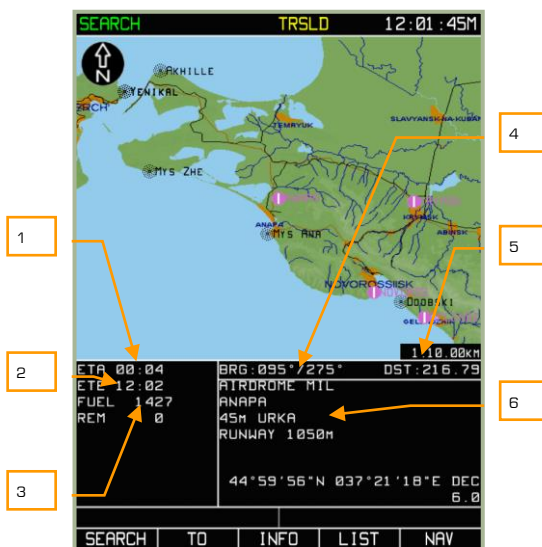


When the search is complete, the page will display a table with objects (locations) sorted according to the following criteria:

- At the top of the list will be navigational points whose names are in strict correspondence with the request, i.e., if a search was made with the name "URK" in the AIRPORT object type category, then at the beginning of the list will be AIRPORT's with URKA in the name.
- These will be followed by AIRPORT category objects whose names start with URK (URKK, URKM).

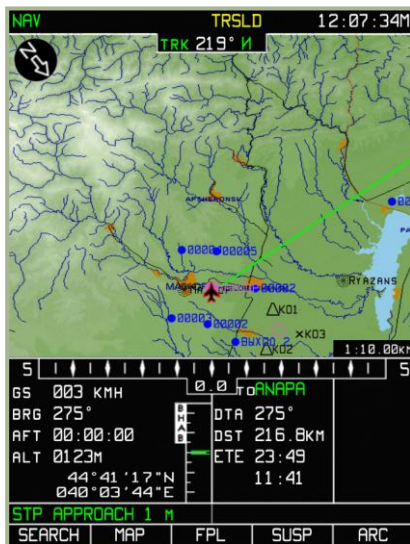
With an entry in the search results table selected (indicated by the entry number being highlighted in blue), press the **INFO** FSK button to display the **INFO** page that will provide the following information on the selected table entry:



**7-114: Information on searched point**

1. Steerpoint ETA (based on current ground speed).
2. Estimated time enroute (ETE) to the point (based on current ground speed).
3. Current fuel level and estimated remaining fuel after reaching point from current coordinates.
4. Bearing to/from current aircraft position to the selected point.
5. Distance between current aircraft position to the selected point.
6. Depending on the type of point, various kinds of information may be displayed here: object type, name, elevation, frequency, callsign, runway length, and coordinates.

To create a direct route between your current location and the selected point, press the **TO** FSK button. If you do this, the active route will be unloaded and only one flight leg will be activated – from your current position to the selected point.



#### 7-115: Active navigational calculations to the selected point

To return to the **NAV** mode, press the **ARC** FSK button.

## MAP Sub-mode



### 7-116: MAP sub-mode

In the **MAP** sub-mode, the following functions can be performed:

- **INFO** function – To obtain information on an object displayed on the map beneath cursor.
- **ERBL** function – To measure distances and bearing between objects plotted on the map, arbitrary points, between the current aircraft position and a map object, or an arbitrary point.
- **TO** function – To create a route between your current position and a selected object (arbitrary point on the map). This is accessed through the **INFO** sub-mode. Attention! With the selection of this mode, the active route will be unloaded.

The Map sub-mode also provides you the ability to change the scale of the moving map: **SCALE+** and **SCALE-**.

The FSK buttons at the bottom of the Map sub-mode page have the following meanings:


1. **INFO** – To obtain information about an object
2. **ERBL** – To measure bearing and distance from present position to an object
3. **SCALE+** – To increase map scale
4. **SCALE-** –To decrease map scale
5. **NAV** – To switch to NAV mode

## MAP/INFO Sub-mode

The **INFO** sub-mode provides information about map objects from the databases within the ABRIS digital cartographic and aeronautical information system; as this function is performed, **ERBL**, **TO**, and **SCALE±** functions are available.


To activate the sub-mode, press the **INFO** FSK button.

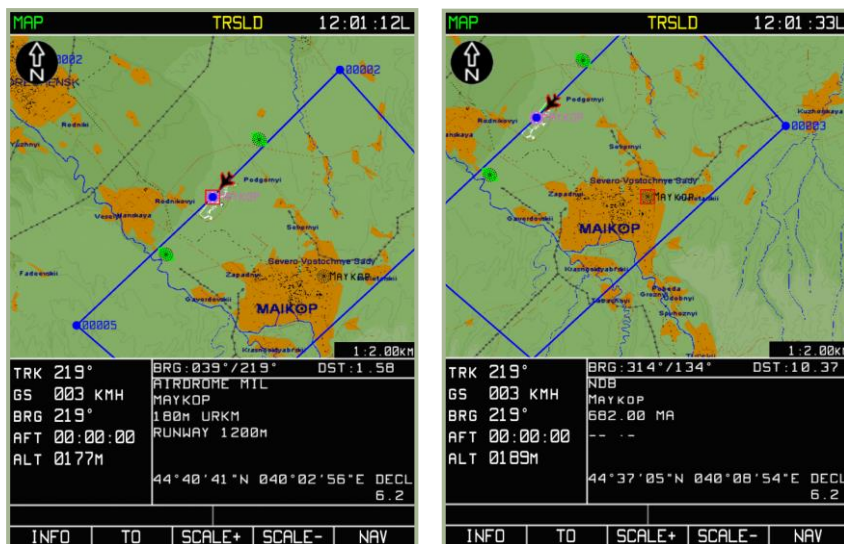
The following is shown on the **INFO** page:

- North-up, stabilized map
- Flight information area with an additional line indicating aircraft heading value
- Active cursor marker (red square - )
- Cursor current coordinates in the top right portion of the flight information area (indicated by the MRK abbreviation)



**7-117: INFO sub-mode**

To obtain information about a map object, use the cursor manipulator () to move the active marker over the map object you are interested in. Remember that you need to click on the cursor manipulator to toggle horizontal and vertical control.



**7-118: Information for Maikop airfield**

**7-119: Information for Maikop NDB**

Once the cursor is over the object, press the **INFO** FSK button again and information about the object is displayed in the lower right portion of the flight information area. In this case, instead of the marker's coordinates, the flight information area displays the direct and reciprocal bearing and distance from the aircraft position to the object. If no object is displayed within the active marker box, the information field is not updated, i.e., it retains the same information as displayed before pressing the **INFO** button.

If the **INFO** FSK button is pressed, the **ERBL** FSK button changes to be a **TO** FSK button. If the **TO** FSK button is then pressed, a direct route between the aircraft position and the object point will be created and unload any current route.

The **ERBL** mode is returned to with any motion of the marker.

To exit the MAP/INFO page, press the **NAV** FSK button or press the **TO** FSK.


## MAP/ERBL Sub-mode


The Estimated Range and Bearing Line (**ERBL**) function enables measurement of distance and bearing between two points. The starting point of an **ERBL** measurement can coincide with the aircraft's position or an arbitrary point on the map. The terminal end of the measurement can be any object or an arbitrary point on the map. When this function is performed, the **INFO**, **TO**, and **SCALE±** functions are available.

To activate the **ERBL** function, press the **ERBL** FSK button.

The following is shown on the MAP/ERBL page:

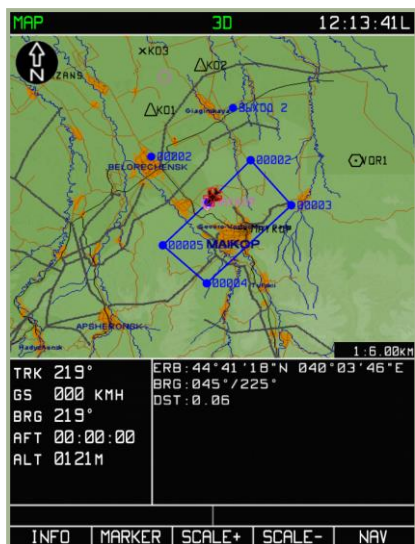
- North-up stabilized map

- Flight information area with an additional information line: aircraft actual track angle value
- Active cursor marker - red cross 
- Current marker coordinates are displayed in the top right portion of the flight information area (ERB – marker latitude and longitude; BRG – direct and reverse azimuths to the measured leg beginning point, set initially to the aircraft position; DST – distance from the leg beginning to the current marker position)
- In this mode, the screen does not display the route information field, current heading (above the map), or the true airspeed
- The FSK button changes from ERBL to MARKER

To take an ERBL measurement, position the marker  on the object or map point that will act as the anchor in the to/from measurement. To move the marker, rotate the cursor manipulator control and press it to change between horizontal and vertical control. The measured leg is shown as a red line from the beginning of the measured leg (aircraft position) to the current marker position. As the marker moves beyond the boundaries of the displayed map area, the map is re-drawn automatically, and marker direction of motion is taken into account.

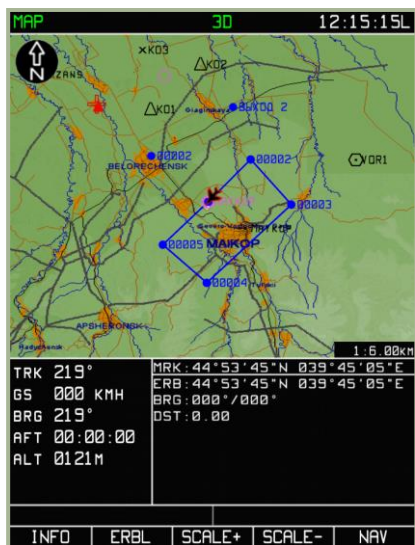
To measure a distance from a selected object, or map point, to another object or map point:

- Move the cursor to the object or map point that you wish to measure from and press the **MARKER** FSK button. This will create a red triangle at that location.
- Move the cursor to the object or map point that you wish to measure to. You will see the red measurement line between the two object/map points.
- ERB, BRG, DST fields move one line down and contain data on the corresponding parameters measured relative to the set marker.



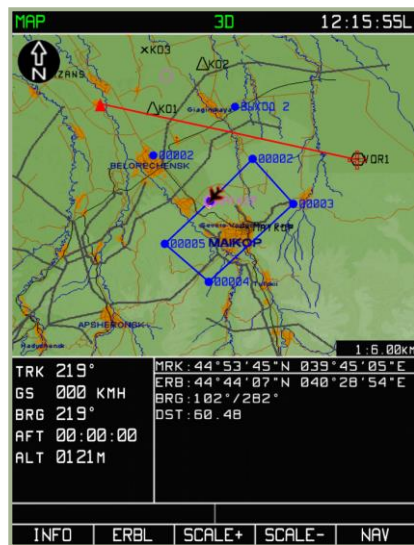
7-120: ERBL function activated

7-121: Marker moved from aircraft initial point



7-122: MARKER FSK button pressed and new initial measurement point created

7-123: Measurements between objects (arbitrary points)



The **SCALE+** and **SCALE-** functions enable you to change the map scale during this function.

To exit the **ERBL** function, press the **NAV** FSK button.

## FPL Sub-mode

The Flight Plan (**FPL**) sub-mode displays flight information in a tabular form, provided there is an active route loaded. In addition to viewing a route, this sub-mode enables re-targeting of the aircraft to a specified waypoint. The **FPL** page displays the following information:

- Waypoint name
- Waypoint coordinate
- DTK/DMTK/MC of the route leg
- Route leg length
- WPT OVER altitude
- WPT ETO
- Estimate flight time of each leg
- Comments for each leg

In the **FPL** sub-mode, the FSK buttons have the following functions:

1. **VNAV** – Switch to VNAV (vertical navigation) sub-mode to calculate climb and descent points to reach assigned flight altitudes.
2. **TO** – Select a waypoint manually from those available in the **FPL** table and create a new direct route plan. This will unload the current route and replace it with this direct route consisting of only one leg.
3. **WPT**– Select a waypoint manually from those available in the **FPL** and set it as the steerpoint. Flying to the steerpoint will display an XTE relative to the route leg to the WPT preceding the selected waypoint.
4. **NAV** – Switch to **NAV** mode.



1	FPL	PDOP 30					09:35:01L	16	
2	URKA-URKK								17
3	TC	WIND	TAS	DST	ETA	FUEL	ALT	18	
4	TH	KMH	GSKMH	REMKm	ETA	REM	T°C	19	
5				208.8	09:07	1022	20		
6	TO 01 URKA 5 44°59'56"N 037°21'16"E								21
7	051°	030°	150	20.4	00:06	780	500	22	
8	047°	036	184	136.3	09:13	1022	+16°C	23	
9	022°	0002	45°06'58"N	037°33'14"E				24	
10	086°	030°	200	51.4	00:13	780	1000		
11	079°	036	222	84.9	09:27	1022	+16°C		
12	030°	0003	45°10'49"N	038°12'04"E					
13	103°	030°	200	78.2	00:21	780	200		
14	093°	036	214	6.7	09:49	1022	+16°C		
15	040°	0004	45°05'30"N	039°11'16"E					
16	203°	030°	060	6.7	00:16	780	24		
17	193°	036	025	0.0	10:05	1022	+16°C	25	
18	05 URKK	5	45°02'05"N	039°09'45"E				26	
19								27	
REM 208.8km ETE 00:00 FUEL 0kg									
VNAV		TO		MOVE		WPT		NAV	

7-124: Flight plan sub-mode

- System bar
- Route name
- Desired track angle
- Heading calculated from entered weather data
- Active route leg (green color field)
- Wind direction (entered manually)
- Wind speed (entered manually)
- True air speed (planned)
- Ground speed
- Distance between waypoints



11. Distance from aircraft position to route terminal point
12. Length of route
13. Time enroute on a route leg calculated from the entered true speed and weather data
14. Waypoint estimated time of arrival (ETA)
15. Departure time
16. Current time
17. Flight altitude (entered manually)
18. Ambient temperature at flight altitude level (entered manually)
19. Fuel flow (entered manually)
20. Estimated fuel remaining at waypoint
21. Fuel quantity (entered manually)
22. Time enroute on a route leg calculated from the entered true air speed and weather data
23. Waypoint ETA calculated from the previously entered time of departure
24. Waypoint ETA calculated in flight from current ground speed
25. Distance from aircraft position to route terminal point, calculated from current ground speed
26. Time to go from aircraft position to route terminal point calculated from current ground speed.
27. Required amount of fuel for flight from aircraft position to route terminal point, calculated from current ground speed

## FPL/VNAV Sub-mode

The in-flight vertical navigation is called **VNAV** and is accessed by pressing the **VNAV** FSK button from the **FPL** sub-mode.

FPL			30		10:00:20M	
KARSNOGVARDEYSKOYE-OCTYABRSKOYE						
TC	WINDTAS	DST	ETE	FUEL	ALT	
TH	KMH	GSKMH	REMKH	ETA	REM	T °C
				10:00	1496	50
10:00:20M 45°34'16"N 034°17'13"E						
238°	000°	100	14.0	00:08		500
				10:08	786	
238°	000°	100	23.3	10:08	1496	+17°C
02 00002 45°30'27"N 034°08'01"E						
206°	000°	100	15.4	00:05		500
				10:16	786	
206°	000°	100	7.9	10:17	1496	+17°C
03 00003 45°23'05"N 034°02'40"E						
152°	000°	100	7.9	00:04		50
				10:22	786	
152°	000°	100	0.0	10:22	1496	+20°C
04 00004 45°19'20"N 034°05'24"E						
REM 38.9KM ETE 00:00 FUEL 0KG						
VNAV	TO	MOVE	WPT	NAV		

### 7-125: Select VNAV from FPL sub-mode, left-most FSK

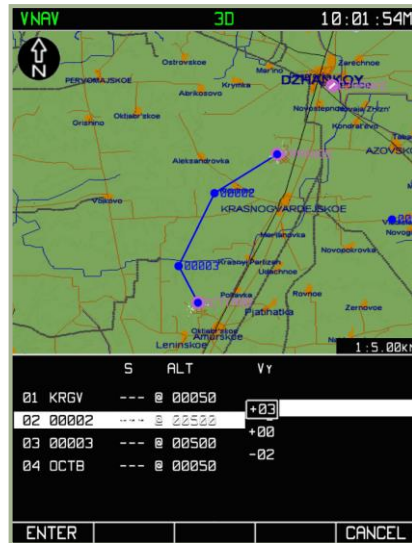
The FSK buttons on the **VNAV** sub-mode consist of:

- **EDIT**: Enter or modify **VNAV** values.
- **VNAV TO**: After pressing the **VNAV TO** FSK button, the page remains in **VNAV** vertical **NAV** mode. The table displays calculated altitudes and vertical speeds. If a vertical speed exceeds performance limits, it is displayed in yellow. You can cycle between waypoints by rotating the cursor manipulator control and pressing the **EDIT** FSK button allows you to edit the values for each waypoint.



#### 7-126: TGT VS function from VNAV sub-mode

- TGT VS:** Pressing the **TGT VS** FSK button plots a profile consisting of the horizontal route and climb/descent at a target vertical speed to/from the selected waypoint. The profile start point is the aircraft's current position and altitude. The end point is at a distance of an S "delta" from the selected waypoint, the delta set in this waypoint, and has an altitude set in this waypoint. The bottom-of-climb (top-of-descent) point is calculated so that moving at a set vertical speed, the aircraft gets exactly to the profile end point. In the intermediate WPT's available in this profile, the altitudes are filled with calculated values; S deltas are set to zero.



### 7-127: Entering of target vertical speed for reaching an altitude

- **ACTIV:** Makes current plan active
- **NAV:** Exits VNAV mode and switches to the NAV main operating page. A press on the **TGT VS** button opens a vertical speed input box. If you press the **ENTER** FSK in this box, the system will return to **VNAV** mode. The table displays calculated altitudes and vertical speed equal to the set speed. If the vertical speed exceeds the performance limits, it is displayed in yellow.



### 7-128: Calculated top-of-climb point

The distance from the start-of-maneuver point (from the current position for **VNAV TO** mode) to the WPT following next, is recorded in the "limit" box of this WPT. This distance is used for initiating an alarm (audio alert) and for the operation of the vertical indicator between this point and the WPT.

The calculated top-of-climb (top-of-descent) points are displayed as part of the flight graphic plan in the form of blue colored dots with "C" for climb, "D" for descent

## SUSP Sub-mode

Pressing the Suspend (**SUSP**) FSK button will cycle through the waypoints in the active route. The Waypoint selected becomes your steerpoint and a green line will connect your current position to it.

## Manually Setting the Steerpoint

During a sortie, it may become necessary to quickly set an arbitrary waypoint in the route as the steerpoint. Two easy ways to do this are:

### WPT or TO function from the FPL mode

1. Select the **FPL** FSK button and the screen will display **FPL** sub-mode page.
2. Rotate the cursor manipulator to select the waypoint that you want to set as the steerpoint and press the **WPT** FSK button.
3. The aircraft course will be re-targeted to the selected waypoint and the cross track error will be displayed as from the route leg connecting the preceding route WPT and the selected WPT.

You could also press the **TO** FSK button from the **FPL** sub-mode page to create a direct, one-leg route to the selected waypoint. This will however unload the current route plan.

