



Collective	Collective pitch	Quick decrease to 1/3 range	Up: [Numpad +] Down: [Numpad -]
Cyclic	Cyclic pitch	Push down Pitch 20...25° to dive	[Arrow Up], [Arrow Down], [Arrow Left], [Arrow Right]
With reaching speed 40...50 km/h			
Collective	Collective pitch	Increase to transition to level flight	Up: [Numpad +] Down: [Numpad -]
Left panel	Failed engine cut-off valve	Close	[RCtrl + Page Up] or [RCtrl + Page Down]
Wall panel	ПЕРЕКРЫВ КРАНЫ – ДВИГ. (Failed engine fuel shut-off valve switch)	Close	Left engine: Cover: [RCtrl + RAlt + RShift + J] Switch: [RCtrl + RShift + J] Or Right engine: Cover: [RCtrl + RAlt + RShift + K] Switch: [RCtrl + RShift + K]
Estimate the chance of continuing level flight at no less than 70 km/h speed. Restarting a failed engine is not advised.			
Make decision about emergency landing.			

BOTH ENGINES FAILURE IN FLIGHT

Panel	Controls, checks	Check, operation, message	Key commands
With both engines failed in flight.			
Collective	Collective pitch	Quickly decrease to maintain RPM	Up: [Numpad +] Down: [Numpad -]
Cyclic	Cyclic pitch	Push down to maintain a speed of 100...180 km/h	[Arrow Up], [Arrow Down], [Arrow Left], [Arrow Right]
Left panel	Engine cut-off valves	Close	[RCtrl + Page Up] or [RCtrl + Page Down]
Wall panel	ПЕРЕКРЫВ КРАНЫ – ДВИГ. (Engines fuel shut-off valve switch)	Close	Left engine Cover: [RCtrl + RAlt + RShift + J] Switch: [RCtrl + RShift + J] Or Right engine: Cover: [RCtrl + RAlt + RShift + K] Switch: [RCtrl + RShift + K]
Center panel	АВАР СБРОС (External stores jettison)	On	[LAlt + R]
Center panel	УСКОР ПАЗГРУЗ (Emergency ATGM launch jettison)	Push and hold until full jettison	[RCtrl + W]
Cyclic	Trim	On	[T]

Left forward panel	Landing gear	Lower landing gear	[G]
Find a location for a power off autorotation landing and make the approach into wind if possible.			

AUTOROTATION LANDING

Panel	Controls, checks	Check, operation, message	Key commands
At 50 m altitude, set speed to 100...120 km/h, RPM – 86%.			
At 30 m altitude, start landing flare.			
Cyclic	Cyclic pitch	Up to 25°. Keep pitch up to full braking or up to 3 m altitude	[Arrow Up], [Arrow Down], [Arrow Left], [Arrow Right]
Collective	Collective pitch	Increase to 2/3 range	Up: [Numpad +] Down: [Numpad -]
On the 3 m altitude			
Cyclic	Cyclic pitch	Landing pitch	[Arrow Up], [Arrow Down], [Arrow Left], [Arrow Right]
Collective	Collective pitch	Bump up to max	Up: [Numpad +] Down: [Numpad -]
Land on main gears. Hold cyclic back to avoid the nose coming down too hard.			
Cyclic	Cyclic pitch	Neutral	[Arrow Up], [Arrow Down], [Arrow Left], [Arrow Right]
Collective	Collective pitch	Down to stop	Up: [Numpad +] Down: [Numpad -]
Cyclic	Wheels brake	On	[W]

RESTART ABORTED ENGINE IN FLIGHT

Panel	Controls, checks	Check, operation, message	Key commands
Aborted engine RPM when no more 7%.			
Start-up APU. APU light check ВСУ ВКЛЮЧЕНА (APU in operate).			
Throttle levers	Set aborted engine to Work mode.	IDLE	Press two times from AUTO: [RAlt + Page Down] Or [RShift + Page Down]
Left panel	Left engine cut-off valve	Close	[RCtrl + Page Up] or [RCtrl + Page Down]
Left panel	ЗАПУСК – ПРОКРУТКА – ЛОЖНЫЙ ЗАПУСК (Start-Up-Crank-False Start engine work mode switch)	ЗАПУСК (Start-Up)	[LAlt + E]
Left panel	ВСУ – ДВИГ ЛЕВ – ДВИГ ПРАВ – ТУРБОПРИВОД (APU-Left engine-Right engine-Turbo gear engine selector)	Aborted engine	[E]
Left panel	ЗАПУСК (Start-Up button)	Press	[HOME]
Left panel	Left engine cut-off valve	ОТКРЫТО (Open)	[RCtrl + Page Up]
Engine comes out to idle automatically after one minute.			
Throttle levers	Set aborted engine to Work mode	AUTO	Press two times from Idle: [RAlt + Page Up]

			or [RShift + Page Up]
Engine instruments check			
APU shut off			

RECOVERY FROM VORTEX RING

Panel	Controls, checks	Check, operation, message	Key commands
Collective	Collective pitch	Quickly decrease to 1/3 of total range	Up: [Numpad +] Down: [Numpad -]
Cyclic	Cyclic pitch	Push down Pitch 20...25° to a dive	
Dive with acceleration to a speed more than 50 km/h.			
Collective	Collective pitch	Increase for transition to level flight	Up: [Numpad +] Down: [Numpad -]
Cyclic	Cyclic pitch	Adjust to attain level flight	[Arrow Up], [Arrow Down], [Arrow Left], [Arrow Right]
In case altitude is not enough for recovery, eject.			



13

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SERVICE LIMITS AND SYSTEMS



13 KA-50 SERVICE LIMITS AND SYSTEMS

This chapter provides only the basic service limitations of the helicopter imposed by flight safety conditions, assuming all the systems and equipment are working properly.

Limited parameter	Value	Reason
Maximum takeoff and landing weight, kg Maximum ferry takeoff and landing weight, kg	10,800 11,900	Airframe and landing gear strength
Maximum airspeed km/h: IAS in gear-up and gear-down configuration During landing gear extension/retraction IAS Ground speed at touchdown	300 200 80	Blade's stall, flutter and strength Landing gear doors strength Nose gears shimmy
Vertical speed in descent (glide) at 50 km/h, m/s IAS: Above 200 m radar altimeter (true) altitude Below 200 m radar altimeter (true) altitude	5 3	Avoid vortex ring
Maximum wind speed, m/s: For taxi; Head wind Crosswind and tailwind For takeoff and landing: crosswind and tailwind	20 10 10	Controllability
Pitch-up and pitch-down maximum angle, degrees	60	
Maximum bank angle, degrees	65	
G-load factor: Maximum up to IAS 250 km/h Minimum	3.0 0	Airframe strength Minimum clearance between lower rotor blades and fuselage

Maximum for ferry configuration	1.5	
Maximum rotor's RPM, %: Up to 190 km/h 190...245 km/h 245...265 km/h 265...280 km/h 280...300 km/h	 98 95 93 91 90	Flutter
Minimum rotor's RPM, %: At takeoff power During maneuvers	 86 83	
TV3-117VMA engines limitations:		
Continuous operation time for all modes, min: Takeoff: Normal conditions Emergency conditions One engine inoperative (OEI) Maximum continuous (nominal) Idle	 6 6...30 90 60 20	Engine reliability and service life
Maximum gas-generator RPM at takeoff mode, %	101.15	Engine strength and endurance
Maximum exhaust gas temperature (EGT) at the gas-generator turbine inlet, °C: Takeoff mode Startup and idle mode	 990 780	Engine thermal endurance
Oil pressure, kgf/cm² Minimum Maximum	 2 4	
Gearboxes limitations:		
Oil pressure, kgf/cm² Minimum at idle mode Minimum at all other modes	 0.5 1.3	
Oil temperature, °C: Minimum during startup and idle mode	 -30	



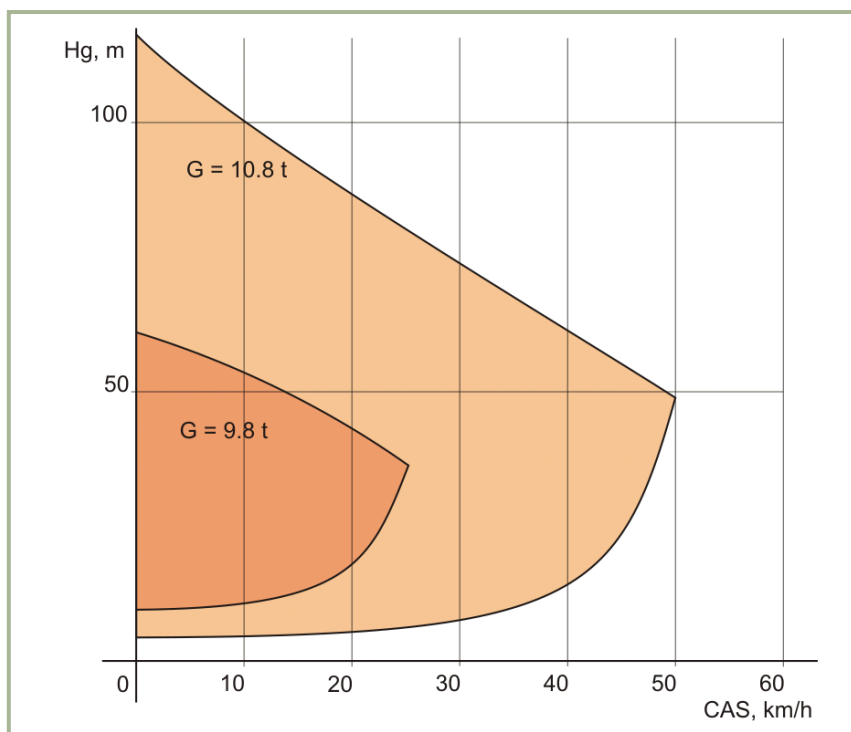
Maximum	+90	
Service limitations of I-251V Shkval		
Distance measuring range, km:	9.9 - 0.6	
Laser rangefinder operation mode for one flight, series: Each serie consists of 16 cycles of 10 seconds with 5 sec interval between the cycles.	5	
Interval between the series, min:	30	
Maximum bank angle when tracking a target in AT mode, degrees:	±45	
Maximum pitch angle when tracking a target in AT mode, degrees:	±50	
Angular velocities range, degrees per second: - in yaw: - in pitch: - in roll:	±30 ±20 ±60	

Critical Altitude-Velocity Zone

The critical altitude-velocity zone is based on the ability to safely land when one engine fails. If an engine fails when helicopter is "within" this critical zone, a safe landing is not guaranteed. Therefore, the pilot should always avoid flying in such conditions.

The upper zone limit is based on sufficient altitude to gain the velocity necessary for an emergency landing maneuver. The lower limit on the other hand is based on an altitude low enough that the helicopter does not gain too high a vertical velocity such that it cannot land safely.

Zone limits are shaped by gross helicopter weight and atmospheric conditions. The picture below illustrates the critical zones for standard and maximum takeoff weights of 9.8 and 10.8 tons.



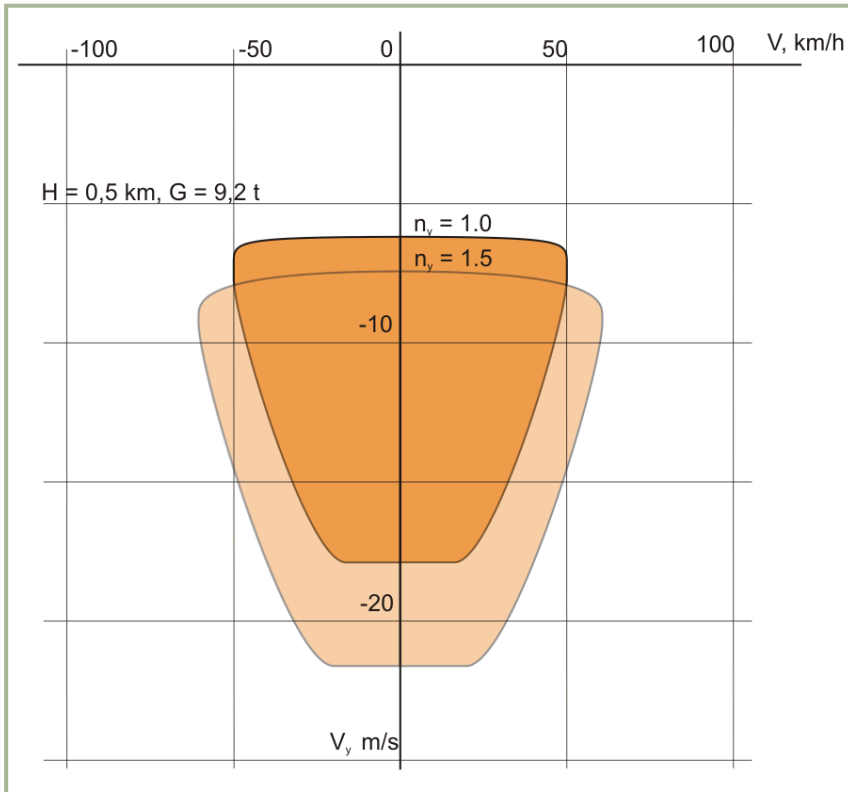
13-1: Critical Altitude-Velocity zone

Vortex Ring Safety Zone

The vortex ring safety zone pictured below is based on the helicopter's weight of 9.2 tons and additional G-force of 1 and 1.5 when flying at an altitude of 500 m.

When the helicopter inadvertently induces a vortex ring state, the pilot should take immediate steps to exit it.

The most reliable way to exit this state is to reduce throttle to 30% and gain enough horizontal speed to get into "clean air". Gaining airspeed quickly usually requires a rapid pitch down. When losing altitude in such a state, this may at first seem counterintuitive.



13-2: Vortex Ring safety zones

Helicopter Control

Lift System

The lift system of a helicopter consists of two rotors connected to the main drive gearbox by a coaxial shaft. This provides the aerodynamic forces required for lift, propulsion, and aircraft maneuvering.

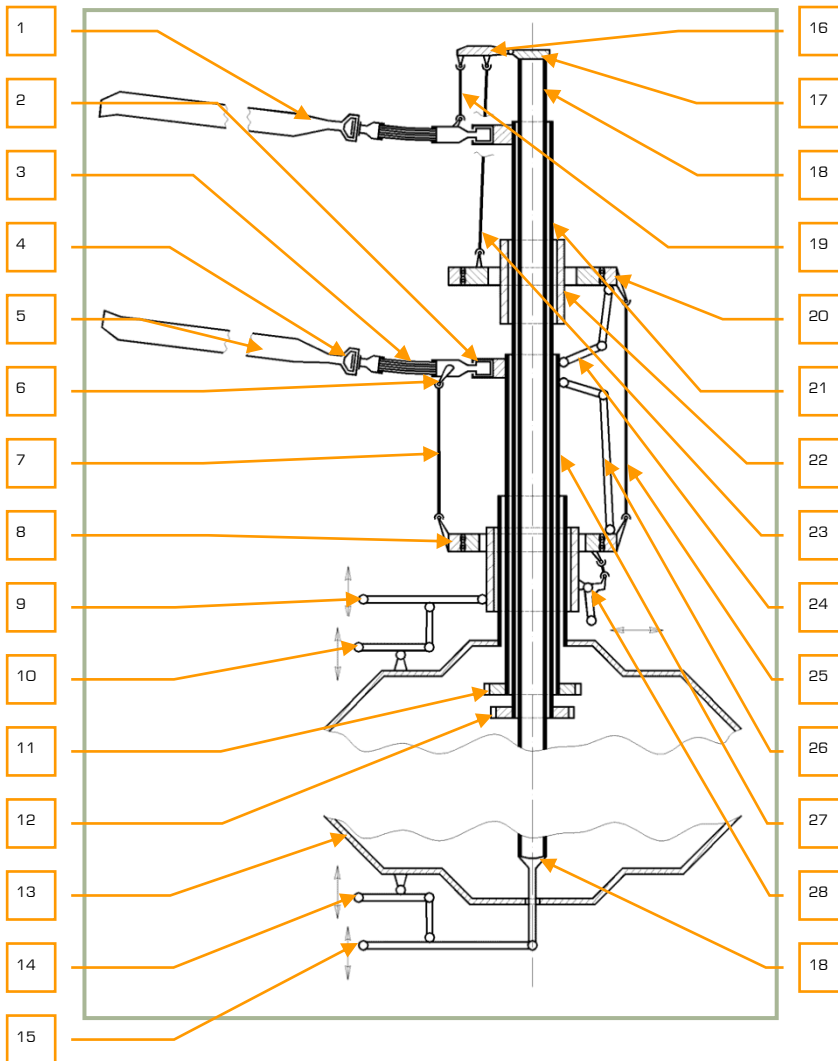
The mechanical blade pitch control rod assemblies for both the upper and lower rotors are integrated with the vertical coaxial rotor shaft, including the hub assemblies, swashplates, and other components. The lower rotor is connected to the outer shaft assembly, which rotates in the opposite direction around the inner shaft that is connected to the upper rotor. This coaxial shaft assembly is used to transfer torque from the engines to the rotor blades and it also delivers lifting force from the rotor blades to the aircraft.

