

Instrument NDB Approach

Fly the landing heading using one of the described approaches after having set the required heading needle of the HSI to the landing (runway) heading.

Make drift angle corrections while keeping the descent airspeed at 140 km/h and a sink rate of 2 to 3 m/s.

Altitude in the glide path should be maintained according to the following formula:

$$H = \frac{D}{20} + H_{hov}$$

Where:

H – Altitude in the glide path

D – Distance to the estimated hover point (m)

H_{hov} – Altitude in the estimated hover point (m)

After crossing the inner NDB at 1000 m away from the runway threshold, smoothly slow the helicopter down using the following formula for reference:

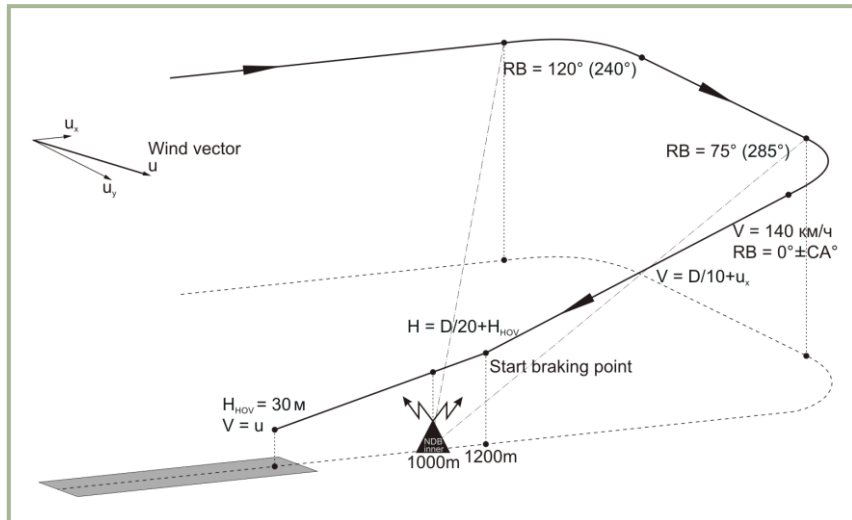
$$V = \frac{D}{10} + U_x$$

Where:

V – Airspeed

D – Distance to the estimated hover point (m)

U_x – Wind vector component in the landing heading



10-4: Instrument NDB approach

ROUTE, DESCENT AND HOVER MODES

In this chapter we will discuss the use of a flight route via the PVI-800 navigation control panel. This assumes that a flight route has first been created in the Mission Editor (ME). Keep in mind that the PVI-800 flight and navigation system can only operate with up to six pre-loaded waypoints (WP) from the ME or created when in the cockpit. Therefore, when using the autopilot route mode, you should consider this limit when placing WPs in the ME for the mission. Routes created in the ABRIS cannot be used by the PVI-800 navigation system for automatic route flight. The PVI-800 and ABRIS navigation systems are not linked!

During pre-flight, perform a test of the navigation system prior to take off:

- Set altimeter pointers to zero.
- Set the minimum safe altitude.
- Check that the heading indication on the HSI and magnetic compass are in relation to the takeoff (runway) heading.
- Check that the selected NDB radio bearing RMI needle is correct on the HSI.
- Check that the Mode selector switch on the PVI-800 Navigation Control panel is in the **"РАБ"** (Operation) position. Press the **"ППМ"** (Waypoint) push-light and then the desired WP number on the keypad.
- Check that the **"ЗПУ-ЗК АВТ – РУЧН"** (Desired Track Angle-Desired Heading, Auto - Manual) switch next to the HSI is in the **"АВТ"** (Auto) position.
- Check that the **"ЗК-ЛЗП"** (Desired heading - Desired track) switch on the Autopilot panel is in the correct position according to desired hold, heading, or course hold, as task requires.
- Check that the helicopter's position on the ABRIS is at the initial point and the heading is to the first WP.
- Start the flight time Clock.

Pre-loaded Route Autopilot Flight

Prior to loading a flight route:

- From the INU heading data selector switch on the right panel, set the switch to the middle **"ГПК"** (Directional Gyro) position.
- From the **"ЗПУ-ЗК АВТ – РУЧН"** (Desired track angle - Desired heading, Auto - Manual) switch next to the HSI, set the switch to the **"АВТ"** (Auto) position.

After takeoff, stabilization, speed, heading, and trimming, engage the Route Flight mode by setting the **"МАРШРУТ-СНИЖЕН"** (Route - Descent) switch on the collective to the **"МАРШРУТ"** (Route) position. This in turn will engage **"МАРШРУТ ЗК (МАРШРУТ ЛЗП)"** (Route DH (Route DT) and the helicopter will automatically initiate a turn to the first waypoint with a bank angle up to 15°.

According to the selected **"ЗК-ЛЗП"** (Desired Heading - Desired Track) switch position on the Autopilot panel, the helicopter will automatically turn toward the WP from either its current location (fly directly to steerpoint) or to intercept and stabilize on the desired course track.

Once you have climbed to the desired altitude, set the altitude stabilization selector **"БАР-РВ"** (BARO/RAlt altitude hold modes) switch on the Autopilot panel to the desired position according to task. Ensure that the Altitude Hold autopilot channel is engaged (blue push-light with "B" in the center).

When the RAlt hold sub-mode is on, the HUD altitude scale and a numeric are visible when below 50 m. When BARO hold sub-mode is selected, a barometric altitude numeric is indicated on the HUD.

When approaching the next WP in DT mode, a linear lead turn is estimated in such a way that prior to reaching the WP an automatic turn is initiated to intercept the next track of the route. In DH mode on the other hand, the turn begins when the WP is passed. In both DT and DH modes, the **"ППМ РАЗВОРОТ"** (Turn to the next waypoint) light will illuminate a hundred meters prior to turn initiation. The automatic turn is then initiated toward the next WP with bank angle no more than 15°. When the turn is initiated, the current navigation route data is replaced by the data of the next track in the route. 5° prior to reaching the new heading, the **"ППМ РАЗВОРОТ"** (Turn to the next waypoint) light goes off and the heading is automatically corrected in accordance to the current location of the helicopter at the end of the turn and drift angle.

The procedure during the other tracks of the route is the same.

250 m before the last WP, the **"КОНЕЦ МАРШРУТА"** (Last waypoint; end of route) light will illuminate. 2 km after passing the last WP, the ROUTE Mode disengages, the **"КОНЕЦ МАРШРУТА"** light goes off, and the helicopter stabilizes on its current heading.

During this flight route process you will monitor the aircraft's position on the ABRIS map, control the automatic estimation of the navigation parameters, and compare the heading information of the HSI and the magnetic compass.

According to the flight plan, you may need to switch ADF channels and use the NDB bearing indication to properly navigate to the intended navigation points(s).

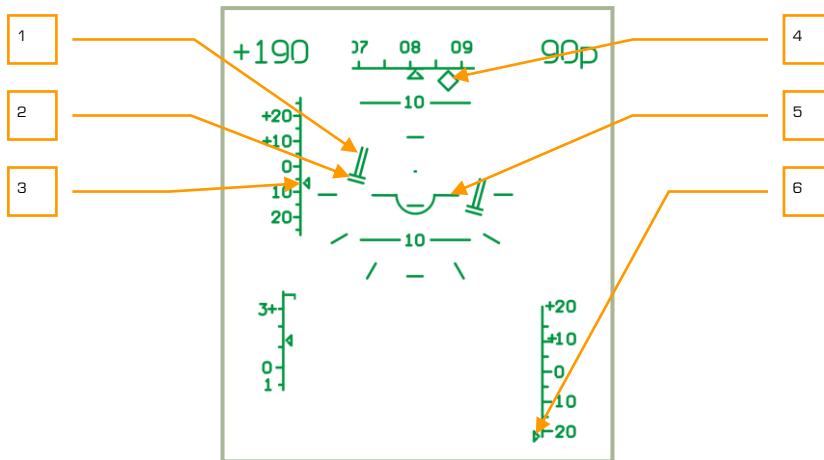
Flight Director Control

When in flight director mode, the task of the pilot is to maintain the angular position of the helicopter with the cyclic and the altitude with the collective by using the directors indicated on the HUD and ADI.

This mode is most often used instead of automatic enroute flight.

To disengage the automatic mode and enable director control, it is necessary to press the **"ДИР УПР"** (FLT DIR) push-light on the Autopilot panel. By disengaging automatic control, the automatic angular stabilization is disabled but damping remains for all channels.

The joint pitch-bank director and altitude director appear on the HUD.



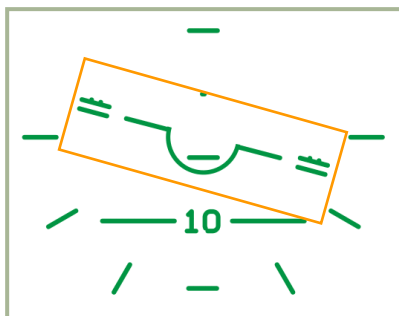
10-5: Director control mode. The altitude and airspeed are below what is required.

1. The altitude flight director indicates the needed altitude change.
2. The pitch-bank flight director indicates that it's necessary to set 15° right bank with slight negative pitch.
3. Index for deviation of the desired IAS indicates deviation from the desired speed -6 km/h.
4. The desired heading indicates a deviation of 7° to the left.
5. Aircraft datum.
6. The index for deviation of the desired true altitude indicates a deviation of more than -20 m (the index is at the bottom limit).

The desired airspeed is maintained by changing the pitch angle, and the altitude is changed by adjusting engine power.

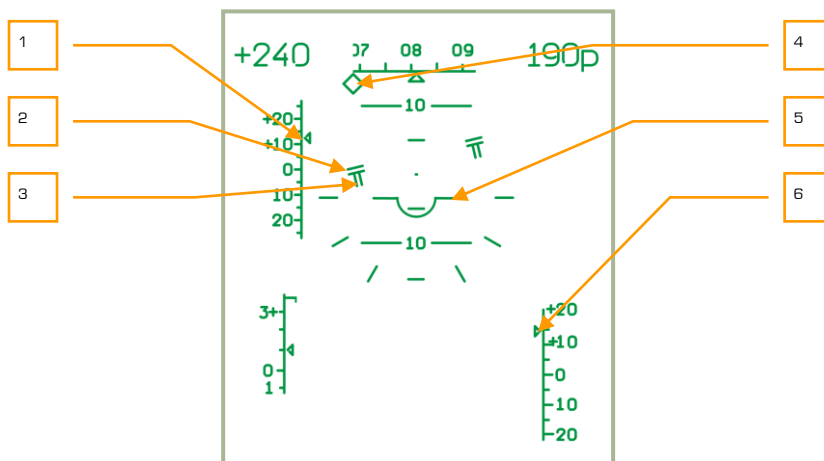
When flying with director control, it is necessary to set the pitch and bank angles with the cyclic in reference to the aircraft datum. Use collective pitch adjustments to decrease the altitude director to the minimum. If the altitude director is "increasing" up, it's necessary to increase the collective pitch; if it's going down, decrease it.

In the example given above, the pilot must set a right bank of 15° with a small negative pitch (see 2), reach the desired speed (see 3, deviation -6 km/h), and increase collective pitch to gain the desired altitude (see 1 and 6, true altitude deviation more than -20 m).



10-6: Director control mode. Correct maintaining of the desired regime.

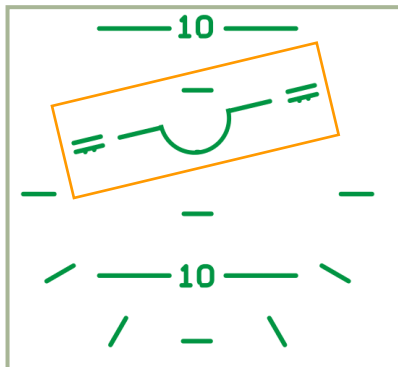
To set a new airspeed and altitude, it is necessary to press and hold the trim button and change the speed and altitude. Then release the trim button and the current values of the airspeed and altitude are set as desired.



10-7: Director control mode. The altitude and airspeed are above what is required.

1. Index for deviation of the desired IAS indicates deviation from the desired speed +12 km/h.
2. The pitch-bank flight director indicates that it's necessary to set 15° of left bank with a slight positive pitch.
3. The altitude director indicates that it's necessary to descend.
4. The desired heading indicates deviation of more than 15° to the right.
5. Aircraft datum.
6. Index for deviation of the desired true altitude indicates a deviation of more than +15 m.

In this example the pilot must set a left bank of 15° with a slight positive pitch (see 2), reduce the speed to the desired value (see 1, deviation +12 km/h), and reduce the collective pitch to descend to the desired altitude (see 3 and 6, altitude deviation more than +15m).



10-8: Director control mode. Correct maintaining of the desired regime.

By pressing the **“ДИР УПР”** (FLT DIR) push-light on the Autopilot panel again, the flight directors mode is disabled and the automatic control is enabled.

Changing WP Sequence in Flight

When you wish to change the WP sequence, you can perform the following procedure:

- Disengage ROUTE mode by setting the **“МАРШРУТ-СНИЖЕНИЕ”** (ROUTE - DESCENT) switch on the collective to the neutral position.
- Turn off the **“ППМ”** (Waypoints) push-light on the PVI-800 Navigation Control panel. This light and the WP indication number on the display will go out.
- Press the **“ППМ”** (Waypoints) push-light and it will illuminate.
- On the Navigation Control panel keypad, set the new first WP by pressing the corresponding keypad button. The number (WP), will then be visible on the display.
- Press the **“ВВОД”** (Enter) push-light and the first WP will be saved into navigation computer memory.
- Repeat this process for the next five WPs.
- When complete, turn off the **“ППМ”** (Waypoints) mode. The new WP sequence will be saved in navigation computer memory.
- To activate the new route, press the **“ППМ”** (Waypoints) push-light again (the number of the first WP and navigation data will appear in the display) and check the correct flight direction to the new, first WP of the route.
- Engage ROUTE mode by setting the **“МАРШРУТ-СНИЖЕНИЕ”** (ROUTE – DESCENT) switch on the collective to the ROUTE position. According to the

selected DH or DT sub-mode, the **“МАРШРУТ ЗК”** or **“МАРШРУТ ЛЗП”** (DH ROUTE or DT ROUTE) lights will illuminate and the helicopter will initiate automatic turns to complete the new route.

Ingress to a Target Point Using Route Mode

10 target points (TP) can be stored in the PVI-800 navigation system. Each TP coordinate is loaded into the navigation computer from the Mission Editor or manually while in flight. While in flight, the Route mode can be used to navigate from any WP to any selected TP by the shortest distance. This can be done with heading stabilization in DH or DT sub-modes.

In addition to an **“ОТ”** (TP) symbol on the HUD, the target’s bearing and the distance are also displayed if the target is less than 100 km away.

Ingress procedure:

- Disengage ROUTE mode by setting the **“МАРШРУТ-СНИЖЕНИЕ”** (ROUTE - DESCENT) switch on the collective to the neutral position. This will cause the **“МАРШРУТ ЗК / МАРШРУТ ЛЗП”** (ROUTE DH / ROUTE DT) light to go off.
- Press the **“ППМ”** (WP) push-light on the Navigation Control panel and its light will go off, as well as the WP number indication on the display.
- Press the **“ОТ”** (TP) push-light and its light will illuminate.
- From the Navigation Control panel keypad, press the button with the TP number that appears on the display. Navigation data for automatic flight to the TP from the helicopter’s current position is processed and indicated on the HSI, Navigation Control panel, and HUD.
- Engage ROUTE mode by setting the **“МАРШРУТ-СНИЖЕНИЕ”** (ROUTE – DESCENT) switch on the collective to the ROUTE position. The helicopter will then initiate an automatic turn towards the TP.

When approaching a TP, the **“КОНЕЦ МАРШРУТА”** (Last waypoint; End of route) light illuminates. 2 km after passing over a TP, the ROUTE Mode will disengage, the **“КОНЕЦ МАРШРУТА”** (Last waypoint; End of route) light will go off, and the helicopter will stabilize on its current heading.

Return to Base Using Route Mode

Using Route mode, you may fly to one of the two pre-loaded airfields with heading stabilization in DH or DT sub-modes. The navigation data indications are the same as for a next WP.

Airfield ingress procedure:

- Disengage ROUTE mode by setting the **“МАРШРУТ-СНИЖЕНИЕ”** (ROUTE - DESCENT) switch on the collective to the neutral position. This will cause the **“МАРШРУТ ЗК / МАРШРУТ ЛЗП”** (ROUTE DH / ROUTE DT) light to go out.
- Press the **“ППМ”** (Waypoints) push light on the Navigation Control panel and its light and WP number on the display will go out.

- Press the **"АЭР"** (Airfield) push-light and its light will illuminate.
- From the keypad on the Navigation Control panel, press the button of the airfield number (1 or 2) that appears on the display. The navigation data for automatic route flight to the airfield from the helicopter's current position is then processed and indicated on the HSI and Navigation Control panel.
- Engage ROUTE mode by setting the **"МАРШРУТ-СНИЖЕНИЕ"** (ROUTE – DESCENT) switch on the collective to the ROUTE position and the helicopter will initiate an automatic turn towards home base.

When approaching an airfield using this method, the (End of ROUTE) light will illuminate, and 2 km after passing over the airfield, the **"КОНЕЦ МАРШРУТА"** (Last waypoint; End of route) light will go off, as well as the Navigation Control panel indication. Automatic flight steering will then disengage and the helicopter will stabilize on its current heading.

Route without Task

If a navigation task is not selected, meaning that no waypoint, target, or airfield is selected from the Navigation panel, it is possible to engage Route mode to maintain your current flight path. Thus, current flight path parameters like pitch, roll, yaw, and altitude are saved in the navigation system.

To engage Route mode without a task, switch off all task buttons on the Navigation panel: Waypoints, Targets, and Airfields.

The position of the Desired Heading – Desired Track Angle switch does not influence navigation.

- Stabilize the helicopter in level flight with the desired speed.
- Engage ROUTE mode by setting the **"МАРШРУТ-СНИЖЕНИЕ"** (ROUTE – DESCENT) switch on the collective to the ROUTE position and the helicopter will hold current flight parameters and bearing.

For changing flight parameters it is necessary to:

1. Press and hold the Trimmer on the cyclic stick.
2. Set new flight input (bearing, pitch and speed).
3. Release the Trimmer button.

During such flight, monitor the aircraft's position on the ABRIS map and compare the heading information of the HSI and the magnetic compass.

According to the flight plan, you may need to switch ADF channels and use the NDB bearing indication.

Hover and Descent Modes

Hover

To hover automatically over a ground-point after decelerating to near-zero airspeed, you can engage HOVER mode using the following procedure:

- Set the **"МАРШРУТ-СНИЖЕНИЕ"** (ROUTE - DESCENT) switch to the neutral position.
- Press the **"ВИСЕНИЕ"** (HOVER) button on the cyclic and this will illuminate the **"ВИСЕНИЕ"** (HOVER) light on the overhead panel. The helicopter will then stabilize above the hover point; radar altitude stabilization mode will engage; and the **"Нрв СТАБ"** (RAIt HOLD) light will illuminate on the overhead panel.

If there is any deviation from the initial hover point, the helicopter will automatically return to its initial position.

When HOVER mode is enabled, the following flight indications are provided:

- On the Attitude and Director Indicator (ADI) – Deviation from the set altitude and lateral position at Hover initiation is indicated by the pitch and bank flight directors.
- On the HSI – Longitudinal and lateral deviation from the hover point is indicated.
- On the HUD – Hover area and hover symbol deviation from the set hover altitude; flight directors for bank, pitch and altitude; commands for return to the desired hover point at the desired altitude, and a ground speed vector in any direction are all provided.

To disengage the Hover mode, press the HOVER button on the cyclic again and the HOVER light and all hover indications on the ADI, HSI, and HUD will be removed.

Vertical Descent

If while in HOVER mode it is necessary to decrease altitude, you can use the VERTICAL DESCENT mode. To do so, press and hold the **"МАРШРУТ-СНИЖЕНИЕ"** (ROUTE - DESCENT) switch on the collective in the DESCENT position. When this is done, the **"ВИСЕНИЕ"** (HOVER) light and the **"Нрв" СТАБ** (RAIt HOLD) lights will go off and the **"СНИЖЕН"** (DESCENT) light will turn on.

The helicopter will initiate a vertical descent with a sink rate of up to 2 m/s while stabilizing its position at the hover point and keeping the hover indication.