### SUSP FSK to cycle steerpoint

1. From the **NAV**, **ARC**, or **HSI** operating pages, press the **SUSP** FSK button.
2. Each press of this button will cycle through the waypoints in the active route; when a waypoint is cycled to, it becomes the steerpoint.

## Tactical Information

Tactical information regarding the helicopters in your flight, mission targets, and threats is available in the **NAV** operating mode. To display or hide this information, TACTICAL SITUATION settings can be configured from the **MAP** options page. The settings are all enabled by default.

Types of tactical information that can be displayed include:

- Up to four helicopters in a flight with corresponding identification numbers
- Three target types
  - Armor and other types of vehicles
  - Air defense systems (AAA and SAM)
  - Other targets including buildings
- Target ingress points (IP)
- Detection zones of known and plotted air defense systems



#### 7-129: Tactical information

1. "Other" target type. Building, structure #2
2. Target, ADS, or SAM #2
3. Helicopter wingman #3
4. SHKVAL line of sight
5. Helicopter wingman #4
6. Ownship helicopter
7. Target, type "other". Structure #1
8. Target, armor #2
9. Target, armor #1
10. Helicopter wingman #2



## 11. Ingress point #1

Additionally, a yellow SHKVAL line of sight line is displayed. The length of the line corresponds to the range measured by the laser rangefinder.

Targets are marked using three types of blue markers: Air defense systems are marked




, armor and vehicles are marked



, and other targets including buildings are marked. The target number is assigned using the external targeting system, and this number is displayed within the target marker. The external targeting system can only process up to four targets of the same type. If a fifth target of a type is added, it will overwrite the first one.

**IMPORTANT! Targets may not have same ID numbers on different helicopters.**

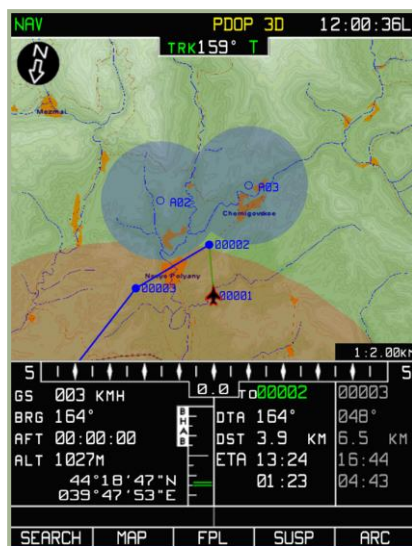
The ingress point is marked as . There can be up to four ingress points. Adding a fifth point will overwrite the first one.

For more details on external targeting system procedures and operations, refer to the "External Targeting System" section of this manual.

The SHKVAL line of sight is displayed as a yellow line connecting your helicopter and a line of sight endpoint (two vertical bars). The length of line represents the range calculated by the laser rangefinder. Two vertical bars at the end of the line indicate the ground area that the SHKVAL camera is focused on.

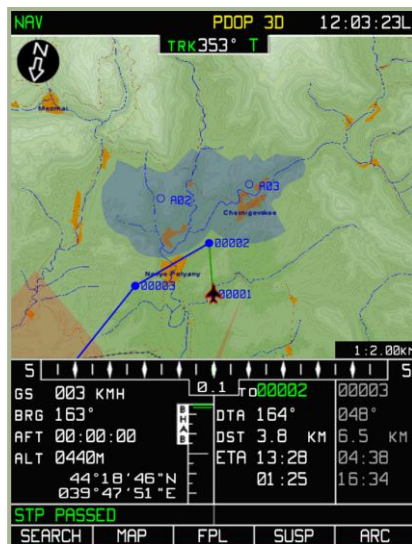
Known air defenses are marked as shaded areas where the circle represents the system's detection range. Known enemy air defenses are those set up in the mission editor as non-hidden. Enemy air defense zones are marked with a blue transparency, and friendly air defense zones are marked with a red transparency.

A red circle with a flight direction line extending from it is used to indicate a helicopter within your data link flight (four aircraft maximum). The wingman helicopter ID number is displayed inside the circle. This number corresponds to the setting using the "КТО Я" (WHO I AM) knob on external targeting panel. The flight leader is marked using two concentric circles.



### 7-130: Tactical information, air defense detection zones.

Terrain masking of air defense system sensors is taken into account in accordance with your helicopter's altitude. This is determined by superimposing the detection zone plane on a cross section of the terrain based on your helicopter's altitude. Sections that intersect with terrain are removed. This can be a very useful tool for terrain masking tactics.





**7-131: Tactical information, air defense detection ranges in a given terrain and in accordance with current helicopter altitude**

Only detection zones for stationary air defenses are displayed. Also, because this information is not updated in real-time, these zones will still be visible after the air defense unit is destroyed.



8

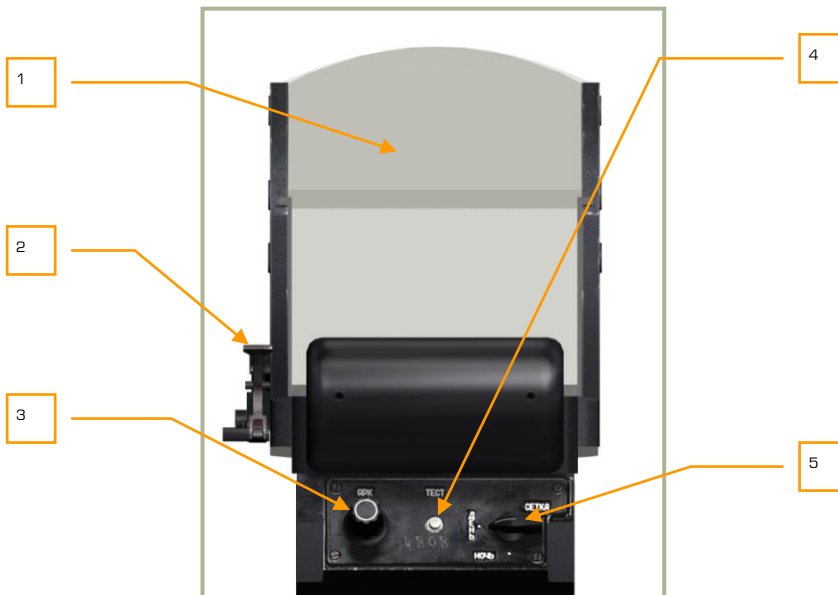
# INFORMATION DISPLAY SYSTEMS

## 8 INFORMATION DISPLAY SYSTEMS

The Information Display System (IDS) is intended for the display of targeting and navigation indications on the heads-up display (HUD), the IT-23 television screen, and the Helmet Mounted Sight (HMS) system.

### Heads Up Display (HUD) Panel

HUD modes include fully operational modes (day and night sub-modes) and the reticle "Setka" sight. The reticle sight can be turned on manually with the **"НОЧЬ-ДЕНЬ-СЕТКА"** (Night-Day-Reticle) selector switch on the HUD panel when in the **"СЕТКА"** (Reticle) position. [RShift + 8]

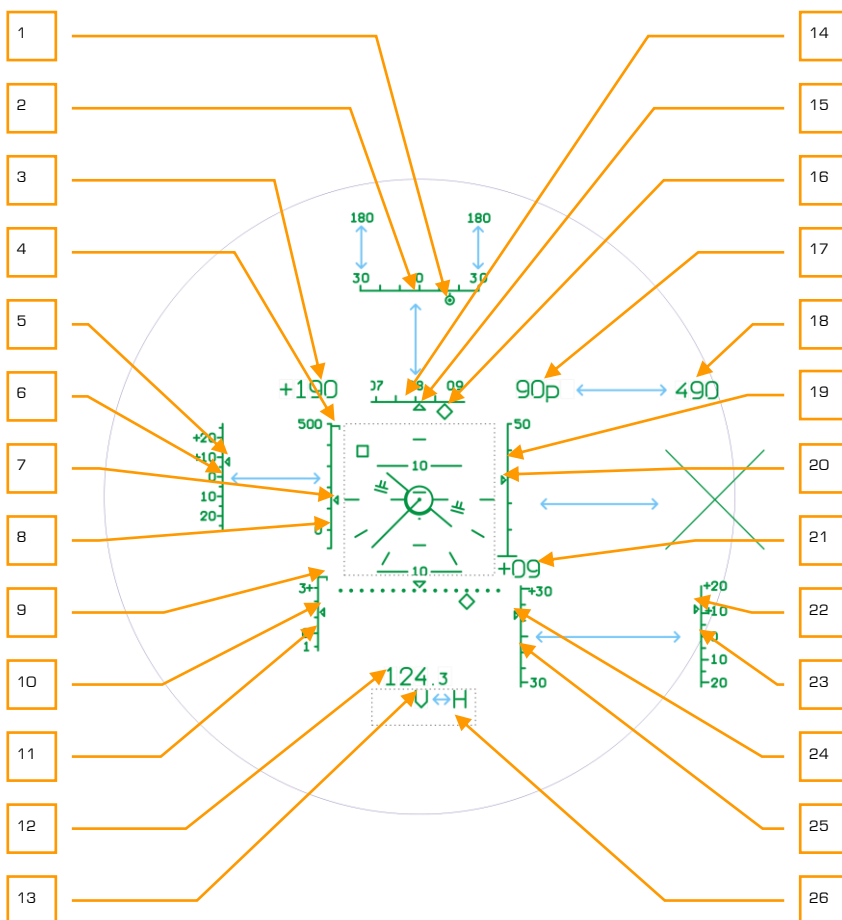


**8-1: Collimator head-up indicator (HUD)**

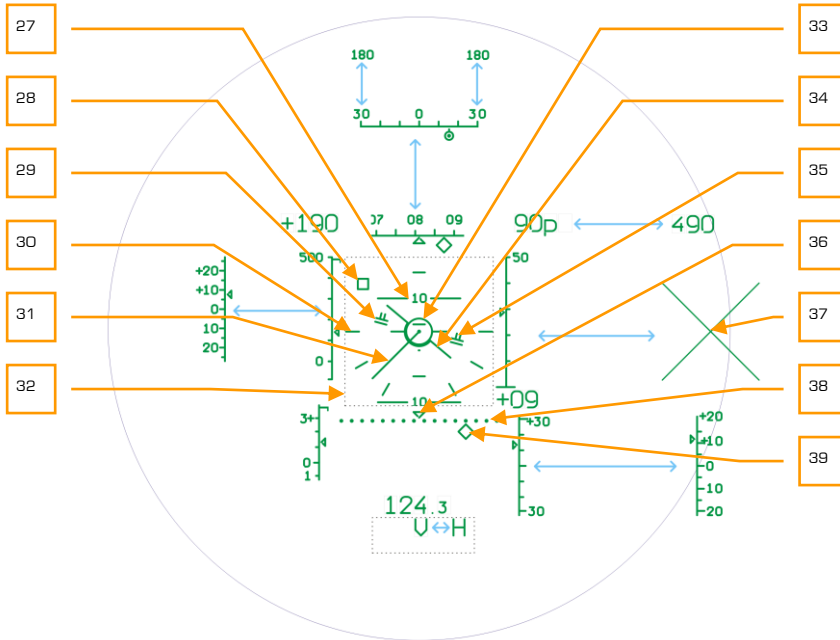
1. Reflector glass
2. Color filter lever [RShift + H]
3. HUD symbology brightness knob up [RCtrl + RShift + H] and down [RAlt + RShift + H]
4. Self-test button [RCtrl + RAlt + RShift + H]
5. HUD mode selector [RShift + 8]
  - **"ДЕНЬ"** (Day) – normal operational mode (green color symbols)

- Filtering of HUD information is set by the “**ОГР ИНФ – ПОЛН**” (Rejected information – Full information) switch [**RCtrl + S**] on the Targeting Display Control Panel. When filtering is enabled, only targeting information is displayed.

## Flight and Navigation HUD Information



## 8-2: Display of Flight-Navigation data on the HUD (1)



**8-3: Display of Flight-Navigation data on the HUD (2)**

1. **Target Bearing Marker.** This small circle with a dot in the center is aligned with the Target Bearing Scale and indicates the angle off nose to the target. When this marker is in the center of the scale, the target is directly in front of the aircraft.
2. **Target Bearing Scale.** After a target has been designated, the Heading Scale changes to a Target Bearing scale that provides an angular measurement from off the nose of the aircraft. The center of the scale indicates directly in front of the aircraft and either end of the scale indicates 30 degrees left / right off the nose. When the target is greater than 30 degrees left / right off the nose, the scale will automatically change to be 180 degrees left / right. The position of the Target Bearing Marker on this scale indicates angular target direction off the nose.
3. **Ground Speed Numeric.** This is the digital indication of airspeed in regards to ground speed (the speed at which the aircraft is moving across the ground). When moving forward or backwards, a "+" sign precedes the number.
4. **Maximum Airspeed Marker.** When flying greater than 50 kph, the IAS scale will appear on the HUD. On the IAS scale is a small horizontal line that indicates the maximum safe airspeed. When reached or exceeded, the master caution light will light and a maximum speed tone is heard.
5. **Current Deviation from Assigned IAS.** See below.



6. **Scale of Deviation from Assigned IAS.** This index and scale appear when route mode is engaged. Assigned IAS is designated each time the trim button is pressed. After that, the deviation marker indicates deviation in km/h from the last trim assigned IAS. This indication consists of the deviation caret and the deviation reference scale.
7. **Current IAS Caret.** Running vertically along the IAS scale, this small caret indicates the aircraft's current Indicated Air Speed (IAS). The caret will flash when at or above maximum airspeed, which is indicated by the Maximum Airspeed Marker.
8. **IAS Scale.** Located along the left side of the HUD when the aircraft is flying at or greater than 50 kph, this scale goes from -100 to +500 and is used in reference to the Current IAS caret to indicate IAS.
9. **Maximum Load Factor (G) Marker.** Located at the top of the Load Factor Scale, this horizontal line indicates the maximum allowable load factor for the aircraft.
10. **Current Load Factor (G). Caret.** This small caret moves vertically along the Load Factor Scale and indicates the current load factor on the aircraft. If the caret reaches the Maximum Load Factor marker, the master caution light will activate and the maximum-G tone will be heard.
11. **Load Factor (G) Scale.** This vertical scale in the bottom left of the HUD indicates current load factor when in reference to the Current Load Factor caret. The scale represents +4 G at the top and -1 G at the bottom.
12. **Range.** Using the Shkval, the range to a location/target can be displayed if a weapon is selected and the sensor is un-caged.
13. **Warning Cue(s).** Various warnings and notices can be displayed in this area of the HUD. Please see the HUD Cue Descriptions below.
14. **Heading Scale.** Located at the top of the HUD, this horizontal scale rotates left and right such that the center of the scale indicates the aircraft's current heading in degrees.
15. **Current Heading Marker.** This marker is located at the center point of the Heading Scale and represents the aircraft's current heading.
16. **Desired Heading Cue.** When a navigation destination has been set from the PVI-800 control panel, a diamond will appear along the Heading Scale that represents the heading to the navigation point. If the Desired Heading Cue is aligned with the Heading Marker, then the aircraft is flying a direct course to the navigation point. If however the Desired Heading Cue is off to one side of the Heading Scale, the aircraft must be directed in that direction to reach the navigation point.
17. **Radar Altitude Numeric.** When aircraft altitude is at or below 300 meters, the radar altimeter indication will be displayed. This appears as a "p" next to the digital readout.
18. **Barometric Altitude Numeric.** When the aircraft is 300 meters above ground level, barometric altitude will be displayed in relation to altitude above sea level.





19. **Radar Altitude Scale.** When the aircraft is at or below 50 meters, a vertical radar altitude scale is displayed on the right side of the HUD. This scale ranges from 0 meters at the bottom to 50 meters at the top.
20. **Current Radar Altitude Caret.** Along the inside of the Radar Altitude Scale is the Current Radar Altitude Caret that moves up and down the scale to represent the aircraft's current radar altitude.
21. **Vertical Velocity Numeric.** This two-digit numeric indicates the positive (+) or negative (-) vertical velocity change of the aircraft in meters per second. For example: an indication of +03 would mean that the aircraft is gaining altitude at a rate of three meters every second.
22. **Current Deviation from Assigned Radar Altitude.** See below.
23. **Scale of Deviation from Assigned Radar Altitude.** This index and scale appear when route mode is engaged with altitude hold. An assigned altitude is set each time you release the collective brake (see Collective stick description). After you reach the desired altitude you release the brake on the collective and the current altitude will be set as the Assigned Altitude. After that, the deviation index indicates deviation from Assigned Altitude in meters.
24. **Current Vertical Velocity Caret.** Moving vertically up and down the Vertical Velocity Scale, this caret indicates the current vertical velocity rate of the aircraft. For example: if the caret is centered, it would indicate zero vertical change and if it were  $\frac{3}{4}$  up the scale it would indicate +15 meters per second.
25. **Vertical Velocity Scale.** In the lower right portion of the HUD is a vertical scale that measures the aircraft's rate of vertical velocity. The center of the scale marks zero change and the top and bottom represent +30 and -30 meters per second respectively. The scale works in reference to the Vertical Velocity Caret.
26. **Warning Cue Display** (not visible). Various warnings and notices can be displayed in this area of the HUD. Please see the HUD Cue Descriptions below.
27. **Pitch Scale.** Spaced every 10-degrees of pitch with intermediate five degree marks, the pitch scale is located centrally on the HUD and ranges from zero pitch (represented by a single dot) to 90 degrees.
28. **Hover Point Deviation Marker** (dynamic). When Hover mode is activated, this small, square marker appears on the HUD and represents the point on the ground when the mode was initiated. Depending on movement of the aircraft after Hover mode was initiated, the marker may move around the HUD to represent the aircraft's position in relation to that initial hover point. For example: if the square moves to the bottom of the HUD, it indicates that the aircraft has moved too far forward; if the square is off on the right side of the HUD, it would indicate that the aircraft has moved too far to the left of the hover point location. Keeping the marker in the center of the HUD within the Hover Point Reference Circle indicates the aircraft is maintaining the initial hover point location.
29. **Bank and Pitch Steering Cues** (rolled in proportion to roll input). If "ДІП УПР"– director control channel autopilot is selected with route mode, the Bank and Pitch Steering cues will appear on the HUD. These cues indicate the needed degree of bank and pitch to fly to the set navigation point from the

PVI-800 navigation panel. The cues appear as double-horizontal lines and they will be tilted in the direction the aircraft needs to bank to reach the navigation/target point.

30. **Bank Scale** (marked for 0°). Within the center of the HUD are bank indications for 0-degrees (level), 30-degrees, and 60-degrees.
31. **Velocity Vector**. When airspeed is below 50 kph, a velocity vector line is drawn from the center of the Aircraft Datum. This line points in the direction that the aircraft is traveling and the length of the line represents the aircraft's relative speed. The line will be longest when the aircraft is traveling at 50 kph in any direction and shortest when the aircraft is at or near a hover. The Velocity Vector line is a useful tool when used in conjunction with the Hover Point Deviation Marker to hold a battle position.
32. **Central Display Box** (not visible). This is the central area of the HUD that displays indications like the Pitch Scale and Aircraft Datum.
33. **Hover Point Reference Circle** (static). When Hover mode is initiated, a static circle is displayed in the center of the HUD. This circle represents the hover point.
34. **Aircraft Datum** (dynamic in bank). Located in the center of the HUD, the datum represents where the nose of the aircraft is pointed. The datum also rotates with bank angle in relation to the Bank Scale.
35. **Assigned Altitude Indicators** (climb/descend cue). If the "ДИР УНР"—director control channel autopilot is selected with altitude hold and route modes engaged, the Assigned Altitude Indicators will appear on the HUD. Extending up or down from the Bank and Pitch Steering Cues are two lines that indicate the needed collective setting to reach/maintain the assigned altitude.
36. **Cross Track Error (XTE) Reference Marker** (static). The marker is located above the center of the XTE scale and indicates the zero cross track error heading.
37. **Fire Inhibit Cross**. The large "X" cross appears over the HUD when the selected weapon is inhibited from firing. The most common reason for this inhibit is a weapon's minimum range.
38. **XTE Scale**. This dotted line across the bottom of the HUD provides a reference for the XTE Steering Cue. The further the steering cue is from the center of the Scale (marked by the Reference Marker), the greater the aircraft is off the planned course line to the selected steerpoint.
39. **XTE Steering Cue**. This diamond-shaped symbol under the XTE Scale moves horizontally across it to indicate cross track error along the course to the steerpoint. Having the cue underneath the Reference Marker indicates the aircraft has zero cross track error.

