DCS GUIDE
KA-50 BLACK SHARK

By Chuck
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Special thanks to Paul "Goldwolf" Whittingham for creating the guide icons.

PART 1 – INTRODUCTION

The Kamov Ka-50 “Black Shark” is probably one of the strangest and meanest-looking machines in the whole aviation industry. While the A-10C is often being associated as the flagship of developer Eagle Dynamics, people often forget that before the Hog started flying in the skies of Georgia, the Black Shark was actually the first fully clickable high-fidelity module released for DCS.

Many people give up learning the Shark: it’s a cramped, cluttered cockpit with different systems that aren’t that familiar to westerners like myself. Lots of tutorials are scattered all across the web, some of them old, obsolete and done in Minecraft-worthy 480p resolution (gasp!). Aye, the Ka-50 was released in 2008, people.

“But why should I care for a franken-copter like the Shark, Chuck?” Good question. In a nutshell, the Ka-50 is probably one of the most interesting machines in flight sim history. Not only does it have an unconventional design, but it also has a level of depth that makes the whole experience very rewarding. Helicopters like the Huey are all about flying the thing: it’s a very “physical” experience. However, modern choppers like the Ka-50 have stability augmentators that allow the pilot to have a much smoother flying experience. You can do some absolutely crazy stuff in it if you wish, but features like the Auto-Hover and the autopilot mean that you can concentrate on weapon employment rather than “keep fighting against the machine”. The Ka-50 is a wild beast that can easily be tamed if you try it for yourself. In the hands of a skilled pilot, it can become a deadly force to be reckoned with.

So do yourself a favour, would ya? Try it! There is plenty to do in the Shark and there is always something to do no matter your level of proficiency. There is plenty of great single-player content like the **Georgian Oil War** campaign and the upcoming **Republic** DLC campaign. You can also take it online and fly missions with your friends in multiplayer.

I hated the Shark at first sight, cursing the gods for not being an AH-64 Apache instead. I was glad a friend told me to **stop being a wuss** and fly the damn thing. Now, I feel like a complete badass flying at treetop level, dodging power lines and unleashing VIKHR missiles, volleys of 122 mm rockets and cannon fire. I’m having a total blast. The Black Shark is without the shadow of a doubt a force to be reckoned with.

Like Shia Labeouf says… **DO IT! JUST… DO IT!**

PART 1 – INTRODUCTION

By the mid-1970s, the Soviet Defense Ministry leadership determined that the Mi-24 “Hind” attack helicopter (then the backbone of the Soviet Army Aviation) was not meeting Army requirements. The attempt to develop a multi-role helicopter resulted in deficiencies in the aircraft's weight and dimension as well as its flight performance. This in turn led to decreased combat efficiency. Additionally, in late 1972 the U.S. commenced the AAH program that resulted in the development of Bell's YAH-63 and Hughes' YAH-64. The latter, designated “Apache”, was approved for mass-production and now serves as the U.S. Army’s primary attack helicopter.

Following these developments, the Central Committee of the Communist Party and the Council of Ministers of the Soviet Union passed a resolution on the development of a new-generation combat helicopter that could be fielded with the Soviet Army Aviation in the 1980s. The prospective helicopter's primary purpose was to destroy the armored forces close to the forward edge of battle area (FEBA). This resolution pitted competing programs run by N.I. Kamov and Ml. Mil's design bureaus against each other such that only one of them would be selected for series production. At that time, both developers had already gained valuable experience in designing and producing rotary-wing aircraft.

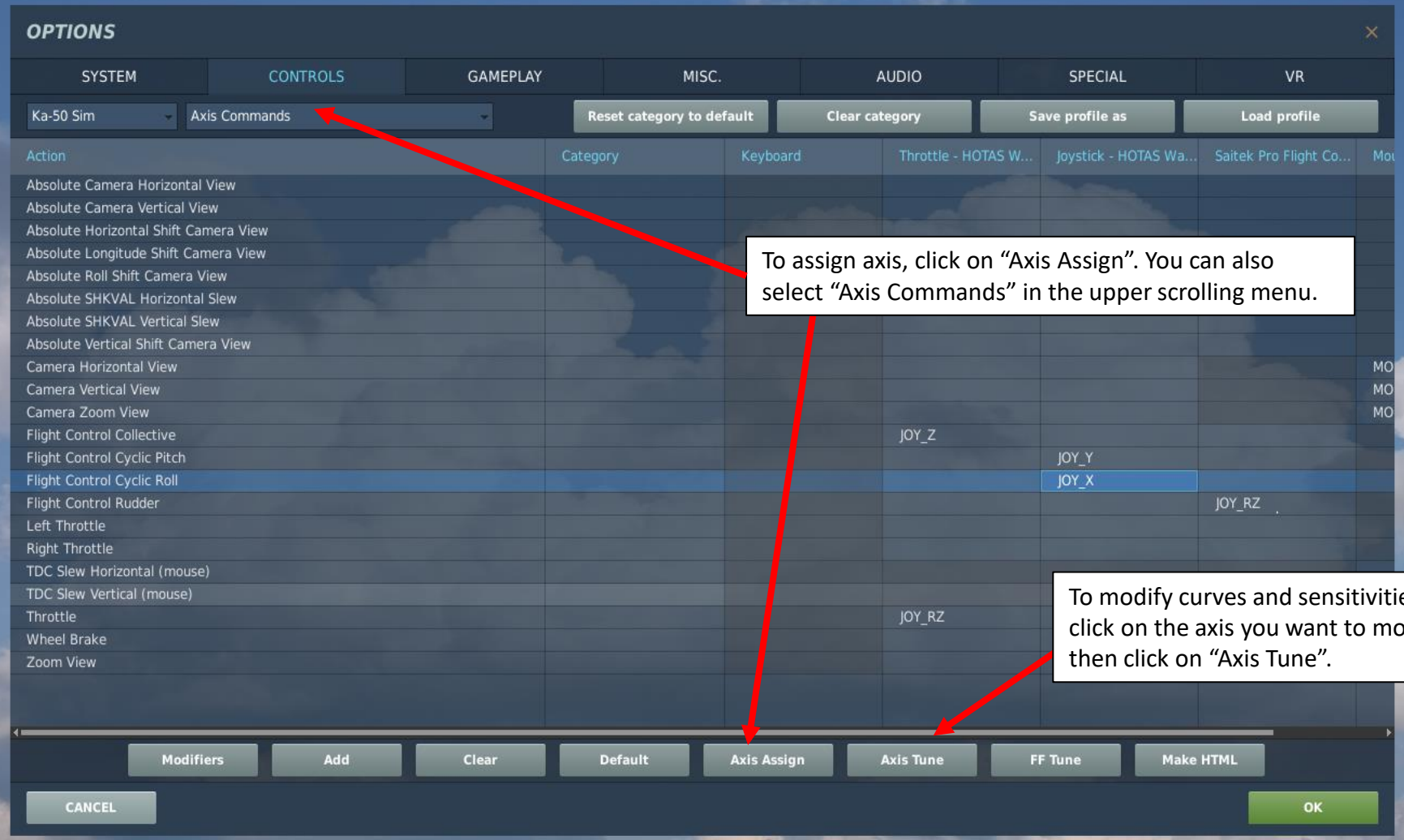
The design of the new Army combat helicopter, designated V-80 (later, Ka-50), began at the Kamov Helicopter Plant in January 1977. The program was run by the head of the design bureau, Chief Designer Sergei Mikheyev, who was later to become Designer General. Various aerodynamic configurations were considered for the future helicopter; however, the choice was made to use the Kamov's coaxial configuration due to its unique advantages. The substantial reduction in the power loss provided a hefty increase in main rotor thrust compared to a single-rotor configuration. This resulted in a higher static ceiling when the same power-level was used to power a coaxial-rotor versus a single-rotor configuration.

The aerodynamic symmetry and the lack of cross-linkages within the flight control system helped simplify flying the helicopter. A coaxial helicopter has fewer restrictions on side-slipping angles, angular speeds, and acceleration within the entire speed range. Additionally, there are relatively low moments of inertia due to the coaxial-rotor helicopters' compact size. Another unique feature of the V-80 design was it being a single seat aircraft with no provision for a dedicated weapons operator. This was compensated for by incorporating a highly automated targeting/navigation suite. The feasibility of building a single-seat combat helicopter was validated by the experience drawn from the operation of fixed-wing attack aircraft and fighter-bombers whose pilots were tasked with piloting, navigation, and weapon employment.

Kamov designers believed that combining the duties of flying, navigation, target detection, and tracking could be automated to a degree that a single crew member could perform all functions. Further, it was not expected that this would cause an excessive psychological and physical strain on the pilot. A single-person crew would provide the benefits of weight reduction, better flight performance, reduce training costs and reduce the number of possible combat casualties.

Needless to say, the Ka-50 remains one of the greatest technological achievements in modern aviation history.


Uncage SHKVAL, Designate Target
(Grey button on RHS)
KU-31 SHKVAL SLEW UP
KU-31 SHKVAL SLEW RIGHT
KU-31 SHKVAL SLEW DOWN
KU-31 SHKVAL SLEW LEFT
TV TARGET FRAME INCREASE SIZE
SHKVAL NARROW VIEW 23X
TV TARGET FRAME DECREASE SIZE
SHKVAL WIDE VIEW 7X
RELEASE WEAPONS
ZOOM IN SLOW
LOCK TARGET
ZOOM OUT SLOW
GUN FIRE (CANNON)
Trimmer
UV-26 Start Dispensing (Flares)
Trimmer Reset
UV-26 Stop Dispensing (Flares)
P
COMMUNICATION MENU
HOVER ON/OFF
ENGAGE/DISENGAGE ROUTE MODE
ENGAGE DESCENT MODE
GUN SELECT
WEAPON SELECTION (INWARD)
WEAPON SELECTION (OUTWARD)
WHEEL BRAKE
(Press and Hold)
Collective Brake


OPTIONS
SYSTEM
CONTROLS
GAMEPLAY
MISC.
AUDIO
SPECIAL
VR
Ka-50 Sim
Axis Commands
Reset category to default
Clear category
Save profile as
Load profile
Action
Category
Keyboard
Throttle - HOTAS W...
Joystick - HOTAS Wa...
Saitek Pro Flight Co...
Absolute Camera Horizontal View
Absolute Camera Vertical View
Absolute Horizontal Shift Camera View
Absolute Longitude Shift Camera View
Absolute Roll Shift Camera View
Absolute SHKVAL Horizontal Slew
Absolute SHKVAL Vertical Slew
Absolute Vertical Shift Camera View
Camera Horizontal View
Camera Vertical View
Camera Zoom View
Flight Control Collective
JOY_Z
Flight Control Cyclic Pitch
JOY_Y
Flight Control Cyclic Roll
JOY_X
Flight Control Rudder
JOY_RZ
Left Throttle
Right Throttle
TDC Slew Horizontal (mouse)
TDC Slew Vertical (mouse)
Throttle
JOY_RZ
Wheel Brake
Zoom View
To assign axis, click on “Axis Assign”. You can also select “Axis Commands” in the upper scrolling menu.
To modify curves and sensitivities of axes, click on the axis you want to modify, and then click on “Axis Tune”.
Modifiers
Add
Clear
Default
Axis Assign
Axis Tune
FF Tune
Make HTML
CANCEL
OK

CONTROLS SETUP

BIND THE FOLLOWING AXES:

- CYCLIC PITCH (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 85, CURVATURE AT 21)
- CYCLIC ROLL (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 85, CURVATURE AT 21)
- RUDDER (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 14)
- COLLECTIVE (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 11)
- THROTTLE (CORRECTOR) – CONTROLS ENGINE RPM

NOTES ABOUT CONTROLS

If you are more familiar with airplanes than with helicopters, you might not be quite familiar with a "collective" and a "cyclic". In a prop aircraft, you generally set your engine to a given RPM by changing the propeller's pitch, and you throttle up and down to change your thrust. Rudder pedals are used to change the orientation of your vertical stab.

In a helicopter, it's the opposite. You set your throttle to a given setting, and you change your thrust with your **collective**, which changes the pitch of your rotor/propeller's blades. Unlike most helicopters, the Ka-50 has an actual rudder instead of a tail rotor. This is because of the coaxial rotors, which lateral forces cancel each other (more on that in the "Principles of Helicopter Flight" section). The **cyclic**, on the other hand, is used just like a regular stick on a plane. The cyclic modifies the orientation of swashplates, to which are attached push rods that define the orientation of the rotor.

In very simple terms, you could say that the collective is used like a throttle on a plane, the throttle is used like a RPM setter on a plane, and the cyclic is used like a joystick on a plane.

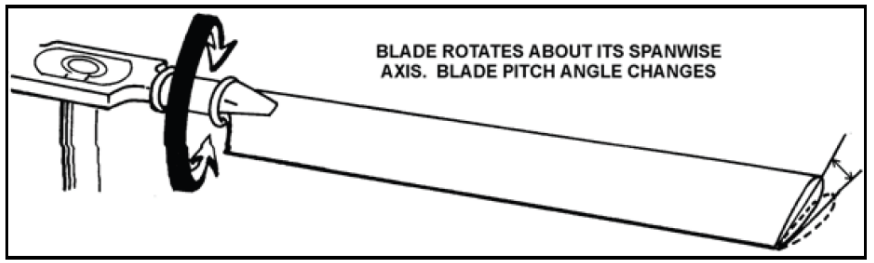
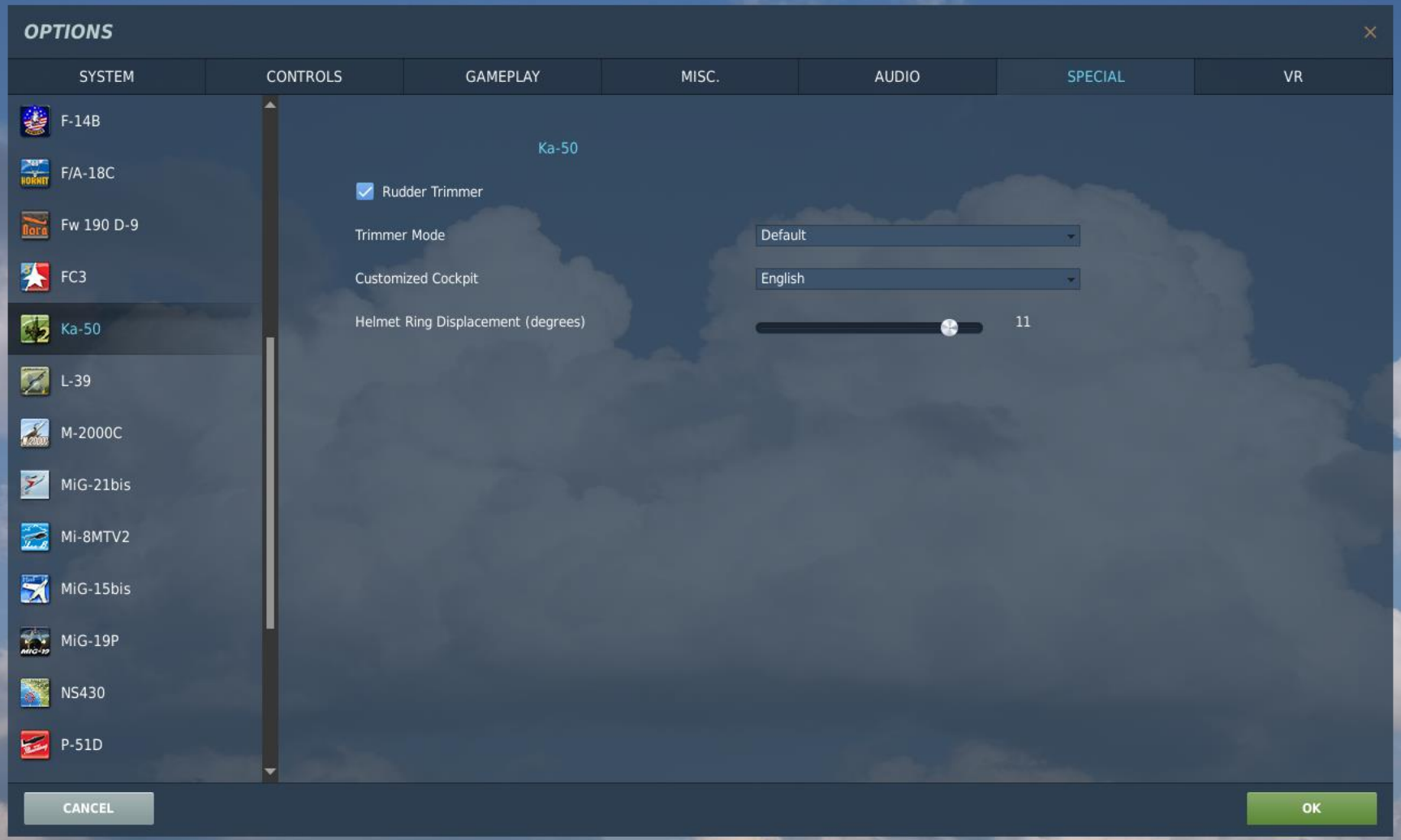
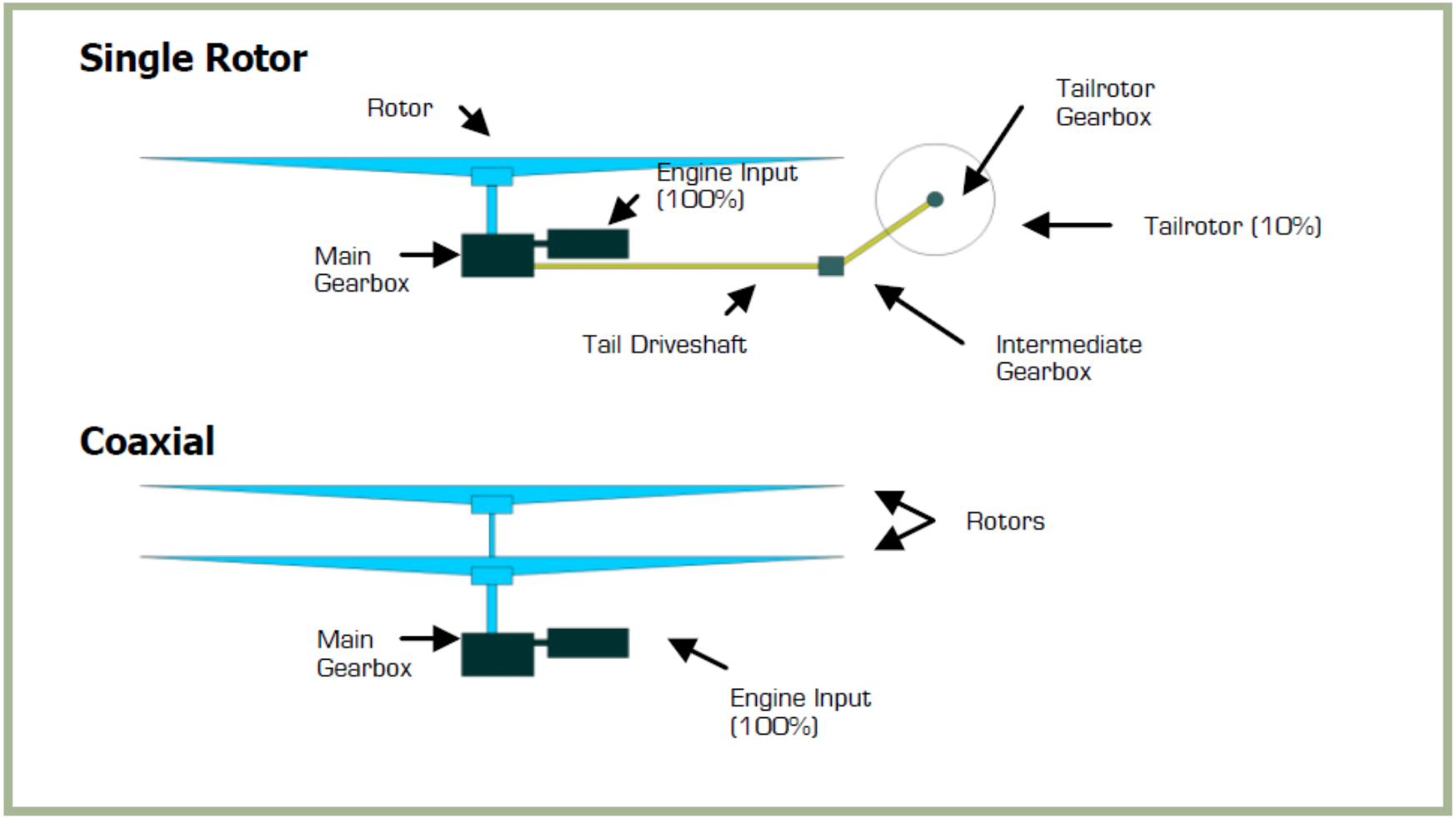


Figure 1-17. Feathering

PART 2 – CONTROLS SETUP



CONTROLS SETUP

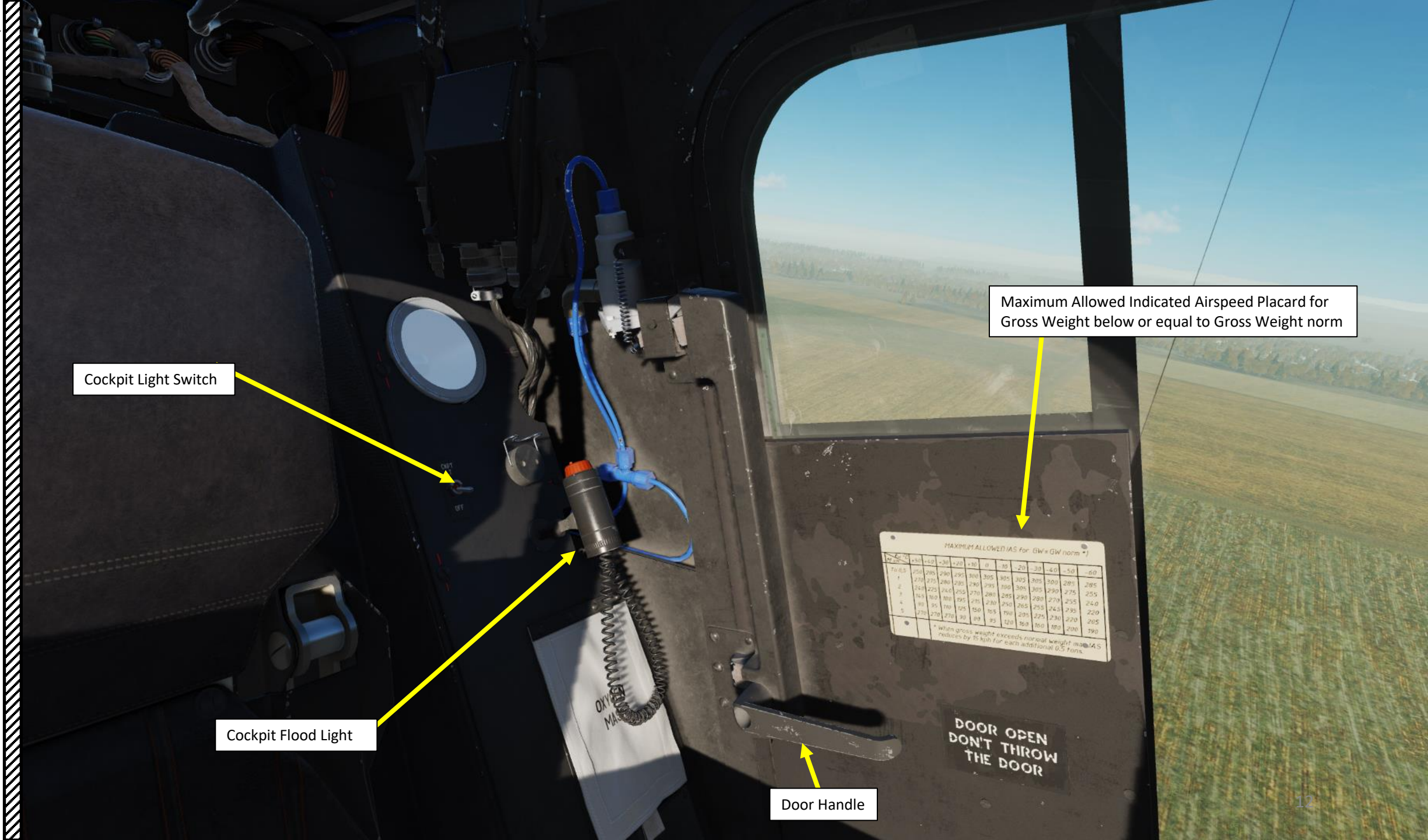


5-3: Coaxial and single rotor helicopters drive train

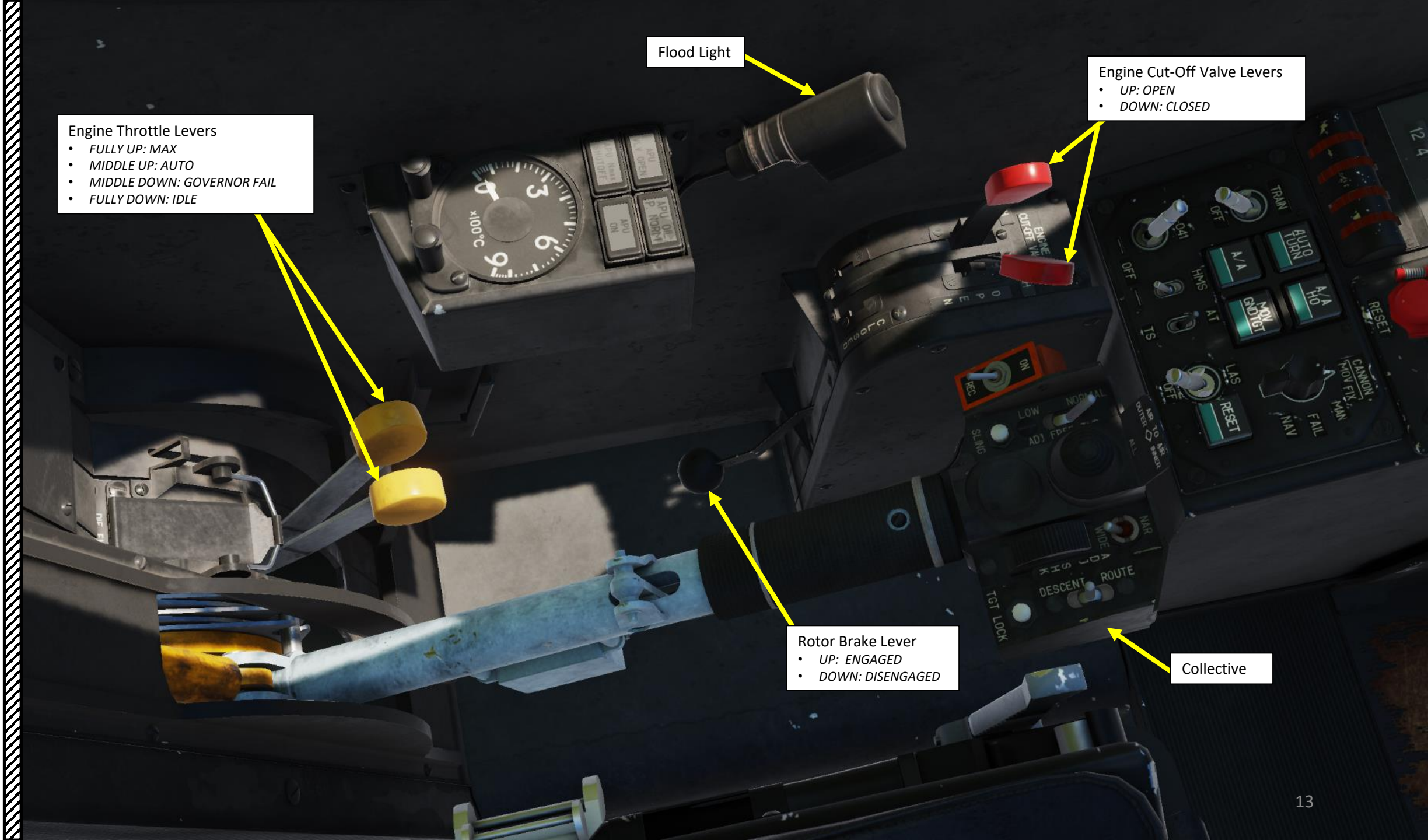

064
SIDE
QUANT-NUM
RESET PROG
STOP
START
CLEAR
SEND MEM


DOOR OPEN
DON'T THROW
THE DOOR

PART 3 – COCKPIT & GAUGES

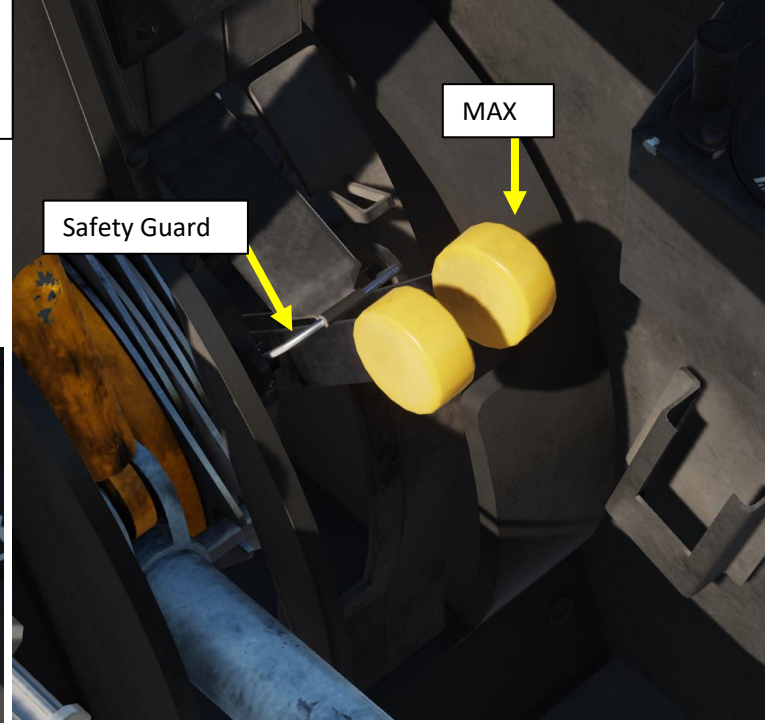


PART 3 – COCKPIT & GAUGES



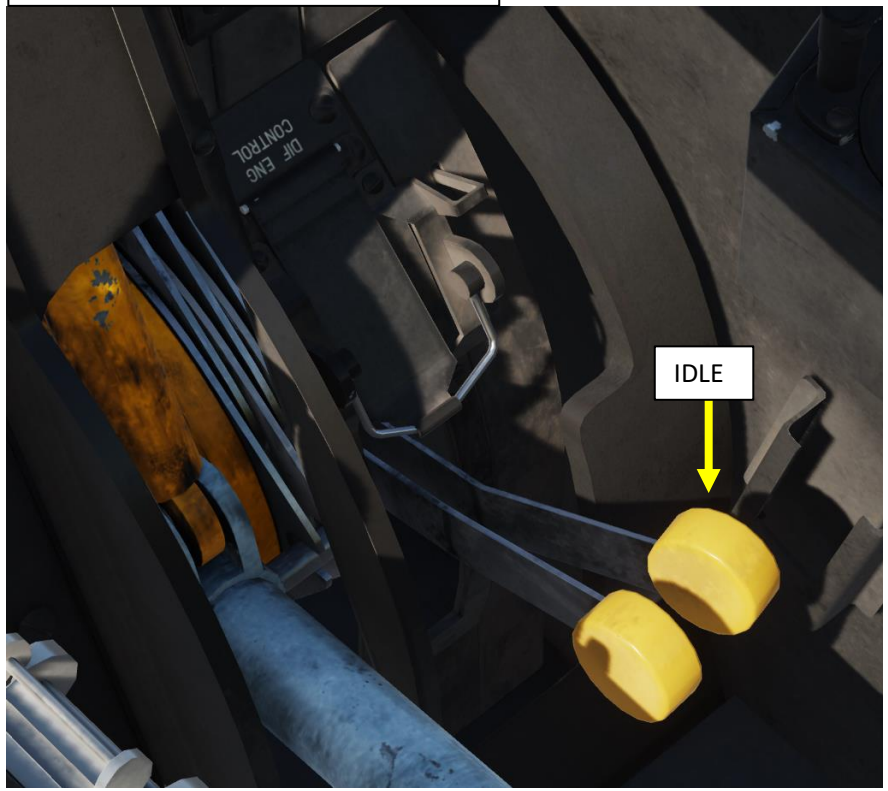
Engine Throttle Levers
- ***FULLY UP: MAX***

Intended to ensure maximum power of one engine in case of failure of the other engine (OEI, One Engine Inoperative)



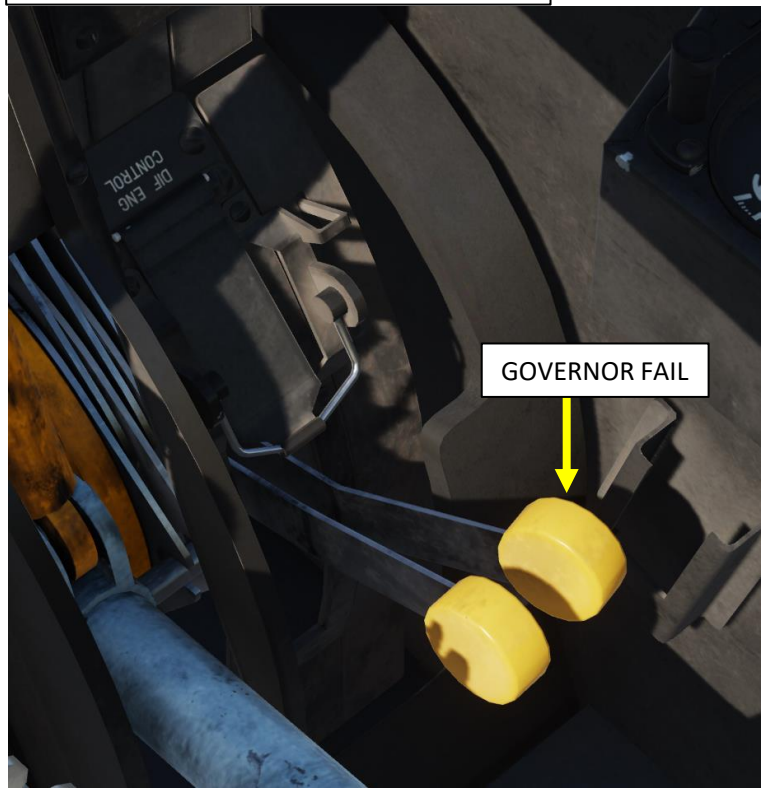
Engine Throttle Levers
- ***FULLY DOWN: IDLE***

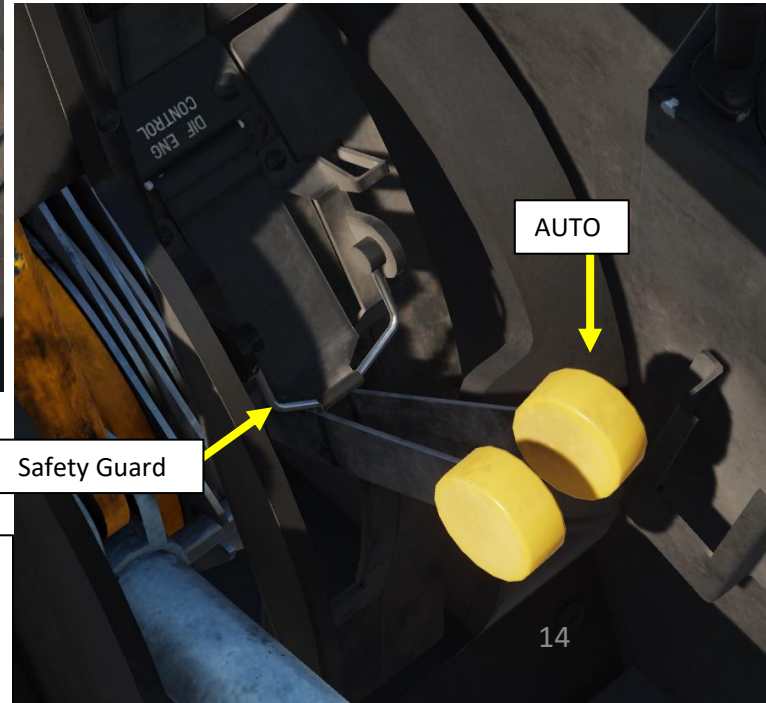
IDLE mode is used to perform start-up procedures and most system functional tests.



Engine Throttle Levers
- ***MIDDLE DOWN: GOVERNOR FAIL***

Needed in case of failure of the power turbine's RPM governor to avoid engine overspeed.

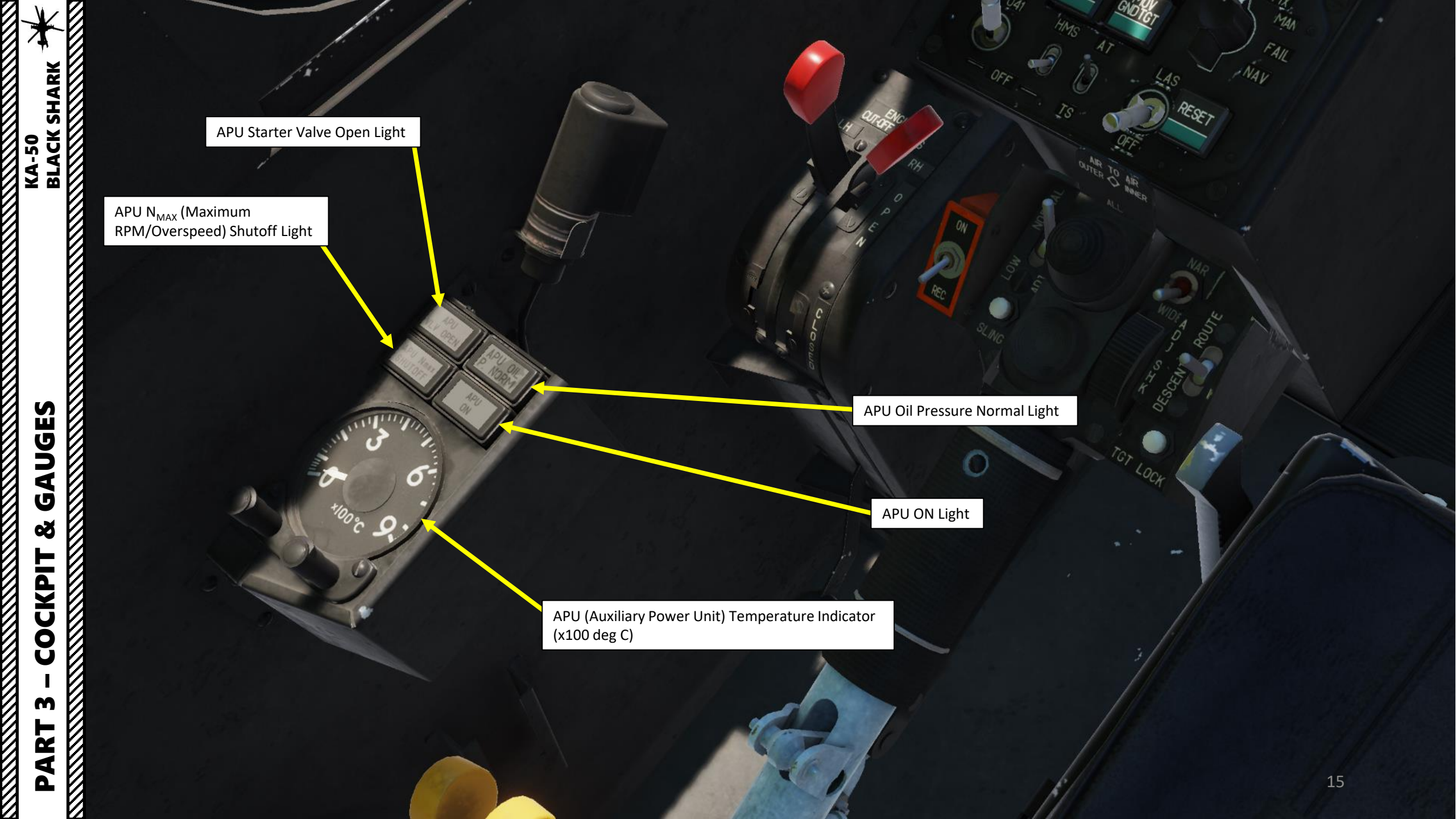




Engine Throttle Levers
- ***MIDDLE UP: AUTO***

AUTO is the main mode during normal engine operation. All flights must be performed at this mode except for specific emergencies.