Upon reaching the desired altitude, set the DESCENT push-button back to neutral and thus cease the descent. The **"СНИЖЕН"** (DESCENT) light will turn off, the **"ВИСЕНИЕ"** (HOVER) and **"Нрв СТАБ"** (RAIt HOLD) lights will illuminate, and HOVER mode will be implemented at the new altitude.

If the push-button is still held in the DESCENT position, the helicopter will descend down to 4m true altitude; after that the descent is cancelled.

Helicopter Coordinate Corrections

The Inertial Navigation Unit (INU) has a tendency to gradually accumulate errors due to imprecise sensors (gyroscopes and accelerometers) and due to the limitations of calculation methods. A cumulative error in coordinate calculations can be up to 4 km after 1 hour of flight.

Errors in coordinate calculations will affect flight path and determination of target locations. To compensate for these errors, they need to be corrected using one of two methods.

When planning a flight path in the mission editor, INU reference points need to be setup (up to 4 reference points). It is recommended to use locations that stand out in the terrain – buildings, towers, bridges, road crossings, and river merge points that are easily located along the route.

Coordinate Corrections Using Over-flight Method

Once you are within 18 km of a reference point, the EKRAN will sound an audio cue and display **“ПРОВЕДИ КОРРЕКЦ КООРД”** (Perform Coordinates Correction).

To perform the correction:

1. On the PVI-800, press the **“ОП”** (Fix point) push-light and this will light up the button.
2. Press the key on the PVI-800 keypad that corresponds to this reference point number; this number will be displayed on the small right window.
3. Set **“И-251В – ПРОЛ”** (I-251V Shkval – Fly over) switch to **“ПРОЛ”** (Fly over) on the PVI-800.
4. Visually locate the reference point, fly towards it, and once located exactly above it press the **“ЦУ”** (Uncage Shkval –designate target) button on the cyclic. This will set the current coordinates in the onboard navigation system to the reference coordinates.

Once the correction is complete, the **“ОП”** push-light and its number will no longer be lit.

Coordinate Corrections Using Shkval

If a reference point is not located along the flight route it is recommended to perform corrections using the I-251V Shkval.

To perform the correction:

1. On PVI-800 navigation control panel, press the **“ОП”** (Fix point) push-light which will light it up.
2. Press the key on the PVI-800 keypad that corresponds to this reference point number; this number will be displayed on the small right window.
3. Set **“И-251В – ПРОЛ”** (I-251V Shkval – Fly over) switch to **“И-251В”** (I-251V Shkval) on the PVI-800.

4. Visually locate the checkpoint on the terrain.
5. On the Targeting Mode Control Panel, set the **"ИЗЛ – ОТКЛ"** (Laser standby – Off) switch to **"ИЗЛ"** (Laser standby).
6. Press **"ЦУ"** (Uncage Shkval – designate target) on the cyclic (this will uncage the Shkval sensor).
7. Move the cursor over the reference point.
8. Adjust target tracking gate size to cover the reference point object and press the **"АВТ ЗАХВ"** (Auto-lock) button on the collective.
9. When the Shkval displays **"ТА"** (Autotracking), press **"ЦУ"** (Uncage Shkval – designate target) again on the cyclic. This will perform proper calculations to determine coordinate offset and store them in the navigation system as the helicopter's current coordinates.

During the calculation, the HUD will display the **"КОРР"** (Correction) message.

Once the correction is complete, press the **"СБРОС"** (Reset) button on the Targeting Mode Control Panel, which will clear the **"КОРР"** (Correction) message from the HUD, turn off **"ОП"** (Fix point) and reference point number on the PVI-800 navigation panel, and cage the Shkval.

Operating engines in extreme modes

Maximum power output of TV3-117 engine is limited by electronic engine governor ERD-3VM. It limits the turbo-compressor RPM and along with RT-6-12 temperature regulator limits gas temperature before the turbine.

Increasing the RPM or temperature severely reduces engine life. Increasing temperature is particularly dangerous because it weakens turbine blades and can lead to their deformation which in turn leads to reduced performance. It can also lead to turbine's catastrophic failure.

If electronic engine governor fails the collective needs to be controlled carefully so that ОГРАН. РЕЖ. indicator does not light up when RT-6-12 temperature regulator is still functional (it works only in indication mode when engine governor is off). If RT-6-12 fails the only way to maintain engine operation within limits is by checking engine status gauges in particular ensuring that the gas temperature is below 980°C.

Icing

When flying at temperatures below 0°C there is a danger of ice forming on various components of helicopter.

Engine inlet icing

Engine inlet icing leads to reduced inlet cross-section area thus reducing the air flow and causing compressor to operate closer to its dynamic gas stability limit (stall line). Reduced air flow reduces also engine power. Reduced power causes automatic regulators

to increase fuel flow which increases temperature before turbo-compressor which again leads to compressor operating closer to stability limit.

If the icing is severe enough the engine can stall. Generally it will occur if the engine increases its power (spools up) when the gas temperature is rising as additional fuel is injected in the combustion chamber.

The icing occurs due to free water presence in the air when the temperature is below 0°C. The icing also depends on helicopter's airspeed and amount of free water present in the air.

The first indication of inlet icing is increased temperature before turbo-compressor.

To prevent inlet icing the engine anti-icing system needs to be engaged.

Rotor blades icing

Ice forming on rotor blades changes their air-dynamic properties, reducing thrust and causing increased engine power output required to maintain required RPM.

Pitot and AoA sensors icing

Ice buildup on pitot causes incorrect readings on barometric indicators (air speed indicator, vertical speed indicator, barometric altitude indicator). In extreme cases it can render them completely inoperable.

The same problem can occur to AoA sensors – icing will prevent free rotation of its components.

When outside conditions are such that ice buildup can occur the heaters for pitot and AoA sensors should be turned on.

Dust effects on engines

Flying through dust kicked off by main rotors causes increased engines wear. To prevent it when taking off or flying over the dusty ground the engines dust protection system must be engaged. The amount of dust getting into the engines depends on air flow through them as well as amount of dust kicked by main rotors - therefore until helicopter is ready for takeoff engines should not be operated above idle power setting.

MANEUVERING THE KA-50

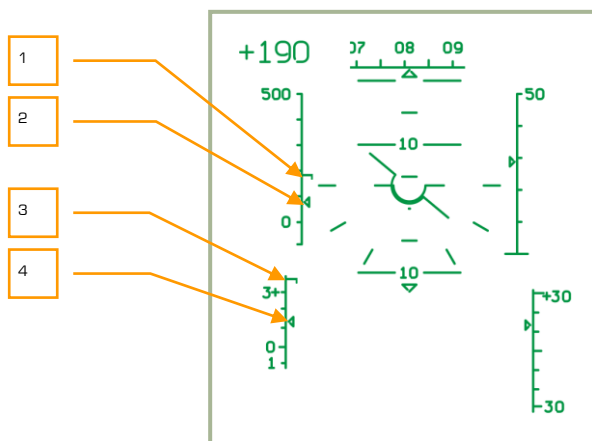
General

The purpose of learning the following basic maneuvers is to form a foundation for more advanced combat maneuvers. The following basic maneuvers can be achieved in the Ka-50:

- Turns, yaw turns, horizontal eights, and snakes
- Climbing and descending spirals
- "Combat" turns and break turns
- Side slips
- Turns on a climb
- Acceleration and deceleration
- Low altitude maneuvering
- Flat yaw turn

When maneuvering, the minimum safe altitude is no less than 10 m AGL.

The current and the maximum allowed load factor (G-load) are indicated on the G scale on the HUD. If the maximum load factor is reached on the moving index, the maximum G symbol will begin flashing. The small horizontal index on the G scale indicates maximum G-load. Additionally, the red "n_y" (G over limit) light will illuminate. The current load factor can also be monitored from the gauge in the left forward panel.



10-9: Airspeed and G-load scales on the HUD

1. Maximum allowed speed index
2. Current IAS index



3. Maximum allowed G index
4. Current G-load index

The current and maximum airspeed values are also indicated as a scale on the HUD. When the current airspeed caret on the scale reaches the maximum speed index, it will start flashing. Additionally, a red **"Vmax дон"** (IAS over-speed) light will illuminate on the master warning panel.

Illumination of the **"ny"** and **"Vmax дон"** lights is allowed only for a short period of time. If the **"ny"** light comes on, it is necessary to decrease collective pitch and pull a little bit back on the cyclic until the light goes off. If the **"Vmax дон"** light still illuminates, continue to reduce forward airspeed until the light goes off.

NOTE: For every 1,000 m of altitude, the maximum G-load **"ny"** and airspeed **"Vmax дон"** values decrease with 0.3 to 0.4 units and 30 to 40 km/h accordingly.

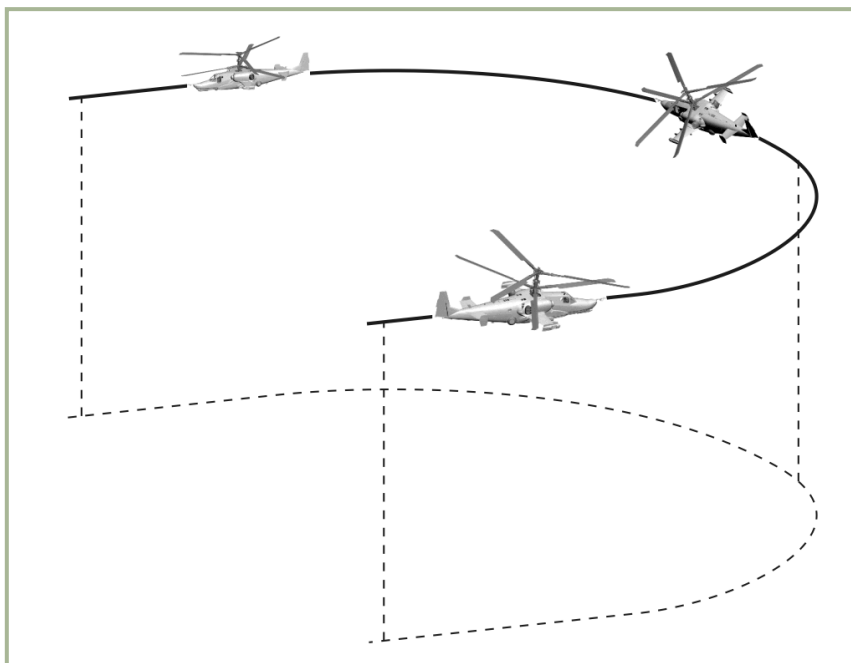
Turns and Spirals

Prior to executing a turn, look for a reference point on the ground to end the turn by, in reference to the desired heading.

A coordinated turn is accomplished when the aircraft is banked into a turn with a coordinated deflection of the cyclic and pedals toward the turn's direction. Collective pitch is simultaneously increased to maintain current altitude and airspeed.

20 to 30° prior to completing the turn, deflect the cyclic in the opposite direction of the turn and gradually return the pedals to the neutral position. This should cease the turn in reference to the estimated ground reference point. Upon reaching reference point, the aircraft should be at a zero bank angle.

When performing horizontal eights and snakes, the flying technique is analogous to a single coordinated turn as described above. However, transition from one bank angle to another is implemented by a continuously coordinated deflection of the cyclic and pedals.



10-10: Coordinated turn

When performing turns at very low altitude, pay close attention to your altitude and stay above 10 m. This should be done visually in concert with periodic checks of the radar altimeter. Keep an eye out for ground obstacles such as buildings, towers, and terrain. Remember that every non-coordinated turn will cause inner or outer side slip and this can lead to altitude loss.

Performing a spiral maneuver is analogous to a coordinated turn but with altitude change (climb or descent).

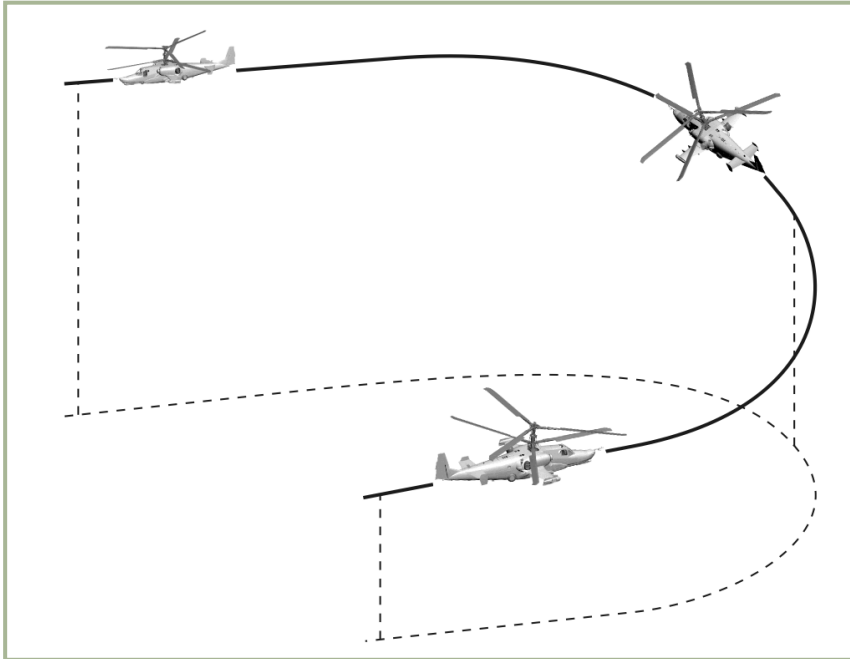
Climbing U-turn ("Combat" Turn)

This maneuver should be initiated at an airspeed between 150 and 300 km/h; the pitch and bank angles should not exceed 30° and 45° respectively at takeoff power, and the G-load should not exceed the maximum value.

Upon reaching the initial entry airspeed, pull back on the cyclic and deflect it and the pedals toward the direction of turn while simultaneously increasing the collective up to takeoff power. Start climbing in a spiral while increasing the pitch and the bank angles.

20 to 30° prior to completing the ascending the turn, begin a coordinated deflection of the cyclic and pedals in the opposite direction of the turn and push forward on the cyclic to bring the nose down to level. Using a ground reference point, cease the turn when the heading has changed 180° from the previous heading. Upon rolling out from the

turn, the helicopter should be in horizontal flight with no bank angle and at an airspeed of no less than 80 km/h.



10-11: "Combat" turn

You can control the amount of altitude gained and the time to complete the turn, by altering the bank and pitch angles and engine power. Altitude gain at the recommended bank and pitch angles at a barometric altitude up to 1,000 m is:

- At initial airspeed 150 km/h – 50...100 m
- At initial airspeed 250 km/h – 200...230 m
- At initial airspeed 300 km/h – 230...290 m

The time to complete a 180° turn is about 20 seconds.

To improve turn rate it is possible to use a deep side slip when in the outside portion (second 90°) of the turn.

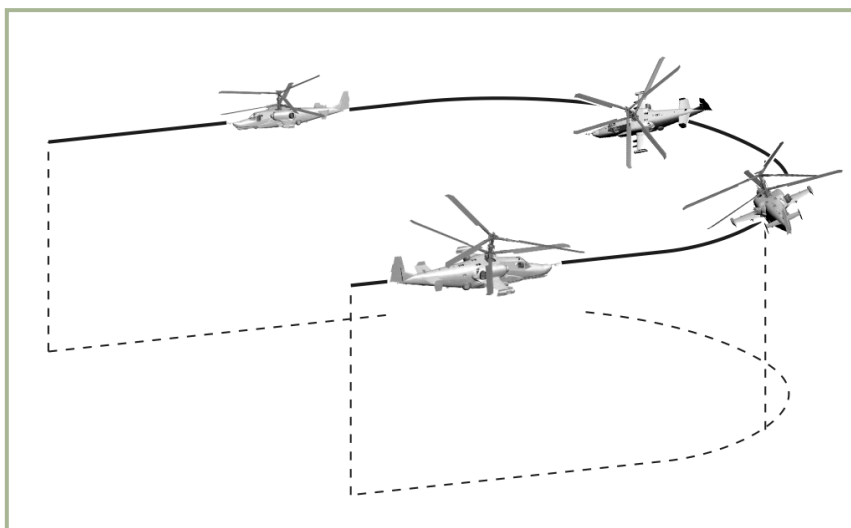
Break Turn

A break turn is initiated by a vigorous and coordinated deflection of the cyclic and pedals towards the direction of turn. Use the collective to maintain altitude.

Upon reaching a 30° bank angle, increase pedal input (up to 2/3 of the range) toward the turn, pull on the cyclic with a rate to ensure that the helicopter will stay in the horizontal plane, and control the G-load. The greater the bank angle and the lower the speed will require you to pull back further on the cyclic.

The turn is implemented with outer side slip (the yaw ball of the slip indicator will be full left or right) and airspeed will decrease dramatically.

15 to 20° prior to completing the turn, perform the opposite cyclic and pedal commands to reverse the turn while simultaneously decreasing the collective pitch to avoid any climb.



10-12: Break turn

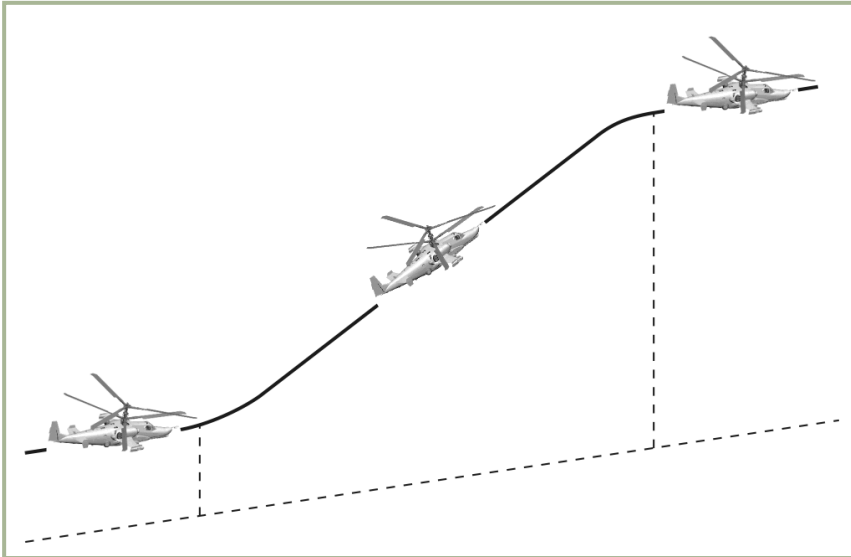
The airspeed at the end of the break turn should be no less than 60 km/h from when you initiated it. Using a deep side slip can greatly increase the efficiency of the maneuver.

The minimum time to complete a 180° turn with 60° bank and 250 km/h initial speed is seven seconds.

Climb

A climb should be initiated by pulling back on the cyclic when airspeed is greater than 150 km/h; the maximum pitch angle should be 60°. This maneuver can be performed at either a constant or variable collective pitch. Upon reaching the desired pitch angle, set it by slightly pushing forward on the cyclic.

To complete the climb, push forward on the cyclic while estimating that the airspeed is no less than 50 km/h at an altitude above the hover ceiling, and up to 0 km/h when the altitude is below the hover ceiling. The recommended G-load during this phase of the maneuver is no less than 0.1 G.



10-13: Climb

Altitude gain during a climb from low altitude with a 30° pitch angle:

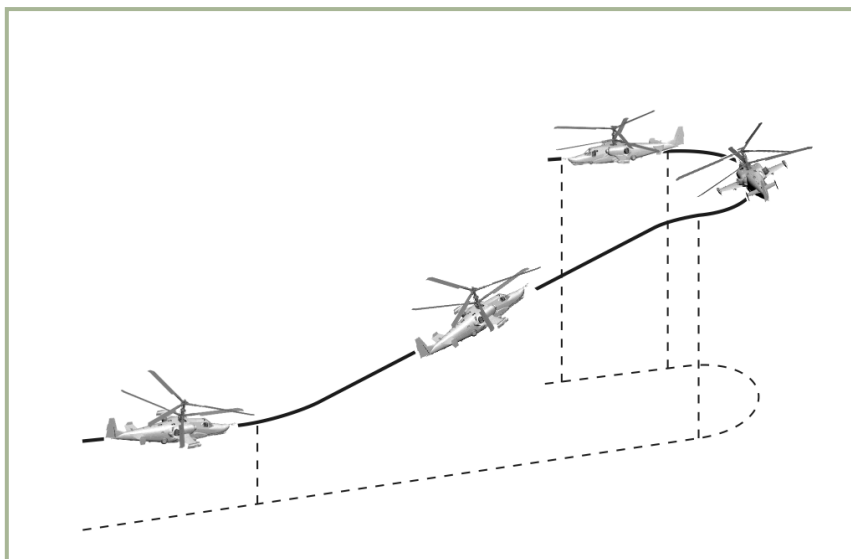
- Initial airspeed 300 km/h – altitude gain 400 m.
- Initial airspeed 270 km/h – altitude gain 350 m.
- Initial airspeed 250 km/h – altitude gain 200 m.
- Initial airspeed 200 km/h – altitude gain 100 m.