### HUD Cue Descriptions:

1.	Н	Ground collision warning
2.	V	Maximum speed warning
3.	ОТ	Processing target point
4.	РЕЗ-Н	Navigation control computer is processing
5.	ИД	Laser range-finder is active
6.	ТА	Auto-tracking engaged by the electro-optical tracking system
7.	П	'Memory' mode (Auto-Tracking prolongation, e.g. LOS obstruction)
8.	С	Launch authorized ('shoot') cue
9.	ИУ	Beam-riding laser channel is active
10.	ПАУЗА	'PAUSE' cue - cooling cycle of the laser range-finder in the Target Marker ("ПМ") targeting mode
11.	РУ-ТА	Electro-optical tracking system operating in reserve control mode
12.	ТА-ИД	Auto-Tracking engaged and the laser range-finder is active
13.	ТА-ИУ	Auto-Tracking engaged and the beam-riding laser channel is active
14.	ТРЕНАЖ	Simulation mode
15.	КОРР	Coordinates updating via the I-251 (И-251) Shkval electro-optical targeting system (depression of the 'DESIGNATE' ("ЦУ") button)
16.	<u>КУРС</u> НВ	Course update error: Invalid heading entry in the Manual Heading ("ЗК") mode or invalid magnetic heading in the Magnetic Heading ("МК") mode
17.	<u>ИКВ</u> ЭП	Inertial Navigation Unit (INU) emergency warm-up
18.	<u>ИКВ</u> УВ	Inertial Navigation Unit (INU) fast warm-up
19.	<u>ИКВ</u> НВ	Inertial Navigation Unit (INU) normal warm-up
20.	<u>ИКВ</u> ТВ	Gyroscopic calibration for 0°
21.	<u>ИКВ</u> ВГП	Gyroscopic calibration for 180° (flashing cue)

## HUD Flight and Navigation Information Regardless of Combat Mode:

Data	Data Symbols when in Navigation Mode	Indication Range and Operation
Bank $\gamma$	All modes: Stabilization and control: - Route (ALT, RAlt hold, DH, DTA) - Hovering - Descent	Rotation of aircraft datum (34). Clockwise - right bank.  Scale graduation value of 30°
Pitch $\theta$	All modes	Pitch scale (27) moving. Dive to go up.  Scale graduation value of 5°
Current Heading $\psi$	All modes	Heading scale (14) moves relative to current heading marker (15).  Movement is to left with right turn.  Indication of $\pm 15^\circ$ of heading scale segment around current heading marker.  Scale graduation value of 5°
Radar (true) Altitude  Hr	All modes	From 0 to 50 m altitude scale index (20) on a scale (19).  Increase of altitude bottom to top. Scale range of 0...50 m. Scale graduation value of 10 m.  From 50 to 300 m altitude indication on the radar altitude numeric (17). Scale (19) and index (20) does not appear.  Above 300 m radar altitude, the numeric (17) is replaced with barometric altitude numeric (18).
Barometric Altitude	All modes	Barometric altitude numeric (18) above 300 m or with radio altimeter malfunction.
Desired Radar Altitude Deviation  $\Delta Hr$	Stabilization and control: - Route RAlt hold - Hovering	Movement of desired radar altitude deviation index (22) on the scale (23).

		<p>A positive desired radar altitude deviation above the center point on the scale.</p> <p>Range scale of <math>\pm 20</math> m, scale graduation value of 5 m.</p> <p>With turn on either of pointed modes scale (25) is replaced with scale (23).</p>
Vertical Velocity $V_y$	Stabilization and control: - Descent	<p>Movement of current vertical velocity index (24) on the scale (25).</p> <p>Climb is indicated vertically up.</p> <p>Vertical velocity numeric (21).</p>
G Meter $n_y$	Stabilization and control: - Route, RAlt stabilization  - Descent	<p>Movement of current load factor (G) index (10) on the scale (11).</p> <p>Positive G moves up on the scale.</p> <p>Range scale of <math>-1...+3</math> g.</p> <p>Scale graduation value of 1.</p>
IAS $V_{np}$	All modes except route autopilot (desired speed stabilization)	<p>Movement of current IAS index (7) on the scale (8).</p> <p>Increased speed indicated as up on the scale.</p> <p>Range scale of <math>100...500</math> km/h.</p> <p>Scale graduation value of 100 km/h.</p>
Desired IAS Deviation $\Delta V_{np}$	Route mode	<p>Movement of desired IAS deviation index (5) on the scale (6).</p> <p>A positive desired IAS deviation is above the center point on the scale.</p> <p>IAS scale (8) is replaced with desired IAS deviation scale (6) in route mode.</p> <p>Range scale of <math>+25-20</math> km/h.</p> <p>Scale graduation value of 5 km/h.</p>
Ground Speed $W$	All modes	<p>Ground speed indication (3).</p> <p>With speed below 50 km/h, velocity vector (31) appears.</p>
Hover Point Drift	Hovering, descent	<p>Movement of hover drift marker (28) is relative to the hover point reference circle (33).</p>

		<p>Movement of hover drift marker to the right indicates that the helicopter has drifted to the left.</p> <p>Movement of hover drift marker forward of center indicates that the helicopter has drifted back.</p>
XTE Deviation	Route, XTE	<p>Movement of XTE deviation index (39) on the scale (38).</p> <p>Index movement to right indicates XTE deviation to the right.</p> <p>Scale graduation value of 40 m.</p>
Desired Heading DH	Stabilization and control: - route DH, DTA	Movement of heading steering cue (16) on the scale (14).
Relative Target Angle	Stabilization and control: - Ingress mode - Combat mode (after engaging Shkval targeting system)	<p>With Ingress mode on.</p> <p>Heading scale is replaced with relative target angle scale (2) with <math>\pm 30^\circ</math> range with a relative target angle cue (1).</p> <p>Relative target angle cue movement to the right indicates a turn to right is needed to align target.</p> <p>Scale graduation value of <math>10^\circ</math>.</p>
Bank Director Control	Route DH, DTA - Hovering - Descent	<p>Rotation bank and pitch steering cues (29) around aircraft datum (34)</p> <p>For clockwise rotation, move cyclic stick to right</p>
Pitch Director Control	Route DH, DTA - Hovering - Descent	<p>Movement of bank and pitch steering cues (29) around aircraft datum (34)</p> <p>For upward movement, pull back on the cyclic stick.</p>
Altitude Director Control	Route RAlt hold - Hovering - Descent	<p>Appearance and length of the altitude steering cues (35) over and under the bank and pitch steering cues (29).</p> <p>Increasing size of altitude steering cues above the bank and pitch steering cues indicates the collective needs to be increased.</p>
Ground Proximity Warning	All modes	Displayed in the warning cue display box (26) as a flashing H symbol.

Maximum Limit Speed	All modes	Displayed in the warning cue display box (26) as a flashing V symbol.
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The specific type of HUD indication for a unique combat mode in relation to the selected weapon system mode is discussed in the appropriate combat application chapter.

## The I-251 “Shkval” Electro-Optical Targeting System

The I-251 (И-251) “Shkval” electro-optical targeting system is designed to detect targets via electro-optical imagery that provides 7x and 23x magnification under visual, daylight conditions. It can then process that information and use it for automated targeting and weapons delivery.

As part of the K-041 Weapons and Navigation Control System, the targeting system provides:

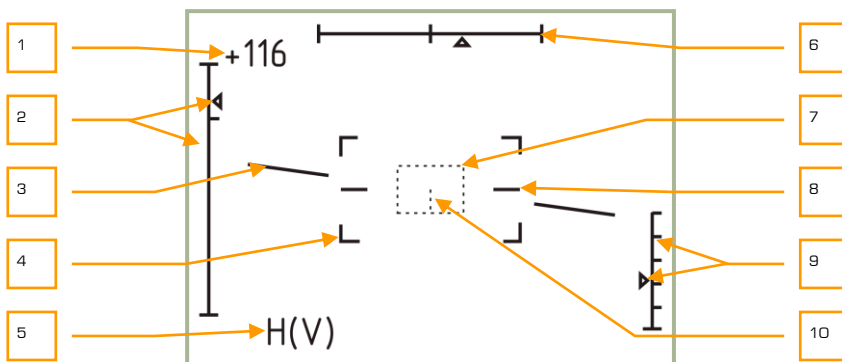
- Target detection via the IT-23 (ИТ-23) television monitor (TVM) and automatic, inertial, or manual (by use of a hat switch) tracking of moving and stationary ground targets; this includes small targets such as tanks.
- Supports guidance of Vikhr ATGM against moving and stationary targets.
- Targeting and employment of the on-board automatic cannon in either slaved or boresighted modes of operation.
- Targeting and employment of unguided rockets.
- Calculation of range, azimuth and elevation angles of designated point (Target Point).
- Entry of a target’s angular coordinates (Reference Point) and range information into the Weapons and Navigation Control System for the display of targeting information on the TVM. This can also be used for automatic target tracking and weapons employment, as well as correction of helicopter INS coordinates and acquisition of target coordinates (Target Point).
- Visual display of the target area on the TVM at 7x or 23x magnification with superimposed targeting information.

The system is electro-optical-based and is responsible for displaying target imagery on the TVM. The system has two selectable fields of view: wide angle (2.7 x 3.6)°, with a 7x magnification factor, and narrow angle (0.7 x 0.9)°, with a 23x magnification factor.

Selection of the wide field of view and narrow field of view is made via the “ШПЗ-УПЗ” (Wide FOV-Narrow FOV) switch [+ ] and [- ] on the Collective.

Information and symbology used for targeting and helicopter control is superimposed over the target imagery on the TVM.

Image quality can be adjusted via the “ЯРКОСТЬ” (brightness) [RCtrl + RAlt + ] and [RCtrl + RAlt + ] and “КОНТРАСТ” (contrast) [RCtrl + RShift + ] and [RCtrl + RShift + ] knobs and selection between black or white symbol overlay is made with the “ФОН БЕЛЫЙ – ЧЕРНЫЙ” (tone white – black) [RCtrl + RShift + B] switch on the Targeting Display and Control Panel.



#### 8-4: Display of the IT-23VM (MT-23BM) TVM in target search mode (Wide FOV)

1. Current airspeed
2. Line of sight elevation scale and marker (+15°...-80°)
3. Artificial horizon
4. Narrow FOV (0.7 x 0.9)° boundary markers
5. Flashing warning cues: "H" - ground collision and "V" - maximum airspeed
6. Line of sight azimuth scale and marker (±35°)
7. Tracking gate
8. Zero bank (wings-level) reference lines
9. Scale and marker of radar altitude (displayed below 50 m. of radar altitude)
10. Centerline of the tracking gate (displayed if the tracking gate size is increased four or more settings over the minimum)

The TVM stabilization device is used to compensate for aircraft roll and pitch. This stabilization and control system is designed to help you slew the electro-optical system onto the target (Target Point) and maintain gyro-stabilization while the aircraft is in motion.

The system's line of sight can be controlled by the Helmet Mounted Sight (HMS), the hat switch on the Cyclic Control Stick or by the electro-optical tracking system. The system's line of sight corresponds to the center of the TVM video picture and is linked to the target marker on the Head Up Display (HUD). The sensor's line of sight field of view (FOV) is ±35° in azimuth and +15° / -80° in elevation. When the sensor is in stand-by, the line of sight is caged and boresighted along the aircraft's longitudinal axis.

For expanded target search capability, the 'SCANNING' mode conducts automatic scanning in the horizontal axis ±10° from the initiation point. The scan rate is adjustable from 0.25°/sec to 3°/sec by using the Shkval optics scan rate dial on the right panel, below the autopilot controls.

When the "ЦУ" (Designate) [O] button on the Cyclic is pressed, the sensor is uncaged from boresight and the system becomes gyro-stabilized on the point in the center of the





display. If this point's azimuth is greater than  $\pm 35^\circ$  (when targeting via the HMS) the line of sight moves to its limit of  $\pm 35^\circ$ . This can then be followed by an automated Turn to Target or a manual maneuver towards the designation point. As the point's azimuth becomes less than  $\pm 35^\circ$ , the line of sight begins tracking the point's azimuth as directed by the HMS. Initial (search) line of sight placement and target detection is generally performed in the Wide FOV mode by positioning the target marker on the HUD over the point of interest (using the hat switch or HMS). Target identification is then performed in the Narrow FOV mode. Pressing the "СБРОС" (Reset) [BACKSPACE] button on the Weapon Status and Control Panel cancels the stabilization settings and resets the system to stand-by (sensor cued to boresight).

The electro-optical tracking system ("TA") provides automatic tracking of moving and stationary targets placed within the tracking gate of the TVM. After detection and identification of a target on the TVM at the stabilization point, maneuver the aircraft or use the hat switch on the Cyclic to place the target in the center of the TVM within the tracking gate. Next, adjust the size of the tracking gate to fully enclose the target by using the "ПАМКА М – Б" (TV target frame Increase – Decrease size) [↑] and [↓] according to the range to and size of the target. Automatic target tracking is enabled when the "АВТ 3АХБ" (Lock) [Enter] button on the Collective is pressed and released; this initiates the Auto-Tracking mode and maintains line of sight to the target throughout the engagement (assuming the target stays within  $\pm 35^\circ$ ). When in Auto-Tracking mode, the size of the tracking gate is automatically adjusted. This is accomplished by comparing the target's original image (committed to memory upon Auto-Tracking initiation), with the target's current image. The difference between the target's original image and current image is recognized by the system and processed for correlation.

Several cues are provided on the TVM regarding this process:

- "ТГ" cue when the sensor line of sight has been slewed from boresight and is now ground stabilized on a point.
- "ТА" cue when the system has locked on to a target and has initiated auto-tracking.
- "П" cue when the sensor is in memory mode after losing a lock.

During Auto-Tracking, the tracking gate may be unstable and 'breathe' around the target due to changes in the target's image; however, the target line of sight will remain in the center of the TVM image and provides a more accurate target location direction.

After a target is being tracked in Auto-Tracking mode, the sensor slew controls will be inoperative. This is to prevent unintended cancellation of an Auto-Track. To regain sensor slew control, you must first cancel the Auto-Track. You can adjust the position of the tracking gate by holding the "АВТ 3АХБ" (Lock) button down while slewing the hat switch. Releasing the "АВТ 3АХБ" (Lock) button automatically re-engages Auto-Tracking.

If optical contact with a target is lost during Auto-Tracking (for example: if the target goes behind a building), the "ТА" cue on the TVM changes to a "П" cue (Russian for "memory"). The electro-optical tracking system stores the direction and motion parameters of the line of sight and initiates a tracking prolongation for up to three seconds. If the target reappears within this time, Auto-Tracking will be re-established. If however contact is lost for over three seconds, Auto-Tracking is disabled ("ТА" cue disappears) and the system automatically engages Inertial Tracking by utilizing data from the onboard computers based on range to target, coordinates and helicopter movement.

Inertial Tracking ("**ПКС**") is enabled the first time you depress the "**АВТ ЗАХВ**" (Lock) button on the Collective and range to target/point information is then provided. This data is corrected by a summation of inertial and automatic tracking parameters. When Auto-Tracking is disengaged, Inertial Tracking is disabled as well. Inertial Tracking allows the pilot to slew the line of sight in a ground stabilized mode without having to continually press the "**АВТ ЗАХВ**" (Lock) button. The sight slew rate depends on its inertial motion, which is translated to you as unequal steering rates in different directions.

All tracking modes of the electro-optical tracking system are disengaged when the "**СБРОС**" (Reset) button is pressed on the WCS Control Panel.

The laser-range finder of the targeting system measures slant range to target and is directed toward the same point as the line of sight of the electro-optical targeting system.

If the "**АС-ПМ**" (Auto-Tracking – Gun sight) switch [P] on the Targeting Mode Control Panel is set to "**АС**" (Auto-Tracking) and the "**ППУ**" (Moving canon – automatic weapons mode) mode is selected, the laser range-finder is activated with the first depression of the "**АВТ ЗАХВ**" (Lock) button and remains active for three seconds. The laser range-finder also activates when Auto-Tracking mode is entered and will fire from three or eight seconds, depending on the range and closure rate to the target. If the "**АС-ПМ**" (Auto-Tracking – Gun sight) switch is set to "**ПМ**" (Gun sight), the laser is activated with every depression of the "**АВТ ЗАХВ**" (Lock) button and remains active until the button is released. After this, the "**ПАУЗА**" (Pause) cue is displayed on the HUD, as well as the time remaining until another laser firing is possible. Laser firing is prevented when in 'PAUSE' mode and the 'PAUSE' time is generally equal to the time of the last firing.

The "**ИД**" (Range-finder) cue will appear on the HUD while the laser range-finder is active.

The beam-riding laser channel creates a control zone along the helicopter-target line of sight for the guidance of the Vikhr ATGM. It is created by scanning two lasers along the horizontal and vertical axis to form the control zone, which is approximately 7 m in radius starting 100 m in front of the helicopter and extends to the target. Missile guidance commands are transmitted inside the control zone relative to the center line of sight and guides the missile's trajectory within it. The size of the control zone relative to the missile is maintained constant throughout the missile's flight by algorithmically narrowing the emission angles as the missile travels away from the helicopter.

The laser beam channel is formatted by a special scanner and laser transmitter. A single missile is launched with a press of the weapon release [RAIt + SPACE] button; the scanner will start scanning; and with the missile launched, the laser transmitter will start working. If two missiles are launched in salvo, the first missile launched starts the scanner, but the laser transmitter will not start working until the second missile is launched.

Manual slewing control of the targeting system allows you to align the target line of sight with the electro-optical targeting system. Slewing of the system's line of sight is accomplished via the "**МЕТКА**" (Target Marker) hat switch on the Cyclic Stick [J], [J], [J] and [J].

The range of the laser range-finder can be set from 10 km to 0.6 km.

To maintain Auto-Tracking, the helicopter is limited to  $\pm 45^\circ$  in bank and a rate of  $\pm 20^\circ/\text{sec}$ . in pitch and yaw.

## The Helmet-Mounted Sight (HMS) System

The Helmet-Mounted Sight (HMS) determines the angular coordinates of the line of sight to a visually acquired target (tracked via the pilot's head position) and then outputs targeting commands to the K-041 Weapons and Navigation Control System. This in turn can cue the electro-optical targeting system to the target. The HMS directs the targeting system according to the line of sight coordinates of the helicopter's coordinate system.

When integrated with the Weapons and Navigation Control System, the HMS provides preliminary guidance to the target for employment of ATGMs, the onboard automatic cannon, or unguided rockets.