PART 3 – COCKPIT & GAUGES



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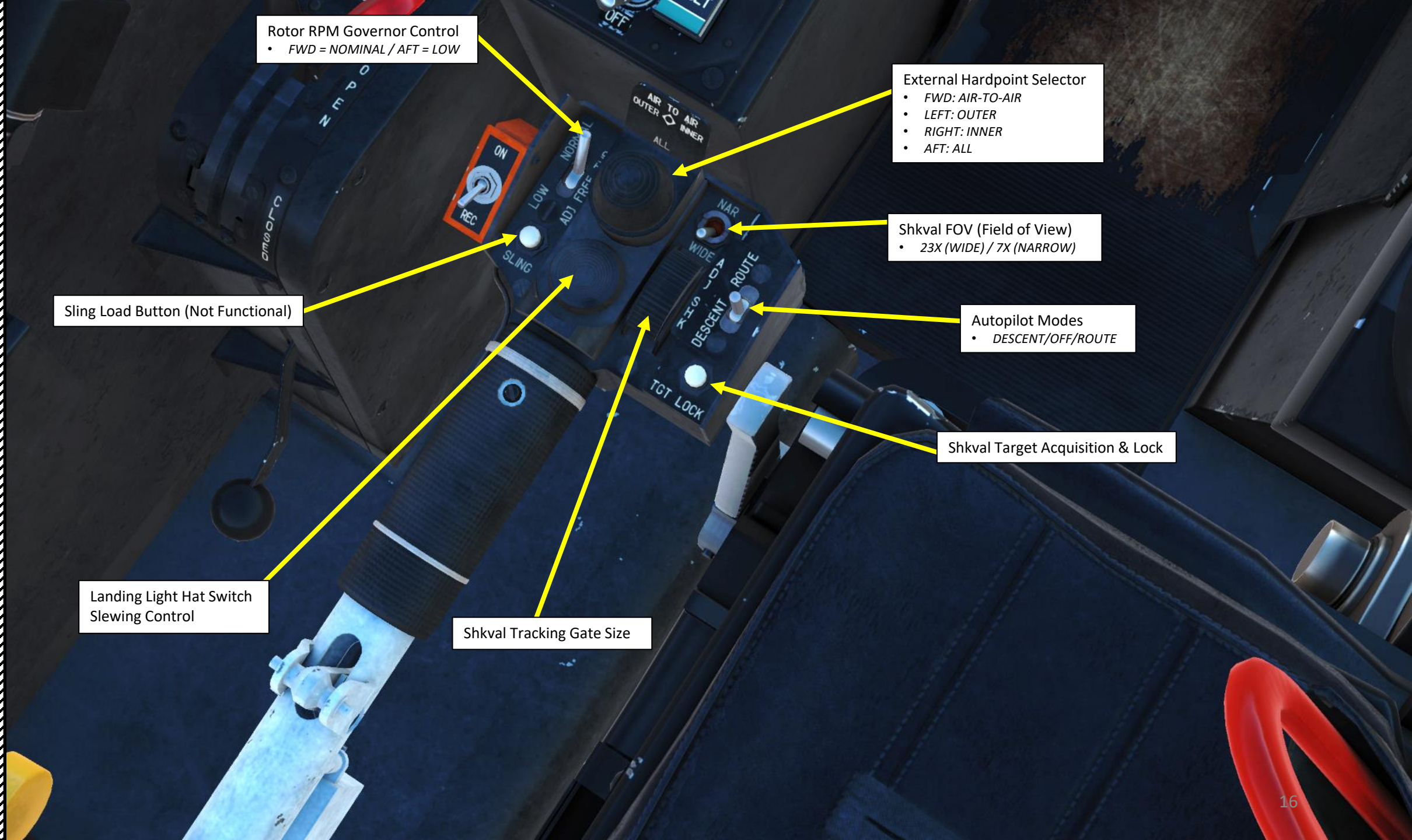
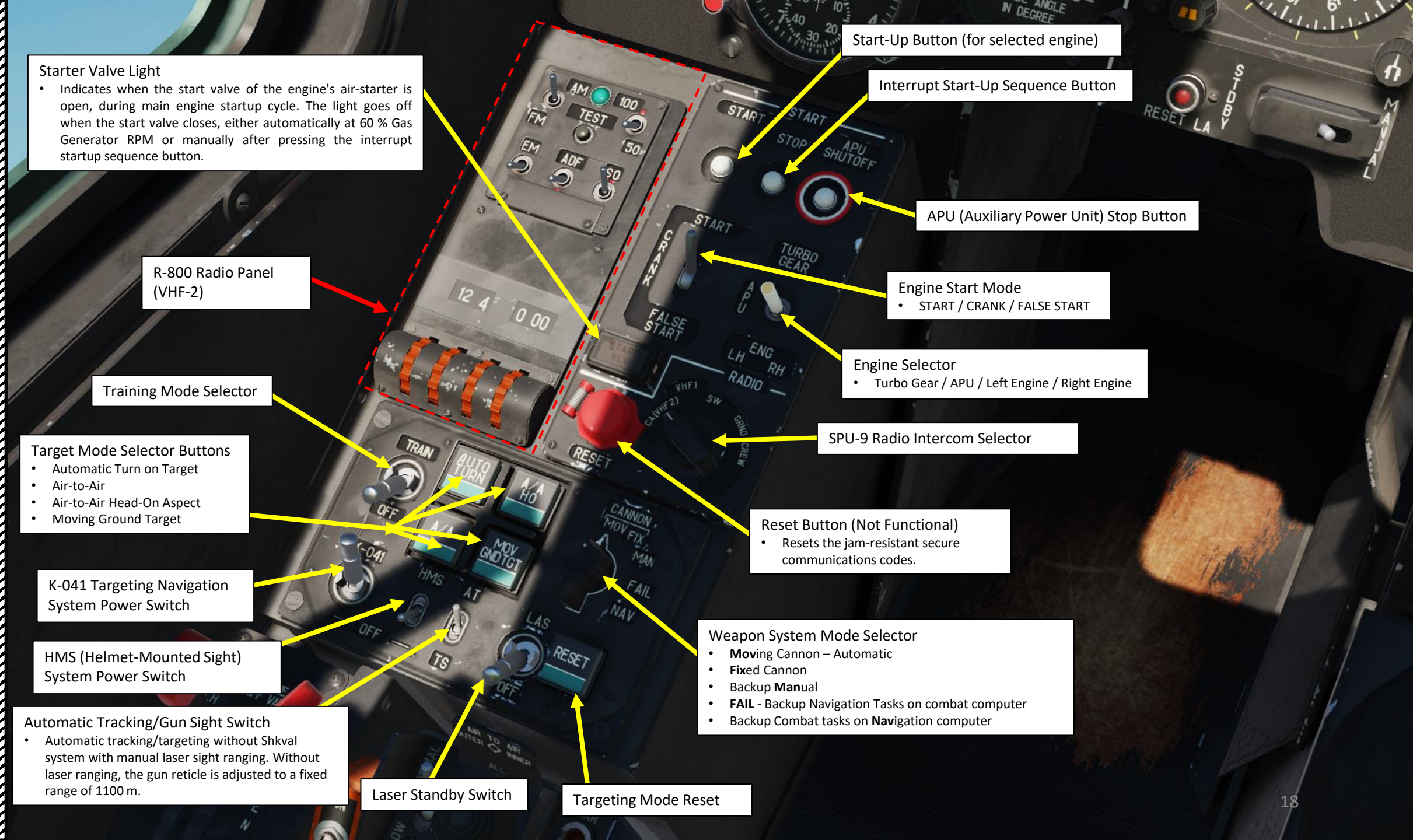
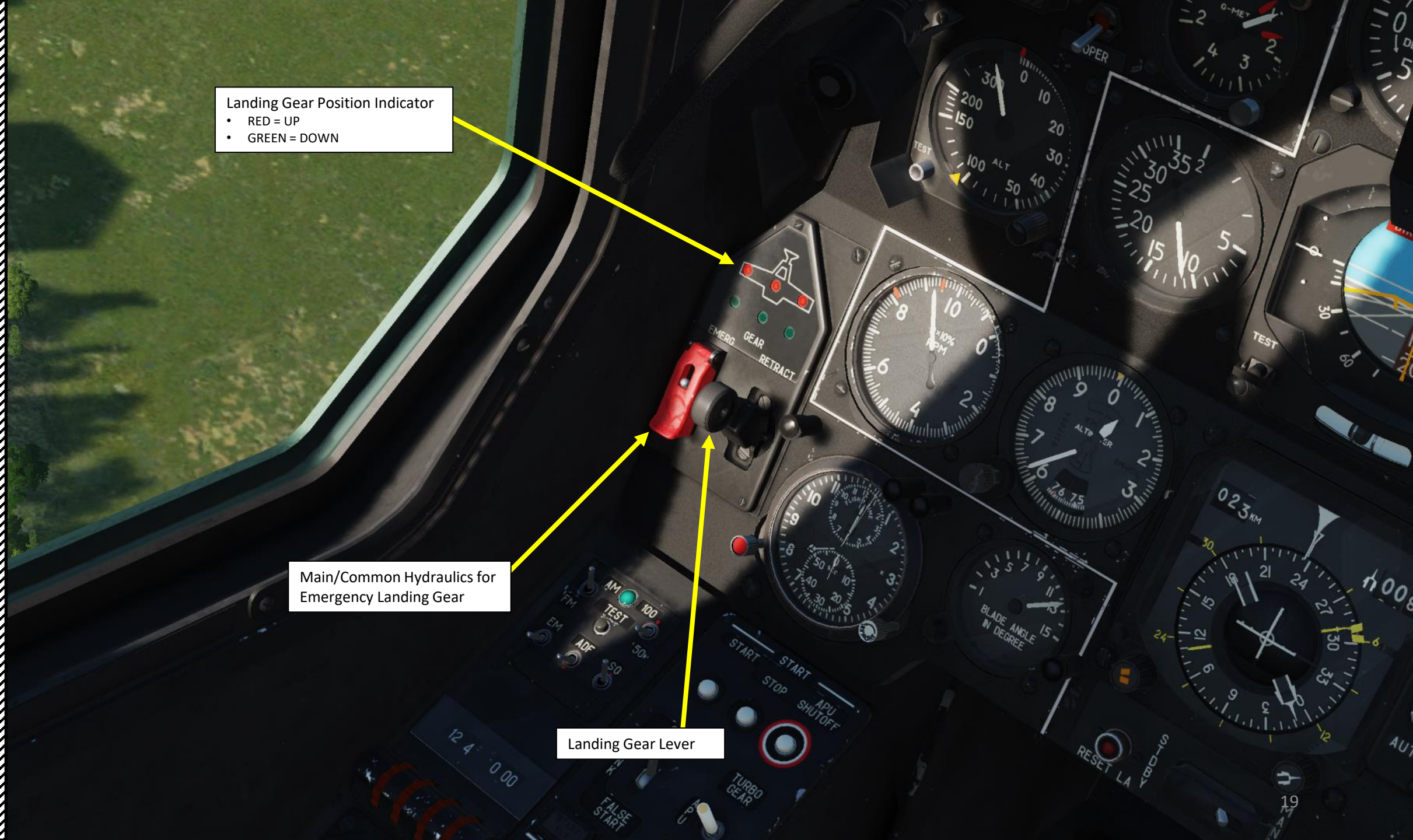



Collective brake – Assign Altitude Lever


Starter Valve Light
• Indicates when the start valve of the engine's air-starter is open, during main engine startup cycle. The light goes off when the start valve closes, either automatically at 60 % Gas Generator RPM or manually after pressing the interrupt startup sequence button.
Start-Up Button (for selected engine)
Interrupt Start-Up Sequence Button
APU (Auxiliary Power Unit) Stop Button
R-800 Radio Panel (VHF-2)
Engine Start Mode
• START / CRANK / FALSE START
Engine Selector
• Turbo Gear / APU / Left Engine / Right Engine
Training Mode Selector
SPU-9 Radio Intercom Selector
Target Mode Selector Buttons
• Automatic Turn on Target
• Air-to-Air
• Air-to-Air Head-On Aspect
• Moving Ground Target
Reset Button (Not Functional)
• Resets the jam-resistant secure communications codes.
K-041 Targeting Navigation System Power Switch
Weapon System Mode Selector
• Moving Cannon – Automatic
• Fixed Cannon
• Backup Manual
• FAIL - Backup Navigation Tasks on combat computer
• Backup Combat tasks on Navigation computer
HMS (Helmet-Mounted Sight) System Power Switch
Automatic Tracking/Gun Sight Switch
• Automatic tracking/targeting without Shkval system with manual laser sight ranging. Without laser ranging, the gun reticle is adjusted to a fixed range of 1100 m.
Laser Standby Switch
Targeting Mode Reset

PART 3 – COCKPIT & GAUGES



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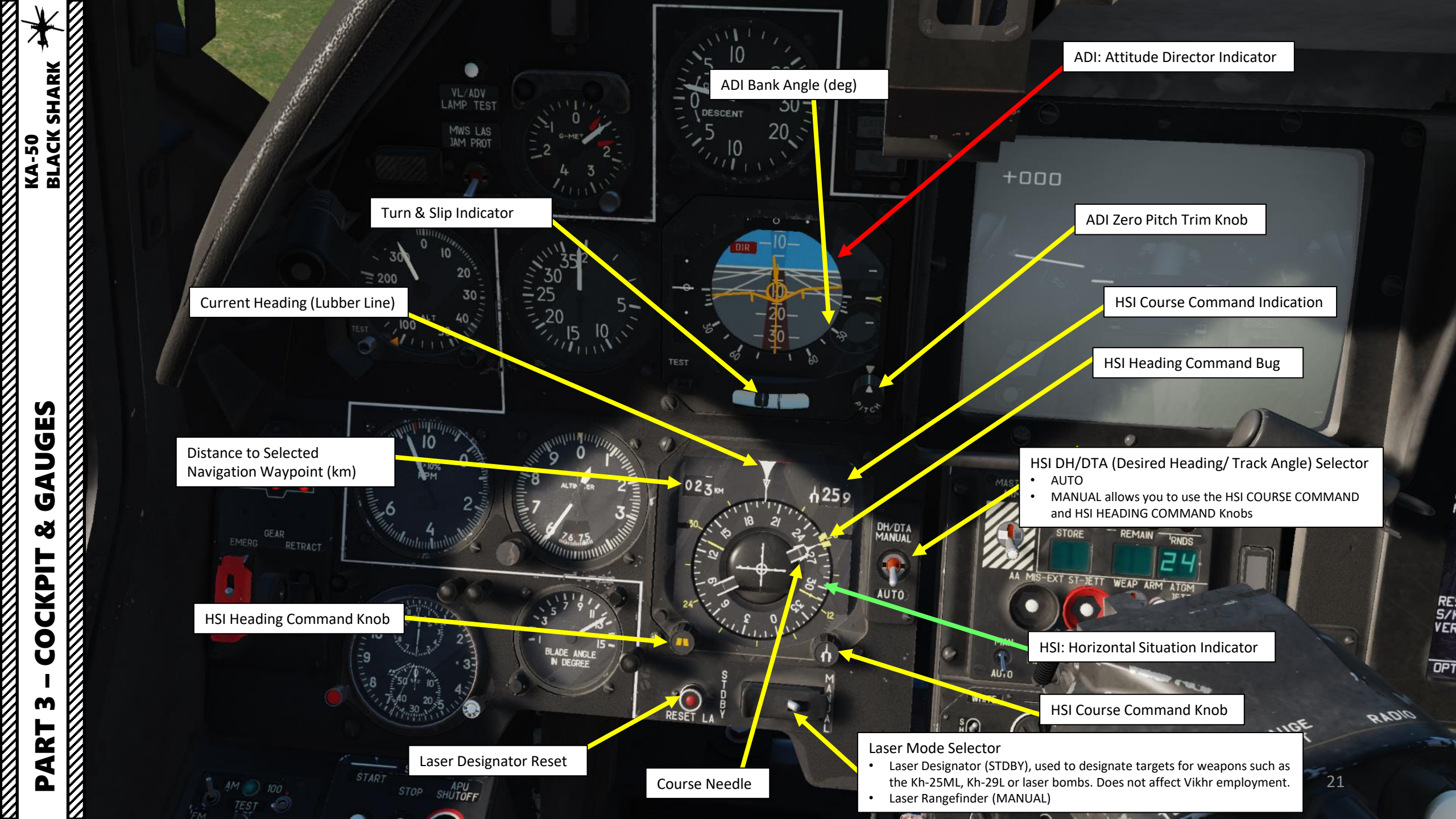


MWS (Missile Warning System) Operation Mode (not functional)
Accelerometer (g)
Vertical Velocity Indicator (m/s)
BRT
TEST
GRID
DAY
NIGHT
VL/ADV LAMP TEST
CLIMB
DESCENT
DIR
ALT
RPM
DATE SETUP: 22:06
NAV.SENSORS
GNSS READY
ALTIMETER READY

PART 3 – COCKPIT & GAUGES

Caution Lights Panel

LH ENG OVERSPD Left engine turbine overspeed	**RH ENG OVERSPD** Right engine turbine overspeed	**OVER-G** Excessive G is being pulled
LH ENG VIBR Left engine vibration excessive	**RH ENG VIBR** Right engine vibration excessive	**IAS MAX** Aircraft is exceeding maximum airspeed
MAIN GRBX • Minimum Main Gearbox Pressure • Main Gearbox Oil Overheat • Oil Metallic Chip Detected	**FIRE** Fire Detected	**IFF FAIL** Identify-Friend-or-Foe System Failure

PART 3 – COCKPIT & GAUGES

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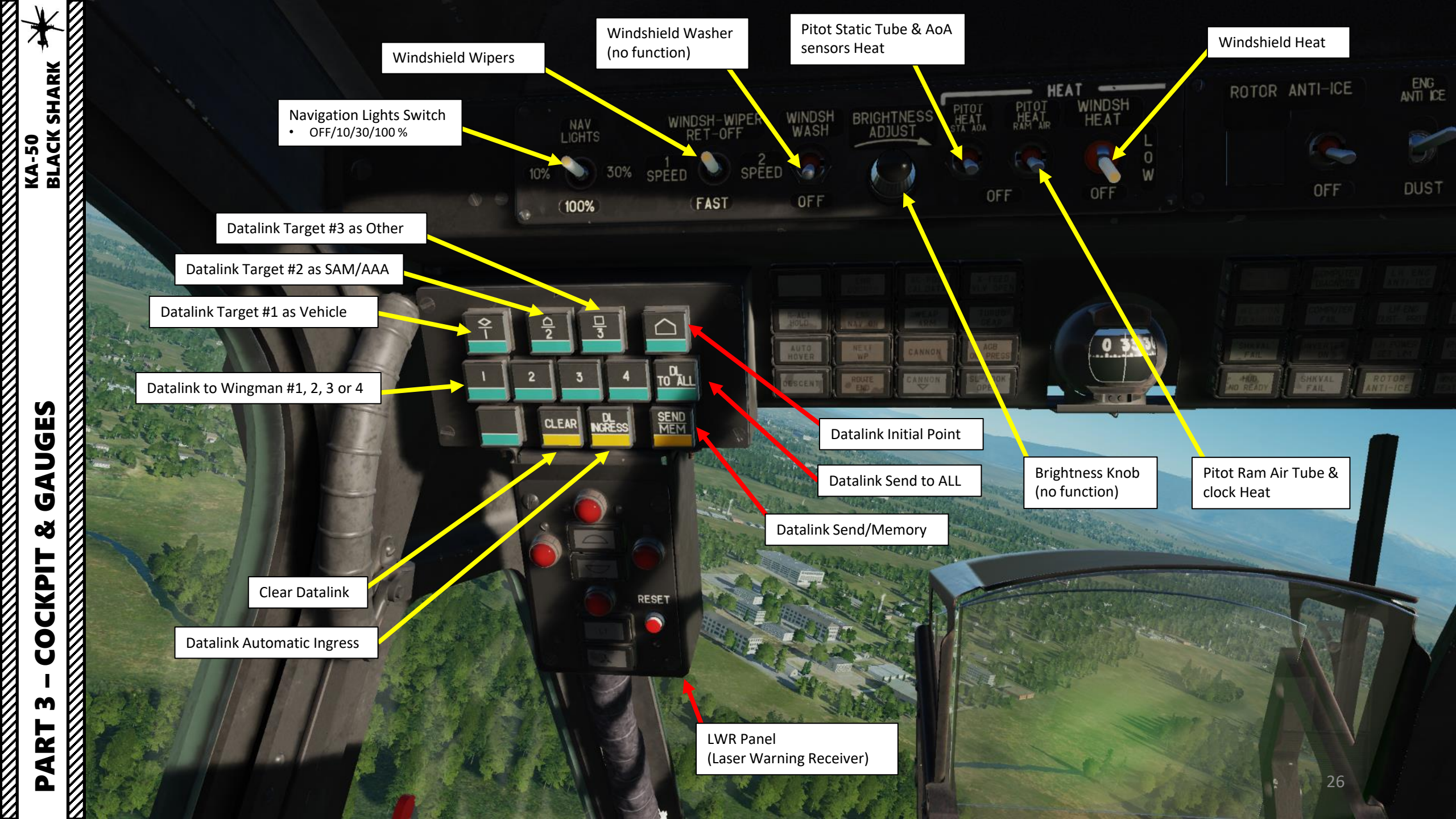


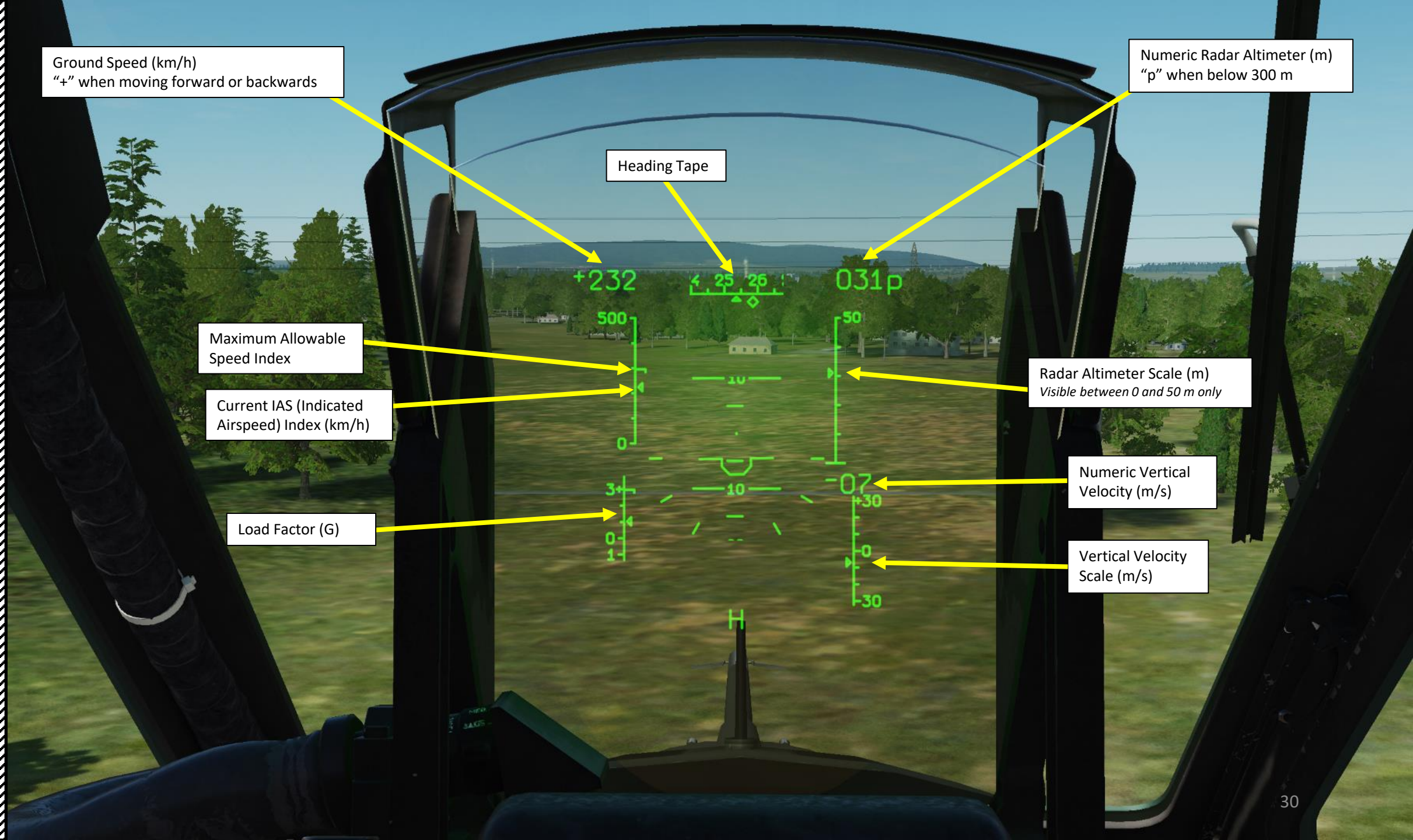

Left Pitot Heat Indicator Light
Illuminates when pitot heat control button is pressed and the pitot tube heat system is operating normally
Engine Anti-Ice/Dust Protection Switch
Engine Anti-Ice/Dust Protection Switch
Ventilation Switch (not functional)
UV-26 Countermeasures Panel
Numbers = Flare Dispensing Parameters
Quantity/Program Selector
Flare interval (time-delay between flare release)
Reset Program
Start Countermeasure Program
Rotor Anti-Ice Switch
Pitot Heat Test Switch
Flare side deployment
• Left/Both/Right
Number of flare sequences options
Salvo: set number of flares dispensed per salvo
Stop Countermeasure Program
HEAT
PITOT HEAT RAM AIR
WINDSH HEAT
OFF
OFF
LOW
ROTOR ANTI-ICE
OFF
ENG ANTI ICE
DUST
PITOT HEAT TEST
LH STATIC AOA RAM AIR RH
VENT TWO
OFF
ONE
FWD TANK PUMP ON
AFT TANK PUMP ON
064
SIDE
QUANT-NUM
L.4,5(12), 6,7(15),8
L6,8, 7(0,25C) 9(0,5C)
L8
RESET PROG
STOP
START
0-CONTINUOUS
99-AUTOCONTR

Caution Lights Panel

	ENR COURSE Route navigation with course following is enabled	**AC-POS CAL DATA** Aircraft position is roughly calculated using air data systems information	**X-FEED VLV OPEN** Fuel is shared between tanks (crossfeed ON)
R ALT HOLD Radar altitude-hold autopilot mode is ON	**ENR NAV ON** Route navigation with direct flight to steerpoint is enabled	**WEAP ARM** Weapons Armed	**TURBO GEAR** Accessory gearbox disconnected from rotor drive
AUTO HOVER Hover autopilot mode is ON	**NEXT WP** Notification of passing one waypoint and advancing to the next	**CANNON** Cannon has been slewed away from boresight position	**AGB OIL PRESS** Accessory Gearbox oil pressure is normal (before start)
DESCENT Controlled descent autopilot mode is ON	**ROUTE END** Last waypoint reached notification; end of flight plan	**CANNON (DOWN ARROW)** Cannon has been slewed downward away from boresight position	**SL-HOOK OPEN** Sling Load lock (hook) is open

Caution Lights Panel

MASTER ARM ON Master Arm is ON	**COMPUTER DIAGNOSE** On-board computers running in diagnostic mode	**LH ENG ANTI-ICE** Left engine de-icing active	**RH ENG ANTI-ICE** Right engine de-icing active	**FWD TANK PUMP ON** Forward fuel tank has pressure	**AFT TANK PUMP ON** Aft fuel tank has pressure
WEAPON TRAINING Training mode for guided weapons is ON	**COMPUTER FAIL** Failure of one or more central computers	**LH ENG DUST-PROT** Left engine dust protector is active	**RH ENG DUST-PROT** Right engine dust protector is active	**LH VLV CLOSED** Left engine fuel valve is closed	**RH VLV CLOSED** Right engine fuel valve is closed
SHKVAL FAIL Helmet-Mounted Sight malfunction detected	**INVERTER ON** Electrical DC/AC inverter is ON	**LH POWER SET LIM** Left engine was limited by the electronic engine governor and prevented an overspeed	**RH POWER SET LIM** Right engine was limited by the electronic engine governor and prevented an overspeed	**LH OUTER TANK PUMP** Left outer fuel tank has pressure	**RH OUTER TANK PUMP** Right outer fuel tank has pressure
HUD NO READY Heads-Up Display failure (or not ready)	**SHKVAL FAIL** SHKVAL targeting system failure detected	**ROTOR ANTI-ICE** Rotor de-icing system is active	**WINDSHIELD HEATER ON** Windshield heater is ON	**LH INNER TANK PUMP** Left inner fuel tank has pressure	**RH INNER TANK PUMP** Right inner fuel tank has pressure


Ground Speed (km/h)
"+" when moving forward or backwards
Heading Tape
Numeric Radar Altimeter (m)
"p" when below 300 m
Maximum Allowable Speed Index
Current IAS (Indicated Airspeed) Index (km/h)
Load Factor (G)
Radar Altimeter Scale (m)
Visible between 0 and 50 m only
Numeric Vertical Velocity (m/s)
Vertical Velocity Scale (m/s)
+232
25
26
031p
500
0
3
0
1
10
50
07
+30
0
-30
H

PART 3 – COCKPIT & GAUGES

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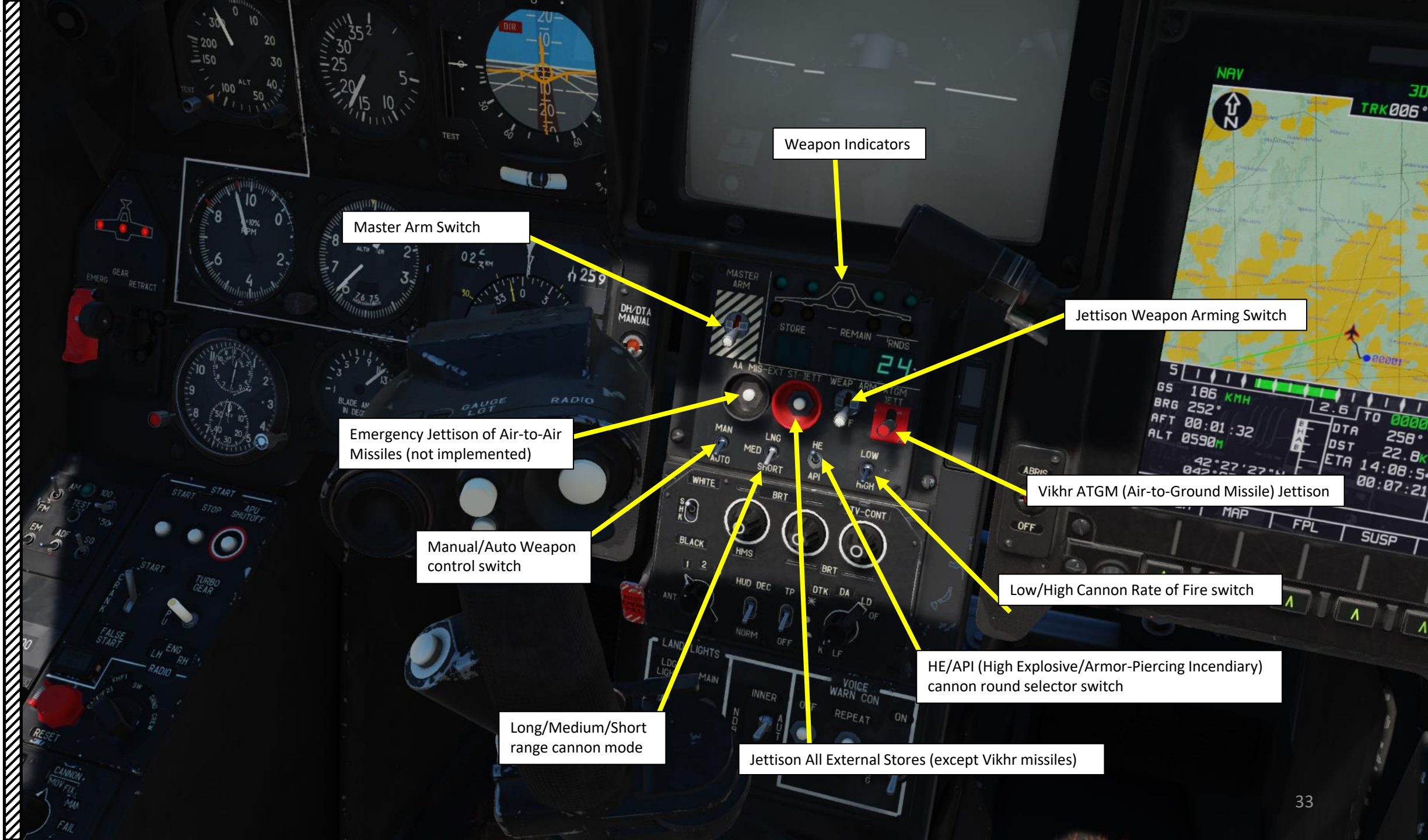

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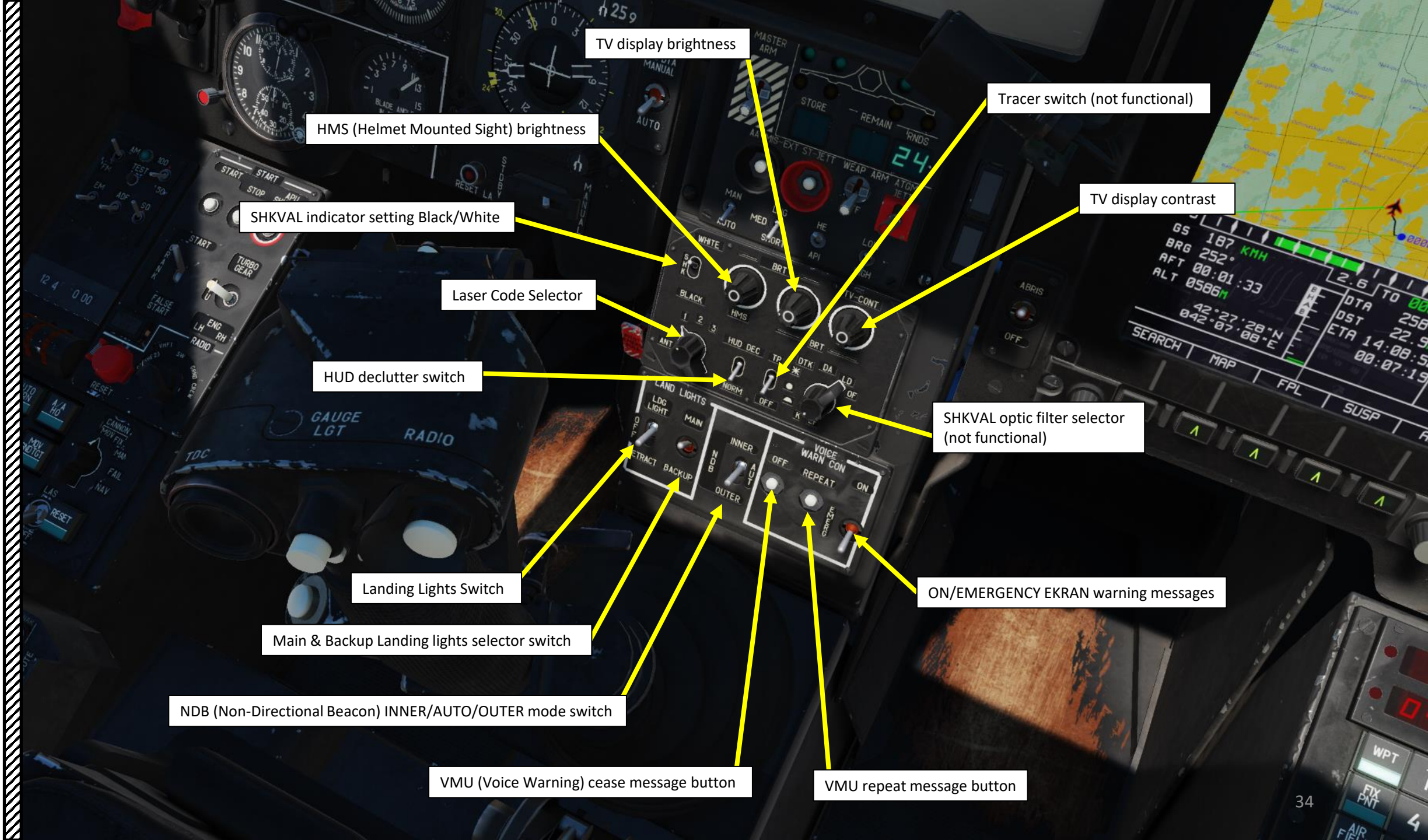

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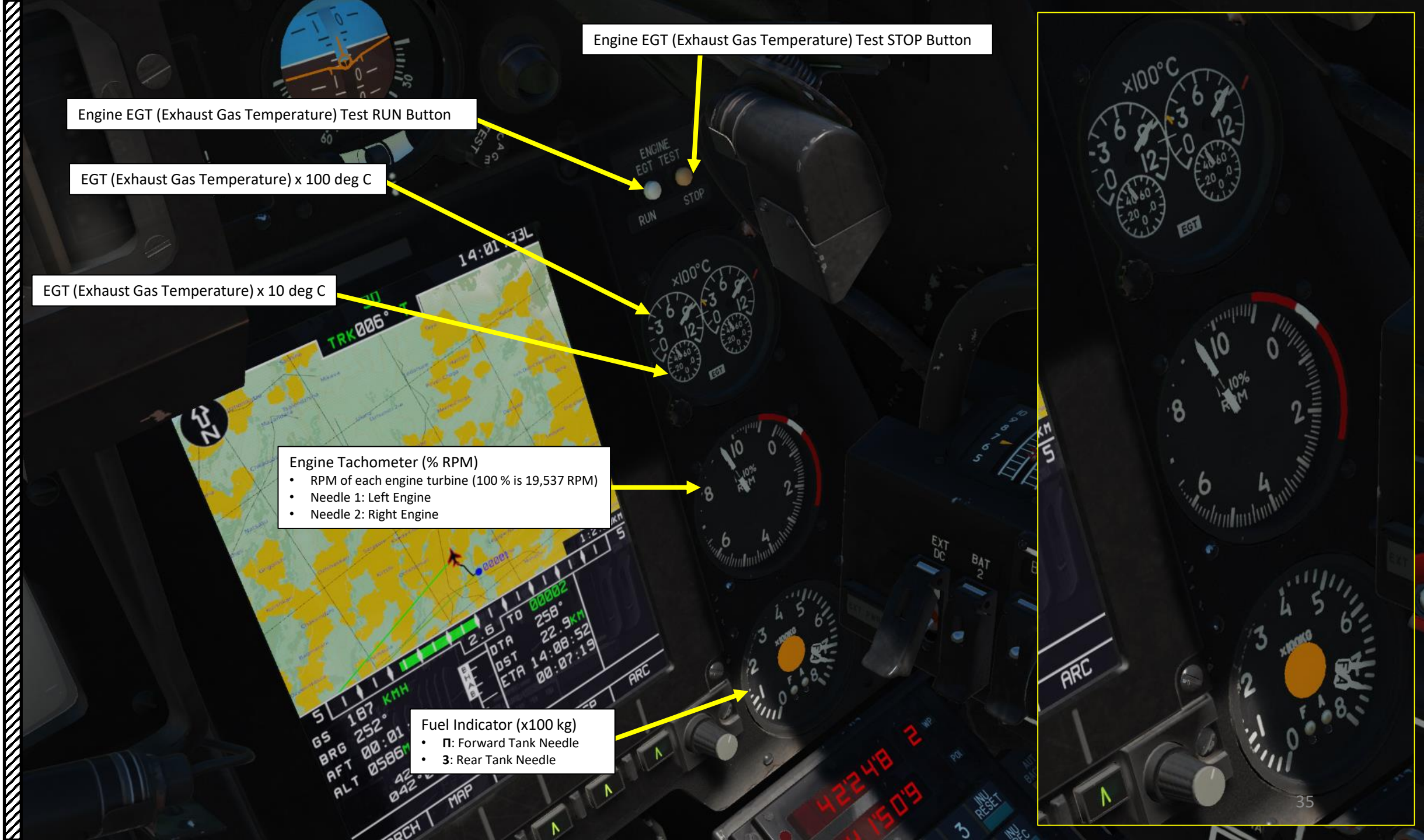

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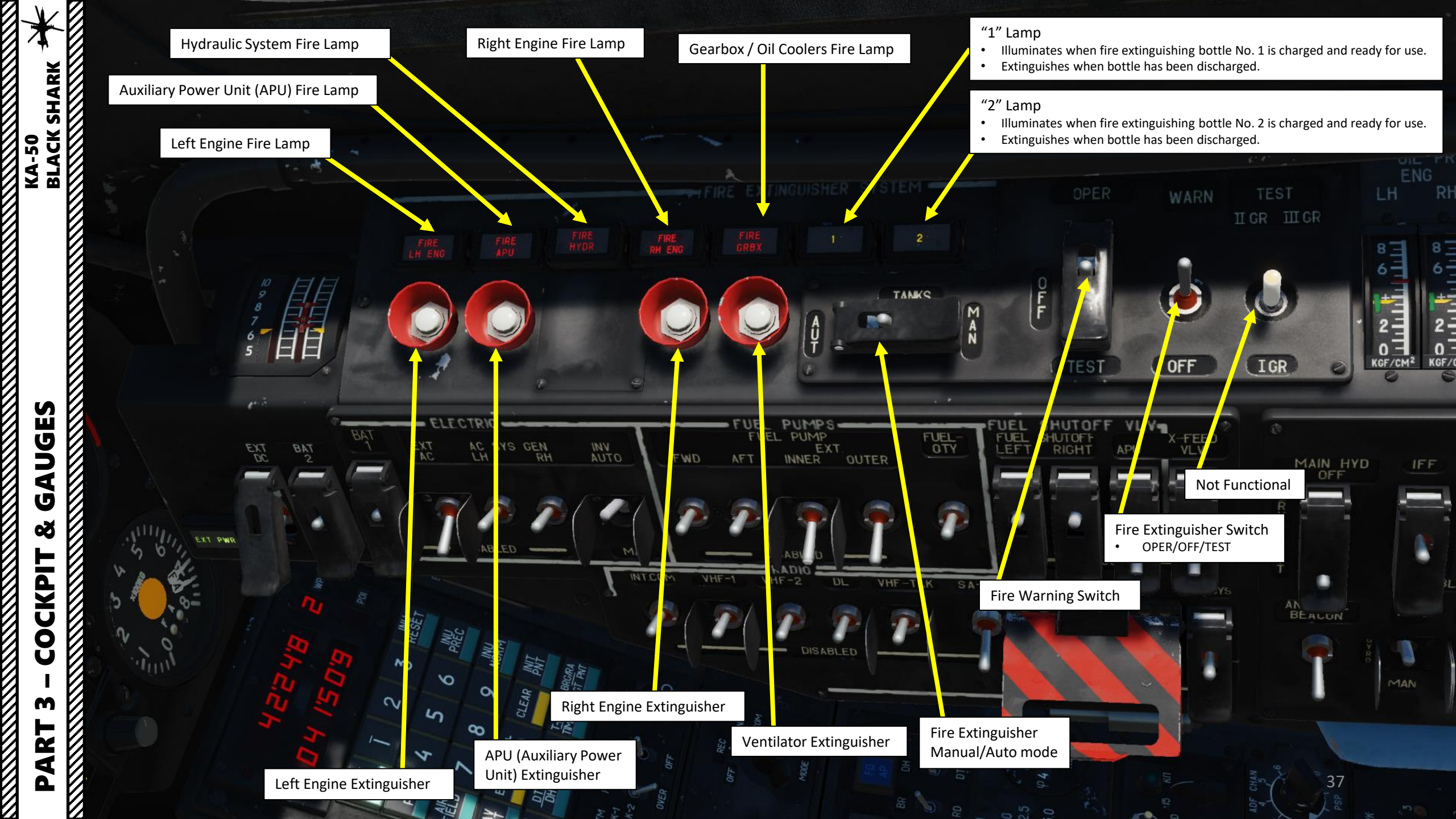

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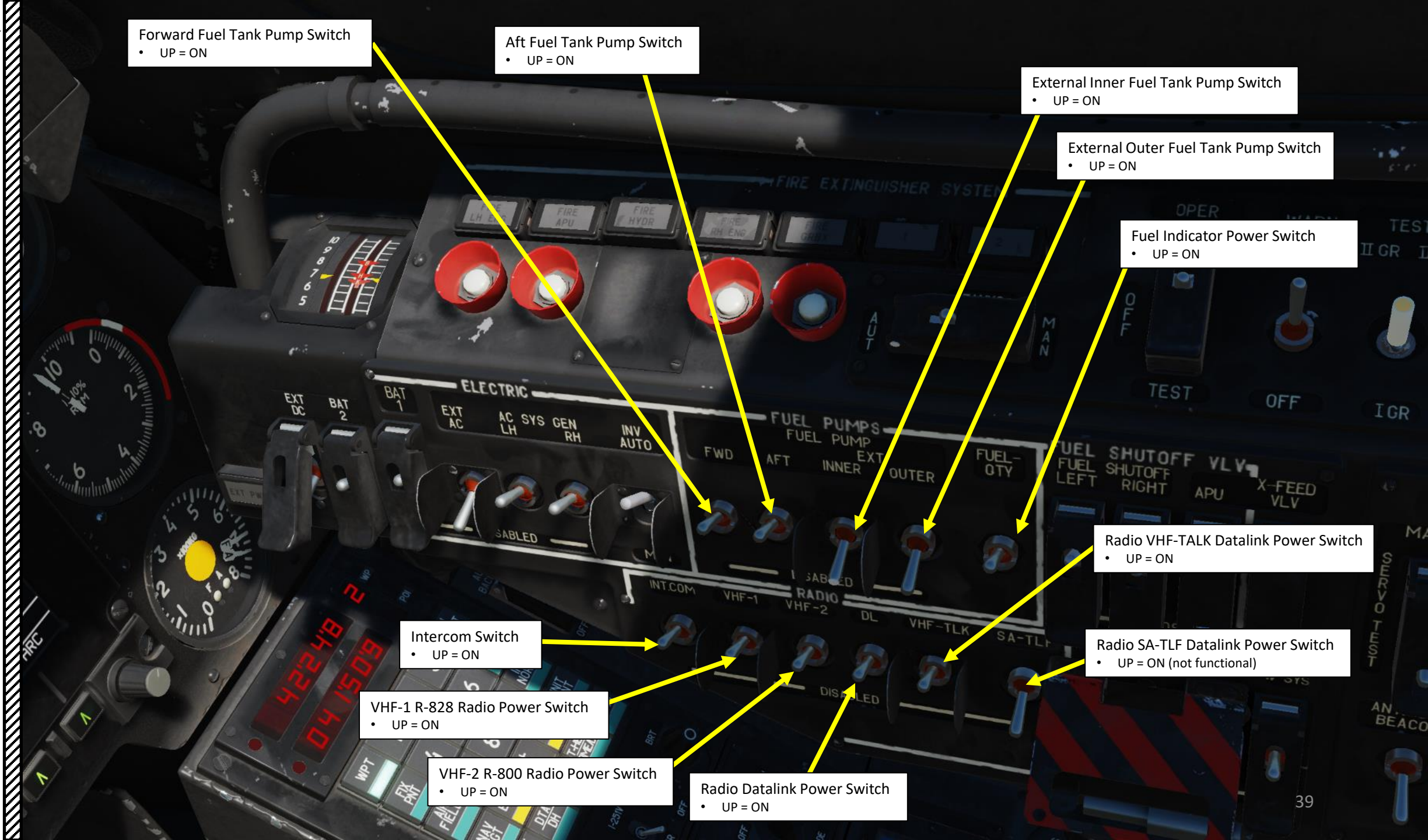

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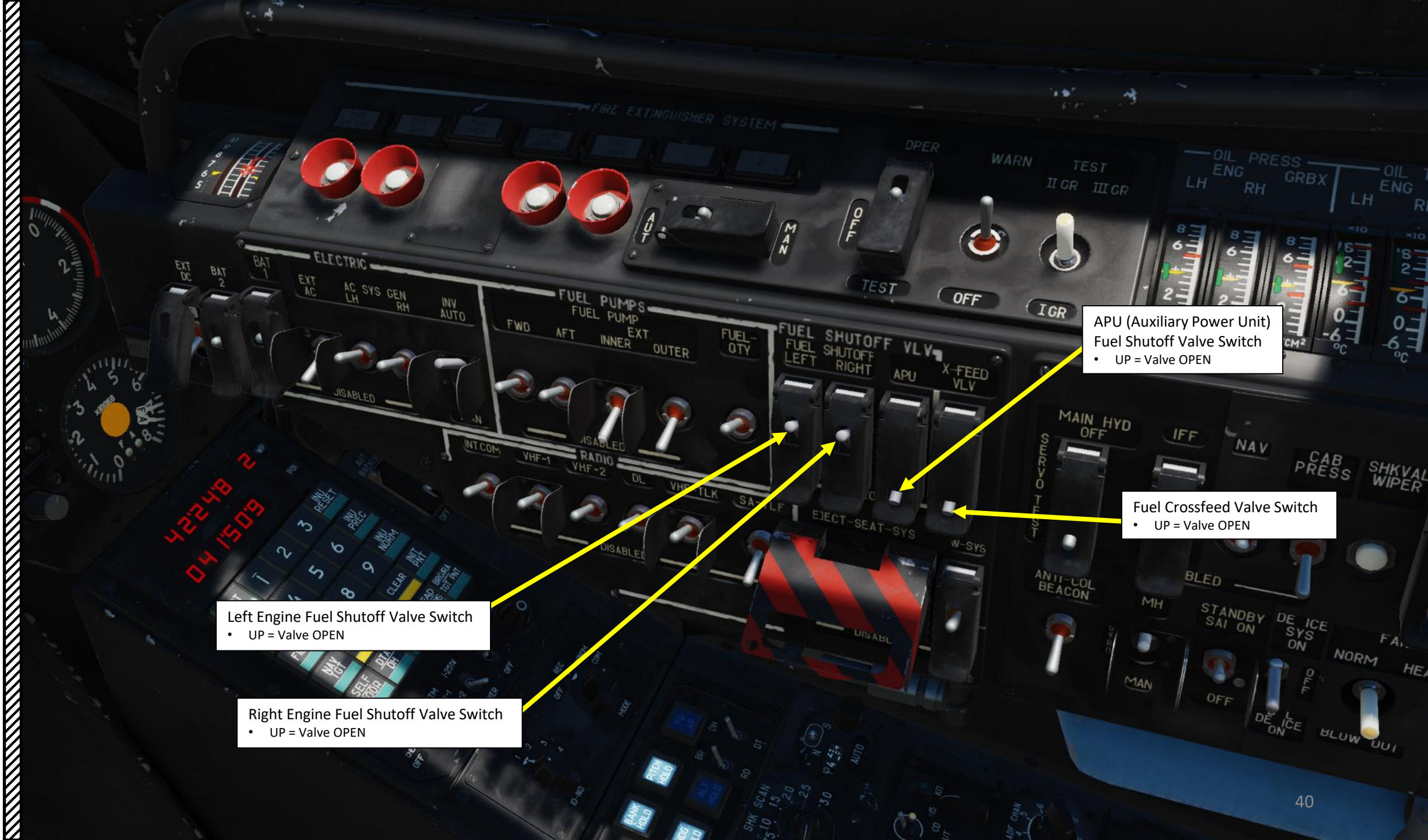