Altitude can be significantly increased in the above examples by increasing collective pitch.

Climbing Turn

Initiate a climb maneuver and upon reaching an airspeed of 100 km/h, push forward on the cyclic to exit the climb. Immediately initiate a 30 to 45° bank in the desired turn direction. After the bank has been established, use the cyclic and rudder to keep the aircraft in a coordinated turn; do not allow the airspeed to drop below 60 km/h.

When you are 20 to 30° from reaching the desired heading, begin moving the cyclic and rudder in the opposite direction to start exiting the bank. When the turn is complete, the helicopter should be in horizontal flight with no bank, and on the desired heading.



10-14: Turn on climb

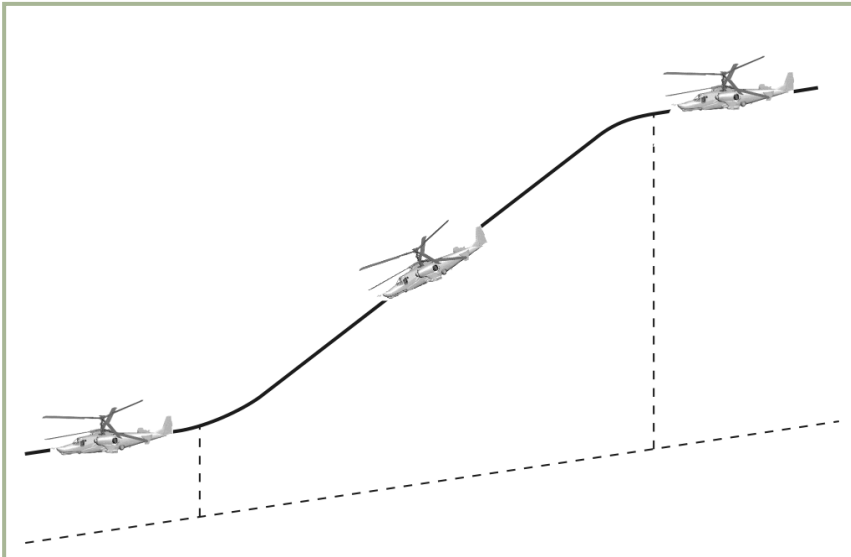
Dive

A dive, depending on the initial altitude and airspeed, should be performed at a dive angle of no greater than 60° .

Dives can be performed from either horizontal flight or from a turn with either constant or variable collective pitch. This can help correct the helicopter's desired trajectory.

Initiate a dive from horizontal flight by pushing forward on the cyclic while removing bank and yaw with coordinated deflections of the cyclic and pedals. When diving to a particular point on the ground, maintain the desired angle with corresponding, coordinated cyclic, collective, and rudder pedal deflections.

Pull back on the cyclic to cease the dive and increase collective pitch; the cyclic and collective inputs must be coordinated this way or the pilot risks an over-G of the aircraft. During an exit from a dive, keep a close eye on G-load and airspeed; exceeding either of these could damage the aircraft.



10-15: Dive

The loss of altitude when pulling out from a dive can be minimized by using the cyclic to set a positive pitch angle of 5 to 10° while simultaneously increasing collective pitch.

When exiting the dive, compensate for the rotor RPM increase by increasing the collective accordingly. Also, consider the helicopter's inertia when estimating the final pull-out altitude.

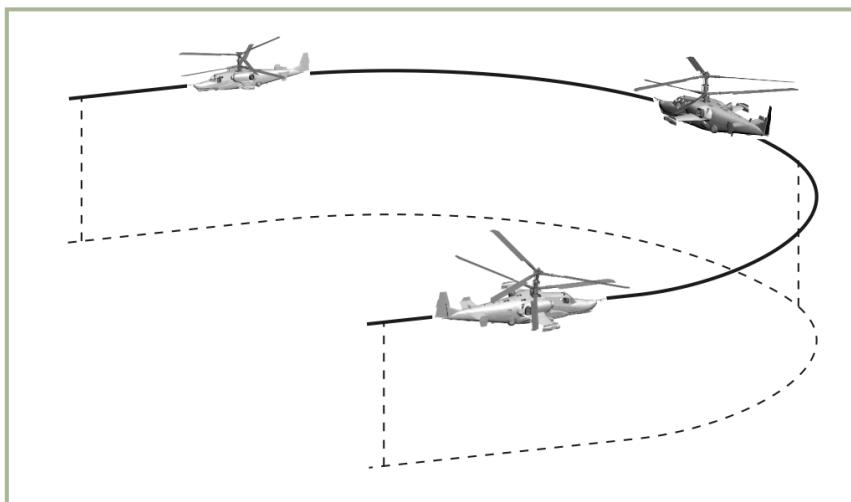
Flat Yaw Turn

A flat yaw turn is a turn of up to 90° in the plane of motion without any bank angle. Yaw turns can be performed at airspeeds of up to 100 km/h.

Initiate a yaw turn with a vigorous, maximum pedal input that corresponds to the desired heading facing change. After the desired heading facing is reached and maintained, stop the turn by releasing the pedal a little in the opposite but not to the point of having it return to the neutral position.

During a flat yaw turn, any change of bank, pitch, altitude, and vertical speed should be compensated for.

During a flat yaw turn, airspeed will decrease. The rate of airspeed loss mainly depends on initial entry airspeed, the angle of turn, and the time the turn is maintained.

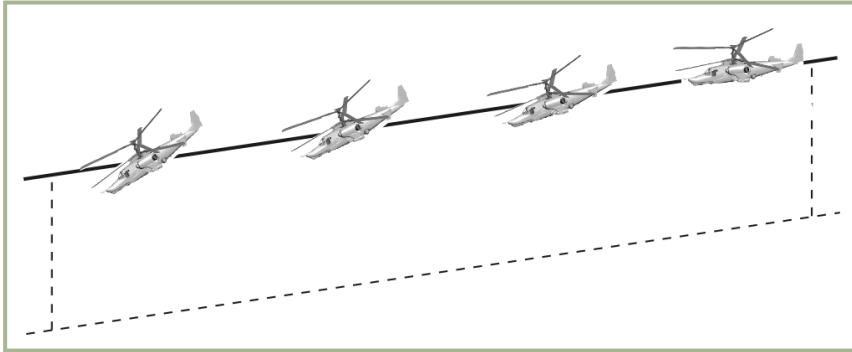


10-16: Flat yaw turn

Acceleration and Deceleration at Maximum Rates

The pitch limits for acceleration and deceleration maneuvers is $\pm 30^\circ$.

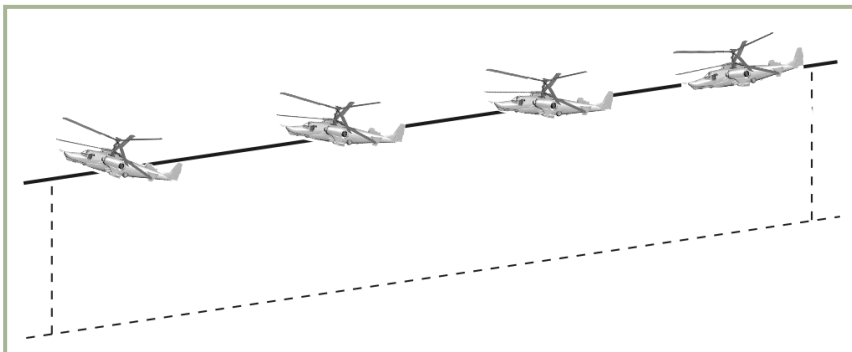
The acceleration rate depends on excessive engine power. To accelerate from a hover, increase collective pitch up to the takeoff power setting with a simultaneous negative pitch to avoid altitude loss. During acceleration (up to 120 km/h), the additional power increase can be used for greater pitch angle, thus increasing the acceleration rate.



10-17: Acceleration

Aggressive deceleration is possible at any operational pitch angle. To avoid gaining altitude when decelerating, the collective pitch must be lowered accordingly, which will cause rotor RPM increase in the initial moment of the deceleration. The deceleration rate depends on pitch angle: the greater the pitch angle, the greater the deceleration rate.

At about five seconds prior to reaching a hover after an aggressive deceleration, it is necessary to smoothly lower the pitch angle to 10 to 15° and increase collective pitch to avoid altitude loss.



10-18: Deceleration

If you are at a hover point and need to change hover position against the wind:

- Deflect the cyclic toward the desired heading and set the desired acceleration rate (aircraft pitch).
- During the acceleration, the fuselage of the helicopter will start to turn upwind as a result of its yaw (feather) stability. You may correct the direction using the flight controls.
- When moving to another hover point, the helicopter will turn its nose against the wind (when the pedals are neutral), during deceleration.

When accelerating backwards (tail-on), initiate turns at the beginning of the acceleration with smooth pedal inputs.

When decelerating with a tail wind, it is necessary to set a positive pitch angle of up to 15°. When the airspeed decreases to 50 to 70 km/h, use smooth pedal inputs to start a yaw turn at 180° (against the wind) while simultaneously increasing the collective to prevent any vertical descent.

The flying technique for crosswind acceleration and deceleration is analogous to the above.

When in a crosswind hover, it is possible to lose maximum pedal use. To regain yaw control range, turn the helicopter against the wind and start moving from there.

Maneuvering at Low Altitude

Lateral movements and lateral accelerations are performed with maximum input of the opposite pedal. Airspeed in lateral flight can be up to 90 to 100 km/h. Further lateral acceleration will cause the nose to turn toward the direction of motion. This is termed "weather cocking". Maintain the direction by use of opposite pedal input.

Tail acceleration without descent is possible at airspeeds up to 90 to 100 km/h. A self-generated yaw turn will occur when over this maximum airspeed, and so:

- If the helicopter begins to make a 180° yaw turn, do not take any action.
- If the cyclic stick is pulled full back or if the nose has a tendency to go down quickly, make a 180° yaw turn without decreasing collective pitch.
- If it is necessary to decelerate from a fast tail-first flight, the helicopter must be maneuvered into nose forward flight and then decelerated the usual way.

The intensity of a vertical maneuver is governed by excess engine power available. When losing altitude after maneuvering to avoid entering a vortex ring state, consider that at airspeeds less than 50 km/h the vertical speed should be no less than 3 m/s at altitude below 200m and 5 m/s above 200m.

EMERGENCY FLIGHT PROCEDURES

This section of the Ka-50 flight manual discusses equipment malfunctions and flight conditions that could cause an in-flight emergency. To inform you of any dangerous situation malfunctions and defects, the helicopter is equipped with a built-in emergency indication system that controls the “ЭКРАН” warning system, voice warnings, and indication of the flight performance over-limits.

In regards to a voice message and caution notices, it is important that you quickly locate the malfunction and decide what action(s) needs to be taken. Some of the highest priority situations relate to conditions that can result from RPM conditions:

- If the rotor speed is within the limits of 87 to 90%, you can calmly investigate the reason that has caused flight conditions to change.
- If the rotor RPM goes outside these limits, or is changed too aggressively, fast action must be taken with the collective and/or throttles to bring the RPM within normal operating range.
- If the rotor speed drops below 75 % and the collective is fully down at an airspeed less than 120 km/h, eject from the helicopter.

In-flight Engine Start-up

An in-flight engine start may be needed if an engine has shut down. However, an in-flight start-up is discouraged if the engine was shut down due to mechanical failure.

The in-flight start-up is possible only with a gas-generator RPM (Ngg) value less than 7% at autorotation, which corresponds to an indicated airspeed of 120 km/h.

To start an engine in-flight:

1. Start the APU and the “**ВСУ ВКЛЮЧЕНА**” light will illuminate.
2. Set the throttle control lever of the engine to be re-started to the idle position (from the Auto mode, two key presses down).
3. Move the engine cut-off valve to the closed position.
4. From the Engine and APU Start-up Control panel, select the desired engine to re-start with the Engine / APU select switch.
5. From the Engine and APU Start-up panel, select the “**ЗАПУСК**” (Start-Up) position from the Start-up mode switch.
6. From the Engine and APU Start-up panel, press and release the “**ЗАПУСК**” (Start-Up button) button.
7. When the Ngg value is greater than 10%, move the engine cut-off valve lever to the Open position. After that, the engine should automatically reach idle mode.
8. Allow the engine to run for one minute and then move the throttle control lever to the Auto position.

9. After re-start, check the engine's operation by the instruments and then shut down the APU.

Onboard Fire

In case of fire on the ground or in flight, it will be necessary to take immediate action before it becomes catastrophic. In case of an engine fire, shut down engine by moving the engine cut-off valve to the closed position and immediately close the fuel shut-off valve.



10-19: Fire extinguishing system control panel

Fire in the power plant compartment is indicated by:

- Illumination and flashing of the Master Warning Light (MWL) and the **"ПОЖАР"** (Fire) light on the instrument panel will light.
- Voice Message Unit (VMU) message about fire in one of the compartments.
- Illumination of the wall panel (fire extinguishing system) red fire lights. Each light is labeled according to the compartment where a fire has been detected: **"ПОЖАР ЛЕВ ДВИГ"** (Left engine fire), **"ПОЖАР ВСУ"** (APU fire), **"ПОЖАР ПРАВ ДВИГ"** (Right engine fire) and **"ПОЖАР ВЕНТИЛ"** (Oil cooling fan fire).

When a fire has been detected, take the following actions:

Check for the illumination of the yellow light **"1"** on the wall panel. A **"1"** indicates that an automatic discharge of the first extinguishing sequence has been selected. If the automatic system hasn't worked, engage it manually by selecting the corresponding button underneath the **"ПОЖАР ЛЕВ ДВИГ"** (Left engine fire), **"ПОЖАР ВСУ"** (APU fire), **"ПОЖАР ПРАВ ДВИГ"** (Right engine fire), or **"ПОЖАР ВЕНТИЛ"** (Oil cooling fan fire) warning light.

If a fire is detected in any of the engine compartments, shut down the engine in the compartment where the fire has been detected by closing the cut-off and the shut-off valves. Continue the flight by operating on a single engine.

In case of a fire in the APU compartment, shut down the APU by pressing the **"ОСТАНОВ ВСУ"** (Stop APU) button and close the APU shut-off valve.

Confirm that the fire has been extinguished by checking that the **“ПОЖАР”** (Fire) and MWL lights going out.

If after the 1st automatic sequence discharge the **“ПОЖАР”** (Fire) light and the MWL are still illuminated, discharge the 2nd sequence by switching the **“БАЛЛОНЫ АВТ – РУЧН”** (First – second extinguishers) selector on the wall panel to the **“РУЧН”** (Second) position and press the corresponding button under the light that is indicating a fire. A yellow **“2”** light will illuminate, indicating the discharge of the 2nd extinguisher.

WARNING! Use extreme caution when operating the cut-off and the shut-off valves to avoid shutting down the serviceable engine.

After the fire has been eliminated, it is advised that you do not start an engine in whose compartment a fire has been detected.

If the fire elimination is unsuccessful, attempt an emergency landing.

In-flight Single Engine Failure

If one engine fails or there is an automatic engine shut down due to the free-turbine (FT) protection function of the electronic engine governor EEG in case of a FT over-speed, be aware of the following:

Single engine failure indication:

- Rotor RPM decreases and the «zebra» light (rotor speed less than 85%) illuminates
- Noise of an engine shutting down
- Uncontrollable descent of the helicopter
- Ngg and EGT decrease for that failed engine
- Engine inlet oil pressure drop (by the oil pressure gauge)
- Ngg increase in still operating engine

Actions to take:

1. Decrease collective pitch to avoid rotor RPM less than 85%.
2. Check the instruments to identify which engine has failed and close its cut-off and shut-off valves.
3. Set airspeed to 110 to 120 km/h and move the throttle control lever of the still operating engine up to FULL mode position to regain the rotor RPM.
4. Make sure there's no fire aboard the helicopter.
5. Open the fuel cross-feed valve.
6. Make sure the remaining engine is operating normally and that the helicopter is able to maintain horizontal flight and maintain altitude.
7. Decide whether to do an emergency landing or to continue the flight.

Operate at high engine power with a rotor RPM of no less than 83% when flying in One Engine Inoperative (OEI) conditions.

WARNING! The minimum IAS in OEI conditions is 70 km/h. It is not advised to re-start an engine that has failed due to mechanical failure or fire

Single Engine Landing

When in One Engine Inoperative (OEI) conditions, a landing is performed vertically with no roll-out and on an unprepared field, or horizontally with a short roll-out when landing at an airfield. In either case, make the landing approach against the wind if possible.

To perform an OEI vertical landing:

1. Until reaching an altitude of 60 m, descend to the landing point at an airspeed of 100 to 120 km/h.
2. At an altitude of 60 m, start decelerating and reduce speed to 50 to 70 km/h.
3. At an altitude of 8 to 10 m, increase collective pitch and pitch the nose up to 15°, thus eliminating forward airspeed.
4. At an altitude of 2 to 3 m, rapidly increase collective pitch to reduce vertical descent speed to minimum at the moment of touchdown.
5. Land the helicopter on the main wheels and smoothly decrease collective to minimum.

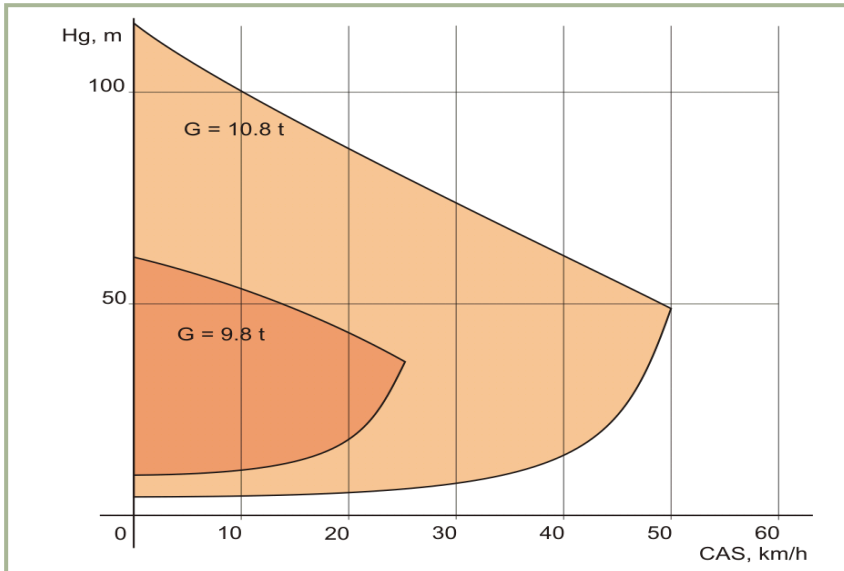
To perform an OEI landing with roll-out:

1. Descend to the estimated point at an airspeed of 100 to 120 km/h.
2. Starting from an altitude of 50 m, use ground references to visually gauge and control altitude.
3. At an altitude of 30 m, start leveling the helicopter by pulling back on the cyclic and estimate the landing point to coincide with an altitude of 0.5 to 1 m.
4. Maintain landing pitch angle to ensure a smooth landing on the main wheels with a forward speed of between 30 and 40 km/h.
5. Smoothly decrease collective to minimum.
6. Try not to counter the lowering of the nose with the cyclic stick.

WARNING! Do not allow any lateral drift during the landing. If there is drift prior to touchdown, counter it with pedal input toward the drift (toward the approaching ground direction).

Single Engine Failure during Hover

In case of single engine failure during a hover at approximately 10 m (below the danger «altitude-airspeed» range), the vertical speed must not exceed the safe value of 3.6 m/s.



10-20: Critical Altitude-Velocity zone

Actions to take:

1. Rapidly decrease collective pitch to 2 to 3° while simultaneously pushing forward the cyclic to set a -20 to -25° pitch angle on dive.
2. At altitude of 3 to 5 m, rapidly increase collective pitch up to $\frac{3}{4}$ of the full range and perform a "hop up" (fast pitch up) to decrease the vertical speed and then set a landing pitch angle with the cyclic.
3. If possible, land the helicopter on the main wheels and avoid any lateral movement.
4. Fully reduce collective pitch.
5. Do not counter the lowering of the nose with the cyclic.