The HMS system includes:

- The NVU-2M helmet-mounted sighting device that is integrated into the pilot's helmet (consisting of three illuminators/projectors and the monacle sight for display of targeting information).
- Scanning devices that are adjacent to the HUD and determine the position of the sight's illuminators/projectors.

HMS control is incorporated into the K-041 Weapons and Navigation Control System. The Weapons and Navigation Control System outputs the following commands to the HMS system: Built-in Test (BIT), Helmet, Target Lock, and Launch Authorized. Upon receiving the 'Helmet' command, the HMS outputs angular coordinates, as well as the Active and Turn to Target cues.

The HMS is controlled from the K-041 Weapons and Navigation Control System and the system is activated with the "K-041" switch [LShift + D] on the WCS Control Panel. From the WCS panel, the "ОБЗ" (Helmet) switch [H] is used to activate the system. Display brightness can be adjusted with the "ЯРКОСТЬ" (Brightness) knob [RCtrl + RAlt + RShift + ] and [RCtrl + RAlt + RShift + ] on the WCS Control Panel. Pressing the "ЦУ" (Designate) button [O] on the Cyclic automatically slews the targeting system to the angular coordinates provided by the HMS. However, if a TP is selected on the PVI-800 and the HMS is activated, pressing the designate command will slew the targeting system to the TP and not to the designated HMS point.

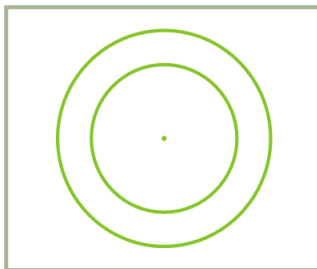
Targeting cues from the Weapons and Navigation Control System are displayed on the helmet sighting monacle:

## HMS Indications

### Operative Mode

Indicates the normal operative mode of the HMS.

Two solid, concentric circles.



**8-5: HMS Operative**

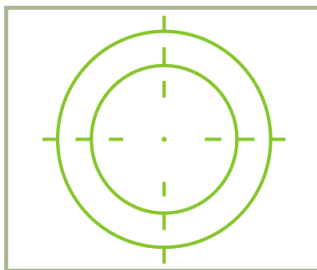
Conditions:

- Automatic weapon system control mode enabled (AC).
- HMS within Shkval's gimbal limits.
- Shkval's tracking system doesn't engage.
- "ЦУ" (Uncage Shkval, designate target) button on the cyclic stick is not pressed.

### PROCESSING

Indicates that the HMS is processing targeting system coordinates.

Flashing (2 Hz) crosshairs are surrounded by two solid, concentric circles.



**8-6: HMS Processing**

Conditions:

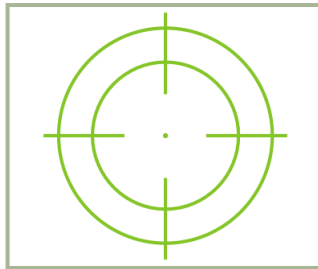
- Automatic weapon system control mode enabled (AC).

- HMS in Shkval's gimbal limits.
- Shkval's tracking system is not engaged.
- "ЦУ" (Uncage Shkval, designate target) button has been pressed and the displacement angle between HMS and Shkval LOS is more than 2°.

## LOCK

Indicates that processing is complete and the Shkval system is in auto-tracking mode.

Solid crosshairs are surrounded by two solid, concentric circles.



**8-7: HMS LOCK**

There can be one of two conditions:

### Set 1:

- Automatic weapon system control mode is enabled (AC).
- HMS in Shkval's gimbal limits.
- "ЦУ" (Uncage Shkval, designate target) button has been pressed and the displacement angle between the HMS and Shkval LOS is less than 2°.
- Shkval has been un-caged and cued to the HMS. With release of the "ЦУ" (Uncage Shkval, designate target) button, Shkval transitions to "ТГ" (Tracking system ready) mode with laser ranging.

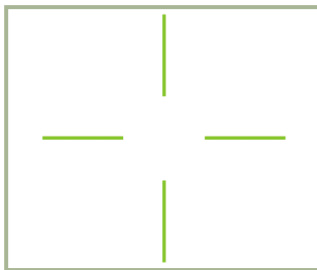
### Set 2:

- Automatic weapon system control mode enabled (AC).
- HMS in Shkval's gimbal limits.
- TA (Shkval's tracking system engaged).

## LAUNCH AUTHORIZED

Indicates that weapon may be launched.

Solid crosshairs.



#### 8-8: HMS LAUNCH AUTHORIZED

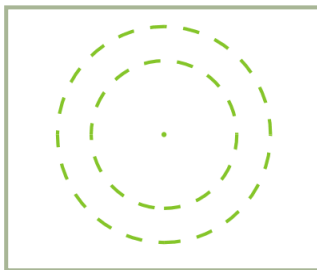
Conditions:

- Automatic weapon system control mode enabled (AC).
- HMS in Shkval's gimbal limits.
- Launch authorized.

#### OVER-LIMIT

Indicates that the HMS line of sight is beyond the Shkval's gimbal limits ( $\pm 30^\circ$ ).

Flashing (2 Hz) concentric circles.



#### 8-9: HMS OVERLIMIT

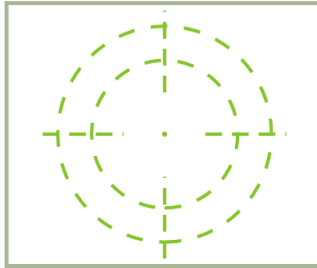
Conditions:

- Automatic weapon system control mode enabled (AC).
- HMS is beyond the Shkval's gimbal limits ( $\pm 30^\circ$ ).
- "ЦУ" (Uncage Shkval, designate target) button on the cyclic stick is not pressed.

#### TURN TO TARGET

If a target is beyond of the Shkval's gimbal limits ( $\pm 30^\circ$ ), it is required to maneuver to bring the target within the targeting system's scan limits. With "АДВ" (automatic auto turn to target) mode enabled, the helicopter will orient toward the target.

Flashing (2 Hz) crosshairs and concentric circles.



**8-10: HMS TURN TO TARGET**

Conditions:

- Automatic weapon system control mode enabled (AC).
- HMS is beyond the Shkval's gimbal limits ( $\pm 30^\circ$ ).
- "ЦУ" (Uncage Shkval, designate target) button is pressed.
- "АДВ" (Automatic turn to target) mode active.

### **HMS Inoperative**

HMTD is not visible.

Either of the conditions:

- HMS is beyond the HMS sensor limits ( $\pm 60^\circ$ ).
- "ПМ" (Gun sight) is not in automatic mode.





9

**FLIGHT  
PREPARATION**



## 9 FLIGHT PREPARATION

Flight preparation and system checks are conducted in the following conditions:

- The helicopter is armed and fueled according to the flight task.
- Electrical power is disabled and disconnected from the helicopter; PrPNK preparations have been performed according to the flight task and initial flight data is entered into the PNK (by default the preparation is complete when the data is entered).
- The route and the flight plan from the mission editor are loaded in the ABRIS (by default).

### Systems Activation and Checks

When performing start-up preparations and checks, an external power unit should be the source of electrical power. In case no ground power unit (GPU) is available, it is possible to use the onboard batteries (with restrictions).

- Flip up the **"BAT1"** (Battery 1) cover and switch and the **"BAT2"** (Battery 2) cover and switch.
- Check that the **"ПРЕОБР АВТ – РУЧН"** (Electrical power inverter auto – manual) switch is in the **"ПРЕОБР АВТ"** (Auto) position.
- Turn on the **"INT.COM"** (Intercom).

Enabling AC and DC GPU:

- Turn on DC power, **"=ТОК АЭР ПИТ"** (Ground DC power) switch.
- Turn on AC power, **"~ ТОК АЭР ПИТ"** (Ground AC power) switch.

Turn on the EKRAN system serviceability check:

- Set the **"ВМГ ГИДРО ЭКРАН – ОТКЛ"** (Hydraulics/transmission group and EKRAN power supply) switch on the rear panel to the down position. The EKRAN display will illuminate for a short time and the **"ЭКРАН ОТКАЗ"** (EKRAN FAILURE) signal will go off.
- Press and release the MWL button and the EKRAN will display the **"САМОКОНТ"** (SELFTEST) message. If the system is serviceable, the message will be replaced by the **"ЭКРАН ГОДЕН"** (EKRAN READY) message after five seconds.

Check the Emergency Warning System (EWS) and the lighting systems:

- Press the **"КОНТРОЛЬ СИГНАЛИЗАЦИИ"** (Warning, Cautions and Advisory lamps test) button on the left forward panel. All lights should then illuminate. Release the Warning, Cautions and Advisory lamps test button and all lights should return to their initial status.
- When flying at night, turn on the following lights:

- **"ПОДСВЕТ ПУЛЬТЫ"** (Gauges illumination)
- **"ПОДСВЕТ АГР ПКП"** (ADI and HSI illumination)
- **"АНО КОД"** (Navigation lights) (overhead panel)
- **"КОНТУР ОГНИ"** (Tip lights)
- **"СТРОВ ОГНИ"** (Formation lights)
- **"ПРОБЛЕСК МАЯК"** (Anti-collision light)
- **"ПОСАД ФАРЫ"** (Landing-search light) (center panel, bottom)

When using the night vision goggles, turn on the adaptive blue cockpit illumination **"ПОДСВЕТ ПРИБОРЫ"** (Cockpit night illumination) before takeoff and turn-off the white illumination **"ПОДСВЕТ ПУЛЬТЫ"** (Gauges illumination) and **"ПОДСВЕТ АГР ПКП"** (ADI and HSI illumination).

## ABRIS Activation

Turn on the power switch on the ABRIS control panel [**RShift + 0**].

## PrPNK Preparation

Preflight PNK preparation procedures:

1. Initial data input. By default, the initial data input is from the mission file (.miz) created in the mission editor
2. Data entry check (according to mission)
3. INU alignment. Normal preparation is selected by default (Align the attitude and heading reference system. By default, this process will be accelerated.)
4. Course correction (if necessary)

Set the **"K-041"** switch to the on position (located on the Targeting mode control panel)

Set the PVI mode selector to the **"OPER"** (Normal operation) position.

If the preflight setup of the HUD is performed simultaneously with the INU alignment, then, if necessary, prior to switching on the INU, first input the INU alignment into the control and display unit by pressing either the normal (**"INU NORM"**) or gyrocompass-assisted precision alignment (**"INU PREC"**) button. (Not necessary for accelerated alignment)

As a general rule, if there is no need to edit the flight plan specified in the mission, you may proceed directly to the next stage of the preflight setup – [INU alignment](#).

The flight plan (route) editing procedure is listed below.

If it is necessary to edit the existing flight plan or create a new one, it should first be created in the ABRIS.

## Inputting waypoint coordinates into the PNK

1. From the ABRIS, load the flight plan you wish to program into the PNK and select the Flight Plan sub-mode for selecting WP coordinates.
2. Set the PVI mode selector to the **"ВВОД"** (Enter-Edit) position.
3. From the PVI, enter WP (AF, TP, Fix point) sub-mode by pressing the **"ППМ"** (WP) (AF, TP, Fixed point) push-button. This will then illuminate the PVI display and indicate the number of pre-programmed points.
4. Press the push-button on the PVI-800 keypad that corresponds to the desired WP (AF, TP, or Fixed point) number. This will then display that number on the WP Waypoint display and the AF, OP, REF number will appear on the lower display.
5. From the PVI panel, enter the coordinates of the first point using the keypad.
  - Enter the geographic latitude positive-negative with the 0 «+» or 1 «-» buttons (the entire territory modeled in the game has positive latitude and longitude). The «+» sign is not displayed during input.
  - Sequentially enter the digits of the geographic latitude with decimals. The value of the latitude is displayed on the upper PVI display window.
  - Enter «+» sign for the geographic longitude with the 0 button. The «+» sign is not displayed during input.
  - Sequentially enter the digits of the geographic longitude with decimals. The value of the longitude is displayed on the lower PVI display window.
6. Once you have entered the latitude and longitude values, the **"ВВОД"** (Enter) push-button will illuminate.
7. Make sure the entered data is correct and then press the **"ВВОД"** (Enter) button.
8. In case of data entry error, press the **"СБРОС"** (Reset) button and repeat the process of coordinate input of a given point.
9. To disengage the WPs (AF, TP, Fixed point) sub-mode, press the **"ППМ"** (WP) (AF, TP, Fixed point) push-button again and the button illumination will extinguish.
10. Using this procedure, use the data from the ABRIS to enter the coordinates of all required WPs, AFs, TP, and Fix points.

In the ABRIS, the coordinates of any point of the surface can be determined by using the cursor in INFO mode (NAV→MAP→INFO)

## Changing the WP sequence

If you wish to change the WP sequence or add a new WP in the current route, the following steps are required:

1. Set the PVI mode selector to the **"РАБ"** (Normal operation) position.
2. Set the **"ЗК-ЛЗП"** (Desired Heading – Desired Track Angle) switch on the Autopilot panel (right side panel) to the **"ЗК"** (DH) position.
3. Press the **"ПНМ"** (WP) push-button on the PVI.
4. Using the PVI keypad, select the WP number selected as initial. After doing so, the number of the pre-programmed WP is displayed on the Waypoint display.
5. Press the **"ВВОД"** (Enter) button and the initial WP is loaded in the PNK.
6. Repeat this procedure for the rest of the WPs in the new sequence.
7. After inputting the last WP, press the **"ПНМ"** (WP) push-button again. The WP sequence will then be saved in navigation computer memory.

## INU Alignment

The INU (Altitude and heading reference system) is designed to monitor the following parameters:

- The aircraft's true (gyrocompass-assisted) heading or gyroscopic heading;
- The aircraft's roll and pitch angles;
- The components of absolute acceleration along the longitudinal, transverse, and vertical axes of the aircraft;
- The longitudinal and transverse components of the aircraft's inertial velocity.

Turn on the **"K-041"** switch (on the Targeting Mode Control Panel) via the shortcut [\[LShift + D\]](#).

Choose the type of INU alignment required for system startup.

The types available are listed below:

On the ground:

- [Accelerated](#): Selected automatically after switching on the INU. This mode takes the parameters (normal alignment, or gyrocompass-assisted precision alignment) stored in the aircraft's onboard computer;
- [Normal](#): Selected by pressing the Normal Alignment (**"INU NORM"**) button on the control panel;
- [Precision](#): Selected by pressing the Precision Alignment (**"INU PREC"**) button on the control panel.



In flight:

- Accelerated alignment occurs when [restarting the system](#) (via the "**INU RESET**" button). Occurs relative to the true vertical in horizontal flight (for at least 2 minutes). This takes into account the coordinates of the aircraft's position received via the corresponding reckoning mode from the TsVM-N.

The time required for INU alignment, as well as the output information received after alignment, is shown in the table below.

Alignment Type	Time (mins)	Output Information
Accelerated	3	Roll, pitch, True heading (from computer memory) or gyrocourse 0°
Normal	15	Roll, pitch, True heading (from computer memory) or gyrocourse 0°, Measured absolute inertial velocity components
Precision (Gyrocompass-assisted)	20	Roll, pitch, True heading, Measured absolute inertial velocity components

## Accelerated INU Alignment

Accelerated Alignment (AA) of the INU is performed in the following order:

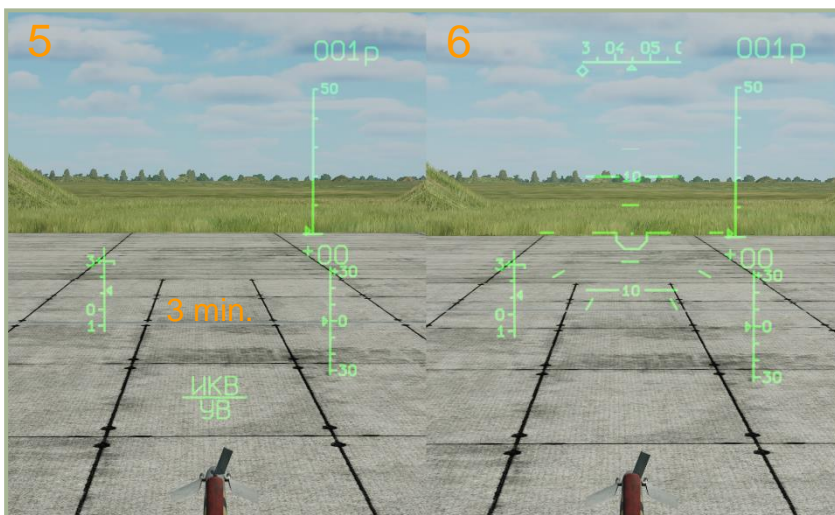
Prior to switching on the INU, first set the wafer switch located on the control and display unit to the "**OPER**" position (turn left – [\[RAlt + V\]](#) turn right - [\[RAlt + B\]](#)). After this, switch on the "**INU**" power switch [\[RCtrl + RAlt + I\]](#) located on the control panel, along with the "**INU HEAT**" [\[RAlt + RShift + I\]](#) switch. Prior to switching on the INU proper, the INU heating **MUST ALSO BE SWITCHED ON** regardless of the outside temperature. Finally, switch on the power source for the reserve artificial horizon ("**STANDBY SAI**") [\[RShift + N\]](#). When this is done:

- The HUD will display the symbol “**IKB/YB**” (if 3 minutes have passed since the “**K-041**” was powered on, and if the BRIGHTNESS switch on the HUD unit is set to ON);
- The alarm flags **K** and **Γ** will disappear from the HSI.

Once the accelerated INU alignment process has finished (after about 3 minutes), the “**IKB/YB**” (INU/AA) symbol will disappear from the HUD and the INU will switch to operational mode. Additionally:

- The flashing indicator lights on the Flight Mode Control Panel labeled **K**, **T**, **H** will switch off;
- The alarm flag labeled **KC** will disappear from the HSI, which will then display the heading values taken from the onboard computer;
- The alarm flag labeled **ΑΓ** will disappear from the INU, which will then display the aircraft’s parking roll and pitch values.





### 9-1: INU Accelerated Alignment

The procedure for accelerated and normal alignment requires that the pilot make [corrections to the indicated heading](#) on the HSI.

## Normal INU Alignment

Normal Alignment (NA) of the INU is performed in the following order **prior to engine startup**:

**WARNING.** Initiating either Normal or Precision alignment while the aircraft's engine is running, as well as interrupting the alignment process before it has finished completely, will lead to an erroneous reckoning of the aircraft's coordinates. This will result in erroneous values being displayed for parameters such as the aircraft's speed, coordinates (when transmitting to wingmen), and will also disrupt normal operation of the autopilot system.

Prior to switching on the INU, first set the wafer switch located on the control and display unit to the **"OPER"** position (turn left - [RAlt + V] turn right - [RAlt + B]) and push the Normal Alignment (**"INU NORM"**) indicator button, which will light up once pressed. After this, switch on the **"INU"** power switch [RCtrl + RAlt + I] located on the control panel, along with the **"INU HEAT"** [RAlt + RShift + I] switch. Finally, switch on the power source for the reserve artificial horizon (**"STANDBY SAI"**) [RShift + N].

When this is done:

- The HUD will display the symbol **"ИКВ/УВ"** (INU/AA);
- The alarm flags **К** and **Г** will disappear from the HSI.

Approximately 3 minutes after switching on the INU, the **"ИКВ/УВ"** (INU/AA) symbol will begin to flash.

