starts, but after the first revolutions it stops | Presence of air in the fuel supply system | Bleed air from the fuel supply system |
| | Engine fuel priming pump does not supply fuel | Unscrew the plug on the fine fuel filter cover and, turning the engine crankshaft with an air starter or starter, check the fuel supply.<br>If the engine fuel priming pump does not supply fuel, replace it |
| The engine crankshaft does not turn with the starter-generator | The TOW START switch on the driver's panel is turned on | Set the TOW START switch to the OFF position. |
| | There is no oil in the hydraulic system tank of the transmission unit (oil was pumped from the tank to the input gearbox during previous unsuccessful attempts to start the engine). | Check that the system is completely filled, if necessary, fill the tank with oil, after draining it from the input gearbox and gearbox, or start the engine with air. |
| | The tug's MZN pump is faulty | Replace the pump |
| | The starter-generator does not rotate: | |
| | Failure of the starter-generator | Replace starter - generator |
| | Failure of ballasts | Replace ballasts |
| Insufficient oil pressure in the engine lubrication system | Air leak in the oil intake line | Check the tightness of the oil line connection from the tank to the pump and eliminate the leakage |
| | MAF oil filter clogged | Wash the MAF oil filter or replace the slot sections |
| | Pressure receiver faulty | Replace pressure receiver |
| No or reduced oil consumption | Fuel enters the engine crankcase through the oil seal of the engine fuel priming pump. Symptom - fuel leaking from the control hole | Replace engine fuel priming pump |
| | Fuel leaking from a faulty injector into the engine crankcase. | Replace the injector. It is recommended to install an injector of the same hydraulic resistance group as the injector removed from the engine.<br>The hydraulic resistance group number is indicated on the nozzle body. Tighten the injector mounting nuts with a torque wrench from the tank's group spare parts kit. Tightening torque from 30 to 35 Nm (from 3 to 3.5 kgf m) |
| | Cracks in injector nozzles | |
| | Leaks along the cones of the high-pressure pipes on the side of the cylinder heads | Tighten the fittings of the high pressure pipes with a wrench with a shoulder length of 200 mm |
| Exhaust gas penetration | Cracks in exhaust manifolds | Replace exhaust manifolds |
| | Exhaust gases leaking through exhaust manifold gaskets | Tighten the nuts securing the exhaust manifold flanges. If the defect is not eliminated, replace the gaskets. Replace the gaskets as a complete set. In the event of a break in the additional stud securing the outer flanges of the exhaust manifolds, operation of the engine without this stud is permitted |

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| | Punching of gases at the joint between the block head and the cylinder jacket.<br>Signs:<br>- when idling at low speed, a whistle or popping sound is heard;<br>- oil leaks and the presence of soot in the place of gas penetration | Determine where the gases are leaking.<br>The engine needs to be repaired |
| | Punching of gases through gaskets at the joint between the flange of the gas line to the turbocharger and the flange of the exhaust manifold or exhaust pipe on the turbocharger | Tighten the bolts and nuts securing the clamps and lock them. If the defect is not eliminated, replace the gaskets |
| The engine does not develop full power | Malfunction of fuel pump drive adjustment | Adjust the drive according to paragraph 5.8.11.5of this manual |
| | The injectors are faulty. To determine faulty injectors, it is necessary to sequentially turn off one injector at a time at a minimum stable idle speed by loosening the pressure fitting.<br>When a working injector is turned off, the engine speed decreases.<br>When a faulty injector is turned off, the rotation speed does not change | Replace faulty injectors |
| | The coarse or fine fuel filter is clogged | Wash the coarse fuel filter or replace the fine filter elements |
| | The fuel supply advance angle is off | Check the fuel supply advance angle and, if necessary, restore it, following the instructions in the engine operating manual |
| | Insufficient air pressure into the engine cylinders | Check the tightness of the connections of the pipelines from the turbocharger to the intake manifolds |
| The engine smokes | Air cleaner clogged | Service the air purifier |
| | Injectors are leaking: the nozzle needle is stuck or stuck | Replace faulty injectors |
| | Turbocharger faulty, no boost | Replace engine |
| The engine is knocking | Given a heavy load without preheating the engine | Warm up the engine |
| | Faulty injectors | Replace faulty injectors |
| | Presence of air in the fuel supply system | Bleed the system |
| | Fuel pump faulty | Replace engine |
| The engine is running wild | The high pressure fuel pump rack is stuck.<br>Symptom - the engine develops a rotation speed greater than the maximum permissible | Close the fuel distribution valve and load the engine as much as possible (shift into high gear, brake the tank). Replace engine |
| High coolant temperature (coolant temperature quickly reaches and exceeds the permissible value specified in Table 1 of this manual) | Exit blinds closed | Open the blinds |
| | Insufficient amount of coolant in the cooling system | Determine the cause of the loss of coolant and eliminate the problem.<br>Top up the cooling system with coolant |
| | Engine overloaded | Change to a lower gear and increase the crankshaft speed |
| | The water pump is faulty or the water pump spring is damaged | Replace a damaged spring or faulty water pump |
| | Radiators clogged | Clean radiators |
| | The thermometer receiver is faulty | Replace thermometer receiver |
| High outlet oil temperature (oil temperature quickly reaches and exceeds the maximum permissible) | Engine overloaded | Switch to a lower gear and reduce the crankshaft speed |
| | Insufficient amount of oil in the engine lubrication system | Refill the engine lubrication system |
| | The thermometer receiver is faulty | Replace thermometer receiver |
| | Oil radiators clogged | Clean radiators |

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| No deposits in the MC-1 rotor | Rotor nozzles clogged | Clean the nozzle holes with soft (copper or aluminum) wire with a diameter of no more than 1.8 mm and blow with compressed air |
| Presence of coolant in the engine lubrication system | Coolant entering the oil from the engine cooling system | Find out the reasons for coolant getting into the oil. Depending on the reason, replace the engine or eliminate the defect. After replacing the engine or eliminating the cause, change the oil in the engine lubrication system, rinse the MAF and MC filters |
| | Coolant entering the oil through the water pump seal | Replace the water pump. Change the oil in the lubrication system, wash the MAF and MC filters |
| The heater does not start: | Air entering the heater fuel pump | Bleed the air from the pump and pump it using the tank's fuel priming pump - electric or RNM. |
| | One or both glow plugs have burned out, with the corresponding information displayed on the DCM display | Replace spark plug |
| | The bypass valve is clogged | Flush the valve |
| | Nozzle clogged | Clean the nozzle |
| | The fuel valve of the heater is faulty, with the corresponding information displayed on the DKMV display | Replace valve |
| | The capacitive sensor is faulty, with the corresponding information displayed on the DKMV display | Replace capacitive sensor |
| Slow heating of the power plant with a heater | Poor fuel spray from the injector (white smoke coming out) | Clean the nozzle |
| | There are large deposits of incomplete combustion products on the walls of the heat exchanger (black smoke comes out) | Remove carbon deposits from the walls of the heat exchanger with compressed air using the device located in the group spare parts kit for the tank. |
| Presence of water in fuel system tanks | Filling tanks with water-flooded fuel | Carry out work in accordance with clause 5.8.8.3of this manual |
| The PVV system does not work: | One or both spark plugs have burned out | Replace the spark plugs from the tank's group spare parts kit |
| | Spark plug power supply circuits are faulty | Fix the problem |
| | The spark plug in the tee is loose | Warm up the engine with a heater |
| An engine using PVV cannot be started:<br>- when the crankshaft is cranked, the intake manifolds at the points of connection with the compressor tee do not heat up | The batteries are discharged more than normal | Charge the battery |
| | Air is not supplied to the heater: | |
| | - air cylinders are closed; | Open air tanks |
| | - electric air valve EK-48 does not work | Turn on the electro-pneumatic valve using a mechanical drive when cranking the crankshaft with the starter and keep it turned on for 2 minutes.<br>Replace the valve from the tank group spare parts kit |
| | The PVV heater valve is faulty | Replace the valve from the engine spare parts or warm up the engine with a heater |
| Damage to external fuel tank | | Turn off the external tanks using the tap. Replace the tank and turn on the external tanks with a tap. Test the system for leaks |

### 7.7 Transmission installation

#### 7.7.1 Possible malfunctions of the transmission unit and ways to eliminate them

Possible malfunctions of the transmission unit and methods for eliminating them are indicated in Table 42.

Table 42

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| Lubricant oil pressure is less than 1.5 кгс/см$^2$) (tank is moving) | Not enough oil in the system | Check that the hydraulic system is completely filled, following paragraph 2.3.10of this manual. If necessary, refill to normal, following paragraph 2.3.11of this manual. |
| | Pressure receiver faulty | Replace receiver |
| | Improper adjustment of the lubrication spool in the valve device | Adjust the lubricant pressure in the valve device, following paragraph 5.8.10.7of this manual |
| There is no oil pressure on the lubricant (the tank is moving) | Pressure receiver faulty | Check the receiver, replace if necessary |
| | Break in the wires connecting the pressure receiver to the indicator | Eliminate break |
| | Improper adjustment of the lubrication spool in the valve device | Adjust the lubricant pressure in the valve device, following paragraph 5.8.10.7of this manual. If this fails, replace the valve device. Check and, if necessary, wash the filter of the pumping line, following paragraph 5.8.10.3of this manual |
| No oil pressure on the lubricant (tank does not move) | Not enough oil in the system | Check that the hydraulic system is completely filled, following paragraph 2.3.10of this manual. If necessary, refill to normal levels, guided by paragraph 2.3.12of this manual. |
| | Sticking of the pumping spool in the valve device | Measure the gearbox control pressure, guided by paragraph 5.8.10.7of this manual. If the pressure is less than normal, check the operation of the pumping valve. To do this, remove the plug securing the pumping spool and the return spring. Determine by hand whether there is axial movement of the spool. If necessary, eliminate the cause of the spool valve jamming. If the jamming cannot be eliminated, replace the valve device. Wash the filter of the pumping line |
| | One of the pumps is not working | Pump out the oil following paragraph 5.8.10.1of this manual. Drain the oil from the input gearbox and gearbox housings. If the housing of the input gearbox or one of the gearboxes is full of oil, replace the bilge pump on this unit |
| | The injection pump does not work | Remove the left gearbox and replace the charge pump |
| When the OIL PUMPING FROM Gearbox switch is turned on, the pressure on the lubricant does not drop to zero. Oil from the system is not pumped into the tank | AZR B1 on the driver's panel is turned off | Enable AZR |
| | Broken wires to the pumping solenoid on the valve device | Eliminate break |
| | The electromagnet of the pumping spool in the valve device is faulty | Replace valve device or solenoid |
| | Sticking of the oil pumping spool in the valve device | Eliminate the jamming of the spool, and then rinse the filter of the pump-out line. If the jamming cannot be eliminated, replace the valve device |
| When changing gears, the tank jerks to the side | Clutch drive adjustment is incorrect (gearbox engagement is not synchronized) | Check and restore the clutch drive adjustment, guided by paragraph 5.8.11.3 of this manual |
| When changing gears there are jerks, the engine is heavily loaded or stalls | The adjustment of the gear shift drive is broken, the arrows of the distribution mechanisms do not coincide with the marks on the dials | Check and restore the adjustment of the gear shift drive, guided by paragraph 5.8.11.6of this manual |
| When moving the steering control lever to the final position, the tank turns poorly | The rotation drive adjustment is broken | Check and restore the adjustment of the rotation drive, guided by paragraph 5.8.11.8of this manual |
| When the parking brake pedal is depressed, the tank brakes ineffectively | The adjustment of the stopping brake drive is disrupted due to wear of the friction disks of the $F_4$ and $F_{5\ clutches}$ | Restore the adjustment of the stopping brake drive, guided by paragraph 5.8.11.4of this manual |

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| When you press the fuel pedal (the brake button is pressed), the brake indicator on the TV remains on | The sensor on the fuel pedal does not work | Clean the hinge and the gaps under the moving pedal platform from dust and dirt and make sure the sensor is activated |
| When the brake button is released, the brake indicator on the TV is on, and the brake pedal is stuck in the forward position | Failure to operate electric air valves EK-48 | Replace two electric air valves EK-48 of the braking device with new ones from the single and group spare parts kits of the tank |
| When the parking brake pedal is installed on the latch, it is possible to engage first gear or reverse gear | The selector lock cable is stretched out | Shorten the cable using the adjusting fork |
| When the tank is moving in fifth, sixth, seventh gears and the engine speed is more than 1600 rpm, the EM-30 electromagnet on the gear selector does not turn on | The electromagnet EM-30 is faulty<br>The malfunction is diagnosed by the DCMV and the corresponding frame is issued. | Replace electromagnet |
| | Broken power wires of the electromagnet EM-30<br>The malfunction is diagnosed by the DCMV and the corresponding frame is issued. | Fix the problem |
| | The speed sensor in the left guide wheel is faulty | Replace speed sensor |
| When the steering control lever is returned to its original position, and when moving in a straight line, the tank moves to the side | The adjustment of the rotation drive or clutch is incorrect | Check and restore the adjustment of the rotation drive, guided by paragraph 5.8.11.8of this manual, or the clutch, guided by paragraph 5.8.11.3 of this manual |
| The gear shift lever has stopped in an intermediate position and cannot be returned to the comb locking groove | Shift mechanism jammed during automatic gear shift system operation | Disable the AMS mode with the toggle switch on the selector, unscrew the four screws securing the electric motor to the switching mechanism housing, move the electric motor to the side, turning the worm with a screwdriver, return the shift lever to the fixing groove of the comb and install the electric motor in place, turn on the AMS mode |
| The fan does not rotate when the engine is running and when the coolant temperature is more than 90 °C, the message " COOLING SYSTEM FAN DRIVE FAILURE " is displayed on the DKMV APU. | 1 The forced fan shut-off valve is turned out | Stop the engine and open the roof over the transmission unit. Loosen nut 11 (Figure 3.7) and screw stop 10 clockwise until it stops. Tighten nut 11 |
| | 2 The rotation of the cooling system fan is blocked by foreign objects (dirt, sand, ice, etc.) | Stop the engine and open the roof over the transmission unit. Free the fan from foreign objects, ensuring its free rotation |
| | 3 Fan speed sensor circuit failure | Fix the problem |
| | 4 Failure of the fan control spool box | Replace the spool box |
| | 4 Fan drive fluid coupling failure | Replace input gearbox |

### 7.8 Dynamic protection complex

#### 7.8.1 Possible KDZ malfunctions and methods for eliminating them

During operation and storage of the EDS, the following malfunctions may occur:

– damage to the EDS body;

– chipping of ceresin from the gaps between the lid and the cuvette;

– damage to the paintwork of the body.

EDS that have received dents in the cuvette bottom and lid with a depth of less than 3 mm during operation are subject to further use.

EDS that have received damage to the ceresin layer in the gap between the lid and the cuvette during operation or storage are subject to repair and further use.

EDS that have received damage to the paint coating during operation or storage with an area of less than 5% of the total area of the element are subject to repair and further operation.

Repairs are carried out indoors at normal temperatures from plus 15 to plus 35 °C.

#### 7.8.2 Paintwork repair

If there is ceresin on the surface of the EDZ in the area of damage to the paintwork, it is removed with a wooden rod and then wiped.

The surface of the damaged paint coating is cleaned with sandpaper until there is a smooth transition from the main coating to the surface to be repaired.

The cleaning area is degreased with white spirit.