The upper and lower rotor hub assemblies have an analogous construction, with the rotor blades connected to the hub by a bearingless elastic torsion bar attachment made up of steel plates. This torsion bar is sufficiently flexible to allow the desired flapping of the rotor blades under centrifugal force (thus helping to counter the rolling movement on the aircraft in forward motion), as well as permitting control over the rotor blade pitch angle.

Rotor swashplate tilt is used to apply cyclic control to the rotors, effectively translating your linear cyclic control stick movements into rotational control over the rotor blades. The swashplates apply collective and differential rotor pitch control to all blades.

The blades of the upper and lower rotor assemblies are also analogous, differing only in their direction of rotation. Seen from above, the upper rotor rotates clockwise, the lower rotor counter-clockwise.

The rotor blades are equipped with a thermo-electric de-icing system. The lower rotor blades are fitted for tracer illumination in their tips.



13-3: Rotor mast

1. Upper rotor blade
2. Feathering hinge
3. Torsion bar
4. Lagging hinge
5. Lower rotor blade

6. Lower rotor blade driver
7. Lower rotor dynamic regulation rod
8. Lower swash plate
9. Collective pitch control lever
10. Differential pitch control lever
11. Outward drive shaft
12. Inward drive shaft
13. Main gearbox housing
14. Differential pitch control lever
15. Upper rotor collective pitch control lever
16. Sliding member crank
17. Sliding member body
18. Sliding member rod
19. Upper rotor dynamic regulation rod
20. Upper swash plate
21. Inward drive shaft
22. Upper slide-block
23. Upper rotor static control rod
24. Upper swash plate torsion link
25. Linkage rod
26. Lower swash plate torsion link
27. Outward drive shaft
28. Swash plates inclination control cranks

Helicopter Flight Controls

A helicopter can be controlled in longitudinal (forward/backward), lateral (sideways), and rotational (yawing) movement, and also by changing the collective pitch angle of the rotor blades. Longitudinal and lateral flight are accomplished by varying the differential rotor blade pitch on opposite sides of the aircraft, and are both controlled by a single joystick-style control stick, called the "cyclic" control. Two rudder pedals are used to control the aircraft rotation in yaw.

Collective rotor blade pitch angle and engine power are controlled by a second control stick at the left side of the cockpit, called the "collective" control.

A helicopter's controls are connected to the rotor assemblies via one-way hydraulic augmentation. Moving the cockpit controls thus allows the rotor blades to generate and



control imbalances in the lifting force, which cause the aircraft to be propelled in the desired direction along any combination of the three axial directions: longitudinal, lateral, and vertical.

Deflecting the cyclic control in the longitudinal and(or) lateral directions will tilt the rotor swashplate mechanisms accordingly, to create a "feathering" effect that increases the pitch angle of the rotor blades more sharply on one side of the aircraft than on the other. This uneven rotor blade pitch generates a differential lift that is stronger on one side, tilting and propelling the aircraft in the desired direction.

Moving the cyclic control forward and backward increases and decreases the pitch of the helicopter, respectively, and is used to propel the helicopter forward and backward, respectively. Moving the cyclic control to either side will bank the helicopter in the corresponding direction, and is used to propel the helicopter sideways.

Pressing on the left or right rudder pedal increases the collective rotor blade pitch on one rotor, while simultaneously decreasing the rotor blade pitch of the other rotor. In this way, the total lift is maintained, but a differential torque is created between the unbalanced contra-rotating upper and lower rotors, which rotates the aircraft in azimuth. Pressing on one of the rudder pedals also tilts the helicopter's aerodynamic tail rudder in the same (left or right) direction.

Moving the collective control applies a simultaneous equal change of pitch to all rotor blades, both the upper and lower rotors. This is used to control the total (collective) lifting force for movement in the vertical axis (i.e. climb or descent).

The collective control also simultaneously controls engine power, via an automatic engine throttle. Increasing the collective rotor pitch also increases the engine power to generate more lift, while decreasing the collective simultaneously reduces power.

Each flight control (i.e. cyclic, collective, and rudder) is independently connected to the mechanical rotor assemblies and tail rudder control surface. Each control is provided with hydraulic augmentation to reduce the pilot steering force required to control the helicopter in every direction.

In addition to the flight controls described above, the aircraft controls are fitted with trimming mechanisms. These are for:

- Providing an opposite feedback force through the controls to the pilot, linearly proportional to the distance of the control deflection, to imitate conventional aircraft aerodynamic controls.
- Balancing the "neutral" position of the controls, so that the feedback force is absent when the controls are centered.

Special Hardware Considerations for Controlling a Helicopter

Compared to the controls of a real Ka-50, the main difference in this simulation is the need to return the cyclic to a neutral position each time the trim button is activated. In the real aircraft, the cyclic remains in a trimmed position; this is only possible in this simulation if you are using a Force Feedback joystick.

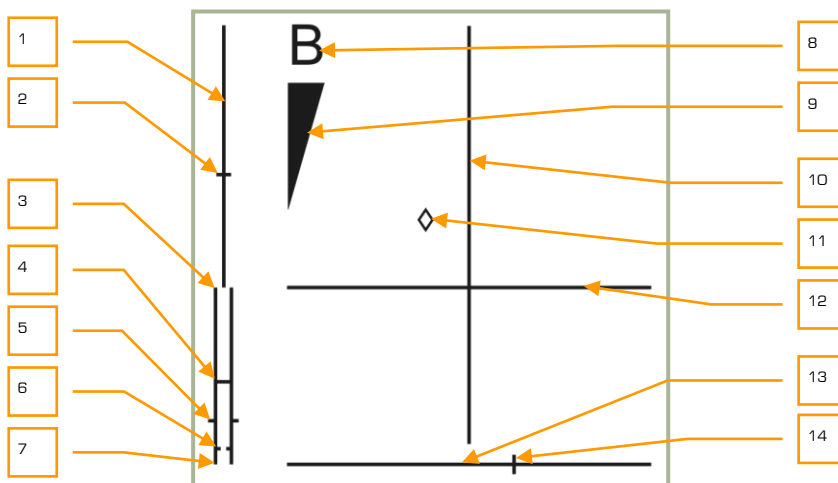
It is highly recommended that you use some sort of rudder input device for controlling the helicopter direction. Three possible ways include:

- Rudder pedals
- Assign a joystick twist grip as rudder control
- Assigning the X-axis of a throttle mini-stick as the rudder control

The collective control in a helicopter is opposite to that in an airplane. In an airplane, you push the throttle(s) forward to accelerate and gain altitude. However, in a helicopter you pull back on the stick to increase power/lift. To achieve greater realism when controlling a helicopter simulation, it is recommended that you invert the throttle axis direction in your joystick configuration.

Flight Controller Position Indicator

To better help users check the range and rate of response for their controllers, a flight controller's position indication can be displayed for cyclic, collective, throttles, and rudder. To toggle this indication on and off, press the **[Enter + RCtrl]** key combination.



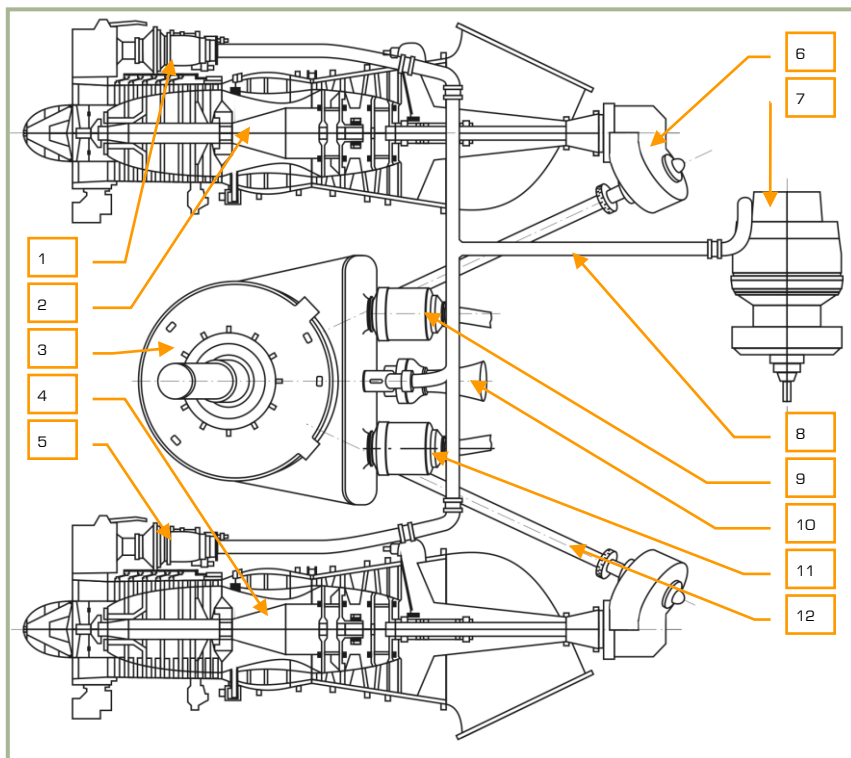
13-4: Flight controller position indicator

1. Collective position scale
2. Collective current position
3. Throttles scale. FULL mode position
4. Throttles scale. AUTO mode position
5. Throttles current position
6. Throttles scale. Engine limit governor failure (MEDIUM) mode position
7. Throttles scale. IDLE mode position
8. Wheels parking brake
9. Wheels brake scale



10. Pitch scale of cyclic
11. Cyclic current position
12. Bank scale of cyclic
13. Pedals scale
14. Pedals current position

Engines and Power Train

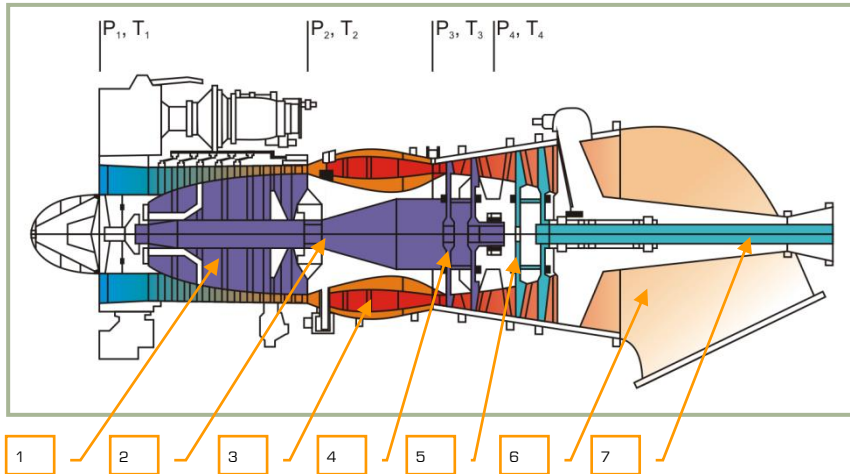


13-5: Engines and power train

1. Right engine impingement starter
2. Right TV3-117VMA engine
3. Main gearbox
4. Left TV3-117VMA engine
5. Left engine impingement starter
6. Intermediate gearbox
7. APU
8. APU bleed air pipeline
9. Right generator
10. Turbine drive

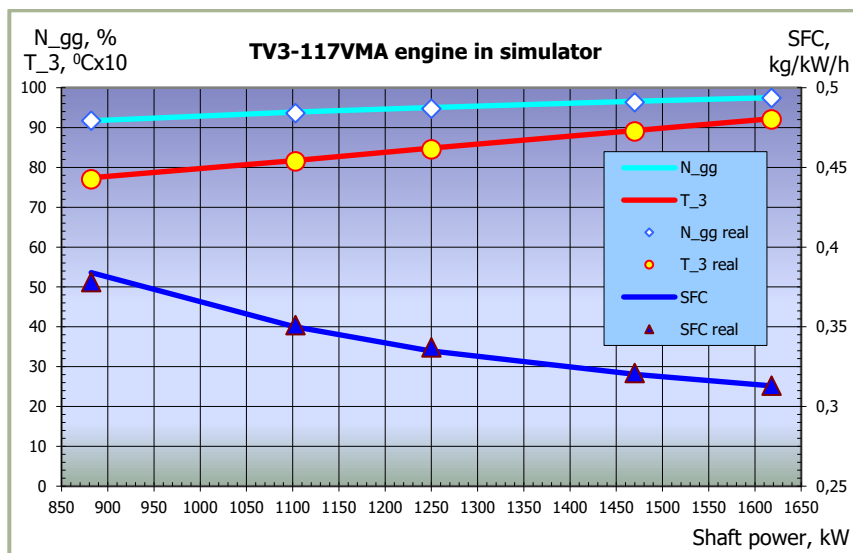
11. Left generator
12. Input drive shaft

TV3-117 Engine



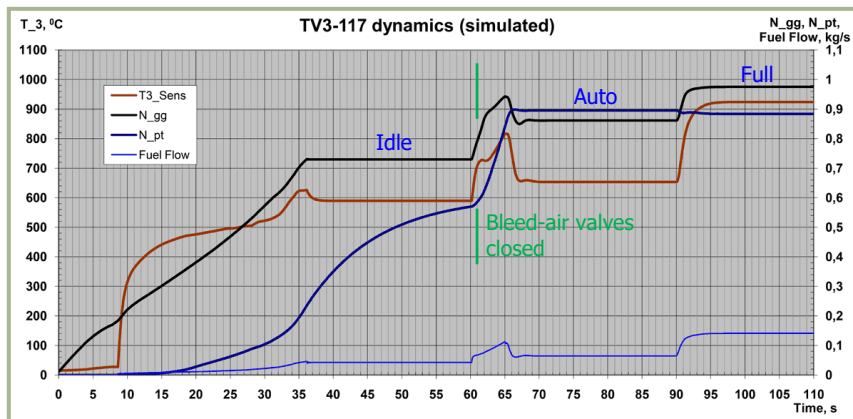
13-6: TV3-117 turboshaft engine

1. Compressor
2. Compressor shaft
3. Annular combustor
4. Compressor turbine
5. Free power turbine
6. Diffuser
7. Power shaft



13-7: TV3-117VMA engine model diagram

- N_gg – RPM gas generator (compressor) model
- N_gg real – RPM gas generator (compressor) of real engine
- T_3 – Turbine entry temperature model
- T_3 real – Turbine entry temperature of real engine
- SFC – Specific Fuel Consumption model
- SFC real – Specific Fuel Consumption of real engine
- N_pt – RPM power turbine model





13-8: TV3-117VMA dynamics

Fuel System

The Ka-50 fuel system supplies the helicopter's engines and APU, and it consists of fuel tanks, fuel lines, a fuel flush system, and various control devices.

The fuel tanks consist of main and external tanks. The main tanks include forward and rear soft tanks. External fuel tanks can be located on all four external hard/wet-points, up to two on each side. The external fuel tanks on the left side of the aircraft are connected to the rear main tank and external tanks on the right side are connected to the forward main tank. The forward tank supplies fuel to the left engine while the rear tank supplies fuel to the right engine. The Auxiliary Power Unit (APU) is fed from the rear main tank. A crossfeed valve is installed between the engines fuel supply lines. When the crossfeed valve is open, either main fuel tank can provide fuel to either engine.

Fuel is directly supplied from the main fuel tanks to the engines and APU, and the main fuel tanks are in turn directly supplied by the external fuel tanks. As such, the external fuel tanks will run empty before the main fuel tanks fall below 100% of capacity. To avoid fuel flowing from the main tanks to the external tanks, non-returning valves are placed on the fuel lines between them.

Fuel pumps are turned on and off manually by setting the boost pump controls in the cockpit. The boost pump indicator lamps are located on the front top indicator panel.