After approximately 9 minutes, the flashing **"ИКВ/УВ"** (INU/AA) symbol will change to **"ИКВ/НВ"** (INU/NA).

The values of methodological errors and angular velocities of gyroscope drift will be calculated.

After approximately 15 minutes, the **"INU NORM"** indicator button on the control and display unit will begin to flash, signifying that the normal alignment preparation process has finished.

Press the button to switch it off [RAlt + Y]. The light will disappear and the INU will switch to operational mode.

- The INU/NA symbol will disappear from the HUD;
- The alarm flag labeled **КС** will disappear from the HSI, which will then display the heading values taken from the onboard computer;
- The alarm flag labeled **АГ** will disappear from the INU, which will then display the aircraft's parking roll and pitch values.







## Precision INU Alignment

Precision Alignment (PA) of the INU is performed in the following order **prior to engine startup**:



Prior to switching on the INU, first set the wafer switch located on the control and display unit to the **"OPER"** position (turn left - [RAIt + V] turn right - [RAIt + B]) and push the Precision Alignment (**"INU PREC"**) indicator button, which will light up once pressed.

**WARNING.** Do not initiate Precision Alignment via the **"INU PREC"** indicator button while the INU is switched on.

Switch on the **"INU"** power switch [RCtrl + RAIt + I] located on the control panel, along with the **"INU HEAT"** [RAIt + RShift + I] switch. Finally, switch on the power source for the reserve artificial horizon (**"STANDBY SAI"**) [RShift + N]. When this is done:

- The HUD will display the symbol **"ИКБ/УВ"** (INU/AA);
- The alarm flags **К** and **Г** will disappear from the HSI and the current heading scale will rotate by approximately 180°.

Approximately 3 minutes after the INU is switched on, the **"ИКБ/УВ"** (INU/AA) symbol will be replaced by a flashing **"ИКБ/ВГП"** (INU/GP - Gyrocompassing Process) symbol.

After approximately 12 minutes, the flashing **"ИКБ/ВГП"** (INU/GP) symbol on the HUD will be replaced with **"ИКБ/ТБ"** (INU/PA). Gyrocompassing will then take place, setting the HSI to the aircraft's true heading value, and the values of methodological errors and angular velocities of gyroscope drift will be calculated.

After approximately 20 minutes, the **"INU PREC"** indicator button on the control and display unit will begin to flash, indicating that the Precision Alignment process has completed successfully.

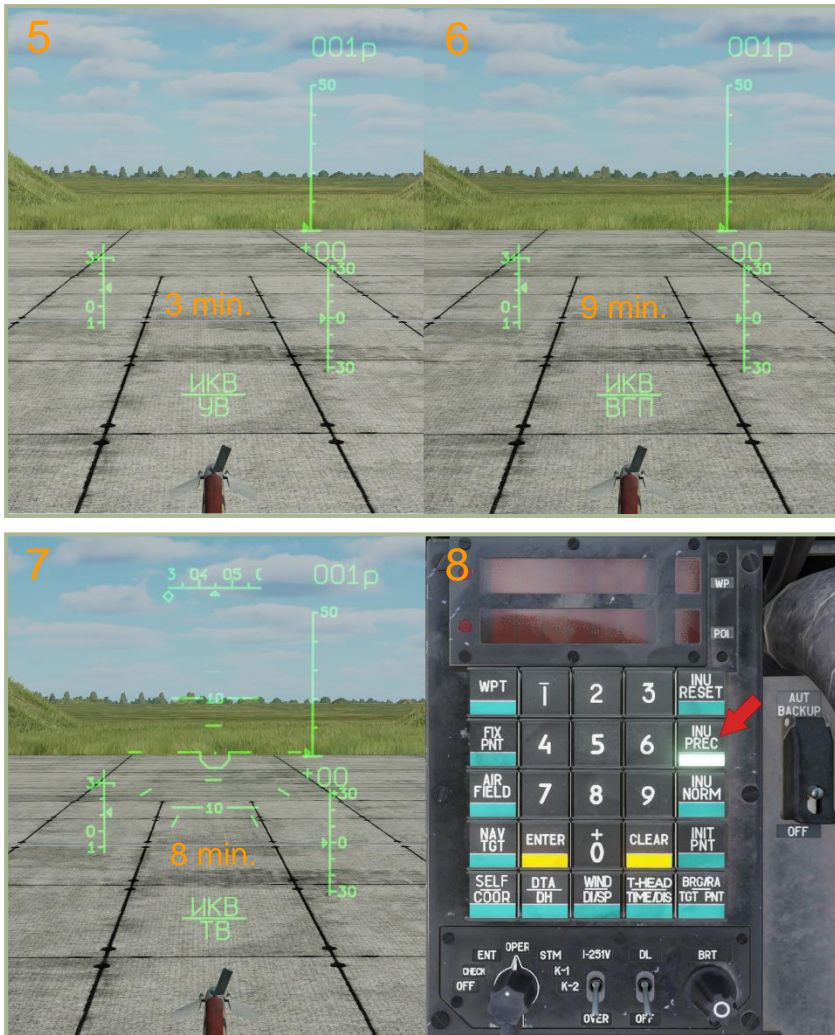
Press the button to switch it off [RAIt + R]. The light will disappear and the INU will switch to operational mode.

- The **"ИКБ/ТБ"** (INU/PA) symbol will disappear from the HUD;
- The alarm flag labeled **КС** will disappear from the HSI, which will then display the heading values taken from the onboard computer;
- The alarm flag labeled **АГ** will disappear from the INU, which will then display the aircraft's parking roll and pitch values.

No further corrections to the heading values will be required once Precision Alignment is complete.







### 9-3: INU Precision Alignment

The Normal and Precision Alignment procedures may be forcibly terminated if the first stage of Accelerated Alignment has already been completed. To do this, press the currently highlighted button ("INU NORM" or "INU PREC"). The precision of the gyrostabilized platform depends on the chosen alignment mode for the INU.

It will not be possible to activate autopilot for the aircraft's ROLL and PITCH prior to completing the INU alignment procedure.

## Restarting the INU

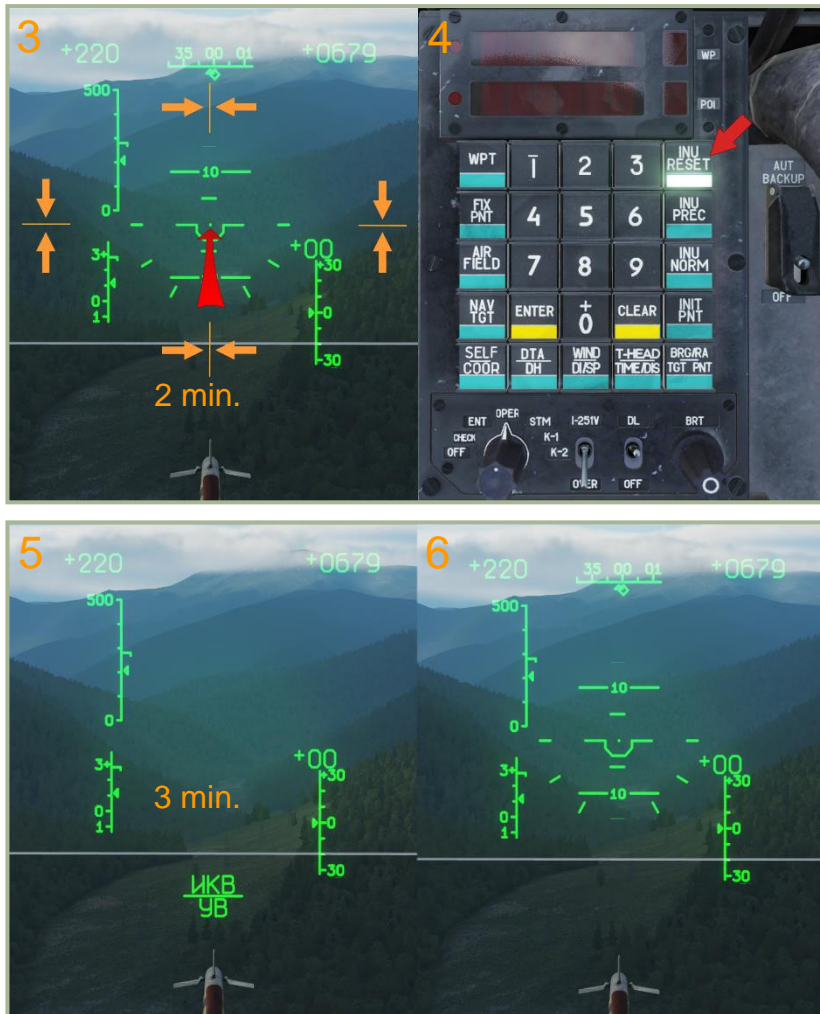
Restarting the INU is an emergency procedure used to forcibly reboot the inertial INU following a brief interruption to the aircraft's power supply, indicated by the **KC** warning flag on the HSI, the flashing **"ОТКАЗ/ИКВ"** (INU Failure) symbol on the HUD, and the flashing **"INU RESET"** (Restart) indicator button on the control and display unit.

When initiating a restart, the aircraft must be held in uniform horizontal flight for at least 2 minutes, during which the system will initiate the Accelerated Alignment procedure.

INU restart is initiated by pressing the **"INU RESET"** indicator button on the control and display unit.

The mode will automatically switch off once Accelerated Alignment has completed.





9-4: Restarting the INU in flight

## Course Correction

Course correction may be performed as necessary after the INU finishes the accelerated alignment procedure (no earlier than 2 minutes after the INU is powered on) or while it is preparing to initiate either Accelerated ([AA](#)) or Normal ([NA](#)) alignment.

The pilot may perform the following types of course correction:

- Correction using to the known true heading of the helicopter (Desired Heading);
- Correction using data from the ID-6 magnetic sensor (Magnetic Heading).

While parked, the pilot may perform either Desired Heading or Magnetic Heading course correction.

While in flight, the pilot may perform only Magnetic Heading course correction.

## Desired Heading Course Correction

Procedures:

- Input the aircraft's known (parked) heading into the magnetic declination encoder using the adjustment lever;
- Set the **"MAN-GYRO-MH"** (Manual Heading – Gyroscope – Magnetic Heading) switch on the right-side control panel to the **"MAN"** position, which will cause the HSI to turn to the true heading value (input value);
- Set the **"MAN-GYRO-MH"** switch to the **"GYRO"** position;
- Compare the heading displayed on the HSI with the course displayed on the magnetic compass;
- Input the magnetic declination value into the magnetic declination encoder (if performing course correction while in flight).

The parking heading of the aircraft and the amount of magnetic declination can be determined by using the "Ruler" instrument at the airfield or FARP, accessible via the F10 map view. Additionally, the amount of magnetic declination will be shown on the compass rose together with the true and magnetic north indicator.







**9-5: Manual Heading Course Correction**

## Magnetic Heading Course Correction

Procedure:

- Input the magnetic declination value into the magnetic declination encoder in order to obtain the aircraft's true heading;
- Set the **"MAN-GYRO-MH"** switch to the **"MH"** position. The HSI will turn to the true heading value shown on the ID-6 magnetic sensor;
- Set the **"MAN-GYRO-MH"** switch to the **"GYRO"** position;
- Compare the heading displayed on the HSI with the course displayed on the magnetic compass.





### 9-6: Magnetic Heading Course Correction

NOTE. Performing Magnetic Course correction while the aircraft is on the ground will result in an erroneous heading value due to magnetic interference from metal objects that may be in the vicinity of the aircraft.

When performing course correction (alignment) while parked, the heading value set on the magnetic declination encoder (Manual Heading), or the sum of the values indicated on the magnetic declination encoder and the ID-6 magnetic compass (Magnetic Heading) will be added to the zero value. Further, while the aircraft is in motion either during taxiing or in flight in Gyroscope mode, the steering angle of the aircraft relative to the direction of the longitudinal axis of the aircraft in the parking lot will be added to the parking heading readings at the HSI.

Obtaining inertial velocities during gyrocompassing requires high accuracy of the initial alignment of the gyroplatform to the horizontal plane, taking into account the gyroplatform's own drift and the angular velocity of the Earth's rotation at the given latitude. This can only be achieved by performing either Normal or Precision INU alignment, where digital integrators come into play. During Accelerated Alignment, determination of inertial velocities is not performed - the gyroplatform is only aligned to the horizon and heading.

## Activating the Weapons Control System

Turn on the "WCS" (Weapon Control System) switch on the wall panel.

## ADF Activation and Check

Make sure that the channel selector is positioned to correspond to the inner and outer NDBs of the airfield you are taking off from.

- From the **"ПРИВОД Р/С. БЛИЖН-АВТ-ДАЛЬН"** (NDB's INNER-AUTO-OUTER beacon mode) switch (central panel), set the switch to the **"БЛИЖН"** (INNER) (by default it's in AUTO) position.
- From the ADF panel, set the **"АНТ-КОМП"** (Antenna – Compass) ADF mode switch to the **"АНТ"** position to receive Inner NDB identification signal broadcast (once every 15 seconds).
- Set the **"АНТ-КОМП"** (Antenna – Compass) ADF mode switch to the **"КОМП"** position and make sure that the bearing needle on the HSI points to the Inner NDB.
- To confirm ADF operation with the outer NDB, set the **"БЛИЖН – АВТ – ДАЛЬН"** (INNER – AUTO - OUTER) switch to the **"ДАЛЬН"** (OUTER) position.

With ADF checks complete, leave the **"ПРИВОД Р/С. БЛИЖН-АВТ-ДАЛЬН"** (NDB's INNER-AUTO-OUTER beacon mode) switch in the **"ДАЛЬН"** (OUTER) position.

## UV-26 IRCM Dispensing Program Preparation

Set the UV-26 IR Counter Measures (IRCM) deployment system according to the flight task and expected threats as follows:

- Turn on the UV-26 with **"УВ-26 ВКЛ – ОТКЛ"** (Onboard defense system power) switch (rear panel, bottom part).
- Set the **"НАЛИЧИЕ – ПРОГР"** (Quantity-program) switch (overhead panel) to the **"ПРОГР"** (Program) position.
- With the **"СЕРИЯ"** (Number of flare sequences) button, set the number of flare sequences.
- With the **"ЗАЛП"** (Salvo) button, set the number of flares to be released in a single program sequence.
- With the **"ИНТЕРВАЛ"** (Interval), set the time-delay between flare release settings.
- Set the **"НАЛИЧИЕ – ПРОГР"** (Quantity-program) switch to the **"НАЛИЧ"** (Quantity) position to control the flares remaining.

# ENGINE START AND POWER TESTS PROCEDURES

## Preparation for Start-up

### Enable electrical power

From the electrical power control panel, you need to supply AC and DC power. This can be done either with the on-board batteries (battery 1 and battery 2) or from ground power outside the aircraft.

#### To use the on-board batteries:

Set the **"ТОК АКК1"** battery 1 and battery 2 switches to up.

#### To use ground power:

#### Turn on **"INT.COM"** switch to provide power to the SPU-9 intercom.

First you will need to radio the ground crew to hook up an external power generator. To do so, first set the intercom dial on the SPU-9 radio panel to the **"НОП"** position. This will provide a communication link with the ground crew. Next, open the radio communication window by pressing the **[N]** key and select: Maintenance → Ground Elec Power... → On. With communication established, set the **"ТОК АЭР ПИТ"** ground DC power switch to on and the **"АЭР ПИТ"** ground AC power switch to on.

#### Press indicator lamp test button and check lamps.

### Check exhaust gas temperature (EGT) indicator

Located over the EGT gauge, press the **"НЕ РАБОТ"** (EGT check with stopped engines) button. This should show more than 800°C on the EGT gauges.

### Check fire extinguishing system

The fire extinguisher system controls are located on top of the right panel.

1. Move the **"ОГНЕТУШ – ОТКЛ – КОНТР"** (Fire extinguisher WORK – OFF - CHECK) to the test position.
2. Set the **"СИГНАЛИЗ"** (Fire signalling) switch to on.
3. Set the **"КОНТР ДАТЧИКОВ"** (Fire warning sensor group tests) switch to the **"1ГР"** (1<sup>st</sup> group) position. If the system is operating normally, the following lights should illuminate: **"ПОЖАР ЛЕВ ДВИГ"** (Left engine fire), **"ПОЖАР ПРАВ ДВИГ"** (Right engine fire), **"ПОЖАР ГИДРО"** (Hydraulics fire), **"ПОЖАР ВЕНТИЛ"** (Oil cooling fan fire), **"ПОЖАР ВСУ"** (APU fire). These warning lights are located on the wall panel. On the left forward panel, the MWL and **"ПОЖАР"** (Fire) lights will illuminate.
4. Set the **"КОНТР ДАТЧИКОВ"** (Fire warning sensor group tests) switch to the neutral position.

5. Turn off and on the **"СИГНАЛИЗАЦИЯ"** (Fire signaling) switch and all warning lights on the right side panel should turn off.
6. Repeat the procedure for the II and III groups of sensors. Note, that the APU fire light doesn't illuminate when making the III sensor group BIT. There are only 2 groups of fire detection sensors in the APU compartment.
7. Set the **"ОГНЕТУШ – ОТКЛ – КОНТР"** (Fire extinguisher WORK – OFF - CHECK) switch to the **"ОГНЕТУШ"** (Extinguishing) position.
8. Set the **"БАЛЛОНЫ"** (Extinguishers) switch to the **"АВТ"** (First extinguisher) position. During normal system operation, the «1» и «2» lights above the **"БАЛЛОНЫ"** selector should not illuminate.

### Turn on the R-800L1 VHF radio

Set the **"УКВ-2"** (VHF-2) switch on the right side panel to the up position. You can now communicate with the tower and wingmen.

### Test the voice message unit (VMU)

Press the **"ПРОВЕРКА – РЕЧЬ"** (ALMAZ check) button located near the top of the rear panel. The following message should be heard: "Voice warning system OK".

### Check area and set lights

Upon receiving start-up clearance, make sure that the rotor area is free of people and foreign objects. In low visibility conditions, turn on the navigation lights and the rotor tip lights – **"КОД АНО"** (Navigation lights) are located on the overhead panel and the **"КОНТУРНЫЕ ОГНИ"** (Tip lights) switch is located in the rear portion of the right panel.

### Turn on the fuel meter

Set the **"ТОПЛИВОМЕР"** (Fuel meter power) switch, located on the right panel, to the up position.

Although optional, you may also consider creating or modifying ABRIS routes before APU and engine start.

### Close the cockpit door

## APU Start-up

Auxiliary Power Unit (APU) start-up procedure:

### Open the APU fuel shut-off valve

Set the **"ВСУ – ЗАКРЫТО"** APU fuel valve switch located in the fuel shutoff valve control panel to on. This switch is located on the wall panel. When set to on, the **"КРАН ВСУ ОТКРЫТ"** (APU valve open) green light should illuminate.



## Turn on forward and aft fuel tank boost pumps

Set the **“НАСОСЫ БАКОВ – ПЕРЕД”** (Forward fuel tank pumps) and **“НАСОСЫ БАКОВ – ЗАДН”** (Rear fuel tank pumps) switches to on. After doing so, the **“БАК ПЕРЕДНИЙ”** and **“БАК ЗАДНИЙ”** green lights on the overhead warning and indication panel (right side) should illuminate.

## Select engine start-up mode

Move the **“ЗАПУСК – ПРОКРУТКА – ЛОЖНЫЙ ЗАПУСК”** (Engine work mode) switch to the **“ЗАПУСК”** (start) position. The engine and APU start-up panel is located on the left side panel.