Places of damage to the paintwork are restored according to the following scheme:

– one layer of primer VL-02 GOST 12707-77, drying time at normal temperature 15 minutes;

– two layers of enamel EP-51 GOST 9640-85, drying time at normal temperature for the first layer from 20 to 30 minutes, for the second layer from 1.5 to 2 hours.

Damaged areas of paintwork with a base coat of XB-518 enamel are restored with PVB-12 varnish with the addition of 2% brilliant green dye in two layers, the drying time of each layer at normal temperature is from 10 to 12 minutes.

EDS with paint and varnish coating restored in accordance with this manual are suitable for further use.

#### 7.8.3 Repair of the ceresin layer in the gaps between parts

EDZ to be repaired is placed horizontally, with the marking facing up.

Ceresin crumbled during operation, peeled off from the walls and bottom of the gaps between the lid and the cuvette, is removed with a wooden rod.

To carry out repairs, ceresin grade 80 or 75 is heated to a temperature of plus 90 ° C, molten ceresin is poured into the gaps between the parts of the product body. It is allowed for ceresin to get on the surface of the product.

After the ceresin has cooled, the EDS are suitable for further use.

### 7.9 Chassis

#### 7.9.1 Removing and replacing the track in the caterpillar

To remove or replace a track you must:

– when moving the tank, place the marked track on the inclined branch of the caterpillar under the drive wheel so that it is fourth from the track located under the sixth road wheel;

– disconnect the track in accordance with paragraph 7.9.2of this manual, without removing it from the drive wheel;

– unscrew the bolts securing the brackets, ridges with shoes, remove them and remove the track;

– connect the track in accordance with paragraph 7.9.2of this manual.

When replacing the track, additionally do the following:

– install a new track, turning it 15 °upwards relative to the adjacent one using a device for connecting the caterpillar;

– install brackets with wedges and combs with shoes;

– tighten the bracket fastening bolts with a torque from 450 to 500 N ·m (from 45 to 50 kgf ·m), the shoe fastening bolts with ridges with a torque of 750 to 800 N ·m (from 75 to 80 kgf ·m);

– bend the bolt flanges in accordance with Figure 5.11 after connecting the track.

#### 7.9.2 Track replacement

To remove the caterpillar you must:

– raise the side flaps;

– loosen the track tension;

– unscrew the bolts securing the brackets and the bolt securing the ridge with the shoe between the two tracks located on the inclined section of the track under the drive wheel;

– dismantle the connecting brackets with a puller for the track bracket and wrench 148.91.181sb from a single spare parts kit for the tank. Remove the comb with the shoe;

– Moving forward in 1st gear, smoothly tighten the track branch and continue moving until the front roller reaches the edge of the track.

To put on the caterpillar you need:

– spread the caterpillar in front of the tank;

– in first gear, smoothly drive over the caterpillar, adjusting it with a crowbar, until the rear track roller rests on the fourth track, then, to prevent rolling and make connection easier, place spare tracks between the second and third, fifth and sixth track rollers;

– brake the tank and stop the engine;

– install the stopping brake pedal on the latch;

– fasten the hook of the cable 1 (Figure 5.12) to pull the caterpillar by the middle of the track pin, wind the other end around the hub of the drive wheel 2 at the limit disk on the side of the bead, making three or four turns;

– start the engine, set the minimum stable speed of the engine crankshaft, remove the stopping brake pedal from the latch and, holding it with your foot, depress the clutch pedal;

– engage reverse gear, move the turning lever opposite to the side where the caterpillar is put on to the final position (towards you);

– at the command of the observer, smoothly release first the brake pedal, then the clutch pedal and pull the upper branch of the caterpillar until the first three or four tracks engage with the drive wheel. Use a crowbar to guide the put-on end of the caterpillar onto the support rollers. Pull the free end of the cable during rotation of the drive wheel to create the necessary friction force between the cable and the hub of the drive wheel;

– When the fourth pair of track brackets engages with the teeth of the drive wheel, sharply depress the brake pedal and, without stopping the engine, press the clutch pedal. If necessary, additionally, just before the end of pulling the track, press the braking button on the left turn lever;

– turn off the gear, release the clutch pedal and put the stopping brake pedal on the latch;

– secure the fourth track to the drive wheel using clamp 1 (Figure 5.13);

– remove the cable by disconnecting it from the drive wheel and track;

– set the engine crankshaft speed in the range from 1000 to 1200 rpm using a manual drive;

– remove the stopping brake pedal from the latch and, holding it, depress the clutch pedal, engage reverse gear and move the turning lever opposite to the side where the track is put on to the final position (towards you);

– smoothly releasing the clutch pedal and, holding the stopping brake pedal, tighten the upper branch of the track as much as possible. Brake the drive wheel by sharply pressing the stopping brake pedal all the way and, without stopping the engine, press the clutch pedal;

– turn off the gear, release the clutch pedal, put the stopping brake pedal on the latch, stop the engine;

– install staples on the ends of the fingers on the outer and inner sides of the track, while leveling the ends of the track using a crowbar and a sledgehammer;

– install the comb with the shoe;

– At the junction of the track, clean holes M (Figure 5.3) and plate B of adjacent tracks from dirt. If ACBs are installed on the tracks to be connected, dismantle them;

– install device 2 (Figure 5.13) to connect the track from the outside. Tighten nuts 3 to ensure a tight fit of the device to the plate;

– install the wedge into the bracket from the outside of the track, while dimension A before installing the bolt should be no more than 4 mm. The working surfaces of the wedge and flat L (Figure 5.3) of the caterpillar fingers must be clean. Screw the bolt into the wedge;

– tighten the bracket bolt with a torque of 450–500 N ·m (45 to 50 kgf ·m) using torque attachment 4 (Figure 5.11) and adapter 8 with internal hexagon S24;

– tighten the bolt securing the comb with the shoe to a torque of 750 to 800 N ·m (75 to 80 kgf ·m) using torque attachment 4 and adapter 2 with an internal hexagon S32;

– dismantle the device for connecting the track from the outside, install it on the tracks from the inside of the track;

– Install a wedge on the inside of the track and tighten it with a bolt. Dismantle the device for connecting the track, remove the clamp. Install ACB if they were dismantled before connecting the track;

– On the finally tightened bolts 1, bend the flanges using the adapter 6 and a hammer;

– remove the brake pedal from the latch and release it, remove the tracks from under the rollers, if necessary, start the engine and move the tank to release the tracks;

– adjust the track tension in accordance with paragraph 3.11.1of this manual. Replace the second caterpillar in a similar way.

### 7.9.3 Replacement of drive wheels and replacement of crowns

To swap drive wheels you must:

– install the tank on a flat and, if possible, solid area;

– loosen the tension of the tracks and disconnect them under the drive wheels, to prevent the tank from rolling, place one track on each side under any rollers except the sixth ones;

– release the drive wheels from the upper branches of the tracks, clean the hubs and plugs from dirt. Place the stopping brake pedal on the latch;

– Unscrew the bolts securing the toothed washer, remove it, use the key located in the group spare parts kit for the tank, and unscrew the plug securing the drive wheel;

– press out the outer cone using the device located in the tank's group spare parts kit and remove the drive wheel;

– remove the second drive wheel in a similar way;

– clean the driven shafts of the final drives from dirt and corrosion products and wipe dry;

– clean the labyrinths of the drive wheels and final drives from dirt and fill the grooves with lubricant used for the chassis.

Replace the drive wheels complete with cones in the following order:

– install an internal cone on the shaft, lubricate the final drive shaft splines with lubricant used for the chassis;

– install the drive wheel and outer cone. Install the cones dry and clean; lubrication on the surfaces of the cones adjacent to the drive wheel hub and shaft is not allowed;

– install the toothed washer on the pins of a special key to the drive wheel plug;

– Screw in the plug and tighten it to a torque of 4000 to 4500 N ·m (400 to 450 kgf ·m) (with a force of three people on the shoulder of 2 m), when tightening, make sure that the holes for the bolts in the toothed washer coincide with the holes in the hub of the drive wheel. If the holes do not match, turn the plug in the direction of screwing;

– install the toothed washer and tighten the bolts securing the washer;

– install the second drive wheel in a similar way;

– connect the tracks, remove the tracks from under the rollers and tension the tracks to normal.

To replace the drive wheel rims you must:

– remove the drive wheels;

– Unscrew the nuts securing the rims using an S32 wrench (from the group kit of spare parts for the tank) and remove the rims;

– clean the seating surfaces on wheel rims and new rims from corrosion products and dirt;

– install new crowns, while the base teeth should be located one against the other, the base tooth has a distinctive mark - tide in the tooth recess;

– fix the rims by replacing damaged bolts, washers and nuts;

– tighten the nuts to a torque of 540 to 600 N ·m (54 to 60 kgf ·m);

– for tightening, use the S32 key, located in the tank's group spare parts kit, and a crowbar;

– install the drive wheels in place;

– connect the tracks and tension them to normal.

### 7.9.4 Replacing the bushings of the hydraulic shock absorber levers

The procedure for replacing bushings:

– Unscrew the bolts securing the covers, remove the rod and bushings of the upper and lower hinges;

– install new hinge bushings;

– install the rod in such a way as to ensure maximum clearance between the rod rod and the balancer (the requirement is ensured by rotating the rod around its longitudinal axis);

– install the cover and bolts of the upper hinge;

– install the washer, cover and lower hinge bolts, while the washer should be installed so that its radius part (without the flat) is directed towards the nose of the tank;

– tighten the bolts of the upper and lower hinges with the wrench provided in the group spare parts kit for the tank;

– rivet the threads of the lower hinge bolts through the holes in the washer with a special rod (located in the group spare parts kit for the tank).

In the assembled unit, the rod should have lateral play.

### 7.9.5 Replacing the track roller

#### 7.9.5.1 Hanging the track roller

To replace the track roller, it is necessary to hang it above the ground or track ridges (so that they do not interfere with the removal of the roller) in one of two ways:

– collision of the replaced roller with a previously prepared pit with the track disconnected;

– using a device for removing and installing the track roller without disconnecting the track (removal and installation is provided on all suspensions except the 6th -right).

To install the track roller replacement tool without disconnecting the track, you must:

– place the tank on a level (visually) and, if possible, solid area, stop the engine and install the stopping brake pedal on the latch;

– install grip 5 on the balancer of the roller being removed (Figure 5.14) so that pin 6 enters the blind hole on the back side of the balancer, press the grip to the balancer and secure it in this position with bolts 1 (on the 1st, 2nd and 6th suspensions, the grip is on the balancer do not install).

**ATTENTION:**

**BEFORE INSTALLING THE DEVICE, IT IS NECESSARY TO THOROUGHLY CLEAN THE BALANCER FROM DIRT AT THE LOCATION WHERE THE GRIP IS INSTALLED, PAYING SPECIAL ATTENTION TO THE CLEANLINESS OF THE BLIND HOLE ON THE BACK OF THE BALANCER AND THE STAMPINGS ON THE BODY OF THE BALANCER!**

– install the lower stop 3 with pad 4 on the fourth or fifth brackets, and, compressing the spring, rest the upper stop 2 against pin 6 (for 1, 2 and 6 suspensions - against the lower head of the hydraulic shock absorber rod);

– by moving the tank forward, hang the support roller above the ridges of the lower branch of the caterpillar;

– brake the tank and stop the engine - the track roller is ready for replacement;

– if the ridges of the upper branch of the caterpillar interfere with the removal of the roller, install a hydraulic jack (available in the MTO -80) on the support roller located nearby and lift the upper branch of the caterpillar - the support roller is prepared for replacement;

– after replacing the roller, remove the hydraulic jack (if installed), remove the stops, the grip from the balancer and the lining.

#### 7.9.5.2 Removing and installing the road wheel

To remove the support roller you must:

– Unscrew the bolts securing the track roller cover, remove the cover with the sealing gasket;

– cut off the cotter pin with a chisel and a wrench located in the tank's group spare parts kit, unscrew the nut securing the road wheel;

– remove the support roller.

To install the support roller you need:

– secure the roller cover with one bolt to the hub (to prevent the ball bearing from falling out);

– install the cuffs and the roller bearing ring on the axis of the support roller with the polished end facing the rollers;

– install the support roller;

– screw the support roller fastening nut all the way and secure it with a cotter pin;

– Attach the cover to the track roller hub with bolts and spring washers, installing an auto-sealant gasket or a sealing gasket covered with white on both sides under it. Do not screw bolts into the lubrication holes;

– fill the support roller with lubricant and screw the bolts with spring washers into the lubrication holes.

N o t e - Track rollers marked “REINFORCEMENT.” on the hub of the outer disk of the roller, install on the 1st and 6th suspensions. If necessary, track rollers with these marks can be installed on 2nd, 3rd, 4th and 5th suspensions.

## 7.10 Tank electrical equipment

### 7.10.1 Possible malfunctions of sensors, actuators and ways to eliminate them

Possible malfunctions of sensors, actuators and methods for eliminating them are given in Table 43.

Table 43

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| When the battery switch is on and the engine is running, there is no oil pressure reading or it is at maximum values | Pressure sensor faulty | Replace pressure sensor |
| There is no tachometer reading when the engine is running | Tachometer sensor is faulty | Replace tachometer sensor |
| When the tank is moving, there are no speedometer readings | AZR V5 is turned off | Eliminate the malfunction in the AZR B5 circuit, turn on the AZR B5 |
| | Speed sensor faulty | Replace speed sensor |
| | Breakage of the flexible drive shaft of the speed sensor gearbox | Replace flexible shaft |
| Speedometer readings are unstable | Poor contact of wires at the sensor | Fix the problem |
| If there is no fuel in the tanks, the fuel meter readings are more than 50 liters | Reducing the insulation resistance of fuel meters | Remove the meter and wash it in gasoline. If the defect is not eliminated, replace the meter |
| If there is fuel in the tanks, the fuel meter readings differ from the actual amount by more than 50 liters | Lack of contact in electrical connectors, break in power wires | Tighten electrical connectors. If the defect has not been eliminated, you need to check for a break in the power wire. Eliminate faults |
| | Fuel meter faulty | Replace meter |
| A message indicating a failure of the sensor or actuator circuit is displayed on the driver's APU | Broken or shorted wires, incorrect connection or malfunction of this sensor or actuator | Repair the fault in the sensor or actuator circuit.<br>Replace sensor or actuator |

### 7.10.2 Possible malfunctions in the circuits of the engine starting system and power supply to consumers and ways to eliminate them

Possible malfunctions of the starting system and power supply to consumers and methods for eliminating them are given in Table 44.

Table 44

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| No charging current | The 600 A fuse on the battery protection unit has blown | Replace fuse |

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| | | |
| | Lost contact in connecting wires | Fix the problem |
| | Failure of connection between the starter-generator and the battery | Check the reliability of contact connections and eliminate any detected defects |
| | The fuse in the relay regulator has blown | Replace fuse |
| | The relay regulator is faulty | Replace the relay regulator |
| | The starter generator does not work | Replace starter-generator |
| When the STARTER button is pressed, the starter-generator does not work | The fastening of the wires at the terminals of the starter-generator, BCS or battery unit is loose | Tighten the fastening |
| | STARTER button is faulty | Replace button |
| | Self-shutdown of AZR V19 due to a short circuit in the starter circuit | Eliminate the short circuit and turn on AZR B19 |
| | BKS unit is faulty | Replace the BKS block |
| | BSU unit is faulty | Replace the BSU block |
| | The D-20 sensors on the input gearbox are faulty | Replace sensors |
| When you press the STARTER button, the rotation speed of the starter-generator armature increases to the maximum | The D-20 sensors on the input gearbox are faulty | Replace sensors |

### 7.10.3 Possible malfunctions of a diesel generator set and ways to eliminate them

Possible malfunctions of the diesel generator set and methods for eliminating them are given in table 45 .