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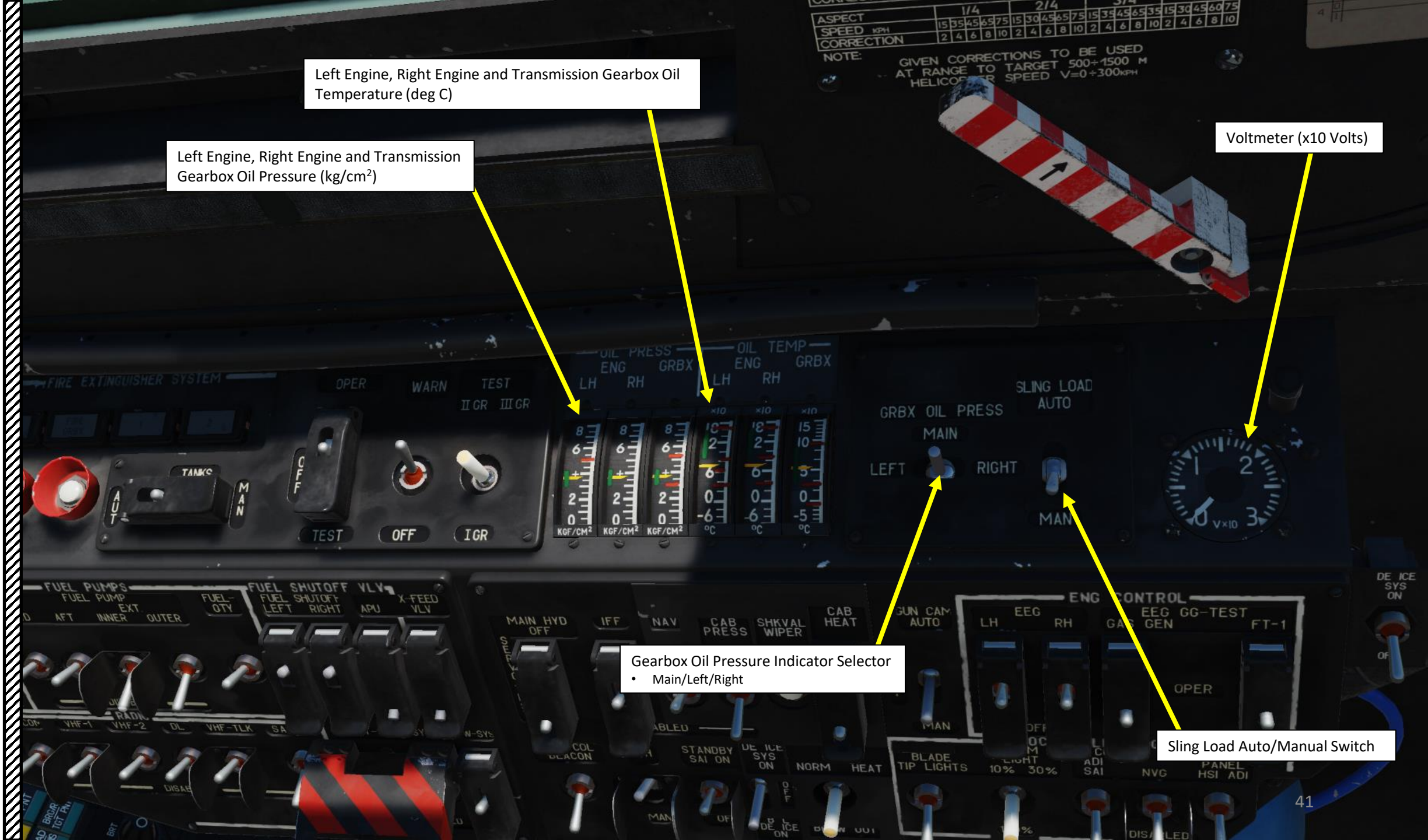

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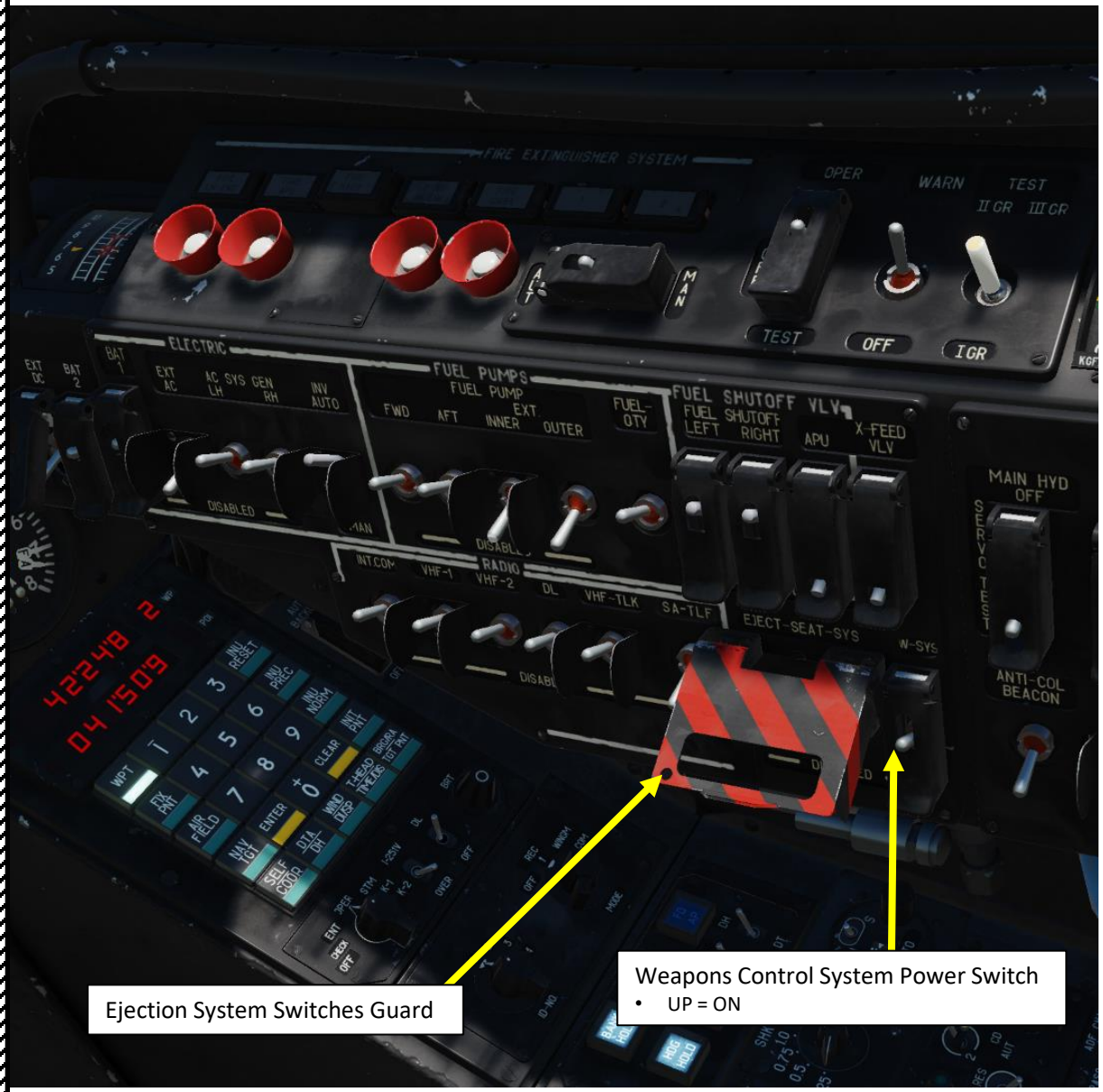
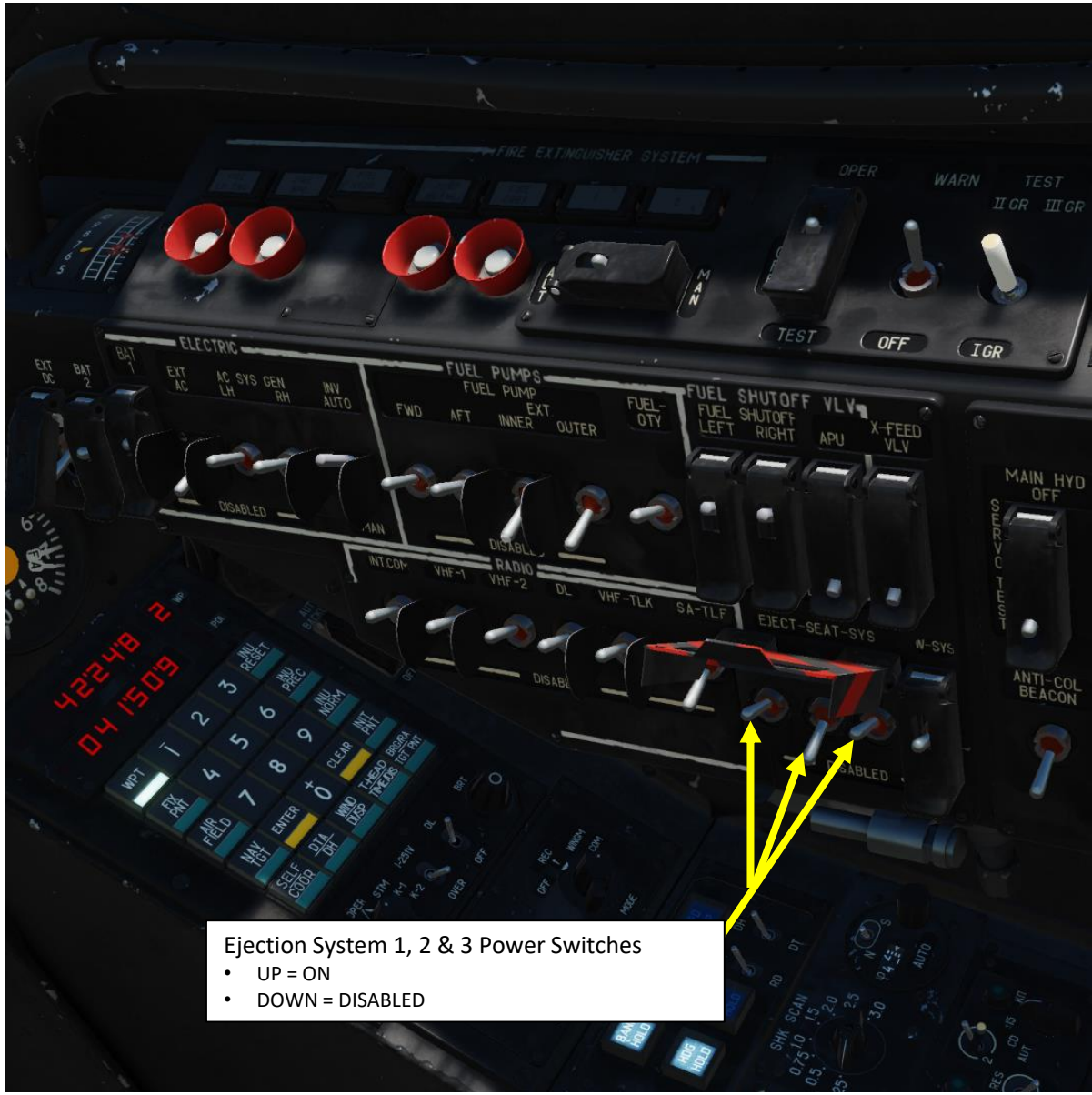
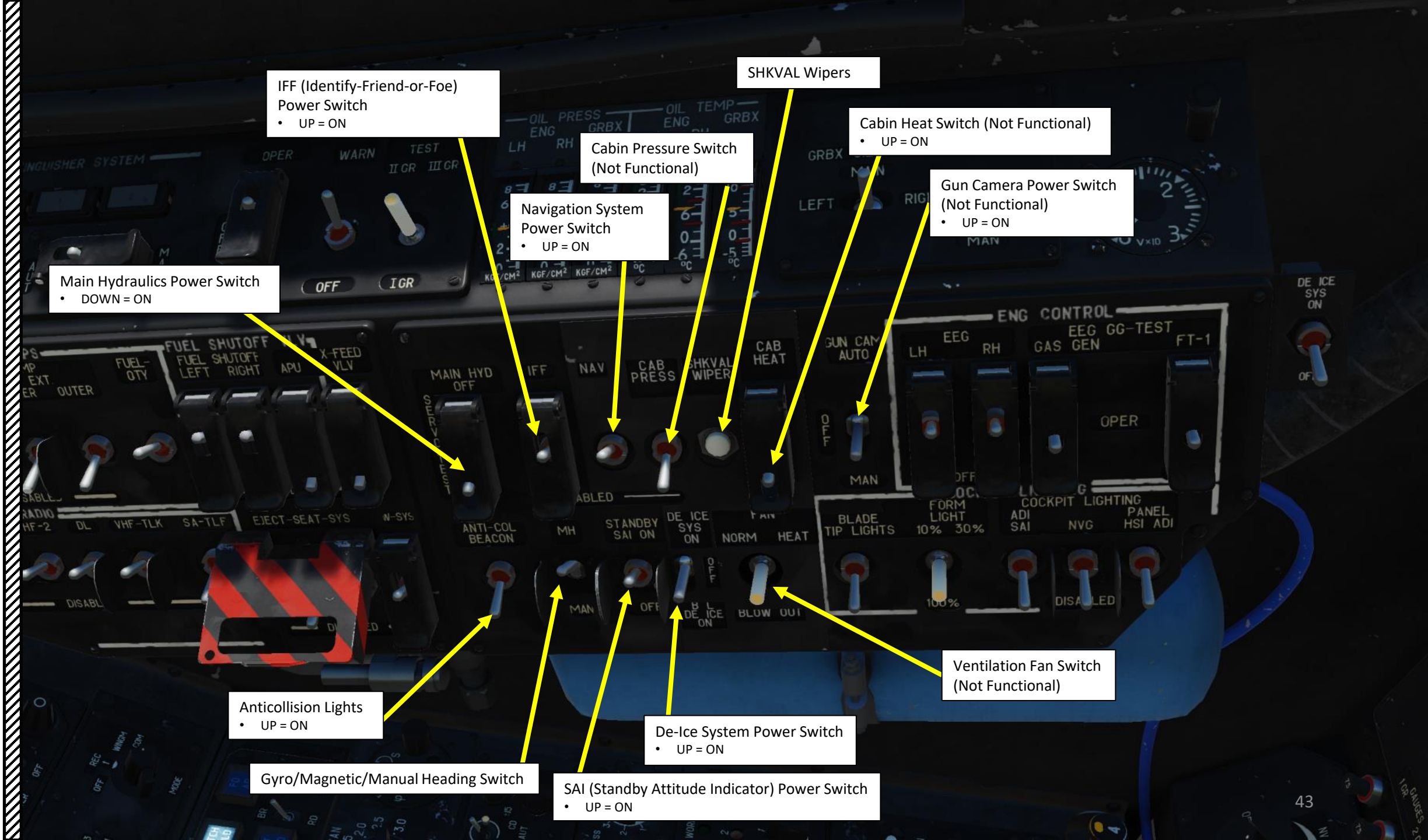




PART 3 – COCKPIT & GAUGES



PART 3 – COCKPIT & GAUGES

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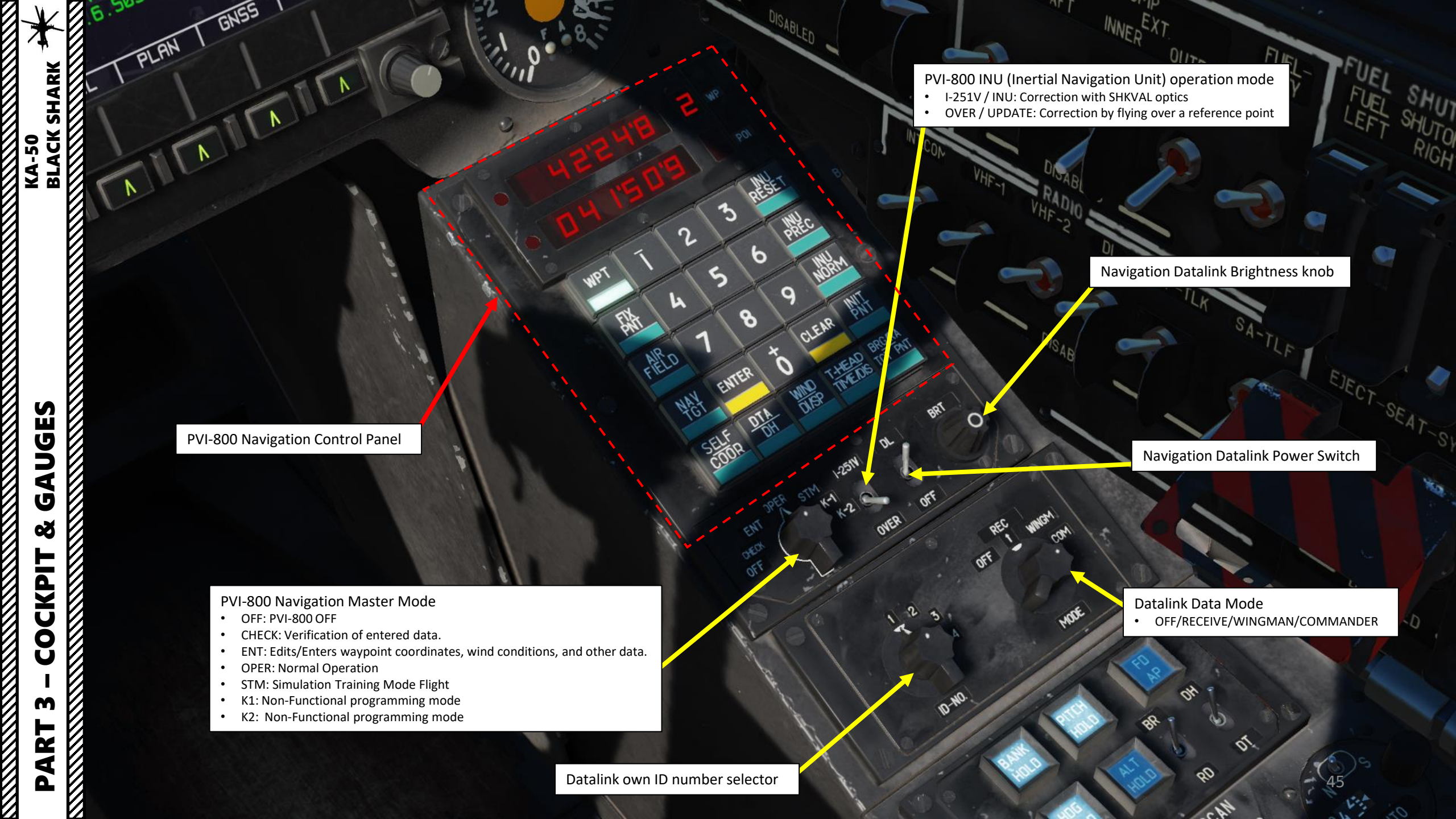
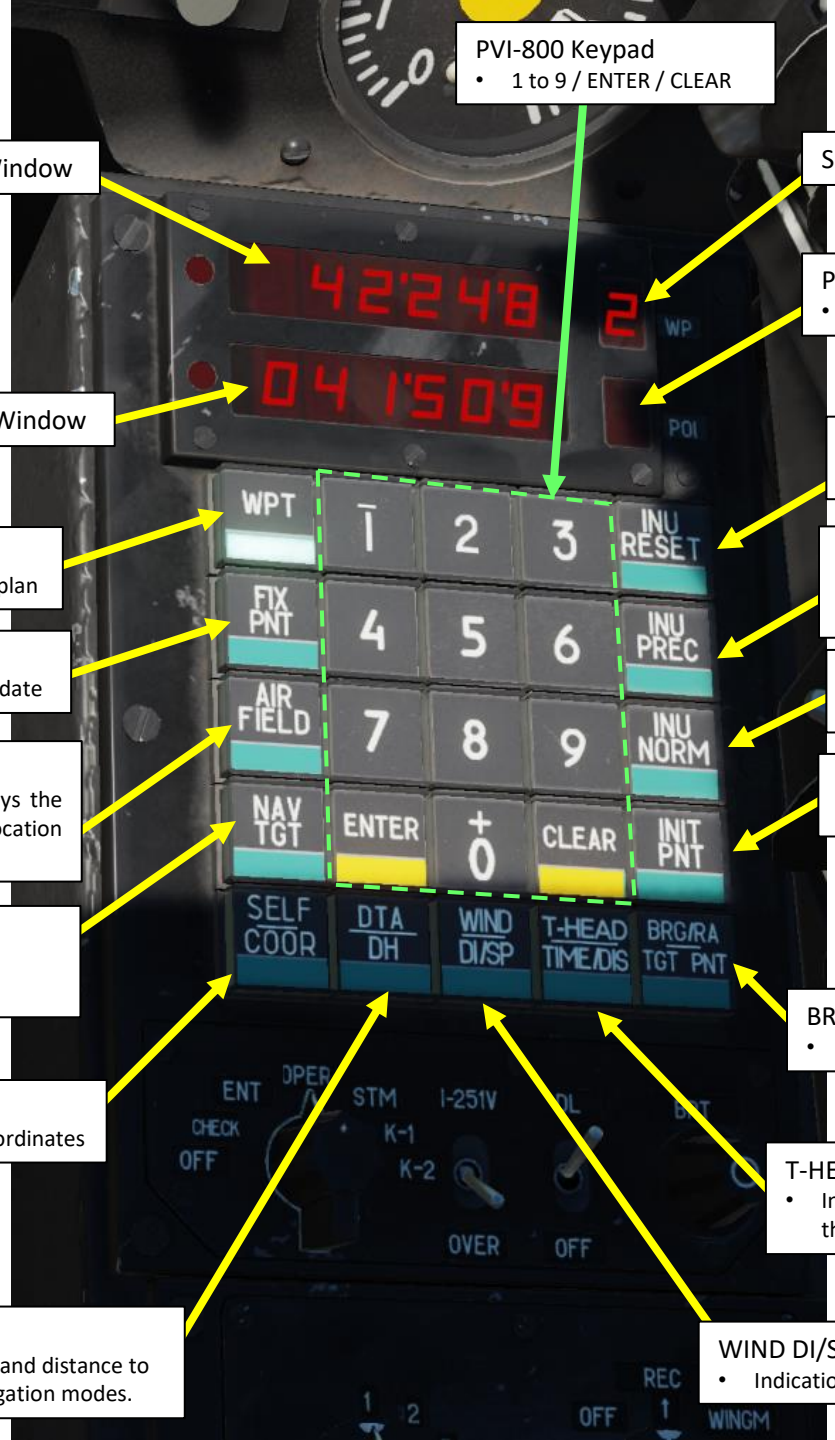




PVI-800 Keypad
- 1 to 9 / ENTER / CLEAR

PVI-800 Upper Display Window

Selected Waypoint (WP) Display

POI (Point of Interest) Display
- Airfield number, fixed point, target point, or correction point display

PVI-800 Lower Display Window

INU RESET Button
- Inertial Navigation Unit reset for in-flight alignment (no function).

WPT Button
- Waypoint Mode selects a waypoint from the flight plan

INU PREC Button
- Inertial Navigation Unit precise alignment. Alignment takes about 30 minutes to complete.

FIX PNT Button
- Selects a reference point for an INU (Inertial Navigation Unit) update

INU NORM Button
- Inertial Navigation Unit normal alignment function.

AIRFIELD Button
- Selects an airfield for RTB (Return to Base) mode and displays the coordinates of one of two airfields. Airfield 1 is your takeoff location and airfield 2 is your landing location.

INIT PNT Button
- Displays initial coordinate point and allows you to enter a new one.

NAV TGT Button
- Selects a target point (TP) for ingress and allows you to enter coordinates for new TPs. Up to 10 TPs can be saved.

BRG/RA / TGT PNT Button
- Indication of bearing and range to target point in the Ingress mode.

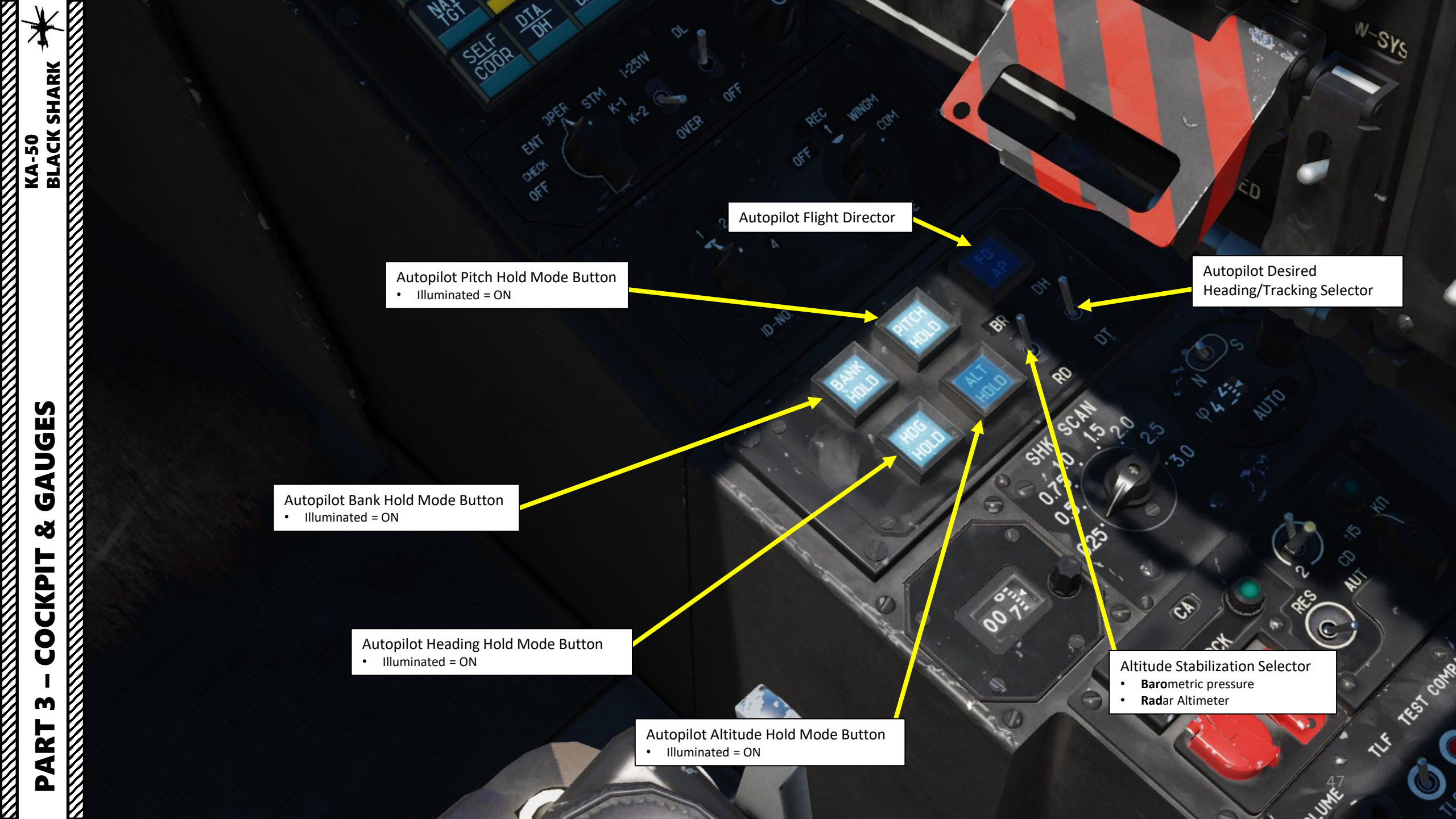
SELF COOR Button
- Displays Ownship coordinates

T-HEAD / TIME/DIS Button
- Indication of True Heading, Time and Distance to final waypoint in the Waypoint, reference, airfield and target modes.

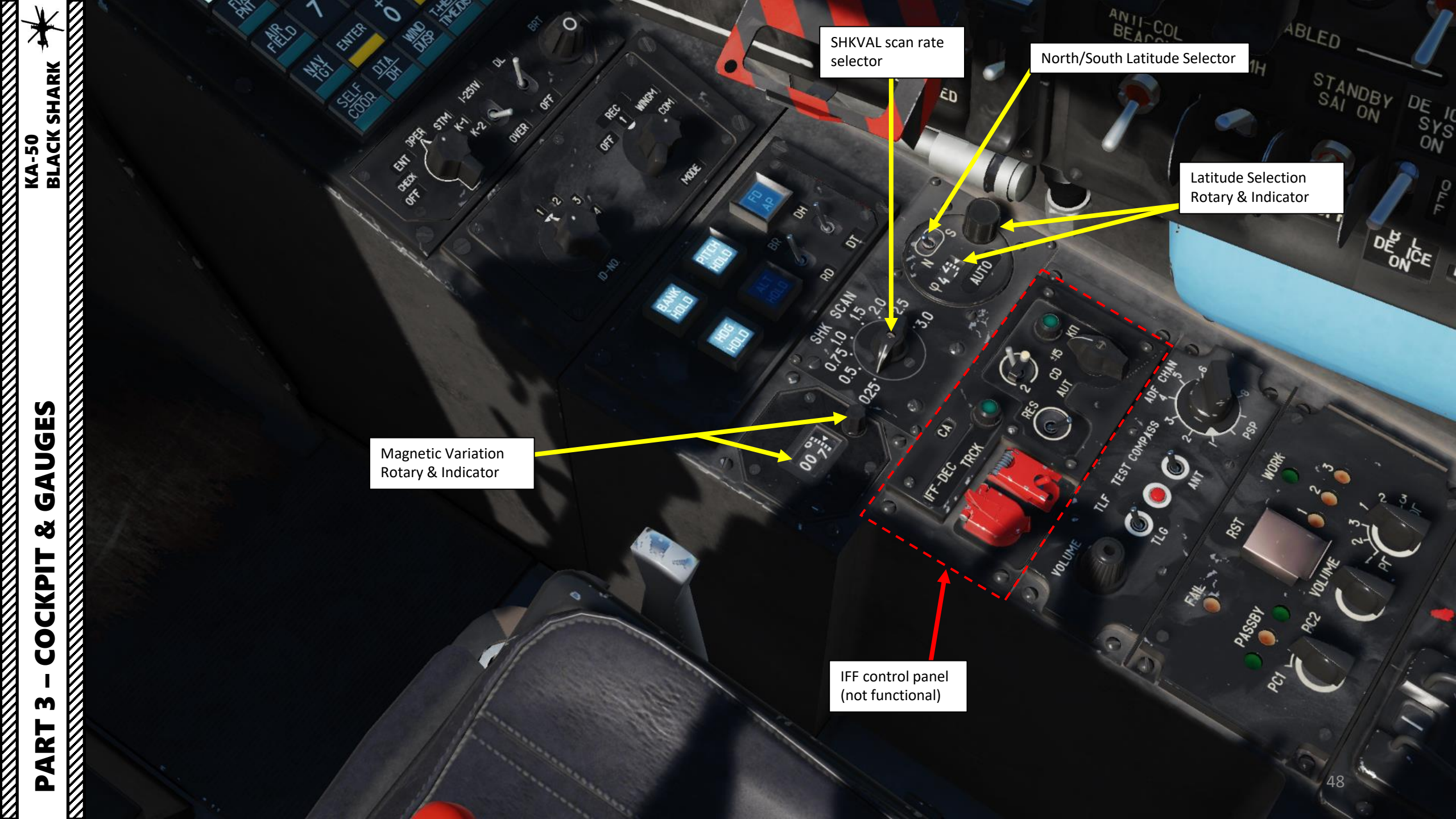
DTA/DH Button
- Indication of DTA (Desired Track Angle) or DH (Desired Heading), time and distance to current waypoint in the Waypoint, Reference Airfield, and Target navigation modes.

WIND DI/SP Button
- Indication of wind direction (FROM) and wind speed (m/s).

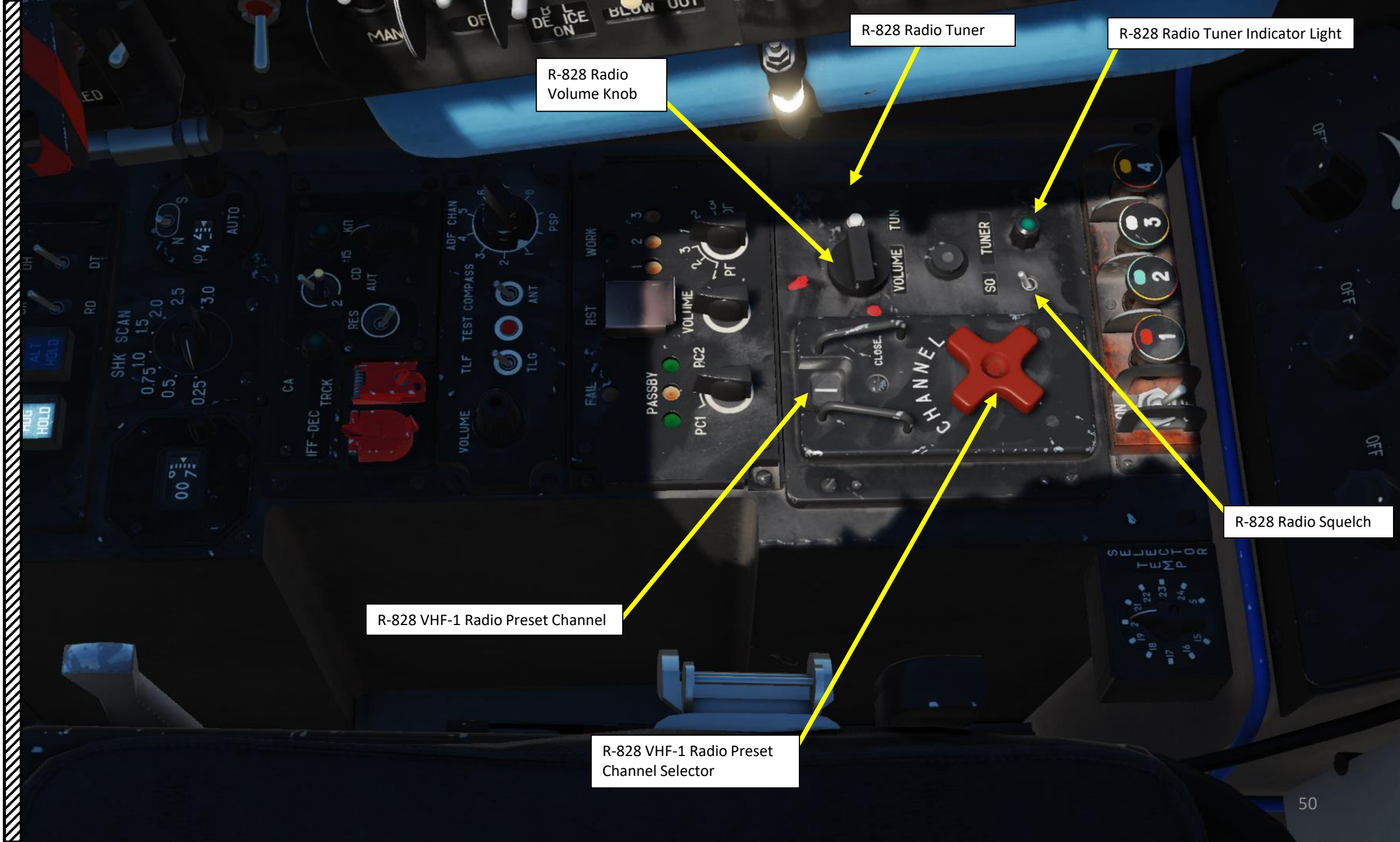
PART 3 – COCKPIT & GAUGES



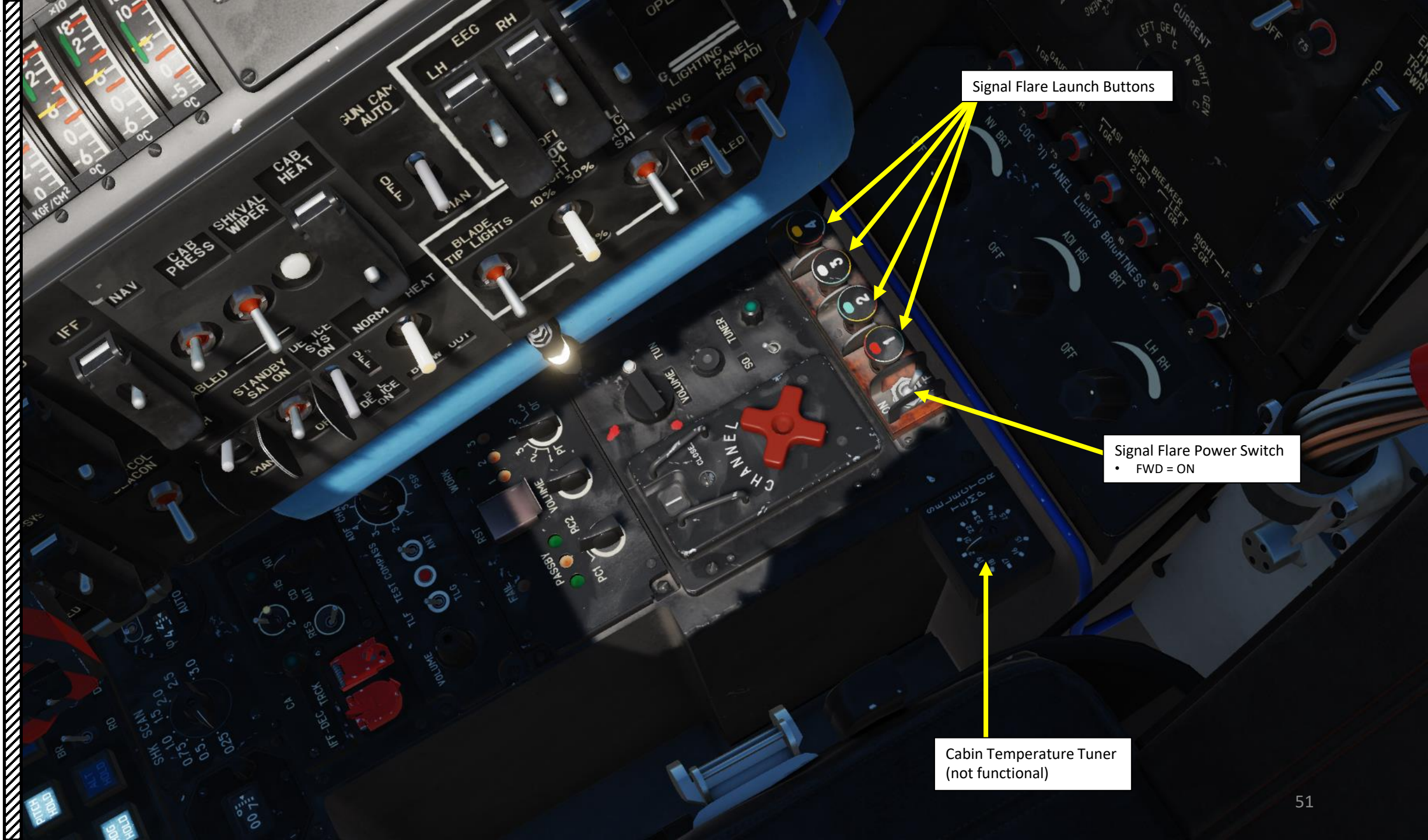
PART 3 – COCKPIT & GAUGES



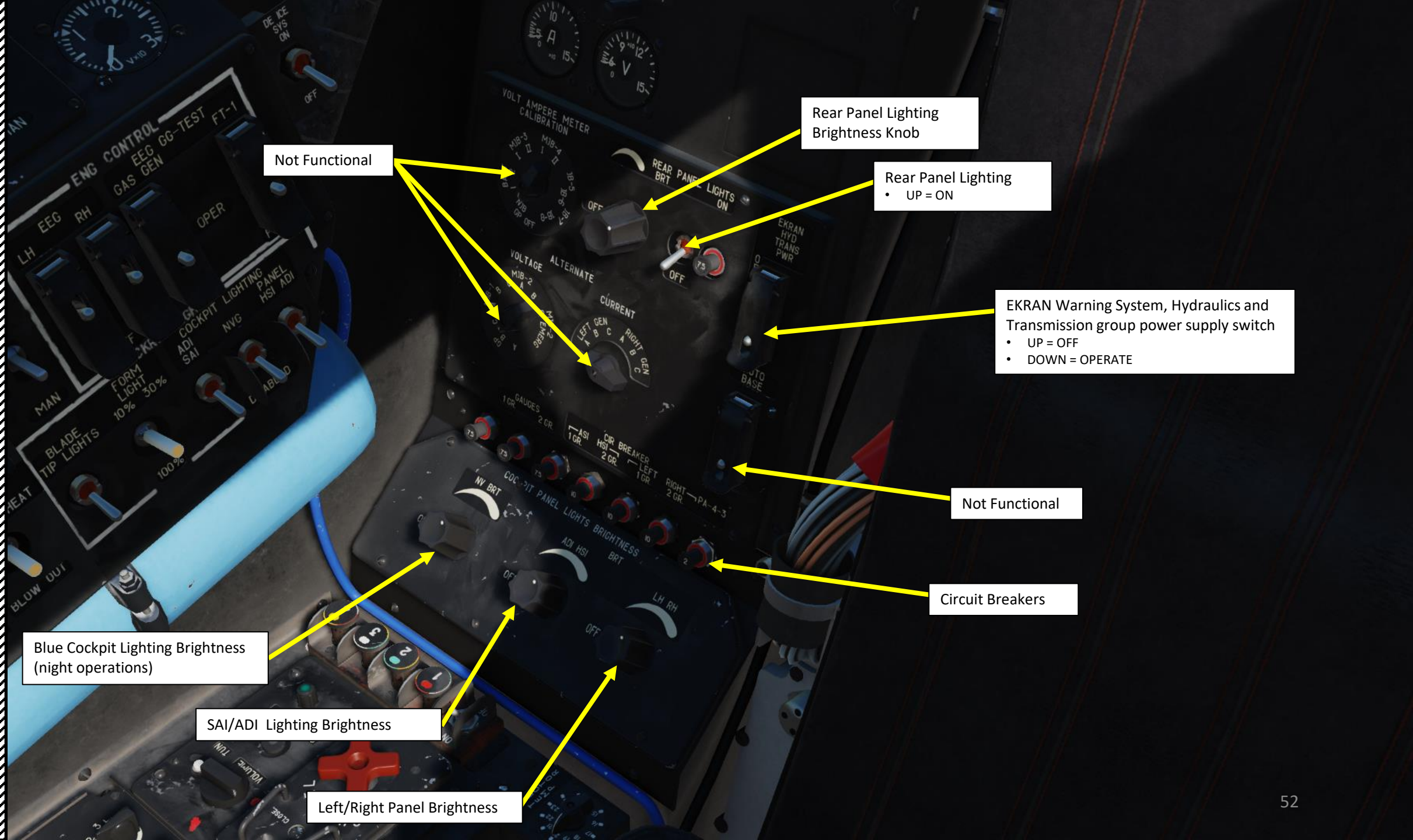
PART 3 – COCKPIT & GAUGES


R-828 Radio Volume Knob
R-828 Radio Tuner
R-828 Radio Tuner Indicator Light
R-828 Radio Squelch
R-828 VHF-1 Radio Preset Channel
R-828 VHF-1 Radio Preset Channel Selector