In case of an engine failure within the danger altitude-airspeed range, a safe landing is not guaranteed. Hence, flight in this zone should be avoided when possible.

In case of an engine failure at the top of the danger zone or higher, the excessive altitude ensures forward acceleration of the helicopter:

1. Rapidly decrease the collective pitch by $\frac{1}{3}$ of the full range while simultaneously pushing forward on the cyclic to set a -20 to -25° pitch angle dive.

2. Upon reaching 40 to 50 km/h IAS, begin the transition to horizontal flight.
3. Close the cut-off and shut-off valves of the failed engine.
4. Achieve 110 to 120 km/h IAS in horizontal flight and depending on the situation decide whether to land or to continue the flight with OEI.

In-flight Dual Engine Failure

Indications of dual engine failure:

- Sudden drop of rotor RPM
- Illumination of the «Zebra» light and MWL
- Engines shutting down sound
- Longitudinal unbalance of the helicopter in forward flight (decrease of the pitch angle into dive)
- Altitude change with descent rate increase
- Rapid drop of engines' RPM, EGT and oil pressure

Actions to take:

1. Rapidly decrease the collective pitch to minimum to maintain rotor RPM.
2. With the cyclic, set the required airspeed for autorotation 100...180 km/h.
3. Close the cut-off and shut-off valves to the engines.
4. Jettison all external payload.
5. Trim the controls.
6. Extend the landing gear.
7. Choose a field and approach for landing; against the wind if possible.

Autorotation Landing

An autorotation landing is performed when both engines are inoperative. This landing method uses the lift generated by the free-spinning rotors for a controlled landing.

At an altitude of 50 m, set an airspeed of 100 to 120 km/h IAS and $86 \pm 1\%$ rotor RPM. Use ground reference to estimate altitude and visual control.

All further actions depend on the chosen landing point (airfield or unprepared field).

Landing on an unprepared field is done vertically or with a short roll-out. It evolves very quickly and requires quick and precise operation of the controls.

To autorotation land on an unprepared field:

1. Bring the helicopter to a level altitude of 30 m and an airspeed of 100 to 120 km/h.



2. From 30 m altitude, initiate the leveling by vigorously pulling back on the cyclic and set a +25° pitch angle followed by a rapid increase of collective pitch to 2/3 of the full range. Maintain the pitch angle until full stop or an altitude of no less than 3 m.
3. At an altitude of 3 m, rapidly push forward on the cyclic to set landing pitch angle and estimate the moment for a "hop-up" (rapid increase of collective pitch to maximum).
4. Land on the main wheels and prevent a vigorous lowering of the nose by pulling back on the cyclic.
5. After nose wheel touchdown, move the cyclic to neutral and decrease the collective pitch to minimum. If necessary use the wheel brakes.

Landing on a prepared field (airfield) is performed with forward speed and roll-out. Compared to the vertical landing, it's easier and allows situational awareness at every stage of the landing.

To autorotation land on an airfield:

1. Bring the helicopter to a level altitude of 30 m and an airspeed of 100 to 120 km/h.
2. From 30 to 50 m, start to smoothly level the helicopter by pulling back on the cyclic with a smooth increase of collective pitch. The cyclic and collective inputs should be estimated to ensure a smooth approach to an altitude of 0.5 to 1 m with landing pitch angle.
3. While holding the helicopter in landing configuration, maintain landing pitch angle, increase the collective to maximum value, and smoothly land the helicopter on its main wheels. Prevent a vigorous lowering of the nose by pulling back on the cyclic. The forward speed at touchdown should be within 40 to 60 km/h.
4. After nose wheel touchdown, move the cyclic to neutral and decrease the collective pitch to minimum. To decrease roll-out distance, engage the wheel brakes.

WARNING! In order to avoid "shimmy" oscillation, the maximum roll-out speed should be no more than 80 km/h.

Dual Engine Failure during Hover

If both engines fail during a hover at an altitude of 25 m or more, take the following actions:

1. Rapidly decrease collective pitch to approximately half of its initial (current) value.
2. At an altitude of 5 to 7 m, rapidly increase collective pitch to maximum (do a "hop-up") to decrease vertical speed.
3. Land on the main wheels followed by the nose wheel.
4. Quickly lower the collective full down after touch down.

5. Close the cut-off and shut-off valves to both engines.
6. Turn off all electric power.

Vortex Ring State

Indication of vortex ring entry:

- Uncontrollable increase of the descent rate and loss of control during vertical descent at airspeeds less than 50 km/h.

Actions to escape vortex ring:

1. Rapidly decrease collective pitch (about 1/3 of total range) while simultaneously pushing forward the cyclic to set a -20 to 25° dive pitch angle.
2. Upon gaining forward speed more than 50 km/h, level the helicopter off in horizontal flight.
3. If there is not enough altitude to recover, eject.

Hydraulics Failure

Main hydraulic system failure can occur due to battle damage or mechanical failure.

Indication of hydraulic failure:

- Flashing illumination of the MWL and a **“ОСНОВНАЯ ГИДРО”** (Main hydraulic) message appearing on the EKРАН warning system display.
- **“КЛАПАН 1 ГИДРО”** (Valve 1 hydro) and **“КЛАПАН 2 ГИДРО”** (Valve 2 hydro) warning lights illuminating on the hydraulics panel, which indicates automatic switch of the common hydraulic system.
- Hydraulic fluid pressure drops in the main system (indicated on the pressure indicator).

Actions to address hydraulic failure:

- Abort the mission and return to base.

Common system failures associated with the main hydraulic operating system.

Indication:

- Flashing illumination of the MWL and a **“ОБЩАЯ ГИДРО”** (common hydraulic) message appearing on the EKРАН warning system display.
- Hydraulic fluid pressure drops in the main system (indicated on the pressure indicator).

Action to take:

- Abort the mission and return to base.



11

**KA-50 COMBAT
EMPLOYMENT**

11 KA-50 COMBAT EMPLOYMENT

Many factors affect survivability over the battlefield, usually complicated by such things as the need to aim and guide one's weapons and weather. When flying over the battlefield, always study the terrain before the mission and use it to your advantage; identify terrain masking and pop-up opportunities, then set up your navigation accordingly in order to minimize the effectiveness of ground defenses. Take note that small ground targets can be detected out to 10-15km on a good day, and target type can be determined at 5-10km when using the Shkval.

Vikhr ATGM Employment Parameters

Minimum Safe Launch Altitude – Hover	10 m
Minimum Safe Launch Altitude – Forward Flight	50 m
Maximum Launch Altitude - Barometric	4,000 m
Maximum Launch Altitude – Practical/All Speeds	3,000 m
Minimum Range to Target	800 m
Maximum Range to Target	8,000 m

Descending below minimum launch altitude can result in ground collision due to increased pilot workload.

The Vikhr launcher can depress downwards up to 11°30'. The launcher will change elevation to match the HUD target marker only when the Vikhr is employed in its standard mode.

Cannon Employment Parameters

Minimum Safe Altitude - Hover	10 m
Minimum Safe Altitude – Level Flight With Shkval	30 m
Minimum Safe Altitude – Level Flight Without Shkval	20 m
Maximum Altitude	5,000 m
Maximum Indicated Airspeed	300 km/h
Minimum Target Range	800 m
Maximum Target Range	2,000 m
Pitch Angle	±60°



Preparations for a Combat Mission

If you properly prepare for a mission, your chances of completing it successfully improve dramatically. The most common steps that need to be considered in mission preparation are:

- Understand the mission objective, possible ways to achieve it, best weapons to use, and possible enemy resistance.
- Clarify route and flight profile.
- Analyze the area around targets, target types, and possible target defenses.
- Determine best Battle Positions (BP), if needed.
- If required, make adjustments and corrections to ingress and egress flight plan.
- Determine attack type and subsequent target attacks from different directions.
- Determine communications plan.

Combat Procedures

General Guidelines

The primary means of flight and navigation for a single helicopter or group is to adhere to a set of pre-programmed waypoints (flight plan) that have been loaded into the Navigation Control system (PVI-800) and into the ABRIS. To minimize exposure to enemy air defenses, flight between the waypoints is generally conducted at the lowest possible safe-altitude to use terrain masking and clutter. Radar-guided air defense systems in particular will have difficulty tracking very low flying helicopters.

When flying over a rapidly changing battlefield, use target information received over the data link and displayed on the ABRIS map and search for additional targets and threats. When approaching a target zone, be careful to not rush in unprepared. Instead, take time to search the area with the Shkval and the wingman reconnaissance commands.

Be sure that the Tactical Situation display mode on the ABRIS screen is enabled. It will generally be on by default, but if not, you can activate it as follows:

1. Press the **MENU/OPTION** FSK.
2. Press the **SETUP** FSK.
3. From the pop-up menu, use the ABRIS cursor manipulator dial or UP or DOWN arrow FSK, to select CHARTS and then press the **SETUP FSK** again.
4. In TACTICAL SITUATION line you will see «+» (set by default). If not, and an «-» is displayed instead, press the **CHANGE** FSK.
5. Select the **NAV** (map) FSK twice.

Adjust the ABRIS map scale. To do this when in the **NAV** operating mode: press the **MAP** FSK and then **SCALE+** or **SCALE-** FSKs. Use them to adjust map scale as required and then return back to **NAV** operating mode by pressing **NAV** FSK.

When approaching the Forward Edge of Battle Area (FEBA):

1. Set appropriate weapon modes.
2. Set MASTER ARM switch to on.
3. Set the “ИЗЛ – ОТКЛ” (Laser standby ON/OFF) switch on the Targeting mode controls panel to the “ИЗЛ” (Laser standby ON) position.
4. Activate the UV-26 automatic flare dispensing program. Use a program suitable to the suspected air defense types.
5. Set the system to **ON** mode by using the **MWS** (Missile Warning System) selector switch located at the left-hand side of the instrument panel.
6. Change flight formation as appropriate.

Leaving the FEBA:

1. Turn the MASTER ARM switch off.



2. Check condition of aircraft systems.

Perform evasive actions (a target flying straight and level is an easy target) and return to base according to the pre-programmed flight plan.

Designate Target Points

The Ka-50 navigation-targeting system can store up to 10 Target Points (TP), which can be actual targets or ingress points. Setting a TP can be done in two ways:

- **Target Point fly-over.** In this scenario, the TP is the ground coordinate that the helicopter was flying over when the TP was created.
- **Shkval I-251 Designation.** Using the Shkval system and the laser rangefinder, a ground location can be designated and set as a TP. This is done by determining range and bearing between designation point and ownship.

Fly-Over Target Point Designation

1. Set the Mode selector dial on the Navigation Control panel to the **"ВВОД"** (Enter) position.
2. Set **"И-251В – ПРОЛ"** (INU fix-taking method) switch to the **"ПРОЛ"** (Over-fly) position.
3. Press **"ОТ"** (Target point) push-light.
4. Select the TP number you wish to assign from the key pad (1...10).
5. Once above the target, press the **"ЦУ"** (Designate target) button on the cyclic and the helicopter's coordinates will be appear on the Navigation Control panel display. The **"ОТ"** (Target point) symbol will be displayed on the HUD.
6. Press the **"ВВОД"** (Enter) button on the Navigation Control panel a second time and the fly-over coordinates will be entered as a TP in the navigation system. The **"ОТ"** (Target point) symbol on the HUD will go out.
7. After creating the TP, set the Mode selector dial on the Navigation Control panel to the **"РАБ"** (Work) position.

Shkval Target Point Designation

1. Ensure that the **"ИЗЛ-ОТКЛ"** (Laser standby ON/OFF) switch on the Targeting Mode Controls panel is set to the **"ИЗЛ"** (Laser standby ON) position.
2. Set the Mode selector dial on the Navigation Control panel to the **"ВВОД"** (Enter) position.
3. Set the **"И-251В – ПРОЛ"** (INU fix-taking method) switch to the **"И-251В"** (I-251V Shkval) position.
4. Press the **"ОТ"** (Target point) push-light button.
5. Select the TP number you wish to assign from the key pad (1-10).

6. Press the **"ЦУ"** (Uncage Shkval) button on the cyclic.
7. Use the sensor slew hat to align the HUD cursor with target point area, and then locate it on the Shkval display.
8. Place the Shkval target box over the target point area, adjust the gate size and press the **"АВТ ЗАХВ"** (Automatic target lock) button on the collective. The range to target area will now be displayed on the TVM screen.
9. Press the **"ЦУ"** (Designate target) button on the cyclic a second time and the target's coordinates will appear on the Navigation Control panel display. The **"ОТ"** (Target point) symbol will display on the HUD.
10. Press the **"ВВОД"** (Enter) button on the Navigation Control panel again and the derived coordinates will be entered as the TP coordinates in the navigation system. The **"ОТ"** (Target point) symbol on the HUD will go out.
11. After creating this new TP, set the Mode selector dial on the Navigation Control panel to the **"РАБ"** (Work) position. On the Targeting Mode Controls panel, press the **"СБРОС"** (Targeting mode reset) button.

Designate Targets and Ingress Points for Data Link

Prior to designating targets and ingress points to other wingmen over the data link, the follow steps need to be followed:

1. Ensure that all flight members are tuned to the same VHF radio data link frequency.
2. Turn on the **"ТЛК"** (Data link radio equipment) switch and the **"УКВ-ТЛК"** (Data link VHF radio equipment) switch on the wall panel and the **"ВЦУ - ОТКЛ"** (Data link power) switch on the Navigation Control panel.
3. Ensure that the **"ИЗЛ-ОТКЛ"** (Laser standby) switch on the Targeting Mode Controls panel is set to the **"ИЗЛ"** on position.
4. Set data link **"КТО Я"** (Self ID) dial on the Off Board Targeting Data Link panel to the appropriate helicopter ID (your helicopter) in the group (1-4). The flight lead should always be set to 1.
5. Set data link **"РЕЖИМ"** (Master Mode) knob on the Off Board Targeting Data Link panel to the **"КОМ"** (Commander – send and receive data. Leader mark on the ABRIS) position. If you are not the flight lead, set knob on the Off Board Targeting Data Link panel to the **"ВЕДОМ"** (Wingman – send and receive data. Wingman mark on the ABRIS) position.

Determining a target's coordinates (or ingress point coordinate) with the Ka-50 can be done using the Shkval I-251 and laser rangefinder. This designation in relation to the know coordinates of your aircraft provide accurate target coordinates that can be sent over the data link. The following eight steps describe the process for *creating* data link targets that will show up on the ABRIS. See the next section for *sending* the targets you create.

1. Press the **"ЦУ"** (Uncage Shkval) button on the cyclic.



2. Use the sensor slew hat to align the HUD cursor over the target area and locate the target/location on the Shkval display.
3. Determine the target type and class, by zooming in from 7x to 23x.
4. Place the Shkval target box over the target, adjust the tracking gate size, and press the automatic target lock button on the collective.
5. Set the target type or ingress point on the Data Link Control Panel (the corresponding button will light).
6. On the Data Link Control Panel, press the **"ПРД/ПАМ"** (transmit /memory) button to place the target in memory. On the ABRIS, the corresponding target symbol with assigned number will appear.
7. If necessary, repeat steps 1-6 to create additional targets.
8. When done creating targets, press the **"СБРОС"** (Reset) button **"ПБР"** on the Targeting Mode Control panel, and this will reset the Shkval LOS to default/boresight.

Data Exchange between Helicopters

Target coordinate information can be passed to other flight members using the following procedure:

1. Select target type on Data Link Control Panel:



/1 – Combat vehicle, Armor



/2 – AAA/SAM



/3 – Other



– Ingress Point

The selected button will light on the Data Link Control Panel.

2. Select the helicopter flight number on the Data Link Control Panel that is to receive the data, or select the **"БСЕМ"** (TO ALL) button to send to all flight members (the selected button will light up on the Data Link Control Panel, and the recipient's icon will flash on the ABRIS).
3. If there is more than one target of the same type in system memory, you will need to go back and press the target type button on the Data Link Control Panel as many times as required to cycle through all targets of the same type in memory; each press of the target type button will select the next target of that type, and the corresponding target symbol will flash on the ABRIS.

It is important to note that if no recipient is chosen before this step, pressing the target type button will not scroll through your targets on the ABRIS, and nothing will be sent. You must choose a target type, then the recipient, and then *go back* to the target type button in order to scroll through targets on the ABRIS. Do not push the send button (step 4) until you have a target symbol

and flight member icon flashing on the ABRIS. The exception to this: if you have selected the **"ВСЕМ"** (TO ALL) button, none of the flight member icons will flash on the ABRIS.

4. Press the **"ПРД/ПАМ"** (Send/Memory) button on the Data Link Panel to send the data to the selected flight members (all lights on the Data Link Panel will go out).
5. On the ABRIS, the selected target marker symbol and flight member icon will stop blinking and stay solid.

If the receiving flight member(s) successfully received and acknowledged data receipt, all the lighted Data Link Panel buttons will turn off. If data receipt is not acknowledged, the **"ПРД/ПАМ"** (Send/Memory) button will start blinking. In such a case, press the **"ПРД/ПАМ"** (Send/Memory) button again and this will turn off the lighted **"ПРД/ПАМ"** (Send/Memory) button, as well as the receiver number, target number, and target marker symbol on the ABRIS. If **"ВСЕМ"** (TO ALL) was selected, the lighted buttons will turn off regardless of successful data receipt acknowledgement.

When handing off target data to a flight member(s) without first creating a target on the ABRIS, (i.e. using Shkval tracking) leave the target type button unpressed, press intended recipient number, and then press the **"ПРД/ПАМ"** (Send/Memory) button on the Data Link Panel. The coordinates on the ground where the Shkval is locked will be sent to the recipient(s).

To delete Data Link targets created on the ABRIS:

1. Press the **"СБРОС"** (Reset) button **"ПВР"** on the Targeting Mode Control panel. The Shkval must be in standby mode in order to delete targets.
2. Press the target type button on the Data Link Control Panel. If multiple targets of this type exist, press the target type button again until the target you want to delete is flashing on the ABRIS.
3. Press the **"СТИР"** button on the Data Link Control Panel. The selected target on the ABRIS will disappear, and the remaining targets of that type will be renumbered.

To send Target Point coordinates created in the PVI-800 navigation system:

1. Press the **"ОТ"** (Target point) push-light button on Navigation Control panel (button will light up).
2. Select the TP ID using the Navigation Control panel keypad. The number will then be displayed on the Navigation Control panel display and the ABRIS will have a blinking marker point as well.
3. Press the desired target type or ingress point push-light button on the Data Link panel (button will light).
4. Select recipient(s) number or all (button will light).
5. Press the **"ПРД/ПАМ"** (Send/Memory) button (button will light briefly).

Once acknowledgement has been received, all lights on these buttons will turn off.

Using Data Link when Approaching a Target Area

Prior to approaching the target area, each wingman will need to set their **"РЕЖИМ"** (Data Mode) dial to receive data link information in either **"ПРИЕМ"** (Receive only), **"ВЕДОМ"** (Wingman – send and receive data. Wingman mark on the ABRIS) or **"КОМ"** (Commander – send and receive data; leader mark on the ABRIS) modes. You can also disable data link communications with the flight by using the **"ОТКЛ"** setting.

When receiving target data, the Voice Messaging Unit (VMU) will announce **«Принять ЦУ»** (received target data). At the same time, the Data Link Panel will have lighted buttons according to target type or ingress point received, and sender's flight number.

Once data is received when you are in **"ВЕДОМ"** (Wingman) mode, the acknowledgement is sent automatically.

With target data received, you can save the data. To do this, press the **"ПРД/ПАМ"** (Send/Memory) button on the Data Link Panel (ABRIS will now show a non-blinking target marker and the Data Link Panel buttons will stop blinking).

Automatic Ingress to Target

When approaching the target area and you wish to point the aircraft at a data linked target, you should:

1. Press the desired target type button (press as many times as needed to select required target) and the ABRIS will show the flashing target symbol.
2. Press the **"ВЫХОД"** (Ingress) button on the Data Link Panel (the button will light and the target type button light will turn off), then set the **"ЗК/ЛЗП"** (Autopilot heading DH/DTA) switch on Autopilot Panel to the **"ЗК"** (Desired heading) position, and set the **"СНИЖ-МАРШРУТ"** (Descent – Route) switch on the collective to the **"МАРШРУТ"** (Route) mode.
3. Press the **"АДВ"** (Automatic turn to target) button on the Targeting Mode Control panel and this initiates the "automatic turn to target" mode. The target marker on the ABRIS will stop flashing and it will be marked with a cross.