When no fuel is left in the external tanks, the appropriate indicator lamps will turn off:

- **"БАК ЛЕВ ВНЕШ"** – Left outer tank
- **"БАК ПРАВЫЙ ВНЕШ"** – Right outer tank
- **"БАК ЛЕВ ВНУТР"** – Left inner tank
- **"БАК ПРАВЫЙ ВНУТР"** – Right inner tank

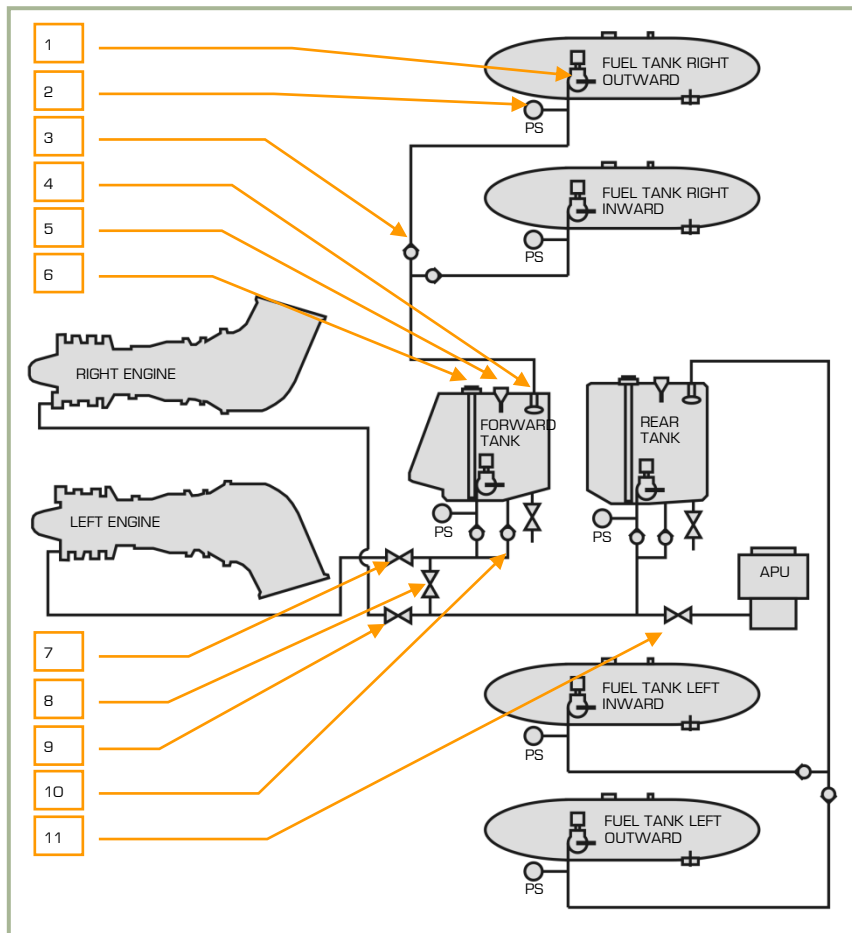
Overall fuel system reliability is enhanced in part due to:

- The fuel pumps are connected to an emergency electrical bus that is fed from the onboard batteries. Thus, fuel supply will continue, even if the electric generators fail.
- The fuel pumps located in the engines are able to pump fuel from tanks through bypass non-returning valves. Thus, the engines will continue to receive fuel, even if the fuel tank pumps have failed.

The overall control of the fuel system and status is represented by the various control valves, fuel gauges, pressure indicators, and indicator lamps. Their locations are:

- The fuel gauge control switch and fuel boost pump controls are located on the **"ТОПЛИВО"** (FUEL) panel of the right wall panel.
- The fuel gauge is located on the right front instrument panel.
- The engine shutoff valves, APU valve, and cross-feed valve are located on the right wall panel.
- Additional indicator lamps are located on the front top indicator panel.

When the remaining fuel quantity becomes critical in one of the main tanks, the master warning light will flash and the EKRAN system will display **"ПЕРЕДНИЙ БАК 110 кг"** (meaning "Forward tank has 110kg remaining") or **"ЗАДНИЙ БАК 110 кг"** (meaning "Rear tank has 110kg remaining").



13-9: Skeleton diagram of Ka-50 fuel system

1. Boost pump. One for each tank
2. Pressure switch. One for each tank
3. Non-return valve
4. Floating valve
5. Scupper assy. For forward and aft tanks
6. Fuel quantity transmitter. For forward and aft tanks



7. Shutoff valve left engine
8. Cross-feed valve
9. Shutoff valve right engine
10. Bypass non-return valve
11. Shutoff valve APU

Total fuel quantity when main tanks are full:	1,450 kg
That includes:	
Forward tank	705 kg
Rear tank	745 kg
Total fuel quantity when main and all external tanks are full:	3,210 kg
Minimum emergency fuel quantity:	
Forward tank	110 kg
Rear tank	110 kg

Emergency jettison of external tanks is performed by pressing the **"ABAP-СБРОС"** (Emergency jettison) button on the central panel.

Electrical System

The Ka-50 electrical system includes:

- 115/200 V AC main power supply
- Emergency AC power supply
- DC power supply
- External power supply

Electrical system controls are located on the wall panel, the instruments are located on the control panel, and the cautions are located on the overhead panel and EKRAN display.

Main electrical power supply consists of a 3-phased AC current with a voltage of 115/200 V. The power source for this is two 3-phased AC generators.

27V DC consumers are supplied by two rectifiers, each operating with one of the two generators.

To ensure flight safety in case of main power failure, there are emergency buses supplied by the batteries. In this case, ~115V AC is provided by the static inverter POS-500B, supplying the emergency AC buses.

External AC power supply can be connected to a plug on the left side of the fuselage. In its absence, electrical power can be provided by the batteries.

To test the serviceability of the equipment on the ground with inoperative engines and lack of ground power, the AC generators are used when the turbo-gear is switched on.

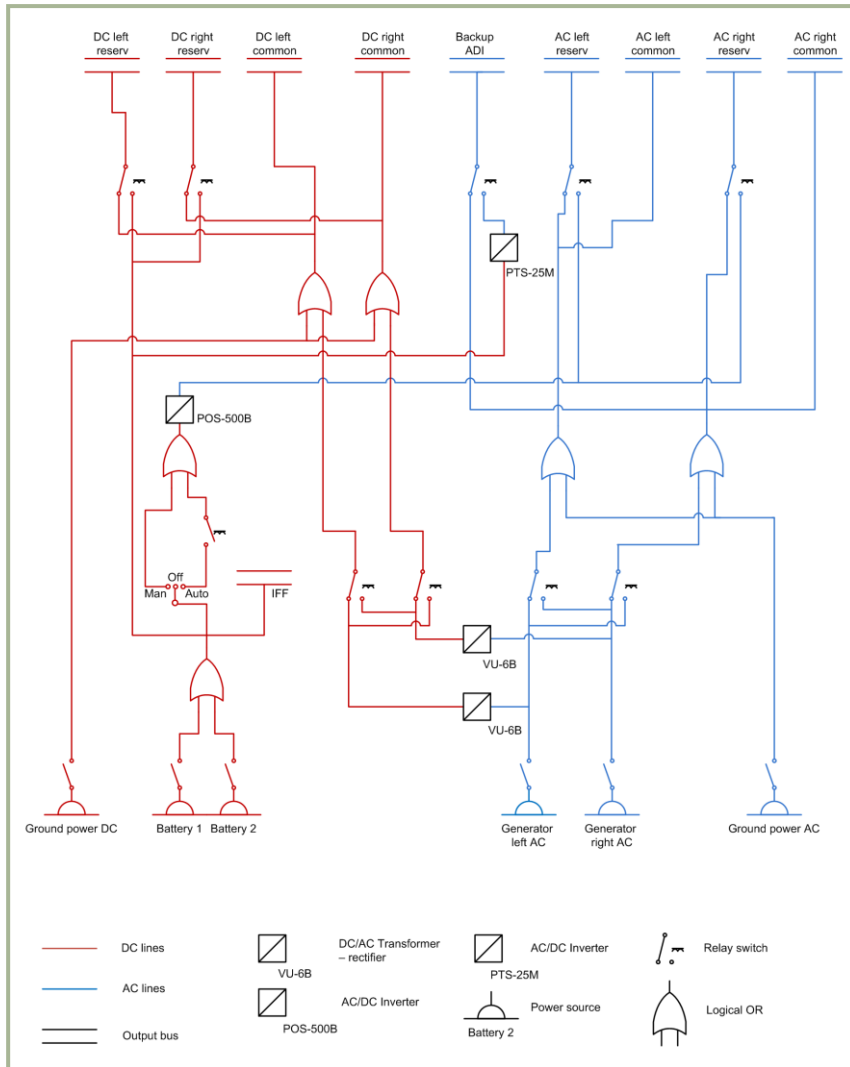
Main AC Power Supply System

The system includes two separate generator channels on the left and right sides of the helicopter. The power source includes two 115/200 V synchronized 3-phased AC generators installed in the rear gearbox, and are driven either by the main gearbox or the turbo-gear.

The left generator is switched to the CDU-1 (Central Distribution Unit) and the right to the CDU-2, which supplies the buses that feed the consumers. In case one generator fails, its buses are automatically switched to the buses of the serviceable generator.

The generators are started by the **"ЭНЕРГЕТИКА ~ТОК"** (AC power), **"ГЕН ЛЕВ"** (left generator), and **"ГЕН ПРАВ"** (right generator) switches, when the rotor RPM is stable above 83-85% or with the turbo-gear operating on ground. When rotor RPM drops below ~80% the AC generators will automatically turn off.

In case both generators fail, the EKRAN will display a **"СЕТЬ НА АККУМУЛ"** (battery bus) message and the audio **"Смотри УСТ"** (Look at the EKRAN panel) message will be heard. On the overhead panel, the **"ПРЕОБРАЗ"** (inverter) light will illuminate, informing the pilot that the POS-500B AC inverter has turned on. On the left side of the instrument panel, the master warning light (MWL) will start flashing.



13-10: Ka-50 electrical power supply schematics

Emergency AC Power Supply

In case of main AC system failure, the AC consumers will be supplied by the static POS-500B inverter. This will transform the 27V DC of the batteries into 115V AC.

The POS-500B inverter supplies the following consumers connected to the emergency bus:

- Radar altimeter
- Power plant's oil pressure switches
- Fuel quantity indicator, G-load accelerometer, engines RPM and EGT indicators, and vibrations monitoring system
- IFF equipment
- Warning and indications systems
- Audio tones for rotor RPM drop
- Emergency instrument panels illumination

The stand-by artificial horizon is supplied by a separate static POS-25M inverter that uses DC input from the batteries. In case both generators fail, this list is expanded with the inclusion of DC emergency bus consumers.

To ensure the automatic activation of the POS-500B inverter, the **"ЭНЕРГЕТИКА ~ТОК"** (AC power) **"ПРЕОБР"** (inverter) selector must be in the **"АВТ"** (Auto) position.

DC Power Supply System

The DC power system consists of two independent channels, installed on the left and right sides of the fuselage.

Each channel includes a VU-6B rectifier, CDU-3 for the left and CDU-4 for the right channel.

In case a CDU channel fails, the buses of the failed channel are switched to the serviceable CDU channel automatically. This ensures a backup to the power supply.

Two batteries are installed in the Ka-50, thus ensuring autonomous engine startup and emergency bus supply if both generators fail. The IFF responder is supplied directly by these batteries.

In the CDU-3 and CDU-4 are two buses.

- Buses №1 is for emergencies, which in case both rectifiers fail, power is supplied by the batteries.
- Buses №2 is for bus disconnection, in case both rectifiers fail and are disconnected.

The following power consumers are supplied by the DC emergency buses (in case both generators and rectifiers fail):

- POS-500B inverter to supply the AC consumers
- Communication equipment: VHF radios, intercom
- Radar altimeter
- IFF responder
- Weapon control system
- Power plant and hydraulic system indicators



- Fuel quantity indicator, fuel pumps, and shut-off valves
- PTS-25 inverter to supply the standby horizon
- Lights
- Pitot heating
- Warning and indication systems and EKRAN system

The batteries are activated by the “ЭНЕРГЕТИКА =ТОК” (DC power), “**БАТ1**” (Battery 1) and “**БАТ2**” (Battery 2) switches on the right wall panel. The rectifiers are automatically turned on when there is an external power source or the generators are online.

In case one of the rectifier fails, the EKRAN display will show a “**ЛЕВ ВЫПРЯМИТ**” (left rectifier) or “**ПРАВ ВЫПРЯМИТ**” (right rectifier) message. At the same time, the Master Warning Light (MWL) will start to flash on the left side of the front instrument panel. If both rectifiers fail, a “**СЕТЬ НА АККУМУЛ**” (Battery bus) message will be shown on the EKRAN display. At the same time, the MWL will start flashing on the left side of the front instrument panel.

Hydraulics

The Ka-50 hydraulic system is used to provide hydraulic power to various helicopter systems. This consists of two subsystems:

- The main hydraulic system supplies the flight control servo actuators for pitch, bank, yaw, and collective. In case of a common system failure, it also ensures emergency landing gear extension.
- The common system supplies the landing gear extend/retract system, the main wheels brakes, and cannon steering. In case of a main system failure, it supplies the flight control servo actuators.

Each system consists of a hydraulic pump, a hydraulic fluid tank, filters, valves, pipes, and control elements. The pressure source for both systems is provided by variable displacement pumps. The main system's pump is mounted on the left accessory gearbox of the main gearbox, and it operates when the rotors are driven by the engines and also when in autorotation. The common system's pump is mounted on the aft accessory gearbox of the main gearbox, and it operates when the rotors are turning or when the APU is on.

There are hydraulic accumulators in each system to prevent pressure oscillations. In the brake system there is a separate accumulator to power the parking brakes (for up to 2 hours) after engines shut down, or power the brakes during taxi in case of a common system failure. The main system's tank has a capacity of 13 liters and the common system tank has a capacity of 17 liters.

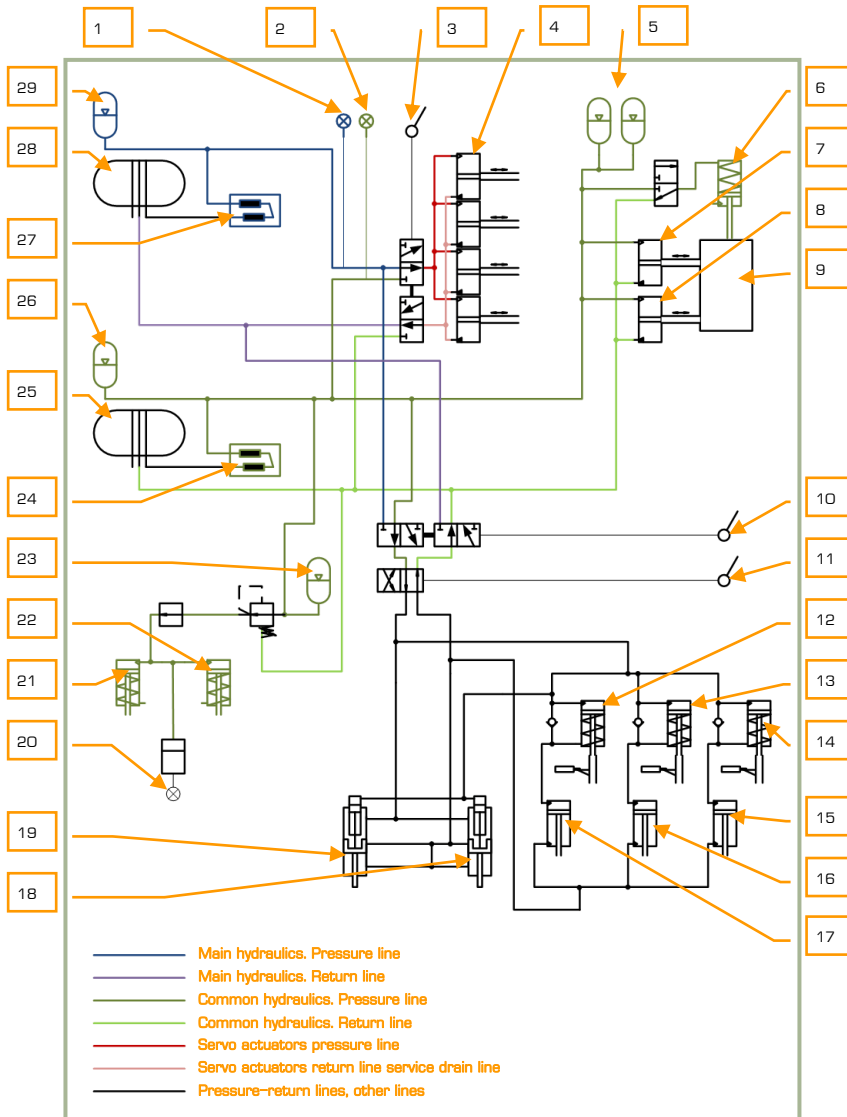
Hydraulic system control is through fluid pressure and temperature indicators and the pressure switches. The indicators are located on the upper part of the cockpit control panel. The indicators include marks that specify the operating range of each indicator:

- Main and common systems pressure indicators. Marks for 64 and 90 kgf/cm²
- Accumulator pressure. Marks for 60 and 90 kgf/cm²
- Brake system pressure indicator. Marks for 0 and 22 kgf/cm²
- Systems fluid temperature indicators. Marks for -10°C and +90°C
- Pressure operating range 65 and 90 kgf/cm²
- Fluid temperature in flight no more than +85°C

Pressure switches are installed in:

- Flight controls servo actuators to indicate pressure drop
- Wheel brake system to indicate pressure drop in the accumulator
- In the tanks pressurization line

Switching hydraulic supply between the main and common system is automatic or manual set by the "**ОСН ГИДРО ОТКЛ**" (MAIN HYDRO OFF) switch and is indicated by the "**КЛАПАН 1 ГИДРО**", "**КЛАПАН 2 ГИДРО**" (VALVE 1 HYDRO, VALVE 2 HYDRO) lights that are located on the control panel above the pressure indicators.