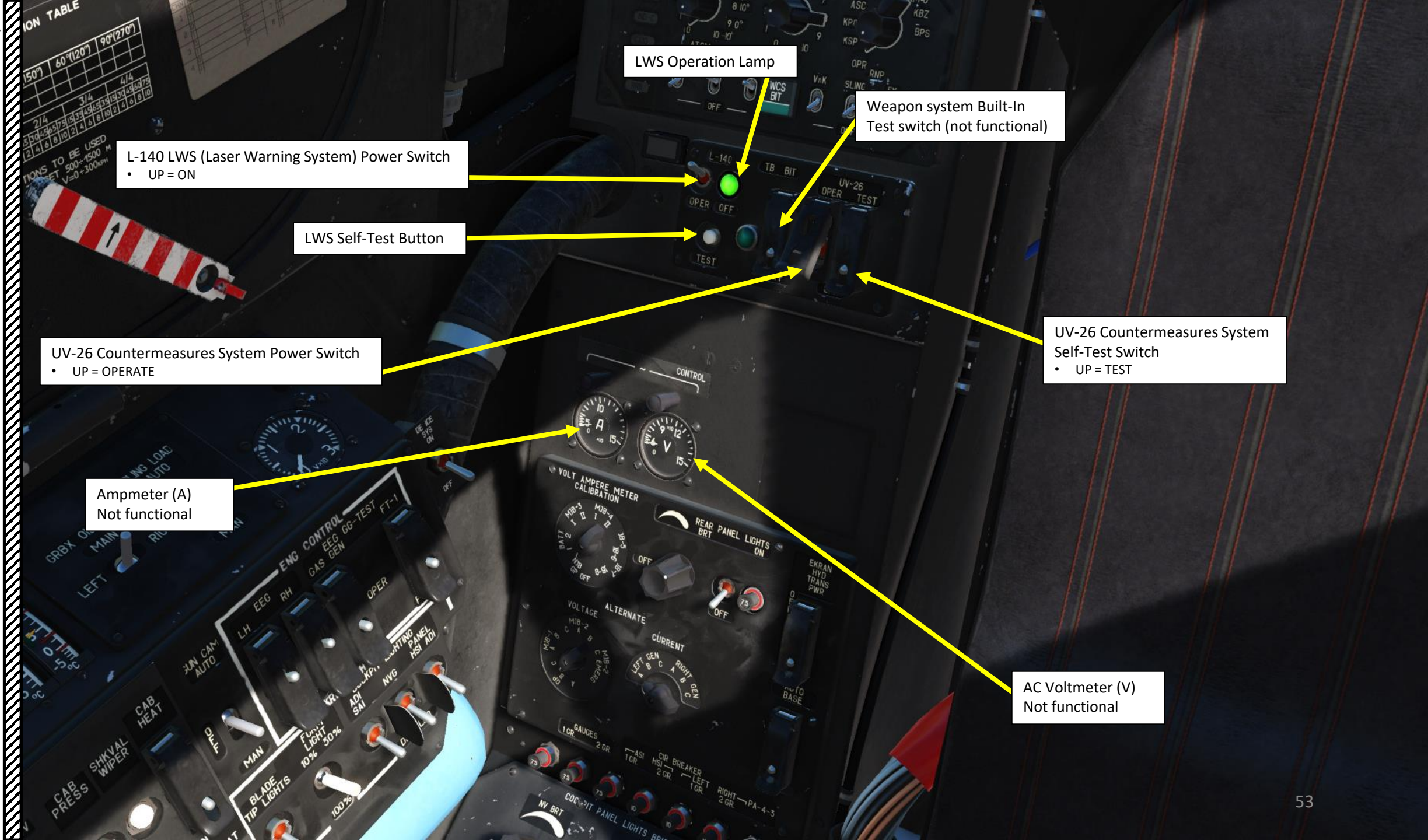
PART 3 – COCKPIT & GAUGES

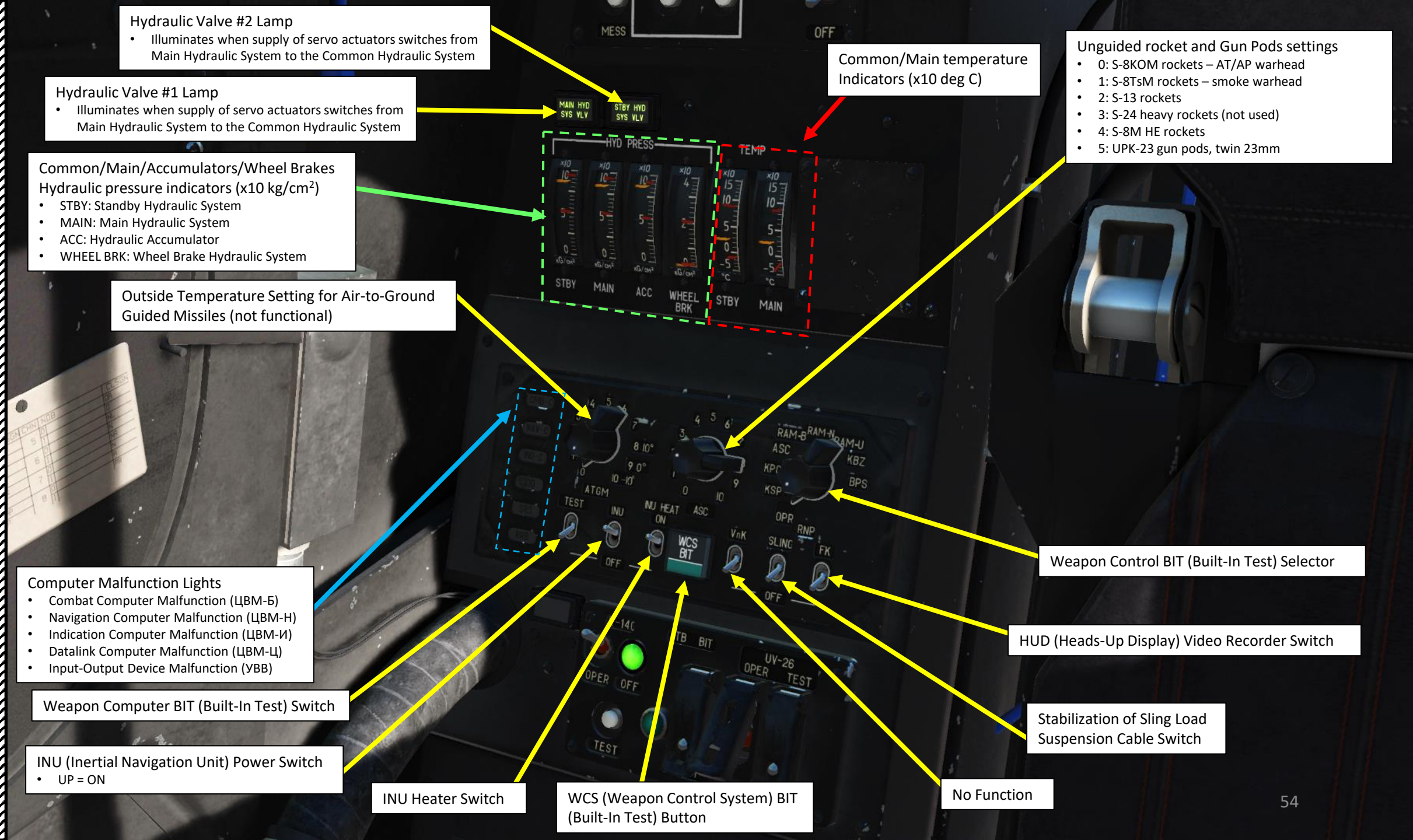


PART 3 – COCKPIT & GAUGES



PART 3 – COCKPIT & GAUGES





Hydraulic Valve #2 Lamp
- Illuminates when supply of servo actuators switches from Main Hydraulic System to the Common Hydraulic System

Hydraulic Valve #1 Lamp
- Illuminates when supply of servo actuators switches from Main Hydraulic System to the Common Hydraulic System

Common/Main/Accumulators/Wheel Brakes Hydraulic pressure indicators (x10 kg/cm^2)
- STBY: Standby Hydraulic System
- MAIN: Main Hydraulic System
- ACC: Hydraulic Accumulator
- WHEEL BRK: Wheel Brake Hydraulic System

Outside Temperature Setting for Air-to-Ground Guided Missiles (not functional)

Common/Main temperature Indicators (x10 deg C)

Unguided rocket and Gun Pods settings
- 0: S-8KOM rockets – AT/AP warhead
- 1: S-8TsM rockets – smoke warhead
- 2: S-13 rockets
- 3: S-24 heavy rockets (not used)
- 4: S-8M HE rockets
- 5: UPK-23 gun pods, twin 23mm

Computer Malfunction Lights
- Combat Computer Malfunction (ЦВМ-Б)
- Navigation Computer Malfunction (ЦВМ-Н)
- Indication Computer Malfunction (ЦВМ-И)
- Datalink Computer Malfunction (ЦВМ-Ц)
- Input-Output Device Malfunction (УВВ)

Weapon Computer BIT (Built-In Test) Switch

INU (Inertial Navigation Unit) Power Switch
- UP = ON

INU Heater Switch

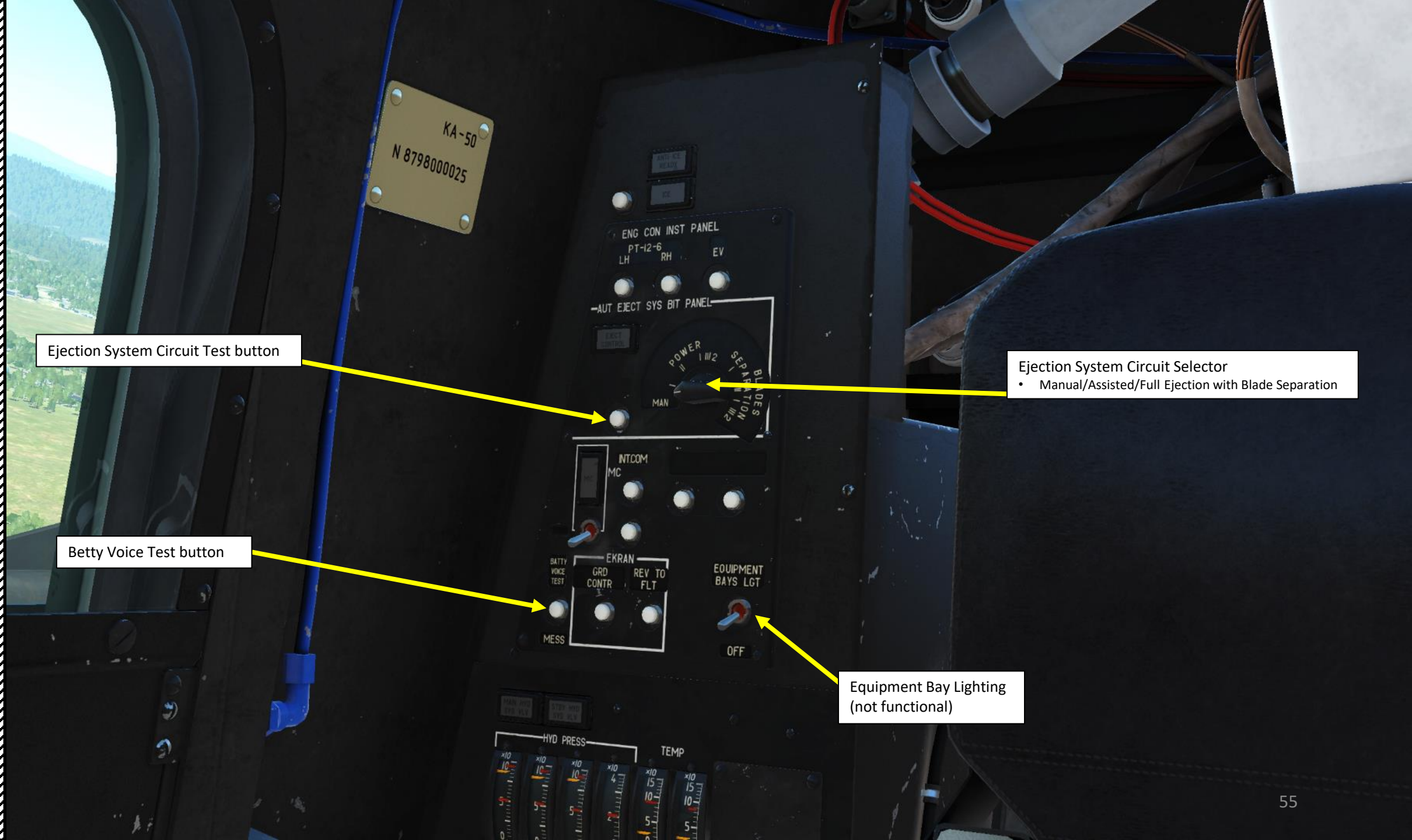
WCS (Weapon Control System) BIT (Built-In Test) Button

No Function

Stabilization of Sling Load Suspension Cable Switch

HUD (Heads-Up Display) Video Recorder Switch

Weapon Control BIT (Built-In Test) Selector

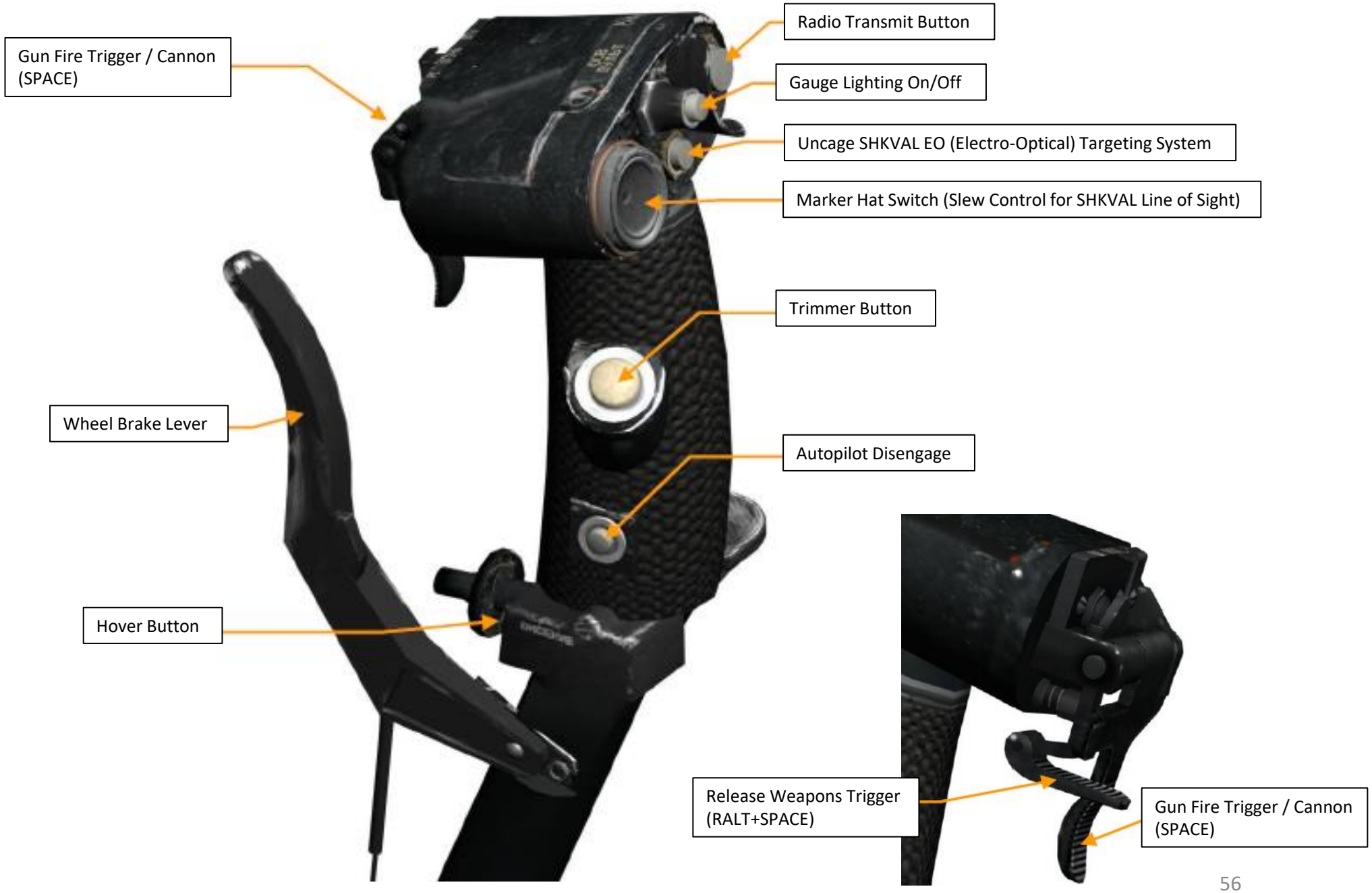


Ejection System Circuit Test button

Ejection System Circuit Selector
- Manual/Assisted/Full Ejection with Blade Separation

Betty Voice Test button

Equipment Bay Lighting (not functional)


Gun Fire Trigger / Cannon (SPACE)
Radio Transmit Button
Gauge Lighting On/Off
Uncage SHKVAL EO (Electro-Optical) Targeting System
Marker Hat Switch (Slew Control for SHKVAL Line of Sight)
Trimmer Button
Wheel Brake Lever
Autopilot Disengage
Hover Button
Release Weapons Trigger (RALT+SPACE)
Gun Fire Trigger / Cannon (SPACE)

ROCKETS CORRECTION TABLE

VERTICAL, MILS

DM \ IAS KPH	0	120	200	300
500	-53	-68	-35	-18
1000	-58	-73	-40	-13
1500	-65	-60	-46	8
2000	-74	-88	-54	1

HORIZONTAL, MILS

CROSSWIND WIND ANGLE	30°(150°)			60°(120°)			90°(270°)		
WIND SPEED M/S	5	10	20	5	10	20	5	10	20
CORRECTION	5	10	19	8	17	32	10	19	38

ASPECT	1/4					2/4					3/4					4/4				
SPEED KPH	15	35	45	65	75	15	30	45	65	75	15	35	45	65	35	15	30	45	60	75
CORRECTION	2	4	6	8	10	2	4	6	8	10	2	4	6	8	10	2	4	6	8	10

ROCKETS CORRECTION TABLE

VERTICAL–MINUS 7 MILS
HORIZONTAL MILS

CROSSWIND WIND ANGLE	30°(150°)			60°(120°)			90°(270°)		
WIND SPEED M/S									
CORRECTION									

ASPECT	1/4					2/4					3/4					4/4				
SPEED KPH	15	35	45	65	75	15	30	45	65	75	15	35	45	65	35	15	30	45	60	75
CORRECTION	2	4	6	8	10	2	4	6	8	10	2	4	6	8	10	2	4	6	8	10

NOTE:

GIVEN CORRECTIONS TO BE USED
AT RANG[illegible] TARGET 500÷1500 M
HELIC[illegible] SPEED V=0÷300KPH

CHN	NDB	CLSGN	CHN	NDB	CLSGN
1	0	OC	5	0	DA
	1	O		1	D
2	0	DG	6	0	NL
	1	D		1	N
3	0	KW	7	0	NR
	1	K		1	N
4	0	AP	8	0	A
	1	P		1	PR

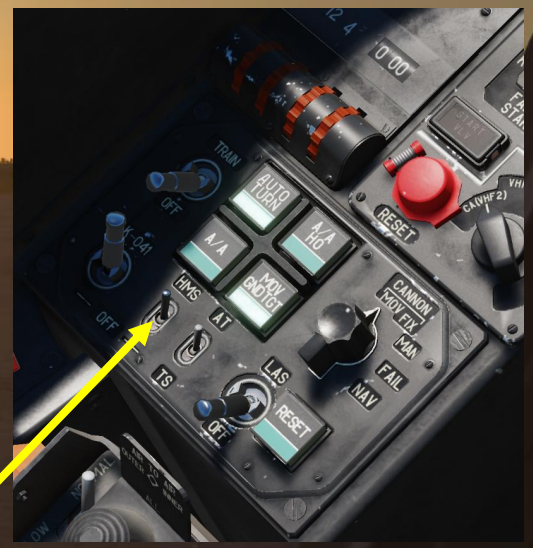
PART 3 – COCKPIT & GAUGES


Outside Air Temperature (deg C)

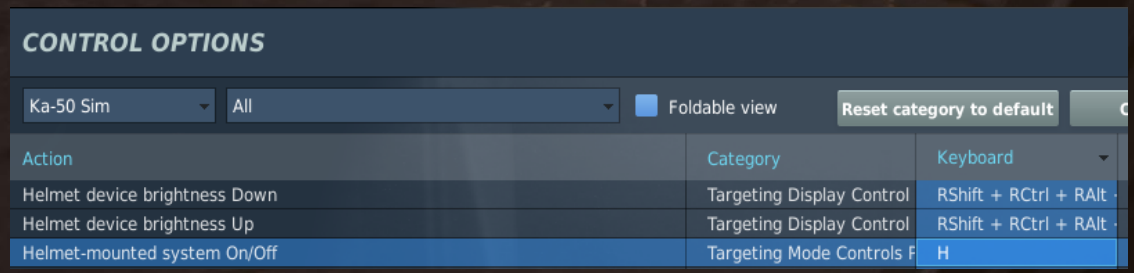
AUTO
2. Main. Ground Crew
F1. Rearm & Refuel
F2. Ground Electric Power...
F3. Request Repair
F4. Change helmet-mounted device...
F5. Select power source...
F11. Previous Menu
F12. Exit

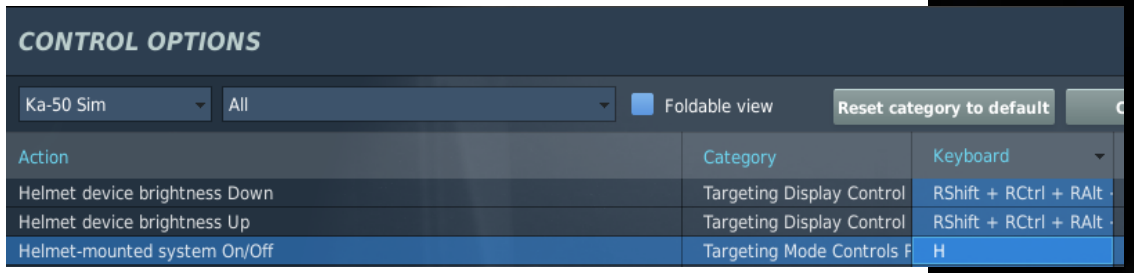
HMS (Helmet-Mounted Sight) Reticle

HMS (Helmet-Mounted Sight) System Power Switch



Head-Mounted System Controls
ON/OFF: "H" key, or the HMS System Power Switch
By default: HMS equipped during Day, NVG (Night Vision Goggles) equipped during Night
Note: You can switch HMS/NVG setup by pressing "/", choosing the "F8: Ground Crew" menu and choosing the "F4: Change helmet-mounted device".



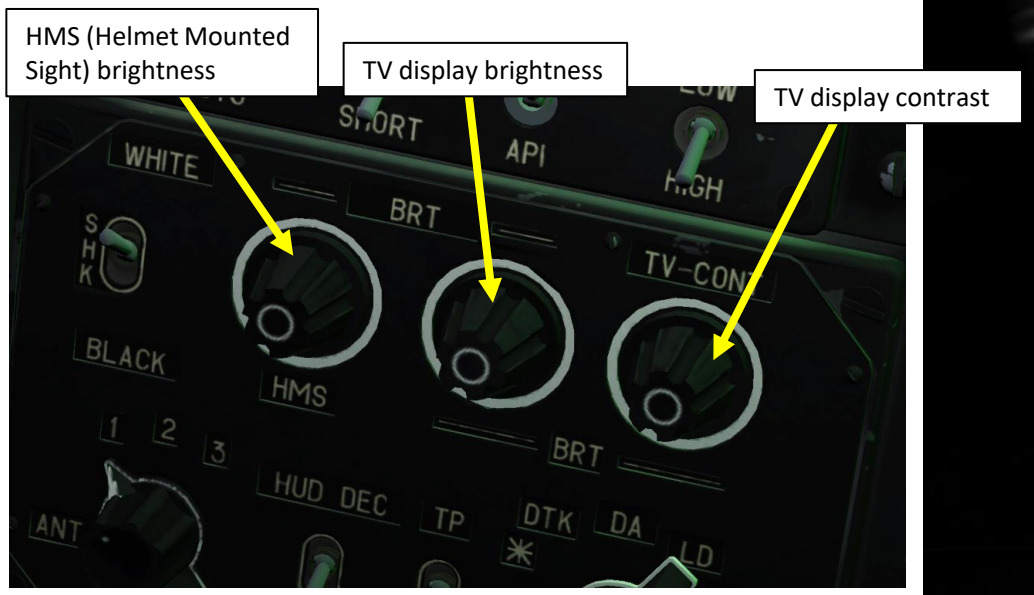


Night Vision Goggles Controls

- ON/OFF: "H" key
- Brightness UP: RALT+RCTRL+RSHIFT+]
- Brightness DOWN: RALT+RCTRL+RSHIFT+[

By default: HMS equipped during Day, NVG (Night Vision Goggles) equipped during Night

Note: You can switch HMS/NVG setup by pressing "/", choosing the "F8: Ground Crew" menu and choosing the "F4: Change helmet-mounted device".




UV-26 Countermeasure
Flare Cartridge Dispenser
Signal Flare
Cartridge Dispenser
22

PART 3 – COCKPIT & GAUGES

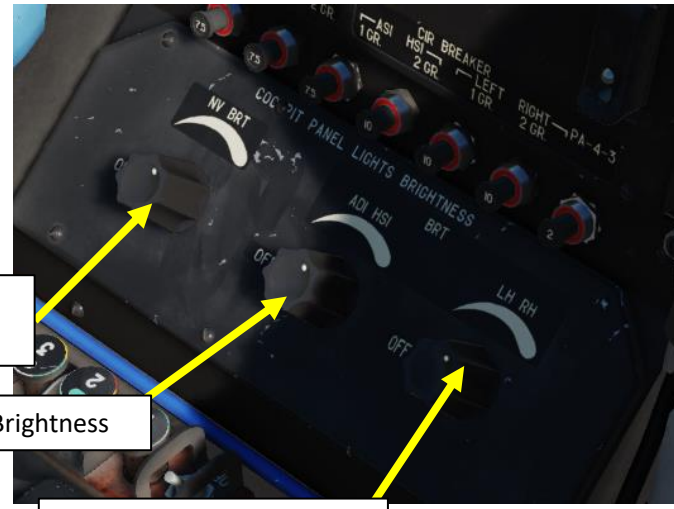
PART 3 – COCKPIT & GAUGES

SAI (Standby Attitude Indicator) & ADI (Attitude Director Indicator) Lighting
- UP = ON

Cockpit Lighting
- UP = ON

Night Vision Cockpit Lighting
- UP = ON

HUD mode
Day/Night/Reticle

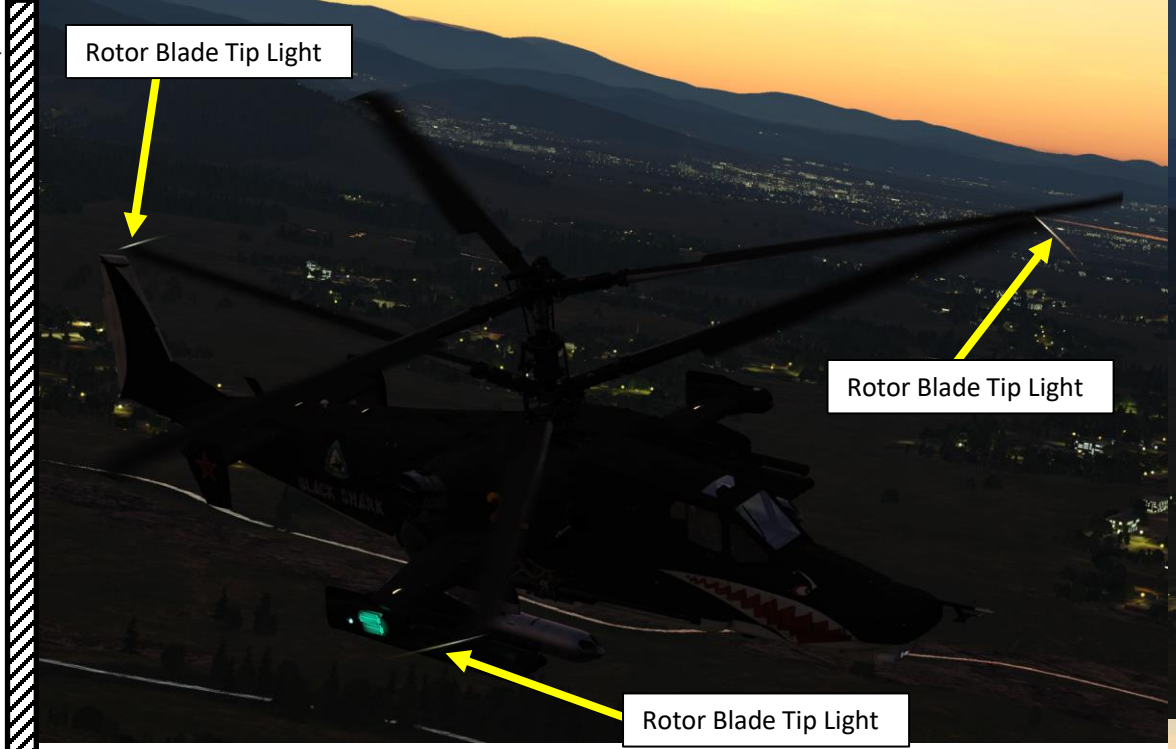


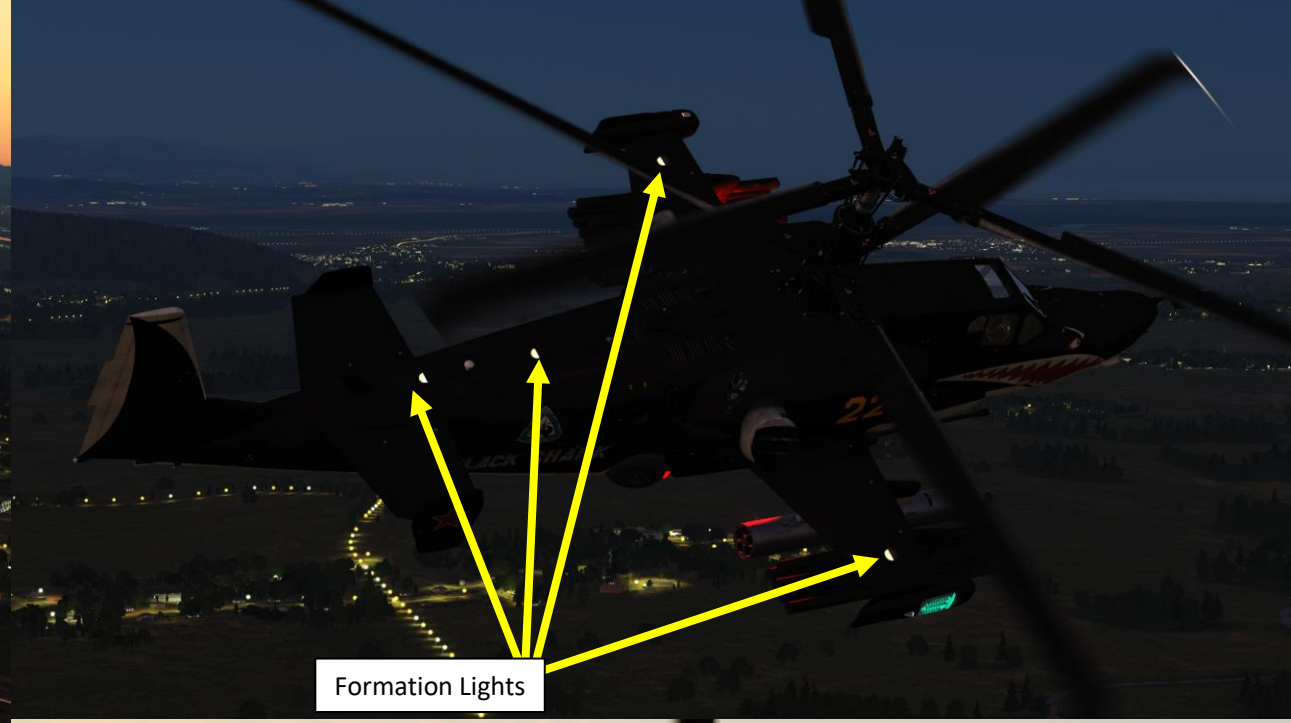
Blue Cockpit Lighting Brightness (night operations)

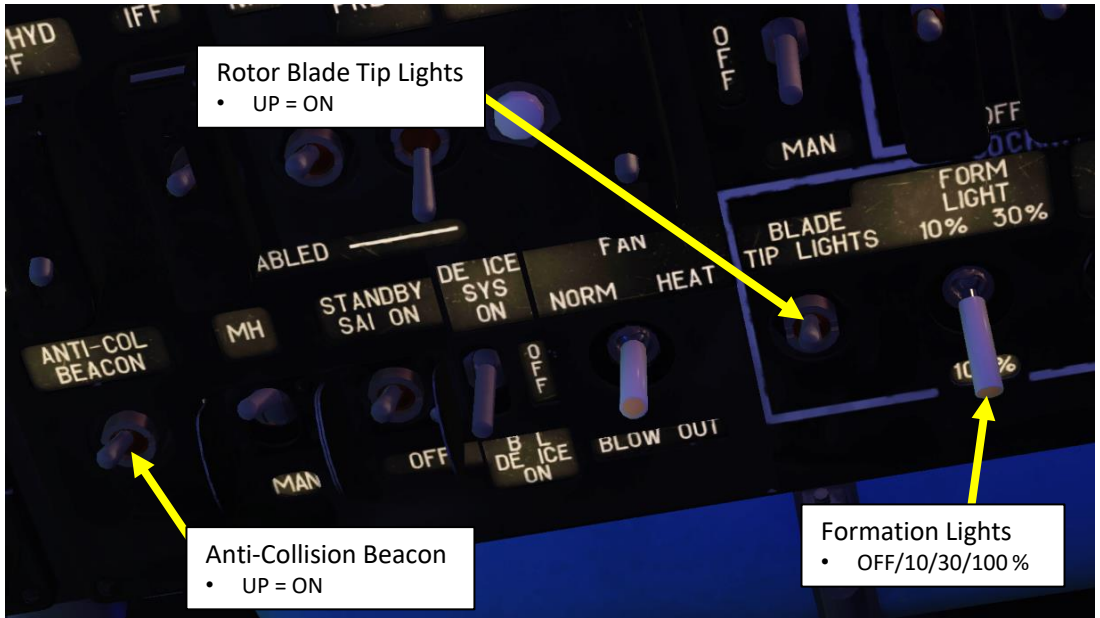
SAI/ADI Lighting Brightness

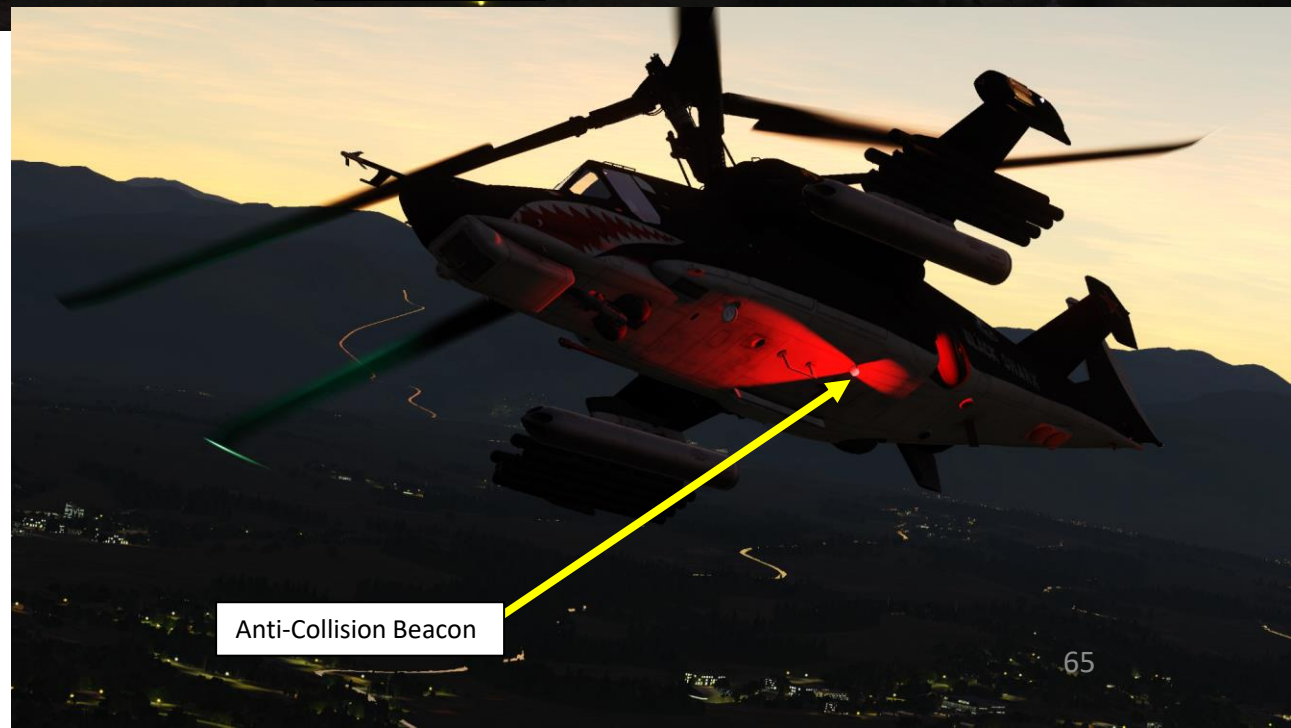
Left/Right Panel Brightness

PART 3 – COCKPIT & GAUGES









PART 3 – COCKPIT & GAUGES

Navigation Lights Switch
- OFF/10/30/100 %

Navigation Light

Navigation Light

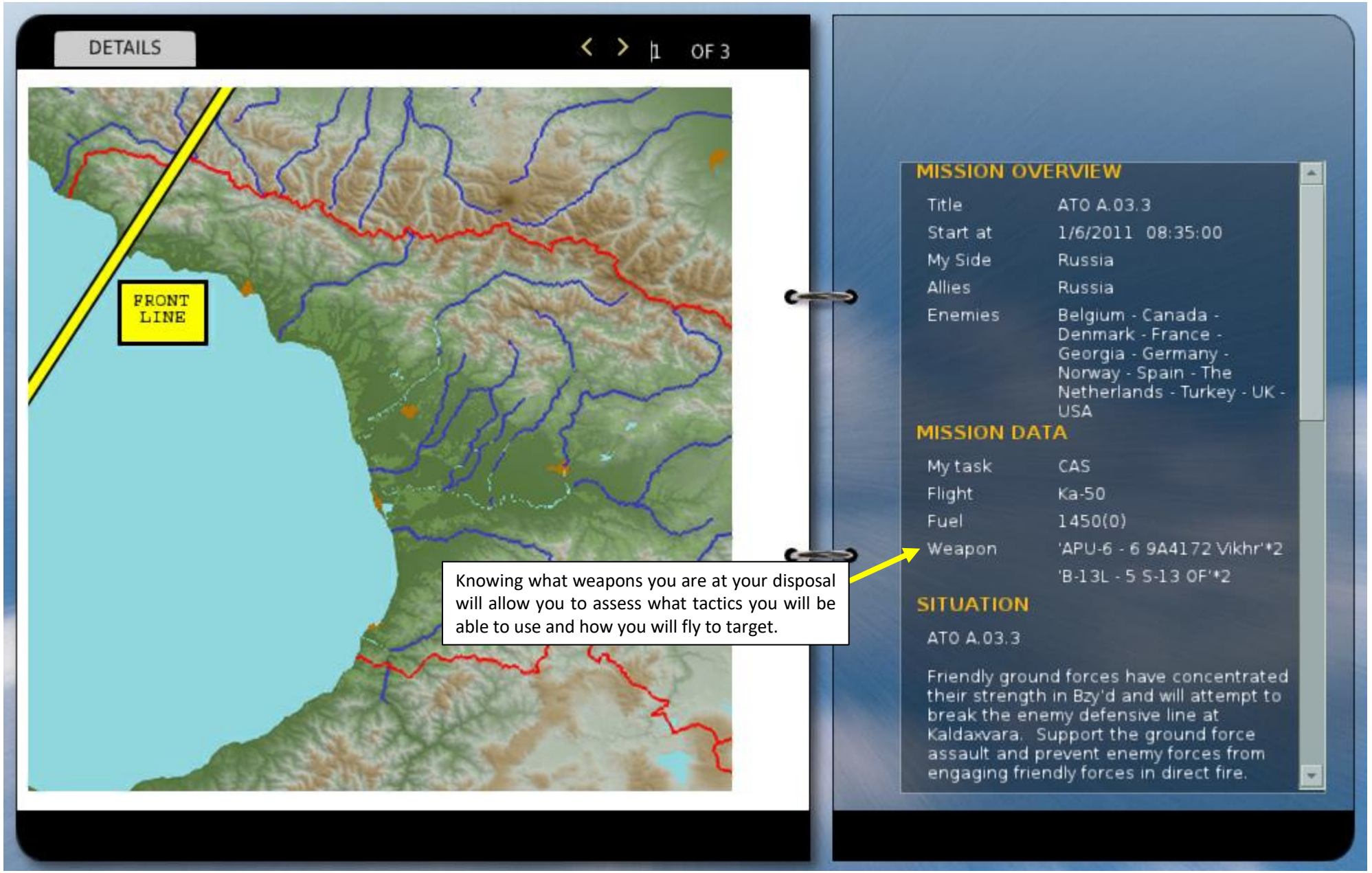
PART 3 – COCKPIT & GAUGES

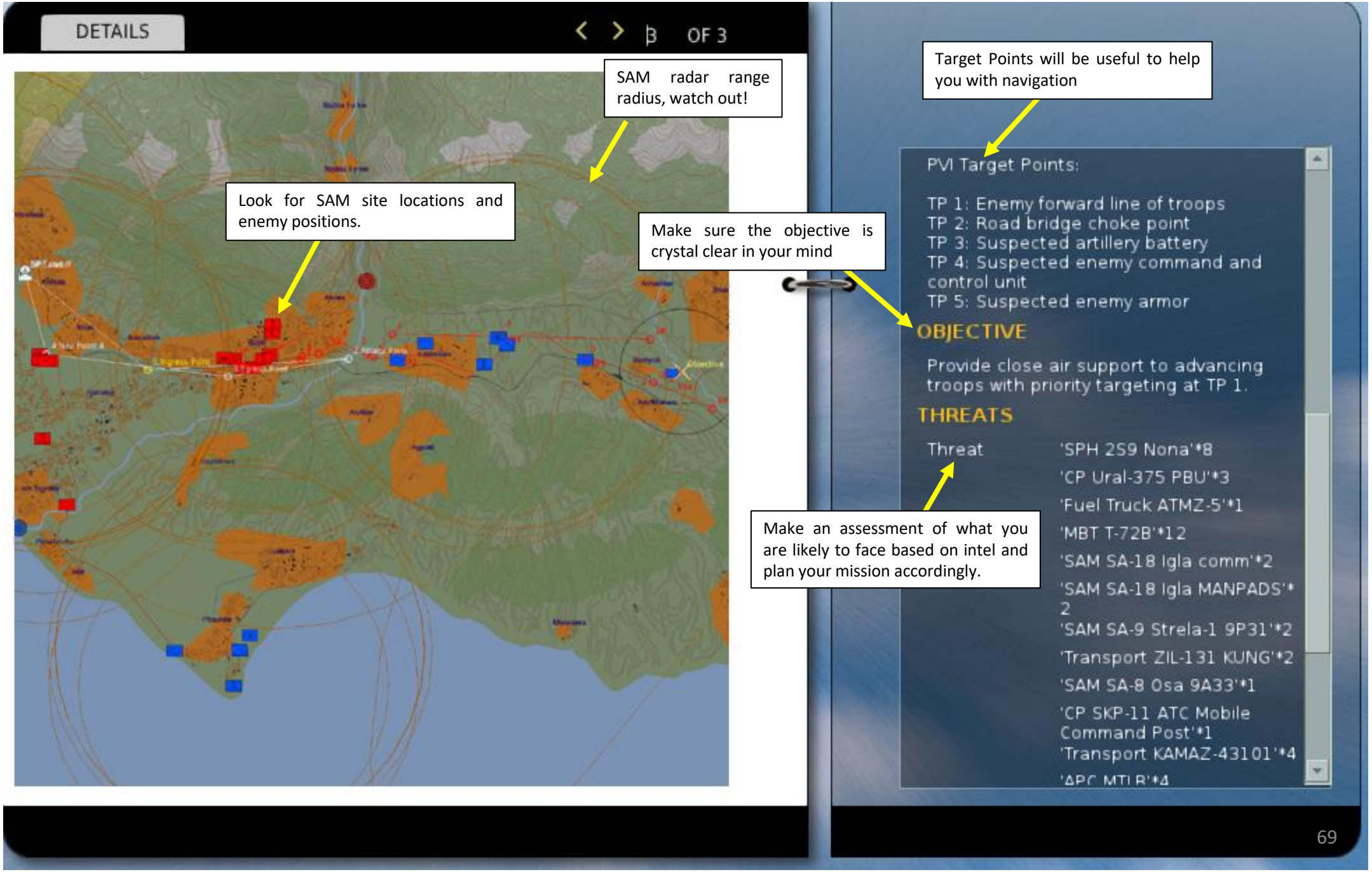
Landing Gears

Landing Light Switch

Landing Light

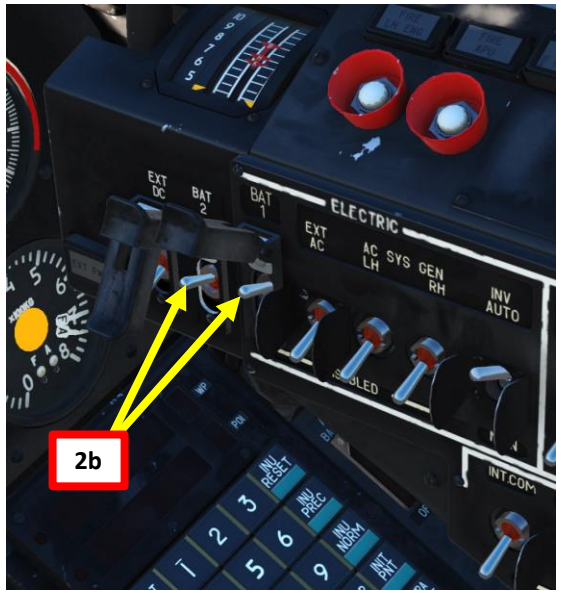
Pre-flight procedures in the Ka-50 can be quite an extensive subject. For each mission, you should read the briefing carefully and look for specific information as shown in the great **Georgian Oil War** campaign.