At the same time on the HUD, the relative target bearing will instead show range to target, while the HSI will show target bearing and range.

When approaching a target within 8 km, press the **"ЦУ"** (Uncage/Designate target) button on the cyclic and begin searching for the target with the Shkval sensor. If necessary, turn on the Shkval's scanning mode by pressing the **"ЦУ"** again.

Once a target is detected, slew the cursor to the target to turn scanning off, adjust the tracking gate size, and turn on automatic tracking.

To turn target ingress mode off, press the **"ВЫХОД"** (Ingress) button again.

Sending Recon Orders to Flight Members

The flight lead can assign reconnaissance tasks to any of his flight members.

The procedure is as follows:

1. Select the radio commands menu [N].
2. Select wingman.
3. Select Recon menu.
4. Select required recon distance or data link point.

Once the order is received, the flight member will start moving at low altitude along the same heading as the flight leader while scanning for targets.

Information about any detected target(s) will be passed to the flight leader through the data link.

Note: Target detection range depends on flight member's skill level.

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

Shkval Scan Mode

While performing combat and navigation tasks, the pilot can automatically scan for targets using the Shkval's scan mode. This mode scans a $\pm 10^\circ$ sector relative to the helicopter's current heading.

Shkval scanning procedure:

1. Press the "**АДВ**" (Automatic turn on target) button and the "**НПЦ**" (Ground moving target) button which are located on the Targeting Mode Controls panel. If using the HMS, turn on the "**ОБЗОР**" (Helmet mounted target designator) as well.
2. Press the "**ЦУ**" (Uncage/Designate target) button on the cyclic and place the cursor within the desired search area using the sensor slew hat.
3. Turn on the Shkval scan by pressing the "**ЦУ**" button again. The Shkval sensor will then start moving side-to-side within 10° of the initial position.
4. You can adjust the scan speed by using the "**СКАНИР**" (Scan rate) knob on the right panel. The scan rate can range from 0.25 to 3 degrees per second.

Stop the scan once a target is detected by moving the sensor slew hat in any direction. Zoom in on the target if required by switching to narrow FOV with the "**ШПЗ – УПЗ**" (Wide – Narrow) switch on the collective. Press "**ЦУ**" again to resume scanning.

To adjust the scan zone:

- Use the sensor slew hat to move the Shkval cursor to the desired scan area.
- Turn on scanning again by pressing the "**ЦУ**" button and scanning will resume in this new area.



To turn off scanning, press the “**СБРОС**” (Targeting mode reset) button on the Targeting Mode Controls panel; this will stop the scan and reset the Shkval to the default boresight position.

Weapons Employment Preparations

Weapons systems are ready to be employed when the following conditions are true.

- For the cannon, the Weapon Status and Control panel: **“ОСТАТОК ВПУ”** (Gun rounds remaining) will indicate cannon rounds remaining in multiples of ten; «25» indicates that the selected round type has 250 rounds.
- Yellow indicators under the helicopter symbol indicates the presence of weapons on those hardpoints.
- Weapon Status and Control panel: the **“ТИП”** (Weapons type) indicator will show the selected weapon type according to the position of the hardpoint selector switch, **“ВНЕШН-ВНУТР”** (Outer – Inner): HP (Rockets), **“ПС”** (ATGM), **“АБ”** (Bombs) or **“СП”** (Gun pods).

ATGM Employment

Targeting Mode Control panel:

1. The **“ОСН РЕЖ”** (Weapon Control System mode selector) dial should be set according to weapon system mode. **“ППУ”** (Moving cannon) is the primary automatic operative mode.
2. Set the **“ИЗЛ – ОТКЛ”** (Laser standby - Off) switch to the **“ИЗЛ”** (Laser standby) setting.
3. Set the **“АС – ПМ”** (Auto-tracking – Gun sight) switch to the **“АС”** position for auto-tracking.
4. Press the **“НПЦ”** (Ground moving target) button to enable tracking of moving ground targets.

Weapon Status and Control panel:

1. The **“РУЧН – АВТ”** (Manual/Auto weapon system control) switch should be set to the **“АВТ”** (Auto) position.
2. The **“ДЛ – СР – КОР”** (weapon mode switch – burst length) switch should be set according to the desired launch mode. **“ДЛ”** (long) or **“СР”** (Medium) will launch two missiles and **“КОР”** (Short) will launch one missile.
3. The **“ВНЕШН – ВНУТР”** (Outer – Inner hardpoints) switch on the collective should be set to the **“ВНЕШН”** (Outer) position. This will be indicated on the Weapon Status and Control panel by two green lamps that indicate that ATGM missiles are ready for employment.
4. Master Arm switch – set to ON.

Rocket Employment

Weapon Status and Control panel:

- Set the **"ДЛ – СР – КОР"** (weapon mode switch – burst length) switch according to desired launch mode.
"ДЛ" (Long) – will launch 10 rockets (half) from each launcher.
"СР" (Medium) – will launch five rockets (quarter) from each launcher.
"КОР" (Short) – will launch one rocket from each launcher.

Master Arm switch – set to ON.

Select which hardpoint to launch rockets from by setting the **"ВНЕШН – ВНУТР"** (Outer – Inner hardpoints) switch to inner, – outer - all. The selected hardpoints will be indicated with green lights, and the number of remaining rockets will be indicated.

Cannon Employment

Targeting Mode Control panel:

1. The **"ОСН РЕЖ"** (Weapon system mode selector) dial should be set according to weapon system mode.
Select **"ППУ"** to allow the cannon to be slaved to the Shkval. This is the primary mode.
Select **"НПУ"** to fix the cannon along boresight as a backup control mode.
2. Set the **"ИЗЛ – ОТКЛ"** (Laser standby - Off) switch to the **"ИЗЛ"** (Laser standby) setting.
3. Set the **"АС – ПМ"** (Auto-tracking – Gun sight) switch to the **"АС"** position for auto-tracking, or select **"ПМ"** (Gun sight) to aim the cannon manually with helicopter controls.
4. Press the **"НПЦ"** (Ground moving target) button to enable tracking of moving ground targets.

Weapon Status and Control panel:

1. Set the **"РУЧН – АВТ"** (Manual/Auto weapon system control) switch according to the desired firing mode:
"АВТ" – main gun mode slaved to Shkval with authorized fire range calculation.
"РУЧН" – backup mode without authorized fire range calculation.
2. Set the **"ДЛ – СР – КОР"** (weapon mode switch – burst length) switch according to:
"ДЛ" (Long) and **"СР"** (Medium) – 20 rounds in a burst.
"КОР" (Short) – 10 rounds in a burst.
3. Set the **"МТ – БТ"** (Cannon rate of fire) switch according to:
"МТ" (Slow ROF) – 300 rounds per minute.
"БТ" (High ROF) – 600 rounds per minute.
4. Set the **"ОФ – БР"** (HE – AP rounds selector) switch to select the desired round type:

"ОФ" – high explosive rounds.
"БР" – armor piercing rounds.

5. Master Arm switch – set to ON.

Bombs Employment

The helicopter's weapon system does not have impact or release point calculation release modes. You must calculate the release point manually.

The switches on the Weapon Status and Control panel do not affect bomb release.

1. Set Master Arm switch – set to ON.
2. Select hardpoints with bombs by setting the "ВНЕШН – ВНУТР" (Outer – Inner hardpoints) switch – inner – outer or - all. The selected hardpoints will be indicated with "АБ" (Bombs) and green lights. The number of remaining bombs will be indicated.

Air-to-Air Missiles Employment

Targeting Mode Control Panel:

- Select the aspect of attack. By default, this is set to rear aspect. To set it to front aspect, press "А/А НО" [LAlt + S] – the button will be illuminated.

PUI-800 Weapon Status and Control Panel:

- Set the "AUTO-MANUAL" switch [A] to the desired firing mode – semi-automatic "AUTO" or manual "MAN".

On the collective stick, set the hardpoint selector switch to "AIR TO AIR" [LCtrl + U].

Set the "MASTER ARM" switch to on. [LAlt + W]

Returning to Weapons-safe Condition

1. To prevent the weapons from accidental use, press the "СБРОС" (Targeting mode reset) button on the Targeting Mode Control panel.
2. Confirm from the overhead message lamps panel that the "ППУ" (Cannon operative) light has turned off if the cannon was used.
3. Master Arm switch should be set to OFF. [LAlt + W]

Automatic Ingress to Target Area

Prior to using the automatic ingress function of the Ka-50, you will need to set up the Targeting Mode Control panel and Weapon Status and Control panels as follows:

1. Press the **"АДВ"** (Automatic turn-on target mode) button on the Targeting Mode Control panel.
2. Select the **"ОБЗ – ОТКЛ"** (Helmet-Mounted Target Designator system power) switch on Targeting Mode Control panel to the **"ОБЗ"** (On) position when using helmet targeting mode; otherwise, set it to the **"ОТКЛ"** (Off) position.
3. Set the **"ИЗЛ – ОТКЛ"** (Laser standby - Off) switch to the **"ИЗЛ"** (standby) position.
4. Set the **"АС – ПМ"** (Auto-tracking – Gun sight) switch to the **"АС"** (Auto-tracking) position.
5. Set the **"ШПЗ – УПЗ"** (Wide FOV – Narrow FOV) switch on the collective to the **"ШПЗ"** (Wide FOV) position.

Ensure that the targeting marker from the HMS and HUD, video image, and FOV limits are displayed on the Shkval IT-23 display.

Using Shkval to Lock Target

Estimate the approximate target location and point the helicopter in that direction. Then perform the following steps:

1. Press the **"ЦУ"** (Uncage Shkval, designate target) button on the cyclic and slew the targeting cursor over the target area.
2. Examine the Shkval display, locate the target, and switch to the narrow FOV to determine target type.
3. Adjust placement of the targeting cursor by using the sensor slew hat to position the cue over the target.
4. Adjust the size of the tracking gate by using the **"ПАМКА М – Б"** (TV target frame Increase – Decrease size) switch on the collective.
5. Control the helicopter's flight stability as it turns towards the target.
6. On target approach, adjust the targeting cursor position and size if necessary.

Using HMS to Lock Target

Estimate the approximate target location and point the helicopter in that direction. Then perform the following steps:

1. On approach to the target area, select the **"ОБЗ – ОТКЛ"** (Helmet-Mounted Sight system power) switch on the Targeting Mode Control panel.

2. Using head movement, place the targeting cursor over the target and press the **"ЦУ"** (Uncage Shkval, designate target) button on the cyclic. This will display the "Processing" HMS symbol (two concentric circles with a flashing cross). Keep the **"ЦУ"** button depressed until the «processing complete – target lock» signal is received. This is indicated by two concentric circles and a solid, stable cross on the HMS display.
3. Release the **"ЦУ"** button. When the button is pressed, the automatic turn-to target will begin. The HUD will display navigation and targeting data and the HUD target mark will align with the helmet target mark.
4. When the **"ЦУ"** button is pressed and the helmet position angle is within the Shkval FOV, the Shkval line of sight will position over the helmet target marker.
5. If the helmet angle is outside the angular confines of the HUD, the HUD target mark will position itself at the closest maximum angle and the helmet display will display a flashing auto-turn signal (two flashing concentric circles and flashing cross). The helicopter will now automatically turn towards the target. Once the angles are within limits, the auto-turn signal disappears and the HUD targeting marker will align with helmet targeting marker. The helicopter will continue to turn itself to align with the target.
6. Keep helmet targeting marker over the target and keep the **"ЦУ"** button depressed until you receive the «processing complete – target lock» message. After this, release the **"ЦУ"** button and the Shkval targeting marker will be positioned roughly over the target. If the **"ЦУ"** button is released during the auto-turn, the auto-turn will be performed to the last marker position where the button was kept pressed.
7. Adjust the helicopter's position manually if required.
8. Verify that the targeting mark is aligned with the target on the HUD and examine the Shkval IT-23 display. Locate the target in wide FOV and then positively identify it in narrow FOV.
9. Adjust the tracking gate size using the **"ПАМКА М – Б"** (TV target frame Increase – Decrease size) switch on the collective.
10. Continue to adjust the automatic turn and flight stability.
11. On target approach, adjust the targeting cursor position and size if necessary.

Weapons Employment in Automatic Mode

ATGM Employment

When approaching the target area, perform the following Shkval adjustments:

1. Use the sensor slew hat on the cyclic and the **"ПАМКА М – Б"** (tracking gate increase – decrease size) switch on the collective to adjust target box position and size.
2. Press the **"АВТ ЗАХВ"** (Lock target) button on the collective. This will ground stabilize the Shkval sensor line of sight.
3. When the **"ТГ"** symbol and distance to target appear on the Shkval display, place the target marker over a valid target and press the lock target button a second time. You will then see the **"ТА"** (auto-tracking target) symbol on the Shkval display and the **"ТА-ИД"** (auto-tracking target – range indicator) symbol on the HUD. Assuming you have a Vikhr selected as the active weapon, a launch circle indicating target range and Vikhr launch range will be displayed on the HUD.
4. When approaching the target, correct the tracking gate position and size if necessary. To make adjustments, press and hold lock target button while making adjustments.

When approaching the maximum Vikhr launch range, perform the following:

1. Maneuver the helicopter to align it in the horizontal axis with the target. This will best align the Vikhr launchers with the target (align launch circle with target line-of-sight on the HUD), and maintain this heading for at least one second.
2. Adjust tracking gate if necessary.

When the **"С"** Launch Permission symbol appears on the HUD, perform the following:

1. Press the weapon launch button and keep it pressed until the missile has launched; this usually takes about one full second. Just tapping the weapon launch button will not suffice.
2. After the missile has launched, verify that the laser rangefinder has switched from **"ТА-ИД"** (auto-tracking target – range indicator) to **"ТА-ИУ"** (auto-tracking target – laser-beam control) on the HUD and that the time-to-impact in seconds also appears.
3. Adjust tracking gate if necessary.
4. If the target moves outside the HUD FOV, the Shkval gimbal limit zone rectangle will appear on the HUD. This indicates the line of sight mark in the zone scale. When approaching within 5° from gimbal limit angles, the line of sight mark will start flashing. Maneuver the helicopter back towards target azimuth until the flashing stops (to avoid losing the missile control).

5. The attack will end if the missile has reached the target, time to impact plus an additional six seconds have passed, or the "X" cross has appeared on the HUD.

Vikhr ATGM Launch Procedure

Approaching the target area

Pilot actions:

Choose weapon –Vikhr ATGM

Collective:

1. Select outer weapon hardpoints. The Weapon Status and Control panel will indicate "**ОСТАТОК**" (Remains) – 12 or 6 and "**ТИП**" (Type) – "**ПС**" (ATGM).
2. Select narrow Field of View (FOV).

Weapon Status and Control panel:

1. Set the "**ДЛ – СР – КОР**" (weapon mode) switch to the "**КОР**" (Short) position to launch a single missile.
2. Set the "**РУЧН – АВТ**" (weapon control) switch to the "**АВТ**" (Auto) position.
3. Set Master Arm switch to ON.

Targeting Mode Control panel:

1. Set the "**ОБЗ – ОТКЛ**" (Helmet-Mounted Sight) switch to the "**ОБЗ**" position. The helmet target marker will then be displayed.
2. Set the "**ИЗЛ – ОТКЛ**" (Laser standby) switch to the "**ИЗЛ**" position.
3. Press the "**НПЦ**" (Ground moving target) button.
4. Press the "**АДВ**" (Automatic turn to target mode) button.

Targeting Display Control panel:

1. Adjust HMS brightness with the "**НБУ**" control knob.
2. Adjust Shkval IT-23 display brightness and contrast.
3. Set the "**ОГР ИНФ – ПОЛН**" (HUD/TV declutter) switch as desired. In "**ОГР ИНФ**" (Declutter) position, the pitch, bank, speed, and aircraft symbols are not displayed.

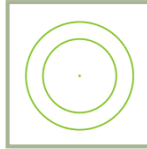
The following data will be indicated on the HUD and Shkval IT-23 display:

- HUD – Indications of flight and navigation information. When altitude is less than 50 m, indication will be in radar altitude scale.
- Shkval display – Displays EO sensor video at appropriate FOV.

Using the HMS with Vikhr

Helmet Mounted Sight (HMS) system displays targeting information as shown below:

Normal Operation



Setting Target Area

Assuming a target with an azimuth greater than 30° is off the nose, begin initial targeting procedures.

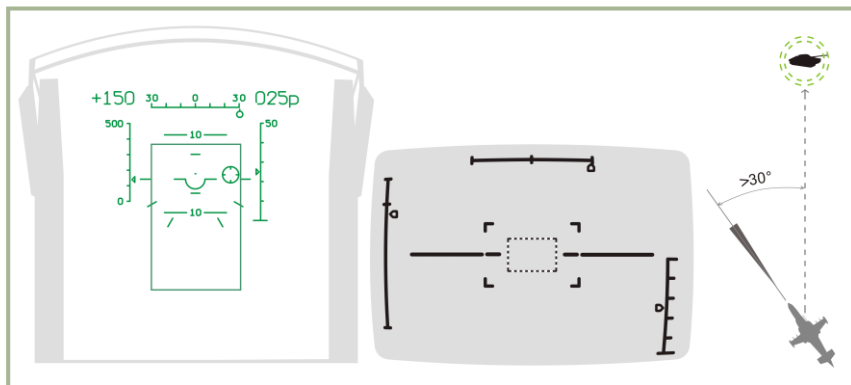
Slew (move your head) the HMS target marker to align with the target. Press and hold the "L" button on the cyclic.



The HMS target marker will look like the image above.

The HUD will show the Shkval rectangle gimbal limit zone: $+10^\circ$ to -85° in the vertical and $\pm 30^\circ$ in the horizontal, with line of sight mark to target within this zone. Also, instead of the heading scale, there will be a relative target angle scale ($\pm 30^\circ$) with a relative target angle symbol.

The helicopter will then begin an automatic turn to target.

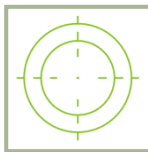


11-1: HUD, Shkval, and HMS indication when setting target area

Automatic Turn to Target

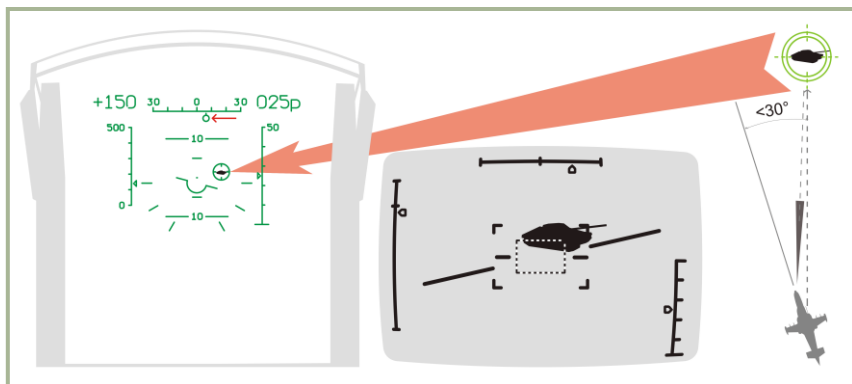
While the helicopter is rotating, continue to align the HMS target mark over the target.

When angle to target is less than 30° , the Shkval gyrostabilizer will uncage. The HUD will no longer show the Shkval rectangle gimbal limit zone and will instead show true target angle.



When the PROCESSING indication appears on the HMS, release the “**ЦУ**” button. When the Shkval has finished processing, the HMS will display the TARGET LOCK indication. The target will also be centered on the Shkval IT-23 display.

Further target marker adjustments should be performed with sensor slew hat.

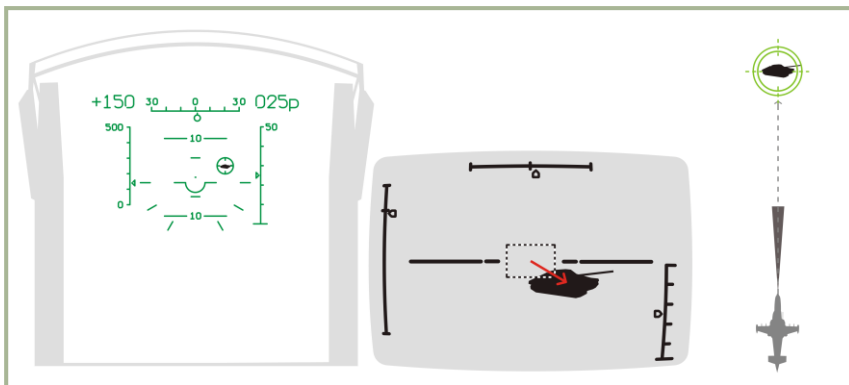


11-2: HUD, Shkval, and HMS indications during automatic turn to target stage

Target Acquisition from Shkval Display

Ensure that the target is located within the HUD field of view and is within $\pm 5^\circ$ of center.