13-11: Hydraulic system model

1. Main hydraulic system pressure indicator
2. Common hydraulic system pressure indicator
3. Servo actuators main-common hydraulics switch
4. Servo actuators. Pitch and bank actuators, yaw actuator and collective actuator

5. Moving gun hydraulic accumulators
6. Moving gun stop lock
7. Moving gun vertical actuator
8. Moving gun horizontal actuator
9. Moving gun
10. Emergency gear selector switch
11. Retract/Extend gear lever
12. Left gear lock check valve
13. Nose gear lock check valve
14. Right gear lock check valve
15. Left gear actuator
16. Nose gear actuator
17. Right gear actuator
18. Right gear door actuator
19. Left gear door actuator
20. Brakes pressure indicator
21. Left wheel brake actuator
22. Right wheel brake actuator
23. Brakes hydraulic accumulator
24. Common system pump
25. Common system tank
26. Common system accumulator
27. Main system pump
28. Main system tank
29. Main system accumulator

Aircraft Targeting and Navigation System

The Aircraft Targeting and Navigation System (abbreviated "PrPNK" in Russian) is the fusion of the radio, gyroscopic, TV, and laser systems with the on-board automatic flight, aerial navigation, and weapon systems. This fusion is then used for the employment of weapon systems against visually identified targets.

Principles of Operation

Prior to the engagement of a mission target, a combat sortie includes the following stages: route flight to the initial point (IP), acquisition and identification of target(s) in target area or target acquisition via data link, approach to the target, and attack with an appropriate weapon system, and return to the designated airfield.

The PrPNK provides the following automatic functions to support the combat sortie stages:

- Flight on a programmed flight plan route to the IP and target area.
- Target acquisition and identification using data link equipment and Shkval targeting system (scan mode).
- Approach to target and attack with the selected weapon.
- Automatic turn to target mode (AT) and automatic target tracking with Shkval.
- Return to airfield (RETURN mode) for landing.

The following automatic target approach and weapon employment functions can be used:

- Shkval targeting via HMD, followed with automatic turn to the target mode (AT).
- Shkval targeting after a manual turn to target; positioning the target in the targeting system field of view; and then locking the target via auto-tracking until target destruction.

The PrPNK uses digital computers and ensures automatic flight solutions, navigation, and combat tasks. The serviceability of the system relies on AC electrical power.

PrPNK Controls

The PrPNK controls are located on the following cockpit panels:

- PVI-800 Navigation Control panel – this is the primary panel to control the PrPNK and it provides mode selection and interaction with the other PrPNK systems. The PVI-800 panel is located on the wall panel.
- Targeting Mode Control panel enables PrPNK power and allows automatic modes and weapon select attack profiles. This panel is located on the left panel.

- The Weapon Status and Control panel controls weapons readiness, weapon employment modes, weapons quantity control, and indication of remaining ordnance. This panel is located on the lower center panel.
- The Targeting Display Control panel allows you to adjust the video image and type of indications displayed on the IT-23 TVM. This panel also allows you to adjust HUD and the helmet mounted device displays. This panel is located on the lower center panel.
- The System Preparation and Checks panel is used by the ground crew to turn on and perform ground functionality tests on several of the PrPNK components. This panel is located in the test panel area.
- The PVTz-800 data link panel, on the wall panel, and the PRTz data link control panel, on the overhead panel, provide data link targeting system control.

The functions of the other switches on these panels that operate separate TNS devices in other various modes are explained in separate chapters.

PrPNK Components

The PrPNK incorporates the following systems and instruments:

- PNK-800 Flight navigation system
- SUO-800 Weapons control system
- I-251V Shkval automatic targeting system
- SOI-800 Information display system
- Helmet Mounted Sight (HMS)
- Data link equipment.
- DUAS-V Angle of attack and side slip sensor
- Digital computers that provide flight and navigation task solutions: TzVM-N ("Computer-N"), combat employment TzVM-B ("Computer-C"), information indication TzVM-I ("Computer-I") and data link targeting TzVM-Tz ("Computer-T")
- Control panels
- Power supply components, connections, and commutation

PNK-800 Flight Navigation System

The PNK-800 flight navigation system is a major component of the PrPNK and it provides automatic flight, navigation, and combat task functions.

Flight task functions:

- Attitude stabilization
- Automatic barometric altitude stabilization
- Automatic true airspeed stabilization
- True (radio) altitude stabilization
- Hover stabilization using data from the ground speed and Doppler drift angle system and the radar altimeter
- Vertical descent with a set vertical speed from hover
- Automatic horizontal route flight and target ingress while maintaining desired flight and navigation parameters
- Weapon recoil disturbance correction
- Flight indications when in director modes

Navigation functions:

- Waypoints (WP), airfields (AF), INU fix (reference) points (FP) and target points (OT) coordinate input into computer memory
- WP sequence programming
- Estimation of navigation parameters when in route flight and target ingress modes
- Automatic computation of the helicopter position coordinates
- Manual coordinate update/correction when flying over a preprogrammed FP or FP lock via I-251V Shkval
- Derive target coordinates with fly over or locking target with the I-251V Shkval
- Current coordinates indication
- Consecutive WP indication
- Autonomous initial on-ground heading setting at extreme, accelerated, and normal with directional gyro alignment of the inertial navigation unit (INU) IK-VK
- Manual correction of the initial heading setting
- Estimated return to two preprogrammed airfields along the shortest track
- Remaining distance and flight time estimation to steerpoint
- Automatic bearing calculation and indication to selected NDB

The system includes the following equipment and instruments:

- On-board digital navigation computer (TzVM-N)
- Attitude stabilization computer (primary function of system)
- Gyro component
- Inertial navigation unit IK-VK
- Ground speed and drift angle Doppler device
- Air-data system (altitude and speed parameters system)
- Stand-by attitude indicator (SAI)
- Attitude director indicator (ADI)
- Horizontal situation indicator (HSI)
- Special mode computer
- Autopilot panel
- KI-13 magnetic compass
- Linear acceleration sensor

Additionally, the PNK-800 includes:

- ARK-22 automatic direction finder
- Radar-altimeter

Main Technical Characteristics

The serviceability of the system is provided under the following conditions:

- Bank and pitch angles up to $\pm 70^\circ$
- Angular velocities (all axis) up to $60^\circ/\text{s}$
- True air-speed from -70 to $+400$ km/h
- Altitude up to 6,000 m
- Full stand-by readiness time in normal preparation is 15 minutes
- Accelerated preparation mode is 3 minutes
- Directional gyro mode is 2 minutes

Precision hold tolerance parameters in steady flight modes:

- Bank and pitch angles - 1°
- Heading – 1.5°
- Barometric altitude ± 20 m
- True altitude in hover ± 1.5 m



- True airspeed set – 10 km/h

Precision of autonomous coordinate calculation when in route flight mode with INU directional gyro alignment for one hour flight time in percents of the distance flown:

- In inertial-Doppler mode – 1.2%
- In course-Doppler mode – 1.6%
- In course-air mode – 10%
- In course-Doppler mode with accelerated flight preparation – 2.4%

Control and Test and Device Indicators

Operating the system is accomplished with the following panels and levers:

- Navigation control panel, targeting mode control panel, targeting display control panel, system preparation and check panel, and data link panel are incorporated in the PrPNK system.
- Buttons on the collective and cyclic controls.
- The weapon status and control panel of the weapon control system.

Switching the PNK and the PrPNK is via the K-041 switch on the left panel.

Attitude (angular) Stabilization Mode

Attitude, altitude, and airspeed stabilization modes are set by pressing the autopilot channel buttons ("**K**", "**T**", "**H**", "**B**") on the autopilot panel.

Pressing the "**TPIMMER**" (TRIM) button on the cyclic stick cancels the autopilot's position signals for bank (**K**), pitch (**T**) and yaw (**H**) and releasing it places the angular position of the helicopter in 3D space in memory.

Pitch angle stabilization allows you to maintain airspeed corresponding to the given negative pitch angle.

Squeezing the handle of the collective (which serves as a collective brake and altitude trim button) will cancel the altitude position signal; releasing it after moving the collective to a new position and flying to a new altitude will set the new altitude into memory and the system will maintain the new altitude. Either the barometric or radar altitude is stabilized according to the selected position of the "**BAR - PB**" (Baro – Radar altitude) switch on the autopilot panel. However, if the switch is set to the "**PB**" position with channel "**B**" enabled and the true altitude is more than 300 m, the autopilot will stabilize to the barometric altitude automatically.

Hover Stabilization Mode

The hover stabilization mode is used to ensure the maintenance of a constant position relative to a set hover point and then maintaining the set hover altitude using the radar altimeter.

This mode is enabled after achieving a hover at an altitude of no less than 4 m and pressing the **"ВИСЕНИЕ"** (HOVER) button on the cyclic stick. When the **"МАРШРУТ-СНИЖЕНИЕ"** (ROUTE-DESCENT) selector on the collective is in the neutral position, the altitude stabilization mode (**"В"**) is enabled automatically. After pressing the **"ВИСЕНИЕ"** (HOVER) button, the **"ВИСЕНИЕ"** (HOVER) and the **"Нрв СТАБ"** (Radar altitude stabilization) lights on the overhead warning panel will illuminate. Displayed on the HUD will be the current hover point and the desired hover zone; how far outside the current hover point is out of the hover zone indicates set hover deviation. On the ADI, the pitch and bank flight directors are enabled, indicating altitude deviation and lateral deviation. Longitudinal and lateral deviation are indicated on the HSI.

This mode is disabled by pressing the **"ВИСЕНИЕ"** (HOVER) button again.

Vertical Descent Mode

This mode allows you automatic descent from a hover by holding down the **"МАРШРУТ-СНИЖЕНИЕ"** (ROUTE-DESCENT) switch in the **"СНИЖЕНИЕ"** (DESCENT) position. This ensures an automatic descent rate of no more than 2-3 m/s and it keeps the helicopter in a constant position over the point of descent.

Automatic Flight Mode

In this mode, the autopilot controls the helicopter on a given trajectory: flight with a set heading, flight, track, and turns. The mode is set after takeoff by moving the **"МАРШРУТ-СНИЖЕН"** (ROUTE-DESCENT) selector on the collective to the **"МАРШРУТ"** (ROUTE) position. The **"ЭК-ЛЗП"** (Desired Heading – Desired Track Angle) and **"БАР-РВ"** (Baro – Radar altitude) switches on the autopilot panel are set in the position corresponding to the selected flight mode.

After turning to the desired heading in **"МАРШРУТ"** (ROUTE) mode, attitude, altitude, and airspeed stabilization are simultaneously set.

Special Mode

The special mode provides automatic stabilization of the helicopter during rocket launches and cannon fire by generating stabilizing pulses to the corresponding autopilot channels.

The special mode is used automatically when firing rockets or the cannon.



PNK-800 Flight Estimation Parameters

Estimation of flight parameters is used to ensure automatic or flight director control of the helicopter when in pre-programmed route or target ingress modes.

COMPUTATION of Helicopter Coordinates Mode

The system processes velocity and direction data to continuously compute the helicopter's position coordinates. The velocity data provided by the INU, air-data, Ground speed, and drift angle Doppler sensors are used to compute coordinates in one of the following modes, graduated by precision:

- Inertial-Doppler (IDM)
- Course-Doppler (CDM)
- Course-aerial (CAM)
- Inertial (IM)

IDM is used as the primary computational mode and it is enabled automatically when the ground speed and drift angle Doppler device are working properly, and absolute velocity data is available from the INU.

The following parameters are estimated in coordinate computation mode:

- Current geographic coordinates of the helicopter
- Ground speed
- Drift angle
- Direction and magnitude of the navigation with meteorological wind

The following navigational parameters are indicated in the computation mode:

- Current geographic coordinates are displayed on the PVI display when the " Φ/λ " button on the PVI is pressed.
- Direction and speed of meteorological wind is displayed on the PVI display when the " δ/V " button is pressed.

Computation mode is enabled automatically with no weight-on-wheels. The mode is disabled upon touchdown.

ROUTE Mode

The Route mode is used to estimate and display the flight-navigation parameters that ensure automatic flight or flight direction during a route flight with up to 6 WP's.

Navigation data is estimated from the current helicopter position to the next consecutive WP.

The following navigational parameters are estimated:

- Desired bearing to WP that accounts for lateral deviation from the desired track (DT)
- Desired course to WP that accounts for wind and the lateral deviation from the DT
- Lateral cross track (XTE) deviation from the DT
- Time and distance remaining to consecutive WP

The two automatic route flight modes are:

- Course, by setting the **"ЗК-ЛЗП"** (Desired Heading – Desired Track Angle) switch on the autopilot panel to the **"ЗК"** (Desired Heading) position.
- Route, by setting the **"ЗК-ЛЗП"** (Desired Heading – Desired Track Angle) switch on the autopilot panel to the **"ЛЗП"** (Desired Track Angle).

The course mode ensures that you reach the WP by continuously eliminating the angle between the ground speed vector and the WP heading. Flight trajectory doesn't coincide with the DT when in this mode.

The turn to the next WP will begin at the current WP without linear lead turn (LLT). The primary advantage of this mode is that the helicopter will always fly the shortest distance to the WP.

The route mode ensures that you reach the WP by the desired track. Thus, the desired direction to reach the WP or target ingress from is provided. When nearing the track to the next WP, a linear lead turn (LLT) is executed prior to reaching the current WP. The estimated turn angle, wind direction and speed, and required bank angle are calculated for the LLT automatically. The primary advantage of this mode is that the helicopter flies continuously on the desired track.

100 m prior to the turn in either mode, the **"ППМ РАЗВОРОТ"** (WP TURN) light will illuminate on the overhead panel. The current navigational parameters are updated for the next stage of the route at the beginning of the turn. The automatic turn is executed with a bank angle of up to 15°.

ROUTE mode is enabled by pressing the **"ППМ"** (WP) light-button on the PVI-800 and setting the **"МАРШРУТ-СНИЖЕН"** (ROUTE-DESCENT) switch on the collective to the **"МАРШРУТ"** (ROUTE) position. The mode is disabled by pressing the **"ППМ"** (WP) light-button again or by setting the **"МАРШРУТ-СНИЖЕН"** (ROUTE-DESCENT) switch on the collective to the neutral position. This mode is automatically disabled 2 km after passing the last WP, the **"КОНЕЦ МАРШРУТА"** (End OF ROUTE), **"МАРШРУТ ЗК (ЛЗП)"** (ROUTE DC (DT)) lights on the overhead panel go off, as well as the lights on the PVI-800.

RETURN Mode

The Return mode is used for automatic flight or manual flight with direction indicators for the return to one of the two pre-programmed airfields from any point on the route by the shortest distance.

The airfield number is selected by pressing the corresponding number after pressing the **"АЭР"** (AIRFIELD) light-button on the PVI-800. The AIRFIELD number is indicated in the PVI-800 display.



The flight is conducted in either the **"ЗК"** (DH) or **"ЛЗП"** (DT) sub-modes.

Estimation of flight navigation data and indicators are analogous to the ROUTE mode.

This mode is enabled by setting the **"МАРШРУТ-СНИЖЕН"** (ROUTE-DESCENT) switch on the collective to the **"МАРШРУТ"** (ROUTE) position and then pressing the **"АЭР"** (AIRFIELD) button on the PVI-800.

During the approach to the selected airfield, the **"КОНЕЦ МАРШРУТА"** (End Of ROUTE) light will illuminate on the overhead panel.

To disable this mode, press the **"АЭР"** (AIRFIELD) button again or set the **"МАРШРУТ-СНИЖЕН"** (ROUTE-DESCENT) switch on the collective to the neutral position. The mode will also be disabled once you automatically over-fly the airfield for more than 2 km.

INGRESS Mode

The Ingress mode is used for automatic flight or manual flight with director indications to one of ten pre-programmed operative (target) points (TP) or targets from any point on the route using the shortest vector.

This mode will estimate the azimuth and distance to the selected TP. The azimuth and distance data is indicated on the PVI-800 display after pressing the **"Ац/Дц"** (Heading/range to target) button. Estimation of other flight navigation data is analogous to the ROUTE mode.

This mode is enabled by setting the **"МАРШРУТ-СНИЖЕН"** (ROUTE-DESCENT) switch on the collective to the **"МАРШРУТ"** (ROUTE) position and then pressing the **"ОТ"** (TP) button on the PVI-800. The TP numbers are assigned by pressing the button with the corresponding digit after pressing the **"ОТ"** (TP) button.

To disable this mode, press the **"ОТ"** (TP) button again or set the **"МАРШРУТ-СНИЖЕН"** (ROUTE-DESCENT) switch on the collective to the neutral position. Automatically over-flying the target for more than 2 km will also disable this mode.

CORRECTION Mode

The correction mode is used to correct coordinate calculation errors that are caused by inaccurate sensor information and computation.

The following correction sub-modes are implemented:

- Fly-over correction
- Correction by locking a reference point with the I-251V

Fly-over and I-251V corrections are done in reference to up to four INU reference points. Each reference point is set in the mission editor and the coordinates are then input into the PNK. Correction is possible after pressing the **"ОП"** (Fix point – Update point) button on the PVI-800.