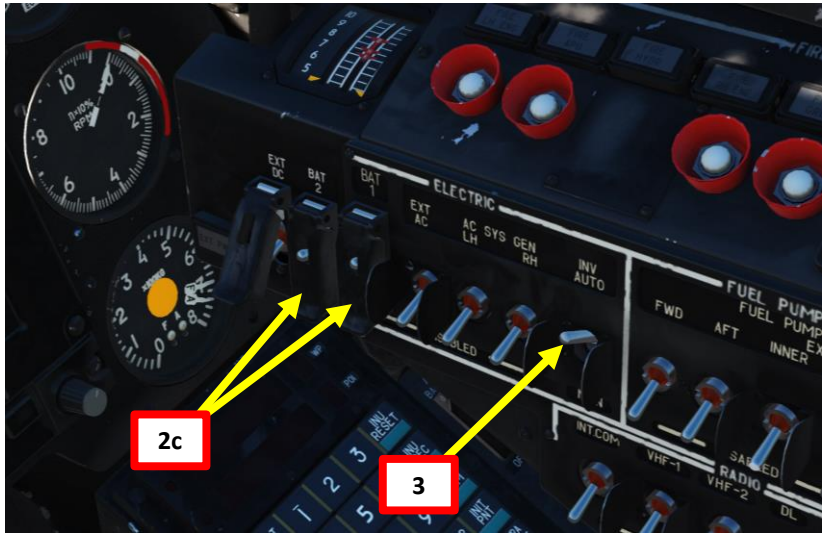



DETAILS
β OF 3
SAM radar range radius, watch out!
Look for SAM site locations and enemy positions.
Make sure the objective is crystal clear in your mind
Target Points will be useful to help you with navigation
Make an assessment of what you are likely to face based on intel and plan your mission accordingly.
PVI Target Points:
TP 1: Enemy forward line of troops
TP 2: Road bridge choke point
TP 3: Suspected artillery battery
TP 4: Suspected enemy command and control unit
TP 5: Suspected enemy armor
OBJECTIVE
Provide close air support to advancing troops with priority targeting at TP 1.
THREATS
Threat
'SPH 2S9 Nona'*8
'CP Ural-375 PBU'*3
'Fuel Truck ATMZ-5'*1
'MBT T-72B'*12
'SAM SA-18 Igla comm'*2
'SAM SA-18 Igla MANPADS'*2
'SAM SA-9 Strela-1 9P31'*2
'Transport ZIL-131 KUNG'*2
'SAM SA-8 Osa 9A33'*1
'CP SKP-11 ATC Mobile Command Post'*1
'Transport KAMAZ-43101'*4

PRE-START

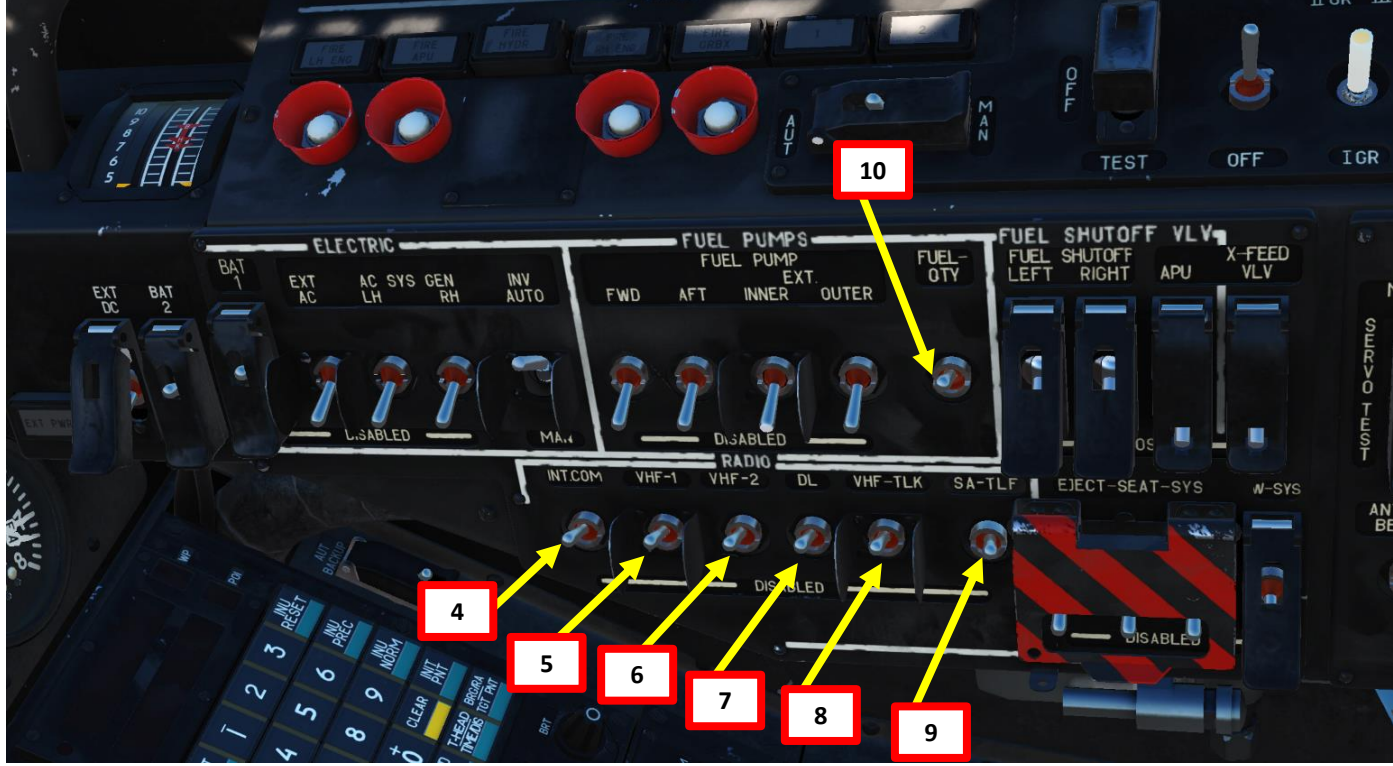
1. Close side door using RCTRL+C
2. Battery 1 & 2 – ON
   - Set cover UP, set switch UP, then set cover DOWN
3. Inverter switch – AUTO (UP)

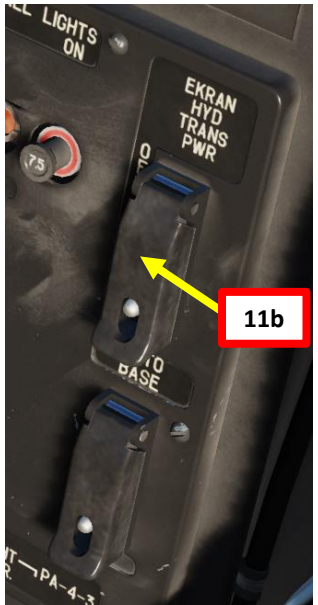




PRE-START

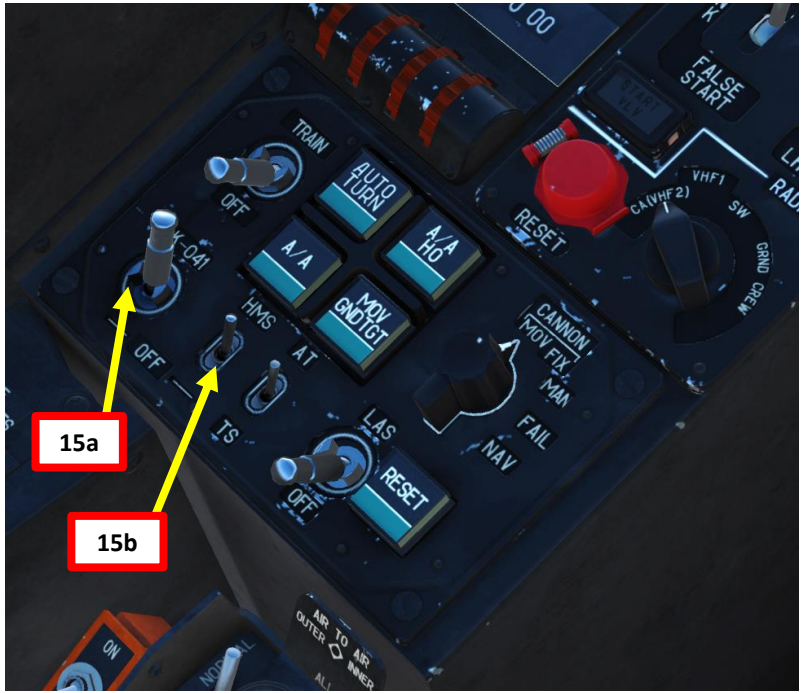
4. Intercom switch – ON (UP)
5. R-828 VHF-1 power switch – ON (UP)
6. R-800 VHF-2 power switch – ON (UP)
7. DL (Datalink) power switch – ON (UP)
8. VHF-TLK switch – ON (UP)
9. SA-TLF switch – ON (UP)
10. Fuel Quantity switch – ON (UP)
11. EKRAN-HYDRO – ON (DOWN)
    - Set cover UP, set switch DOWN, then set cover DOWN
12. INU switch – ON
    - Press Master Caution light to turn it off

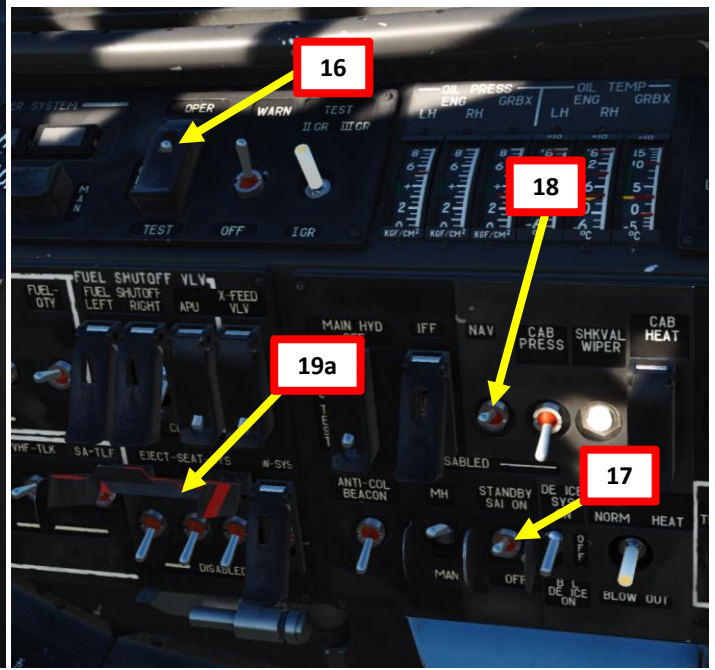


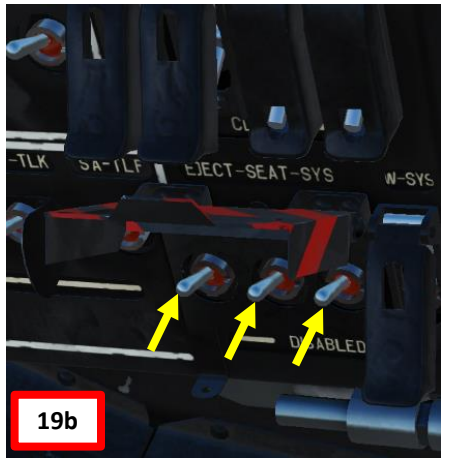


PRE-START

13. ABRIS (AMMS, Advanced Moving Map System) Power switch – ON (UP)
    - Start-up sequence takes about 120 seconds
14. Set interior and exterior lights – As Required
15. K-041 Targeting System and HMS (Helmet-Mounted system) switches – ON (FWD)
16. Fire Extinguisher switch – OPER
    - Set cover UP, set switch to OPER, then set cover DOWN
17. SAI (Standby Attitude Indicator) switch – ON (UP)
18. Set PVI-800 NAV SYSTEM switch – ON
19. Arm ejecting system power switches – UP
    - Flip cover UP, set three switches UP, flip cover DOWN

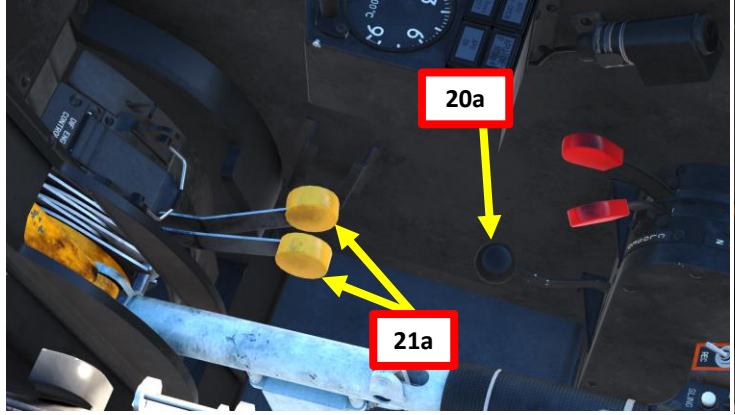


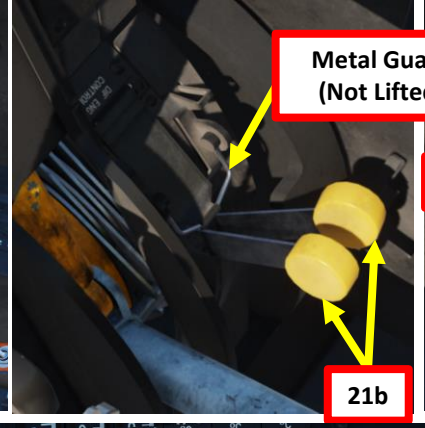


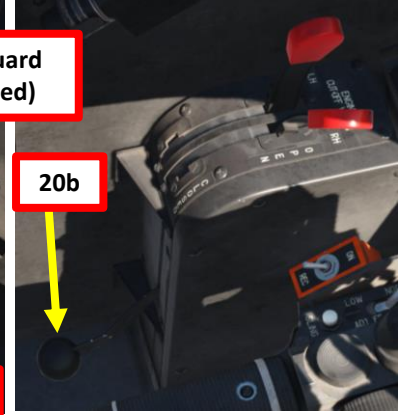


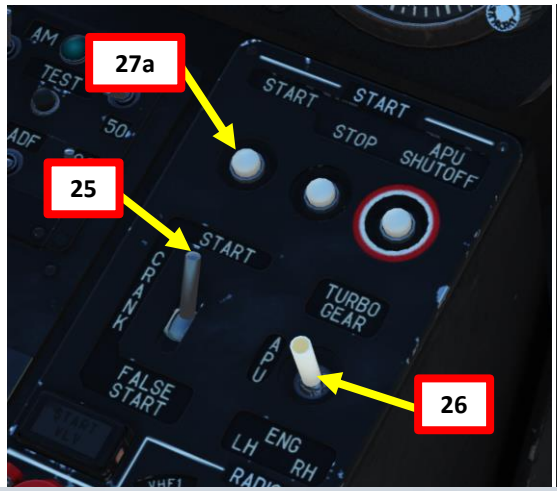
ENGINE START

20. Disengage rotor brake – DOWN position
21. Set throttle to AUTO (UP, just prior to lifting the metal guard).
    - *Note: Normally, we would leave throttles at IDLE (DOWN) first, start the engines, then back to AUTO… but for simplicity we will set them at AUTO from the beginning.*
22. Forward and Aft fuel pumps – ON (UP)
23. Left (Fwd), right (Aft) and APU fuel tank shutoff valves – OPEN (UP)
    - Set cover UP, set switch UP, then set cover DOWN
24. Left and Right EEG (Electronic Engine Governor) switches – ON (UP)
    - Set cover UP, set switch to ON, then set cover DOWN
25. Startup/Crank/False Start switch – START
26. Turbo Gear/APU/Left Engine/Right Engine switch – set to APU (centered position)
27. Press START button for 2-3 sec to start APU (Auxiliary Power Unit), which is later used to drive the engine starter.
    - APU start is completed within about 20-30 seconds in normal temperature conditions, but can take up to 1 minute in very cold conditions.
    - Once APU is running/operational:
      - APU EGT (Exhaust Gas Temperature) should stabilize to approx. 600 deg C (no more than 720 deg C)
      - APU OIL P NORM indication should be illuminated
      - APU ON indication should be illuminated as well.
    - Note: APU warm up, with no air bleeding, should take one minute before using it for main engine starts







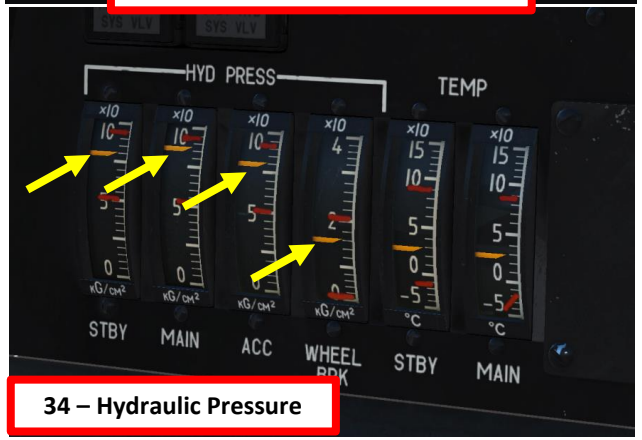


ENGINE START

ENGINE START

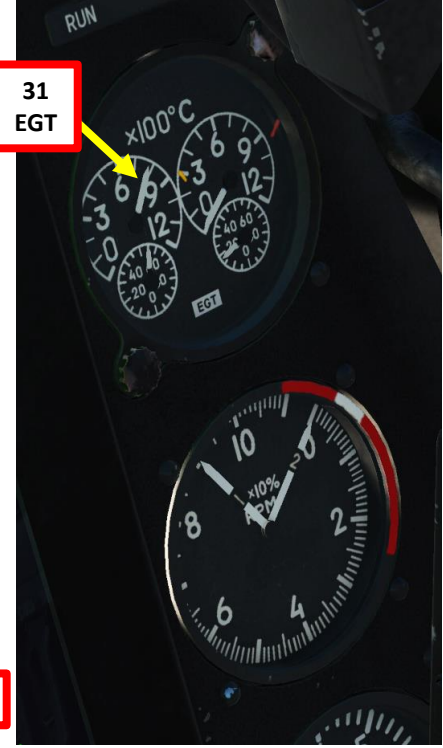
28. Turbo Gear/APU/Left Engine/Right Engine switch – set to LEFT engine
29. Press START button for 2-3 sec to start LEFT engine. START VLV light indicates the start valve is open.
30. When Left Engine's Gas Generator Speed reaches 20 % RPM, open LEFT engine shutoff valve (left red lever UP)
31. Confirm EGT (Exhaust Gas Temperature), engine oil pressure and transmission gearbox oil pressure increase. Monitor oil temperature accordingly.
32. Rotors motion should initiate at Gas Generator RPM of no more than 25% (visual confirmation by looking at the nearest blade)
33. Starter will disengage at Gas Generator RPM between 60 and 65%. Monitor this with the START light going off.
34. Confirm that hydraulic fluid pressure increases in all systems.

31 - Engine & Transmission Oil

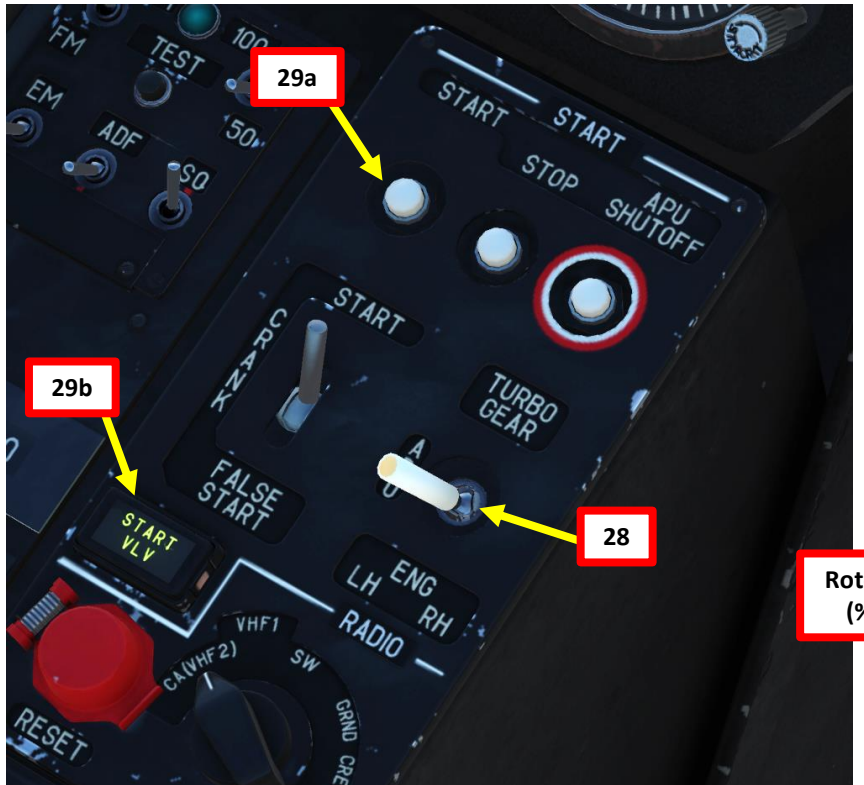


34 – Hydraulic Pressure

30a



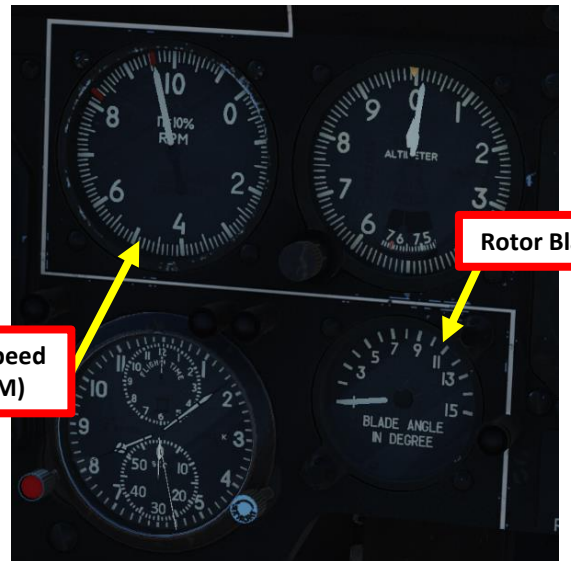
31 EGT



29a

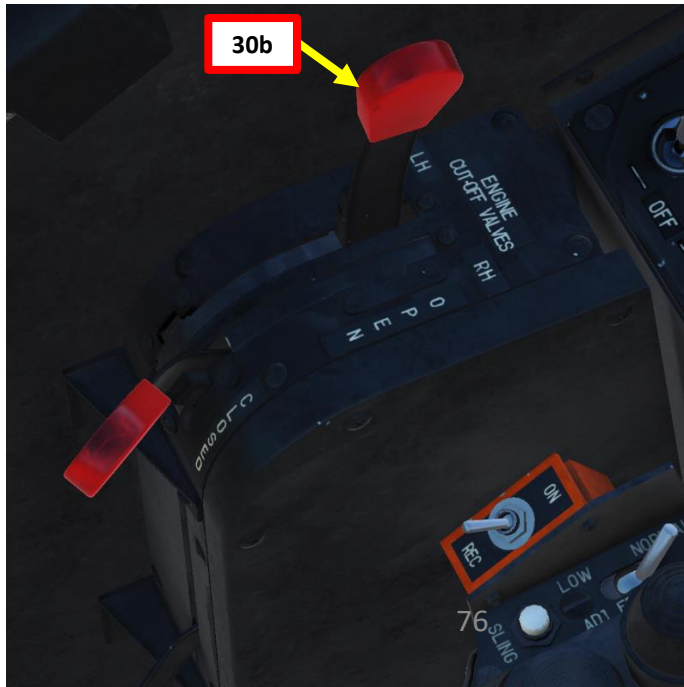
29b

28



Rotor Speed (% RPM)

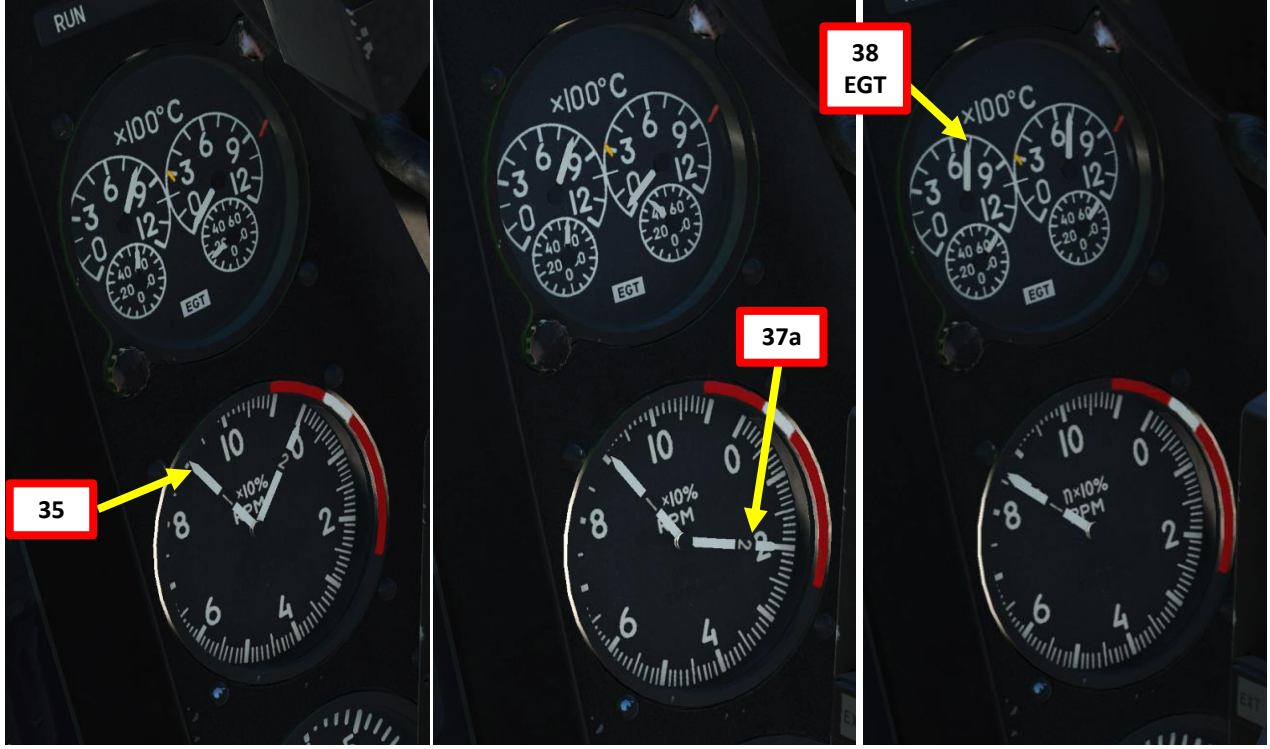
Rotor Blade Angle (deg)

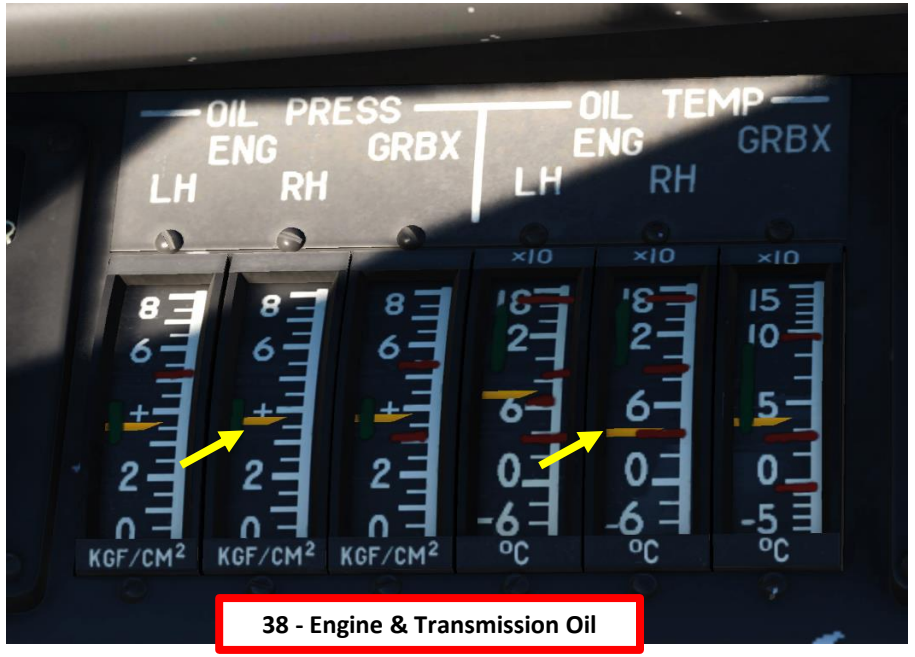


30b

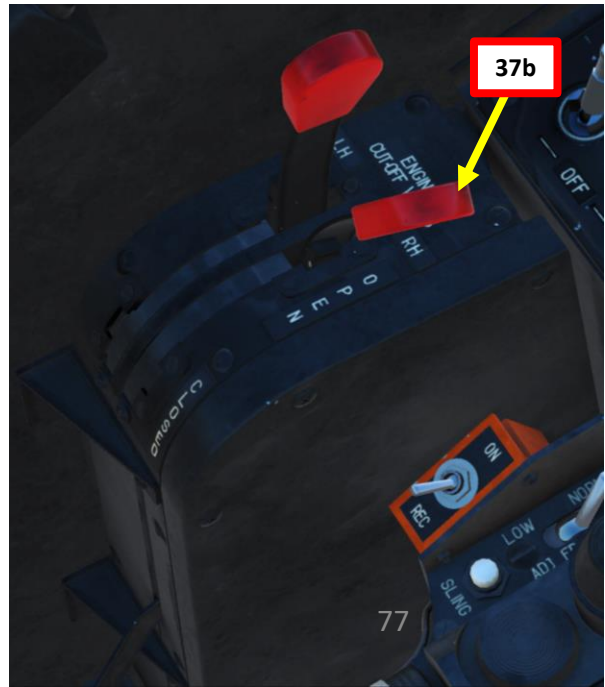
ENGINE START

35. When Left Engine's Gas Generator Speed stabilizes over 60 % RPM, you are ready for right engine start-up. Set Turbo Gear/APU/Left Engine/Right Engine switch to RIGHT engine.
36. Press START button for 2-3 sec to start RIGHT engine. START VLV light indicates the start valve is open.
37. When Right Engine's Gas Generator Speed reaches 20 % RPM, open RIGHT engine shutoff valve (right red lever UP)
38. Confirm EGT (Exhaust Gas Temperature), engine oil pressure increase. Monitor oil temperature accordingly.
39. Starter will disengage at Gas Generator RPM between 60 and 65%. Monitor this with the START light going off.



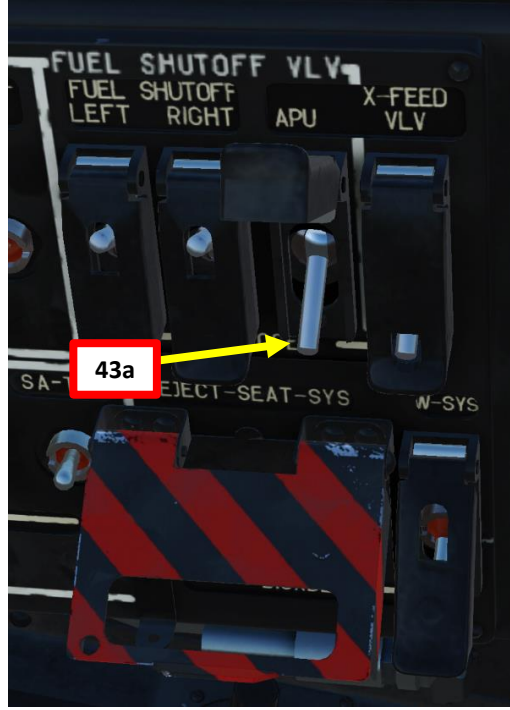


38 - Engine & Transmission Oil



ENGINE START

40. Verify that Rotor Speed stabilizes around 95-100 % RPM.
41. When Right Engine's Gas Generator Speed stabilizes over 60 % RPM, set Turbo Gear/APU/Left Engine/Right Engine switch to central position
42. Press APU SHUTOFF button when both engines are at IDLE power or above.
43. APU fuel tank shutoff valve – CLOSED (DOWN)
    - Set cover UP, set switch DOWN, then set cover DOWN

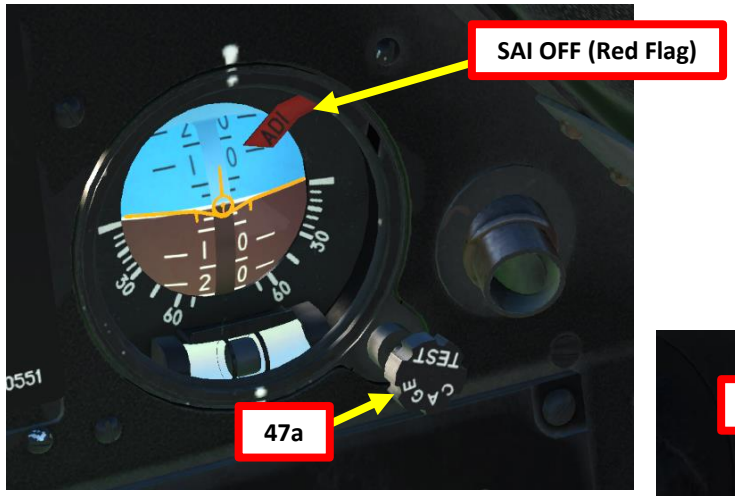


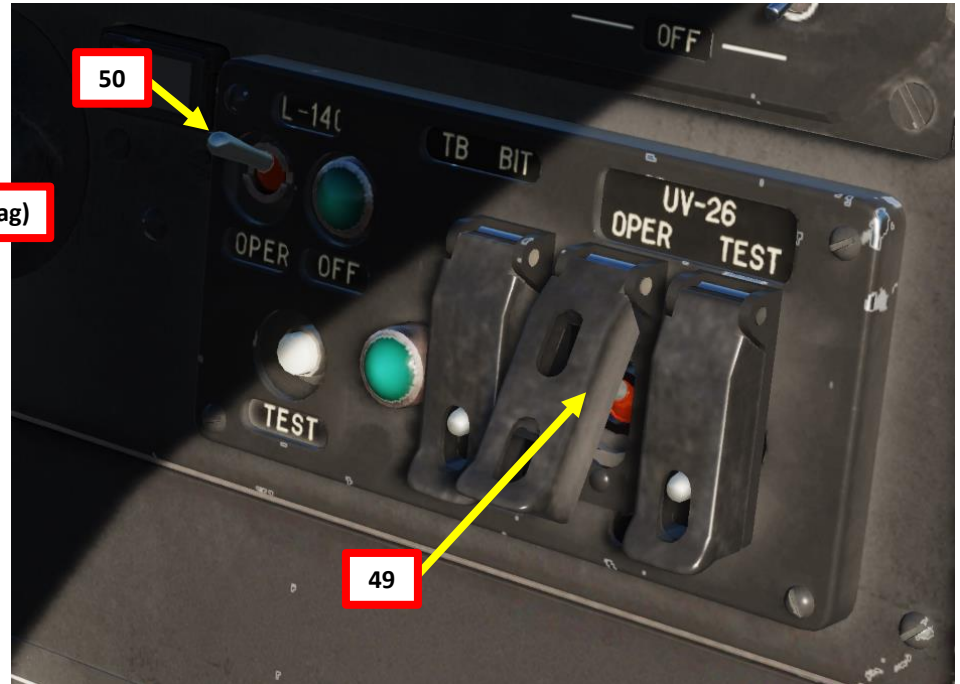
POST-START

44. LEFT and RIGHT AC Generators – ON (UP).
45. If Helmet-Mounted System (HMS) display appears and you want to turn it OFF, press “H” toggle it.

POST-START

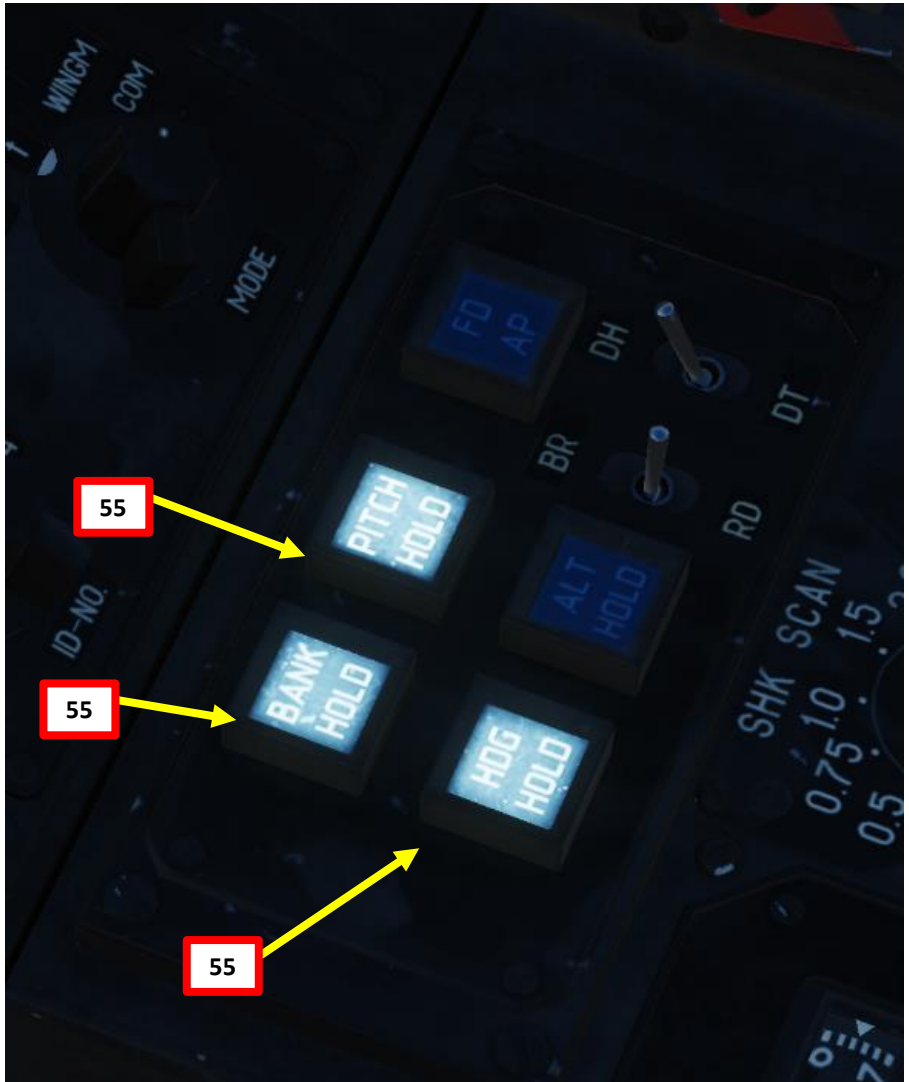
46. IFF (Identify-Friend-or-Foe) switch – ON (UP)
47. Uncage Standby ADI (Attitude Director Indicator) by scrolling mousewheel on the caging knob.
48. Engine Dust Protection system switch – ON (DOWN)
49. UV-26 Countermeatures power switch – ON (UP)
50. L-140 Laser Warning Receiver power switch – ON (UP)

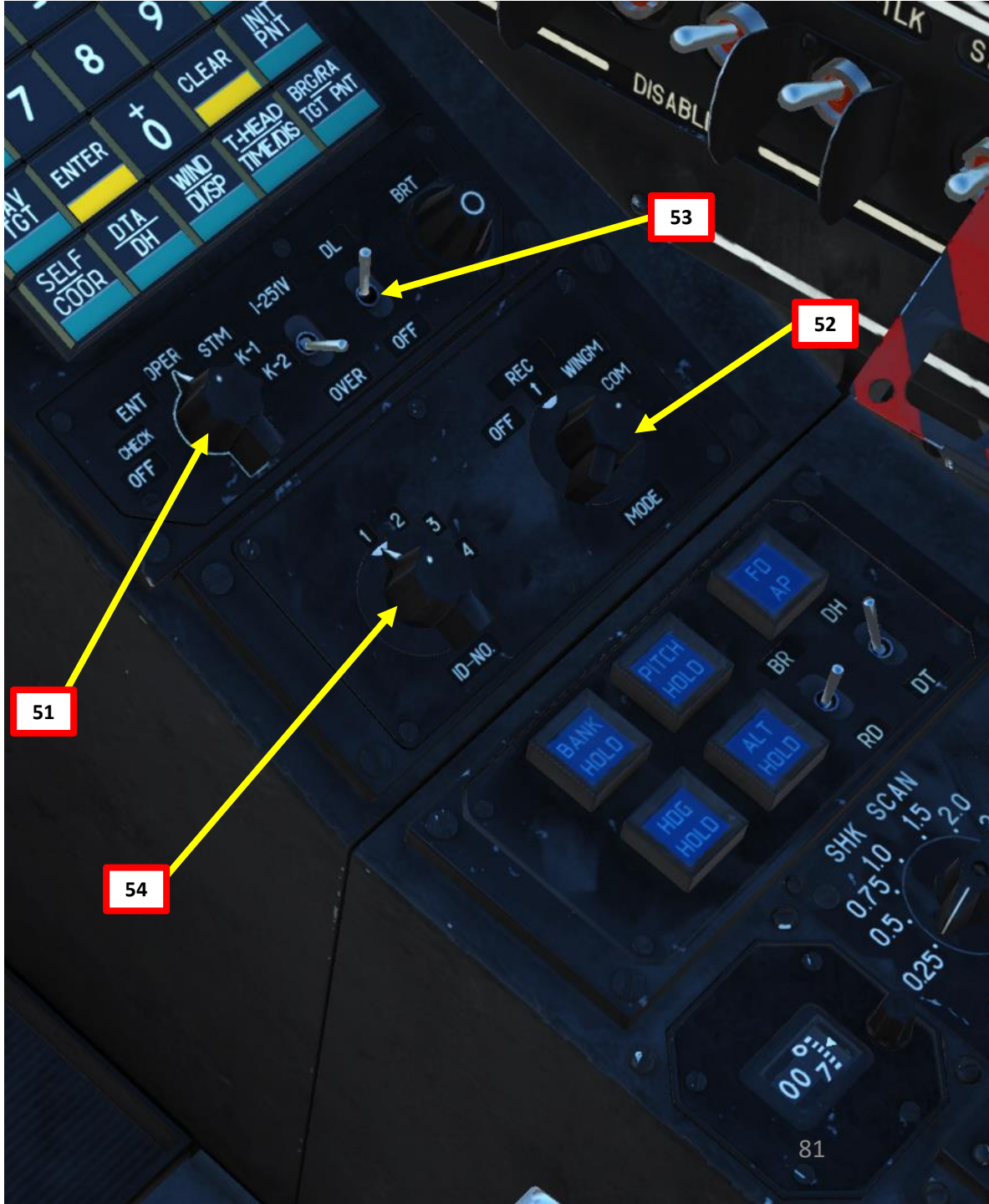




POST-START

51. Set PVI-800 NAV MODE selector to OPER
52. Set PVI-800 OPERATING MODE to COM
53. Set PVI-800 Power switch to ON
54. Set PVI-800 ID NUMBER to 1.
55. Engage BANK (K), PITCH (T) and HDG HOLD/YAW (H) stability augmentators





TAKEOFF

NOTE: There are many ways to takeoff in a Ka-50. The best way is generally a function of your loadout, weight and mission.

1. Check that all your engine gauges (RPM, pressure & temperature) are in the green (see picture).
2. Check to see if all your flight instruments all set up properly.
3. Once you have performed a hover check and are maintaining a hover between 2 and 10 meters high, you can taxi to the runway. Just push your nose down slightly to move forward and use your wheel brakes and rudder pedals to turn left and right while taxiing and lining up.
4. Push nose slightly forward to start gaining horizontal speed. No collective input should be required since you are already in a hover state. This is the normal takeoff and the safest procedure. You can also attempt a maximum performance takeoff, which will be more taxing on the rotor blades and can end in tragedy if you are too heavily loaded or the environmental conditions don't allow for it. I recommend using the normal takeoff since you are very unlikely to fly at empty weight. You're better off being safe than sorry.
5. NORMAL TAKEOFF: Keep accelerating and you will start generating more and more translational lift, naturally climbing. Try to maintain an airspeed of 100-120 km/h when climbing. This is basically like a running/rolling takeoff.
6. Retract landing gear using the gear lever (UP).