Positively identify the target to avoid friendly fire by switching to the narrow FOV on the Shkval display. If the target is not visible in narrow FOV, switch to wide FOV and slew the targeting marker until the target is found. Once the target is found, return to narrow FOV.



11-3: HUD, Shkval, and HMS indications during Shkval target acquisition stage

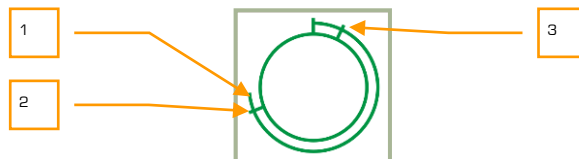
Target Auto-tracking

Adjust the tracking gate size by using the **"ПАМКА М – Б"** (TV target frame Increase – Decrease size) switch on the collective.

When the **"ТГ"** (tracking ready) symbol appears, press the **"АВТ ЗАХВ"** (Automatic target lock) button. Release it when target range is indicated. When the **"АВТ ЗАХВ"** button is pressed, the laser rangefinder is turned on for approximately three seconds. The HUD displays the **"ИД"** symbol and shows remaining time until range-finding will be complete.

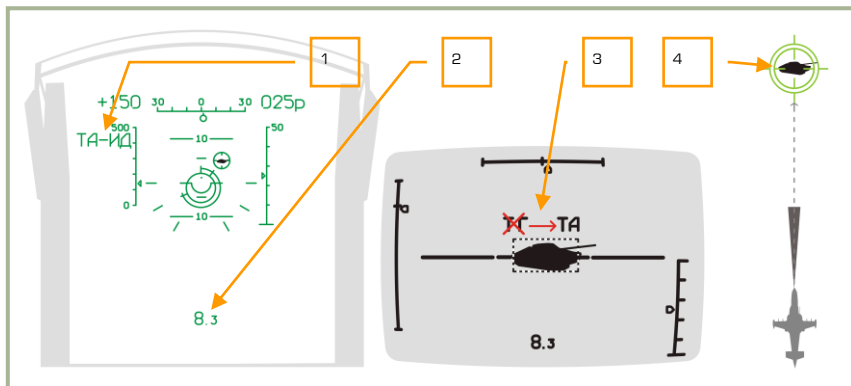
The target will now be in auto-tracked mode, indicated on the HUD and Shkval display by the **"ТА"** (target locked), along with target range.

Additionally, the missile launch zone appears on the HUD along with current, maximum, and minimum launch distances.



1. Current range to the target
2. Maximum launch range
3. Minimum launch range

The HMS will display the following symbol that indicates the target is auto-tracked.



11-4: HUD, Shkval, and HMS indications during auto-tracking stage

1. "ТА-ИД" (Auto-tracking target – range indicator)
2. Range to target
3. "ТГ" (tracking ready) changes to "ТА" (target locked)
4. Helmet mounted sight indication

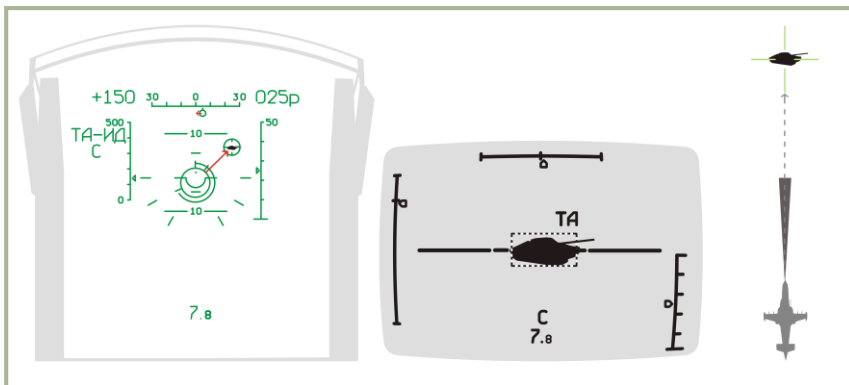
Aiming

Upon reaching maximum launch range, maneuver the helicopter to position the target marker within the missile launch zone reticle. Once aiming is complete, the target line-of-sight symbol will be within the missile launch zone reticle.



When range to target is within permitted values and the helicopter's angular speed does not exceed 3-degrees per second, both the HUD and Shkval TVM display the "C" (launch permitted) symbol. The HMS changes to indicate LAUNCH AUTHORIZED.



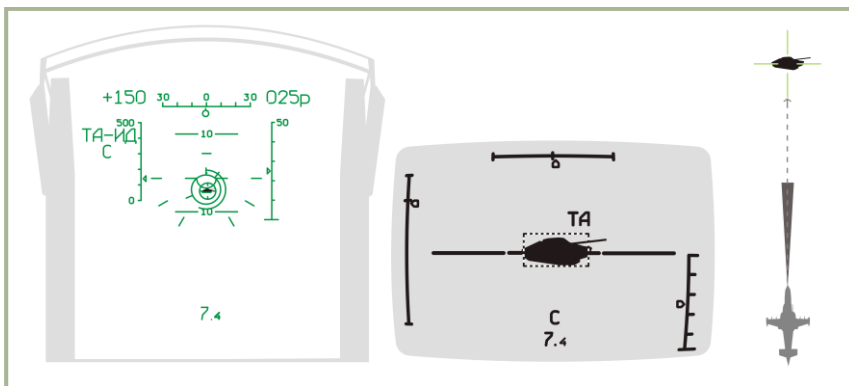


11-5: HUD, Shkval, and HMS indication during aiming stage

Launching a Missile

Once the "C" symbol appears, verify that the "TA" symbol is also on HUD and Shkval TVM and launch the missile by pressing and holding the weapon release button on the cyclic until missile has launched.

When the weapon release button is pressed, the missile laser-beam control channel is automatically activated.



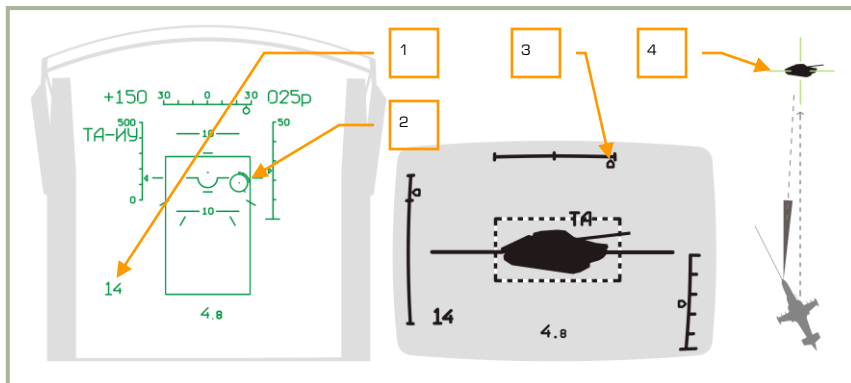
11-6: HUD, Shkval, and HMS indications during launch stage

While the Missile is in Flight

While the Vikhr missile is in flight, maintain the helicopter's current heading such that it does not exceed the Shkval's angular gimbal limits. Try to avoid high angular velocity that can cause missile to lose the laser-guidance beam.

- Laser-beam control channel activated
- The "TA-IV" symbols (auto-tracking target – laser-beam control) will appear

- Time to Impact count-down timer will appear



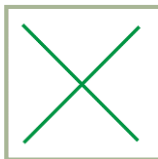
11-7: HUD, Shkval, and HMS indications while missile is in flight

1. Estimated time to impact + 6 seconds
2. Target marker with range to target inscribed
3. Flashing angle indicator when approaching Shkval gimbal limits
4. Helmet mounted sight indication

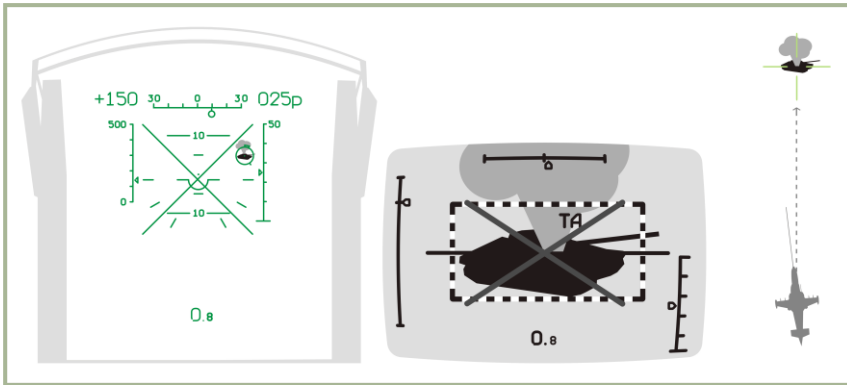
End of attack and Egress

After the missile has hit its target (or ground), or when reaching the minimum launch distance, press the "**СБРОС**" (Reset) button on the Targeting Mode Control panel and turn away from the target. As a rule, you should never over-fly your target.

When within weapon minimum range, the HUD and HMS will display a "launch prohibited" flashing "X" symbol.



After the "**СБРОС**" (Reset) button is pressed, the Shkval will be caged, target tracking and laser-beam channel is turned off, the selected weapon type is reset, and system switches to NAV mode.

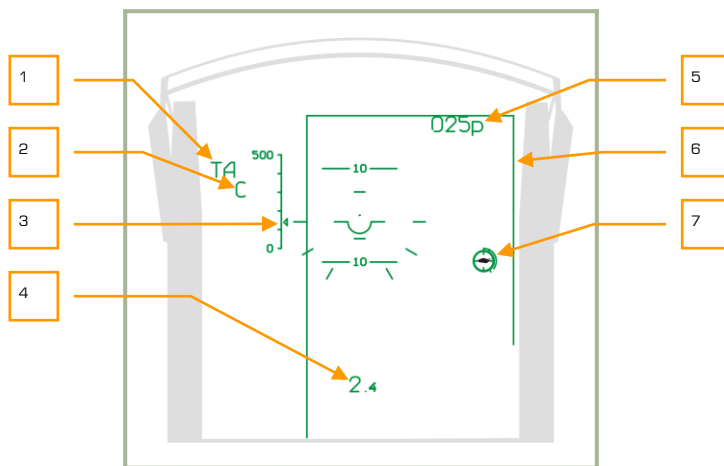


11-8: HUD, Shkval, and HMS indications after attack

Using the 2A42 Cannon with Auto-tracking

To use the 2A42 30mm on-board cannon with auto-tracking, perform the following steps:

1. Select the 2A42 cannon. This will display the cannon's range of motion as a "gate" box on the HUD. The box will be biased to the right because the cannon is mounted on the right side of the helicopter.
2. Maneuver the helicopter to place the target / target marker within the gate.
3. Confirm that target is locked and is being auto-tracked.
4. Once the target is within attack range (2000 m for cannon), and assuming the target / target marker is within the gate box, the "C" symbol will be displayed. Press cannon fire button and hold it until the burst is completed. Release button and press and hold again if another burst is needed to destroy the target.
5. If the gate on the HUD starts flashing, this indicates that you have reached maximum range of motion for the cannon and firing will cease. Fly the helicopter back on target to attack with cannon again.
6. When the target is destroyed, or the attack prohibited "X" symbol appears, break off the attack.



11-9: HUD indications when attacking with cannon in auto-track mode

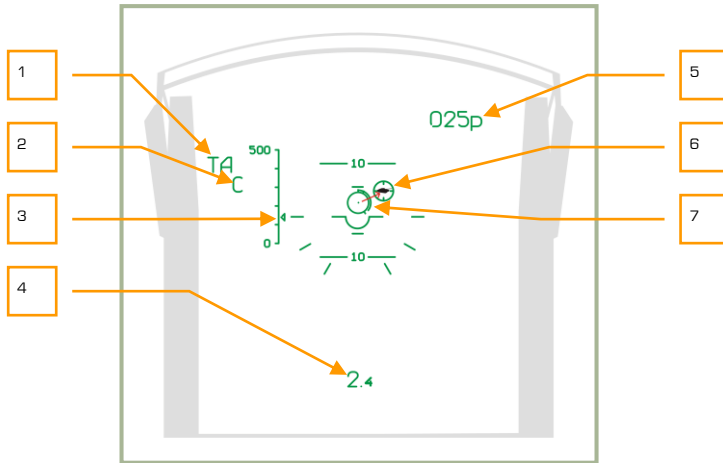
1. "TA" Automatic tracking active (target is tracked)
2. Weapon release authorized "C"
3. Current airspeed
4. Range to target
5. Current altitude
6. «Gate» - cannon motion limits
7. Target marker with range scale inscribed

Using Rockets or Fixed Cannon with Auto-tracking

To attack a target with the cannon in the fixed position, first set the "ОЧ ПЕЖ" (weapon system mode) selector on the Targeting Mode Control panel to the "НПУ" (fix cannon to boresight) position.

Attacking with fixed cannon or rockets using auto-tracking mode requires the following:

1. Verify that target is being tracked by Shkval.
2. Once the target is within attack range, maneuver the helicopter to aim HUD target marker over the target.
3. Once the "C" symbol appears, press weapon release (rockets) button or fire the cannon according to the selected mode.
4. Break off the attack when the target is destroyed or too close, indicated by the "X" symbol.



11-10: HUD indication when attacking with fixed cannon or rockets in auto-track mode

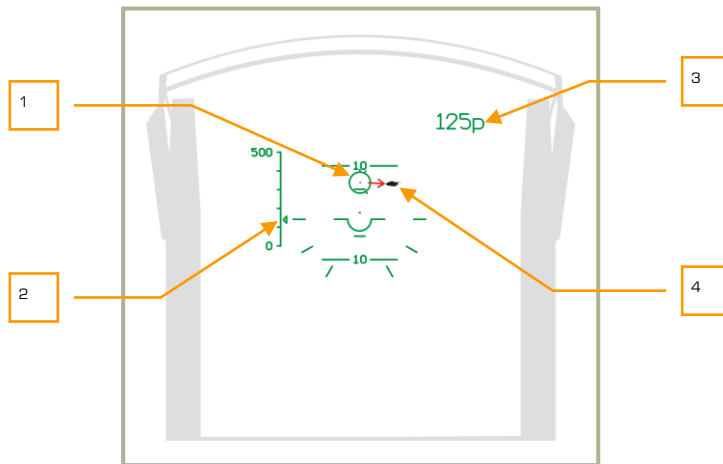
1. "TA" Auto-tracking is active (target is tracked).
2. Launch authorized "C"
3. Current airspeed
4. Range to target
5. Current altitude
6. Target mark
7. Aiming mark with inscribed range

Firing Rockets or Cannons without Auto-tracking

Firing rockets or gun pods (cannon) can also be performed without the use of auto-target tracking. Instead, an aiming mark with range-finding can be used, or even without the range finder.

Firing Rockets or Cannons Using Laser-Rangefinder

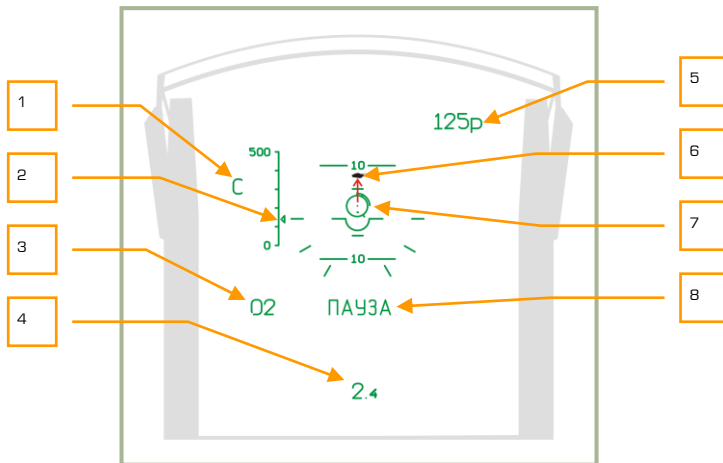
Set the **"AC – ПМ"** (Auto-tracking – Gun sight) switch on the Targeting Mode Control panel to the **"ПМ"** (Gun sight) position. The HUD will display the gun sight aiming mark and is aligned with the laser rangefinder axis.



11-11: HUD indications when attacking with fixed gun or rockets without auto-track mode before ranging

1. Gun sight aiming mark
2. Current airspeed
3. Current altitude
4. Target

Maneuver the helicopter to align the aiming mark with the target and then press and hold the **"ABT 3AXB"** (Lock target) button (this turns on laser rangefinder) and you will see the range scale inscribed on the aiming mark. Once range to target is measured, the aiming mark will move to the predicted weapon impact point. The HUD will also display a countdown timer; during the countdown, you cannot turn on the range finder.



11-12: HUD indications when using rockets or fixed cannon without target auto-tracking

1. Launch authorized symbol "C"
2. Current airspeed
3. Countdown timer until rangefinder can be activated again
4. Range to target
5. Current altitude
6. Target
7. Gun sight aiming mark with inscribed range scale
8. "ПАУЗА" (Pause) symbol – cannon activate rangefinder

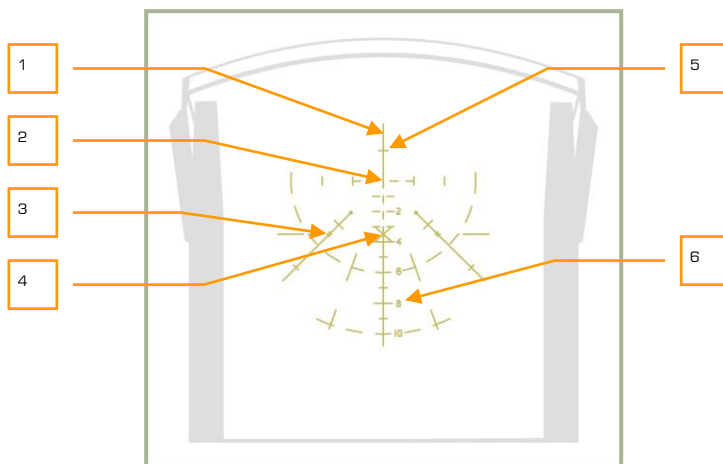
Perform these steps again to align gun aiming mark with the target, and after the launch authorized symbol appears, press the cannon button or rocket (gun pods) button.

Employing Rockets or Cannon with the Standby Reticle

After the appropriate weapons system has been selected, set the HUD mode knob to the "CETKA" (Reticle) position. Maneuver the helicopter to place the aiming point on the target and then fire weapon. Depending on the range and angle to target, the aiming point will vary along the fixed sight.

Lead aiming considerations:

- When considering wind speed, put in lead opposite to the wind direction.
- When considering target speed, put lead in front on the target's movement direction. The greater the target speed will require more lead.



11-13: HUD indications using the standby reticle

1. Helicopter's longitudinal axis
2. Helicopter's horizontal axis.
3. Mark according to vertical angle of 2° and course angle of 3° .
4. HUD center (minus 2°)
5. Vertical angle of 1°
6. Scale in 10 mils

Mils - Abbreviation for milliradian; Bomb/Gun sight settings are expressed in mils, an angular measurement; one degree is equal to 17.45 mils.

Employing Bombs

To employ bombs from the Ka-50, you must estimate a release point calculation.

When making a bombing run, avoid any banking and side slips, and stay higher than 200 m. When below 200 m, the release of bombs is blocked. There is however no minimum release altitude for the KMGU dispenser.

Taking into account speed and true altitude, you must calculate the release point and then press and hold the release button.

Note. The release of sub-munitions from the KMGU dispensers takes place after 1.5 seconds after pressing the weapon release button.

Employing marking rockets S-8TsM

Targeting or marking rockets S-8TsM are intended to improve the efficiency of the ground attack aircraft by targeting (marking) ground objects. The warhead of these rockets consists of body, container, fairing, piston. In the container is located smoke element with retarder and deployment fuse. When the rocket hits the ground it forms a well seen smoke cloud which marks the target or any point of the ground surface.

Implementation of these rockets is the same as for high-explosive rockets and it's possible either from automatic ranging or manual mode.

It is recommended to launch the rockets in short burst, on the Weapons control panel the ripple quantity selector must be in LO position. Thus will be launched 2 rockets per salvo.