Table 45

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| The engine does not start | Fuel does not enter the engine cylinders: | |
| | - presence of air in the fuel supply system; | Bleed air from the fuel supply system by operating the fuel electric pump of the diesel generator set for 20 to 30 s before the subsequent engine start (the pump is turned on by turning the AZR to the ON position) |
| | - fuel filters or pipelines are clogged (ice may form in winter) | Replace the fuel filter, following paragraph 5.8.15.5of this manual and blow out the pipelines (in case of blockages, warm the pipelines without using an open flame) |
| The engine starts, but after the first revolutions it stops | Presence of air in the fuel supply system | Bleed air from the fuel supply system by operating the fuel electric pump of the diesel generator set for 20 to 30 s before the subsequent engine start (the pump is turned on by turning the AZR to the ON position) |
| The engine does not develop full power | Malfunction of fuel pump drive adjustment | Carry out repairs at a service center |
| | Fuel filter clogged | Replace the fuel filter, following paragraph 5.8.15.5of this manual |
| | Air filter clogged | Replace the air filter, following paragraph 5.8.15.4of this manual |

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| High coolant temperature | Insufficient amount of coolant in the cooling system | Determine the cause of the loss of coolant and eliminate the problem.<br>Top up the cooling system with coolant |
| | Radiator clogged | Clean the radiator according to paragraph 5.8.15.7of this manual |
| | The cooling fan on the radiator does not work | Repair the fault in the circuit.<br>Replace fan |
| The engine does not start at low ambient temperatures | Faulty glow plugs | Replace glow plugs |
| | Broken or shorted wires in the power supply circuit of the glow plugs or oil heater | Repair the fault in the circuit |
| | Oil heater faulty | Replace oil heater |
| Lack of charging current (according to information from DKMV) | Broken drive belt | Replace the belt in the SG drive |
| | The 400 A fuse on the battery protection unit has blown | Replace fuse |
| | Lost contact in connecting wires | Fix the problem |
| | Failure of connection between the starter-generator and the battery | Check the reliability of contact connections, eliminate any detected defects |
| | The fuse in the relay regulator has blown | Replace fuse |
| | The jumper in the B-200 diode circuit has burned out (in the connection box) | Replace safety jumper |
| | The relay regulator is faulty | Replace the relay regulator |
| | The starter-generator does not work | Replace starter-generator |

## 7.11 Surveillance equipment

### 7.11.1 Possible malfunctions of strategic offensive weapons and ways to eliminate them

The list of malfunctions in the operation of START television cameras and methods for eliminating them are given in Table 46.

Table 46

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| There is no video image on the APU | The electrical contact is broken in the electrical connectors of the cables connecting the television cameras, KVI and APU | Check electrical connectors, restore contacts |
| Cloudy protective glass or cloudy image on the APU | The presence of moisture on the glass in the frame or on the lens inside the camera | Replace the drying cartridge from the single START spare parts kit (the availability of a spare drying cartridge depends on the type of camera supplied as part of the system) or replace the television camera |
| | Matting and scratches on the outside of the framed glass | Replace the glass in the frame with a new one from the single spare parts for the SNV (the availability of spare glass in the frame depends on the type of camera supplied as part of the system) or replace the television camera |

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| | In winter, the presence of frost means the heating of the television camera does not work | Replace the television camera. |

### 7.11.2 Possible malfunctions of the rear view camera and how to eliminate them

A list of malfunctions in the operation of the television camera and methods for eliminating them are given in Table 47.

Table 47

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| There is no image on the APU screen after pressing the VIDEO button on the driver's panel | The protective cover of the television camera did not open: | |
| | - insufficient pressure in the air system of the tank | Open the valves of the air system cylinders or eliminate the malfunction of the air system |
| | - dirt getting into the pneumatic cylinder of the protective cover drive, damage to the pneumatic drive parts | Disassemble the pneumatic cylinder, wash the parts in gasoline, coat them with CIATIM-201 GOST 6267-74 lubricant, fill the annular groove on the piston with the same lubricant.<br>If necessary, replace the wiper, sealing rings on the piston and damaged parts with new ones from the group spare parts kit for the tank |
| | - the camera harness is damaged | Replace harness |
| | - malfunctions of the electrical equipment of the tank hull | Troubleshoot |
| | Loss of transparency of the outer lens glass: | |
| | - presence of moisture on the outer glass of the lens inside the camera | Replace the TVKT-65N chamber drying cartridge with a new one from a single set of spare parts television cameras.<br>Replace the TV camera TKV-1-65 |
| | - matting and scratches on the outer lens glass | Replace the outer glass of the TVKT-65N camera with a new one from a single set of spare parts for the TV camera.<br>Replace the TV camera TKV-1-65 |
| | - camera malfunction | Replace the camera |

### 7.11.3 Possible malfunctions of the TVN-5 device and ways to eliminate them

Possible malfunctions and methods for eliminating them in the TVN-5 device are given in Table 48.

Table 48

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| When the device is turned on and the aperture is open, the yellow-green background glow is not visible | AZR is turned off on the driver's control panel | Enable AZR |
| | There is no contact between the socket and the plug of the electrical connector | Hand tighten the union nut of the electrical connector |
| | Poor contact in the appliance switch | Turn the DIAPHRAGM knob multiple times (3 or 4 times) to turn on the device.<br>If it does not turn on, send the device for repair. |
| | The device is faulty | Send the device for repair |

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| The image in the device is dim and unclear | The eyepiece lens or prism is dirty | Clean contaminated surfaces with a clean flannel cloth. |
| | The prism fogged up | Turn on prism heating |
| | Burnt out bulbs in headlights | Replace lamps |
| | Mismatch between the optical axes of the headlight and the device | Match the axes of the headlight and the device |
| Installation of the device is not provided | Shock absorbers destroyed | Install new shock absorbers from the group spare parts kit for the tank |
| The head prism of the device is destroyed or severely damaged | | Install a new upper prism housing from the group spare parts kit for the tank, while connecting the plug and socket of the prism heating cable.<br>After replacing the housing, check the operation of the prism heating |
| N o t e - In case of malfunctions that cannot be eliminated using the above methods, the TVN-5 device should be sent for repair. | | |

### 7.12 Thermoelectric air conditioner

#### 7.12.1 Possible air conditioner malfunctions and ways to eliminate them

Possible CHP malfunctions and methods for eliminating them are given in Table 49.

Table 49

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| When the KHP is turned on, the green signal LED 9 (Figure 13.2) on the CP does not light up. KHP operates and supplies cooled air | LED burned out | Replace the LED from a single set of spare parts for the tank |
| When the KHP is turned on, the green signal LED 9 (Figure 13.2) on the BO does not light up, the KHP does not work | AZR COND is turned off. | Enable AZR COND. |
| | The auto-return thermostat has failed | Replace BO |
| When the KHP is turned on, signal LED 12 lights up (Figure 13.2) “Emergency state” | Electric fluid pump does not work | Check the serviceability of the electric liquid pump |
| | | Check the contacts in the electrical connector of the electric liquid pump and correct the fault. |
| | | Check the continuity of the electric fluid pump fuse on the control unit |
| | | Replace Electric Fluid Pump |
| | The heat dissipation radiator fans do not work | Check the serviceability of the heat removal radiator fans |
| | | Check the contacts in the electrical connector of the heat rejection radiator fans and eliminate the fault |
| | | Check the integrity of the fuses on the control unit |
| | | Replace the faulty heat release radiator fan |
| When the CHP is turned on, LED 10 lights up (Figure 13.2) “Minimum coolant level” | Coolant level is below acceptable | Fix the leak in the KHP cooling system, fill with coolant according to the recommendations of clause 5.8.20.1of this manual |
| CHP is on but does not provide effective cooling | KHP supply voltage is less than permissible | Measure voltages, troubleshoot |
| | The heat release radiator does not work effectively | Clean the heat release radiator from dust and dirt |

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| KHP is on, but there is no supply of cooled air | BO electric fan fuse blown | Replace fuse |
| | The electric cooling air fan does not work | Check the contacts in the electrical connector for connecting the BO. Fix the problem |
| | | Replace BO |

### 7.13 Air system

#### 7.13.1 Possible malfunctions of the air system and ways to eliminate them

Possible malfunctions of the power plant and methods for eliminating them are given in table 50.

Table 50

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| The pressure in the air system rises above 165 kgs / cm$^2$ | Long interruption in operation of the pressure machine | With the engine running, close the cylinder valves, let the pressure switch operate three to five times, bleeding air through the gas pumping system in AIR mode |
| | The air pressure gauge is faulty | Replace pressure gauge |
| The pressure in the system when the compressor is running does not rise above 120 *kgs/cm*$^2$ or when the pressure is from 120 to 160 *kgs/cm*$^2$ the compressor idle mode does not turn on | Air leakage in the air system piping connections and compressor piping | Check for air leaks by hearing or moistening with soap suds. If necessary, tighten connections |
| | Pressure switch malfunction:<br>- foreign particles entering under the valves;<br>- violation of regulations | Check the operation of the pressure automatic to fill the cylinders.<br>The switch-on pressure of the machine must be at least 120 *kgs/cm*$^2$, the switch-off pressure - from 135 to 160 *kgs/cm*$^2$.<br>If the parameters do not match, blow out or rinse the pressure switch.<br>If necessary, replace the pressure switch |
| The automatic sludge drain valve is activated when the compressor fills the air cylinders or constantly poisons the air | The fuel priming pump is faulty. The pressure in the engine fuel supply system is less than permissible | Fix the malfunction of the fuel priming pump |
| | Valve seal wear | Replace valve |
| The automatic sludge drain valve does not operate after stopping the engine | When the engine was stopped, the compressor was idling. | Using the driver's GPO system, set the pressure in the air system to 100 *kgs/cm*$^2$, start the engine and stop it after 30 to 40 seconds. The valve should work |
| | Foreign particles entering the valve cavity | Open the roof with radiators over the transmission.<br>Remove the valve, disassemble, wash all parts in diesel fuel, dry, lubricate the rubber sealing rings on the piston with CIATIM-201 GOST 6267-74 grease, fill the annular groove between them with the same grease, assemble the valve and install it in place |

## 7.14 Fire-fighting equipment

### 7.14.1 Possible malfunctions of the software system and ways to eliminate them

Possible malfunctions of the software system and methods for eliminating them are given in Table 51.

Table 51

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| When the battery switch is turned on, the inscriptions 1B, 2B, 3B, 4B on the P13 remote control do not light up | The circuits of the squibs of the fire extinguishing aerosol cylinders (electric igniters of fire extinguishing aerosol generators) are faulty or there is no pressure in the cylinders | Check the presence and serviceability of the squibs, the charge of the fire extinguishing aerosol cylinders and the serviceability of the circuit to the electric igniters of the fire extinguishing aerosol generators. Eliminate detected deficiencies |
| | The 2 A or 10 A fuse on the P13 control panel has blown | Replace fuse 2 A or 10 A |
| | Burnt out lamps | Replace lamps |
| When you press the CHECK button, the inscriptions SO or ZO on the P13 remote control do not light up | Lamp burned out | Replace lamp |
| | Block B13-1S is faulty | Replace block B13-1S |
| When you press the CHECK button on the P13 remote control, the time from 15 to 25 seconds for the PO inscription to burn and from 30 to 50 s for the 30 sign to burn is not maintained. | Block B13-1S is faulty | Replace block B13-1S |
| When you press the CHECK button on the P13 remote control, the inscriptions PO, ZO light up, but the light alarm is not emitted | Broken wires between block B13-1S and DKMV | Check the serviceability of the wires, repair if necessary |
| When checking one of the temperature sensors in the power compartment using the KPK13 device, the sign ZO does not light up on the P13 control panel | Dirty thermocouple junctions | Check the condition of the thermocouples, if necessary, clean the temperature sensors from dirt and dust with a soft hair or nylon brush |
| | Broken thermocouple junctions (temperature sensor faulty) | Check the condition of the thermocouples, replace the temperature sensor if necessary |
| When checking one of the optical sensors of the habitable compartment with the KPK13 device, the software inscription on the P13 remote control does not light up | The optical sensor is faulty. | Replace optical sensor |
| | Broken wires to the optical sensor | Check the serviceability of the wires, repair if necessary |
| When checking the temperature sensor with the KPK13 device, the fuse burns out | Short circuit in the temperature sensor circuit | Check the temperature sensor wires for short circuits between the wires. Eliminate short circuit. |
| When checking the temperature sensor with the KPK13 device, the word 30 lights up on the P13 remote control immediately after pressing the CONTROL button | The thermocouple junctions of the temperature sensor are closed to the housing | Eliminate short circuit of thermocouples to the housing. |

## 7.15 Defense system against weapons of mass destruction

### 7.15.1 Possible malfunctions of the WMD protection system and ways to eliminate them

Possible malfunctions and methods for eliminating them are given in Table 52.

Table 52

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| No indicator lights on the measuring panel | The 4 A and 5 A fuses on the measuring panel have blown | Replace the fuses using the spare parts kit -01A of the PKUZ1A complex |

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| The input rotameter of the sensor is not illuminated | Lamp burned out | Open the PDF compartment cover, check the lamp, replace if necessary |
| It is impossible to adjust the flow rate of pumped air using the input rotameter | Tube 5 (Figure 16.4) or air exhaust tube (rubber tube in a spring braid connecting the sensor to the cyclone) is pinched. | Correct the tubes |
| | The cyclone holes are clogged or the sensor microsupercharger is faulty | Set the valve handle of the input rotameter to the SET position. ZERO (horizontal position), disconnect the air exhaust tube from fitting 4 (Figure 16.4) of the sensor, while:<br>- if the rotameter float has risen, then the cyclone must be cleared of blockages<br>- if the rotameter float does not rise after disconnecting the tube, replace the PKUZ-1A complex |
| | The filter elements under cover 3 (Figure 16.4) of the sensor are dusty | Replace filter elements |
| When checking the functionality or during operation of the PKUZ-1A complex, the flashing symbols “NRCh”, “NA”, “NOB”, “NB2” or “ROM” are turned on (repeatedly) on the digital indicator of the measuring console | “NRF” - circuit “P” in block B-1 is faulty | Replace the PKUZ -1A complex |
| | “HA” - circuit “A” in block B-1 is faulty | Replace the PKUZ -1A complex |
| | “NOB” - lack of contact at the connection point of the heating tube or breakage of the heater in the heating tube or cyclone | Check the contact at the heating tube connection points<br>Replace the heating tube or PKUZ -1A complex |
| | “NB2” - circuit “O” in block B-2 is faulty.<br>Poor contact in one of the cable's electrical connectors.<br>Break inside the cable | Replace the PKUZ -1A complex.<br>Check that the electrical connector sockets and plugs are securely connected.<br>Replace cable |
| | “ROM” - block B-1 is faulty | Replace the PKUZ -1A complex |
| When switching the FVU valve to filter ventilation mode, the F lamp on the P13 remote control does not light up | Lamp burned out | Replace lamp |
| | The contact on the FVU valve box is broken | Clean the contact from dirt or adjust its position using the fastening bolts |
| | There are foreign objects under the valve | Clear the valve of foreign objects |
| When checking the support, the ball does not move to the upper position | The pressure gauge tube is dirty | Replace sub-pressure meter |
| | The supercharger valve protection screen is clogged with dirt or foreign objects | Clear grid |
| | The plug is not installed on any hull or turret hatch | Install the plug |
| The supercharger is not started by the SUPERCHARGER - EL switch. DESCENT | Air system pressure less than $40 кгс/см^2$ | Charge the air system cylinders. Turn the battery switch off and on |
| | AZR SUPERCHARGER CONTROL on the driver's panel is turned off (AZR handle is pressed against the protective bar and is not fixed in the extreme on position) | Remove the protective strip and turn on the AZR. Turn the battery switch off and on. Check the operation of the supercharger and install the protective strip in place |
| | The KUV11-6-1S box is faulty | Replace box |
| | Electric air valve EK-48 is faulty | Replace electric air valve EK-48 |
| | The booster of the supercharger valve drive is faulty | Replace booster |
| The blower does not start or stop with the SUPERCHARGER - EL switch. DESCENT | AZR EL is turned off. DESCENT on the right or left tower switchboard | Enable AZR |

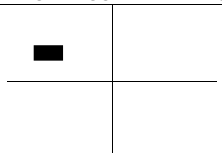
| Malfunction | Probable Cause | Remedy |
|---|---|---|
| The blower is not started by the manual backup drive | The AZR SUPERCHARGER on the driver's panel is turned off (the AZR handle is pressed against the protective bar and is not fixed in the extreme on position) | Remove the protective strip and turn on the AZR. Check the operation of the supercharger and install the protective strip |
| | The switch in the manual drive is faulty | Replace the switch |
| The tape drive mechanism of the sensor does not provide a change of PDF frames when turning knob 4 (Figure 16.7) all the way | PDF delay in cassette 1 (Figure 16.7) | Open the lid and correct the PDF |
| | The tape transport mechanism is faulty | Replace the PKUZ -1A complex |

## 7.16 Curtain setting system

### 7.16.1 Possible malfunctions of the SPS and ways to eliminate them

Possible malfunctions and methods for eliminating them are outlined in Table 53.