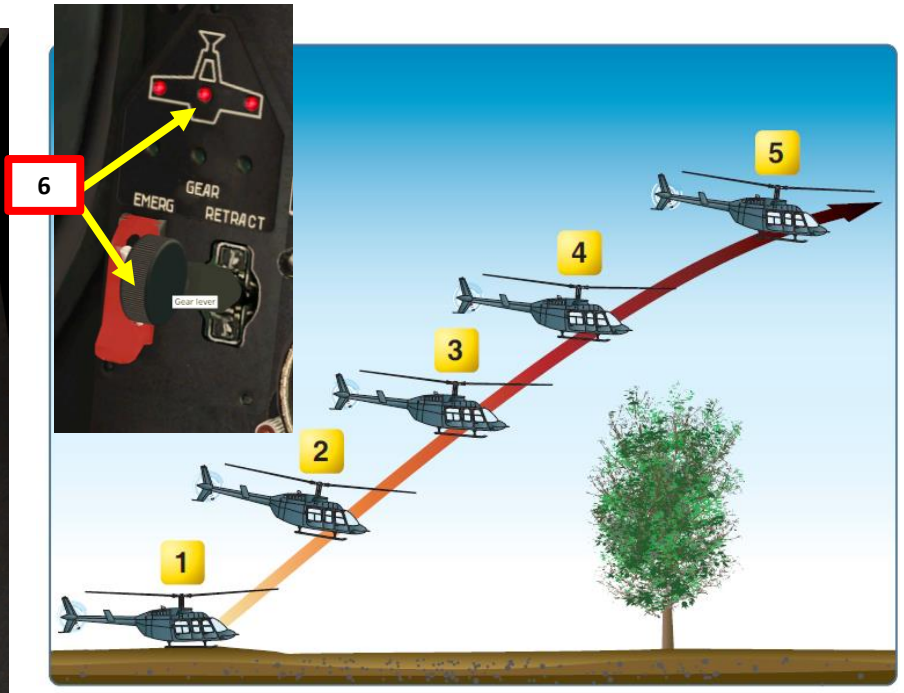


Figure 10-1. *Maximum performance takeoff.*

Figure 9-7. *The helicopter takes several positions during a normal takeoff from hover.*

Figure 10-2. *Running/rolling takeoff.*

VISUAL LANDING

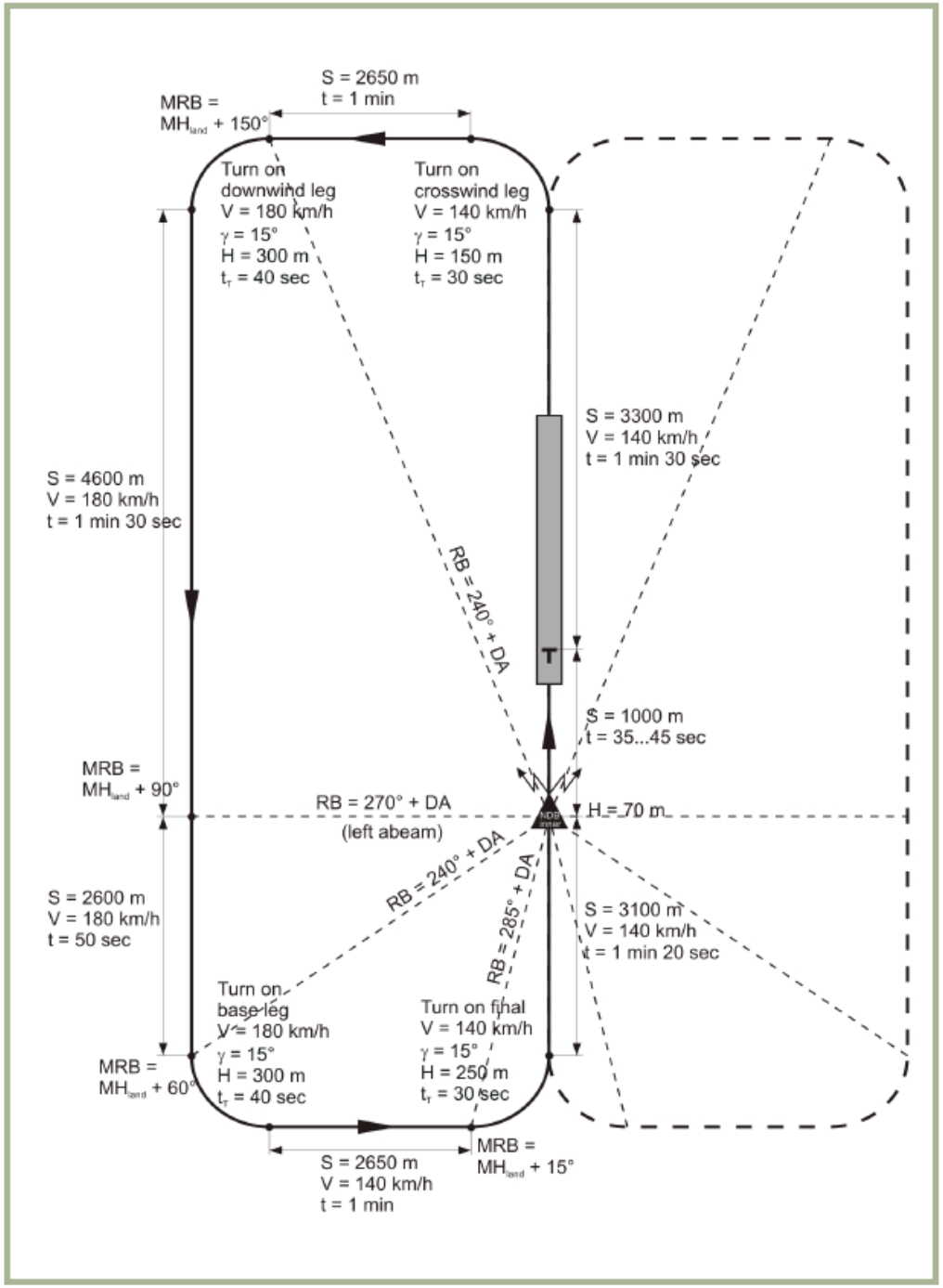
NOTE: When you think about it, a helicopter is usually landed like an aircraft: you maintain a descent rate, reach a touchdown point and pull back on your cyclic to bleed speed and come to a full stop. There are many different types of approaches. Your approach and landing type will depend on the type of LZ (landing zone) and the type of mission you are doing.

1) Start descent from 400 m. Fly towards a reference point on the runway. Pay particular attention to the Vortex Ring State (state in which the helicopter is settling in its own downwash and gets sucked down, which is caused by a flight profile of forward flight less than ETL (Effective Translational Lift, helicopter is slower than 70 km/h), rate of descent of 300ft/min or more and at least 20% power applied). VRS is further explained in the "Principles of Helicopter Flight" section.
2) Maintain 100-120 km/h for a descent rate between 3 and 5 m/s
3) You should reach your reference point in a 10 m hover. Use your cyclic to come to a full stop, and raise your collective to "cushion" the sudden drop caused by the loss of translational lift (which is caused by the loss of airspeed).
4) Once you have come to a full stop in a 10 m hover, deploy landing gear and **then** you can slowly reduce collective to safely land on the ground.

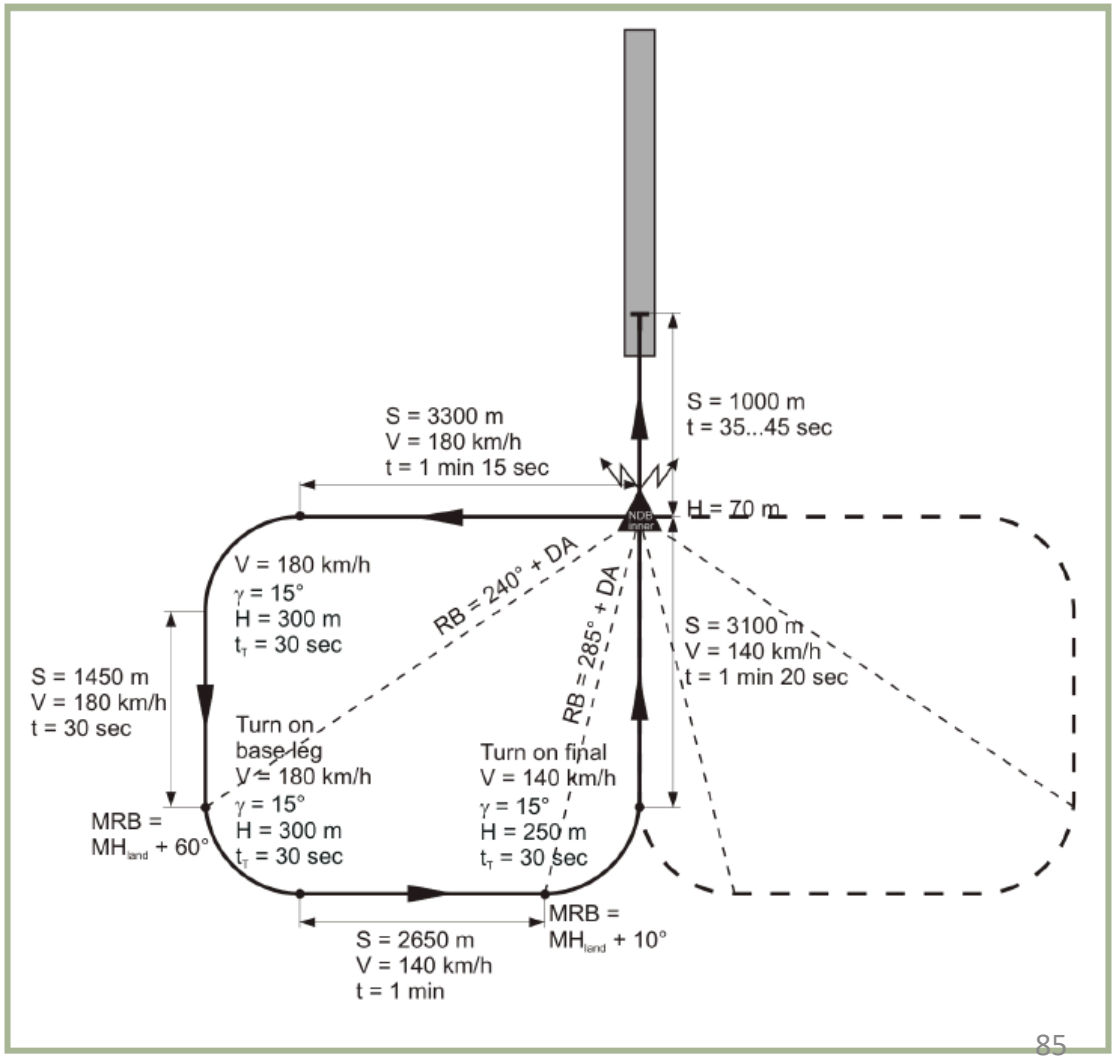
NOTE: It takes a lot of practice to be able to counter the different flight states you will go through when coming for an approach and landing. This is why performing hover power checks before takeoff is very useful: it helps you master the hover state.

Good tutorial on landing by Teach Yourself DCS:
https://www.youtube.com/watch?v=YDZQgCdYh4Y&index=3&list=PLpWui61PBlo2_RfPRrWVQk1jtIlBSE-FO

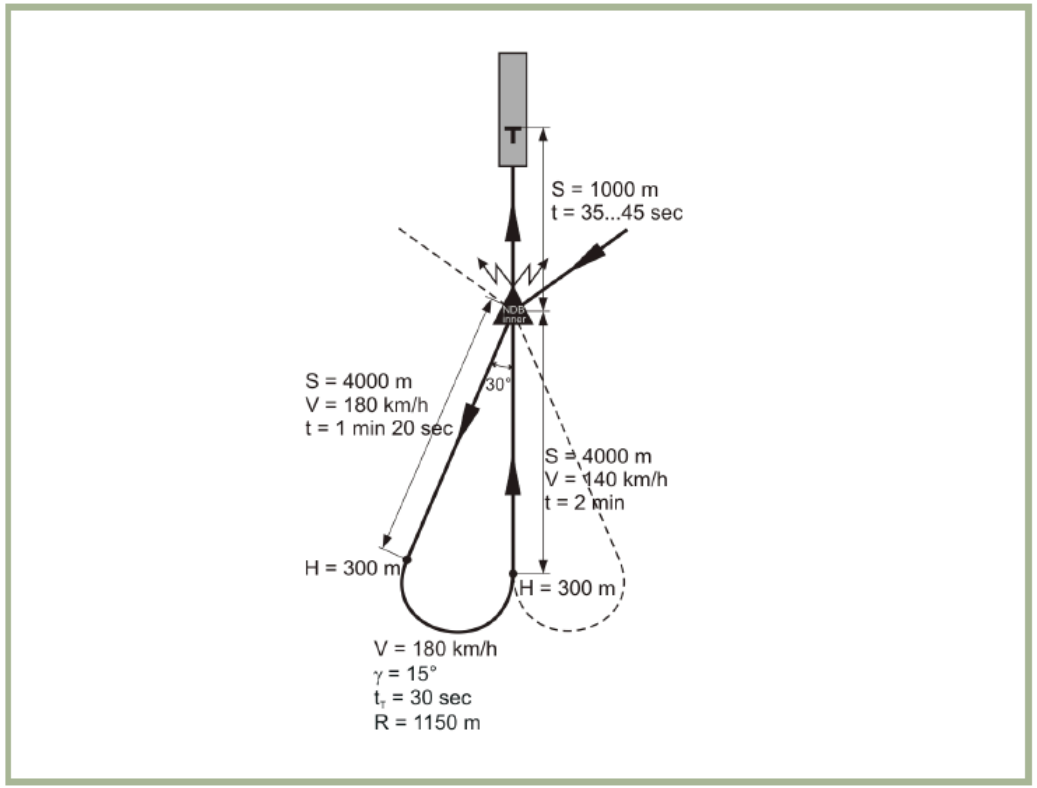
To know more about different landing procedures and approach patterns, read the Black Shark manual from page 352 (10–16) to 358 (10–22).



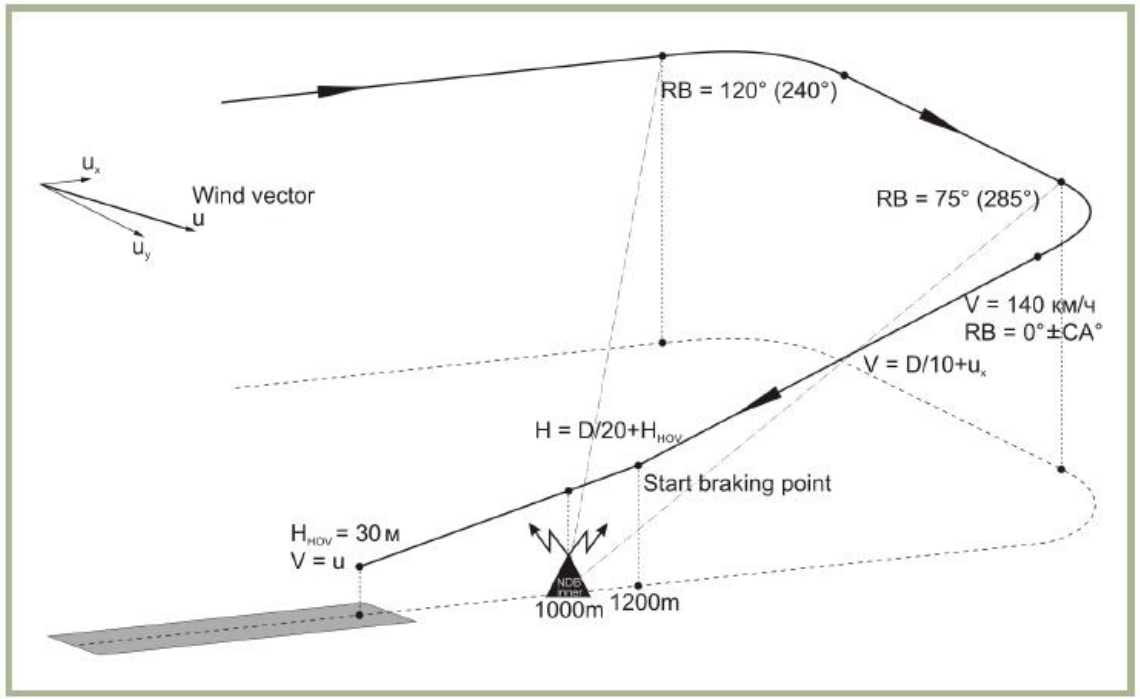
10-1: Left-hand pattern approach (large)



10-2: Left-hand small pattern approach



10-3: Straight in approach using teardrop procedure turn



10-4: Instrument NDB approach

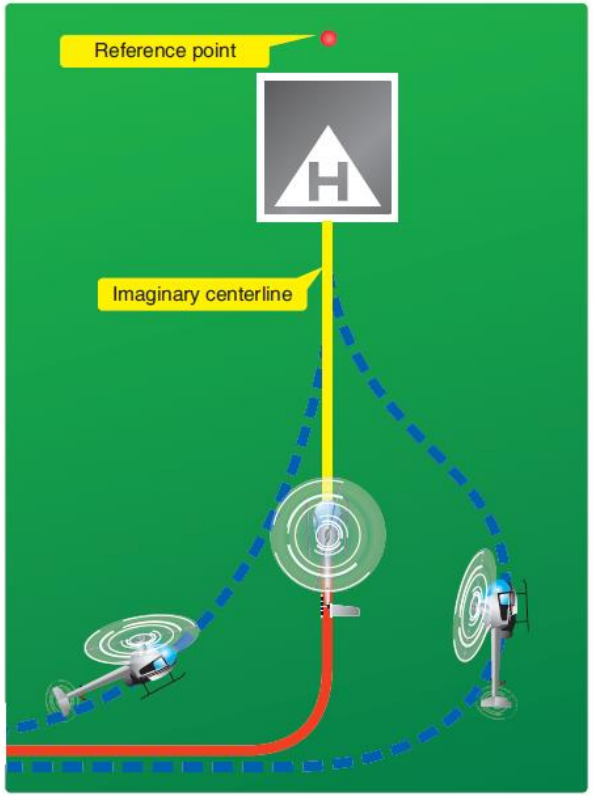


Figure 9-20. *Plan the turn to final so the helicopter rolls out on an imaginary extension of the centerline for the final approach path. This path should neither angle to the landing area, as shown by the helicopter on the left, nor require an S-turn, as shown by the helicopter on the right.*

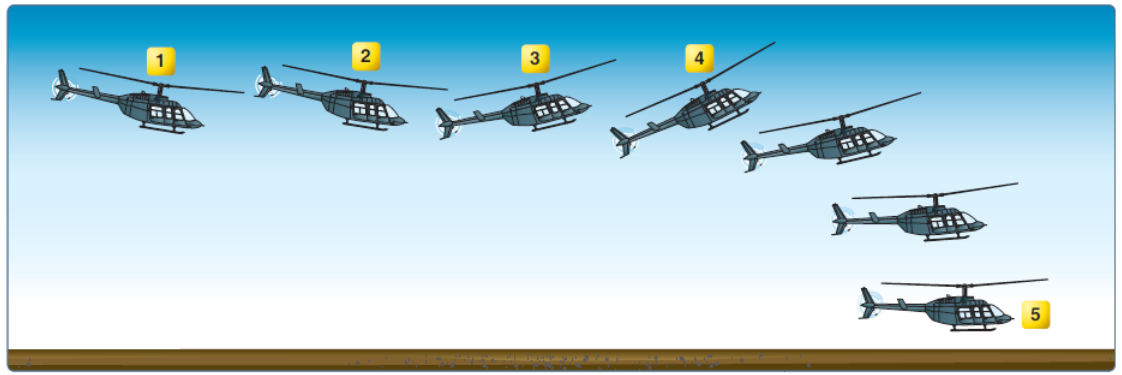


Figure 10-3. *Rapid deceleration or quick stop.*

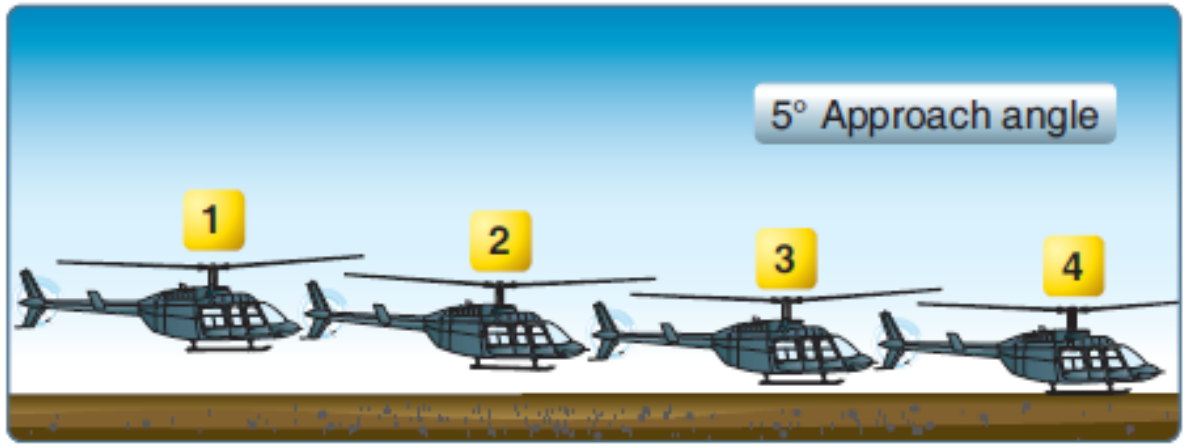


Figure 10-5. *Shallow approach and running landing.*

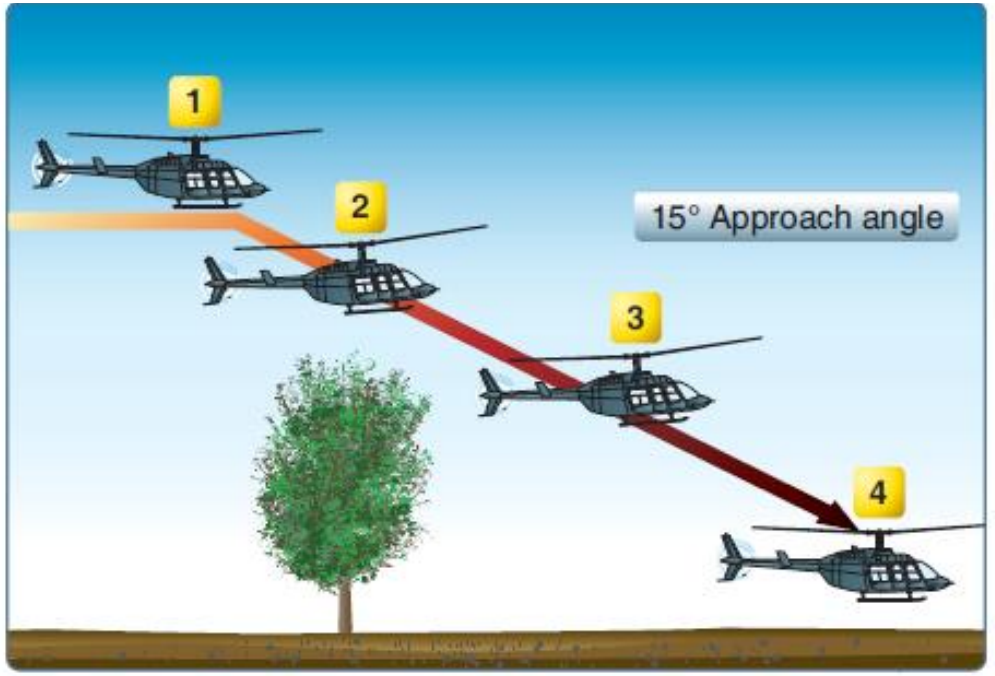


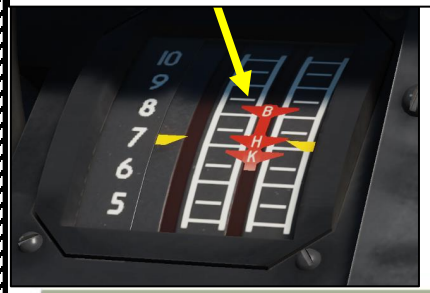
Figure 10-4. *Steep approach to a hover.*

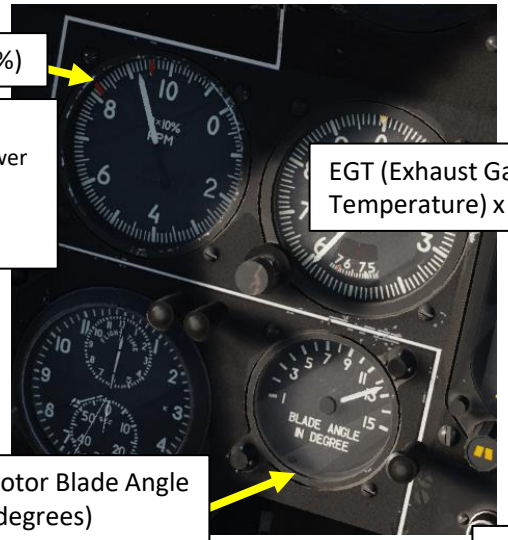
KLIMOV TV3-117 TURBOSHAFT ENGINES

The Ka-50 is powered by two Klimov TV3-117 turboshaft engines. An APU (Auxiliary Power Unit) is also available to provide air pressure to start the engines.

Rotor RPM Indicator (x10 %)

Engine Power Indicator
- Yellow Index: Right/Left current Engine Power
- B Index: Takeoff power reference
- H Index: Max continuous power reference
- K Index: Cruise power reference



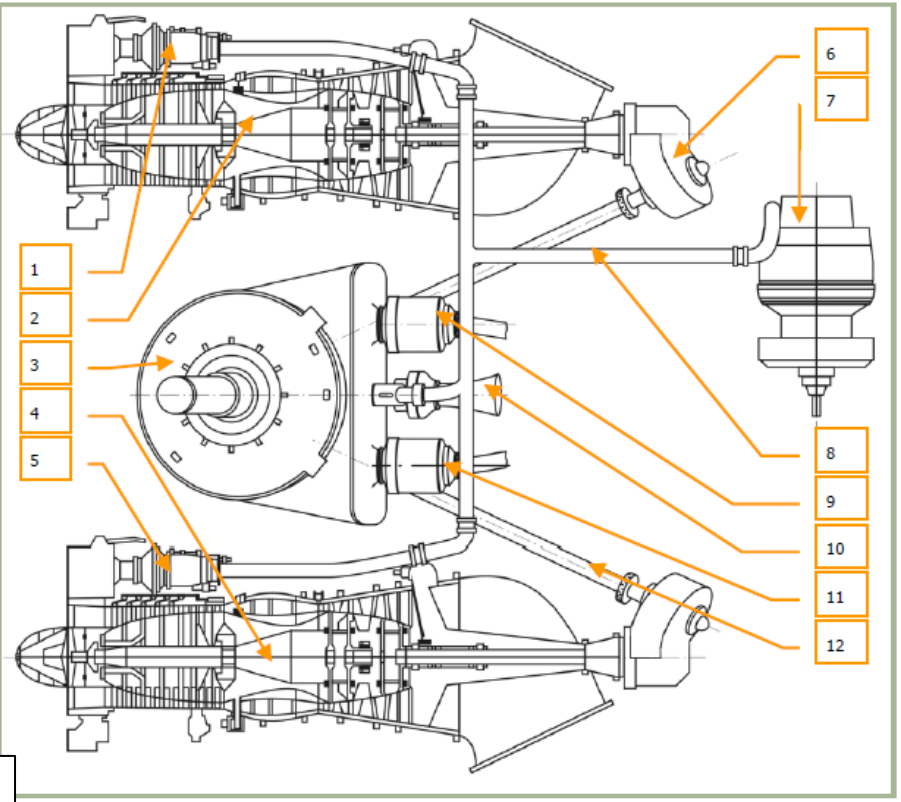


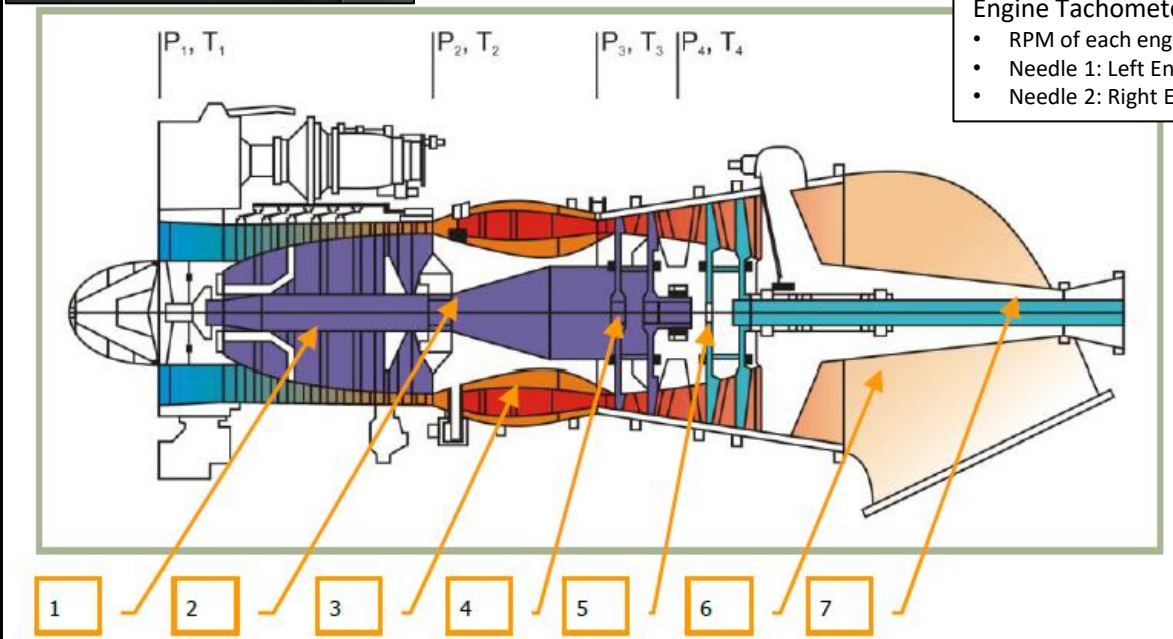
Rotor Blade Angle (degrees)

EGT (Exhaust Gas Temperature) x 100 deg C

EGT (Exhaust Gas Temperature) x 10 deg C

Engine Tachometer (% RPM)
- RPM of each engine turbine (100 % is 19,537 RPM)
- Needle 1: Left Engine
- Needle 2: Right Engine



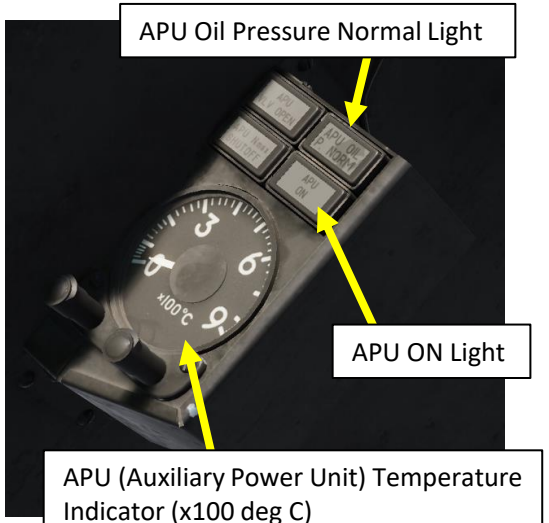


13-6: TV3-117 turboshaft engine

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

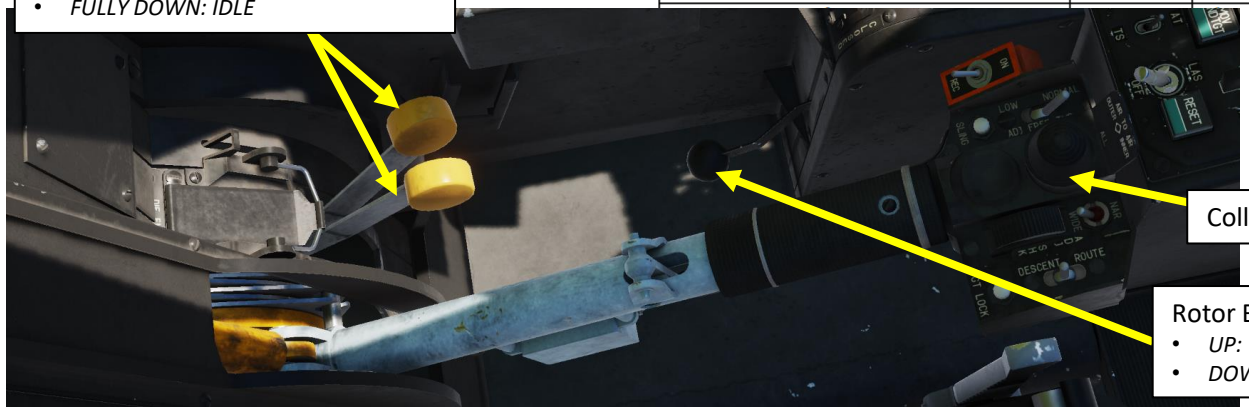
13-5: Engines and power train

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



Limited parameter	Value	Reason
Maximum takeoff and landing weight, kg	10,800	Airframe and landing gear strength
Maximum ferry takeoff and landing weight, kg	11,900	
Maximum airspeed km/h:		
IAS in gear-up and gear-down configuration	300	Blade's stall, flutter and strength
During landing gear extension/retraction IAS	200	Landing gear doors strength
Ground speed at touchdown	80	Nose gears shimmy
Vertical speed in descent (glide) at 50 km/h, m/s IAS:		Avoid vortex ring
Above 200 m radar altimeter (true) altitude	5	
Below 200 m radar altimeter (true) altitude	3	
Maximum wind speed, m/s:		Controllability
For taxi;		
Head wind	20	
Crosswind and tailwind	10	
For takeoff and landing:		
crosswind and tailwind	10	
Pitch-up and pitch-down maximum angle, degrees	60	
Maximum bank angle, degrees	65	
G-load factor:		
Maximum up to IAS 250 km/h	3.0	Airframe strength
Minimum	0	Minimum clearance between lower rotor blades and fuselage
Maximum for ferry configuration	1.5	

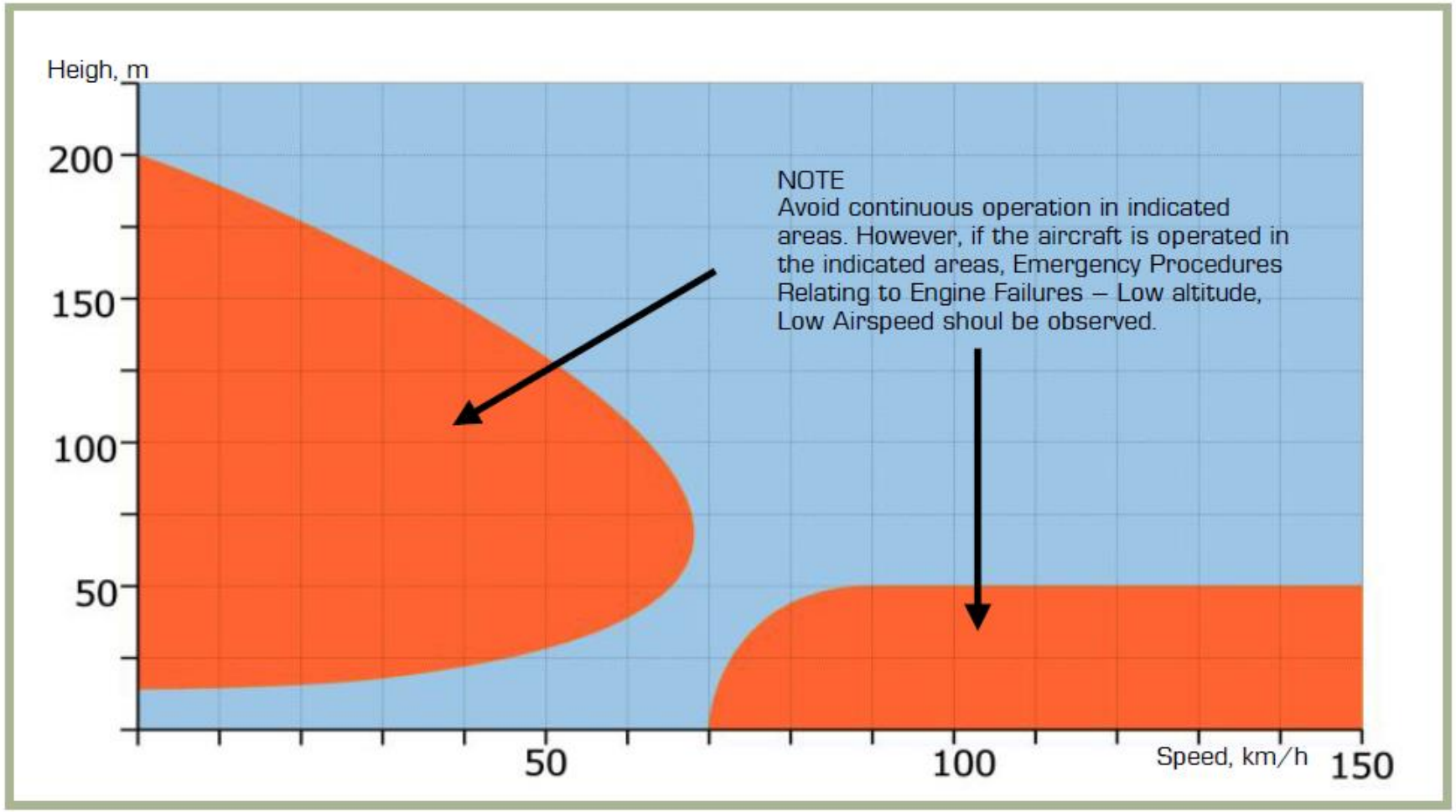
Engine Throttle Levers
- *FULLY UP: MAX*
- *MIDDLE UP: AUTO*
- *MIDDLE DOWN: GOVERNOR FAIL*
- *FULLY DOWN: IDLE*



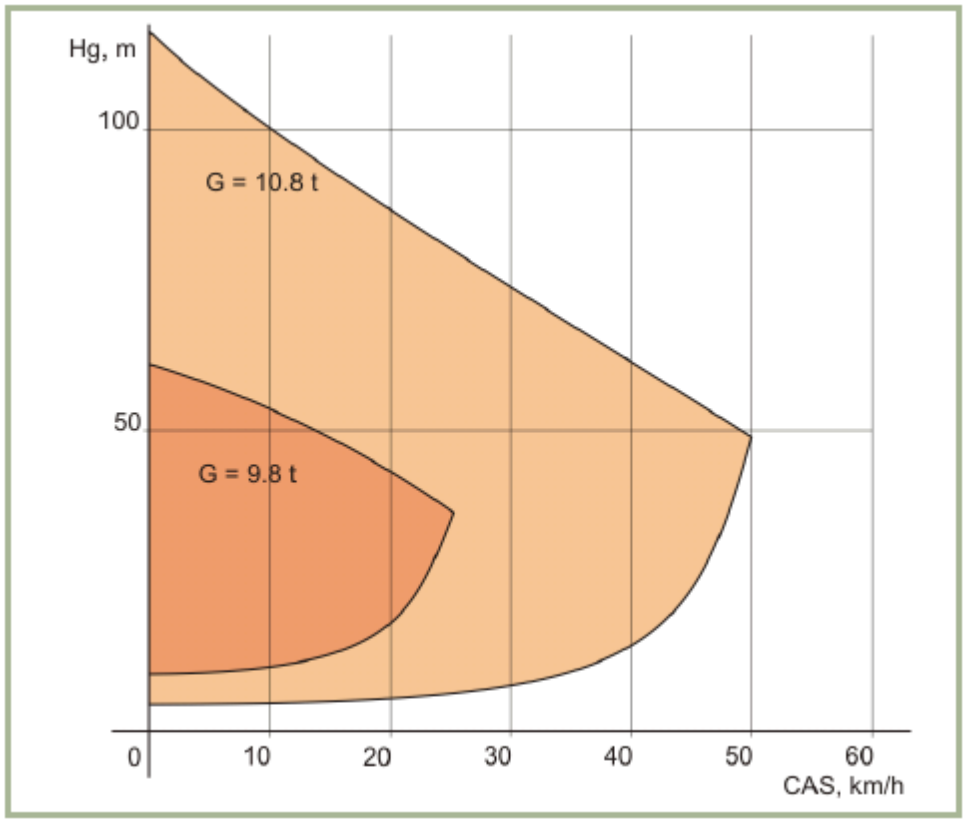
Maximum rotor's RPM, %:		Flutter
Up to 190 km/h	98	
190...245 km/h	95	
245...265 km/h	93	
265...280 km/h	91	
280...300 km/h	90	
Minimum rotor's RPM, %:		
At takeoff power	86	
During maneuvers	83	
TV3-117VMA engines limitations:		
Continuous operation time for all modes, min:		Engine reliability and service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

FLIGHT ENVELOPE: HEIGHT VS SPEED & "DEAD MAN'S CURVE"

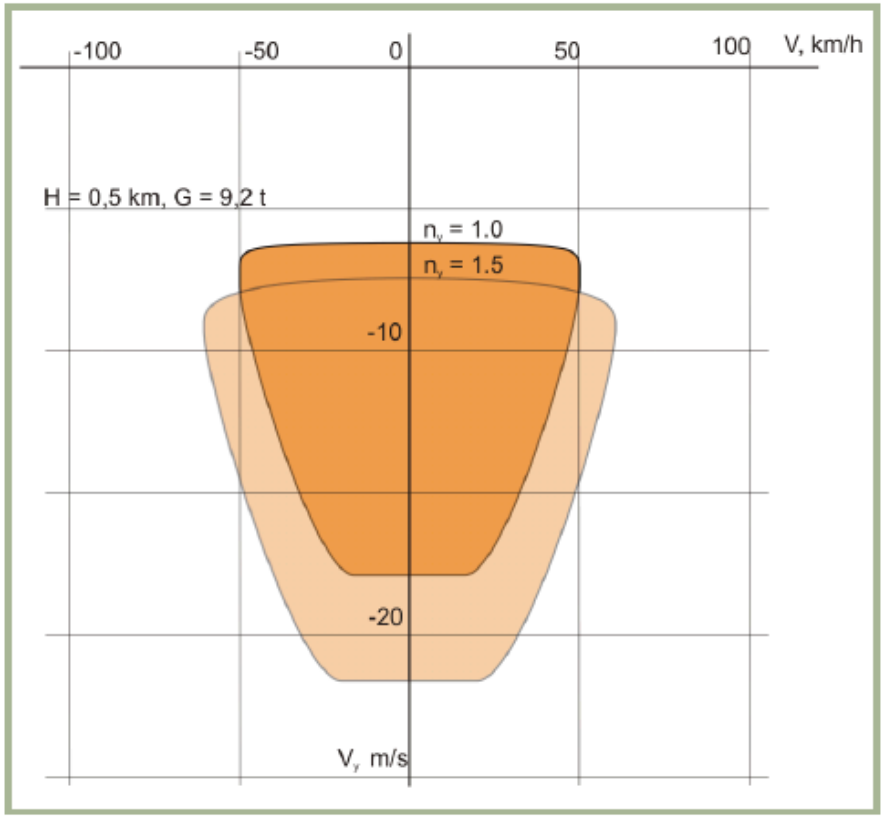
All helicopters carry an operator's manual that has an airspeed versus altitude chart similar to this one. The shaded area on this chart must be avoided. It is often referred to as the "dead man's curve" and "avoid curve". Proper manoeuvres for a safe landing during engine failure cannot be accomplished in these areas.



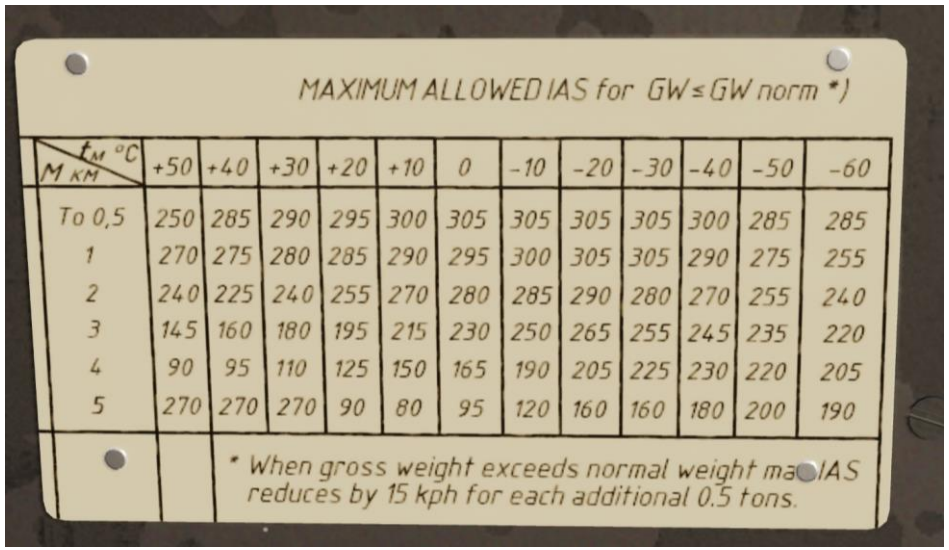
4-20: Height-Velocity Diagram



13-1: Critical Altitude-Velocity zone



13-2: Vortex Ring safety zones



MAXIMUM ALLOWED IAS for GW ≤ GW norm *)

t_H °C / M KM	+50	+40	+30	+20	+10	0	-10	-20	-30	-40	-50	-60
To 0,5	250	285	290	295	300	305	305	305	305	300	285	285
1	270	275	280	285	290	295	300	305	305	290	275	255
2	240	225	240	255	270	280	285	290	280	270	255	240
3	145	160	180	195	215	230	250	265	255	245	235	220
4	90	95	110	125	150	165	190	205	225	230	220	205
5	270	270	270	90	80	95	120	160	160	180	200	190

* When gross weight exceeds normal weight ma IAS reduces by 15 kph for each additional 0.5 tons.

A lot of people are having difficulties flying the Black Shark because they do not understand all the small aerodynamic phenomenon that define the Ka-50's manoeuvering abilities.

Froogle goes in a lot of detail about the art of flying the Ka-50. He explains the **<u>importance of trimming</u>** since many mistakes happen because of the peculiar aerodynamics of the Black Shark. You trim by basically holding down the trim switch (make sure you have one mapped in your controls) until you come to a stable state, and THEN release the trim button. You can reset trim by using the "Trim Reset" button.