## Select Engine/APU

Move the **“ВСУ – ДВИГ ЛЕВ – ДВИГ ПРАВ – ТУРБОПРИВОД”** (Engine selector: APU-left engine-right engine-turbo gear) switch to the APU position (left).

## Start APU

Press the **“ЗАПУСК”** (Start-up selected engine/APU) button.

The APU will automatically reach stand-by mode, which is indicated by the illumination of the **“ВСУ ВКЛЮЧЕНА”** (APU on) light on the APU panel.

During the APU start-up cycle, monitor the following parameters:

- Exhaust gas temperature (EGT) of the APU is no more than 850 C°.
- Time elapsed until stand-by mode is reached (from start to “APU on” light illumination) is no more than 24 seconds.

Once the APU reaches stand-by mode, make sure that:

- The **“ВСУ ВКЛЮЧЕНА”** light on the APU panel is on.
- The EGT of the APU is no more than 720 C°.
- The green **“Р масла ВСУ”** (APU oil pressure normal) light illuminates.

APU warm up, with no air bleeding, should take one minute before using it for main engine starts.

## APU Start-up Troubleshooting

Cancel APU start up if:

- There is no EGT response after the start button has been pressed for 9 seconds.
- There are any anomalies in APU operation.
- There is an APU uncontrolled shut down.

The APU can be shut down by pressing the **“ОСТАНОВ ВСУ”** APU shutdown button.



In case of a start-up cancellation due to lack of the EGT increasing or an uncontrolled shut down, perform an engine crank before initiating another start-up.

The **"АИ-9В"** (APU) will automatically shut down in case of RPM over-limit, which is indicated by the **"ОСТАНОВ ВСУ по n"** (APU off RPM max) light on the APU panel.

## APU Crank and False Start

A false start is used to check the APU system but without fuel ignition.

### APU false start procedure

1. Check the onboard or external electrical power supply.
2. Open the APU shut-off valve and turn on the rear fuel tank boost pump.
3. Move the engine start-up mode switch to the **"ЛОЖНЫЙ ЗАПУСК"** (false start) position.
4. Move the Engine/APU select switch to the **"ВСУ"** (APU) position.
5. Press the **"ЗАПУСК"** (Start) button.
6. After 15 seconds press the **"ОСТАНОВ ВСУ"** (Stop APU) button.

After a false start, you need to vent the remaining fuel from the combustion chamber and then do an engine crank. An APU crank serves to blow out any fuel in the APU combustion chamber after a failed start-up or false start.

### APU crank procedure

1. Check onboard or external electrical power supply.
2. Open the APU shut-off valve.
3. Turn on the rear fuel tank boost pump.
4. Move the engine start-up mode switch to the **"ПРОКРУТКА"** (crank) position.
5. Move the Engine/APU select switch to the **"ВСУ"** (APU) position.
6. Press the **"ЗАПУСК"** (Start) button.
7. After 15 seconds press the **"ОСТАНОВ ВСУ"** (Stop APU) button.

A false start and the crank should not exceed 15 seconds; therefore 15 seconds after pressing the Start button it will be necessary to press and release the **"ОСТАНОВ ВСУ"** (Stop APU) button to cut the fuel supply.

## Main Engines Start-up

Before starting the engines, the APU must be online.
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### Engines startup procedure:

#### 1- Disengage rotor brake





Click on the brake lever and move it down to the **"РАСТОРМОЖЕНО"** (brake off) position.

## 2- Open the fuel shut-off valve to the selected engine

Select either the **"ДВИГ. ЛЕВ. – ЗАКРЫТО"** (left engine fuel shutoff valve switch) or the **"ДВИГ. ПРАВ. – ЗАКРЫТО"** (right engine fuel shutoff valve switch), depending on which engine you are starting. When you do so, either the amber **"КРАН ЛЕВ ЗАКРЫТ"** (left valve closed) or **"КРАН ПРАВ ЗАКРЫТ"** (right valve closed) light will extinguish.

## 3- Check operation of the forward and rear fuel tank boost pumps

Confirm that both the **"НАСОСЫ БАКОВ ЗАДН"** (aft fuel pump) switch and **"НАСОСЫ БАКОВ ПЕРЕД"** (forward fuel pump) switch are enabled and that the **"БАК ПЕРЕДНИЙ"** (forward tank) and **"БАК ЗАДНИЙ"** (rear tank) status lights are illuminated green.

## 4- Turn on the electronic engine governors

Located in the rear portion of the wall panel, set the **"ЭРД ЛЕВ"** (left engine governor) and the **"ЭРД ПРАВ"** (right engine governor) switches to on.

## 5- Select engine start-up mode

Check the position of the **"ЗАПУСК – ПРОКРУТКА – ЛОЖНЫЙ ЗАПУСК"** (engine start-up mode) and set the switch to the **"ЗАПУСК"** (start) position. The engine start-up switch is located on the left panel.

## 6- Select engine to start

Use the engine/APU switch to select the engine to be started on the **"ВСУ – ДВИГ ЛЕВ – ДВИГ ПРАВ – ТУРБОПРИВОД"** (engine selector: APU-left engine-right engine-turbo gear). The appropriate choices include **"ЛЕВ"** (left engine) or **"ПРАВ"** (right engine).

## 7- Start engine

Press the **"ЗАПУСК"** (Start-up selected engine) button.

## 8- Open cut-off valve lever of the selected engine

Once the engine RPM reaches 20%, move the appropriate red engine cutoff lever to the **"ОТКРЫТО"** (open) position, the engine will automatically reach idle mode in less than 60 seconds.

Upon reaching normal oil pressure in the engine gearbox, the green **"Р масла ПРИВОДОВ"** (gearbox oil press norm) light will illuminate.

CAUTION! It is forbidden to start the engines with no operating boost pumps.

During the engine startup cycle, monitor the following parameters:

- Smooth engine (gas-generator- GG) acceleration (lack of RPM "freezings").
- Increasing EGT.
- Rotors motion should initiate at GG RPM of no more than 25% (visual confirmation by looking at the nearest blade).

- Disengagement of the starter at GG RPM 60...65%. Monitor this with the **"КЛАПАН ЗАПУСКА"** (start valve) light going off (engines startup control panel on the left hand side panel).
- Hydraulic fluid pressure increases in all systems (auxiliary control panel).

After the first engine has been started, check the rotor's RPM at idle power.

Start the second engine by repeating the above procedure.

CAUTION! It is not advised to move the Engine/APU selector switch from one engine to another before the first engine has reached idle power. Rotor operation between 54...62% is not advised.

After both engines have been started, check the rotor RPM at Idle power, operation below 62% rotor RPM is not advised. If necessary to meet this requirement, move the engines' throttle levers up to attain a rotor speed of 62...70%.

After both engines have been started and are running normally, shut down the APU by pressing the **"ОСТАНОВ ВСУ"** (Stop APU) button and close the APU shut-off valve. The **"ВСУ ВКЛЮЧЕНА"** (APU on), **"КРАН ВСУ ОТКРЫТ"** (APU valve open), and **"и Р масла ВСУ"** (APU oil pressure normal) lights will go off.

Do not increase engine power past idle until the output oil temperature reaches +30 °C for the engines and no less than - 15°C for the main gearbox.

The throttle levers should only be moved to the **"АВТОМАТ"** (Auto) position after the engines have warmed up sufficiently.

## Main Engines Start-up Troubleshooting

Close the engine cutoff valve levers and press the **"СТОП ЗАПУСК"** (Interrupt start-up) button to cancel an engine start in the following situations:

- Rotor motion doesn't initiate at GG RPM 25%.
- There's no EGT or GG RPM increase (no ignition).
- EGT over-limit.
- GG RPM "freezing" for more than 3 seconds.
- The engine hasn't reached idle power 60 seconds after start-up initiation.
- Engine oil pressure at idle power is less than 2 kgf/cm<sup>2</sup>
- There's no hydraulic fluid pressure in the systems.
- The **"КЛАПАН ЗАПУСКА"** (start valve) light on the start-up panel hasn't gone off at GG RPM 66-67%.

Another start-up is allowed after an aborted start-up, only after reaching a full stop of the GG and addressing the reason(s) for the failed start-up. To attempt another start-up, attempt to do an engine crank first.

## Engine Crank and False Start

Doing a false start is used to check the functionality of the systems taking part in the start-up without the ignition process.

### Engine false start procedure

1. Engage the rotor brake.
2. Turn on the boost pump supplying the appropriate engine and open the shut-off and the cutoff valves.
3. Set the engine start-up mode switch to the **"ЛОЖНЫЙ ЗАПУСК"** (false start) position.
4. Set the APU/engine select switch to the Left or Right position, depending on engine to false start.
5. Press the **"ЗАПУСК"** (Start) button.

During the false start, monitor the following:

- The oil pressure should be no less than 0.5 kgf/cm<sup>2</sup>
- GG RPM should be no less than 20%

After the false start, it is necessary to do an engine crank.

The main engine crank procedure is analogous to the false start procedure but with the only difference being that the fuel cut-off valve is closed. Its purpose is to vent fuel from the combustion chamber.

### Engine crank procedure

1. Engage the rotor brake.
2. Open the fuel shut-off valve of the cranked engine and turn on the fuel tank boost pump supplying it. The cut-off valve lever must be closed (down position).
3. Move the engine start-up mode switch to the **"ПРОКРУТКА"** (crank) position.
4. Move the APU/engine selector switch to the Left or Right position, depending on which engine is being cranked.
5. Press the **"ЗАПУСК"** (Start) button.

During engine crank, monitor the following:

- Oil pressure should be no less than 0.5 kgf/cm<sup>2</sup>
- GG RPM should be no less than 20%

## Pre-flight Tests

After both engines have been started and are running normally at idle power, you can perform the following tests:

Check the operation of the anti-ice system of the engines and their dust protectors. Anti-ice test should only be performed when the ambient temperature is less than 5°C.

### Check engine anti-ice system

1. Move the collective to the full down position (minimum collective pitch).
2. Move the engines throttle levers to the **"АВТОМАТ"** (auto) position by pressing twice on the Page up key when in idle mode.
3. Set the **"ПОС ДВИГ – ОТКЛ – ПЗУ"** (engines anti-icing/dust protection systems) switch to the **"ПОС ДВИГ"** (engines anti-icing) position, on the overhead panel **"ПОС ЛЕВ ДВИГ"** (anti-ice left engine) and the **"ПОС ПРАВ ДВИГ"** (anti-ice right engine) lights should illuminate. The EGT should increase up to 60°C and GG RPM should increase up to 2%.
4. Turn off the anti-ice system switch (middle position) and the lights should go off.

### Check engine dust protectors

1. Set the **"ПОС ДВИГ – ОТКЛ – ПЗУ"** (engines anti-icing/dust protection systems) switch to the **"ПЗУ"** (engine dust protectors) position. The **"ПЗУ ЛЕВ ДВИГ"** (left engine dust protector) and **"ПЗУ ПРАВ ДВИГ"** (right engine dust protector) lights should illuminate. The EGT should increase up to 30°C and the GG RPM should increase up to 0.5%.
2. Turn off the dust protectors (middle position) and the lights should go off.

### Check rotors anti-ice system (AIS)

A rotor AIS test should be performed when the ambient temperature is less than 5°C.

1. Press the **"КОНТРОЛЬ СО"** (ice detector control) (top part of auxiliary control panel) button; after about 10 seconds, the **"ЛЕД"** (ice) light should illuminate.
2. Move the **"ПОС ВИНТОВ – ОТКЛ"** (ROTOR ANTI-ICE - OFF) switch on the overhead panel to the **"ПОС ВИНТОВ"** (ROTOR ANTI-ICE) and the **"ПОС ВИНТ"** (ROTOR ANTI-ICE) light should illuminate.
3. Move the **"ПОС ВИНТОВ – ОТКЛ"** (ROTOR ANTI-ICE - OFF) switch to the **"ОТКЛ"** (OFF) position and the **"ПОС ВИНТ"** (ROTOR ANTI-ICE) light should go off.

### GG and PT EEG tests

These functions allow you to test the operation of the GG channel of the EEG as follows:

- Raise the cover and set the **"КОНТР. ЭРД ТК"** (EEG GG Test) switch to the **"ТК"** (GG) position.



- Move the throttle lever of the tested engine to the upper limit (max).
- Increase the collective pitch until the rotor RPM drops to 86...87%, on the overhead panel the **"ОГРАН РЕЖ ЛЕВ"** (LEFT ENG PWR LIMIT) or **"ОГРАН РЕЖ ПРАВ"** (RIGHT ENG PWR LIMIT) yellow lights will illuminate.
- The GG RPM should be set at 4% below the estimated maximum value.

Set the **"КОНТРОЛЬ ЭРД ТК"** (EEG GG Test) switch to the operation position (down) and close the cover and the LEFT ENG PWR LIMIT or RIGHT ENG PWR LIMIT yellow lights should go off.

Caution! Do not increase the engine's power above lift-off value.

Test the PT contour of the EEG as follows:

- Set the throttle levers to the IDLE position.
- Open the cover and set the **"КОНТР. ЭРД СТ-1 – РАБОТА – СТ-2"** (EEG PT-1 Test – Operate – EEG PT-2 Test) switch and select the **"СТ-1"** (PT-1) position.
- Slowly move the throttle levers from the IDLE position until the **"н ст ПРЕД ЛЕВ ДВИГ"** (LEFT ENG PT OVRSPD) and **"н ст ПРЕД ПРАВ ДВИГ"** (RIGHT ENG PT OVRSPD) lights illuminate. This should occur at rotor RPM around 86%. Simultaneously, a **"Раскрутка турбины левого двигателя"** (Left engine power turbine over-speed) and **"Раскрутка турбины правого двигателя"** (Right engine power turbine over-speed) voice message will be heard.
- Use the throttle levers to decrease rotor RPM by 5...7%, and the light should still be illuminated.
- Set the **"КОНТР. ЭРД СТ-1 – РАБОТА – СТ-2"** (EEG PT-1 Test – Operate – EEG PT-2 Test) switch to the middle **"РАБОТА"** (Operation) position and the light should go off.
- Move the throttle levers back to IDLE.
- Set the **"КОНТР. ЭРД СТ-1 – РАБОТА – СТ-2"** (EEG PT-1 Test – Operate – EEG PT-2 Test) switch to the **"СТ-2"** (PT-2) position and repeat the procedure described above.

After this test, set the **"КОНТР. ЭРД СТ-1 – РАБОТА – СТ-2"** (EEG PT-1 Test – Operate – EEG PT-2 Test) switch to the middle **"РАБОТА"** (Operation) position and close the switch cover.

**"РТ-12-6 ЛЕВ"** and **"РТ-12-6 ПРАВ"** buttons decrease the control threshold of the EGT governors to check the serviceability of the EEG. When either of these buttons is pressed, the GG contour of the EEG disengages. If the EGT is no less than 850°C and GG RPM is no less than 87%, the EGT decreases by 30°C or more and the GG RPM decreases by 84% of the maximum value.

### Rotor RPM readjustment check

1. Check the rotor RPM readjustment range with collective stick full down and both throttle levers in the Auto position. Move the readjustment selector on

the collective stick handle from the **"НОМИНАЛ"** (nominal) position to the **"НИЗК"** (low) position. Make sure that afterwards the rotor RPM decreases at about 5% and the "zebra" light starts flashing.

2. After the test, move the rotor readjustment selector to the nominal position. Thus, the rotor RPM should increase to the nominal value and the "zebra" flashing light should go off.

### Check flight controls and the hydraulic systems

1. Move the cyclic in both axis, press the rudder pedals and lift the collective (no more than 1/3 of the range) one at a time and make sure that flight controls are working properly.
2. On the hydraulic systems pressure indicators (located on the rear panel), make sure that flight controls operate within 65...80 kgf/cm<sup>2</sup> during flight.
3. Turn off the main hydraulic system (wall panel) by moving the **"ОСН. ГИДРО ОТКЛ"** (hydr. syst. main off) switch to the **"КОНТП"** (main off) up position. The master warning light (MWL) will start flashing and the **"КЛАПАН I ГИДРО"** (hydraulic valve 1) and **"КЛАПАН II ГИДРО"** (hydraulic valve 2) lights will illuminate. On the EKRAN display, the message **"ОСНОВНАЯ ГИДРО"** (main hydraulic system) will be shown.
4. Move the **"ОСН. ГИДРО ОТКЛ"** (hydr. syst. main off) switch to the **"Р/С"** (off) down position and all lights should go off.
5. Check the pressure in the emergency hydraulic accumulator on the auxiliary control panel and this should be the same as in the main hydraulic system.

### Final electrical power setup

1. With the throttle levers in the Auto position, turn the AC left and right generator switches to on (right hand side panel): **"ТОК ГЕН. ПРАВ"** Right generator switch and **"ТОК ГЕН. ЛЕВ"** Left generator switch.

This check list is mandatory to avoid AC power loss to the <b>"ИКВ"</b> (inertial navigation system INS).
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2. Disconnect ground power unit (GPU) by setting **"=ТОК АЭР ПИТ "** and **"~ТОК АЭР ПИТ "** to off (down). With communication to the ground crew select: Maintenance >Ground Elec Power >to Off (the ground crew must retract the power cord).
3. Move the **"ПРЕОБР АВТ – ОТКЛ – РУЧН"** (AC/DC inverters: auto-off-manual) switch to the **"АВТ"** (auto) up position, and the **"ПРЕОБРАЗ"** (inverter) light should go off.



## Final Checks

After performing the above pre-flight checks, you may wish to configure secondary systems before lifting off. You may find it easier to configure these systems on the ground rather than in flight. The below check lists do not have to be performed in this exact order.