A fly-over correction is accomplished when the helicopter is over one of the four pre-programmed INU reference points, and when near the reference point, pressing the **"ОП"** (Fix point – Update point) button again on the PVI-800. Then, with the **"И-251В -**

ПРОЛ (I-251V Shkval – Fly over) switch in the **ПРОЛ** (Fly over) position, press the button with the number corresponding to the reference point on the PVI-800's keyboard. The number is then displayed on the PVI display. At the moment of reference point fly-over, press the **ЦУ** (Uncage Shkval – designate target) button on the cyclic and the current computed coordinates are updated with the correct coordinates of the reference point. The light on the **ОР** (Fix point – Update point) button will go off on the PVI-800 and the reference point number indication will extinguish.

Correction mode using a lock by the I-251V is accomplished when within visual range of a reference point after setting the **И-251В - ПРОЛ** (I-251V Shkval – Fly over) switch to the **И-251В** position. When approaching a reference point, press the **ОР** (Fix point – Update point) button again and then enter the INU reference number on the PVI-800 keypad. Turn on the I-251V and slew the sensor's line of sight to the selected reference point. The **ИЗЛ – ОТКЛ** (Laser standby – Off) switch on the targeting mode control panel should be set to the **ИЗЛ** (Laser standby) position. Using the IT-23 TV indicator, place the tracking gate on the reference point and minimize its tracking gate to be smaller than the size of the reference point. Initiate an automatic track lock by pressing the **АВТ ЗАХВ** (Auto Lock) button on the collective. After the **ТА** (Tele-automatic lock) symbol is displayed, press the **ЦУ** (Uncage Shkval – designate target) button again on the cyclic. When this is done, the values of the range and the aiming angle (azimuth and elevation) of the reference point are loaded. With this data now known, the coordinates of the reference point are estimated and used to correct the helicopter's ownship coordinates.

Press the **СБРОС** (Targeting mode reset) button on the targeting mode control panel to disable this mode.

RECORD Mode

The record mode is used to record up to 10 operative Target Points (TP) in system memory.

There are two sub-modes to record a TP:

- Fly-over record
- Record using the I-251V Shkval

In both types of record modes, the recording of the TP is initiated by pressing the **ОТ** (TP) button on the PVI-800 and then assigning a number by pressing a button on the PVI's keyboard. The rotating selector of the PVI must be in the **ВВОД** (INPUT) position.

A fly-over TP record is made by setting the **И-251В - ПРОЛ** (I-251V Shkval – Fly over) switch to the **ПРОЛ** (Fly over) position. At the moment you fly over the new TP, press the **ЦУ** (Uncage Shkval – designate target) button on the cyclic. The computed coordinates of the helicopter are then saved in the TzPU-N as a TP coordinate.

A TP record using the I-251V is done by setting the **И-251В - ПРОЛ** (I-251V Shkval – Fly over) switch to the I-251V position. Use the I-251V to aim at the intended TP and then press the **ЦУ** (Uncage Shkval – designate target) button on the cyclic. The computed coordinates generated by the I-251V and known ownship current position are then saved in the TzPU-N as a new TP coordinate. **ОТ** (OP) single command will then be displayed on the HUD.



This mode may be disabled by pressing the “**СБРОС**” (Targeting mode reset) button on the targeting mode control panel, which also cages the I-251V.

You may over-write the coordinates of an existing TP with any number (0...9), by performing a new TP record using an existing TP number.

TURN Mode

The TURN mode allows automatic target ingress using the I-251V.

This mode is enabled by pressing the “**АДВ**” (Automatic turn on target) button on the targeting mode control panel. This mode will ensure a coordinated turn toward the target – point aimed by the I-251V. The TURN mode can be enabled simultaneously with any other flight mode.



14

**RADIO
COMMUNICATIONS**

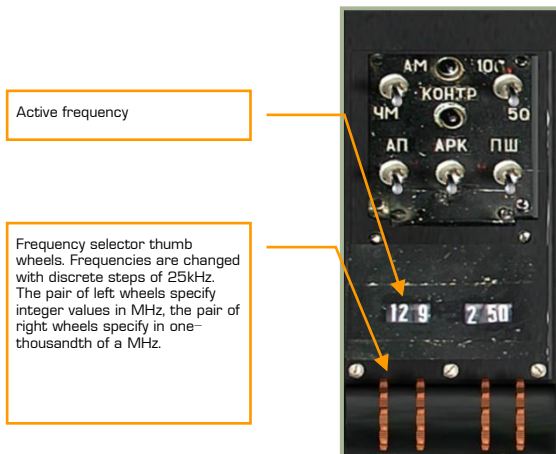
14 RADIO COMMUNICATIONS

The simulation supports radio communications with other entities in the virtual world. This includes wingmen, ground crew, and air traffic control.

Radio Frequencies

All radio commands are available from the communications menu [\\] and are transmitted and received using the helicopter's radio system. As in real life, to establish communication in the game it is necessary for both communicating parties to be on the same frequency. If this condition is not fulfilled, all transmitted messages will be lost.

The Ka-50 uses the R-800 VHF radio to communicate with other helicopters and ground crew. The R-800 operates at frequencies between 100 and 149 MHz as well as 220 to 400MHz.



14-1: The R-800 VHF radio

Communications between flight members are performed at a preset frequency that can be adjusted in the mission editor. The air traffic control is performed at a frequency of airdrome's tower. The frequencies of towers are listed in the "Airdromes data" table in the SUPPLEMENTS chapter.

VHF communications work only when direct line of sight is present. This is true in both real life and the simulation. For a message to be received, a direct line of sight is required between sender and receiver, and the distance should not exceed 150 km. If the receiver is located beyond maximum range, or if there is blocking terrain, the messages will be lost.

Encoded, external data link targeting information is also transmitted by the R-800 and is thus also subject to the same transmission limitations.

For an encoded data link transmission to work properly, each of the four flight members must have their own, unique ID's.

In single-player missions, all flight members have unique ID's that correspond to their status in the formation. In a multi-player game (up to 4 players), players will need to agree upon and assign to themselves unique ID's as well as a common communications frequency. Frequency can be specified in discrete steps of 25 kHz; this allows for up to 9,200 possible frequencies.

Players in a multi-player mission will need to agree upon a communications frequency and set it on their R-800. Additionally, they will need to specify different ID numbers (using the "WHO AM I" knob) in order to transmit target information over the data link.

Erroneous transmissions and inaccurate ABRIS positions will be displayed on the ABRIS if other players join with the same ID's that are on the same frequency.

Ground Services

Ground services in the simulation include ATC and ground maintenance personnel (HOP).

The availability of ground services depends on the presence of specific units associated with the corresponding services. For example, communication with ATC requires the presence of an undamaged ATC tower at an airfield, an CP SKP-11 ATC for red coalition FARP's, or a M1025 HMMVV vehicle for blue coalition FARP's.

The following table indicates the required conditions for the various ground service options possible:

Service	Required units (red coalition)	Required units (blue coalition)	Conditions
Airfield, ATC	Tower	Tower	Not destroyed
Airfield, ground crew, rearming, refueling, ground power, aircraft repair	Not required	Not required	Repair occurs automatically three minutes after the rotors (supporting propellers) are stopped
FARP, ATC	CP SKP-11 ATC, FARP Command Post	APC M1025 HMMVV, FARP Command Post	Within 150 meters from the FARP center
FARP, ground crew, rearming	GAZ-3308, GAZ-66, KAMAZ-43101, KrAZ-6322, Ural-375 KUNG, Ural-375, Ural-4320-09-31, Ural-4320T, FARP Ammo Storage	M818, FARP Ammo Storage	Within 150 meters from the FARP center



FARP, ground crew, refueling	ATMZ-5, ATZ-10, FARP Fuel Depot	Tanker M978 HEMTT, FARP Fuel Depot	Within 150 meters from the FARP center
FARP, ground crew, ground power	GPU APA-5D, GPU APA-80	M818	Within 150 meters from the FARP center
FARP, night lighting system	CP SKP-11 ATC	APC M1025 HMMWV	Within 150 meters from the FARP center
FARP, repair	UAZ-469, Ural-4320-09-31, Ural-4320T, ZIL-131 KUNG, KAMAZ-43101, FARP Tent	M818, FARP Tent	Within 150 meters from the FARP center. Repair occurs automatically three minutes after the rotors (supporting propellers) are stopped

If an airfield ATC tower is destroyed, no communication with ATC will be possible, however ground refueling and rearming services will be continue to function.

If a FARP does not include the required ground service units or they have been destroyed, no ground services will be possible.

Attempts to communicate with ground services of an opposing coalition will be unanswered.

Helicopter repair occurs automatically within the repair zone of an airfield or FARP three minutes after the rotors are stopped.

Commands Menu

The commands menu is selected with the **[V]** key.

The following sub-menus are available:

[F1] Flight...

[F2] Wingman 2...

[F3] Wingman 3...

[F4] Wingman 4...

[F5] ATC...

[F8] Ground Crew...

"Flight...", "Wingman 2...", "Wingman 3...", "Wingman 4..." allow you to communicate with the entire flight or each wingman separately. "ATC..." is for communications with Air Traffic Control. "Ground Crew..." is for communications with ground service personnel.

To exit the communications menu, press **[F12]** or **[ESC]**.

Detailed command descriptions are provided below.

Flight

To give the command to all members of the flight press:

[V] Commands → **[F1]** Flight ...

The following flight sub-menu will then become available:

[F1] – Engage...

[F2] – Go Pincer...

[F3] – Go To...

[F4] – Cover Me

[F5] – Go Formation...

[F6] – Hold Position

[F7] – Rejoin Formation

[F10] – Jettison Weapons

Wingmen

To give commands to individual wingmen:

[V]Commands → **[F2]** Wingman 2 ...



[\\]Commands → [F3] Wingman 3 ...

[\\]Commands → [F4] Wingman 4 ...

You (flight lead) will then have the following commands available for each wingman:

[F1] – Engage...

[F2] – Go Pincer...

[F3] – Go To...

[F4] – Cover Me

[F5] – Reconnaissance...

[F6] – Hold Position

[F7] – Rejoin Formation

[F10] – Jettison Weapons

Engage

The "Engage" submenu has commands to specify targeting for wingmen. These can be given to each wingman individually or to the entire flight.

To give the commands to the whole flight, the following key sequence needs to be pressed:

[↵] Commands → [F1] Flight → [F1] Engage...

To give commands to individual wingmen:

[↵]Commands → [F2] Wingman 2 → [F1] Engage...

[↵]Commands → [F3] Wingman 3 → [F1] Engage...

[↵]Commands → [F4] Wingman 4 → [F1] Engage...

You (flight lead) will then have the following commands available:

[F1] – My Target

[F2] – My Enemy

[F3] – Bandits

[F4] – Air Defenses

[F5] – Ground Targets

[F6] – Mission and Rejoin

[F7] – Mission and RTB

[F8] – Data link Target...

Engage My Target

Wingmen will stop their current task and will attack your target. You may set the target using padlock or by locking it with the Shkval.

Engage My Enemy

Wingmen will attack the target (aircraft or air defense vehicle) that is a threat to you.

Wingmen will analyze the situation and attack the target that is of the highest threat.

Engage Bandits

Wingmen will search and engage enemy helicopters that are within their detection range.

The detection range depends on weather, time of day conditions, and the wingman's skill level. If no target is detected, the wingmen will report back accordingly.

Engage Air Defenses

Wingmen will search for and attack enemy air defenses.



If wingmen have ATGMs they will attack SAM sites, both stationary and mobile, including search radars and launch vehicles.

If wingmen do not carry ATGMs they will not attack SAM sites but may attack Anti-Aircraft Artillery (AAA) targets. These include Shilka, Vulcan, ZU-23, etc.

Man-Portable Air Defense System (MANPADS) SAM's will only be attacked when their missile launch is detected.

Engage Ground Targets

"Engage Ground Targets" instructs wingmen to stop their current task and start searching for and attacking ground targets.

Ground targets are all moving and stationary enemy vehicles.

Once the order is received, the wingmen will attack targets based on their threat priority. Air defense systems have the highest priority while unarmed vehicles have the lowest priority.

If wingmen are not carrying ATGMs or rockets, they will attack targets with their cannons and machine guns but only if targets are not protected by enemy air defenses.

Mission and Rejoin

"Mission and Rejoin" instructs wingmen to attack targets that are mission goals and then rejoin formation.

Mission and RTB

"Mission and RTB" instructs wingmen to carry out mission tasks and then return to base.

Engage Data link Target

The "Engage Data link Target..." group of commands instructs wingmen to attack targets assigned through the datalink. These commands can be assigned to the flight or individual wingmen.

To give commands to the entire flight, the following key sequence needs to be pressed:

[V] Commands → [F1] Flight → [F1] Engage → [F8] Data link Target...

To give commands to individual wingmen:

[V] Commands → [F2] Wingman 2 → [F1] Engage → [F8] Data link Target...

[V] Commands → [F3] Wingman 3 → [F1] Engage → [F8] Data link Target...

[V] Commands → [F4] Wingman 4 → [F1] Engage → [F8] Data link Target...

This in turn will give you (flight lead) the following command options:

[F1] – Target

[F2] – Targets

[F3] – Target by Type

[F4] – Targets by Type

1. "Datalink Target – Target" instructs wingmen to stop their current tasks and attack a target or group of targets nearest to the datalinked target location.
2. "Datalink Target – Targets" instructs wingmen to stop their current tasks and attack all targets within a 3km radius of the datalinked target location.
3. "Datalink Target – Target by Type" instructs wingmen to stop their current tasks and attack a target or group of targets of a specified type (SAMs, Vehicles, or Other) nearest to the datalinked target location.
4. "Datalink Target – Targets by Type" instructs wingmen to stop their current tasks and attack all targets of a specified type (SAMs, Vehicles, or Other) within a 3 km radius of the datalinked target location.

When the engagement is over the wingmen will automatically rejoin formation.

Target Detection

All aircraft in the simulation have an advanced target detection model that takes into account the following conditions:

- Cockpit geometry. Targets will only be detected in sectors that are visible from the cockpit. For example: the Su-25 and Ka-50 have a smaller detection sector in the rear hemisphere due to cockpit design compared to aircraft like the A-10 and Su-27.
- Target's angular size. The closer and larger a target is will result in a shorter time it will take to detect the target. For example: a large ship that is far away may be detected just as quickly as a tank nearby.
- Lighting conditions. During daylight hours, a target will be detected faster than during the night, dawn, and dusk. Targets will not be visually detected at night.
- Terrain and ground object blocking. If a target is blocked by a hill, mountain, building, or trees, it will not be detected.
- Fog. The thicker the fog the harder it is to detect a target. Targets will not be detected visually in thick fog.
- Full cloud cover. If a target is below the cloud base (and the aircraft is above it), the target will not be detected visually.
- Group of targets. If there are other targets in the vicinity they all will be detected faster than one lone target.

Maximum detection range for an object the size of a tank is 7 km. The range of immediate detection is around 2.5 km. The closer the target, the shorter time to detect it.

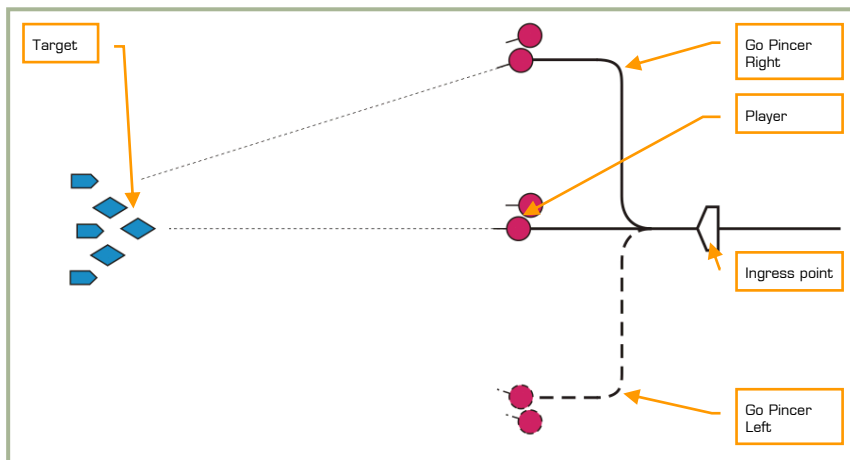
Pincer

This maneuver is used to attack a target from multiple directions. In the simulation there are two commands that can be used with a flight of helicopters: "Go Pincer Right" and "Go Pincer Left".

A pincer maneuver should be initiated when reaching the target area ingress point and still out of range of the enemy air defenses. Generally, this maneuver should be started when the target area is still out 8-15 km away when the ingress is performed at low and very low altitudes.

It may be beneficial to attack a target from three sides at once. For example: wingman 3 could be instructed to "Go Pincer Right", wingman 4 instructed to "Go Pincer Left", and you with wingman 2 attack the target head-on.