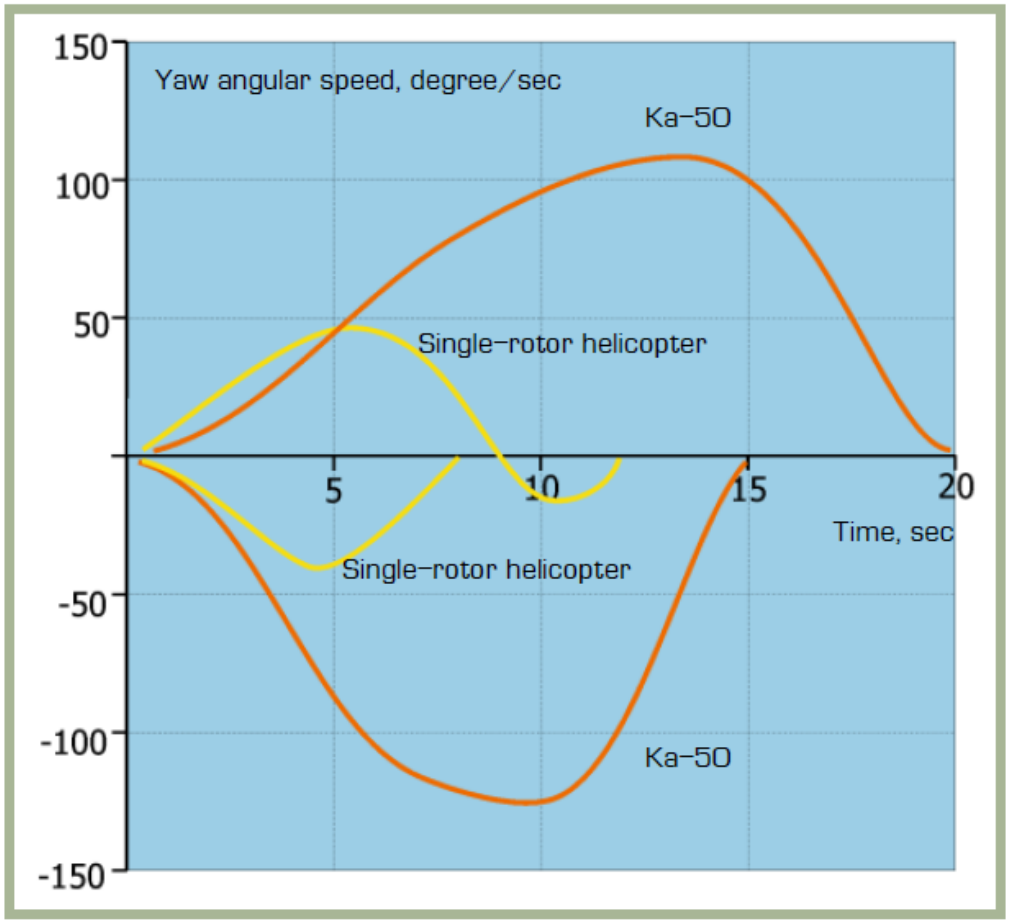
Flying the Ka-50
https://www.youtube.com/watch?v=aH4tSiU7TCE

Mastering the Trim
https://www.youtube.com/watch?v=aH4tSiU7TCE

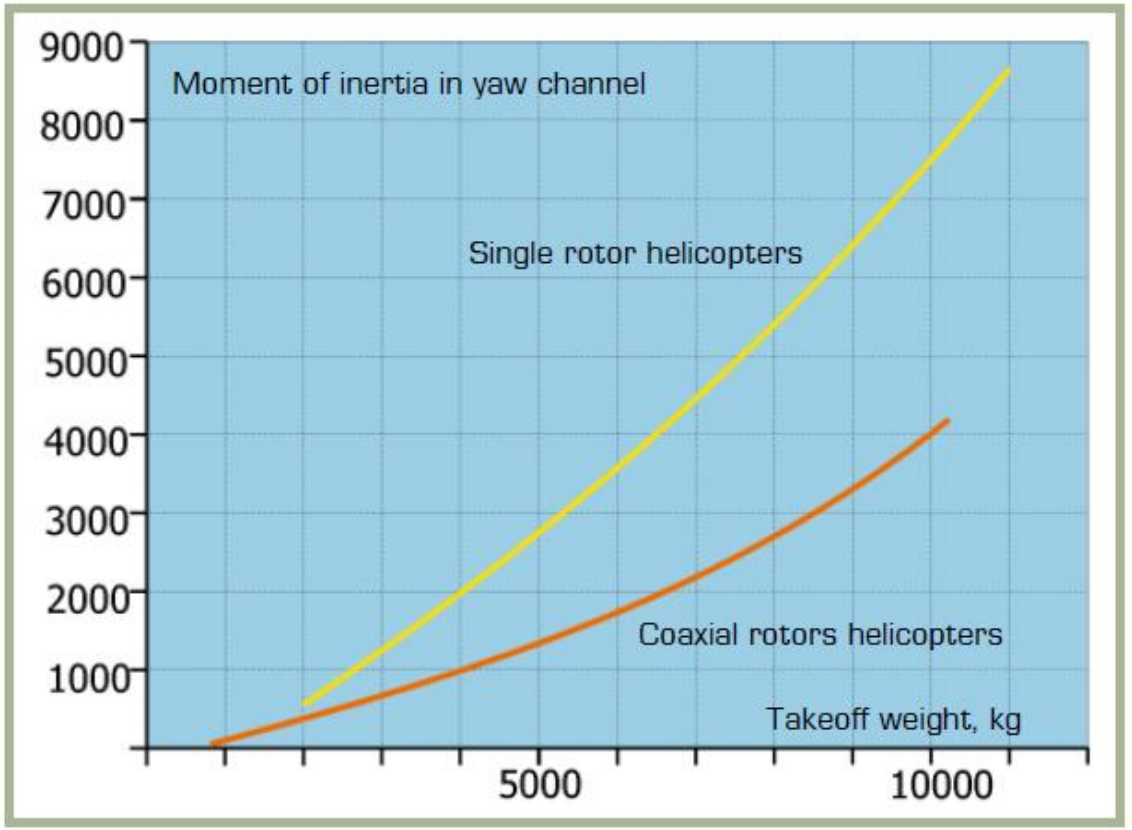
A very nice tutorial by Erik "EinsteinEP" Pierce explaining the trim on the Shark
http://www.simhq.com/_air13/air_428a.html

FLIGHT MODEL – HOW COAXIAL ROTORS DIFFER FROM "TRADITIONAL" HELICOPTERS

Believe it or not, there are actually advantages to using a coaxial rotor configuration. We could talk about it for hours, but I will let these two graphs speak for themselves.



5-6: Yaw angular speed in the hover



5-4: Coaxial-rotor and single-rotor helicopters' moment of inertia

THE MYSTERY OF TRIM

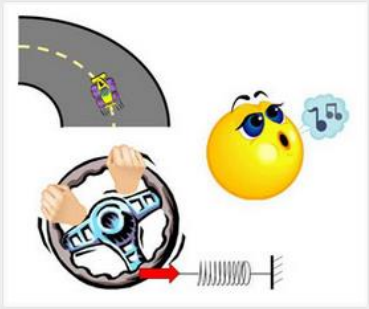
Tutorial taken from Erik "EinsteinEP" Pierce's article on SIMHQ

Just Push the Button

Imagine driving a car at a constant speed around a perfectly circular track. To make the constant turn, you have to hold the steering wheel in the proper position, turning it against the straightening tendency of the wheels on the road surface. If, because of the size of the track, the speed you were driving, etc., the required force was 50 lbs (~23 kg), or more, how long do you think you could keep this up before your arms felt like they had turned to rubber?

Driving a Circular Track

Now imagine that you were to drive the same course in car with a spring installed to the steering column that pulled the steering wheel in one direction. If we designed the spring so that it had just the right tension and was installed in just the right place, the spring could apply all the force needed to keep the wheel in the right position. You could literally drive hands-off all the way around the course. In reality, you would still need to provide minute corrections as the car's heading was perturbed by the uneven road surface, wind, etc., but the effort would be minimal and you could probably drive until you ran out of gas without your arms giving up on you.



Driving a Circular Track with a Spring

If you were driving in any condition other than the one that the spring was designed for (faster or slower, bigger or smaller track, straight road, etc.), either the spring wouldn't be helping enough or you'd be fighting its input. However, if a spring were installed that allowed you to adjust tension in real-time, then you could minimize the control force needed for any driving condition. This is the essence of control system trim.

Over the years, aircraft designers have come up with some very clever methods to implement trim, from springs and weights to tabs and cables and pulleys to complex computer algorithms and electronic servos. Some methods, like the one used in the Kamov Ka-50 helicopter simulated in the DCS: Black Shark simulation, are much more complicated than our spring example, and require additional explanation and some hands-on experimentation to really understand.

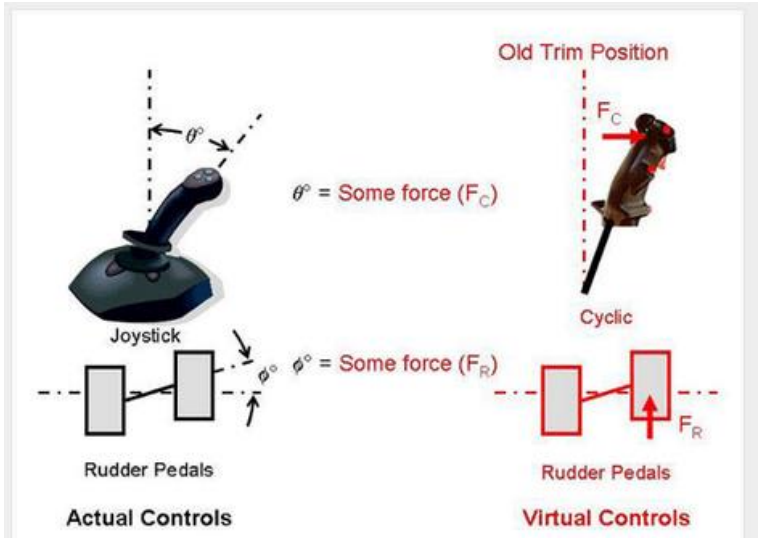
In the Ka-50, just like in our spring example, control system trim is accomplished by adjusting stuff "behind the scenes" to the pilot so that the pressure needed to be applied to the flight controls is reduced to zero. The actual workings of the Ka-50's trim system (aka the Trimmer) involve electromagnets, hydraulic controls, and a bunch of other "magic" stuff, but you don't need to understand these mechanics to know how to use the Trimmer.

No Easy Explanation

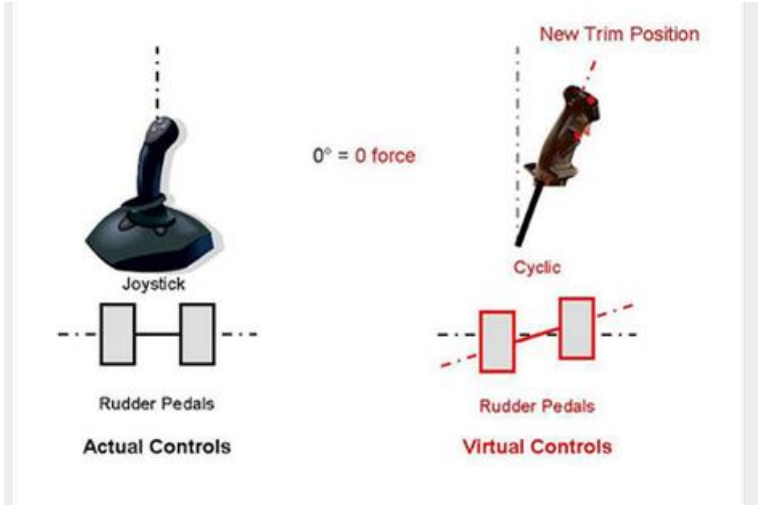
If a pilot finds they have to constantly hold back pressure on the cyclic control stick to keep the Ka-50's nose at the right attitude, they can press (then release) the Trimmer button while holding the cyclic steady in a position that gives the desired attitude. This action causes the control system to readjust itself, just like the spring with adjustable tension in our previous example, so that no additional force is required to keep the stick in that position. This is referred to as "trimming", "re-centering", or even "re-zeroing" the controls. Whatever you choose to call it, it means that you don't have to hold pressure on the controls to maintain the desired attitude for a given flight condition.

THE MYSTERY OF TRIM

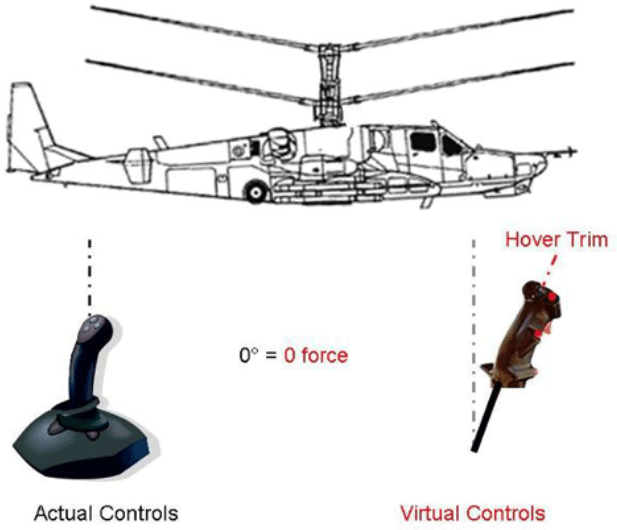
Tutorial taken from Erik "EinsteinEP" Pierce's article on SIMHQ



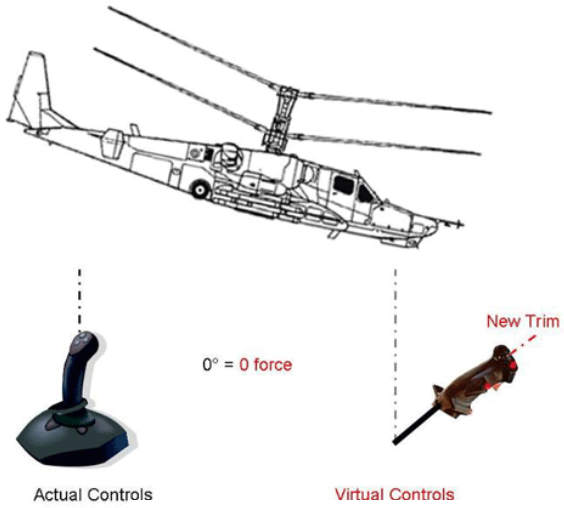
Before Trimming



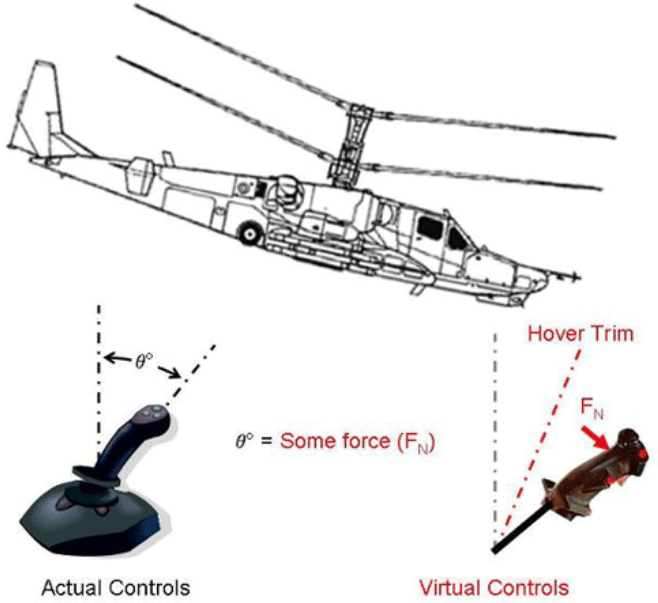
After Trimming



Trimmed for Hover



Trimmed for Acceleration



Pitch Down for Forward Flight

FORCES: TORQUE, TRANSLATIONAL & VERTICAL LIFT

IN A NUTSHELL…

In a hover, you will most likely generate vertical lift only since the lift vector is pointing upwards. However, if you push your nose down and gain horizontal speed, you will notice that you will generate much more lift as you gain speed. This is called "**Translational Lift**": your blades gain much more lift efficiency as you accelerate.

You might also wonder why you need to apply left pedal when you are hovering. This is simply because of the torque created by the propeller blades' rotation: we call this "**Translating Tendency**", or simply "drift". In a prop airplane, the torque will force you to use rudder on takeoff to stay straight. The same principle applies for a helicopter, but in a different axis.

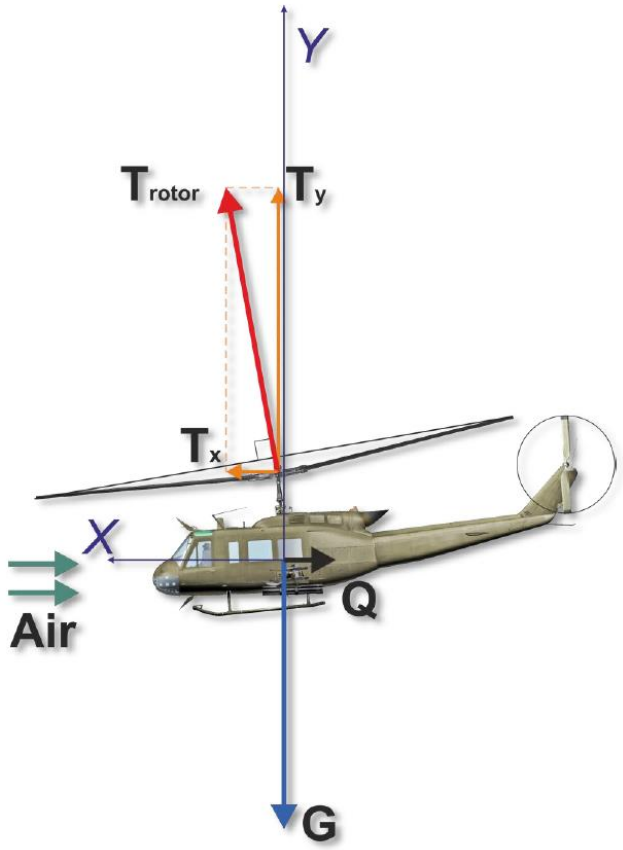


Figure 3.1. Forces Acting on a Helicopter

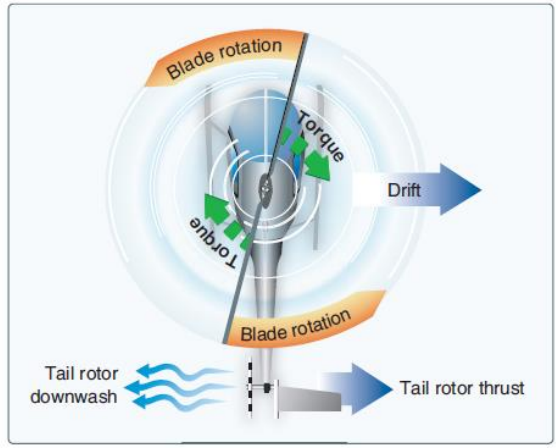


Figure 2-25. *A tail rotor is designed to produce thrust in a direction opposite torque. The thrust produced by the tail rotor is sufficient to move the helicopter laterally.*

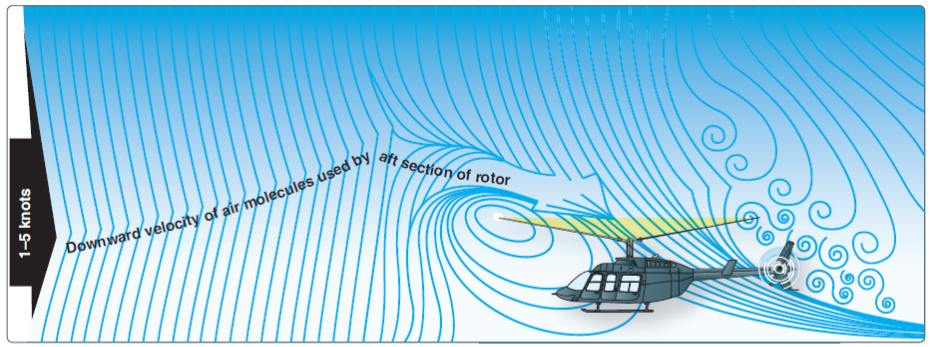


Figure 2-37. *The airflow pattern for 1–5 knots of forward airspeed. Note how the downwind vortex is beginning to dissipate and induced flow down through the rear of the rotor system is more horizontal.*

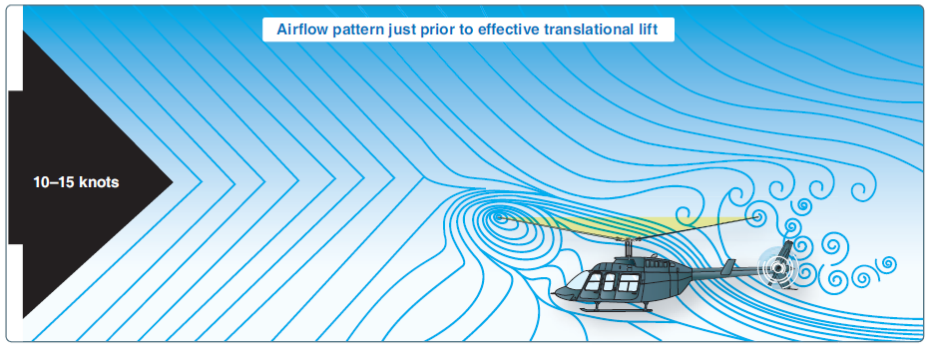


Figure 2-38. *An airflow pattern at a speed of 10–15 knots. At this increased airspeed, the airflow continues to become more horizontal. The leading edge of the downwash pattern is being overrun and is well back under the nose of the helicopter.*

RETREATING BLADE STALL & DISSYMMETRY OF LIFT

In forward flight, the relative airflow through the main rotor disk is different on the advancing and retreating side. The relative airflow over the advancing side is higher due to the forward speed of the helicopter, while the relative airflow on the retreating side is lower. This dissymmetry of lift increases as forward speed increases. To generate the same amount of lift across the rotor disk, the advancing blade flaps up while the retreating blade flaps down. This causes the AOA to decrease on the advancing blade, which reduces lift, and increase on the retreating blade, which increases lift.

At some point as the forward speed increases, the low blade speed on the retreating blade, and its high AOA cause a stall and loss of lift. Retreating blade stall is a major factor in limiting a helicopter's never-exceed speed (VNE) and its development can be felt by a low frequency vibration, pitching up of the nose, and a roll in the direction of the retreating blade. High weight, low rotor rpm, high density altitude, turbulence and/or steep, abrupt turns are all conducive to retreating blade stall at high forward airspeeds. As altitude is increased, higher blade angles are required to maintain lift at a given airspeed.

Thus, retreating blade stall is encountered at a lower forward airspeed at altitude. Most manufacturers publish charts and graphs showing a VNE decrease with altitude.

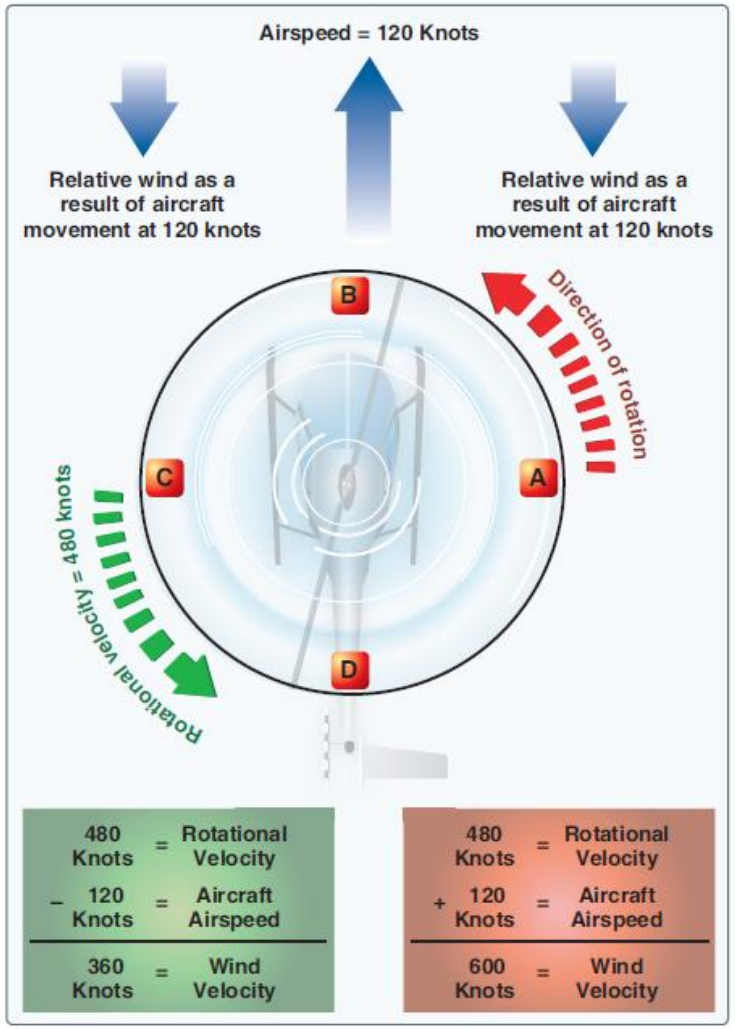


Figure 2-33. *Airflow in forward flight.*

IN A NUTSHELL…

Did you ever wonder why your helicopter can never stay straight when you center your cyclic stick? The reason why you always need to hold your stick to your left and towards you is because the lift generated by your rotor blade is not equal everywhere on your blades. Therefore, the lift profile is **not symmetric.** "Lift dissymmetry" is just other fancy ways to refer to this phenomenon.

"Retreating Blade Stall" is a major factor in limiting a helicopter's maximum forward airspeed. Just as the stall of a fixed wing aircraft wing limits the low-airspeed flight envelope, the stall of a rotor blade limits the high-speed potential of a helicopter.

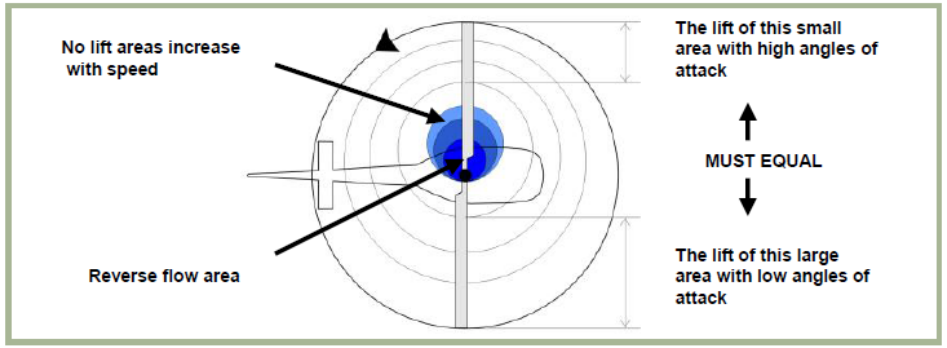


Figure 3.8. Normal Cruise Lift Pattern

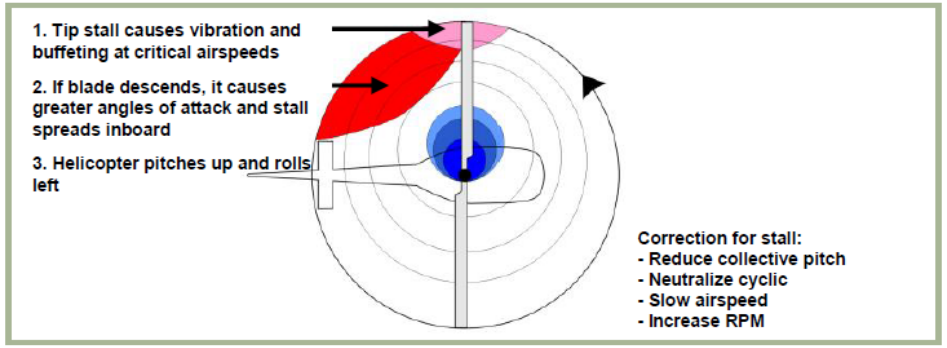


Figure 3.9. Lift Pattern at Critical Airspeed

OGE VS IGE: UNDERSTANDING GROUND EFFECT

Ground effect is the increased efficiency of the rotor system caused by interference of the airflow when near the ground. The air pressure or density is increased, which acts to decrease the downward velocity of air. Ground effect permits relative wind to be more horizontal, lift vector to be more vertical, and induced drag to be reduced.

These conditions allow the rotor system to be more efficient. Maximum ground effect is achieved when hovering over smooth hard surfaces. When hovering over surfaces as tall grass, trees, bushes, rough terrain, and water, maximum ground effect is reduced. Rotor efficiency is increased by ground effect to a height of about one rotor diameter (measured from the ground to the rotor disk) for most helicopters. Since the induced flow velocities are decreased, the AOA is increased, which requires a reduced blade pitch angle and a reduction in induced drag. This reduces the power required to hover IGE.

The benefit of placing the helicopter near the ground is lost above IGE altitude, which is what we call OGE: Out of Ground Effect.

IN A NUTSHELL…

Ground Effect is what gives you additional lift when you are flying close to the ground. A hover, for instance, is much easier to maintain close to the ground torque-wise since ground effect is nullified at higher altitudes.

Ground effect is specially important on missions where you need to fly NOE (Nap-Of-Earth, where even lawnmowers dare not set foot).

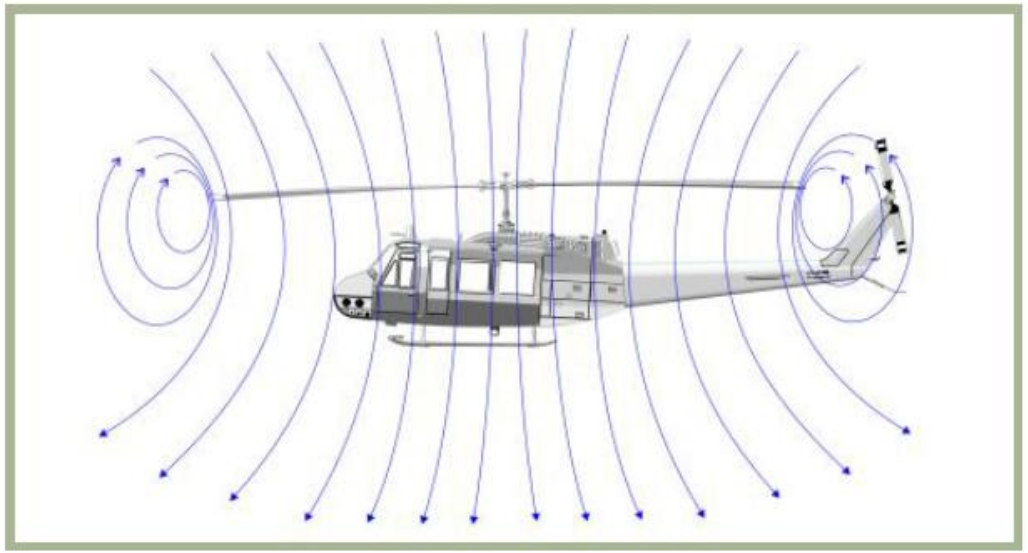


Figure 3.13. Airflow When Out of Ground Effect

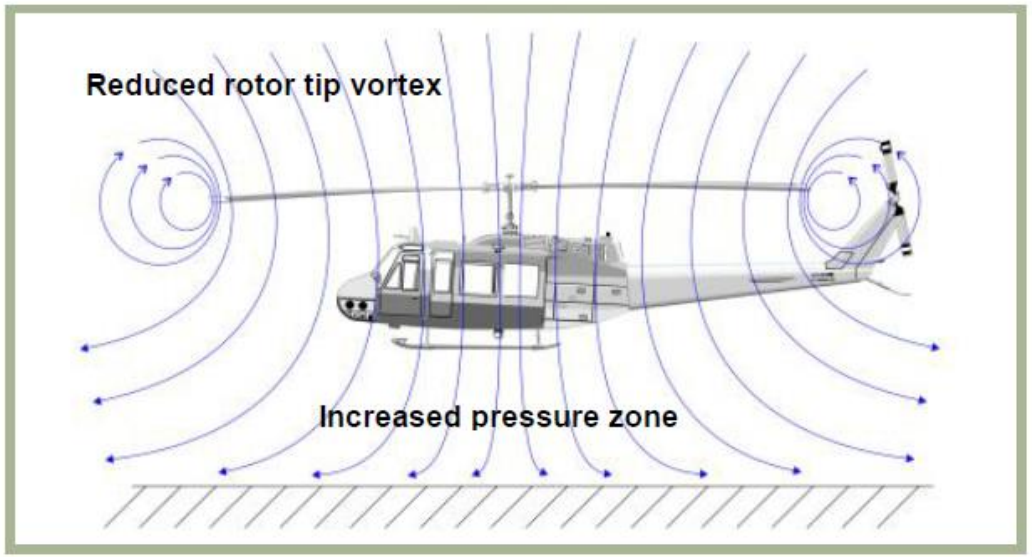


Figure 3.14. Airflow When In Ground Effect

VORTEX RING STATE (VRS)

Vortex ring state describes an aerodynamic condition in which a helicopter may be in a vertical descent with 20 percent up to maximum power applied, and little or no climb performance. The term “settling with power” comes from the fact that the helicopter keeps settling even though full engine power is applied.

In a normal out-of-ground-effect (OGE) hover, the helicopter is able to remain stationary by propelling a large mass of air down through the main rotor. Some of the air is recirculated near the tips of the blades, curling up from the bottom of the rotor system and rejoining the air entering the rotor from the top. This phenomenon is common to all airfoils and is known as tip vortices. Tip vortices generate drag and degrade airfoil efficiency. As long as the tip vortices are small, their only effect is a small loss in rotor efficiency. However, when the helicopter begins to descend vertically, it settles into its own downwash, which greatly enlarges the tip vortices. In this vortex ring state, most of the power developed by the engine is wasted in circulating the air in a doughnut pattern around the rotor.

A fully developed vortex ring state is characterized by an unstable condition in which the helicopter experiences uncommanded pitch and roll oscillations, has little or no collective authority, and achieves a descent rate that may approach 6,000 feet per minute (fpm) if allowed to develop.

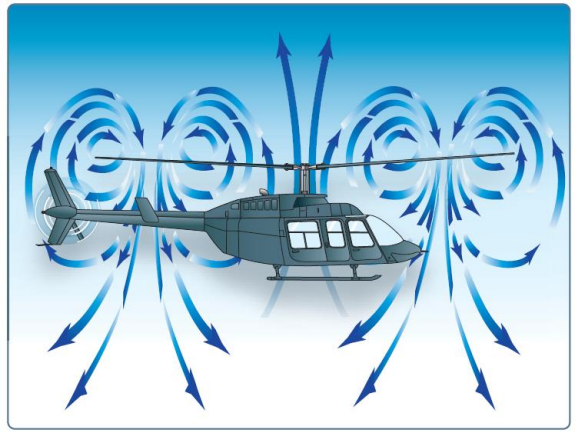


Figure 11-5. *Vortex ring state.*

WHY SHOULD YOU CARE?

One of the biggest issues new pilots have is that they do not understand what VRS is, what it does, why it happens and how to counter it. In simple terms, your sink/descent rate is greater than -5 m/s, you will experience a sudden loss of lift that will cause you to drop like a rock. More often than not, VRS happens when you are trapped in a column of disrupted air created by your own rotor blades, and this (unfortunately) often occurs at the most critical part of flight: on **LANDING.**

Oh, now I’ve got your attention? Good. One of the biggest problems Peter Pilots experience is to land their chopper. Even in real life, there are many pilots who do what we call a “hard landing” because they did not anticipate correctly the sudden loss of lift caused by VRS. A hard landing is when you impact the ground at a vertical speed that is too great, which causes structural damage to the skids, and possibly other structural components. The helicopter is not a total loss, but it will require extensive inspection and repairs, which costs time, money, and temporarily deprives the operator from one of its main sources of income.

Countering VRS is easy if you pay attention to your airspeed and descent rate. Once you enter VRS, raising the collective (which is instinctively what someone would do) will do nothing at best, or aggravate the situation at worst. To reduce the descent rate, you need to get out of that column of disrupted air. **You counter VRS by pointing the nose down (or in any direction) to pick up some speed and get away from these nasty vortices**.

Note: Many pilots confuse VRS with the inertia of your machine. If you come in too fast and raise your collective too slowly, it is to be expected that you will crash.

AUTOROTATION

Autorotation is a flight state where your engine is disengaged from the rotor system and rotor blades are driven solely by the upward flow of air through the rotor. It can be caused by engine malfunction or engine failure.

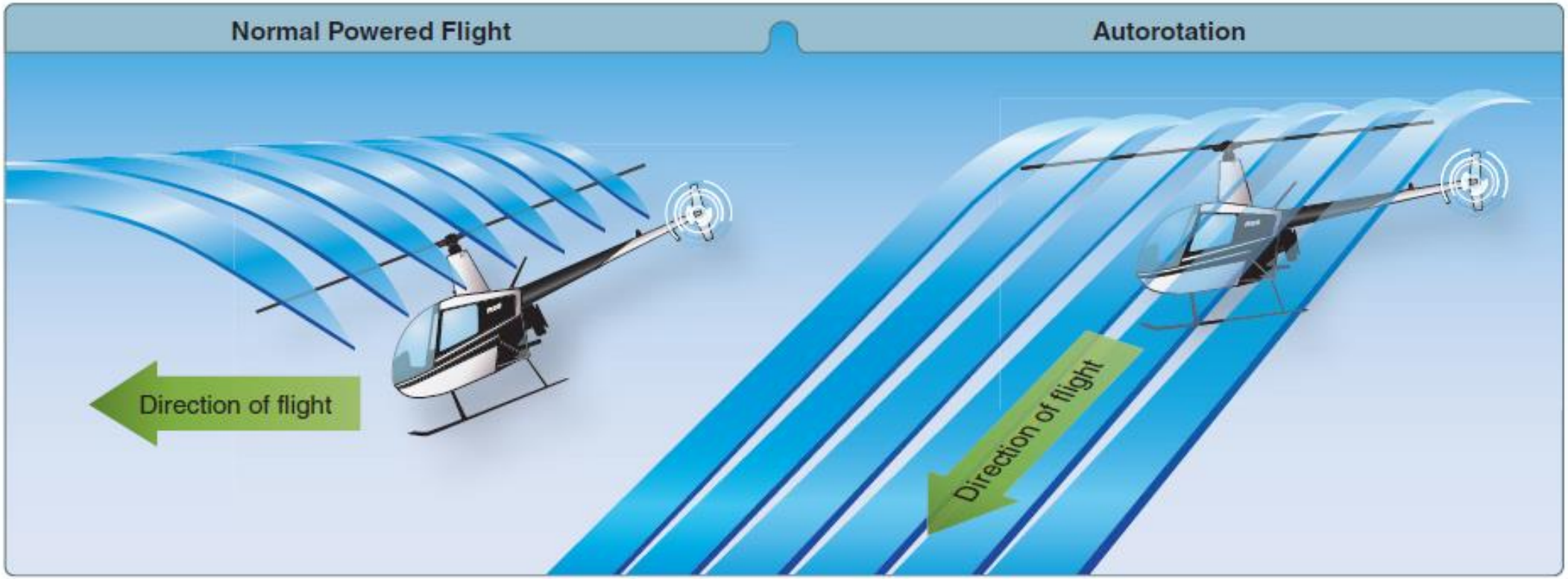


Figure 11-1. *During an autorotation, the upward flow of relative wind permits the main rotor blades to rotate at their normal speed. In effect, the blades are "gliding" in their rotational plane.*

AUTOROTATION – CORRECTIVE ACTIONS

WHY SHOULD YOU WANT TO SIMULATE AUTOROTATION?

Real life does not come with a "re-spawn" button. Life is imperfect: there is always a chance that you could lose engine power for a million reasons. In the world of DCS, odds are that you will be sent on dangerous (read: SUICIDAL) missions. Forget about milk runs: combat landings, close gunship support, CSAR… there are very high chances that you will be fired upon. With so much crap flying in the air, you are bound to get zinged by something. This is why if you enter in an autorotation state, you MUST know what you do.

HOW TO SIMULATE AUTOROTATION

Autorotation can be simulated if you reduce your throttle to IDLE (hold PAGE DOWN until you get to IDLE position). Train yourself to deal with autorotation and you will be surprised to see how much better your flying will become.

AUTOROTATION RECOVERY EXAMPLE:

1) Find a good place to land first and make sure you are at an altitude of 1000 m or more.
2) Simulate engine loss of power by moving the throttle levers to the STOP position by pressing "PAGE DOWN" twice.
3) Push TRIM RESET switch
4) Apply left rudder to center the helicopter, lower collective and pull up cyclic to compensate for sudden RPM loss: make sure the power turbine reaches 86% RPM at the very least.
5) Adjust cyclic for a constant descent at 110-130 km/h
6) Maintain 86%-90% RPM and 110-130 km/h airspeed.
7) Once condition at step 6) is respected , continue descent, deploy landing gear (very important!) and do not touch throttle.

a) At 30 m AGL, apply aft cyclic to level out and decelerate. Descent rate should be around 3-5 m/s.
b) At 10 m ft AGL, start flaring very gently and raise collective with decision to cushion the landing: not too fast, not too slow.
c) Use wheel brakes if necessary

Here is a video demonstration of a **powered autorotation recovery**
LINK: https://www.youtube.com/watch?v=2jvQLRkU24M

Here is a video demonstration of an **autorotation recovery without engine power**
LINK: https://www.youtube.com/watch?v=4sPb9adtq_I

INTRODUCTION TO SENSORS & WEAPONS

The Black Shark has a great arsenal of weapons at its disposal. Lots of new players tend to get overwhelmed by the whole weapon delivery procedure. The trick is to understand what does what.

- ***I-251 "Shkval" Electro-Optical Targeting System***
  - The Shkval targeting system is basically the "eyes" of your Ka-50. You use it to spot targets and lock them. What the SHKVAL sees is displayed on the grey TV screen.

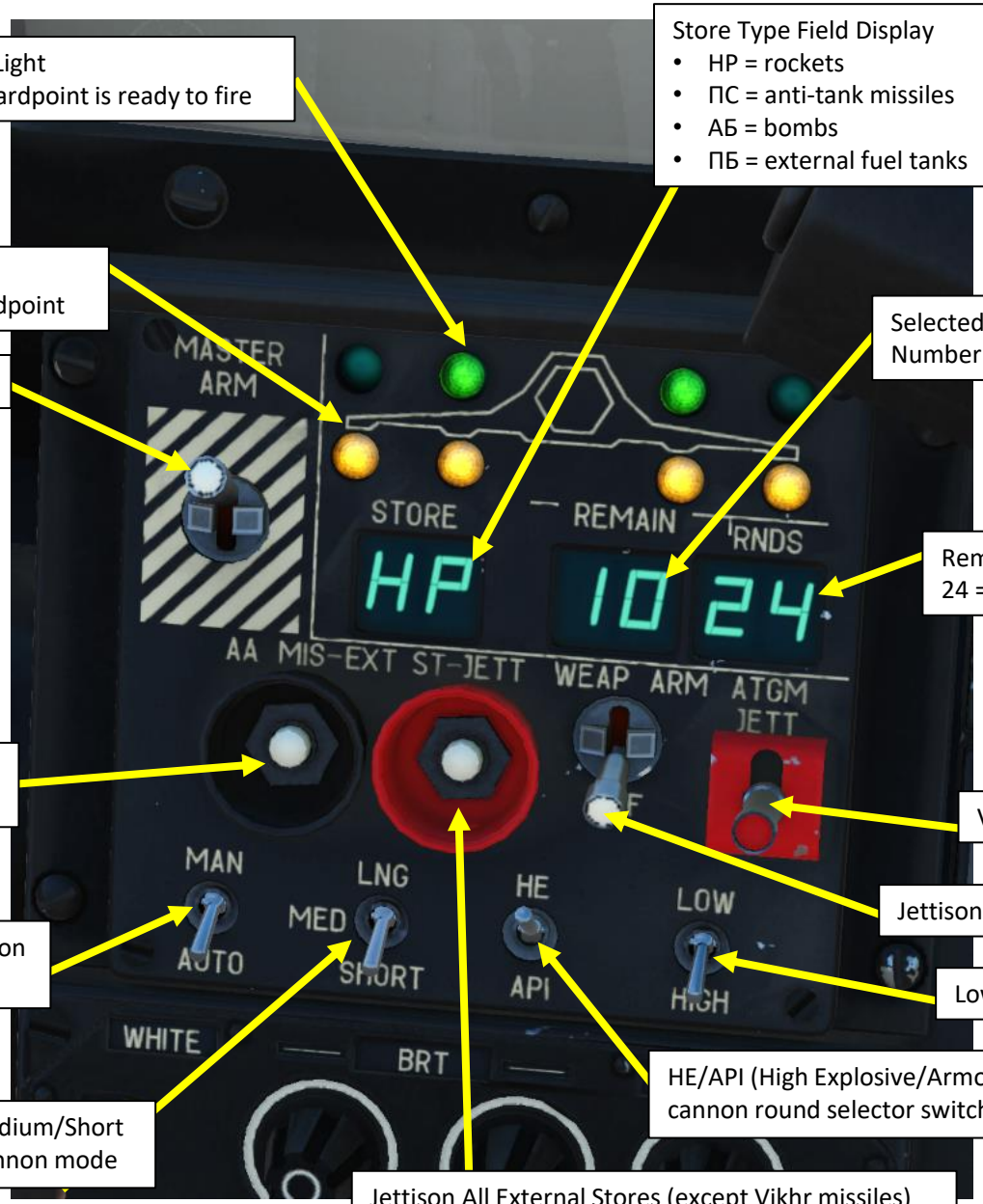
- ***HMS: Helmet-Mounted System***
  - The HMS allows the SHKVAL to track where your helmet is facing. This is useful if you want to quickly shift the helicopter towards a new target.

- ***9K121 VIKHR (AT-9)***
  - The VIKHR ATGM (air-to-ground missile) is a beam-riding anti-tank missile.
  - Range: min 800 m / max 8000 m

- ***2A4A CANNON***
  - A 30-mm auto-cannon similar to the one mounted on the BMP-2 IFV (Infantry Fighting Vehicle). One of its particularities is that it can rotate and track targets with the SHKVAL, which allows you to fire on targets very precisely if you know how to use it. It is powered by the helicopter's hydraulic drive system, and the semi-rigid mount allows the cannon to be deflected from -2°30' to +9° in azimuth and from +3°30' to -37° in elevation.

- ***ROCKETS/GUNPODS/BOMBS***
  - The Black Shark can be equipped with UPK-23 gun pods, FAB-250 bombs, KMGU-2 Sub-Munition Dispenser, 80mm S-8 rockets and 122mm S-13 rockets.

WEAPON STATUS & CONTROL PANEL



Weapon Readiness Indicator Light
Green = store attached to a hardpoint is ready to fire

Store Type Field Display
- НР = rockets
- ПС = anti-tank missiles
- АБ = bombs
- ПБ = external fuel tanks

Weapon Presence Indicator Light
Yellow = store is attached to a hardpoint

Selected Weapons Remaining
Number of selected weapons (rockets or Vikhr) remaining.