### Wall panel

1. Turn on the navigation and targeting system switch **"ПНК ВКЛ – ОТКЛ"**
2. Set PVI-800 navigation control mode and settings as needed
3. Enable data link power **"ВЦУ - ОТКЛ"**
4. Adjust PVI-800 brightness
5. Select PVTs-800 ownship data link ID **"КТО Я"**
6. Select PVTs-800 data link send/receive mode **"РЕЖИМ"**
7. Select autopilot flight modes
8. Select autopilot altitude hold mode
9. Select autopilot heading/course mode
10. Turn on **"УКВ-2"** switch to provide power to R-800L1 radio (**"УКВ-1"** should already be on)
11. Turn on **"ТЛК"** switch for data link power
12. Turn on **"УКВ-ТЛК"** switch for data link communication
13. Run self-test on ARK-22 ADF
14. Set ARK-22 compass channel if needed
15. Set R-828 radio channel
16. Set automatic tuner function for set R-828 channel
17. Enable power to signal flare panel
18. Enable power to the weapon control system **"СУО – ОТКЛЮЧЕНО"** switch
19. Turn on pilot ejection control (3 switches)
20. Enable lighting to the back-up ADI if needed
21. Turn on anti-collision light if needed

22. Turn on rotor tip lights if needed
23. Turn on formation lights if needed
24. Turn on HSI and ADI lighting if needed
25. Turn on NVG cockpit lighting if needed
26. Turn on cockpit lighting for labels if needed

Note that you can adjust cockpit lighting brightness by using the lighting brightness control panel at the bottom of the auxiliary panel

### **Left and Right Forward panels**

1. Reset/adjust clock/stop watch as needed
2. Turn on ABRIS and configure as needed
3. Test ADI and calibrate if needed
4. Adjust HSI heading and flight path if HSI set to manual control
5. Set floor on barometric altimeter
6. Test radar altimeter (check ABRIS altitude sensor reading)
7. Reset accelerometer (g-meter) if needed
8. Re-cage backup ADI if needed
9. Test fuel quantity gauge

### **Rear panel**

1. Turn on INU power
2. Turn on "Л-140 – ОТКЛ" laser warning system power
3. Perform "Л-140 КОНТР" LWS self-test
4. Turn on "УВ-26 ВКЛ – ОТКЛ" Countermeasure system power
5. Perform "УВ-26 КОНТР – ОТКЛ" CMS self-test
6. Check that hydraulic value lights 1 and 2 are lit

### **Overhead panel**

1. Pitot static port heat switch to on





2. Pitot ram air heat switch to on
3. Configure UV-26 countermeasure panel as desired
4. Reset laser warning system panel if needed

### **Center panel**

1. Select cannon round type (armor piercing or high explosive)
2. Select burst length (short, medium, or long)
3. Select manual or auto weapon control mode
4. Select rate of fire (low or high)
5. Adjust HMS/NVG brightness (first enable HMS/NVG from left panel)
6. Select Shkval symbology polarity
7. Select HUD declutter on or off
8. Select Shkval laser designation code
9. Adjust Shkval display brightness
10. Adjust Shkval display contrast
11. Select main landing light or back up landing light
12. Turn on landing light if needed
13. Set ADF beacon mode switch as needed (near, distant, or auto)

### **Left panel**

1. Run R-800L1 radio self-test
2. Select R-800L1 AM or FM band
3. Select R-800L1 guard frequency if needed
4. Select R-800L1 ADF mode if needed
5. Set R-800L1 radio frequency
6. Select training or combat mode **"ТРЕНАЖ – ОТКЛ"**
7. Enable power to the K-041 targeting system **"К-041 – ОТКЛ"**
8. Enable power to the helmet mounted sight if needed **"ОБЗ – ОТКЛ"**



9. Select weapon firing mode
10. Set laser to standby **"ИЗЛ. – ОТКЛ"**
11. Select manual or automatic "Shkval" targeting mode **"АС-ПМ"**
12. Set SPU-9 intercom accordingly (R-828, R-800L1, ADF, or ground crew)



**10**

**FLIGHT  
SCHOOL**

## 10 FLIGHT SCHOOL

### General Requirements

The following ground school sections are here to provide you with the requirements and our recommendations for flying the Ka-50. Ground school will cover each phase of a sortie, from taxi prep to engine shut down, and it assumes that all helicopter systems are working properly. Particular attention is paid to the description of acceptable flight parameters and the results of exceeding them.

It is recommended that the helicopter always be flown with the autopilot (AP) modes engaged; this provides much greater stability in all flight regimes. Nevertheless, flights can be performed without AP in case of systems failure or training purposes. The Ka-50 is still quite controllable without AP assists.

The primary way to fly the helicopter is by using instrument flying with reference to the attitude direction indicator (ADI) and the head-up display (HUD) indication.

Flight level changes should be made by using the collective while maintaining a constant pitch angle (on the ADI or HUD). To change airspeed, set the cyclic to match the desired airspeed (forward to increase speed and back to decrease speed).

### Taxi Preparation and Taxi

Check the instruments for any indications that engines, rotor system, helicopter systems or components are not working properly. Make sure that there are no emergency indications on the warning lights panel and EKRAN display. All warning systems should indicate normal operations.

When taking off from an airfield, request engine start-up, hover test, and taxi clearance from the ground traffic controller.

Engage the autopilot channels:

- **K** – Bank hold
- **T** – Pitch hold
- **H** – Heading/course hold

Engage the ejection system switches by first raising their safe cover (yellow-black zebra) and then turning on the three switches **“АВАР ПОКИДАН”** (emergency ejection).

Uncage Standby Attitude Indicator (SAI) by rotating the SAI knob counterclockwise while holding down the right mouse button on the knob.

## Taxi Initiation

Taxi procedure:

1. Request taxi permission from control tower.
2. Make sure that there are no obstacles or foreign objects in the taxi path of the helicopter.
3. Disengage the parking brake.
4. Smoothly increase the collective pitch by  $\frac{1}{4}$  of its range and gradually move the cyclic stick forward to start moving.

Using the ground as reference, control taxi speed with the cyclic, collective, and wheel brakes. You can also use the anti-torque pedals to turn the facing of the helicopter. Taxi should be performed on hard, smooth surfaces at speeds up to 15km/h with a wind speed less than 20m/s.

To halt the helicopter during a taxi, you should move the cyclic to a neutral position, decrease the collective pitch, and engage the wheels brakes. In case of brake failure, you can halt the aircraft by pulling the cyclic back while increasing collective pitch to nearly hover. The helicopter must be carefully controlled with the cyclic to avoid the tail hitting the ground.

In case of low visibility conditions, turn on the blade tip lights, the navigation lights, and the anti-collision light. You can also turn on the main or backup landing lights and manually direct the main light.

## Taxi

Taxi turns are executed with smooth and simultaneous input of the anti-torque pedals and cyclic stick towards the direction of the turn. Be careful to avoid a banking angle over 5° and high speed turns.

**CAUTION!** Backward taxi and turns on one wheel are not advised.

During taxi in a crosswind, the helicopter will have a tendency to turn toward the wind. This should be compensated for by reacting with a neutral bank angle towards the wind direction up to 5°.

Taxi on soil or snow should be performed with extreme caution and at speeds up to 5 km/h or less. Nose wheel bounce should be avoided by controlling the helicopter via the cyclic and collective sticks.

## Takeoff and Climb

There are two takeoff methods:

- Helicopter style takeoff – no forward speed with vertical lift-off and forward speed gained only after hover.
- Airplane style takeoff – forward acceleration on the ground to achieve lift-off speed.

Your choice of either of these two methods should be based on the takeoff airfield (dimensions, condition, and elevation), weather conditions, and payload. By default, airplane-style takeoffs should be performed against the wind.

Before takeoff, check the operation of the power plant, control systems, center of gravity balance, and whether it is possible to generate enough vertical lift in the given atmospheric conditions to provide a hover check at 2 to 10m.

## Hover Check

Vertical takeoff and hover procedure:

1. Orient the helicopter to face against the wind and taxi for 2-3m to align the wheels.
2. Engage the parking brake.
3. Check the pitch angle.
4. Make sure the flight instrument indications are within normal limits.
5. Evaluate the takeoff area space and request hover check permission from the control tower.
6. Upon receiving clearance, release the wheel brakes, smoothly pull up the collective stick, and set the desired hover altitude. Be careful not to let the aircraft bank or yaw.
7. Trim the helicopter by pressing the trim button. **If you don't have a Force Feedback joystick, after pressing the trim button you must move the stick to the neutral position.**
8. Maintain the required altitude with smooth movements of the collective. Use the radar altimeter and visual ground references to hold a constant altitude in the hover. Hover turns should be executed with smooth pedal inputs towards the turn (left turn-left pedal), and the pilot should avoid any forward or lateral cyclic control inputs.
9. It may help to leave the cockpit door open to provide a better ground visual reference.

In hover mode, the helicopter has positive feather stability and it tends to turn against the wind (weather cocking). Therefore, when making a turn with full pedal input, it should be understood that during the first half of the turn that the turn rate is slow and that it will be much faster in the second part, depending on the wind speed.

During a hover check, the following checks are performed:

- Aircraft control. When moving the controls, the helicopter executes the required maneuvers with enough control reserve range in all channels.
- Center of gravity (CG) position - according to the cyclic stick (joystick) position after balancing the helicopter in a hover. In the middle CG position, the cyclic stick must be centered and the trims must be cancelled.
- Hover mode stabilization. At an altitude of at least 4m, balance the helicopter, trim the helicopter, and engage the Hover mode by pressing the Hover button. After doing so, the **"ВИСЕНИЕ"** (hover) light will illuminate. On the HSI, the needles become perpendicular to each other and their deflection corresponds to the helicopter's hover position. After the check, turn off this mode. A neutral (zero) position should be indicated on the pitch scale on the **"ИКП"**.
- The vertical lift-off ability of a helicopter is heavily dependent on atmospheric conditions.

If during a hover check the helicopter is unable to reach the required hover altitude, it is best to land and decrease the takeoff weight (TOW).

## Vertical Takeoff Using the Rotor-In-Ground Effect

You may perform such a takeoff when the helicopter is in a stable hover at an altitude of no more than 2 meters. The engines will need to be at maximum power.

Takeoff procedure:

1. Establish a hover check 2 to 3 meters above the ground.
2. Request takeoff permission from the control tower.
3. Make sure all flight instrument indications are within acceptable limits and descend to 1m.
4. Smoothly push the cyclic forward and initiate forward flight acceleration while increasing engine power to takeoff mode (in case spare power is available). This is in order to prevent any sinkage of the helicopter.
5. Forward flight acceleration should take place in the rotor-in-ground zone with a gradual climb to 5 m altitude at 90 to 100km/h IAS.
6. Further acceleration should be performed with a slight climb.

## Vertical Takeoff without Using the Rotor-In-Ground Effect

You can perform such a takeoff when the helicopter is in a stable hover at no less than 10 m above obstacle height in the takeoff direction. Maximum engine power would be used.

Takeoff procedure:

1. Establish a hover check at no less than 10 m.
2. Request takeoff permission from the control tower.

3. Make sure all flight instrument indications are within acceptable limits and that the altitude is enough for a helicopter style takeoff.
4. Smoothly push the cyclic stick forward and initiate forward flight acceleration while increasing engine power in order to prevent any sinkage of the helicopter.

If the collective input for takeoff power is not enough to compensate for the sinking (descent) of the helicopter, it will be necessary to pull back on the cyclic to increase the pitch angle and decrease both the acceleration rate and sink rate.

## Running Takeoff

You can perform such a takeoff when the helicopter is in a stable hover at an altitude no less than 1m. Engines will need to be at takeoff power and the field conditions need to permit operations in the rotor-in-ground zone.

Takeoff procedure:

1. Perform a hover check.
2. After the hover, land smoothly.
3. Request takeoff permission from the control tower.
4. Smoothly push the cyclic stick forward and initiate forward acceleration while increasing engine power to takeoff mode. Accelerate with the maximum possible rate (pitch angle no more than  $-10^\circ$ ). The main landing gear wheels will lift-off the ground.
5. At an IAS of 30 to 40 km/h, with negligible pull on the cyclic, lift the helicopter off.
6. Once airborne, accelerate with a gradual climb up to 100 to 120 km/h and then continue the climb at this airspeed.

## Takeoff Peculiarities

During a crosswind takeoff, deflect the cyclic in the direction against the wind; this will compensate the drift in the lift-off moment. Simultaneously, apply pedal input to prevent the wind's yaw momentum. The required controls deflection depends on wind speed.

During takeoff and landing on dusty or snowy fields, the helicopter creates dust/snow vortices that impact visibility. Takeoff and landing in dusty conditions should be performed with the Engines' Dust Protectors (EDP) on. Prior to takeoff it is recommended to blow off the dust from the field with the rotors' wash.

## Climb

Climb is implemented according to the established flight pattern of the particular airfield.

After takeoff and transition to climb, set the required flight regime, trim the controls, and proceed to the given waypoint or departure route.





During a climb, maintain maximum continuous engine power and maximum range cruise speed. If necessary, apply takeoff power or a regime lower than the maximum continuous setting.

During a flight, do not allow rotor RPM to drop below the minimum level. At 85% rotor RPM, the rotor's RPM "zebra" warning light starts flashing.

Upon reaching the required altitude, level off, set the required IAS by setting the pitch angle with the cyclic, and with the collective, set the engine regime corresponding to the required IAS. Trim the controls and engage the altitude stabilization mode.

## Horizontal Flight and Transitions

Recommended IAS in the traffic pattern is 160 to 200 km/h.

Barometric altitude stabilization is advised in horizontal flight at altitudes greater than 50 m. To change the flight level by more than 100 m, the altitude on the autopilot control panel and the stabilization mode should be disengaged by pressing the "B" push-light. After reaching the required altitude, re-engage the mode and the push-light will illuminate.

## Visual Flight Rules (VFR) Traffic Pattern

The VFR traffic pattern is implemented at the altitudes and IAS according to the flight operations manual of the particular airfield (helipad). On airfields without radio navigation equipment, use ground landmarks for reference and time estimation using the track needle when the HSI is in the manual mode ("3ПУ" (track angle) selector in the "ПУЧ" (manual) position).

After takeoff and reaching an altitude of 40m, with an airspeed of 120km/h IAS, make sure that the power plant and aircraft systems are operating normally; then retract the landing gear.

During the climb-out, maintain 120 to 140 km/h IAS and a 3 to 5 m/s vertical speed. Maintain the runway heading, and upon reaching a 100 to 150m altitude, turn to the crosswind leg 90° left (right). At a pattern altitude and airspeed of 160 km/h IAS, level off and trim the controls.

After level flight is established, turn to the downwind leg, heading opposite to the takeoff runway direction.

Turn the base leg in level flight at 120 to 140 km/h IAS, extend the landing gear, and request landing clearance from the control tower.

Upon turning on the base leg, maintain 120 to 140 km/h IAS and start descending with a vertical speed of 3 to 4 m/s. Complete the final turn of the leg at no less than 100 m.

During the approach, estimate the vertical speed to ensure the estimated touchdown point (ETP). When using the helicopter style of landing (most used), the ETP should be determined 50 to 100 m before touchdown.

At 400 to 500 m from the ETP and 50 to 70 m altitude, start to smoothly decrease the airspeed.

Before landing, double-check that the landing gear is extended.

## Transitional Flight Regimes

The barometric altitude hold mode can be engaged when radar altitude is above 50 m. To change your altitude when in altitude hold mode, press the collective brake lever; to retain it for the duration of the transition maneuver, release the brake lever. After this, a new altitude hold altitude will be set.

- To initiate a hover during vertical climb, smoothly lower the collective to cease the climb. Any altitude deviation should be corrected with small collective inputs.
- To initiate a manual, vertical descent from a hover, decrease the collective so that the descent rate is no greater than 3 m/s at altitudes above 10 m but greater than 3m/s. If it is too high, you risk a vortex ring entry.
- To initiate forward flight from a hover, push the cyclic forward and set a pitch angle corresponding to the desired acceleration rate. Simultaneously, maintain the altitude by collective inputs. Upon reaching the desired speed, set a pitch angle corresponding to this speed.
- To increase forward airspeed, smoothly move the cyclic forward while simultaneously increasing the collective pitch to maintain altitude. If takeoff power is applied (rotor RPM drop and engagement of the "zebra") to maintain altitude, it will be necessary to decrease the acceleration rate by pulling the cyclic back and decreasing the collective until the rotor's RPM recover to the desired value. Avoid any bank, pitch and yaw tendencies by compensating with appropriate cyclic and rudder inputs.
- To reduce airspeed in horizontal flight, smoothly pull back on the cyclic to set the desired deceleration pitch angle. Hold the current altitude with collective input.
- To transition from forward flight to a hover at the same altitude, pull back on the cyclic to set the desired pitch angle and slow the helicopter down with the desired rate. Compensate any climb tendency by applying the corresponding collective input. Yaw and roll should be compensated for with the cyclic and pedals.
- To descend during horizontal flight, smoothly move the collective down until the desired vertical speed is reached. Maintain the pitch angle with the cyclic and make sure that the airspeed is constant.
- To level off the helicopter into horizontal flight after a descent, smoothly increase the collective, and using the vertical speed as a reference, stabilize the helicopter in horizontal flight.
- To transition from a descent to a hover, pull back on the cyclic to set the desired pitch angle and start decelerating. Decrease the vertical speed (sink rate) smoothly by increasing the collective until the helicopter is in a hover mode. Use the cyclic to eliminate any forward speed of the helicopter and balance it in a hover.



- To level off the helicopter after a climb, set the desired pitch angle with the cyclic to ensure the desired IAS and maintain the desired altitude with the collective.
- To transition to a climb from horizontal flight, smoothly increase the collective while simultaneously maintaining a constant pitch angle.

In all transition regimes, the collective and cyclic inputs should be done with such rates and magnitude that it will ensure rotor RPMs are within operating limits.

All forces on the controls during transition modes will be cancelled by the trim mechanisms. Any deviation in pitch, bank, and yaw should be compensated for by an appropriate input of the cyclic and the pedals.

## Descent

The following descent regimes can be used:

- Descent with operating engines and forward speed
- Vertical descent with operating engines
- Autorotation

Descent with operating engines and forward speed on a flat trajectory is the most common type of descent. Before the approach, request landing permission from the control tower and set the airfield barometric pressure for the airfield.

At an IAS below 50 km/h, do not exceed a sink rate of 5 m/s to avoid entering into a "vortex ring" state.

## Descent with Operating Engines and Forward Speed

Descent procedure:

1. Set a pitch angle to correspond with the desired IAS (no less than 70 km/h). The recommended forward speed is 120 to 140 km/h.
2. Set the collective to correspond to the desired vertical speed; do not allow rotor RPM over-speed. Rotor RPM over-speed up to 91 to 98% is allowed for up to 20 seconds.
3. At the desired altitude, level off the helicopter into horizontal flight.

## Vertical Descent with Operating Engines

This type of descent is suggested with a vertical descent:

- At altitudes below 10 m - anytime.
- At altitudes between 200 m to 10 m when a descent with forward speed is not possible or during combat.

A vertical descent should be performed with vertical speed of no more than 3 m/s. Close to the ground, vertical descents should be performed against the wind if possible and avoid lateral movement and yaw turns at touchdown.

Vertical descent procedure:

1. Hover at the desired altitude.
2. Smoothly decrease the collective while estimating the vertical speed to be no more than 3 m/s.
3. In case the vertical speed increases above 3 m/s, smoothly increase the collective to avoid entering a "vortex ring".

4. In case the vertical speed unintentionally increases above 5 m/s, move the cyclic forward and slightly decrease collective in order to move the helicopter into forward flight.
5. If vertically descending from an altitude of 10 m, smoothly increase the collective, decreasing the vertical speed and smoothly land the helicopter.

Use ground references during a descent to avoid any lateral movement at touchdown.

## Descent in Autorotation

Descents in regimes close to autorotation are implemented at the engines' minimum power settings in the following cases:

- For training purposes to simulate both engines failing in flight.
- When extreme rate-of-descent is required. The maximum vertical speed, depending on the weight and the IAS, is 13 to 16 m/s. Minimum vertical speed is achieved at a forward speed of 130 km/h.

Descent using autorotation procedure:

1. During horizontal flight, set the IAS that will be used for the descent, balance the helicopter, and trim the controls.
2. Zero-out collective input but do not allow rotor over-speed.
3. Move the throttle levers to the idle power position, recheck the rotor RPM, and correct it with the collective stick. The rotor RPM during the steady descent should be within 86 to 90%. Any turns should be performed with bank angles up to 30°.
4. At a safe altitude, move the engines throttle levers to the Auto position and start pulling the helicopter out of the descent while maintaining a rotor RPM within 86 to 90%.