Once the order is given, you should reduce speed and wait until your wingmen take their new positions. Only then should the engage orders be given.



14-2: Pincer maneuver

To execute a pincer maneuver, order all members of the flight by using the communications pincer commands menu with the following key sequences:

[V] Commands → [F1] Flight → [F2] Go Pincer...

To give this order to individual wingmen, press:

[V] Commands → [F2] Wingman 2 → [F2] Go Pincer...

[V] Commands → [F3] Wingman 3 → [F2] Go Pincer...

[V] Commands → [F4] Wingman 4 → [F2] Go Pincer...

Then, the following sub-menu will be available:

[F1] – Right

[F2] – Left

Go Pincer Right

“Go Pincer Right” instructs wingman to turn right 90°, fly 3 km from the turn point and then turn left to initial course.

Go Pincer Left

“Go Pincer Left” instructs wingman to turn left 90°, fly 3 km from the turn point and then turn right to initial course.

Go To

This command group is used to direct wingmen to a specific location.

To give the command to all members of the flight press:

[↵] Commands → [F1] Flight → [F3] Go To...

To give the command to a specific wingman, press:

[↵] Commands → [F2] Wingman 2 → [F3] Go To...

[↵] Commands → [F3] Wingman 3 → [F3] Go To...

[↵] Commands → [F4] Wingman 4 → [F3] Go To...

The following sub-menu will then become available:

[F1] – Return to Base

[F2] – Route

[F3] – Data link Point

Return to Base

Wingman will stop their current task and will fly directly and land at the assigned airfield.

Route

Wingman will return to the predefined flight plan and then proceed to the airfield and land.

Data link Point

Prior to sending this message, you must first select the desired PVI Target Point from the PVI-800 control panel. Once selected and blinking on the ARIS display, select the wingman number from the PRTz Data Link Control Panel and then press the Send button. You may now issue the radio command and the selected wingman will proceed to the location specified via the Data Link transmission. Once the location has been reached, he will hover and await further orders.

Cover Me

The "Cover Me" command is used when enemy aircraft has become a threat to your helicopter.

Once a wingman receives it, they stop their current tasks and provide cover for you. If they detect an enemy aircraft, they will attack it without need of further orders.

To give this command to the flight, press:

[↵] Commands → [F1] Flight → [F4] Cover Me

To give it to individual wingmen, press:

[↵] Commands → [F2] Wingman 2 → [F4] Cover Me

[↵] Commands → [F3] Wingman 3 → [F4] Cover Me

[↵] Commands → [F4] Wingman 4 → [F4] Cover Me

Reconnaissance

Reconnaissance is required when there is little or no information about mission targets in the assigned target area (kill box). Rather than blindly enter a target area and face unseen enemy air defenses, it is wise to first recon the area before committing to the attack. Charging into an attack without proper recon is a fast way to get shot down.

As flight lead (player), you have commands at your disposal to perform reconnaissance with your wingmen. All orders are given individually to wingmen.

Reconnaissance is performed by flying at a specified heading for a specified distance, or flying to a particular location specified through the external targeting system data link. When the order is received, the recon helicopter proceeds at low altitude and scans the terrain using the Shkval. Scanning is performed within $\pm 35^\circ$ of the helicopter's longitudinal axis. When an enemy is detected, its type and location are transmitted to you using the external targeting system data link.

When the recon destination is reached, the wingman informs you and returns to formation.

Target detection range depends on each wingman's experience level.

- Excellent – detects targets out to 8 km.
- High and Good – detects targets out to 6 km.
- Average – detects targets out to 4 km.

Thus the less experienced the wingman is, the greater the chance that certain targets will go undetected.

Just as in real life, reconnaissance does not guarantee that all targets will be detected.

To give the reconnaissance order to a wingman, press:

[↵] Commands → [F2] Wingman 2 → [F5] Reconnaissance...

[↵] Commands → [F3] Wingman 3 → [F5] Reconnaissance...

[↵] Commands → [F4] Wingman 4 → [F5] Reconnaissance...

This will display a submenu that allows you to specify reconnaissance depth:

[F1] – In Depth 1 km

[F2] – In Depth 2 km

[F3] – In Depth 3 km

[F4] – In Depth 5 km

[F5] – In Depth 8 km

[F6] – In Depth 10 km

[F7] – To Data link Point

Reconnaissance to Bearing and Depth

After the order is received, the wingman will fly in the direction that you are facing (at the time the order is given) to the specified depth (1, 2, 3, 5, 8, 10 km).

Reconnaissance to Data Link Point

After this order is received, the wingman will fly towards the specified location while scanning the terrain for targets. The location point can be a target, operations point, or ingress point.

Go Formation

Formations are tactical flight patterns that can be used at different stages of flight and combat.

Different flight formations need to be chosen depending on mission task, onboard weapons, expected air defenses, and wingmen skill. There are three components to the formation: distance, interval, and altitude. Depending on these parameters, formations can be tight and spread out. In tight formation, flight members fly at minimum-allowed distances and intervals from each other. In spread formation, intervals and distances are extended but within visual limits.

To give formation orders to the flight, press:

[↵] Commands → [F1] Flight → [F5] Go Formation...

This will display a sub-menu with the following commands:

[F1] – Heavy

[F2] – Echelon

[F3] – Spread

[F4] – Trail

[F5] – Overwatch

[F6] – Left

[F7] – Right

[F8] – Tight

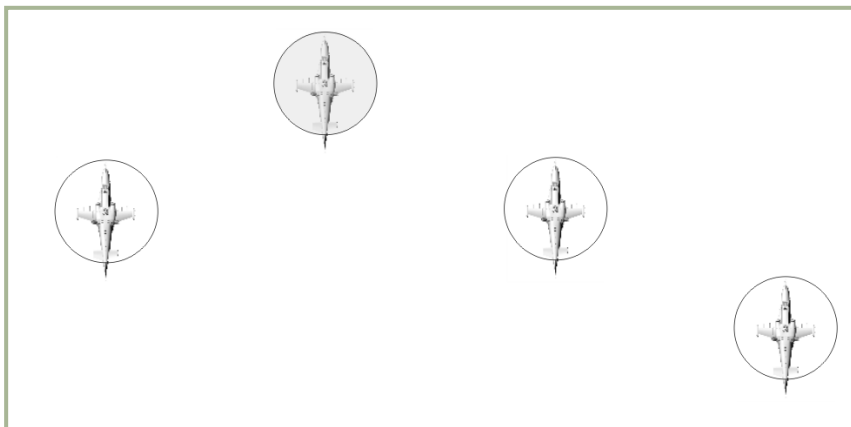
[F9] – Cruise

[F10] – Combat

Using these commands, you can form each of the three flight formations: Heavy, Echelon, and Spread, in left or right configuration, and in three levels of density: Tight, Cruise, and Combat.

For Trail formation player can select Tight, Cruise, or Combat patterns.

“Heavy” formation

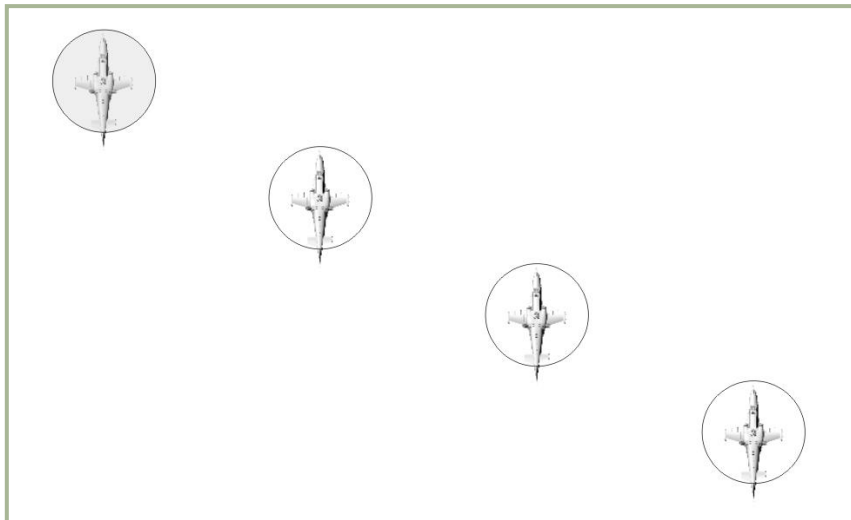


14-3: “Right Heavy” formation

“Right Heavy” formation is used as the default formation.

Flight lead (player) is at the head of the formation with wingman 2 staggered back to the left. To the right are wingman 3 and 4 staggered back.

"Echelon" formation

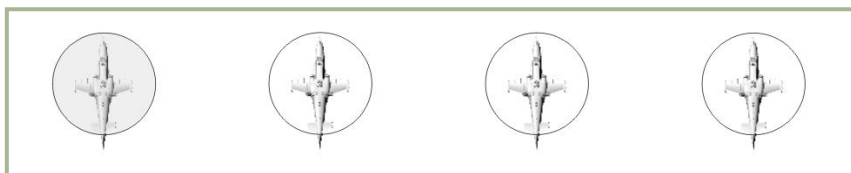


14-4: "Right Echelon" formation

In the "Right Echelon" formation, flight lead is located on the left at the forefront and to the right are wingmen 2, 3 and 4. Each wingman is staggered behind the one ahead of it.

The Echelon formation is used for fast and concealed flight. It provides good observation, freedom for maneuvering, and defense of the aircraft in the front.

"Spread" formation

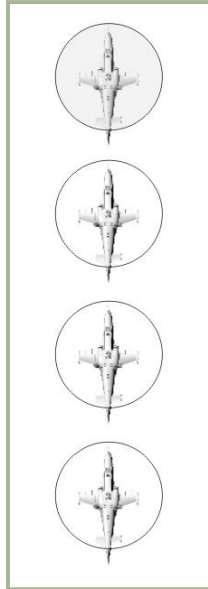


14-5: "Right spread" formation

In the "Right Spread" formation, you are located on the left side of the formation with wingman 2, 3, and 4 to the right. All wingmen are abreast of each other.

"Spread" formation is used in combat when freedom of maneuverability and concentrated firepower are required. Observation and fire sectors overlap between flight members and this allows the flight to mutually focus on higher priority targets.

“Trail” formation



14-6: “Trail” formation

In the “Trail” formation, you are at the forefront and the wingmen are in line behind.

“Trail” formation is used when flying through mountainous terrain to reduce the risk of ground collision for wingmen.

Overwatch

With the “Overwatch” command flight lead (player) can assign one wingman as the observer. The wingman will then fall back 1,500 m and follow the flight.

This will provide him with good view of the rest of the flight and the battlefield and warn the group of any threats.

Left of Right formation types

“Heavy”, “Echelon”, and “Spread” formations can be setup to the left or to the right of you.

By default, the “Right” formation type is used in the simulation.

Formation density

As in real life, formations can be tight or spread out.

- **Tight.** Helicopters are positioned within minimum allowed distances and intervals. The distance between aircraft is around 50 m.
- **Cruise.** Used for concealed flight along route. Distance between helicopters is around 100 m.
- **Combat.** Used in combat to allow freedom of movement and weapons employment. Distance between helicopters is around 200 m.

Hold Position

The "Hold Position" command instructs wingmen to stop their current tasks and initiate circulate at low altitude around point and wait for further orders.

To give this command to the flight, press:

[N] Commands → [F1] Flight → [F6] Hold Position

To give this command to individual wingmen, press:

[N] Commands → [F2] Wingman 2 → [F6] Hold Position

[N] Commands → [F3] Wingman 3 → [F6] Hold Position

[N] Commands → [F4] Wingman 4 → [F6] Hold Position

Rejoin Formation

After contact with the enemy, the formation often falls apart and wingmen perform separate attacks and evasive actions. When the formation needs to be restored, you can issue the "Rejoin" command.

[N] Commands → [F1] Flight → [F7] Rejoin Formation

To give this command to individual wingmen, press:

[N] Commands → [F2] Wingman 2 → [F7] Rejoin Formation

[N] Commands → [F3] Wingman 3 → [F7] Rejoin Formation

[N] Commands → [F4] Wingman 4 → [F7] Rejoin Formation

Once all wingmen receive the order and confirm it, they will stop their current tasks and return to the set formation. When each wingman is back in their formation position he acknowledges it over the radio.

Jettison Weapons

"Jettison Weapons" instructs wingmen to jettison all weapons from external hardpoints.

This reduces helicopter weight and drag, and increases lift power and flight range.



Weapons jettison is performed in emergency situations. For example: when there is a sudden air defense threat that requires immediate evasive maneuvers, engine damage, or low fuel situations.

When all weapons are jettisoned, the wingmen have virtually no ability to continue their mission because the only weapon remaining will be their cannon.

To give this order to all flight members, press:

[↵] Commands → [F1] Flight → [F10] Jettison Weapons

To give this order to an individual wingman, press:

[↵] Commands → [F2] Wingman 2 → [F10] Jettison Weapons

[↵] Commands → [F3] Wingman 3 → [F10] Jettison Weapons

[↵] Commands → [F4] Wingman 4 → [F10] Jettison Weapons

Air Traffic Control

The Air Traffic Control (ATC) menu group contains commands for interaction with airfield traffic controllers and includes operations for start-up, taxiing, takeoff, and landing procedures.

To bring up this submenu press:

[↵] Commands → [F5] ATC...

This will display the 10 closest available airdromes and FARPs ATC: F1...F10.

Press desired ATC callsign. This will display available commands.

NOTE. Not all commands are available at any moment, only proper commands
--

For example, if you are in air you can't select the Start Up or Take-off requests, because those have not a sense. But you can select Inbound and Landing.

The full list of commands:

- Request Start-Up
- Request Taxi to Runway
- Request Hover Check
- Request Takeoff
- Inbound
- Request Landing
- Request Azimuth

Request Start Up

You ask the tower for permission to start up the engines. If the weather does not preclude this, permission is given. Permissible conditions include a wind speed that does not exceed 20 m/s for head-on wind and a 10 m/s for side or tail-wind.

Request Taxi to Runway

You ask permission to taxi. If the weather does not preclude this, permission is given. Permissible conditions include a wind speed that does not exceed 20 m/s for head-on wind and a 10 m/s for side or tail-wind.

Request to Hover Check

You ask permission to do a hover check. If the weather does not preclude takeoff the permission is given. Permissible condition is wind speed that does not exceed 10 m/s in any direction.

Request Take Off

You ask for takeoff permission. If the weather does not preclude this and there is no other aircraft in the air nearby, permission is given. Permissible conditions include a wind speed that does not exceed 10 m/s in any direction.

Inbound

You ask the tower for information about landing at the airfield. The tower replies with heading (in degrees), distance, QFE (air pressure at airfield elevation) and recommends the pilot to assume the pattern altitude. This altitude is usually specific for each airfield; however it can be assumed to be 300 m by default. FARP's will illuminate the their landing pad at night after this message is sent.

Request Landing

When you are within 5 km of the airfield you can ask for permission to land. If the runway is free, the tower gives permission along with a landing course, wind speed, and direction on ground. If the runway or landing pad is occupied, the permission is denied and you will be instructed to go around. Once the landing area is free, the tower will provide permission, without the need to request it again.

If you have not asked for landing permission, the tower informs you about landing conditions when you are within 1 km of the runway or other landing area.

Request Azimuth

The "I'm Lost" request is sent to an automatic radio beacon at the air base when an aircraft loses situational awareness in flight.

In real life, this request is sent when navigation equipment has failed, during inclement weather, or at night. Once received, the air controller replies with the heading information to the airfield.

This is modeled the same way in the simulation. If you lose situational awareness, you can send an "I'm Lost" request. The heading to the nearest airfield or landing area will then be sent. To reach it, you need to change the helicopter's heading to the specified value.

Ground Crew

This menu group contains commands to communicate with the ground crew. The ground crew can change weapon payloads, refuel the aircraft, provide electrical power supply, change helmet devices, and connect the APU to the turbo gear.

In real life, all this work is performed by the ground crew. The communication is done through the pilot's and ground crew's telephone headsets when the Comms knob is set to "НОП".



14-7: Radio panel

When the helicopter is "cold", communication is done by voice through the open door.

As in real life, there are two communication methods with the ground crew:

- Through the telephone headset device when the radio knob is set properly and when the "INT.COM" switch is set to "ON" on the side panel.
- Through normal voice when the helicopter is "cold" and the door is open. This assumes that the engines, APU, and rotors are off.

When at airfields, communication with ground crew is only possible on the concrete areas. At Forward Arming and Refueling Points (FARPS), the entire landing pad is a valid area.

When any command is given, the crew replies with a "Copy" to acknowledge that the order was received and understood. If the acknowledgement is not received, you should assume the command was not received. In such a case it is advisable to check the radio control knob, that the door is open, or that there is no noise from the engines, APU, or rotors.

The time to complete the order is usually one to three minutes.

To bring up the ground crew commands menu press:

[↵] Commands → [F8] Ground Crew ...