Employing illuminating rockets S-80 (OM)

The illuminating rockets S-80 (OM) are intended to improve the efficiency of the aviation and other armed forces in night conditions. The warhead includes a parachute system, candle torch, fuse, retarder and igniter. 17 seconds after rocket's launch the candle's igniter activates, the torch is separated from the rocket and the parachute system deploys. The burning torch free-falls 35 seconds on a parachute at average descent rate of 8,3 m/s and illuminates the area.

The candle torch separates the rocket flies at range of about 7 km, in 17 seconds from launch. This should be taken in consideration during aiming.

To achieve optimal illumination over the target is necessary to launch the rocket in such way that the torch should separate exactly over the target at altitude from 500 to 1000 meters.

For that is necessary to launch the rockets from the estimated point, 7km range to target, with 15...20 degrees pitch up toward the target.

It is recommended to launch the rockets in short burst, on the Weapons control panel the ripple quantity selector must be in LO position. Thus will be launched 2 rockets per salvo.

Special Considerations when Attacking Air Targets

Aiming at an air target can be done when the air target stands out sufficiently against the background. When target range is over 1,500 m it is often best to use Vikhr missiles, otherwise use the cannon. Missile launch and cannon attacks should be done when the target is being auto-tracked. When beginning a target auto-track procedure, make sure that the tracking gate is sized to capture all target elements. When a target's angular velocity is high, maneuver the helicopter to keep it within the HUD's FOV limits.

When attacking air targets with the built-in cannon when in a dive, consider rapidly increasing helicopter speed with a dive angle of around -60° (speed will increase at about 30 km/h per second). Pitch angles should be kept within allowed limits and exit from the dive should be performed accordingly to avoid excessive helicopter speed on exit.

When attacking an air target with the cannon during a climb, consider the rapid reduction in speed, especially at angles over $+60^{\circ}$ (which leads to speed bleeding by 40 km/h per second). Also, keep angles within limits to avoid speed reduction under 50 km/h when exiting.

To use the Vikhr's proximity fuze that will detonate the warhead with a near miss, turn on the **"BU"** (Airborne target) button from the Targeting Mode Control Panel.

Depending on the target's aspect (attack hemisphere), it may be necessary to adjust the missile's proximity fuze delay.

If performing a pursuit or side attack, fuze adjustment is not required.

If attacking at high aspect (in the Head-on hemisphere) it is necessary to decrease the fuze delay in order to increase hit probability. From the Targeting Mode Control Panel, press the **"HNC"** (Head-on hemisphere) button to do so.

Employing "Iгла" Air-To-Air Missiles

To launch the "Iгла" missile, the pilot must set the hardpoint selector on the collective stick to **"AIR TO AIR"** [L^{Ctrl} + U].



11-14: Hardpoint selector set to AIR TO AIR

The indicator button labeled **A/A** (Air to Air) on the Targeting Mode Control Panel [V] will light up.



11-15: Targeting Mode Control Panel

1. **"A/A"** (Air to Air) button [V]. Sets the Weapon Control System to air-to-air mode.
2. **"A/A HO"** (Head-on airborne target) button [LAlt + S].
3. **"RESET"** (Targeting mode reset) button [Backspace].

The HUD will then display "IGLA", along with a visual representation of the missiles on the aircraft's hardpoints and the remaining number of missiles. Additionally, the command **"НАКОЛИ НИП"** (CONNECT MSL PWR) will be displayed.



11-16: Ka-50 HUD, Air-to-Air mode, IGLA

1. Crosshair.
2. Air-to-air weapon, type and number remaining.
3. Hardpoints.
4. Command **"НАКОЛИ НИП"** (CONNECT MSL PWR) tells the pilot to use the power sources to activate the missile.
5. Rear aspect **"ЗПС"**.
6. Index of the selected weapon on the hardpoint.

The crosshair is located at the zero point of the HUD along the aircraft's fuselage axis. It displays the target lock zone of the missile seeker with a field of view angle of 1° and will remain until target lock is acquired.

"НИП", hereinafter the "NIP", is a ground power source and cooling supply that got its name from the ground-based MANPADS version. **"НАКОЛИ НИП"** translates from Russian as "Pierce Power Supply" and is a term used because of that MANPADS reference. The action consists of a special thrust that pierces the membrane of a nitrogen bottle and presses on the firing pin of the battery to activate the power supply.

The NIP performs the following functions:

1. Supplies compressed nitrogen to the missile seeker for cooling.
2. Provides electric power to the missile during the launch preparation.

One NIP Power Supply works for 30 seconds. Two NIPs are connected to each missile, activated one after another, giving the total time of preparation and seeker operation up to 55 seconds. If the pilot resets this process with the RESET button before the second NIP is activated, with more than 30 seconds left, the second NIP will not be used. It is

possible to use the missile again with the second NIP, with its corresponding time limit of 25 seconds (5 seconds are taken to spin up the gyro and activate the missile etc.).

After both NIPs have been consumed, the missile is de-energized and can no longer be used.

Summarizing this, when attacking a target with an "Iгла" air-to-air missile, the pilot should complete aiming and launching the missile within 55 seconds.

To connect NIP Power Supply, the pilot must pull the hardpoint weapon trigger [RAlt + SPACE] on the control stick once. Doing so will supply the missile with power and coolant, and the command "НАКОЛИ НИП" (CONNECT MSL PWR) will disappear from the HUD.

To abort, simply press the indicator button labelled "RESET" (Targeting Mode Reset) [Backspace] on the Mode Select Panel to return the missile to its non-armed state.

Launching the "Iгла" in Semi-Automatic Mode

Missile launch may be performed in one of two modes: semi-automatic and manual.

Select the launch mode by setting the mode select switch "MAN – AUTO" [A] on the central panel to the desired mode.

This is set to Semi-automatic by default "AUTO". In semi-automatic mode, the seeker head is automatically uncaged once the missile is connected to its power source.



11-17: PUI-800 Weapon Status and Control Panel, Semi-Auto mode

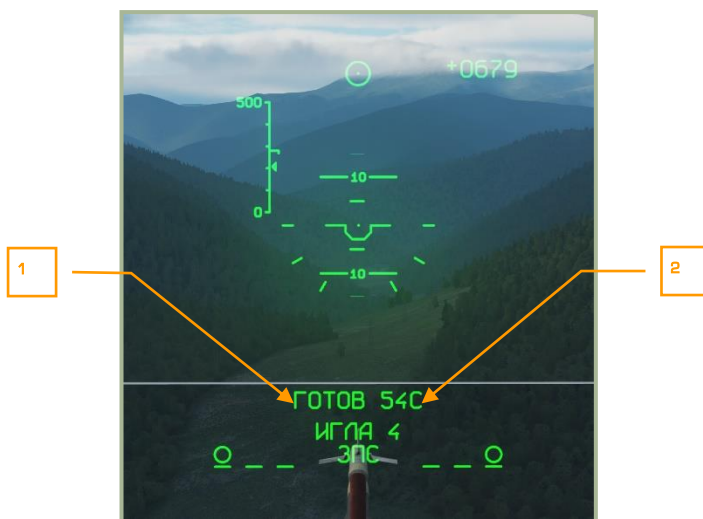
IGLA launch mode is activated by the hardpoint selector switch on the collective stick. Press [LCtrl + U] to push the switch forward to "AIR TO AIR". Once this is done, the HUD will display "IGLA", along with a visual representation of the missiles on the aircraft's hardpoints and the remaining number of missiles. Additionally, the command "НАКОЛИ НИП" (CONNECT MSL PWR) will be displayed, and "ЗПС" (for a rear aspect launch).



11-18: HUD elements, "НАКОЛИ НИП" command

To connect missile power, the pilot must pull the hardpoint weapon trigger [\[RAlt + SPACE\]](#) on the control stick once. The HUD will then display a message that the first missile has begun the arming cycle.

Once 5 seconds have passed after gyroscope spin-up and the missile's seeker head being supplied with coolant, the "НАКОЛИ НИП" (CONNECT MSL PWR) message on the HUD will be replaced with the message "ГОТОВ" (READY), along with a countdown to the end of the missile's arming cycle. The arming cycle will last no longer than 55 seconds assuming the aircraft has both ground power supply units available on the launch modules.



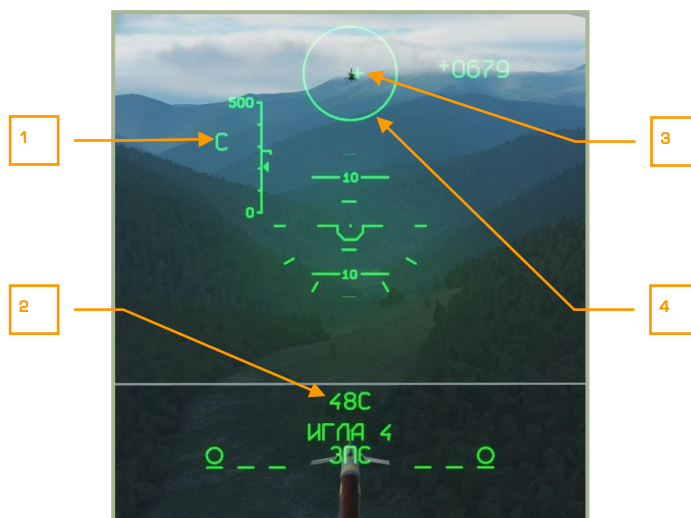
11-19: HUD, Igla missile arming cycle countdown

1. "ГОТОВ" (READY) message.
2. Countdown to the end of missile's arming cycle.

While the countdown is active, bring the crosshair over your target. If the target has a large enough IR signature to be recognized by the seeker, the missile will achieve target lock in 1-2 seconds.

Once target lock is achieved, the HUD will display the command "С" (FIRE) on the left-hand side, while the missile arming cycle countdown will continue to be displayed. The size of the target lock zone on the HUD will increase to 4°. The crosshair, represented by a 0.6°-small cross, will move along with the seeker head's direction of view.

To launch the missile, pull the hardpoint weapon trigger [[RAIt](#) + [SPACE](#)] once more.



11-20: HUD, Launch Authorized status

1. Launch authorized symbol "C" (FIRE).
2. Arming cycle countdown.
3. Seeker head crosshair.
4. IR signature capture zone.

Should the target move beyond the IR signature capture zone, or if the pilot presses **"RESET"** [[Backspace](#)] on the Targeting Mode Control Panel, the "C" (FIRE) command will be replaced again with the message **"ГОТОВ"** (READY), while the IR signature capture zone will shrink back to 1°. The pilot must once again maneuver to place the crosshair over the target and wait for target lock.

Once 55 seconds have elapsed without the missile being launched, the Weapon Control System will automatically select the next available missile, indicated by **"НАКОЛИ НИП"** (CONNECT MSL PWR) reappearing on the HUD. The indicator for the missile that reached the end of its arming cycle will disappear.

Should the pilot have to launch another missile after the first, they must once again perform the launch procedure from the beginning.

Press **"RESET"** [[Backspace](#)] on the Targeting Mode Control Panel to exit air-to-air missile mode.



11-21: HUD, next missile

Manual Launch Mode

Select the launch mode by setting the mode select switch **"MAN – AUTO"** [A] on the central panel to the **"MAN"**.

Manual launch mode differs from Semi-automatic mode only in that prior to achieving target lock, the pilot must manually uncage the missile seeker by pressing **"AUTO LOCK"** [Enter] on the collective stick, which will allow the missile to begin searching for targets.



11-21: PUI-800 Weapon Status and Control Panel, Manual mode



12

CHECK
LISTS

12 CHECK LISTS

ENABLE ELECTRICAL POWER AND INTERCOM

Panel	Controls, checks	Check, operation, message	Key commands
Wall panel	BAT1 (battery 1)	On	Switch: [LCtrl + LShift + E] Cover: [LCtrl + LAlt + LShift + E]
Wall panel	BAT2 (battery 2)	On	Switch: [LCtrl + LShift + W] Cover: [LCtrl + LAlt + LShift + W]
Wall panel	ПРЕОБР (AC/DC inverters)	ABT (Auto)	[LCtrl + LShift + I]
Wall panel	INT.COM (Intercom) to request external power from ground crew	On	[LCtrl + LAlt + Z]
Wall panel	= ТОК АЭР ПИТ (DC ground power)	On	Switch: [LCtrl + LShift + Q] Cover: [LCtrl + LAlt + LShift + Q]
Wall panel	~ ТОК АЭР ПИТ (AC ground power)	On	[LCtrl + LShift + R]

ENABLE AND TEST EKRAN SYSTEM

Panel	Controls, checks	Check, operation, message	Key commands
Rear panel (bottom)	ВМГ ГИДРО ЭКРАН (Power plant, hydraulics, EKRAN self test systems)	On (switch down)	Switch: [LCtrl + LShift + N] Cover: [LCtrl + LAlt + LShift + N]

Right forward panel	EKRAN display	ОТКАЗ (Malfunction) short message	
Left forward panel	MWL	Press	[LCtrl + L]
Right forward panel	EKRAN display	САМОКОНТ (Self-test) during 5 second	
Right forward panel	EKRAN display	ЭКРАН ГОДЕН (EKRAN ready) during 5 second	

MESSAGE LAMPS TEST, ENABLE ILLUMINATION

Panel	Controls, checks	Check, operation, message	Key commands
Left forward panel	КОНТРОЛЬ СИГНАЛИЗАЦИИ (message lamp test button)	Press and hold	[LShift + L]
All panels	Lamps	All lit Sound beeper	
Wall panel	ПОДСВЕТ ПУЛЬТЫ (gauges illumination)	On (night)	[RCtrl + K]
Wall panel	ПОДСВЕТ АГР ПКП (ADI and SAI illumination)	On (night)	[RAlt + RShift + K]
Wall panel	КОНТУР ОГНИ (Tip lights)	On (night)	[RAlt + J]
Wall panel	СТРОЕВ ОГНИ (Formation lights)	On (night)	[RCtrl + J]
Wall panel	ПРОБЛЕСК МАЯК (Anti-collision light)	On (night)	[RShift + J]
Overhead panel	АНО КОД (Navigation lights)	On (night)	[RAlt + L]
Center panel (bottom)	ПОСАД ФАРЫ (Landing-search light)	УПР. СВЕТ (Light control)	[RShift + L]
Wall panel	ПОДСВЕТ ПРИБОРЫ (Cockpit night illumination)	On (with nights goggles)	[RShift + K]



Rear panel	ПОДСВЕТ ПУЛЬТ КОНТР (Auxiliary control panel illumination)	On (If needed)	[RAlt + RShift + L]
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TARGETING-NAVIGATION SYSTEM PREPARATION

Panel	Controls, checks	Check, operation, message	Key commands
Rear panel	INU power	On	
Wall panel	SAI power	On	
Wall panel	"ПНК ВКЛ – ОТКЛ" (Targeting Navigation system)	On	
Left panel	Targeting control panel (PVR) K-041 (Targeting-navigation power switch)	On	[LShift + D]
Wall panel	Navigation control panel (PVI) Master mode selector	РАБ (Work)	Left: [RAlt + V] Right: [RAlt + B]
Overhead panel	Message lamps check	РАНЕТ (Navigation system prepare)	
Forward panels	Red flags on gauges check	Off	
Forward panels	IT-23 TV display check	On	

AMMS ABRIS ENABLE

Panel	Controls, checks	Check, operation, message	Key commands
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Right forward panel	АБРИС ВКЛ – ОТКЛ (ABRIS ON – OFF)	On	[RShift + 0]
After ABRIS boot-up (3 min)			
ABRIS	NAV button (5)	Press	[5]
ABRIS	MAP button (2)	Press	[2]
ABRIS	SCALE+ (3), SCALE- (4) buttons	Adjust scale	[3] [4]
ABRIS	NAV button (5)	Press	[5]
For ABRIS implementation see corresponding chapter			

ADF CHECK AND ADJUST

Panel	Controls, checks	Check, operation, message	Key commands
Wall panel, ADF panel	КАНЫЛЫ АРК (ADF channel selector)	Departure airport channel	Next: [LCtrl + =] Previous: [LCtrl + -]
Center panel (bottom)	ПРИВОД РС (Inner-Auto-Outer NDB switch)	БЛИЖН (Inner NDB)	[LAlt + =]
Wall panel, ADF panel	КОМП – АНТ (HSI – antenna switch)	АНТ (Antenna)	[LCtrl + LAlt +]
Sound	Inner NDB Morse code check	Listen	
Wall panel, ADF panel	КОМП – АНТ (HSI – antenna switch)	КОМП (HSI)	[LCtrl + LAlt +]
HSI	Bearing to radio beacon needle check	To Inner NDB	
Center panel (bottom)	ПРИВОД РС (Inner-Auto-Outer NDB switch)	ДАЛЬН (Outer NDB)	[LAlt + =]



Wall panel, ADF panel	КОМП – АНТ (HSI – antenna switch)	АНТ (Antenna)	[LCtrl + LAlt + []]
Sound	Outer NDB Morse code check	Listen	
Wall panel, ADF panel	КОМП – АНТ (HSI – antenna switch)	КОМП (HSI)	[LCtrl + LAlt + []]
HSI	Bearing to radio beacon needle check	To Outer NDB	
Center panel (bottom)	ПРИВОД РС (Inner-Auto-Outer NDB switch)	АВТ (Auto – Outer then Inner)	[LAlt + =]
Wall panel, ADF panel	КАНАЛЫ АРК (ADF channels selector)	By flight plan	Next: [LCtrl + =] Previous: [LCtrl + -]

ONBOARD DEFENSE SYSTEM PROGRAMMING

Panel	Controls, checks	Check, operation, message	Key commands
Rear panel	УВ-26 ВКЛ – ОТКЛ (UV-26 Power switch)	On	Switch: [LCtrl + LShift + C] Cover: [RAlt + RShift + C]
Overhead panel, UV-26 panel	НАЛИЧ – ПРОГР (Amount flares counter–Programming switch)	ПРОГР (Programming)	[RCtrl +]]
Overhead panel, UV-26 panel	СЕРИЯ (Number of flare sequences button)	Set number of flare sequences	[RShift + Insert]
Overhead panel, UV-26 panel	ЗАЛП (Number of flares in sequence button)	Set number of flares in sequence	[RCtrl + Insert]
Overhead panel, UV-26 panel	ИНТЕРВАЛ (Delay between sequences button)	Set delay between sequences	[RAlt + Insert]

Overhead panel, UV-26 panel	НАЛИЧ – ПРОГР (Amount flares counter–Programming switch)	НАЛИЧ (Counter)	[RCtrl +]]
Overhead panel, UV-26 panel	БОПТ (Side LEFT-BOTH-RIGHT switch)	Set by expected threats	[RAIt +]]
ABRIS	NAV button (5)	Press	[5]
ABRIS	NAV button (5)	Press	[5]
ABRIS	NAV button (5)	Press	[5]
ABRIS	NAV button (5)	Press	[5]
ABRIS	NAV button (5)	Press	[1]
ABRIS	NAV button (5)	Press	[5]

LASER WARNING RECEIVER PREPARATION

Panel	Controls, checks	Check, operation, message	Key commands
Auxiliary control panel	Л-140 (LWS L-140 power switch)	On	[LCtrl + N]
Self test LWR equipment up to green lamp lit in 30 second			
LWR panel	СБРОС (Reset)	Press	[L]
Auxiliary control panel	Л-140 КОНТП (LWS L-140 self-test button)	Press	[LCtrl + LAlt + N]
LWR panel	Lamps check	Laser bearing and hemisphere lit	
Left forward panel	Red master warning light and АТАКА БЕРЕГИСЬ (Attack Caution!) check	Flashing	
LWR panel	СБРОС (Reset)	Press	[L]



INDICATION SYSTEM PREPARATION

Panel	Controls, checks	Check, operation, message	Key commands
Overhead panel	With 2-3 minutes from K-041 on	PAHET lamp off	
HUD	ЯРК (Brightness knob)	Adjust	Up: [RCtrl + RShift + H] Down: [RAlt + RShift + H]
Center panel, Targeting display panel (PUR)	ЯРКОСТЬ ИТ (IT-23 TV display brightness)	Adjust	Up: [RCtrl + RAlt +]] Down: [RCtrl + RAlt + [
Center panel, Targeting display panel (PUR)	КОНТРАСТ ИТ (IT-23 TV display contrast)	Adjust	Up: [RCtrl + RShift +]] Down: [RCtrl + RShift + [
Left panel, Targeting control panel (PVR)	ОБЗ (Helmet Mounted Sight Display switch)	On	[H]
Center panel, Targeting display panel (PUR)	ЯРКОСТЬ НВУ (HMTD brightness)	Adjust	Up: [RCtrl + RAlt + RShift +]] Down: [RCtrl + RAlt + RShift + [