Table 53

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| The protective glass of the head OR is dull or damaged | Battle Damage | Replace the protective glass |
| When you turn on the SDS (simultaneously with turning on the OMS) on the PMF or when checking the SDS in the “Control” mode, one of the messages is displayed: | | |
| - NO CONNECTION WITH SDR | AZR SDR is turned off | Enable AZR SDR |
| | The cables to the control unit are faulty | Repair cables |
| - SYSTEM DISABLED<br>The control unit is NOT ERRORABLE | The control unit is faulty | Replace control unit |
| - FAULT<br>IT IS NOT POSSIBLE TO RECEIVE INFORMATION ABOUT IRRADIATION | The control unit is faulty | Replace control unit |
|  <br>- IT IS NOT POSSIBLE TO RECEIVE INFORMATION ABOUT IRRADIATION | The SPR head is faulty (a flickering marker indicates a faulty head) | Replace head |
| | The cable connecting the control unit with the corresponding head is faulty | Repair cable |
| | The fuse link (P9 or P10) on the protection unit has burned out | Replace fuse link |
| - there is no sound signal in AVSKU | The control unit is faulty | Replace control unit |
| | The cable from the control unit to the AVSKU is faulty | Repair cable |
| - on the mnemonic diagram of the charge of launchers, instead of the corresponding number, the symbol “X” is shown | The corresponding launchers are not loaded. | Charge launchers. |
| | The cable from the corresponding launcher to the control unit is faulty | Repair the cable. |
| | The electric striker does not contact the grenade's electrocap sleeve | Discharge the launcher and use a banner to clean the contact and electric striker or remove foreign objects |
| | The control unit is faulty | Replace the control unit. |
| | The grenade's electrocapsule is faulty | Replace grenade |
| | Unreliable contact with the plate “C”-shaped spring on the electric striker | Disassemble the electrical contact assembly and bend the ends of the spring |
| When checking the functioning of the SPZ from the rangefinder, there is no sound alarm and corresponding information on the PMF | The irradiated head is faulty | Replace head |

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| Tight loading of the 902 system launcher with a grenade | The launcher barrel is dirty | Clean launcher |
| The locking ring does not secure the grenade in the launcher | The breech groove is dirty | Unscrew the pipe, remove the retaining ring and clean it and the breech groove with a rag soaked in fuel |
| | Retaining ring is deformed or broken | Disassemble the launcher and replace the retaining ring |

## 7.17 Smoke exhaust system

### 7.17.1 Possible malfunctions of the smoke exhaust system and ways to eliminate them

Possible malfunctions of the smoke exhaust system and methods for eliminating them are given in Table 54.

Table 54

| Malfunction | Probable Cause | Remedy |
|---|---|---|
| When the switch BCN-TDA and AZR TDA is turned on, no smoke is generated | BCN-TDA switch is faulty | Replace switch |
| | AZR TDA faulty | Replace AZR |
| | Solenoid valve MKT-17B does not work | Check the integrity and reliability of contact connections. If necessary, replace the solenoid valve |
| | The nozzle hole is dirty | Clean the hole through the exhaust pipe of the tank using a screwdriver with a diameter of 3.5-4 mm from the spare parts. |
| When the TDA is turned off, the formation of a smoke screen does not stop | Breakage of the return spring MKT-17B | Stop the engine. Replace valve MKT-17B |

## 7.18 Equipment for overcoming water obstacles

### 7.18.1 Possible malfunctions of OPVT and ways to eliminate them

Possible malfunctions of the OPVT and methods for eliminating them are given in Table 55.

Table 55

| Malfunction | Probable Cause | Elimination method |
|---|---|---|
| The sump pump does not work | WATER PUMP AZR or PUMP AZR on the driver's panel is faulty | Replace AZR |
| | Broken contacts in electrical connectors | Check the condition of the electrical connectors |
| | Broken or shorted electrical wiring | Detect an open or short circuit and repair it |
| | The pump is clogged | Remove the pump and clean it from dirt |
| | The filter is clogged | Clear filter |
| Exhaust valve plates do not fit tightly to seats | Shrinkage of springs | Replace springs |
| The sealing covers of the roofs above the power compartment do not close with locks | Significant deformation of covers during operation | Straighten or replace covers |
| Sealing covers are not thrown back by | Cover hinges are dirty | Blow out the hinges with compressed air |

| Malfunction | Probable Cause | Elimination method |
|---|---|---|
| torsion bars | | |

## 8 Tank storage

### 8.1 General provisions

Tank storage is a stage of operation in which tanks not used for their intended purpose are kept in specially designated areas in a given condition, where their preservation and safety are ensured for a specified period of time.

A tank that is not planned to be used for more than a month is subject to storage.

Tank storage includes:

– putting the tank into storage;

– keeping the tank in storage;

– removing the tank from storage.

Tanks in storage must be kept in specially equipped storage areas, which mean storage facilities, sheds and frame tents in open areas.

Tanks prepared for storage are placed on a hard floor (concrete, asphalt). In the absence of a hard covering on wooden or concrete beds. The tracks should be 1 m longer than the supporting surface of the tracks, and their width should be equal to or greater than the width of the track.

Storage conditions are determined by the environmental impact on the tank.

Protection of tank parts and assemblies during storage from corrosion, aging and biological damage is carried out using temporary protection means:

– workers or conservation fuels and lubricants;

– working or conservation fuels and lubricants with static or dynamic dehumidification of air in a sealed tank volume.

In this case, it is necessary to maintain a level of relative air humidity in the sealed volume of the tank from 30 to 60%, at which the processes of corrosion and aging of structural materials are inhibited or stopped.

Depending on the duration of the break in the use of the tank, two types of storage are established:

– short-term, if the use of tanks is not planned for a period of 1 month to 1 year;

– long-term, if the use of tanks is not planned for a period of 1 to 5 years.

Preparing a tank for long-term storage, servicing it during storage and removing it from storage should be carried out in accordance with the requirements set out in the manual (instructions) for the storage of armored weapons and equipment in force in the given region of operation.

This manual contains additional instructions for short-term storage, depending on the design of the tank.

### 8.2 Preparing the tank for short-term storage

To ventilate the habitable compartments when storing tanks in enclosed spaces, remove the prism observation devices of the driver, commander and gunner and place them on the VT flooring under the gun.

Upon completion of preparing the tank for storage, turn off all current consumers, the AZR on the battery protection unit and the battery switch.

When preparing the tank for short-term storage, perform maintenance TO-1 and additionally perform the following work.

#### 8.2.1 Preparing the hull, turret and seats

Check the operation of the roof lift mechanism over the transmission.

Make sure that the rubber seals on hatch covers, covers on outer boxes, plugs, and the roof over the power compartment are in good condition and, if necessary, replace the seals.

Clean, inspect and lubricate hinges, stops and locks of hatch covers, hinges and latch pins of tow hooks.

Fix the commander's and driver's seats in the upper position.

Secure the roof over the power compartment with bolts, close the hatch covers and plugs in the bottom of the hull, as well as the covers of the outer spare parts boxes.

If necessary, restore damaged paintwork.

#### 8.2.2 Preparing the power plant

When preparing the power plant, perform the following work:

– check the condition and tightness of pipeline connections and hose connections and the fastening of parts and assemblies of the engine and its servicing systems.

– check the condition of the sealing gaskets and rings under the filler and drain plugs of the fuel and oil tanks;

– check the condition and, if necessary, clean the basket of water and oil radiators;

– check the adjustment of the control drives of the power plant units and blinds;

– check the performance of the heater;

– prepare the engine for start-up, start it up, warm it up and check its operation in all modes.

Perform the following work on the fuel system:

– drain fuel from the fuel system;

– check the condition of pipelines, hose connections and their fastening, tighten loose clamps and fittings of hose connections (replace defective parts);

– wash the fuel coarse filter;

– wash the fine fuel filters within the time limits established by the operating instructions for the engine, but at least once every 5 years or when preparing the tank for storage again. When washing filters, replace the cardboard filter bags.

Perform the following work on the lubrication system:

– check the condition of pipelines, hose connections, tighten loose clamps and fittings of hose connections (replace defective parts);

– wash the oil filters of the engine lubrication system within the time limits established by this manual;

– replace the oil in the engine lubrication system if it has served the prescribed period, regardless of the engine operating time. When changing the oil, rinse the intake filter of the oil tank, following paragraph 5.8.6.5of this manual.

Perform the following work on the cooling system:

– check the serviceability of the cooling system and its operation in terms of coolant temperature (check simultaneously with checking engine operation);

– Check the serviceability and adjustment of the steam-air valve and its sealing gasket. In case of violation of the adjustment and corrosion of parts, disassemble the valve, clean, reassemble and check the adjustment again. If necessary, adjust the valve;

– flush the cooling system (after five years of operation of new tanks);

– check the tightness of the cooling system (after five years of operation of new tanks) with excess pressure $(3.2 \pm 0.1)$ $кгс/см^2$, using the PPGU device located in the maintenance vehicle, guided by the instructions set out in the subsection “Operation of the PPGU device” of the technical description and operating instructions (supplied with the maintenance machine);

– Fill the cooling system with low-freezing liquid. Set the coolant type setting in the DCMV accordingly.

Perform the following work on heating, heating and air supply systems:

– check the operation of the heater. Turn on and check the operation of the fighting compartment heater;

– check the serviceability of the PVV spark plugs.

Perform the following work on the air supply system:

– check the condition of the air purifier (visually, by inspecting the condition of the cassettes), if necessary, service it in accordance with the requirements set out in paragraph 5.8.9.1of this manual;

– check the reliability of the connection of the air cleaner with the air supply pipe, the air supply pipeline to the TKR compressor and the reliability of locking of the union nuts connecting the dust extraction pipes.

By air system:

– check the operation of air system units and devices with the engine running;

– check the tightness of pipelines and air system units. Eliminate air leaks;

– drain the sediment from the air system sump;

– re-inspect the cylinders once every 5 years.

### 8.2.3 Transmission preparation

When preparing the transmission you must:

– pump out the oil from the transmission units, guided by paragraph 5.8.10.1of this manual ;

– make sure there are no leaks from the hydraulic system connections of the transmission unit;

– wash the intake filters of the gearboxes, following paragraph 5.8.10.5;

– Replace the oil in the hydraulic system of the transmission unit if it has expired.

### 8.2.4 Preparing the chassis

When preparing the chassis, perform the following work:

Perform the following work on the tracks:

– check the serviceability of the tracks, correct assembly, reliability of fastening of brackets and shoes with ridges;

– check the track tension adjustment;

– paint the metal surfaces of the tracks with bitumen varnish BT-577 or black enamel.

Perform the following work on the support and support rollers, and guide wheels:

– check that there is no lubricant leakage through the labyrinth seals;

– Refill the support rollers, idler wheels, and support rollers with oil. Refuel each time the tank is prepared for storage;

– replace the oil in the support rollers if it has served the prescribed period, as well as after the warranty period for its use has expired;

– Wash the rubber tires of the road wheels with warm water.

Perform the following work on the drive wheels:

– check the serviceability of the drive wheels and wear of the teeth of their rims;

– Replace the crowns with wear exceeding the permissible value.

Perform the following work on the suspension system:

– check the serviceability and fastening of assemblies and parts of torsion shafts, balancers and hydraulic shock absorbers;

– Once a year, when preparing the tank for storage, lubricate the bushings of the balancer axles.

### 8.2.5 Weapons preparation

Perform the following work on the gun:

– remove dirt and moisture from the outer surfaces of the gun;

– clean the barrel bore using RChS solution, lubricate the barrel bore with GOI-54p grease, generously lubricate and wrap the front end of the barrel with paraffin paper, put a standard cover on it;

– remove the receiver and clean and lubricate the ejector device, seal the receiver with ZZK-3U putty;

– check and bring to normal the amount of fluid in the recoil brakes and in the knurl, the pressure in the knurl;

– Check the operation of the lifting mechanism, lubricate the sector teeth and gears. Tighten the gun trunnion mounting bolts;

– check the operation of the gun bolt when opening, closing and releasing the firing pin. Carry out partial disassembly of the shutter, cleaning and lubricating its parts;

– Using the device from the group spare parts kit for the gun, roll back the recoil parts of the gun to a length of 140 to 150 mm, clean and lubricate the rods of the recoil parts, check the fastening of the rods. Roll the sliding parts to their original position;

– generously lubricate all unpainted surfaces of the gun and wrap them in waxed paper;

– close the bolt wedge and release the firing pin;

– put the cover on the breech of the gun. Secure the gun in a traveling manner. Preserve spare parts.

On the gun, additionally carry out work in accordance with the technical description and operating instructions for the 2A46M.TO, 2A46M.TO1 gun.

Perform the following work on machine guns:

– remove and check the serviceability of machine guns (barrels, moving and fixed parts, mechanisms, parts) by external inspection. At the same time, pay special attention to the absence of corrosion products, dirt and nicks on the metal parts of machine guns;

– clean and lubricate machine guns, belt boxes and belts (if they are stored without ammunition);

– assemble machine guns, install them in their original places and secure them;

– cover the machine guns.