This will display the following options:

[F1] – Rearm & Refuel

- [F2] – Ground Electric Power...
- [F3] – Request Repair
- [F4] – Change Helmet-mounted Device...
- [F5] – Select power source...

Rearm & Refuel

To bring up the MISSION RESOURCES window press:

[V] Commands → [F8] Ground Crew → [F1] Rearm & Refuel



There are many different loadouts available for the stores from which the most appropriate for the task can be selected:

- By Flight Plan
- Anti-tank
- Ferry
- Lightweight variants
- Deep Strike
- CAS

By Flight Plan

The best suitable weapons loadout from the mission file is selected by default.

Anti tank

This configuration is best suited for anti-tank missions.



- 12x9A4172; 10xS-13; 2A42 (12 ATGM "Vikhr", 10 S-13 rockets, cannon)
- 12x9A4172; 2xKMGU (Anti tank); 2A42 (12 ATGM "Vikhr", 2 KMGU with anti tanks bomblets, cannon)
- 12x9A4172; 2xUPK-23; 2A42 (12 ATGM "Vikhr", 2 UPK-23 gunpods, cannon)
- 12x9A4172; 40xS-8KOM; 2A42 (12 ATGM "Vikhr", 40 S-8KOM rockets, cannon)

Ferry

This configuration is used for distant relocations or long flights. It is optimized for maximum flight range.

- 2xFuel Tanks (2 Fuel Tanks 440 kg)
- 4xFuel Tanks (4 Fuel Tanks 440 kg)

Lightweight variants

This configuration is optimized for when outside temperature is high or when operating from high-mountain areas.

In these conditions, engine power output is reduced, thus there is a need to limit the helicopter's overall weight to enable vertical flight.

- 10xS-13; 2A42 (10 S-13 rockets, cannon)
- 12x9A4172; 2A42 (12 ATGM "Vikhr", cannon)
- 2xUPK-23; 2A42 (2 UPK-23 gunpods, cannon)
- 40xS-8KOM; 2A42 (40 S-8KOM rockets, cannon)
- 6x9A4172; 2A42 (6 ATGM "Vikhr", cannon)

Deep Strike

This configuration is used to perform just that – deep strikes. It has two external tanks on a pair of hardpoints and weapons on the other pair.

- 2xFuel Tanks; 2xKMGU (Anti tank); 2A42 (2 Fuel Tanks 440 kg, 2 KMGU with anti tanks bomblets, cannon)
- 2xFuel Tanks; 2xKMGU (Anti material); 2A42 (2 Fuel Tanks 440 kg, 2 KMGU with anti material bomblets, cannon)
- 2xFuel Tanks; 10xS-13; 2A42 (2 Fuel Tanks 440 kg, 10 S-13 rockets, cannon)
- 2xFuel Tanks; 12x9A4172; 2A42 (2 Fuel Tanks 440 kg, 12 ATGM "Vikhr", cannon)
- 2xFuel Tanks; 2xFAB-250; 2A42 (2 Fuel Tanks 440 kg, 2 FAB-250 bombs, cannon)
- 2xFuel Tanks; 2xFAB-500; 2A42 (2 Fuel Tanks 440 kg, 2 FAB-500 bombs, cannon)

- 2xFuel Tanks; 2xUPK-23; 2A42 (2 Fuel Tanks 440 kg, 2 UPK-23 gunpods, cannon)
- 2xFuel Tanks; 40xS-8KOM; 2A42 (2 Fuel Tanks 440 kg, 40 S-8KOM rockets, cannon)

CAS

This configuration is best suited for close air support of ground troops on the battlefield. Intended targets include armored and unarmored vehicles, artillery, and infantry.

- 10xS-13; 2A42 (10 S-13 rockets, cannon)
- 4xFAB-250; 2A42 (4 FAB-250 bombs, cannon)
- 4xFAB-500; 2A42 (4 FAB-500 bombs, cannon)
- 4xKMGU (Anti tank); 2A42 (4 KMGU with anti tanks bomblets, cannon)
- 4xKMGU (Anti material); 2A42 (4 KMGU with anti material bomblets, cannon)
- 4xUPK-23; 2A42 (4 UPK-23 gunpods, cannon)
- 80xS-8KOM; 2A42 (80 S-8KOM rockets, cannon)

Ground Electric Power

During normal operations, a helicopter needs to be started using a mobile power supply at the airfield or FARP. However, start-up from onboard batteries is possible in emergencies or when operating from unprepared locations where an external power supply is not available.



14-10: Mobile electrical power supply

To bring up the menu for external power supply control press:

[N] Commands → [F8] Ground Crew → [F2] Ground Electric Power ...

This will display the following commands:

[F1] – On

[F2] – Off

When a helicopter is starting from a “cold” state at the beginning of a mission, it is already connected to external power supply by default. Therefore, there is no need to explicitly request to connect to it.

You will need to request this procedure when landing during the mission and the engines are turned off. In this case, the command needs to be issued when the cockpit door is open.

This equipment is available at all airfields and FARPS.

Repair

To bring up the repair press:

[V] Commands → [F8] Ground Crew → [F3] Request Repair

Helicopter repair occurs automatically within the repair zone of an airfield or FARP three minutes after the rotors are stopped.

Helmet-mounted Device

The Ka-50 pilot can use two helmet devices: Helmet Mounted Sight (HMS) targeting system and Night Vision Goggles (NVG).

The HMS system, designated Shel-ZUM, is used to determine angular coordinates of line-of-sight of tracked target (tracking is done by moving your head) and transmitting this information to the Shkval targeting system.



14-8: Helmet Mounted Sight (HMS) targeting system

OVN-1 “Skosok” night vision goggles are used in low-light conditions for takeoff, flight at low altitudes, target detection, and landing on unlit areas.



14-9: Night vision goggles (NVG)

Depending on the mission and flight conditions, you may wish the ground crew to replace the helmet device.

Standard equipment is the HMS targeting system; however, in low light conditions it may be preferable to fly with the night vision goggles.

To bring up the helmet device menu press:

[↵] Commands → [F8] Ground Crew → [F4] Change helmet-mounted device...

This will bring the submenu:

[F1] – Setup HMS

[F2] – Setup NVG

Select power source

Turbo gear allows the testing of helicopter subsystems without the need to have the engines running. This gear operates from compressed air that is supplied by APU power and it powers the AC generator and hydraulics pump.

On the real Ka-50, turbo gear is activated by the ground crew by setting the appropriate controls on the helicopter's main gearbox. This in turn displays "МУФТА ОТКЛ" in the cockpit and disables engine start.

To bring up the menu for turbo gear control press:

[↵] Commands → [F8] Ground Crew → [F5] Select power source...

The available options are:

[F1] – Request turbo gear

[F2] – Use regular launch

Turbo gear is OFF by default.

To connect turbo gear to the main gearbox and start it:



1. Order the ground crew to connect turbo gear to the main gearbox and confirm it by the **"МУФТА ОТКЛ"** indicator.
[N] Commands → [F8] Ground Crew → [F5] Turbogear → [F1] On
2. Launch and warm up the APU as required.
3. Turn the knob (Engine selector: APU-left engine-right engine-turbo gear) [E] to **"ТУРБОПРИВОД"** (engines control panel on the left panel).
4. Turn on the generators and other subsystems as needed.

Perform the above steps in reverse order to turn off turbo gear before starting main engines.

Ground Equipment Requirements

At Forward Arming and Refueling Points (FARP)s, ground equipment resources are tracked to determine the level of support that can be provided to the player. This can include electrical power, radio communications, fuel, and weapons for both AI helicopters and the player.

The ground equipment units must be placed within a 150 meters radius from the center of the FARP (it is circumscribed around corners of the FARP). The units required vary between eastern and western forces:

Eastern forces:

1. CP SKP-11 command post, FARP command post for radio communications
2. GPU APA-50 or GPU APA-80 for electrical power
3. ATMZ-5, ATZ-10, Transport URAL-375 or FARP Fuel Depot for refueling
4. URAL-375 transport or FARP Ammo Dump for rearming

Western forces:

1. M1025 HMMWV APC for radio communications
2. M818 transport for electrical power
3. M978 HEMTT tanker for refueling
4. M818 transport for rearming

If an above unit is absent or destroyed, the assigned resource will be unavailable.

Note: If a FARP is attacked and all units are destroyed, you may wish to set up a trigger to move new units within 150 meters of the destroyed base to provide support functions. For airfields, the above vehicles are not required, but if the control tower is destroyed, radio communications will not resume until a M1025 or CP SKP-11 command is brought to the area.



F10 Other

The mission creator can assign the custom radio message in the trigger panel that will be appearing in the F10 radio menu.



COMMANDS AND MESSAGES

All radio communications use the following format:

Callsign «to whom», callsign «from who», message.

- Callsign to whom – designates the message receiver.
- Callsign from who – designates message sender.
- Message – the actual information message.

Example 1:

Maikop, 251, distance 5, visual to runway, gear is down, ready for landing.

This message is sent to the control tower at Maikop airfield and the callsign of the aircraft is 251. The pilot informs the tower that he is 5 km from the runway, has a visual on the runway, has his landing gear down, and is ready for landing.

Example 2:

Two, SAM launch, 3 o'clock, engaging defensive.

All internal-flight messages are addressed to the flight lead. Therefore, the sender callsign ("to whom") is omitted.

In this example, wingman 2 informs that he detected a surface-to-air missile launch at his 3 o'clock and is performing a defensive maneuver to avoid the missile.

The direction is based on the clock hours that became very common among Allied air forces during the Second World War. The principle is simple; the pilot assumes position at the center of the clock. Current flight direction (aircraft nose) is pointing at 12 o'clock, tail is at 6 o'clock, to the right is 3 o'clock, and to the left is 9 o'clock.

"Target 4 o'clock low" means the target is located to the right and slightly behind and is lower than the aircraft.

Radio messages (brevity codes) need to be short and easy to understand.

The following tables describe types of messages and radio commands in the simulation. Depending on the type of message, from two to four key presses (F1-F10) may be required to send a radio message.

- Receiver – this is the message recipient: flight, wingman, control tower, ground crew.
- Command – this is the message type ("Attack", "Takeoff permission" etc.)
- Subcommand – example "Attack my target" or "Echelon formation".
- Response and comments – receiver's response to the message.

Commands and Messages List

Message Target (Key)	Command (Key)	Sub Command (Key)	Response(s) and comments
(F1) Flight (F2) Wingman 2 (F3) Wingman 3 (F4) Wingman 4	(F1) Engage ...	(F1) My Target	If wingman is capable of carrying out this command, he will respond "(x) Engaging designate target". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable".
		(F2) My Enemy	If wingman is capable of carrying out this command, he will respond "(x) Copy," "(x) Roger," or "(x) Affirm". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable".
		(F3) Bandits	If wingman is capable of carrying out this command, he will respond "(x) Engaging bandits". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable".
		(F4) Air Defenses	If wingman is capable of carrying out this command, he will respond "(x) Engaging air defenses". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable".
		(F5) Ground Targets	If wingman is capable of carrying out this command, he will respond "(x) Engaging ground targets". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable".
		(F7) Mission and Rejoin	If wingman is capable of carrying out this command, he will respond "(x) Engaging primary". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable".
		(F8) Mission and RTB	If wingman is capable of carrying out this command, he will respond "(x) Engaging primary". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable".
		(F9) Data link Target	If wingman is capable of carrying out this command, he will respond "(x) Target assignment received, engaging target". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable".
(F1) Flight (F2) Wingman 2 (F3) Wingman 3 (F4) Wingman 4	(F2) Go Pincer...	(F1) Right (F2) Left	If wingman is capable of carrying out this command, he will respond "(x) Copy," "(x) Roger," or "(x) Affirm". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable".
(F1) Flight (F2) Wingman 2 (F3) Wingman 3 (F4) Wingman 4	(F3) Go To...	(F1) Return To Base	If wingman is capable of carrying out this command, he will respond "(x) Returning To Base ". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable".
		(F2) Route	If wingman is capable of carrying out this command, he will respond "(x) Following to route ". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable".
		(F3) Data link Point	If wingman is capable of carrying out this command, he will respond "(x) Copy," "(x) Roger," or "(x) Affirm". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable". After arrived to the point, wingmen report"(x) "Arrived to point, awaiting the further instructions".
(F1) Flight (F2) Wingman 2 (F3) Wingman 3 (F4) Wingman 4	(F4) Cover Me		If wingman is capable of carrying out this command, he will respond "(x) Copy," "(x) Roger," or "(x) Affirm". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable".
(F1) Flight	(F5) Go Formation...	(F1) Heavy	If wingman is capable of carrying out this command, he will respond "(x) Copy," "(x) Roger," or "(x) Affirm". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable".
		(F2) Echelon	If wingman is capable of carrying out this command, he will respond "(x) Copy," "(x) Roger," or "(x) Affirm". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable".
		(F3) Spread	If wingman is capable of carrying out this command, he will respond "(x) Copy," "(x) Roger," or "(x) Affirm". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable".
		(F4) Trail	If wingman is capable of carrying out this command, he will respond "(x) Copy," "(x) Roger," or "(x) Affirm". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable".
		(F5) Overwatch	If wingman is capable of carrying out this command, he will respond "(x) Copy," "(x) Roger," or "(x) Affirm". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable".
		(F6) Left	If wingman is capable of carrying out this command, he will respond "(x) Copy," "(x) Roger," or "(x) Affirm". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable".
		(F7) Right	If wingman is capable of carrying out this command, he will respond "(x) Copy," "(x) Roger," or "(x) Affirm". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable".



		(F8) Tight	If wingman is capable of carrying out this command, he will respond "(x) Copy," "(x) Roger," or "(x) Affirm". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable".
		(F9) Cruise	If wingman is capable of carrying out this command, he will respond "(x) Copy," "(x) Roger," or "(x) Affirm". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable".
		(F10) Combat	If wingman is capable of carrying out this command, he will respond "(x) Copy," "(x) Roger," or "(x) Affirm". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable".
(F2) Wingman 2 (F3) Wingman 3 (F4) Wingman 4	(F5) Reconnaissance e...	(F1) In Dept 1 km (F2) In Dept 2 km (F3) In Dept 3 km (F4) In Dept 5 km (F5) In Dept 8 km (F6) In Dept 10 km (F7) To Data link Point	If wingman is capable of carrying out this command, he will respond "(X) Proceeding to scan mode". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable". If wingman detects a target, he will report: "[X] Target detected, bearing YYY, range ZZZ, armor (air defense, vehicle)" while simultaneously providing data transfer via data link. After the recon is done the wingmen report: "[X] Reconnaissance complete, rejoining formation". If wingman takes fire or suffers damage during recon, he will report: "[X] Taking damages, aborting task".
(F1) Flight (F2) Wingman 2 (F3) Wingman 3 (F4) Wingman 4	(F6) Hold position		If wingman is capable of carrying out this command, he will respond "(x) Copy," "(x) Roger," or "(x) Affirm". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable".
(F1) Flight (F2) Wingman 2 (F3) Wingman 3 (F4) Wingman 4	(F7) Rejoin Formation		If wingman is capable of carrying out this command, he will respond "(x) Copy," "(x) Roger," or "(x) Affirm". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable". Since wingmen will take the place in formation he gives a report: "[X] in formation right (left)".
(F1) Flight (F2) Wingman 2 (F3) Wingman 3 (F4) Wingman 4	(F10) Jettison Weapons		If wingman is capable of carrying out this command, he will respond "(x) Copy," "(x) Roger," or "(x) Affirm". If wingman is incapable of carrying out command, he will respond, "(x) Negative," or "(x) Unable".
(F5) ATC...	(F1...F10) Tower	(F1) Request Engine Start	If the weathers conditions do not exceed a limit on the start procedure, Tower responds: "[N], [M], cleared to start-up, wind [ZZZ], speed SSS meters per second". If the weathers conditions exceed a limit on the start procedure, Tower does not give permission: "[N], [M], negative".
		(F2) Request Taxi	If the weathers conditions do not exceed a limit for the taxi, Tower responds: "[N], [M], cleared to taxi to runway [ZZZ]". If the weathers conditions exceed a limit for the taxi, Tower does not give permission: "[N], [M], negative".
		(F3) Request Hover Check	If the weathers conditions do not exceed a limit for take-off, Tower responds: "[N], [M], You are cleared for hover check, wind [ZZZ], speed SSS meters per second". If the weathers conditions exceed a limit for take-off, Tower does not give permission: "[N], [M], negative".
		(F4) Request Takeoff	If the weathers conditions do not exceed a limit for take-off, Tower responds: "[N], [M], You are cleared for take-off, wind [ZZZ], speed [SSS] meters per second". If the weathers conditions exceed a limit for take-off, Tower does not give permission: "[N], [M], negative".
		(F5) Inbound	Tower responds: "[N], [M], Fly heading [ZZZ], for [YYY], GFE [PPP.P] millimeters, descent to pattern altitude".
		(F6) Request Landing	If a runway or helipad is free, Tower accords permission to landing and reports of wind: "[N], [M], Cleared to landing runway [ZZZ], wind [ZZZ] degrees at [SSS] meters per second". If the runway or helipad is taken than Tower responds: "[N], [M], Orbit for spacing". After runway or helipad vacation the Tower accords permission to landing without a player request. If player didn't request to landing up to 1 km to runway, the Tower respond: "[N], [M], Runway [ZZZ], wind [ZZZ] degrees at [SSS] meters per second, check landing gear".