**CAUTION!** The efficiency of yaw control decreases at small collective pitch and high rotor RPM; therefore, slowing down below 100 km/h forward speed during autorotation is not advised. The decreased pedal yaw control is partially compensated by the corresponding slip set by the cyclic

To perform a descent with a high vertical speed (in emergency) after readjustment in flight of the rotor RPM from the rated (89%) to the low (84%):

1. Set the descent IAS while in horizontal flight.
2. The minimum IAS should be no less than 70 km/h; the maximum should be no more than 200 km/h. The recommended IAS is 120 to 140 km/h.
3. Change the maintained rotor RPM from rated to low when in horizontal flight by moving the **"ОБОРОТЫ НОМИНАЛ – НИЗК"** (RPM rated-low) readjustment switch on the collective handle from the **"НОМИНАЛ"** (rated) to the **"НИЗК"** (low) position. The maintained rotor RPM should decrease to 84% and the "zebra" warning light should illuminate.

4. Decrease the collective to the minimum. What follows will be an intensive increase of vertical speed, which depending on aircraft weight, IAS, and altitude, could be within 15 to 18 m/s. The rotor RPM in the descent increases slightly to 85 to 86%. At an altitude above 1000 m, correct the rotor RPM with the collective and do not allow it to exceed 86%. In case of MWL and emergency light ( $V_{\text{max доп}}$ )- ( $V_{\text{max}}$ ) illumination, which could occur at high altitude, decrease the IAS. To perform a descent with an even higher sink rate, it is necessary to enter into a spiral with the bank within 30 degree limits. The vertical speed in this case can reach 25 to 35 m/s. Pull the helicopter up from the descent by estimating the altitude needed to decrease and eliminate the vertical speed.
5. Level off the helicopter in horizontal flight. Set the rated rotor RPM by moving the **“ОБОРОТЫ НОМИНАЛ – НИЗК”** (RPM rated-low) switch on the collective handle from the **“НИЗК”** (low) to the **“НОМИНАЛ”** (rated) position while simultaneously increasing the collective pitch to minimize the time needed for the rotor to reach 89%. The “zebra” warning light should go off after that.

## Landing in Clear Meteorological Conditions

Landing is performed using one of the following methods:

- Helicopter style – landing from a hover with no roll-out.
- Airplane style - landing touchdown with forward speed and ground roll out.

The type of landing is generally chosen according to the landing area (dimensions, condition, and elevation), meteorological conditions, and weight of the helicopter. The landing should take place, if possible, against the wind.

### Vertical Landing Using the Rotor-In-Ground Effect

This landing method is essential. The hover is implemented in the rotor-in-ground effect zone.

Landing procedure:

1. On a short final (after passing over the inner NDB), start the approach at 70 m and smoothly pull back on the cyclic to set the corresponding pitch angle to decelerate. Estimate that at 20 to 30 m altitude, the forward speed is 40 to 50 km/h.
2. Further decrease the forward and vertical speeds and estimate the desired point that the helicopter should hover at an altitude of 2 to 3 m.
3. By decreasing the collective smoothly, land the helicopter while avoiding lateral movement.
4. After making sure that the helicopter is stable on the ground, fully lower the collective.

### Vertical Landing Without Using the Rotor-In-Ground Effect

This method is generally used to land at an airfield with limited dimensions, obstacles, or snowy / dusty conditions. The hover is implemented out of the rotor-in-ground effect zone.

Landing procedure:

1. On a short final (after passing over the inner NDB) with an altitude of 70 m, smoothly pull back on the cyclic and set the corresponding pitch angle to decelerate in relation to the estimated landing point. Ensure a safe altitude of at least 10 m above obstacles.
2. Prior to reaching the airfield, or being above it, decelerate to 40 to 50 km/ and do not allow the vertical speed to exceed 2 m/s.
3. Visually control the altitude and the vertical speed from 20 to 30 m and below by using clearly visible ground objects that can serve as altitude references.
4. Hover above the landing area at an altitude at least 5 m above obstacles.

5. After establishing a hover, perform a smooth descent and landing while avoiding any lateral movement.
6. After making sure the helicopter is stable on the ground, fully lower the collective.

## Roll-out Style Landing

This landing is used if it is impossible to perform a hover due to lack of engine power (high mountain fields or high ambient temperatures). The landing is performed on an airfield or on a tested field with available approaches.

Landing procedure:

1. On a short final (after passing over the inner NDB), start at 70 m and smoothly pull back on the cyclic to set the corresponding pitch angle to decelerate. You can estimate that at 20 to 30 m altitude the forward speed is 60 to 70 km/h.
2. Continue the descent and decrease forward airspeed such that at touch down the forward speed will be 30 to 40 km/h.
3. Smoothly land the helicopter on the main wheels and then allow the nose wheel to drop down by lowering the collective further.
4. To decrease the roll out length, the rotors should be used for deceleration by smoothly pulling back on the cyclic stick. Also apply wheel brakes when the speed is below 40 km/h.

## Landing Peculiarities

The approach should be implemented with forward and vertical speed ensuring operation out of the dust vortex zone.

After deciding on an airfield to land at, you must evaluate the situation and plan the approach and landing based on several factors: particular field conditions, the size and the condition of the field, its elevation above sea level, obstacles in the approach course, and the wind direction and speed.

## Engines and Equipment Shut Down

Normal shut down procedure:

1. Move the cyclic and the pedals to their neutral position and move the collective fully down.
2. Turn off ABRIS.
3. Turn targeting and navigation systems, switch K-041, off.
4. Turn off generators. Check that the "ПРЕОБРАЗ" (Inverter) lamp on the overhead panel is lit.
5. Move the engine throttle levers to the idle position.





6. Turn off all electrically-powered systems except for power plant parameter indicators.
7. Shut down the engines by moving the cut off valve levers to the closed position.
8. Engage the rotor brake when rotor RPM is less than 30%.
9. After the engines fully spool down, close the engine fuel shut-off valves.
10. Turn off the fuel boost pumps.
11. Cage SAI by pulling the SAI knob and turning it clockwise.
12. Turn off all switches.
13. Turn off the batteries.

## Instrument Landing Approach

The equipment installed on the Ka-50 allows you to perform landing approaches using the 2NDB ADF airfield approach system in both visual flight rules (VFR) and instrument flight rules (IFR) conditions.

The minimum safe altitude (floor) on the radar altimeter is set after setting the airfield pressure (QFE) or before taxiing the helicopter in a training flight.

### Types of Approach and Planning the Landing

Depending on the radio-navigation systems of the airfield and their condition, one of the following types of approach is used:

- Direct (straight) approach
- Approach from a descend initiation point
- Pattern approach (small or big)
- Double 180° turn approach

A direct approach should be performed when the outer NDB crosses your heading. The angle of approach to the landing approach should be between 30-45° and no more than 60°.

Approach from a descend initiation point is used when the approach lays directly over the route plan.

Big/Small patterns and double 180° turn approaches are used in case of a missed approach (going around); crossing the outer NDB is done through clouds; training purposes (IFR approaches); and to save time and space required to perform the landing maneuvers.

For navigation through the approach points, the ABRIS can only be used with a stable operation of the NAVSTAR and GLONASS satellite navigation systems.

When planning a flight with known wind conditions, it is necessary to estimate headings, route times, radio bearings for starting turns, and when to cross left/right abeam of NDB bearing. It is also required to estimate angle of turn and estimate flight time for the horizontal flight of a straight in approach.

Before the flight, check the settings of the ADF and check the designed pattern altitudes of the airfield.

To approach an airfield using the ADF, it is necessary to:

- Turn on the ADF and set the frequency of the desired NDB (inner or outer). The bearing RMI needle on the HSI should indicate the selected NDB bearing.
- Maneuver the helicopter until reaching a 0° bearing to the NDB and maintain it while factoring in drift angle.
- Crossing the NDB is indicated by radio bearing RMI needle swinging 180°.
- Select the appropriate approach type.

If performing an IFR approach in clouds, the outer NDB should be used. Considering the low airspeed of the helicopter, a straight in approach from the inner NDB (located 1000 m from the runway threshold) can also be performed in order to save time when the weather is clear.

## Large Pattern Approach

Prior to takeoff, set the required landing heading on the HSI.

After takeoff, set the required climb parameters for an airspeed of 120 to 140 km/h with a rate of climb of 2 to 3 m/s. At an altitude of 40 m, retract the landing gear. Perform the first left (right) 90° turn on the crosswind leg, accounting for wind during the climb. The recommended bank angle during turns is 15°.

After reaching the pattern altitude, level the helicopter off and stabilize the airspeed at 160 to 200km/h. After a missed approach, turn into the crosswind leg two minutes after passing over the inner NDB. Turn downwind leg to a bearing of 240° (in a right hand pattern 120°) estimating the time.

When abeam the NDB at 270° (for right pattern 90°), check the minimum safe altitude of the radio altimeter setting.

Turn on the downwind leg when the NDB bearing is 240° (for right pattern 120°). On the base leg, slow down to 120-140km/h, deploy the landing gear, start descending at a rate of 2 to 3m/s, and request landing clearance from the control tower.

The turn into final is executed from level flight at 200 m when the NDB bearing is 285° (for right pattern 75°).

During the turn onto final, use the needle of the heading selector of the HSI ("ЗПВ" needle) for a more precise approach. When the turn into final is initiated, the turn angle between the current NDB bearing and the heading selector should be 15° (without wind taken into account). If this is done properly, you should be using a 30° turn prior to reaching the landing heading and both needles should align.

If during the first half of turn the angle between the NDB radio bearing needle and the required heading needle is constant or increasing, the angle of bank should be decreased.

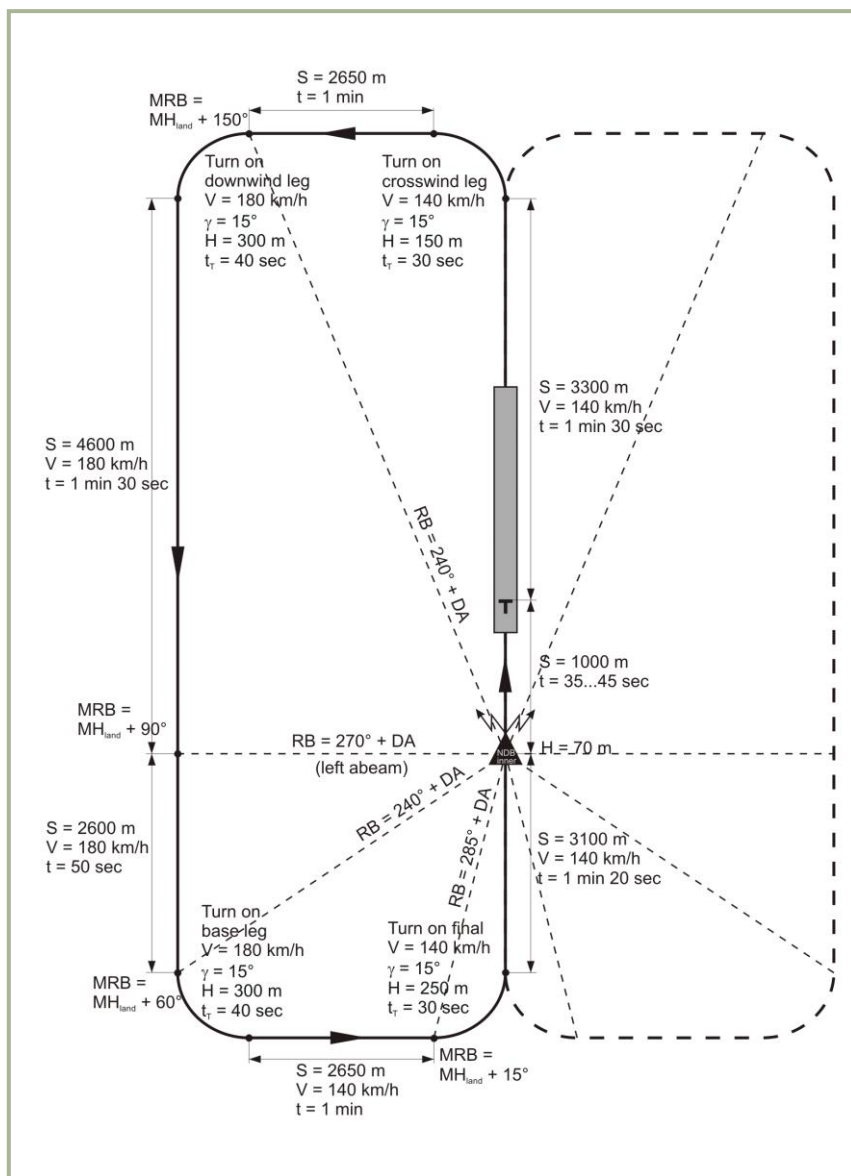
If after the needles align the ADF needle starts falling behind the required heading needle, the angle of bank should be increased, but by no more than 20°. In case of wind drift, align the needles taking wind into account.

After the final turn is completed, descend while maintaining an airspeed of 120 to 140 km/h. The sink rate should be 2 to 3m/s and you should be on the required heading with wind drift angle taken into account.

The inner NDB will be over-flown at 70 to 80 m. If you have descended to 70 m prior to reaching the inner NDB, level off the helicopter in horizontal flight.

On the short final, correct for drift angle in case of misalignment between the NDB radio bearing needle and the landing heading (required heading needle).

After flying over the inner NDB, maintain the corrected heading and continue descending at a 2 to 3 m/s sink rate.



**10-1: Left-hand pattern approach (large)**

S – Distance

V – Airspeed

H – Altitude

$\gamma$  - Bank angle

t – Time

$t_t$  – Turn time

RB – NDB radio bearing

DA – Drift angle

MRB – Magnetic NDB bearing

MH<sub>land</sub> – Magnetic landing heading

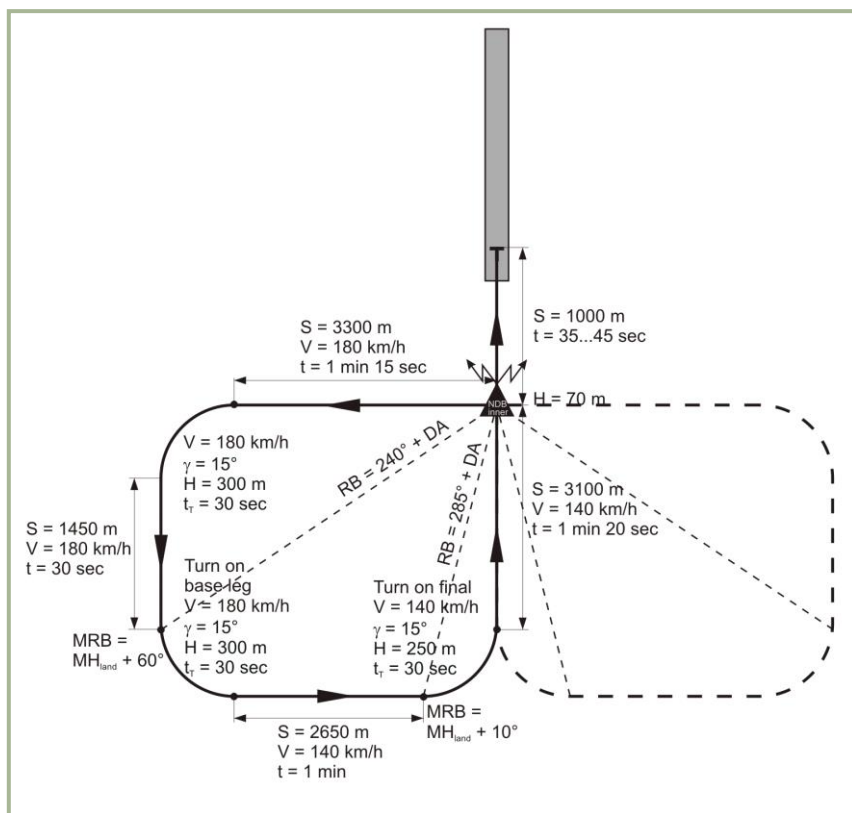
When using the outer NDB big pattern approach, the descent begins after the final turn; the outer NDB is to be over-flown at 200 m. After passing the outer NDB, switch the ADF to the inner NDB. Over-fly it at 70...80 m AGL.

After returning from a sortie it is necessary, after passing over the inner NDB, to turn into the landing heading. After the estimated time is over (in calm-wind conditions - 2 min), turn the crosswind and then continue the pattern as described above. Such a maneuver is suitable when the inner NDB is crossed with a magnetic heading close to the runway heading (difference up to 60°).

## Small Pattern Approach

The small pattern approach is usually performed when the inner NDB is over-flown with a heading greater than 60° away from the runway heading.

After crossing the inner NDB, turn to a heading perpendicular to the landing (runway) heading (estimating the drift angle). After the estimated time has been reached (for calm-wind conditions 1 min 15 s), turn to a heading opposite the landing heading and estimate the drift angle. Afterwards, the pattern is to be completed like the big pattern approach.



**10-2: Left-hand small pattern approach**

S – Distance

V – Airspeed

H – Altitude

$\gamma$  - Bank angle

t – Time

$t_t$  – Turn time

RB – NDB radio bearing

DA – Drift angle

MRB – Magnetic NDB bearing

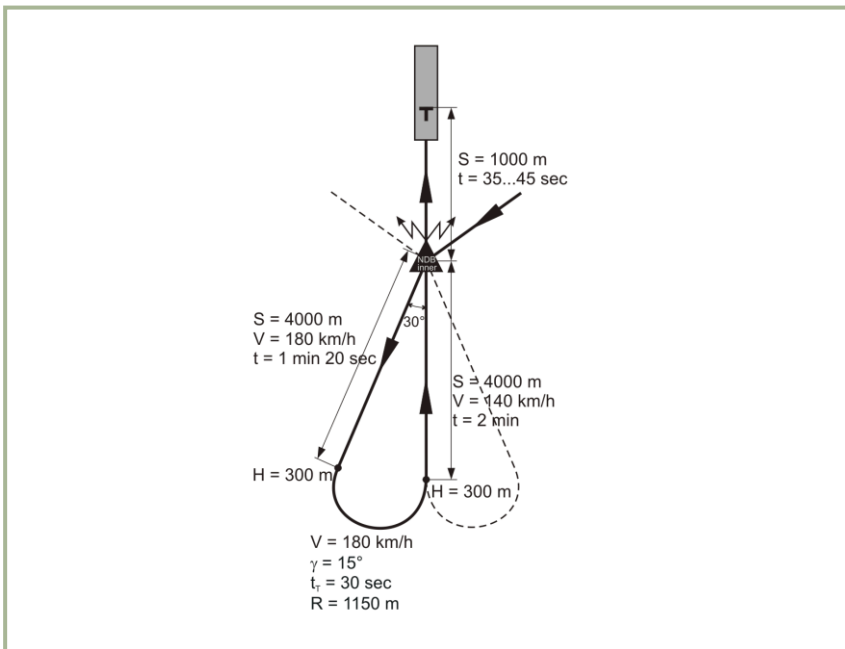
$MH_{land}$  – Magnetic landing heading

## Straight In Approach with Teardrop Procedure Turn

For a straight in approach, a teardrop procedure is used to navigate the helicopter until crossing the inner NDB at a designated altitude. After crossing the inner NDB, make a right (left) turn at the estimated angle and account for drift angle. Maintain this heading until you get the initial approach fix (IAF) turn.

After the estimated time has been reached, make a turn with a 15° bank angle and an airspeed of 140km/h until you align with the landing heading. Then extend the landing gear and start descending.

If the altitude to the IAF is higher than the designated turn should be executed, descend to the required altitude. Visually estimate the approach and land.



**10-3: Straight in approach using teardrop procedure turn**

S – Distance

V – Airspeed

H – Altitude

R – Turn radius

$\gamma$  - Bank angle

t – Time

$t_p$  – Turn time