Perform the following work on the automatic loader:

– clean the bottom under the VT and check the condition of the AZ cassettes, following the instructions in paragraphs. 5.8.4.1and 5.8.4.2of this manual;

– check the operation of the automatic loader in all modes. Check operation in automatic mode only with a mock shot and in the absence of live shots in the VT;

– After checking the functioning, unload the torsion bar of the CBM frame, for which:

– turn off the AZR EL.DOWN, L.R.VT and AZ UPR. on the right switchboard;

– remove the cover on the CBM gearbox that covers the shank of the gearbox worm and, pressing the rod of the electromagnetic stopper, rotate the shank with a screwdriver until it rotates freely, move the frame away from the stop at a distance of 5 to 10 мм;

– put the cover back in place;

– install the locking lever of the cassette lifting mechanism onto the clamp;

– raise the gripper with the cassette using a manual drive to a height of 160 to 200 mm from the original position;

– Remove the stopper lever from the clamp.

Lubricate with a thin layer of GOI-54p lubricant all unpainted metal surfaces, including those with chemical and metal coatings, except for the gun stopper and the bushing for the stopper on the fence.

### 8.2.6 Ammunition preparation

Prepare the ammunition selected for loading into the tank for loading into the tank in accordance with paragraph 3.2.2.2of this manual.

Place and secure ammunition in ammunition racks after preparing the tank for storage.

### 8.2.7 Preparing the weapon stabilizer

When preparing the stabilizer, check:

– no oil leakage from the stabilizer hydraulic system;

– the oil level in the supply unit, if necessary, top up to normal, following paragraph 5.8.3.2of this manual;

– functioning of the stabilizer (guidance of the HV and GN drives) and the serviceability of the main interlocks of the HV drive (blocking of guidance when the driver’s mechanic’s hatch is open, blocking of guidance when the turret

is locked, blocking of guidance when the AVT-RUCH toggle switch is installed on the SLA and AZ control panel or on the loading console in the “ position RUCH").

Replace the oil in the hydraulic system if the stabilizer has worked for 500 hours or if the oil service life has expired (once every 10.5 years). The procedure for changing the oil is set out in paragraph 5.8.3.3of this manual.

Lubricate the piston rod and the mounting pin of the actuating cylinder with engine oil, and the axle of the actuating cylinder and the axes of the angle stop rollers with GOI-54p or CIATIM-201 lubricant.

### 8.2.8 Preparing the fire control system

Carry out an external inspection and check:

– the condition of the optical elements of the devices (protective glass, PNM eyepiece), their cleanliness and transparency (chips, cracks, scratches, deposits are not allowed). If necessary, clean the optical elements of the device with a cloth moistened with rectified alcohol or send the device for repair;

– condition of paint and varnish coatings. If necessary, restore the coating;

– reconciliation of the PNM and PKP, guided by paragraphs. 3.3.8.2.1and 3.3.8.3.1of this manual;

– functioning of sights. Check by turning it on, check that there are no error messages, check that the display is displayed correctly and that the field of view can be adjusted;

– the state of silica gel in desiccant absorbers and drying indicators PNM, including TPK-K, PKP and PDT, if necessary, replace moisture-saturated desiccant or drying indicators using single sets of spare parts for sights.

### 8.2.9 Preparing the air curtain system

When preparing the curtain installation system, you must:

– check the condition of the protective glasses, OR heads (cleanliness, absence of chips, cracks, scratches and deposits). If necessary, clean or replace glass;

– check the operation of the SPS in the “Control” mode;

– check the condition of the silica gel in the OR head housings. Replace if necessary;

– Clean the 902 system launchers and lubricate them with GOI-54p lubricant. Place plugs on the launcher pipes.

### 8.2.10 Preparation of a system for hydropneumatic cleaning of protective glasses of observation and aiming devices

Check the operation of the GPO system by turning it on. After checking the system, drain the water from the tanks and blow out the system 10 to 15 times with compressed air by pressing the corresponding switches at the crew members’ workplaces. Use a clean rag to remove water from glass and parts.

Charge the cylinders of the air system and the hydropneumatic cleaning system in the tower with compressed air to a pressure of 135 to 160 $кгс/см^2$.

### 8.2.11 Preparation of PTC

Check the functionality of the PTC in accordance with clause 3.5.1of this manual.

Perform the following work on UARMk:

– clean the components of the automated control system from dust and dirt;

– check the reliability of fastening of the ARMK components;

– check by external inspection the condition and reliability of the connection of connecting cables and grounding to the automated control unit;

Perform the following work on CO :

– clean the components of the CO from dust and contaminants;

– check the reliability of fastening of the components of the CO;

– check by external inspection the condition and reliability of the connection of connecting cables and groundings to the CO units;

Perform the following work according to the KSS:

– clean the components of the KSS from dust and dirt;

– check the reliability of fastening of the components of the KSS;

– check by external inspection the condition and reliability of the connection of connecting cables and grounding of the components of the KSS.

### 8.2.12 Preparation of observation devices

Carry out an external inspection of surveillance devices and check:

– the condition of the optical elements of the devices (protective glasses, prisms, eyepieces, lenses), their cleanliness and transparency (are there any chips, cracks, scratches and deposits). If necessary, clean the optical elements of the device or send the device for repair;

– condition of the sealing putty (no chipping) and paint coatings. If necessary, restore the paintwork and sealing putty; When wiping metal parts of devices or installation parts with lubricant, do not allow the lubricant to get on the surfaces of optical parts and sealing putty;

– consistency of the optical axis of the FG 125 headlight with the optical axis of the TVN-5 night vision device, guided by the instructions of clause 5.8.18.1of this manual;

– condition of the reflectors and infrared filter of the FG 125 headlight.

### 8.2.13 Preparation of START

Before storing strategic offensive weapons, it is necessary to carry out an external inspection of the set of video cameras on the tower, and check:

– condition of optical elements, paintwork. If necessary, clean the optical elements and restore the paintwork;

– state of silica gel in drying cartridges. It should be bluish-blue in color; if the color changes, replace the drying cartridges with cartridges from a single START spare parts kit (the presence of a single START spare parts kit depends on the type of chamber supplied as part of the system) or replace the chamber.

After checking, it is necessary to wipe the outer surfaces of the optical parts with a cotton swab moistened with rectified alcohol.

### 8.2.14 Preparing electrical equipment

**IT IS PROHIBITED TO PLACE NOT FULLY CHARGED BATTERIES FOR STORAGE**

When storing and servicing batteries, both installed in the tank and outside it, follow the operating instructions for these batteries.

When preparing electrical equipment for storage, you must:

– check the condition of the starter-generator, the reliability of the fastening of wires and leads, clean the starter-generator housing from dust;

– check the serviceability of internal and external lighting;

– check the presence of battery charging and the absence of information about malfunctions on the driver's APU;

– check the functionality of the traffic alarm.

### 8.2.15 Preparing a protection system against weapons of mass destruction

When preparing the WMD protection system for storage, it is necessary to check:

– lack of moisture in the cavity of the VZU glass of the PKUZ-1A instrument complex, for which remove the plug from the glass; After checking, replace the plug;

– closing the supercharger valves;

– on the B-2 sensor, on the frame counter scale, the presence of unused PDF frames; the number of unused frames must be at least 35. If necessary, replace the cassette.

Install rubber caps on the fittings of the air intake device of the PKUZ-1A instrument complex.

Turn the handle of the input rotameter valve on the B-2 sensor of the PKUZ-1A instrument complex to the vertical position until it stops, and turn the throttle handle for adjusting the air flow clockwise until it stops.

### 8.2.16 Preparing fire fighting equipment

When preparing a tank for storage, you must:

– check the charge of fire protection cylinders and hand-held fire extinguishers by control weighing. When weighing, the difference with the mass indicated on the stencil is allowed to be no more than 10 g, with the error of the mass measuring instrument not exceeding ±5 g. If the mass of the fire extinguisher cylinder does not correspond to that indicated on the stencil, it should be replaced. The results of weighing or the fact of replacing fire extinguisher cylinders should be entered into the tank's registration form;

– check that the OPVT-PPO switch on the P13 remote control is set to the PPO position.

### 8.2.17 Preparation of OPVT

When preparing a tank for storage, you need to check:

– check the completeness and condition of the OPVT parts;

– check the condition and fastening of the covers on the gun and PKT;

– check the condition of the seals on the turret hatches, the driver's hatch and the roofs over the power compartment;

– check the operation of the sump pump (by turning it on).

Removable OPVT units should be stored in their standard places of installation.

### 8.2.18 Preparation of KTE

Carry out work in the scope of maintenance No. 1.

### 8.2.19 Preparation of spare parts for the tank

Check the availability of spare parts, tools and accessories in the tank. If necessary, replenish the tank with spare parts, tools and accessories.

Apply a thin layer of lubricant to the unpainted metal surfaces of the spare parts (except electrical contact surfaces).

Check the condition and reliability of fastening of the spare parts boxes.

Check the condition of the belts, tarpaulins for covering the tank and fabric items. If necessary, repair tarpaulins and fabric products, wash and dry them. Repair or replace belts.

### 8.2.20 Preservation of components and assemblies

The following work needs to be done:

– Fill the left bow fuel tank with 90 to 100 liters of winter diesel fuel DT -Zminus 35 -with a sulfur content of up to 2000 mg/kg according to GOST 305 -2013 or Arctic diesel fuel of the DTA brand with a sulfur content of up to 2000 mg/kg according to GOST 305 -2013 with the addition (10±2)% of the additive AKOR-1 GOST 15171-78, start the engine and run for 8 to 10 minutes at a minimum stable crankshaft speed at idle with the BCP turned on and the air release valve open;

– fill the fuel supply route to the PVW heater, to do this, with the engine running, press the lever of the electric air valve EK-48 of the PVV system and hold it for 1.5 to 2 minutes;

– after stopping the engine, start the heater and operate for 10 to 15 minutes;

– preserve the engine in accordance with Appendix B;

– After completing engine conservation, refuel the fuel tanks to normal levels. If additional barrels are included in the fuel system, do not fill the left barrel to the required $45^{+5}$ liter. When the barrels are disconnected, do not fill the rear external fuel tank to the standard liter $20^{+5}$ ;

– set the fuel distribution valve to the TANK ON position and fill the fuel supply lines with a manual fuel priming pump;

– make sure that the handle for shutting off the external tanks is in the ON position;

– top up the engine lubrication system to normal and tightly tighten the filler cap of the additional oil tank;

– close the cylinder valves and relieve pressure in the system using the GPO system;

– wash and clean the mechanical locking lock of the gear selector, set the gear selector lever to the neutral position and remove the stopping brake pedal from the latch;

– remove the batteries, service them and install them in their original places in the tank.

## 8.3 Maintenance of tanks kept in short-term storage

For tanks kept in short-term storage, the following types of maintenance are established:

– control and technical inspection (KTO) - on park and park maintenance days (weekly maintenance);

– maintenance No. 1 (TO-1x) - once every 6 months or according to the results of technical maintenance;

– seasonal maintenance - twice a year when preparing tanks for summer and winter periods of operation;

– regulated maintenance (RTO) - after 10 years of storage.

### 8.3.1 List of works for types of maintenance of tanks kept in short-term storage

The list of types of maintenance work is given in Table 56.

Table 56

| Job title | Implementation instructions | Tools and operating materials |
|---|---|---|
| **Control and technical inspection (KTO)** | | |
| Carry out an external inspection of the tank and clean its parking area | | |
| Check for corrosion on the outer surface of the hull, turret, chassis | If necessary, remove corrosion products, replace preservative lubricant, restore damaged paint | |

| Job title | Implementation instructions | Tools and operating materials |
|---|---|---|
| Check the condition of the tarpaulin, covers and the reliability of their fastening | Breaks, cracks, punctures are not allowed | |
| In summer, in sunny weather, ventilate the internal volumes of the tank by opening the hatches of the hull and turret and the roof over the power compartment | | |
| Check that there are no leaks of fuel, oil or coolant from the engine systems | Check by external inspection the connections of units, components, hose connections, drain and filling plugs of tanks. Fix the leak, check the level if necessary and refill the system | Portable lamp, 27 mm handle key |
| Check the condition of the components and bolted connections of the chassis elements in accessible places | If necessary, remove corrosion products and replace the conservation lubricant.<br>If the fastening is loosened, tighten the bolts | |
| Check the absence of corrosion on the outer surfaces of parts, assemblies, assemblies, weapon mechanisms, communications equipment and equipment inside and outside the hull | If necessary, remove corrosion products, replace preservative lubricant, restore damaged paint. In winter, lubricate areas with damaged paint with preservative grease. | |
| Check the condition of the rubber gaskets and seals of the hatches of the hull, turret, spare parts | | |
| Check the water content of silica gel in the drying cartridges of devices and sights | The silica gel should be a bluish blue color. If the color of the silica gel changes or the glass fogs up, replace the drying cartridges. | |
| Check the voltage in the on-board network | The voltage must be at least 22.5 V | |
| **Maintenance TO-1x** | | |
| Before carrying out TO-1x, perform the work prescribed by the CTO and additionally: | | |
| Check the air pressure in the cylinders, the tightness of pipelines and air system units | Eliminate loose connections. If the air pressure is less than normal, recharge the cylinders. After checking, close the valves of the air cylinders and relieve pressure in the system using the GPO system | |
| Check for oil leaks, grease leaks through the labyrinth seals of the support rollers, support rollers and idler wheels, as well as leaks from the hydraulic shock absorbers | Oil may escape through the labyrinth seals of the supporting rollers in the form of separate drops | |
| Check that there are no fluid leaks from the gun recoil devices | It is allowed to carry out the working fluid in the form of separate drops. If a fluid leak is detected, check the recoil devices | In accordance with the instructions of 2A46M.TO |
| Check the oil level in the weapon stabilizer supply unit and make sure there are no leaks from the hydraulic system | The oil level indicator bar should be opposite the ambient temperature mark with a deviation of ±25 °C. Oil leakage through fixed joints is not allowed. The formation of an oil film on the rod of the actuator cylinder is allowed | Spare parts kit for weapon stabilizer, portable lamp, oil, rags. |
| Check the condition and level of coolant in the CHP | The coolant level in the expansion tank should be between the MAX-MIN marks. Coolant flow through the connections is not allowed | |
| Check the serviceability of the illuminators, the condition of day and night observation and aiming devices | Chips and cracks of prisms and mirrors are not allowed. Check the heating of the protective glasses of the instruments and the serviceability of the scale lighting by turning it on. Supply voltage from an external current source or from a battery tank | External current source |
| Check the operation of the electric triggers of the cannon and machine guns | Check by switching on. Supply voltage from an external current source or from a battery tank | External current source |

| Job title | Implementation instructions | Tools and operating materials |
|---|---|---|
| Check functionality:<br>- means of communication;<br>- stabilizer;<br>- IR devices;<br>- AZ from manual drives;<br>- instrument complex PKUZ-1A without issuing commands;<br>- PPO systems from the CHECK button;<br>- individual driver's fan;<br>- KHP;<br>- SDR built-in control | Check the functionality by turning it on, guided by this operating manual, and the voltage must be supplied from special power plants.<br>After checking the functionality of the PKUZ-1A instrument complex, set the valve handle to the OPERATION position and pump clean air from the surrounding atmosphere through the device for 2 hours | External current source with power quality in accordance with GOST B 21999-86 |
| Check the serviceability of traffic signal lamps, external and internal lighting lamps | Check serviceability by turning on and visually checking external and internal lighting | |
| Check the condition of spare parts and accessories for electrical and radio equipment | Replace electric lamps, squibs and fuses with oxidized contact surfaces. | |
| Check the condition of durite hoses and rubber products, as well as the condition of covers and tarpaulins | Drying, deep cracks, loss of elasticity are not allowed. If necessary, replace durite hoses and rubber products, repair tarpaulin products | |
| Maintain and charge batteries. (Connect the battery to a device for recharging with low currents, if they were kept in storage with recharging) | If any problems are found in the operation of the battery, carry out an extraordinary control and training cycle in accordance with the operating instructions for the batteries. | |

**ATTENTION:**

**RECONSTRUCTION OF THE TANK IS CARRIED OUT ANNUALLY, IF IT IS NOT PLANNED TO BE PUT INTO OPERATION THE NEXT YEAR!**

When re-preserving a tank, check:
– functioning of the fire control system in conjunction with a weapon stabilizer;
– functioning of the AZ;
– functioning of the system of protection against weapons of mass destruction;
– the condition of the sights, as well as the commander's, gunner's and driver's observation devices;
– condition of the OPVT kit parts.