FIRE EXTINGUISHERS CHECK

Panel	Controls, checks	Check, operation, message	Key commands
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Wall panel (top)	ОГНЕТУШ – ОТКЛ – КОНТР (Extinguishers WORK –OFF - TEST switch)	КОНТР (Check)	Switch: [LCtrl + LShift + Z] Cover: [LCtrl + LAlt + LShift + Z]
Wall panel (top)	СИГНАЛИЗ (Fire signaling switch)	On	[RAlt + LShift + Z]
Wall panel (top)	КОНТРОЛЬ IГР-IIГР- IIIГР (Sensor groups BIT selector)	IГР (1st group)	[RShift + Z]
Wall panel (top)	ПОЖАР ЛЕВ ДВИГ (Left engine fire) ПОЖАР ПРАВ ДВИГ (Right engine fire) ПОЖАР ГИДРО (Hydraulics fire) ПОЖАР ВЕНТИЛ (Ventilation fire) ПОЖАР ВСУ (APU fire) Warning lights check	Light	
Left forward panel	Red master warning ПОЖАР (Fire) Warning lights check	Light	
Wall panel (top)	КОНТРОЛЬ IГР-IIГР- IIIГР (Sensor groups BIT selector)	Neutral position	[RShift + Z]
Wall panel (top)	СИГНАЛИЗ (Fire signaling switch)	Off then On All lights off	[RAlt + LShift + Z]
Wall panel (top)	КОНТРОЛЬ IГР-IIГР- IIIГР (Sensor groups BIT selector)	IIГР (2nd group) All fire lights On (like with 1-st group)	[RShift + Z]
Wall panel (top)	КОНТРОЛЬ IГР-IIГР- IIIГР (Sensor groups BIT selector)	Neutral position	[RShift + Z]



Wall panel (top)	СИГНАЛИЗ (Fire signaling switch)	Off then On All lights off	[RAIt + LShift + Z]
Wall panel (top)	КОНТРОЛЬ ИГР-ИГР- IIIГР (Sensor groups BIT selector)	IIIГР (3rd group) All fire lights On, except for the APU fire light	[RShift + Z]
Wall panel (top)	КОНТРОЛЬ ИГР-ИГР- IIIГР (Sensor groups BIT selector)	Neutral position	[RShift + Z]
Wall panel (top)	СИГНАЛИЗ (Fire signaling switch)	Off then On All lights off	[RAIt + LShift + Z]
Wall panel (top)	БАЛЛОНЫ (Extinguishers First (Auto) – Second (Manual))	ABT (First (Auto))	Switch: [RCtrl + RShift + Z] Cover: [RCtrl + RAIt + RShift + Z]

ENGINES START-UP

START-UP PREPARATION

Panel	Controls, checks	Check, operation, message	Key commands
Wall panel	УКВ-2 (R-800 VHF-2 radio power switch)	On	[LCtrl + LAlt + P]
Rear panel (top)	ПРОВЕРКА РЕЧЬ (ALMAZ Voice message system check button)	Press	[RCtrl + RAlt + V]
Sound	Message	«Речевой информатор исправен» (Message system in operate)	
Radio	Request start-up	Start-up when ready	
Door	Cockpit door	Close	[RCtrl + C]
Wall panel	ТОПЛИВОМЕР (Fuel meter power) and confirm correct indication	On	[LCtrl + LShift + H]

APU START-UP

Panel	Controls, checks	Check, operation, message	Key commands
Wall panel	ПЕРЕКР. КРАНЫ – ВСУ (APU fuel shut-off valve)	Open	Switch: [RCtrl + RShift + L] Cover: [RCtrl + RAlt + RShift + L]
Wall panel	НАСОСЫ БАКОВ – ПЕРДН. (Forward fuel tank pumps)	On	[LCtrl + LShift + A]
Overhead panel	Message lamps check	БАК ПЕРЕДН (Forward tank)	

Wall panel	НАСОСЫ БАКОВ – ЗАДН. (Rear fuel tank pumps)	On	[LShift + P]
Overhead panel	Message lamps check	БАК ЗАДН (Rear tank)	
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)	ВСУ (APU)	[E]
Left panel	ЗАПУСК (Start-Up button) and allow APU time to reach steady power	Press	[HOME]
Left panel, APU panel	APU exhaust gas temperature gauge	Temperature growth monitor No more 720°C	
Left panel, APU panel	APU lights check	ВСУ ВКЛЮЧЕНА (APU in operate) Р МАСЛА ВСУ (APU oil pressure)	

ENGINES START-UP

Panel	Controls, checks	Check, operation, message	Key commands
Left panel	Rotors brake	Off	[LShift + R]
Left engine start-up			
Wall panel	ПЕРЕКРЫВ КРАНЫ – ДВИГ. ЛЕВ. (Left engine fuel shut-off valve switch)	Open	Switch: [RCtrl + RShift + J] Cover: [RCtrl + RAlt + RShift + J]

Overhead panel	Message lamps check	КРАН ЛЕВ ЗАКРЫТ (Left shut-off valve closed) off	
Wall panel	ЭРД ЛЕВ. (Left electronic engine governor switch)	On	Switch: [RCtrl + HOME] Cover: [RCtrl + RAlt + HOME] [LAlt + E]
Left panel	ЗАПУСК – ПРОКРУТКА – ЛОЖНЫЙ ЗАПУСК (Start-Up-Crank-False Start engine work mode switch)	ЗАПУСК (Start-Up)	
Left panel	ВСУ – ДВИГ ЛЕВ – ДВИГ ПРАВ – ТУРБОПРИВОД (APU-Left engine-Right engine-Turbo gear engine selector)	ДВИГ ЛЕВ (Left engine)	[E]
Left panel	ЗАПУСК (Start-Up button)	Press	[HOME]
Left panel	Left engine cut-off valve	ОТКРЫТО (Open)	[RCtrl + Page Up]
Forward panel right	Tachometer check	RPM continuously increased	
Forward panel right	Exhaust temperature indicator check	Temperature continuously increased	
	Rotors turning check	At RPM about 25%	
Left panel	КЛАПАН ЗАПУСКА (Engine start valve lamp) check	Off with 60...65% RPM	
Auxiliary control panel (center)	ДАВЛЕНИЕ (Hydraulics pressure-gauges) check	Hydraulics pressure increase	
Right engine start-up			

Wall panel	ПЕРЕКРЫВ КРАНЫ – ДВИГ. ПРАВ. (Right engine fuel shut-off valve switch)	Open	Switch: [RCtrl + RShift + K] Cover: [RCtrl + RAlt + RShift + K]
Overhead panel	Message lamps check	КРАН ПРАВ ЗАКРЫТ (Right shut-off valve closed) off	
Wall panel	ЭРД ПРАВ. (Right electronic engine governor switch)	On	Switch: [RCtrl + End] Cover: [RCtrl + RAlt + End]
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)	ДВИГ ПРАВ (Right engine)	[E]
Left panel	ЗАПУСК (Start-Up button)	Press	[HOME]
Left panel	Right engine cut-off valve	ОТКРЫТО (Open)	[RCtrl + Page Down]
Forward panel right	Tachometer check	RPM continuously increased	
Forward panel right	Exhaust temperature indicator check	Temperature continuously increased	
Forward panel left	Rotor RPM indicator check	Rotors RPM no less than 55% with two engines at idle	
APU off and engines warm-up			
Left panel	ОСТАНОВ ВСУ (Stop APU)	Press	[End]

Wall panel	ПЕРЕКР. КРАНЫ – ВСУ (APU fuel shut-off valve)	Close	Switch: [RCtrl + RShift + L] Cover: [RCtrl + RAlt + RShift + L]
Wall panel (top)	Transmission and engine oil temperature gauges check	Wait for oil temperature to reach 30°C	

PRE-FLIGHT TEST

Panel	Controls, checks	Check, operation, message	Key commands
Collective	Collective pitch	Down to the stop	Up: [Numpad +] Down: [Numpad -]
Throttle levers	Work mode	AUTO	Up two times Up: [Page Up] Down: [Page Down]
Forward panel left	Rotor RPM indicator check	RPM (AUTO) 86...87%	
Overhead panel	ПОС ВИНТОВ (Rotors anti-ice system) When outside air temperature is less than 5°C	On	[LCtrl + LAlt + LShift + S]
Overhead panel	ПОС ДВИГ (Engines anti-ice system) When outside air temperature is less than 5°C	On	[LAlt + I]
Cyclic and rudder	Cyclic pitch and yaw	Move around no more than 1/3 of total range	Cyclic: [Arrow Up], [Arrow Down], [Arrow Left], [Arrow Right] Rudder: [Z] and [X]
Rear panel (center)	ДАВЛЕНИЕ (Hydraulics pressure-gauges) check	Pressure no less than 65 kgf/sm ²	
Wall panel	~ТОК ГЕН. ЛЕВ. (AC left generator)	On	[LCtrl + LShift + Y]

Wall panel	~ТОК ГЕН. ПРАБ. (AC right generator)	On	[LCtrl + LShift + U]
Wall panel	= ТОК АЭР ПИТ (DC ground power)	Off	Switch: [LCtrl + LShift + Q] Cover: [LCtrl + LAlt + LShift + Q]
Wall panel	~ ТОК АЭР ПИТ (AC ground power)	Off	[LCtrl + LShift + R]
Left panel	Radio ground crew and shut off external power.		

FINAL CHECKS AND TAXI

Panel	Controls, checks	Check, operation, message	Key commands
Overhead panel	Message lamps check	No warnings	
Forward panel right	EKRAN display check	No warnings	
Left forward panel	Radar altimeter Dangerous altitude set rotary	Set to 10 m	Left: [LShift + ,] Right: [LShift + .]
Left forward panel	Radar altimeter TECT (test) button	Press and hold until arrow stop, then release	[LAlt + LShift + R]
Left forward panel	Radar altimeter Caution yellow lamp on the rotary check	Lit when the needle passes below dangerous altitude	
Left forward panel	Radar altimeter Caution sound check	Heard with yellow lamp lit	
Left forward panel	Radar altimeter Dangerous altitude set rotary	Set by flight plan	Left: [LShift + ,] Right: [LShift+ .]
Left forward panel	HSI ЗПУ-3К АВТ – РУЧН (Automatic / manual heading and desired track angle)	Set by flight plan	[LCtrl + H]

Radio	Request taxi	Cleared to taxi	
Wall panel	Autopilot panel "K" Bank channel button	On	[LShift + B]
Wall panel	Autopilot panel "T" Pitch channel button	On	[LShift + P]
Wall panel	Autopilot panel "H" Yaw channel button	On	[LShift + H]
Wall panel	АВАР. ПОКИДАН. (Ejection system)	All On	[RShift + RCtrl + RAlt + E] [RAlt + RShift + E] [RAlt + RShift + R] [RAlt + RShift + T]
Right forward panel	SAI	Uncage (Rotate knob counterclockwise up to knob down)	
	Look around for obstacles	All clear	
Taxi			
Collective	Collective pitch	¼ of range	Up: [Numpad +] Down: [Numpad -]
Cyclic	Cyclic pitch	Push smoothly	[Arrow Up], [Arrow Down], [Arrow Left], [Arrow Right]
	Taxi speed on concrete surface	Up to 15 km/h	
Stop			
Collective	Collective pitch	Down to the stop	Up: [Numpad +] Down: [Numpad -]
Cyclic stick	Cyclic pitch	Neutral	[Arrow Up], [Arrow Down], [Arrow Left], [Arrow Right]
Cyclic stick	Wheel brake	On	[W]

BEFORE TAKE-OFF

Panel	Controls, checks	Check, operation, message	Key commands
Left forward panel	Altimeter knob	Set to 0	Up: [RShift + =] Down: [RShift + -]
Left forward panel	HSI Desired track angle check	By flight plan	
Left forward panel	HSI Radio beacon needle check	On the selected NDB	
Left forward panel	ЗПУ-3К АВТ – РУЧН (Automatic / manual heading and desired track angle) check	By flight plan	
Wall panel	Navigation control panel (PVI) Master mode selector check	РАБ (Work)	
Wall panel	Navigation control panel (PVI) ППМ (WPT button)	On	[RAlt + Q]
Wall panel	Navigation control panel (PVI) Number buttons	Press number of desired WPT (1-6)	[RAlt + 1...6]
Wall panel	Navigation control panel (PVI) Numeric display check	Number of WPT with coordinates	
ABRIS	Map helicopter position	At initial point	
Wall panel	Autopilot panel ЗК-ЛЗП (Heading/Course steering mode switch)	By flight plan	
Left forward panel	Clock	Start flight time start	[RCtrl + RAlt + RShift + C]

HOVER CHECK

Panel	Controls, checks	Check, operation, message	Key commands
	Helicopter heading	Against the wind	
	Forward taxi	2...3 meters for wheels alignment	
Cyclic	Wheel brake	On	[W]
	Instruments check	Correct	
	Look around for obstacles	All clear	
Radio	Request take-off	Clearance tack-off	
Cyclic	Wheel brake	Off	[W]
Collective	Collective	Increase up to maximum	Up: [Numpad +] Down: [Numpad -]
Take desired hover altitude			
Cyclic	Trimmer	On	[T]
Collective	Collective pitch	Hold altitude	Up: [Numpad +] Down: [Numpad -]
	Engine instruments check	Correct	
	Controllability	Correct	
	Center-of-gravity position	Correct	
Cyclic	ВИСЕНИЕ (Hover hold button)	On	[LAlt + T]
Overhead panel	Message lamps check	ВИСЕНИЕ (Hover)	
HUD	Hover point	Display	
HSI	Lateral deviation bars	Correct	
ADI	ADI zero pitch trim knob	Set to zero	Left: [LAlt + LShift + ,] Right: [LAlt + LShift + .]

			Right: [LAlt + LShift + .]
Cyclic	ВИСЕНИЕ (Hover button)	Off	[LAlt + T]

HELICOPTER STYLE TAKEOFF

Panel	Controls, checks	Check, operation, message	Key commands
	Hover Check	Performed	
Cyclic	Cyclic stick	Push smoothly	[Arrow Up], [Arrow Down], [Arrow Left], [Arrow Right]
Collective	Collective pitch	Prevent aircraft from sinking	Up: [Numpad +] Down: [Numpad -]
	Acceleration with climb	Up to 100...120 km/h	Up: [Numpad +] Down: [Numpad -]

RUNNING STYLE TAKEOFF

Panel	Controls, checks	Check, operation, message	Key commands
	Hover Check	Performed	
	Land helicopter after hover check		
Cyclic	Cyclic stick	Push smoothly	[Arrow Up], [Arrow Down], [Arrow Left], [Arrow Right]
Collective	Collective pitch	Up to maximum	Up: [Numpad +] Down: [Numpad -]
	Pitch	No more -10°	
	With speed 30...40 km/h	Cyclic stick pull up for takeoff	
	Accelerate with gradual climb	Up to 100...120 km/h	

EN-ROUTE FLIGHT

Panel	Controls, checks	Check, operation, message	Key commands
Collective	МАРШРУТ-СНИЖЕН (Route-descent switch)	МАРШРУТ (Route)	[R]
Overhead panel	Message lamps check	МАРШРУТ ЗК (МАРШРУТ ЛЗП) (Route Heading or Route Course steering)	
Auto turn to WPT			
Climb			
Wall panel	Autopilot Panel БАР-РВ (Baro-Radar altitude hold mode switch)	By flight plan	
Wall panel	Autopilot Panel "В" - altitude hold channel button	On	[LShift + A]
Wall panel	Autopilot Panel "В" - altitude hold channel button	Lit	
250 m before start turning to next leg			
Overhead panel	Message lamps check	ППМ РАЗВОРОТ (WPT Turning)	
Wall panel	Navigation panel (PVI) display check	Next WPT	
ABRIS	Helicopter position check	Current WPT	
Left forward panel	HSI Bearing and desired track angle check	Next WPT	
Next leg passing by the same way			
250 m before last WPT			
Overhead panel	Message lamps check	КОНЕЦ МАРШРУТА (Route end)	

INGRESS TO TARGET POINT

Panel	Controls, checks	Check, operation, message	Key commands
Collective	МАРШРУТ-СНИЖЕН (Route-descent switch)	Neutral (from Route mode)	[R]
Wall panel	Navigation panel (PVI) ППМ (WPT button)	Off	[RAlt + Q]
Wall panel	Navigation panel (PVI) ОТ (Target point button)	On	[RAlt + U]
Wall panel	Navigation Control panel (PVI) Number buttons	Press number of desired target point (0-9)	[RAlt + 0...9]
Wall panel	Navigation Control panel (PVI) display check	Target point number	
Collective	МАРШРУТ-СНИЖЕН (Route-descent switch)	МАРШРУТ (Route)	[R]

HOVERING AND DESCENT

Panel	Controls, checks	Check, operation, message	Key commands
Decelerate speed and hovering in manual mode			
Collective	МАРШРУТ-СНИЖЕН (Route-descent switch)	To neutral	[R]
Cyclic	ВИСЕНИЕ (Hovering)	On	[LAlt + T]
Overhead panel	Overhead Panel Warning and Advisory Lamps	ВИСЕНИЕ (Hovering)	
Overhead panel	Overhead Panel Warning and Advisory Lamps	Нрв СТАБ (RAlt hold)	
If it necessary decrease hover altitude			

Collective	МАРШРУТ-СНИЖЕН (Route-descent switch)	СНИЖЕН (Descent) press and hold	[F]
Overhead panel	Overhead Panel Warning and Advisory Lamps	СНИЖЕН (Descent)	
On reaching desire altitude			
Collective	МАРШРУТ-СНИЖЕН (Route-descent switch)	СНИЖЕН (Descent) release	[D]
Overhead panel	Overhead Panel Warning and Advisory Lamps	ВИСЕНИЕ (Hovering)	
Overhead panel	Overhead Panel Warning and Advisory Lamps	Нрв СТАБ (RAlt hold)	

RETURN TO BASE

Panel	Controls, checks	Check, operation, message	Key commands
Collective	МАРШРУТ-СНИЖЕН (Route-descent switch)	Neutral (from Route mode)	[R]
Wall panel	Navigation Control panel (PVI) ППМ (WPT button)	Off	[RAlt + Q]
Wall panel	Navigation Control panel (PVI) АЭР (Airdrome button)	On	[RAlt + T]
Wall panel	Navigation Control panel (PVI) Number buttons	Press number of desired airfield (1-2)	[RAlt + 1...2]
Wall panel	Navigation Control panel (PVI) display check	Airfield number	
Collective	МАРШРУТ-СНИЖЕН (Route-descent switch)	МАРШРУТ (Route)	[R]

FAILURES AND EMERGENCY SITUATIONS

ONE ENGINE FAILURE IN FLIGHT

Panel	Controls, checks	Check, operation, message	Key commands
With one engine failure in flight			
Collective	Collective pitch	Rotors RPM hold no less than 85%	
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]
	Speed	110...120 km/h	
Throttle lever	Operating engine throttle lever	FULL	[RAlt + Page Up] or [RShift + Page Down]
Check failure engine fire			

Wall panel	КРАН КОЛЬЦЕВАНИЯ (Fuel crossfeed valve)	Open	Switch: [RCtrl + RShift] Cover: [RCtrl + RAlt + RShift + ;]
Estimate the possibility of level flight with a speed of no less than 70 km/h.			
Restart of a failed engine is not advised.			
Make a decision and make an emergency landing if needed.			

ONE ENGINE FAILURE DURING HOVER

Panel	Controls, checks	Check, operation, message	Key commands
With one engine failure on hovering less 10 m altitude (below critical altitude-velocity zone) perform emergency landing			
Collective	Collective pitch	Decrease on 2-3°	
Cyclic	Cyclic pitch	Push down Pitch 20...25° to dive	[Arrow Up], [Arrow Down], [Arrow Left], [Arrow Right]
On altitude 3...5 meters			
Collective	Collective pitch	Hop up to ¾ range	Up: [Numpad +] Down: [Numpad -]
Cyclic	Cyclic pitch	Landing pitch	[Arrow Up], [Arrow Down], [Arrow Left], [Arrow Right]
Landing without side movements			
Collective	Collective pitch	Down to the stop	Up: [Numpad +] Down: [Numpad -]
With one engine failed during a hover in the critical altitude-velocity zone, a safe landing is not guaranteed.			
With one failed engine during a hover at a high critical altitude-velocity zone, the altitude clearance to allow transition to level flight and perform safety landing needs to be evaluated.			