		(F7) Request Azimuth	Automatic Direction Finder operator respond: "[N], [M] your bearing [ZZZ]".
(F8) Maintenance	(F1) Rearm & Refuel		After making the settings in the MISSION RESOURCES window, the player clicks OK. When the ground crew receives a command, they report: "Copy". After completing the reload & refuel, they respond: "Commander, weapons reloaded" and "Commander, refuel complete".
	(F2) Ground Electric Power...	(F1) On	If the ground crew receives a command, they report: "Copy". After reloading is complete they respond: "Commander, ground electric power connected".
		(F2) Off	If the ground crew receives a command, they report: "Copy". After reloading is complete they respond: "Commander, ground electric power disconnected".
	(F3) Request Repair		If the ground crew receives a command, they report: "Copy". Repair lasts 180 seconds. After repairing is complete, they respond "Commander, the repair has been completed"
	(F4) Change helmet- mounted device...	(F1) Setup HMS	If the ground crew receives a command, they report: "Copy". After reloading is complete they respond: "Commander, HMS mounted".
		(F2) Setup NVG	If the ground crew receives a command, they report: "Copy". After reloading is complete they respond: "Commander, NVG mounted"
	(F5) Select power source...	(F1) Turbo Gear	If the ground crew receives a command, they report: "Copy". After reloading is complete they respond: "Commander, Turbo gear connected".
		(F2) Rotor Gear	If the ground crew receives a command, they report: "Copy". After reloading is complete they respond: "Commander, Turbo gear disconnected".

[X] - flight member

[N] - player's callsign

[M] - airfield tower or helipad callsign



AI Messages

AI objects in the game will also send messages to the player. Wingmen will inform the player about their actions and detected threats. The Control Tower will provide information about takeoff and landing procedures.

- Sender – designates object that sends a message.
- Event – situation in which message is generated.
- Radio message – the text of message that player hears.

Report initiator	Event	Radio Report
Wingman	Takeoff	"[X], Takeoff"
Wingman	Wheels up after takeoff	"[X], wheels up"
Wingman	Illuminated by laser	"[X] Laser spike, [Y] o'clock"
Wingman	Surface-to-Air Missile fired at wingman	"[X] Sam launch, [Y] o'clock"
Wingman	Performing defensive maneuver against threat	"[X] Engaged defensive"
Wingman	Hit by enemy fire and damaged	"[X] I'm hit" or "[X] I've taken damage"
Wingman	Is ready to eject from aircraft	"[X] Ejecting" or "[X] I'm punching out"
Wingman	Wingman has spotted enemy ground target	«[X] Ground target detected, bearing [ZZZ] for [YYY]»
Wingman	Wingman has spotted high priority target (SAM, helicopter)	"[X] Request permission to attack priority target"
Wingman	Flying to attack target	"[X] Running in" or "[X] In hot"
Wingman	Bombs released	"[X] Bombs gone"
Wingman	Air-to-ground missile fired	"[X] Missile away"
Wingman	Unguided rockets fired	"[X] Rockets gone"
Wingman	Gun fired	"[X] Guns, Guns"
Wingman	Destroyed enemy ground structure, ground vehicle, or ship	"[X] Target destroyed," or "[X] Good hits"
Wingman	Visual contact on enemy aircraft	"[X] Tally bandit, [Y] o'clock"
Wingman	Shot down enemy aircraft	"[X] Splash one," or "[X] Bandit destroyed," or "[X] Good kill, good kill!"
Wingman	Returning to base due to excessive damage	"[X] R T B," or "[X] Returning to base"
Wingman	Has reached fuel state in which aircraft must return to base or risk running out of fuel	"[X] Bingo fuel"
Wingman	No remaining weapons on wingman's aircraft	"[X] Winchester"
Wingman	Enemy aircraft is behind player's aircraft	"Lead, check six!"
Wingman	Player's aircraft is about to explode or crash	"Lead, bail out!"



ATC – Tower	If player didn't request landing up to 1 km from runway	"[N], [M], Runway (ZZZ), wind (ZZZ) degrees at [SSS] meters per second, check landing gear".
ATC – Tower	After runway or helipad is vacated by other aircraft	"[N], [M] Cleared to landing, runway (ZZZ), wind (ZZZ) degrees at [SSS] meters per second".
ATC – Tower	Player has come to a halt after landing on runway.	"[N], [M], taxi to parking area."
ATC – Tower	Runway is occupied by other aircraft	"[N], [M], execute go-around"

[X] - flight member

[N] - player's callsign

[M] - airfield tower or helipad callsign



15

MISSION
EDITOR


15 MISSION EDITOR

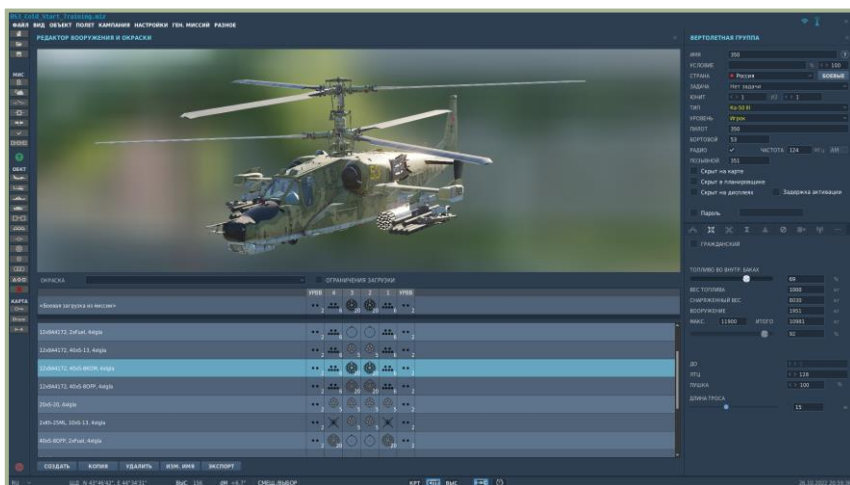
New Options


For detailed information on the mission editor and aircraft settings during mission creation, you may refer to the DCS User Manual found in the game's installation directory under the following directory:
... :\\DCS World\\Doc\\DCS User Manual EN.

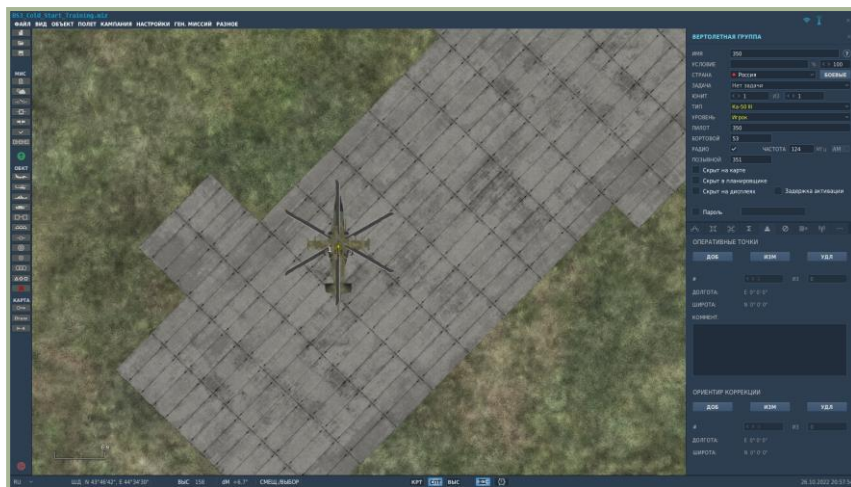
In this section we will talk about the new options for DCS Ka-50 III.

In the center of the panel labeled Helicopter Group you will find a row of mode tabs, which have seen a number of changes and new features.

The loadout editor, accessed by clicking on the  , has been changed to display an interactive 3D window of the currently selected aircraft that reflects changes made to its loadout. The user will be able to view any changes made to the aircraft's loadout in real-time.



The panels previously labeled “Landmarks” and “Operational Points” have now been merged into one single tab  :



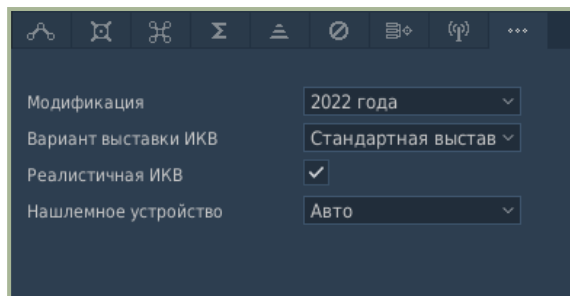
The “Malfunctions” tab  now supports a number of new systems in light of the aircraft’s new inertial INU simulation.

УСТРОЙСТВО	После(ч:мм)		Длит. (мин)	Вероятн.(%)
ГИДРО ОСН.	0	0	1	< > 100
ГИДРО ОБЩ.	0	0	1	< > 100
ЛЕВ. ДВИГ.	0	0	1	< > 100
ПРАВ. ДВИГ.	0	0	1	< > 100
САУ Т	0	0	1	< > 100
САУ К	0	0	1	< > 100
САУ Н	0	0	1	< > 100
САУ В	0	0	1	< > 100
АБРИС, ПРОГРАММНОЕ ОБЕСПЕЧЕНИЕ	0	0	1	< > 100
АБРИС, АППАРАТНОЕ ОБЕСПЕЧЕНИЕ	0	0	1	< > 100
ОТКАЗ ЛАЗЕРА	0	0	1	< > 100
ОТКАЗ РАДИОВЫСОТОМЕРА	0	0	1	< > 100
Отказ ДИСС	0	0	1	< > 100
Отказ инерциальной курсовертикали	0	0	1	< > 100

СЛУЧ
ОЧИСТИТЬ

Please keep in mind that when the Doppler navigator experiences a malfunction while in-flight, you may end up flying in a direction completely different from what you have set in your flight plan, due to the continuously accumulating calculation errors by the KA-50's avionics systems. This may lead to further malfunctions and/or damage to the craft.

We have also added a new tab for "Additional Aircraft Settings".



This tab will display the following options which will be applied to the Ka-50 immediately upon mission start.

Modification. Select the Ka-50 production model:

- 2011
- 2022

INU Alignment. Select the INU alignment setting to be applied upon mission start:

- Accelerated
- Normal
- Normal + Gyrocompass

Realistic INU. Select between a realistic and simplified simulation of the INU.

Helmet-mounted device. Select your pilot's helmet-mounted device:

- Auto
- Helmet-mounted targeting system
- NVG



16

SUPPLEMENTS

16 SUPPLEMENTS

Morse Code Alphabet

Morse code	Alphabet	
	Russian	Latin
•—	А а	A a
—•••	Б б	B b
•— —	В в	W w
— — •	Г г	G g
— ••	Д д	D d
•	Е е	E e
••• —	Ж ж	V v
— — ••	З з	Z z
••	И и	I i
— • —	К к	K k
• — ••	Л л	L l
— —	М м	M m
— •	Н н	N n
— — —	О о	O o
• — — •	П п	P p
• — •	Р р	R r
•••	С с	S s
—	Т т	T t
•• —	У у	U u
•• — •	Ф ф	F f
••••	Х х	H h
— • — •	Ц ц	C c
— — — •	Ч ч	O o
— — — —	Ш ш	Ch ch



-- • --	Щ щ	Q q
- • ---	Ы ы	Y y
• • ---	Ю ю	U u
• - • -	Я я	A a
• ---	Й й	J j
- • • -	Ь ь	X x
• • • •	Э э	E e

Morse code	Digits full
• ----	1
• • ----	2
• • • --	3
• • • • -	4
• • • • •	5
- • • • •	6
-- • • •	7
--- • •	8
---- •	9
-----	0
Morse code	Digits brief
• -	1
• • -	2
• • • -	3
• • • • -	4
• • • • •	5
- • • • •	6
- • • •	7
- • •	8
- •	9

-	0
---	---

Morse code	Punctuation marks
•-•-•-	Period
-•-•-•	Semicolon
-•-•••	Colon
••••••	Point
••-•-••	Question mark
•-••-•	Quotes
-•••-•	Comma
-•-•••	Left brackets
-•-••-•	Right brackets



Acronym List

AAA	Anti-Aircraft Artillery
AC	Alternating Current
ADF	Automatic Direction Finder
ADI	Attitude Direction Indicator
AF	Airfield
AGL	Above Ground Level
AH	Attack Helicopter
ALT	Altitude
AMMS	Advanced Moving Map System
AOA	Angle Of Attack
AP	Autopilot
AP	Armor Piercing
APU	Auxiliary Power Unit
ASL	Above Sea Level
ATC	Air Traffic Control
ATGM	Anti-Tank Guided Missile
BIT	Built In Test
BP	Battle Position
CAM	Course Aerial
CAS	Calibrated Air Speed
CDU	Central Distribution Unit
CDM	Course Doppler
CG	Center of Gravity
DC	Direct Current
DCS	Digital Combat Simulator
DH	Desired Heading
DR	Drift Angle
DST	Distance
DT	Desired Track
DTA	Desired Track Angle
EDP	Engine Dust Protectors
EEG	Electronic Engine Governor
EGT	Exhaust Gas Temperature
EO	Electro Optical
ETA	Estimated Time of Arrival
ETP	Estimated Touchdown Point
FAC	Forward Air Controller
FARP	Forward Arming and Refueling Point
FEBA	Forward Edge of Battle
FOV	Field Of View
FPL	Flight Plan
FSK	Function Select Key
GG	Gas Generator



GNSS	Global Navigation Satellite System
GS	Ground Speed
HDG	Heading
HE	High Explosive
HMS	Helmet Mounted Sight
HSI	Horizontal Situation Indicator
HUD	Heads Up Display
IAF	Initial Approach Fix
IAS	Indicated Air Speed
IDM	Inertial Doppler
IDS	Information Display System
IFF	Identify Friend or Foe
IFR	Instrument Flight Rules
IFV	Infantry Fighting Vehicle
INU	Inertial Navigation Unit
IWP	Initial Waypoint
LAT	Latitude
LLT	Linear Lead Turn
LONG	Longitude
LWR	Laser Warning Receiver
LWS	Laser Warning System
MANPADS	Man-Portable Air Defense System
ME	Mission Editor
MILS	Abbreviation for milliradian; Bomb/Gun sight settings were expressed in mils, an angular measurement; one degree was equal to 17.45 mils.
MRB	Magnetic NDB Bearing
MWL	Master Warning Light
NATO	North Atlantic Treaty Organization
NDB	Non Directional Beacon
NVG	Night Vision Goggles
OEI	One Engine Inoperative
PT	Free Turbine
PNK	Russian "ПНК". Aircraft Flight and Navigation system
PrPNK	Russian "ПрПНК". Aircraft Targeting, Flight and Navigation System
RAIM	Receiver Autonomous Integrity Monitoring
RAlt	Radar Altitude
RB	Radio Bearing
RMI	Radio Magnetic Indicator
RPM	Revolutions Per Minute
ROF	Rate Of Fire
RTB	Return To Base
SAI	Stand-by Attitude Indicator



SAM	Surface-to-Air Missile
STP	Steerpoint
TAS	True Air Speed
TCA	True Track Angle
TH	True Heading
TOW	Takeoff Weight
TP	Target Point
TV	Television
TVM	Television Monitor
UHF	Ultra High Frequency
UTC	Coordinated Universal Time
VHF	Very High Frequency
VFR	Visual Flight Rules
VMU	Voice Message Unit
VNAV	Vertical Navigation
VOR	VHF Omnidirectional Range
VVI	Vertical Velocity Indicator
WCS	Weapon Control System
WPT	Waypoint
XTE	Cross Track Error
АБРИС	Integrated Airborne Onboard Radio-Technical System
БКО	Onboard Defense Suite
ГПК	Flight Gyroscope
ЗК	Command Heading
МК	Magnetic Heading
ЗМС	Magnetic declination encoder
ДИСС	Doppler device for ground speed and drift angle failure
ИК-ВК	Vertical and heading information complex.
ИКВ	Inertial navigation unit
МУП	Universal launch module
НИП	(Missile) ground power source
ПВИ	Control and display unit
ПВЦ	Target designation control panel
ПНК	Flight and navigation system
ПНП	Horizontal situation indicator (HSI)
ППР	Flight mode control panel



ПрПНК	Aircraft Targeting, Flight and Navigation System
ПРЦ	Targeting mode control panel
ПУИ	Control and display unit
WCS	Weapon Control System
УВ	INU accelerated alignment
НВ	INU normal alignment
ТВ	INU precision alignment
ПЗ	INU restart
ЦБМ	Digital computer
ЦБМ-Н	Digital navigation computer

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