### 8.3.2 Seasonal service

If possible, combine seasonal maintenance work (Table 57) with the next maintenance-1x.

Table 57

| Job title | Implementation instructions | Tools and operating materials |
|---|---|---|
| **Preparation for spring-summer operation** | | |
| Drain the low-freeze liquid, flush the engine cooling system and fill it with clean fresh water with a three-component additive | After filling the cooling system with water, change the value of the WATER - ANTIFREEZE setting in DCMV to WATER | Bucket, 27 mm handle wrench, drain nozzle connected to the hose used in the MZA-3 unit, three-component additive, water |
| Remove sediment from internal fuel tanks, replace winter diesel fuel with summer diesel fuel | | MZA-3 refueling unit, funnel bucket with mesh, fuel |
| Check the weight of PPO cylinders and manual halon fire extinguishers | Check by weighing the amount of fire extinguishing mixture in PPO system cylinders and hand-held fire extinguishers | |
| Clean the glass of the optical sensors of the PPO system from dirt | Wipe the glass with a flannel cloth | Flannel napkin |
| Lubricate all leather straps | Apply a thin layer of lubrication | Castor oil |

| Job title | Implementation instructions | Tools and operating materials |
|---|---|---|
| **Preparation for autumn-winter operation** | | |
| Drain the water from the engine cooling system, flush the system and fill with low-freezing liquid | After filling the cooling system with water, change the value of the WATER - ANTIFREEZE setting in DKMV to ANTIFREEZE | Bucket, handle wrench 27mm, drain nozzle connected to a hose used in the MZA-3 unit |
| Replace summer diesel fuel with winter diesel fuel | To extract remaining fuel from the lines, start the engine for a period of 10 to 15 minutes using the PVV system. With the engine running, turn on the AZR TDA on the driver's panel for a period of 5 to 10 s | Drain tip connected to the hose used in the MZA-3 unit |
| Check the serviceability of the engine heating system | Start the heater in single heating mode in accordance with clause 3.6.1 and let it operate for 3 to 5 minutes. During normal operation of the heater, an increase in the coolant temperature should be observed, the exhaust gases should be light gray or colorless, and no frames indicating a malfunction of the heater should be displayed on the driver's APU | External current source |

**ATTENTION:**

**IF THE ENGINE IS STARTED DURING SEASONAL WORK, IT IS NECESSARY TO PRESERVE IT!**

### 8.3.3 Scheduled Maintenance

Regulated maintenance should be carried out in accordance with Appendix D.

## 8.4 Removing a tank from storage

When removing a tank from storage for scheduled operation, it is necessary to carry out a control inspection, installing monitoring devices if they were removed for the storage period.

Before starting the engine after storage or long-term parking of the tank (more than one month), do not refill the engine lubrication system if there is oil in the refill tank. Check the oil level after starting and stopping the engine.

### 8.4.1 Removal of a tank from storage by alarm

When removing a tank from storage due to an alarm, it is recommended to carry out work to bring it into combat-ready condition in two stages.

At the first stage, carry out the work necessary to prepare the tank for leaving the park.

At the second stage, carry out work to prepare the tank for combat use. It is advisable to carry out these works in the concentration area.

When preparing a tank for leaving the park, you must:

– install batteries if they were removed;

– check the compliance of the WATER - ANTIFREEZE setting in the DCMV in view of the actually filled coolant;

– start and warm up the engine;

– fill the gas-fuel system (at an ambient temperature of plus 5 ºC and above) and check its performance;

– check the mounting of weapons “in a traveling manner”;

– check the fastening of the spare parts kit from the outside.

Check the functionality of the communications equipment when the tank leaves the park by turning them on.

When preparing a tank for combat use, in the concentration area, if there is enough time, it is necessary:

– clean the weapon from grease.

**ATTENTION!**

**IT IS PROHIBITED TO FIRE FROM A CANNON, MACHINE GUNS, OR SPZ LAUNCHERS WITH GREASE NOT REMOVED FROM THE BARREL BORES!**

– lower the MPC gripper to its original position using a manual drive, then release the lever from the latch and press it to the gearbox;

– turn on AZR EL. Descent, L.R.VT and AZ UPR. on the right distribution panel, while the CBM frame should lower;

– check the gun's recoil devices;

– inspect the weapon complex and check the operation of its units and mechanisms;

– check the pressure in the habitable compartments;

– load ammunition (if the tank was stored without ammunition);

– carry out work within the scope of a control inspection in accordance with clause 2.2of this manual, with the exception of work performed in preparation for departure and in the process of moving to the concentration area;
– eliminate detected failures;
– replenish the tank with standard equipment (if necessary).

When preparing a tank for combat use, in the concentration area, in the absence of sufficient time, it is allowed to perform only the following work:
– clean the weapons from grease;
– inspect the weapon complex and check the functioning of its mechanisms and assemblies;
– check the gun's recoil devices;
– check the pressure in the habitable compartments;
– load ammunition (if the tank was stored without ammunition);
– carry out work within the scope of a control inspection, with the exception of work performed in preparation for departure and in the process of moving to the concentration area;
– eliminate detected failures;
– replenish the tank with standard equipment (if necessary).

### 8.4.2 Removing a tank from storage for scheduled operation

The following work must be done:
– carry out work within the scope of a control inspection in accordance with clause 2.2of this manual;
– install batteries if they were removed;
– check the compliance of the WATER - ANTIFREEZE setting in the DCMV in view of the actually filled coolant;
– start and warm up the engine;
– refuel the GPO system (at an ambient temperature of plus 5 ºC and above) and check its performance;
– check the fastening of the spare parts kit from the outside;
– check the functionality of communication means;
– clean the weapon from grease.

**ATTENTION!**

**IT IS PROHIBITED TO FIRE FROM A CANNON, MACHINE GUNS, OR SPZ LAUNCHERS WITH THE LUBRICANT NOT REMOVED FROM THE BARREL BORES!**

– lower the MPC gripper to its original position using a manual drive, then release the lever from the latch and press it to the gearbox;
– turn on AZR EL. Descent, L.R.VT and AZ UPR. on the right distribution panel, while the CBM frame should lower;
– check the gun's recoil devices;
– inspect the weapon complex and check the operation of its units and mechanisms;
– check the pressure in the habitable compartments;
– eliminate detected failures;
– replenish the tank with standard equipment (if necessary).

## 8.5 List of measuring instruments subject to periodic verification

The measuring instruments installed in the tank are used as indicators and are not subject to periodic verification.

## 9 Transporting a tank

### 9.1 General provisions

When transporting a tank by land (rail and road) and water (sea and river) transport, you should be guided by transportation instructions 188M.99.001.IT and the Manual on the Transportation of Troops.

A secured tank may be transported by the following types of transport:

– by rail;

– road transport on heavy-duty semi-trailers;

– by sea transport:

– river transport on ships, platform barges and other types of river vessels providing transportation of equipment weighing at least 60 tons;

– by air, following separate instructions.

### 9.2 Transportation by rail

When transported by rail, the tank is a large, heavy load of the second degree of lower and side oversize, into the outlines of which it fits after removing the logs from the tank, side and lattice screens, front folding and side flaps, a pipe with a shield, the extreme left and extreme right frontal containers of the remote sensing tower, together with the adjacent panels.

After completion of transportation, install the dismantled side screens on the tank according to the layout of side screens, lattice screens and shields 188M.06.002IS, supplied with the tank. Install the pipe with the shield onto the exhaust pipe.

Oversize index H2200.

When transporting a tank by rail, you should follow transportation instructions 188M.99.001.IT.

### 9.3 Transportation by road

The tank is transported by road using a heavy-duty road train with a carrying capacity of at least 52 tons at the speed and distance specified in the documentation for the trailer.

When transporting a tank on a road train, the overall height should be no more than 4.5 m.

The road train is heavy and oversized, so the route for transporting the tank must be agreed upon with local traffic control authorities.

### 9.4 Transportation by sea (river) transport

Transportation of tanks by sea (river) transport is carried out, guided by the rules for transporting troops by water transport.

Tanks are loaded:

– for sea vessels with horizontal loading (Ro-Ro type) with access hatch openings of at least 4.0×4.0 m - under their own power;

– for universal dry-cargo sea vessels with hold cargo hatch openings of at least 12.0×6.0 m using loading and unloading equipment (floating, portal, bridge, ship booms and cranes) with a lifting capacity of at least 60 tons;

– on open decks of sea vessels, if the strength characteristics of deck structures ensure reliable placement and fastening of tanks;

The placement and fastening of tanks on ships is carried out by the carrier in accordance with the current rules for sea (river) transportation of large-sized and heavy cargo.

### 9.5 Transportation by air

Transportation by air is carried out in accordance with the instructions for the transportation of large-sized heavy cargo by air, valid in the given region.

**Appendix A**
(mandatory)

**Methodology for bringing the weapon system to normal combat**

**9.5.1.1.1 A.1 General provisions**

The weapon complex was brought to normal combat (targeted) at the tank manufacturer. The necessary amendments $\Delta\alpha$and $\Delta\beta$, taking into account the individual angle of departure (IEA) of each type of projectile, are entered into the fire control system (FCS) and entered into the "Card for bringing the weapon system to normal combat", located in the tank's logbook.

When replacing a gun pipe, it is necessary to make amendments from the pipe passport to the tank registration form and enter amendments into the OMS.

In the army, checking the alignment of the weapon system to normal combat (zeroing) is carried out when systematic deviations of projectiles from the aiming point are detected during firing, as well as in cases where there is an assumption of a possible change in the deviation from the straightness of the barrel bore axis (for example, when the barrel is "stuck" , side impacts of the barrel on obstacles, etc.).

This method uses the provisions of the "Instructions for bringing tank guns 2A46M, 2A46M -1, 2A46M4, 2A46M5 to normal combat" 00241-75-0234I.

If there is a control and inspection machine (KVM) at the place of operation, the shooting should be carried out using this machine, in accordance with its operating instructions and taking into account this appendix.

The shooting includes:

– checking the amendments introduced into the OMS for the IPM for VN and GN;

– firing a group of projectiles with determination of the average point of impact and its deviation from the aiming point with control of sight alignment;

– determination of amendments to the IPM for entry into the OMS;

– measuring the muzzle angle of the barrel;

– Carrying out, if necessary, adjustments to the corrections entered into the control system for the IED for the 3BM42 projectile - based on the results of firing and for cumulative projectiles (hereinafter referred to as KS) and high-explosive fragmentation projectiles (hereinafter referred to as HFS) - based on the results of measuring the muzzle angle of the barrel.

**9.5.1.1.2 A.2 Conditions for shooting**

The sighting is carried out by shooting at a target installed at a distance of 1600 m from the tank. The target must be made in the form of a shield with dimensions of at least 3 ×3 m with a clearly visible aiming mark (crosshair) located in the center and a coordinate grid applied every 300 mm to facilitate determination of the coordinates of the holes.

It is prohibited to carry out zeroing during precipitation, side winds of more than 5 m/s, or with a barrel that has not cooled down after firing.

It is recommended to exclude direct sunlight from hitting the barrel or to carry out shooting in the morning, as well as in cloudy weather.

For zeroing, use 3VBM17 rounds with 3BM42 armor-piercing sabot shells (APS) from the same batch. It is allowed, if necessary, to fire with any type of projectile or several types of projectiles.

HEAT shells and high-explosive fragmentation shells must be inert. The mass of shells selected for one group of shots should not differ by more than one weight mark.

Before firing, it is recommended to keep the shots for at least 48 hours at ambient temperature.

When loading shots into the automatic loader, enter the form data of the shots into the OMS in accordance with this operating manual.

Sighting should be carried out with the main engine of the tank not running. Power must be supplied from the tank's diesel generator set or an external power source with a power of at least 12 kW. In the absence of an external source, power can be supplied from another tank with the engine running at operating speed.

Highly qualified operators under the direction of the unit commander are allowed to fire.

**9.5.1.1.3 A.3 Preparation for zeroing**

Check the numerical values of corrections entered into the OMS for VN and GN for compliance with those recorded in the tank's log. If the difference between the verified numerical values of corrections for the IPM for VN and GN with the last recorded in the tank logbook differs by more than 0.5′, it is necessary to enter into the OMS the corrections for the IPM for VN and GN from the tank logbook in accordance with this manual.

Place the tank on a horizontal platform with solid ground and brake it with the stopping brake. The tilt (roll) of the turret should not be more than 30′, and the elevation angle of the gun relative to the turret should be (0±1)º. The indicated angles should be measured using an optical quadrant from the group spare parts kit for the tank. The distance to the target should be (1600±15) m.

Check and, if necessary, adjust the moment of unbalance of the gun, in accordance with this manual

Align the INM with the target at 1600 m using the alignment device UPV-125 or UPV-125-01 (hereinafter referred to as UPV) available in the group spare parts for the gun. If the sight alignment was adjusted, adjust the built-in IMA control system in accordance with the IMA alignment procedure.

Prepare the cannon for firing and fire one warm-up shot past the shield with a projectile of any type. When the ambient temperature is below minus 25 °C, fire two warm-up shots. Check and, if necessary, adjust the alignment of the Sosna -U IMS using the built-in INM control system.

### 9.5.1.1.4 A.4 Shooting

A.4.1 Turn on the control system in the "Main" mode and make sure that the sensor readings are entered correctly into the BV block in accordance with this manual (in the BV menu "Sensor control" - air temperature, charge and atmospheric pressure, in the BV menu "Barrel wear" - actual barrel wear). In case of incorrect values, enter the correct values.

In the "Projectile Loading/Subtype" menu, in the "BM" line, set the subtype used for zeroing and enter the deviation from the initial velocity $\Delta V_0$ from the shot passport.

Place the diaphragm (from the group kit of spare parts for the tank) on the sight eyepiece instead of the eyecup.

Shoot a group of six shots in the main mode. In this case, aim the central reticle of the PNM at the aiming mark of the target in the same way: from bottom to top and from left to right. It is preferable to carry out guidance from the lead side. After each shot, monitor the alignment of the IMA using the internal control system; if necessary, adjust the alignment using the sight alignment mechanisms.

If the operator makes a mistake when firing a shot, the shot is not counted and an additional shot is fired instead.

A.4.2 Measure the coordinates of the centers of the holes of each projectile relative to the aiming mark (crosshair) with an accuracy of 10 mm. Determine the center of the hole visually. It is allowed to determine the center of the hole by the intersection of imprints from the stabilizer feathers.

Each value of the coordinate of the center of each hole, depending on its location relative to the point of impact, is assigned a sign according to the following rule:

– assign a plus sign when the hole deviates upward or to the right;

– minus sign – when deviating down or to the left.

Calculate the coordinates of the midpoint of impact $Y_{\text{стп}}$ and $Z_{\text{стп}}$, mm, using the formulas

$$Y_{\text{стп}} = \frac{Y_1+Y_2+Y_3+Y_4+Y_5+Y_6}{6}, \quad \text{(A.1)}$$

$$Z_{\text{стп}} = \frac{Z_1 + Z_2 + Z_3 + Z_4 + Z_5 + Z_6}{6}, \quad \text{(A.2)}$$

where $Y_1$ ... $Y_6$, $Z_1$ ... $Z_6$ are the vertical and horizontal coordinates of each hole, respectively (with the corresponding sign), mm.

Round the results obtained to the nearest 10 mm.

Check for abnormal shots in the group.

Shots are considered abnormal if the absolute value of at least one of the differences ( $Y_j - Y_{\text{стп}}$) or ($Z_j - Z_{\text{стп}}$) is greater than 1400 mm, where $Y_j$ and $Z_j$ are the coordinates of the center of the hole of the shot that broke away from the rest, taken with the corresponding sign, and $Y_{\text{стп}}$ and $Z_{\text{стп}}$ are the coordinates of the midpoint of the impact, with the corresponding sign.

Ignore the abnormal shot and instead fire an additional shot. If more than one abnormal shot is received in a group, the group must be re-shooted.

A.4.3 Zeroing is considered completed if the absolute value of the STP coordinates is no more than 500 mm. At the same time, write down the values of the STP coordinates in the tank logbook for the 3BM42 projectile, and in the columns for corrections to IPM for VN and GN, write down the values of corrections to IPM made during the previous zeroing.

A.4.4 If the absolute value of at least one of the coordinates $Y_{\text{стп}}$ is $Z_{\text{стп}}$ more than 500 mm, calculate new values of corrections for IPM for VN and GN based on the results of shooting, $\Delta\alpha_{\sum}$, ...' and $\Delta\beta_{\sum}$ , ...' using the formulas

$$\Delta\alpha_{\sum} = \Delta\alpha_1 - 0{,}001 \cdot Y_{\text{стп}} ,$$

$$\Delta\beta_{\sum} = \Delta\beta_1 - 0{,}001 \cdot Z_{\text{стп}} , \quad \text{(A.4)}$$

where $\Delta\alpha_1$ and $\Delta\beta_1$ are the current amendments to the BV, taken with their own signs.

In the tank log book, write down the coordinates of the STP, and corrections for the IPM according to the VN and GN.

Introduce into the OMS amendments to the IPM for VN and GN for the 3BM42 projectile according to the methodology outlined in this manual.

A.4.5 Measure the muzzle angle of the barrel using the DU-125 or DU-125-01 (hereinafter referred to as DU) device, available in the group kit of spare parts for the gun, according to the method described in the subsection "Measuring the muzzle angle of the barrel" of this appendix. Write down the numerical values of the muzzle angle $\theta_y$ and $\theta_z$.

If the difference between the muzzle angle value measured according to this appendix and the last muzzle angle value recorded in the tank logbook is no more than 0.2 mrad, do not make corrections to the IPM for KS and OFS.

And in the “Card for bringing the weapon system to normal combat”, in the column of corrections for IPM for VN and GN for these shells, write down the values obtained during the previous check.

If the difference is more than 0.2 mrad, it is necessary to calculate new numerical values of corrections for IPM for KS and OFS $\Delta\alpha$and $\Delta\beta$, ...' using the formulas

$$\Delta\alpha = -\left(A \cdot \theta_y + B\right), \quad \text{(A.5)}$$

$$\Delta\beta = -A \cdot \theta_z, \quad \text{(A.6)}$$

where $\theta_y$and $\theta_z$are the measured muzzle angles in the vertical and horizontal planes, mrad, with the corresponding sign;

A, B – coefficients for calculating corrections for the angles of departure of the KS and OFS, given in Table A1.

Table A.1

| Projectile type | Dependency coefficients | |
|---|---|---|
| | A | IN |
| KS | 1.38 | minus 0.83 |
| OFS | 2.06 | minus 0.65 |

The resulting values $\Delta\alpha$are $\Delta\beta$rounded to 0.1 ′and entered into the “Card for bringing the weapon system to normal combat” in the tank’s form, in the columns of amendments to the IPM for VN and GN for KS and OFS.

Introduce into the OMS amendments to the IPM for VN and GN for OFS and KS projectiles according to the methods outlined in this manual.

### 9.5.1.1.5 A.5 Measuring the muzzle angle of the barrel

The measurement is carried out on a gun installed in the tank.

The roll of the turret should not be more than 30 ′, and the elevation angle of the gun relative to the turret should be from minus 1 °to plus 1 °. The bore must be cleared of grease and wiped dry. It is prohibited to take measurements on a barrel that is heated after firing, or when the barrel is exposed to direct sunlight.

Measurements are carried out using a remote control device located in the gun’s group spare parts kit in the following order:

– assemble and install mark 2 (Figure 22.1) into the barrel bore from the rear end, while the position of the flats on the flange of mark 1 must be strictly horizontal (to avoid closing the wedge);

– connect cord 11 of the brand illumination to the tank’s electrical system;

– screw two handles 6 into the body of the device 4 and secure a red flag 9 in one of the handles (a signal that it is impossible to fire when the device is installed in the barrel);

– install the device with shanks 3 and 5 in the bore until stop 10 touches the front end of the barrel (place the stop at the bottom);

– by rotating the diopter ring 8, establish a sharp image of the instrument reticle, and by longitudinally moving the sighting tube 7, establish a sharp image of the mark;

– determine the displacement of the device crosshair relative to the center of the mark scale separately vertically ( $\theta_y$) and horizontally ( $\theta_z$) in milliradians. The mark's scale division value is 0.2 mrad.

The “plus” sign is assigned to the muzzle angle value when the crosshair of the device is shifted up and to the left relative to the center of the mark scale.

The “minus” sign is assigned to the muzzle angle value when the crosshair of the device is shifted down and to the right relative to the center of the mark scale.

To eliminate the error of the remote control device, measurements should be carried out in two positions of the device (initial and rotated by 180 °), in each of which three measurements should be taken. Repeat the measurements with the mark position rotated 180 degrees °. Based on the twelve measurements obtained, determine the arithmetic mean value of the muzzle angle in each plane $\theta_Y$and $\theta_Z$, mrad, taking into account the signs using the formulas

$$\theta_Y = \frac{\sum_{i=1}^{12} \theta_{Y_i}}{12}, \quad \text{(A.7)}$$

$$\theta_Z = \frac{\sum_{i=1}^{12} \theta_{Z_i}}{12}, \quad \text{(A.8)}$$

the $\theta_Z$resulting values $\theta_Y$to 0.01 mrad and enter them into the tank log.

**Appendix B**
(mandatory)
**Alignment device UPV-125**

**9.5.1.1.6 B.1 Working with the UPV alignment device**

The UPV device is designed to align the sight line of the sight with the axis of the gun barrel.

Before use, it is necessary to prepare the UPV device in the following sequence:

– remove grease and dirt from the barrel bore in the area of its front end;

– screw two handles 5 (Figure 8.36) into the body 4 of the device and secure a red flag 9 in one of the handles;

– install the device with shanks 6 and 7 in the barrel bore until the stop 8 touches the front end of the barrel (place the stop horizontally, the handles vertically);

– By rotating the diopter ring 1 of eyepiece 2, set a sharp image of the crosshair of the device;

– achieve, by turning the device in the barrel using handles 5, so that one of the crosshair lines of the device is located vertically;

– using the gun pointing mechanisms, observing through eyepiece 2, align the crosshair of the device with a clearly visible pointing point (target);

– rotate the device 180 °and determine the displacement of the device crosshair in the target plane relative to the aiming point. The vertical or horizontal displacement should not be more than 0.4 mrad (for example, no more than 40 mm at a distance to the guidance point of 100 m). If the displacement is larger, before the alignment, it is necessary to adjust the UPV device.

**9.5.1.1.7 B.2 Adjustment of the UPV-125 device**

If the difference in readings of the UPV-125 device in the initial and 180° rotated positions is more than 600 mm in absolute value, the following must be done:

– remove cover 10 (Figure 8.36), loosen screws 3;

– by tightening one screw 3 and loosening the diametrically opposite screw, achieve such a position of the device crosshair relative to the selected pointing point (target), at which the difference in readings in the initial and 180-degree °position of the device would be no more than 0.4 mrad;

– tighten screws 3 while maintaining the minimum difference in instrument readings;

– put on the cover 10.

**Appendix B**
(mandatory)

**Engine preservation**

**9.5.1.1.8 B.1 General instructions**

Engine preservation involves flushing its cylinders with fresh dehydrated oil.

Flushing the engine cylinders is the most important condition for its long-term and reliable storage, as it ensures the removal of corrosive combustion products of fuel and oil from the cylinders.

Flushing is carried out using an engine preservation unit AKD-1 or AKD-1M, which under pressure supplies a certain amount of heated dehydrated oil to the engine cylinders through an air distributor with the addition of (18 ±2)% additive KP GOST 23639-79 or AKOR-1 GOST 15171- 78 with simultaneous rotation of the engine crankshaft by the starter-generator.

When preserving the engine using an engine preservation unit, the batteries must be fully charged (no more than 10% discharge is allowed).

**9.5.1.1.9 B.2 Engine preservation**

The unit consists of an oil tank, an MZN-2 pump and a control panel mounted in a common housing. The unit turns on and off the tank starter-generator and the unit's oil injection pump in a strictly defined sequence, thereby eliminating the possibility of overfilling individual engine cylinders with oil. The unit kit includes a hand pump and a special spare parts kit, consisting of tips and hoses for connecting the unit to the tank.

The unit is installed so that it is possible to conveniently connect electrical wires and a distribution hose to the preservation device.

From 10 to 12 liters of dehydrated oil is poured into the tank with the addition of the KP additive in accordance with GOST 23639-79 or AKOR-1 GOST 15171-78, in an amount of (18 ±2)% to the oil prepared for washing and preservation, heated to a temperature from plus 80 to plus 90 °C. The amount of oil is controlled by the level installed on the front side of the unit. There is a slider on the glass that is aligned with the oil level, which makes it possible to determine its consumption. The bypass valve of the pump, the handwheel of which is pointed upward, must be closed.

To flush the engine cylinders, it is necessary to connect the unit to the tank's electrical network in the following sequence:

– set all switches on the unit control panel to the off position;

– turn off the battery switch;

– connect cable No. 55 of the unit to the positive terminal of the lower left battery;

– disconnect wire No. 2 from the positive terminal of the lower right battery, going to the "+B3,4" terminal of the BCS unit;

– attach to the free end of wire No. 2 using the M10x25 bolt, M10 nut and two washers of the unit current limit relay included in the group kit of spare parts for the tank;

– connect the second terminal of the unit current limit relay to the positive terminal of the lower right battery;

– connect cable 172.70.130sb (included in the group spare parts kit for the tank) to the AKD electrical connector above the batteries, first connect the second end of this cable to cable No. 54 of the unit, wrap the connection point of the wires with insulating tape;

– connect cable No. 53 of the unit to the tank body under any bolt securing the dust shields of the fender;

– turn on the battery switch.

Warm up the engine (regardless of the time of year) first using a heater to a coolant temperature from plus 90 to 100 ° C, then start the engine and at a crankshaft speed of 1500 to 1600 rpm, warm it up to a coolant temperature from plus 70 to 75 °C and oils at least plus 65 °C. After this, double pump out the oil from the transmission units, following the instructions in paragraph 5.8.10.1of this manual.

Raise the roof over the engine and connect the unit's distribution hose to the engine preservation device in accordance with 92S2F RE1 (part 2). Intended use" supplied with the tank, after first unscrewing the cap on the check valve of the device.

Set the AUTOMATIC and STARTER switches on the unit control panel to the ON position, and the PRESERVATION switch to the ENGINE position (do not use the locking slide).

Press the START button of the MACHINE and hold it in this position for 2 to 3 s until a click appears in the machine; When the machine is turned on, a white signal lamp lights up on the panel, which remains on throughout the entire operation of the machine.

The unit automatically performs one flushing cycle, which consists of pouring oil into the cylinders three times with simultaneous rotation of the engine crankshaft by the starter-generator and subsequent rotation of the shaft without supplying oil to the cylinders.

To preserve the engine, it is necessary to perform two flushing cycles with an interval of 2 to 3 minutes between cycles.

The quality of flushing is controlled by oil consumption, which ranges from 1.8 to 2.4 liters. If it turns out that less than 1.5 liters of oil is poured into the cylinders, it is necessary to carry out another flushing cycle.

At the end of washing, set the AUTOMATIC and STARTER switches on the unit's control panel to the OFF position, disconnect the dispensing hose from the check valve of the engine preservation device and replace the cap.

Remove the nozzle from the distribution hose. Disconnect the cables and wires connecting the unit to the tank's on-board network. Disconnect the cable 172.70.130sb from the unit, the wires from the batteries and place them in the group spare parts for the tank.

The main conditions for high-quality flushing of engine cylinders are:

– strict adherence to the specified engine warm-up modes;

– use for flushing clean dehydrated oil filled into the engine lubrication system, with the addition of the KP additive in accordance with GOST 23639-79 or AKOR-1 GOST 15171-78, in an amount of (18 ±2)% to the oil prepared for flushing and preservation, heated to a temperature not below plus 80 °C.

**Appendix D**
(mandatory)

**Checking readings and adjusting the bend sensor**

D.1 Checking the readings and adjusting the bend sensor (hereinafter referred to as DI) is carried out in all cases associated with the forced dismantling of the measuring unit (when tightening the backlash selecting devices on the gun, when replacing the gun barrel, when replacing the outer cover of the gun, etc.).

Check the readings and adjust the DI in the following sequence:

– make sure that the measuring and optical units are installed in accordance with Figure 8.26, the electrical connector is connected to the measuring unit, the cable fastening elements are attached to the protective visor of the electrical connectors and securely fix the cable and electrical connector;

– set the gun to an elevation angle of about 0º ;

– turn on the control system toggle switch on the fire control control unit and air defense control unit. After the control system equipment enters the operating mode, enter the BV menu by simultaneously pressing the “ ◑ ” and “ ⇨ ” buttons on the Pn-PNM. Enter the “SENSOR CONTROL” submenu. Make sure that the DI is turned on (the “ON” status is displayed in the “HV BARREL DI” and “GN BARREL DI” items), otherwise, you need to set the “ON” status in these items. Save the entered states into the BV memory;

– enter the submenu of the BV menu “SETTINGS” (simultaneously press and hold at least 3 buttons “ ⇦ ”, “ ⇨ ” ), go to the item “DI SETTINGS” and enter the BV submenu “DI SETTINGS”;

– in the BV submenu “DI SETTINGS”, check the values in the “X, pixels” and “Y, pixels” items. If the items do not display values or the values in the “X, pixel” item do not correspond to the range from 180 to 300 or the values in the “Y, pixel” item do not correspond to the range from 316 to 436, it is necessary to loosen bolts 4 (Figure 8.26) securing the measuring unit , locking nuts 10 and adjusting screws 12 for aligning the measuring block in the GN plane. Slowly turning the measuring unit in a horizontal plane with screws 12 (loosening one of the bolts and tightening the other bolt), as well as changing the tilt of the measuring unit body in the longitudinal direction due to the pairwise installation or dismantling of washers 5 (gaskets on the BI fastening bolts between the BI body and the plate) , achieve the appearance in the item “X, pix” of a value corresponding to the range from 180 to 300 and the appearance in the item “Y, pix” of a value corresponding to the range from 316 to 436. Install or dismantle washers 5 (spacers) of the same thickness in pairs (at the same time under front or rear BI mounting bolts);

– finally fix the measuring unit (tighten the BI fastening bolts, secure screws 12 with nuts). The values in the “X, px” and “Y, px” items should remain in the range from 180 to 300 and from 316 to 436, respectively, otherwise, repeat the operations according to the above method;

– enter the main menu of the BV and select the item “ZERO DI”. Perform DI reset by pressing and holding the “ ▤ ” button until the DI is reset and save the operation in the BV (press and hold the “ ▤ ” button);

**ATTENTION:**

**“ZERO DI” SHOULD BE PERFORMED IN THE ABSENCE OF INFLUENCES ON THE GUN THAT CAUSE ITS ONE-SIDED HEATING OR COOLING (FOR EXAMPLE, DIRECT SUNLIGHT), FOR 2 HOURS BEFORE “ZERO DI”!**

– immediately after resetting the DI, reconcile the PNM and PKP relative to the cut of the gun barrel (according to the index on the BO), guided by paragraphs. 3.3.8.2.1and 3.3.8.3.1of this manual;

– immediately after the alignment, check the correctness of the DI zeroing operation, to do this, enter the “SENSOR CONTROL” submenu and make sure that the “HV BARREL DI” and “GN BARREL DI” items display values of no more than 12";

– exit the BV menu, turn off the control system toggle switch on the control panel.

**Appendix E**
(for reference)

**Equivalents of fuels, oils, lubricants and special liquids**

**9.5.1.1.10 E.1 General provisions**

The table of equivalents provides data on the possibility of replacing Russian-made fuels, oils, lubricants and special liquids with foreign-made products.

Foreign-made fuels and lubricants equivalent to Russian varieties may be used on a tank only if there is technical documentation confirming the compliance of a given batch of product with the technical requirements of its specification for all indicators specified therein.

Foreign-made fuels and lubricants listed in the table of equivalents can be used on a tank, subject to the restrictions specified in the note.

When replacing Russian grades of oils with foreign equivalents, as well as when replacing foreign grades of oils with their equivalents produced according to other specifications, it is necessary to drain the oil from the lubrication system as completely as possible, and then double flush the lubrication system (engine or transmission) with the oil to be filled.

**ATTENTION!**

**IT IS PROHIBITED TO MIX EQUIVALENT GRADES OF SPECIAL LIQUIDS PRODUCED IN RUSSIA AND ABROAD**
**IT IS PROHIBITED TO MIX FOREIGN GRADES OF SPECIAL LIQUIDS PRODUCED ACCORDING TO DIFFERENT SPECIFICATIONS**
**IT IS PROHIBITED TO MIX FOREIGN AND DOMESTIC BRANDS OF FUEL, OIL, AND LUBRICANTS.**

When switching from Russian to foreign types of special liquids, as well as when switching to special liquids produced according to a different specification, it is necessary to perform, perhaps, a more complete drain of the replaced liquid and flushing of the system with the refilled liquid.

The use of foreign-made fuels, oils, lubricants and special liquids not included in this Table E.1 of equivalents is not permitted.

Table E.1

| Russian-made fuels and lubricants | Equivalent brands of fuels and lubricants | | Note |
|---|---|---|---|
| | Country (company) | Name, brand | |
| **Fuel** | | | |
| Summer diesel fuel GOST 305-2013 | France | Class M1<br>M 15007 | 1 The minimum temperature for using fuels is 5 °C above the pour point of the fuel.<br>2 Storage on diesel fuel with a sulfur content of no more than 0.2%. |
| | Germany | Class M1<br>DIN 51601 | |
| | Canada | Type B | |
| | Japan | Special N 3 | |
| Winter diesel fuel GOST 305-2013 | USA | 1D | |
| | Japan | Special N 3 | |
| | Canada | Type A<br>Type AA | |
| Arctic diesel fuel GOST 305-2013 | Canada | Type AA | |
| Jet fuel TS-1 GOST 10227-86 | Algeria | Jet A-1 | |
| | Lebanon | Jet A-1 | |
| | Libya | Jet A-1 | |
| Jet fuel T-2 GOST 10227-86 | USA | JP-4<br>Jet B | |
| **Oils** | | | |
| Motor oil<br>VNII NP M-5 $_{3}$/16D $_{2}$, TU 38.401-58-309-2002 | ExxonMobil | Mobil 1 5W-50 with API quality class not lower than CF or ACEA quality class not lower than B 3 | Can be used in summer and winter |
| Transmission oil TSZp-8 | MOTUL | MOTUL Dexron III | |
| | TOTAL | TOTAL ATF 33 | |
| | | ELFMATIC G3 | |
| | ARECA | Transmatic ATF III | |

| Russian-made fuels and lubricants | Equivalent brands of fuels and lubricants | | Note |
|---|---|---|---|
| | Country (company) | Name, brand | |
| **Lubricants** | | | |
| Lubricant Litol-24 GOST 21150-2017 | Shell | Alvania RL3<br>Alvania R3 | |
| | ExxonMobil | Mobilux 3<br>Mobilux EP 3<br>Beacon 3 | |
| Lubricant Litol-24 GOST 21150-2017 | VR | Energease LS3 | |
| | Nyco | Nyco Grease 15 | |
| Grease CIATIM-201 GOST 6267-74 | Shell | Alvania EP2<br>AeroShell Grease 6 | |
| | Nyco | Nyco Grease 22<br>Nyco Grease 51 | |
| | ExxonMobil | Beacon 325 | |
| Graphite lubricant GOST 3333-80 | Shell | Rhodina EP 2<br>Barbatia 4 | |
| | VR | Energrease C-3G;<br>GP-2-G; GP-3-G | |
| | ExxonMobil | Graphite No.3 | |
| | Nyco | Nyco Grease 917 | |
| Grease GOI-54p GOST 3276–89 | Shell | Alvania RL2<br>Alvania R2 | |
| | VR | Energease LS2 | |
| | ExxonMobil | Beacon 325 | |
| **Special fluids** | | | |
| Hydraulic oil<br><br>MGE-10A | Shell | Aeroshell<br>Fluid 41 | |
| liquid<br>brand “40”<br>GOST 159-52 | Canada | CAN 2.3-890-83<br>(50% ob) | |
| | Texas | Antifreeze<br>Coolant (50% ob) | |
| liquid<br>brand “65”<br>GOST 159-52 | USA | MIL-A-4615 3A | |
| | Canada | CAN 2.3-890-83<br>(70% ob) | |
| | Castrol | Antifreeze | |
| | ExxonMobil | Esso Antifreeze | |
| | Texas | Antifreeze Coolant (70% ob) | |
| Automotive cooling fluid “Tosol A40M”, TU 6-57-95-96 | B.P. | BP ANTIFREEZE<br>BP ANTIFROST | |
| | TOTAL | TOTAL COOLELF | |

**9.5.1.1.11 List of accepted abbreviations**

| | |
|---|---|
| AB | - accumulator battery; |
| AB | - astronomical time; |
| AVSKU | - switching internal communication equipment; |
| AZ | - automatic loader; |
| AZR | - circuit breaker (breaking) circuit; |
| AK | - subscriber communicator; |
| ADF | - data transmission equipment; |
| APO | - interference analyzer; |
| AMS | - automatic gear shifting; |
| ARMk | - unified automated commander workstation; |
| AC | - adaptive communication; |
| AS VP | - interface and correction equipment; |
| ASN | - satellite navigation equipment; |
| ASUV TK | - automated control system for combined arms and supporting military formations at the tactical level; |
| ASC | - automatic target tracking; |
| ACB | - asphalt shoes; |
| AUN | - direction indicating equipment; |
| BV | - computer block; |
| BVD | - sighting and rangefinder unit; |
| BVS-E | - small-sized computer system unit; |
| BZ | - mirror block; |
| BZA | - battery protection unit; |
| BIUS | - on-board information and control system; |
| BC | - ammunition; |
| BKVS | - video signal switching unit; |
| BKS | - starter switching unit; |
| BKU | - control button block; |
| BAUD | - engine stop block; |
| BOE | - optical-electronic unit; |
| BP | - power unit; |
| BPR | - backup power supply; |
| BPS | - armor-piercing sub-caliber projectile; |
| BR | - final drive; |
| BS | - on-board network; |
| emergency hospital | - multi-channel sight stabilization unit; |
| BSU | - coordination and control unit; |
| BOO | - Control block; |
| BU PKP | - commander's panoramic sight control unit; |
| BU PNM | - multi-channel sight control unit; |
| BUD | - the engine control unit; |
| BCN | - electric fuel priming pump; |
| BTsOI | - digital image processing unit; |
| VVU | - rotating air device; |
| VDZ | - built-in dynamic protection; |
| VZU | - air intake device; |
| VKU | - input switching device; |
| VKU-1 | - rotating contact device; |
| VLD | - upper frontal part; |
| TDC | - top dead center; |
| VN | - vertical guidance; |
| VNA | - inlet guide vane; |
| IN | - air purifier; |
| Armed Forces of Ukraine | - video viewing device; |
| VT | - rotating conveyor; |
| HF | - high frequency; |
| GA | - group address; |
| GN | - horizontal guidance; |
| GPO | - hydropneumatic cleaning; |
| fuels and lubricants | - fuels and lubricants; |
| DGU | - diesel generator set; |
| DZ | - dynamic protection; |

| | |
|---|---|
| DI | - barrel bend sensor; |
| DCMV | - driver display system; |
| VCT | - roll and pitch sensor; |
| DLU | - linear acceleration sensor; |
| DM | - meteorological sensor; |
| DMV | - decimeter waves; |
| DP | - reception on duty; |
| DPB | - tower position sensor; |
| DPK | - cassette position sensor; |
| DPP | - gun position sensor; |
| DPU | - remote machine gun installation; |
| DSMU | - mechanical universal speed sensor; |
| DTV | - air temperature sensor; |
| DUS | - absolute angular velocity sensor; |
| ETO | - daily maintenance; |
| LCD | - liquid crystal indicator; |
| Spare parts | - spare parts, tools and accessories; |
| HRA | - pre-prepared frequency; |
| ZRV | - shot clearance zone; |
| ZH | - reverse; |
| IA | - individual address; |
| OR | - laser radiation indicator; |
| IPM | - individual departure angle; |
| BWC | - on-board equipment complex; |
| KVI | - video switch; |
| KDA | - additional subscriber block; |
| KDZ | - dynamic protection complex; |
| KKU | - heading indicator; |
| CBS | - channel-forming agent; |
| KS | - cumulative projectile; |
| KP | - Transmission; |
| KSS | - complex of communication means; |
| WHO | - control and technical inspection; |
| KTS | - technical condition monitoring; |
| KHPP | - thermoelectric air conditioner; |
| HDL | - panorama line of sight; |
| LD | - laser rangefinder; |
| LKU | - laser control channel; |
| MOM | - power limiting mechanism; |
| MAF | - oil filter; |
| MV | - meter waves; |
| MZA | - small-sized filling unit; |
| MZN | - oil pump; |
| MAUD | - engine stopping mechanism; |
| MPB | - turret rotation mechanism; |
| IPC | - cassette lifting mechanism; |
| MR | - distribution mechanism; |
| MTO | - engine - transmission compartment; |
| MUP | - pallet catching mechanism; |
| MC | - centrifugal oil purifier; |
| NKA | - navigation spacecraft; |
| BDC | - bottom dead center; |
| ABOUT | - cooling unit; |
| OB | - poisonous substances; |
| coolant | - coolant; |
| RAM | - random access memory; |
| WMD | - weapons of mass destruction; |
| OP | - general military raincoat; |
| OPVT | - equipment for underwater tank driving; |
| OFS | - high-explosive fragmentation projectile; |
| PA | - semi-automatic; |
| PVV | - heating of intake air; |
| PVKU | - driving rotating contact device; |
| PDT | - television double sight; |
| PDF | - smoke filter; |

| | |
|---|---|
| PZ | - loading panel; |
| PZM | - oil injection device; |
| PC | - commander's console; |
| PKP | - commander's panoramic sight; |
| PMF | - multifunctional panel; |
| Mon | - pointing console; |
| Mon-PDT | - television backup sight panel; |
| Mon-PKP | - commander's panoramic sight control panel; |
| Mon-Monday | - multi-channel gunner's sight control panel; |
| PNM | - multi-channel gunner's sight; |
| BY | - software; |
| PP | - transceiver; |
| PPO | - fire-fighting equipment; |
| PPGU | - Leak test device is almost universal; |
| PPRF | - software adjustment of operating frequency; |
| PTK | - software and hardware complex; |
| ATGM | - anti-tank missile system; |
| PU | - Remote Control; |
| PCP | - anti-chemical protection; |
| PS | - noise suppressor; |
| RD | - radio data; |
| RJ | - mode; |
| RMPB | - manual turret rotation mechanism; |
| RMS | - rubber-metal hinge; |
| RNM | - manual fuel priming pump; |
| RPG | - hand-held anti-tank grenade launcher; |
| RPZU | - reprogrammable read-only memory; |
| RSG | - starter-generator relay; |
| RTO | - regulated maintenance; |
| RFS | - barrel cleaning solution; |
| SA | - own address; |
| SVK | - built-in alignment control system; |
| Microwave | - ultra high frequencies; |
| SG | - starter - generator; |
| CIPF | - cryptographic protection means; |
| START | - external video surveillance system; |
| CO | - universal orientation system; |
| SPO | - special software; |
| JV | - scanning reception; |
| SDR | - curtain installation system; |
| SSU | - stabilization and control system; |
| STV | - tank weapon stabilizer; |
| SU DPU | - remote machine gun control system; |
| OMS | - fire control system; |
| TV | - television; |
| TDA | - thermal smoke equipment; |
| TK | - thermal imaging camera; |
| TKZV | - TV rear view camera; |
| TKR | - turbocharger; |
| TM | - technical camouflage; |
| injection pump | - high pressure fuel pump; |
| THAT | - Maintenance; |
| TP | - thermal imaging; |
| TCP | - cold sighting tube; |
| TCPT | - television cold shooting tube; |
| TEM | - thermoelectric module; |
| UARMk | - unified commander's workplace; |
| UVB | - universal computing unit; |
| UVI | - time interval setter; |
| UDP | - remote recharging device; |
| MIND | - amplifier; |
| UM DPU | - remote machine gun power amplifier; |
| UN | - direction indicator; |
| UP | - power supply installation; |
| UPZ | - narrow field of view; |

| | |
|---|---|
| UPZx2 | - narrow field of view with electronic magnification; |
| FVU | - filter and ventilation unit; |
| HPF | - high pass filter; |
| LPF | - low pass filter; |
| FCDS | - fixed frequency - dual-frequency simplex; |
| FES | - fixed frequency – simplex; |
| FChS-TM | - fixed frequency - simplex with technical masking; |
| target audience | - circular address; |
| CV | - circular call; |
| CI | - executive cylinder; |
| CPM | - central aiming mark; |
| CA | - circular communication; |
| CC | - target designation; |
| PPP | - number of jump frequencies; |
| ShPZ | - wide field of view; |
| ShchV | - driver shield; |
| ShchR | - distribution board; |
| ShchRL | - left distribution board; |
| ShchRP | - right distribution board; |
| computer | - electronic computer; |
| ED | - electric motor; |
| EDZ | - dynamic protection element; |
| ECM | - electronic map of the area; |
| EM | - electromagnet; |
| EMPB | - electromechanical turret rotation mechanism; |
| EMC | - locking electromagnet. |