Master Arm Switch

Remaining Cannon Rounds
24 = 240 rounds

Emergency Jettison of Air-to-Air Missiles (not implemented)

Vikhr ATGM (Air-to-Ground Missile) Jettison

Jettison Weapon Arming Switch

Manual/Auto Weapon control switch

Low/High Cannon Rate of Fire switch

HE/API (High Explosive/Armor-Piercing Incendiary) cannon round selector switch

Long/Medium/Short range cannon mode

Jettison All External Stores (except Vikhr missiles)

SHKVAL INTRODUCTION

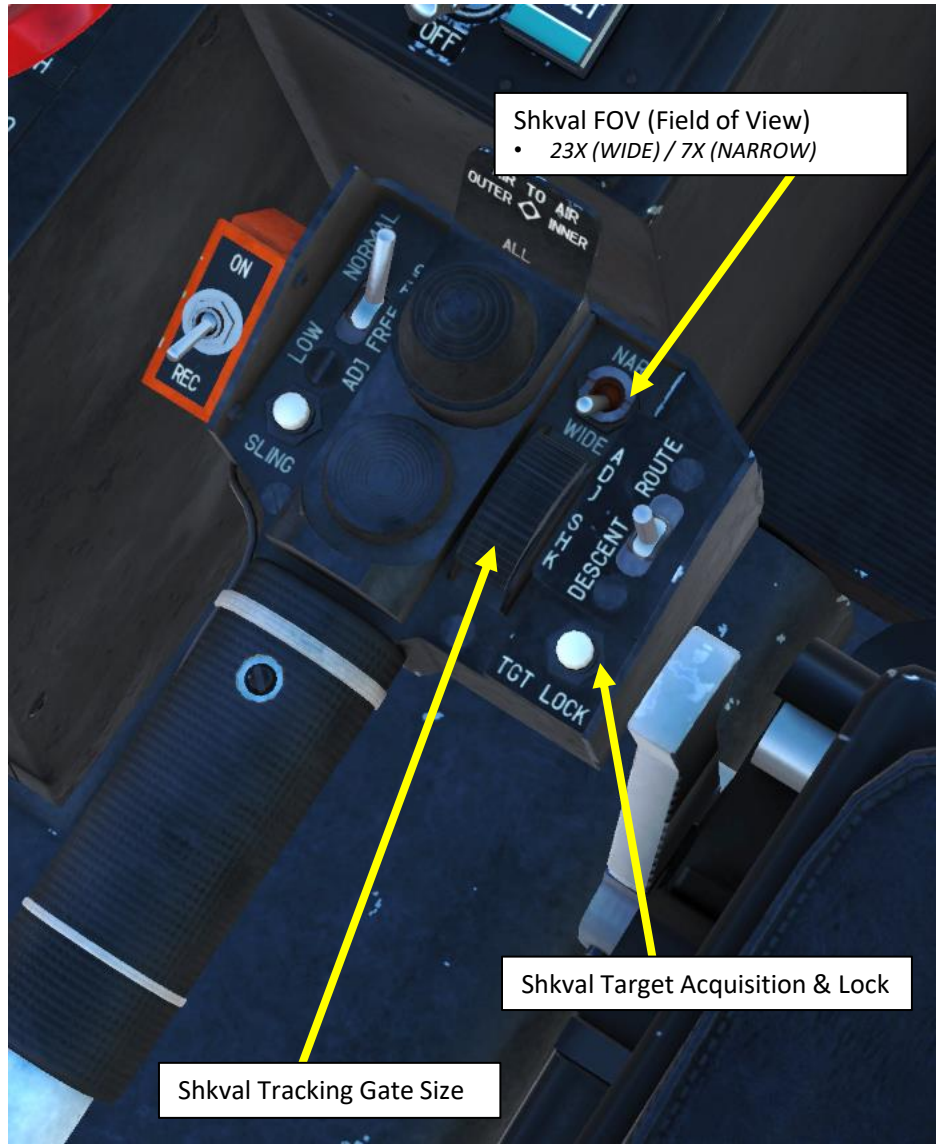
The I-251 (И-251) “Shkval” electro-optical targeting system is designed to detect targets via electro-optical imagery that provides 7x and 23x magnification under visual, daylight conditions. It can then process that information and use it for automated targeting and weapons delivery.

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

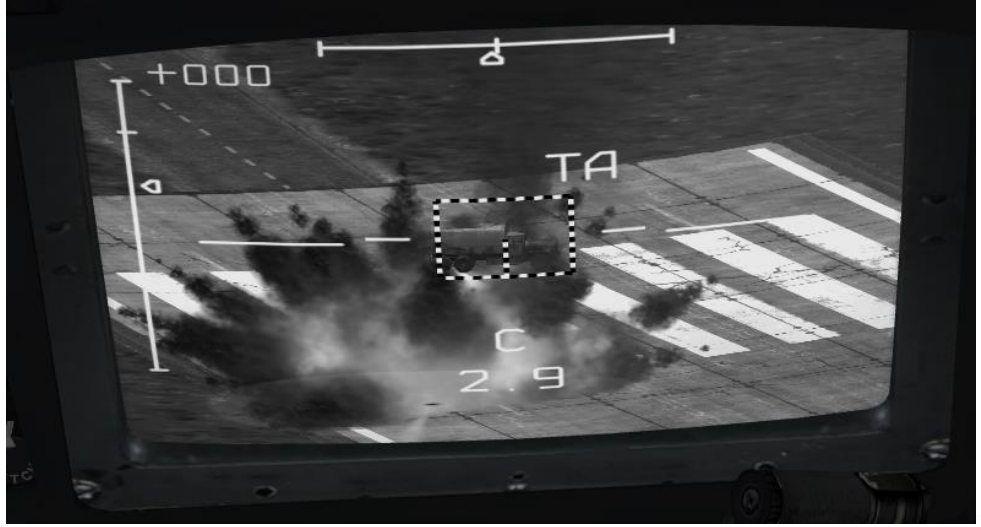
SHKVAL CONTROLS

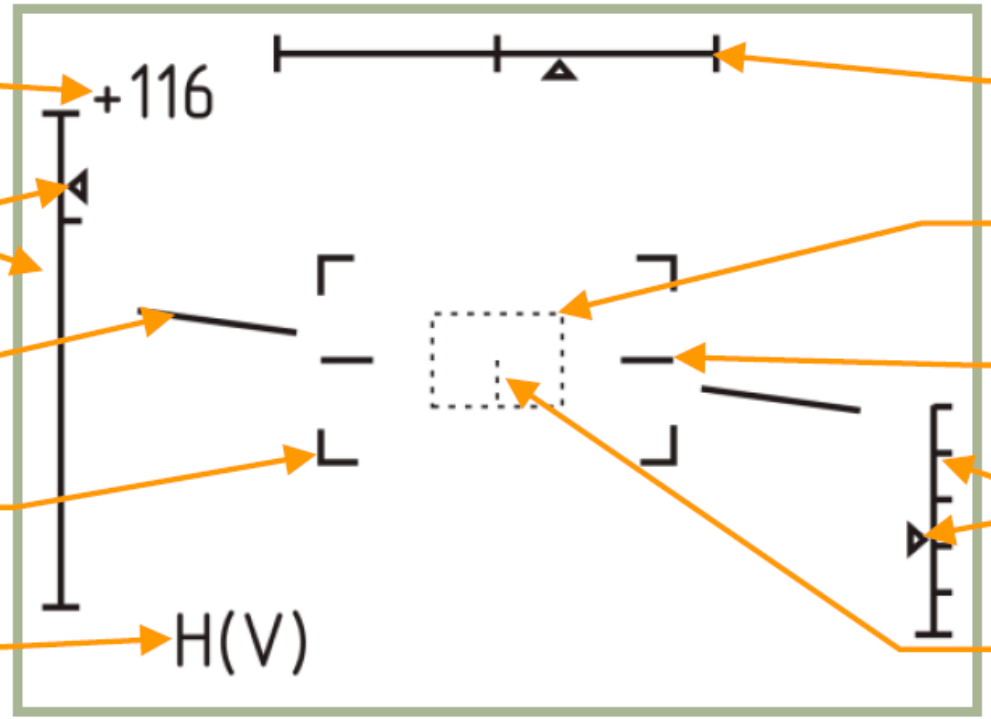
Uncage SHKVAL EO (Electro-Optical) Targeting System

Marker Hat Switch (Slew Control for SHKVAL Line of Sight)



SHKVAL DISPLAY





Current Airspeed (km/h)

Line of sight elevation scale and marker (+15 deg to -80 deg)

Artificial Horizon

Narrow FOV (0.7 x 0.9 deg) boundary markers

Flashing warning cues:
- "H" - ground collision
- "V" - maximum airspeed

Line of sight azimuth scale and marker (+/- 35 deg)

Tracking gate

Zero bank (wings-level) reference lines

Scale and marker of radar altitude (displayed below 50 m of radar altitude)

Centerline of the tracking gate (displayed if the tracking gate size is increased four or more settings over the minimum)

SHKVAL DISPLAY

SHKVAL DISPLAY

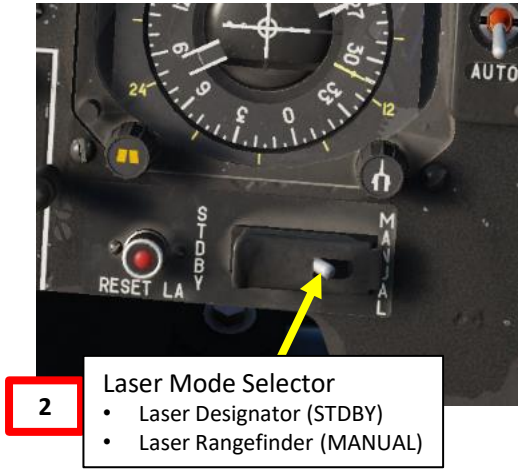
On the ABRIS NAV page, a yellow pointer will indicate where the SHKVAL is designating.

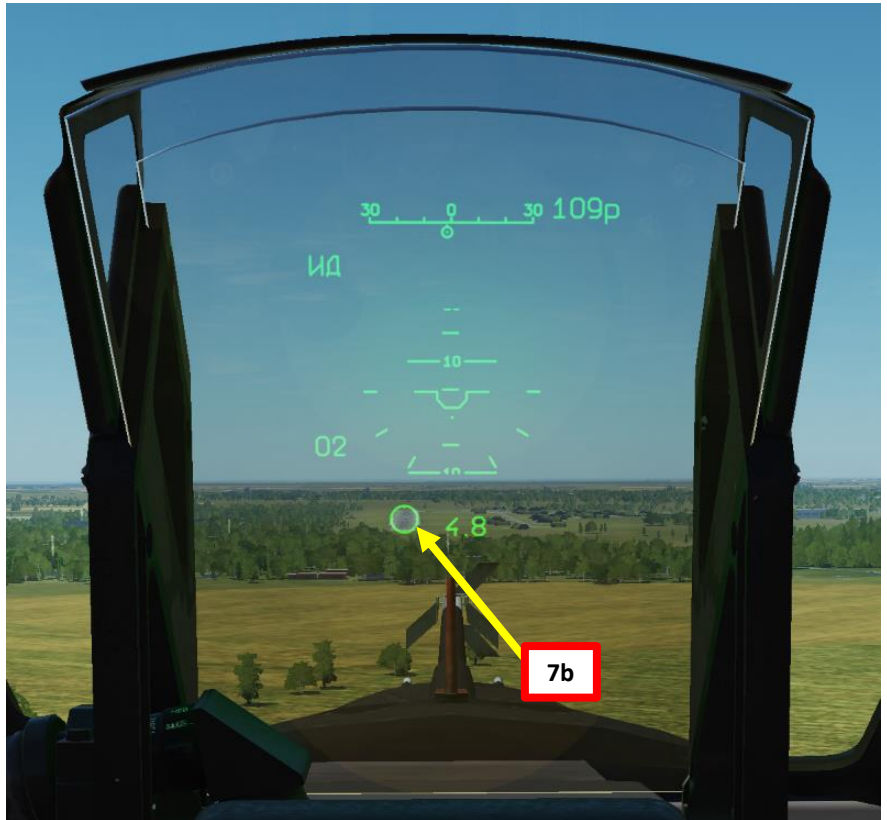
SHKVAL LOCK

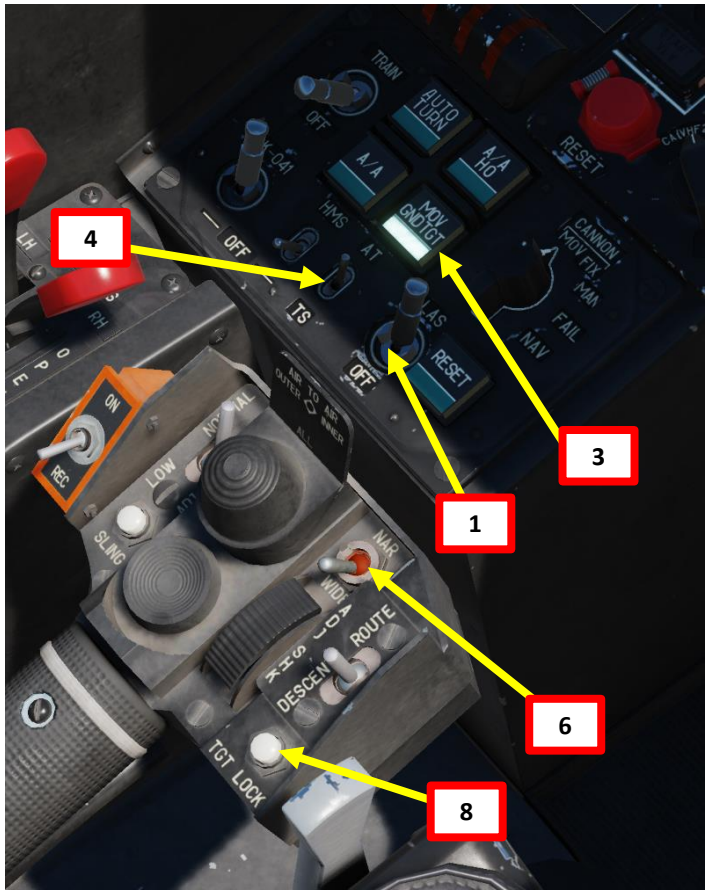
1. Laser Power switch ON (FWD)
2. Set Laser Mode Selector to MANUAL
3. Select “MOVING GROUND TARGET” button if tracking a moving target
4. Select AUTO TRACKING (FWD) mode if using the SHKVAL for tracking.

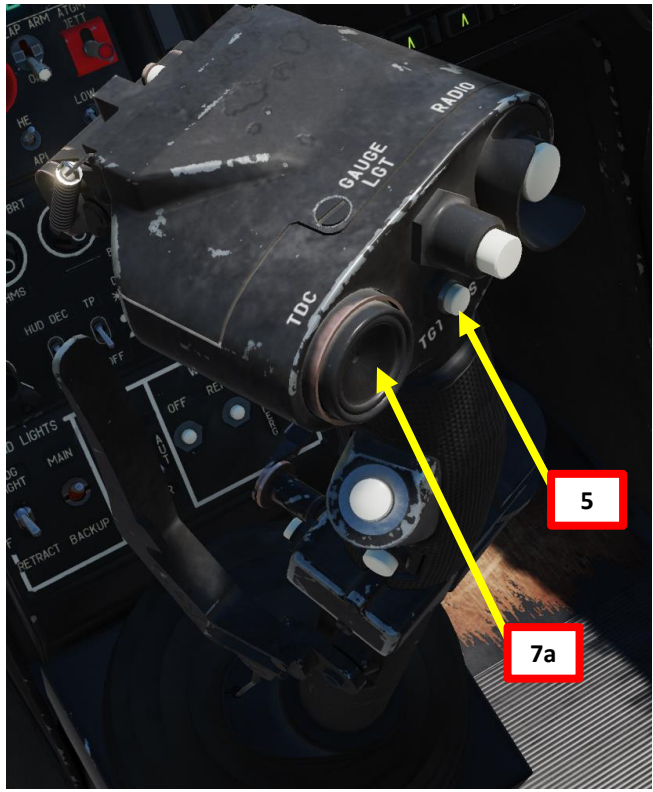
Note: You would usually designate with the HMS (Helmet Mounted Sight) but you can do it without using the HMS as well. In our case, we will leave the HMS OFF.

5. Uncage SHKVAL by pressing “O” (Shkval Uncage Button). Reticle will be boresighted at the center of your Heads-Up Display.
6. Change SHKVAL FOV to either NARROW 7X or WIDE 23X using “+“ or “-” or custom key binding.
7. Slew SHKVAL reticle to desired target using KU-31 Slew UP/DOWN/LEFT/RIGHT controls “,” “.” “/”and “;”
8. Lock target (“Enter” key) using the Shkval Target Acquisition & Lock button.









HMS (HELMET MOUNTED SIGHT)

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.

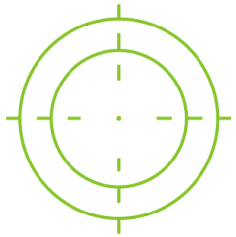
HMS (Helmet-Mounted Sight) System Power Switch

HMS (HELMET MOUNTED SIGHT)

HMS Operative Mode

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.



HMS Processing Mode

Conditions:

- Automatic weapon system control mode enabled (AC).
- HMS within 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°.

HMS Lock Mode

Conditions (Set No. 1):

- Automatic weapon system control mode enabled (AC).
- HMS within Shkval's gimbal limits.
- "ЦУ" (Uncage Shkval, designate target) button has been pressed and the displacement angle between HMS and Shkval LOS is more 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.

Conditions (Set No. 2):

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

HMS Launch Authorized Mode

Conditions:

- Automatic weapon system control mode enabled (AC).
- HMS within Shkval's gimbal limits.
- Weapon Launch Authorized

HMS Overlimit Mode

Conditions:

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

HMS Turn to Target Mode

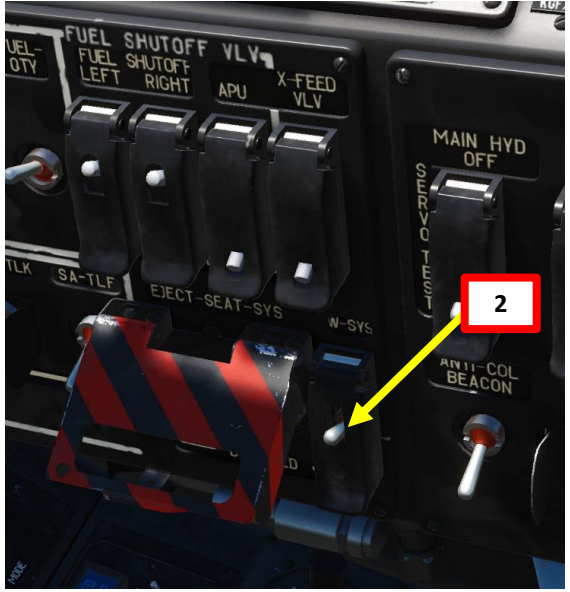
Conditions:

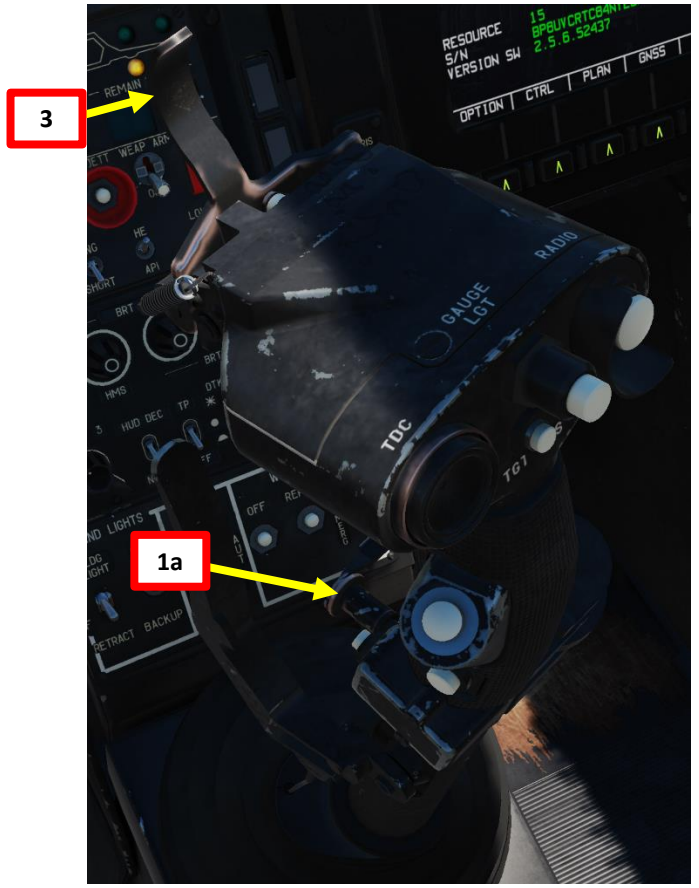
- Automatic weapon system control mode enabled (AC).
- HMS is beyond the Shkval's gimbal limits (+/- 30 deg).
- "ЦУ" (Uncage Shkval, designate target) button is pressed.
- "АДВ" (Automatic turn to target) mode active.

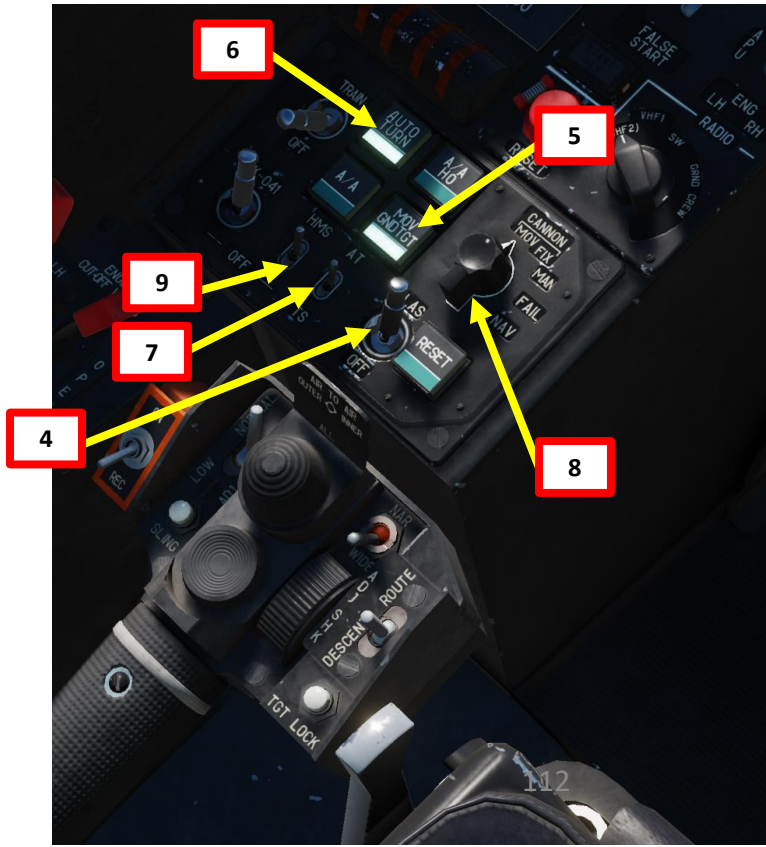
Note: If a target is beyond of the Shkval's gimbal limits, it is required to maneuver to bring the target within the targeting system's scan limits. With "АДВ" (automatic auto turn to target) mode enabled, the helicopter will orient toward the target.

2A42 CANNON TUTORIAL

1. (Optional) Auto-Hover switch ON (LALT+T by default) and collective to 75 % / normal operating position.
2. Weapons Power switch ON
   - Flip cover UP, switch UP, flip cover DOWN.
3. Flip gun safety switch by pressing “C” (or Gun Select key binding)
4. Laser Power switch ON (FWD)
5. Select “MOVING GROUND TARGET” button if tracking a moving target
6. Select “AUTO-TURN” button if you want the Ka-50 to automatically face the direction you are aiming.
7. Select AUTO TRACKING (FWD) mode if using the SHKVAL for tracking or MAN for boresighted (unguided) mode.
8. Select MOV mode (or FIX if you are not using the SHKVAL)
9. Set HMS (Helmet Mounted Sight) switch ON (FWD)

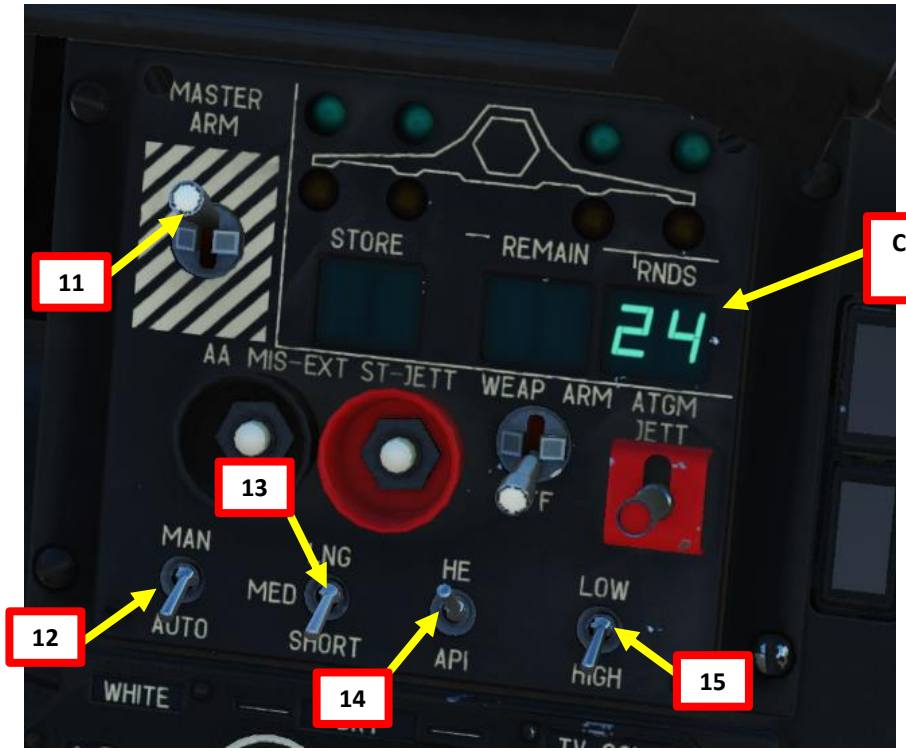


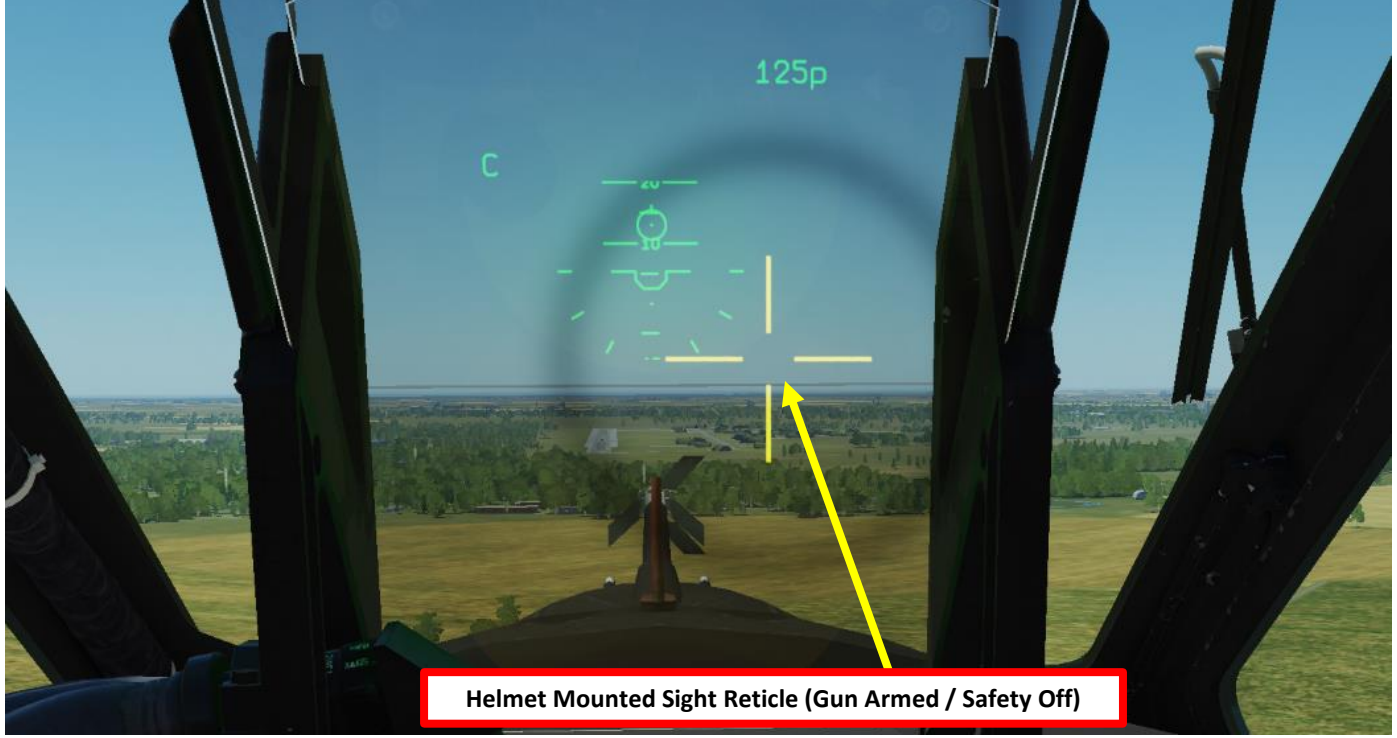




2A42 CANNON TUTORIAL

10. Your Helmet Mounted Sight will be used to designate the target.
11. Set Master Arm switch ON (UP)
12. Set Weapon Launch Mode: Auto
13. Set Weapon Burst Length: As desired
    - SHORT = 10 / MED-LONG = 20
14. Set Ammunition Type:
    - HE: High-Explosive
    - API: Armor-Piercing Incendiary
15. Set Low/High rate of fire (200/600 RPM)



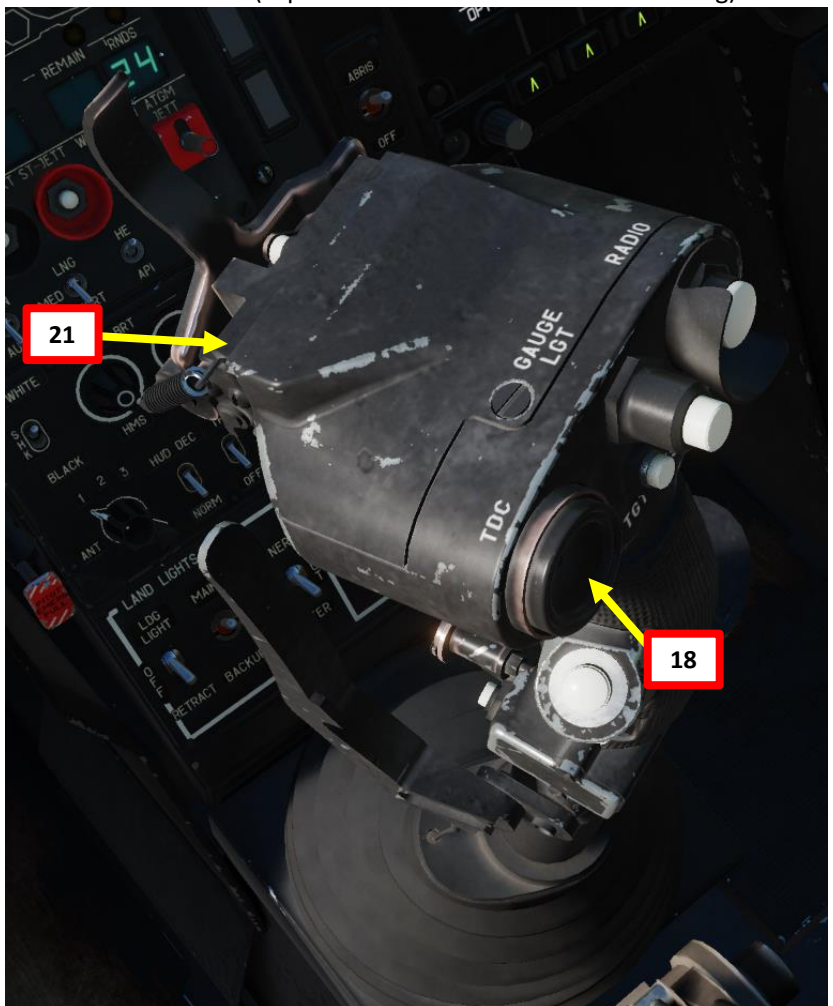


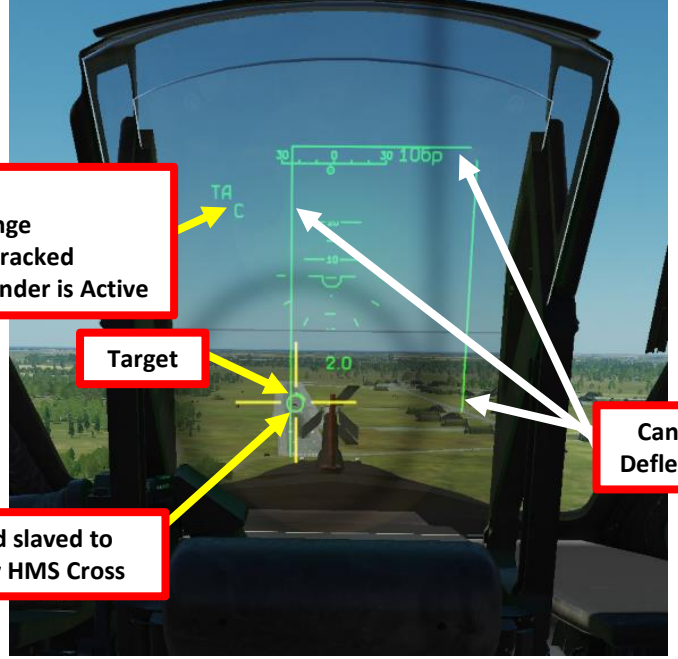
2A42 CANNON TUTORIAL

16. Move your head to place the HMS (Helmet Mounted Sight) cross on the target, then uncage SHKVAL by pressing “O” or using custom binding.

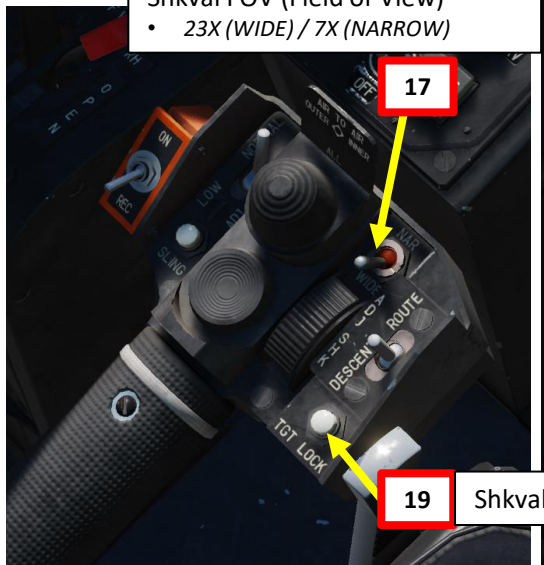
2A42 CANNON TUTORIAL

17. Change SHKVAL FOV to either NARROW 7X or WIDE 23X using “+“ or “-” or custom key binding.
18. Slew SHKVAL reticle to desired target using KU-31 Slew UP/DOWN/LEFT/RIGHT controls “,” “.” “/”and “;”
19. Lock target (“Enter” key) using the Shkval Target Acquisition & Lock button.
20. Make sure the “C” (In Range to Target) and “TA” (Target is being tracked) indication are visible on the Heads-Up Display and SHKVAL display. Verify that you are within the Cannon Max Deflection Zone (Rectangle)
21. Fire Gun (“Spacebar” or custom “Gun Fire” binding)

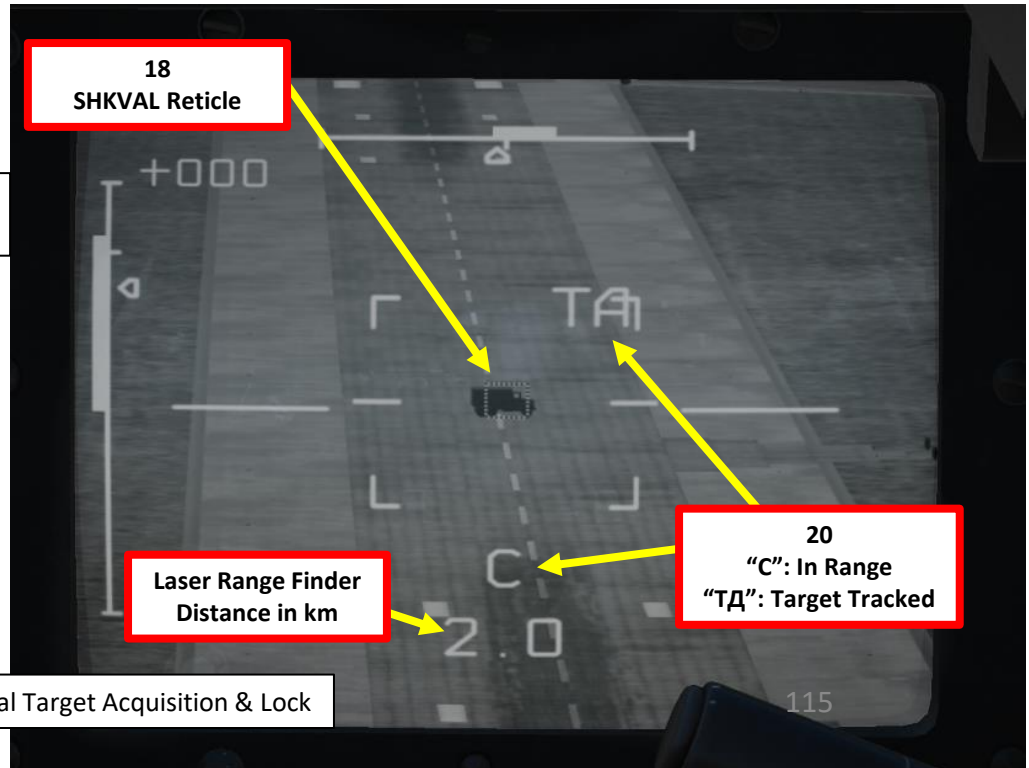




Shkval FOV (Field of View)
- *23X (WIDE) / 7X (NARROW)*



Shkval Target Acquisition & Lock



2A42 CANNON TUTORIAL

22. The cannon will fire on the target designated by the SHKVAL. If you are moving and within the cannon max deflection limits, the cannon will keep tracking the target and fire on the same target if you press the trigger again.

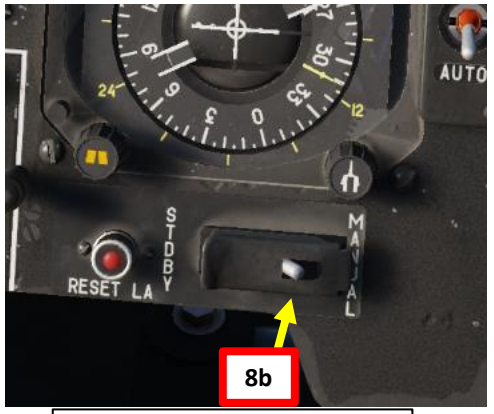
2A42 CANNON TUTORIAL

Cannon Employment Parameters

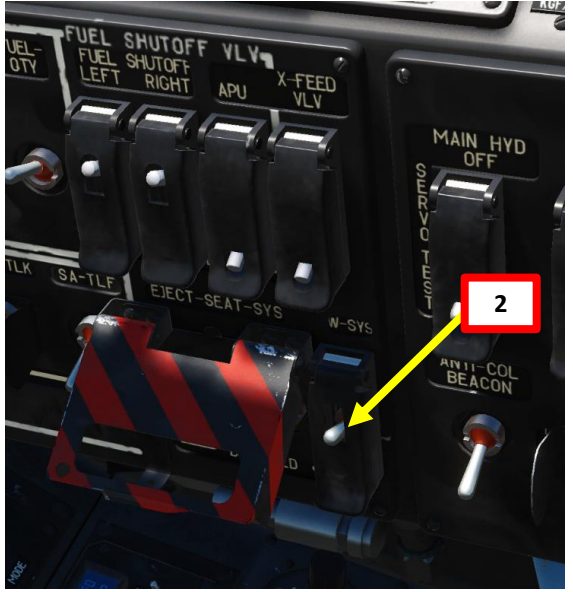
Minimum Safe Altitude - Hover	10 m
Minimum Safe Altitude – Level Flight With Shkval	30 m
Minimum Safe Altitude – Level Flight Without Shkval	20 m
Maximum Altitude	5,000 m
Maximum Indicated Airspeed	300 km/h
Minimum Target Range	800 m
Maximum Target Range	2,000 m
Pitch Angle	±60°

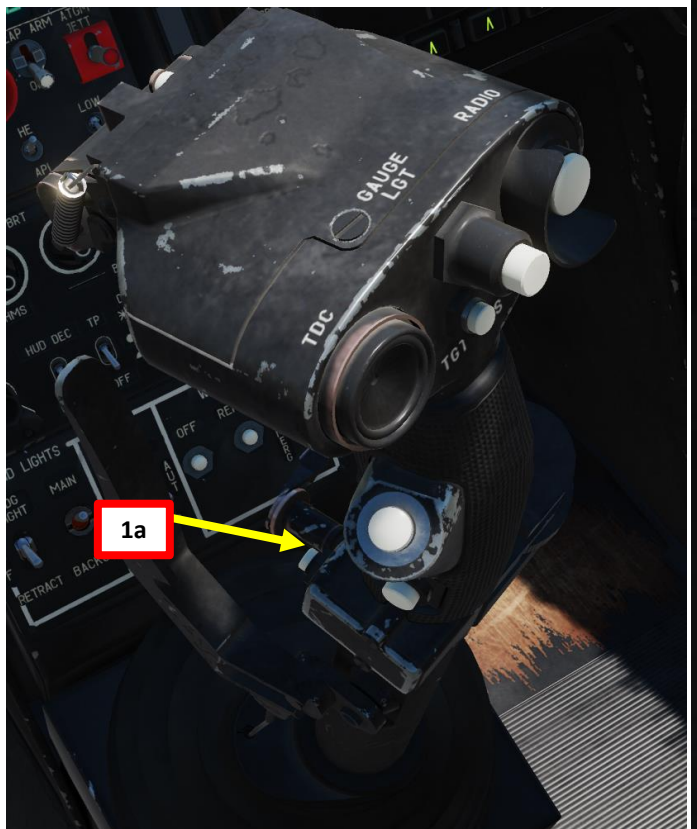
VIKHR AIR-TO-GROUND MISSILE TUTORIAL

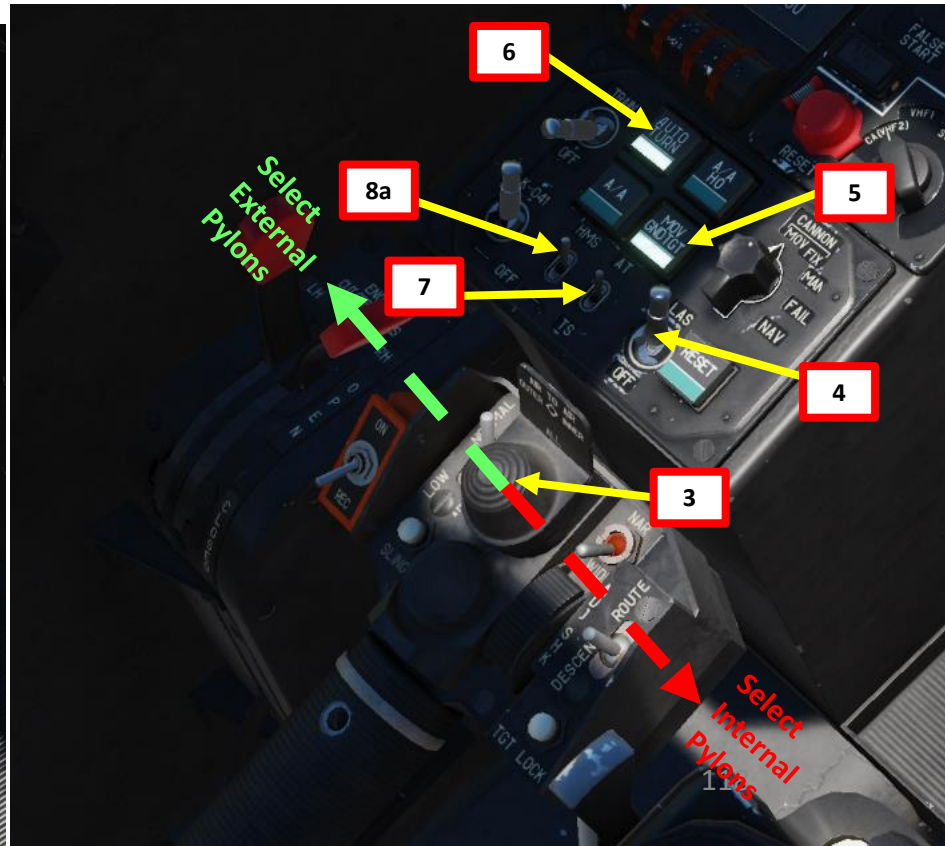
1. (Optional) Auto-Hover switch ON (LALT+T by default) and collective to 75 %/normal operating position.
2. Weapons Power switch ON
   - Flip cover UP, switch UP, flip cover DOWN.
3. Set collective weapon hat switch to the LEFT to select VIKHR missile (outer pylons if equipped as such)
4. Laser Power switch ON (FWD)
5. Select “MOVING GROUND TARGET” button if tracking a moving target
6. Select “AUTO-TURN” button if you want the Ka-50 to automatically face the direction you are aiming.
7. Select AUTO TRACKING (FWD) mode if using the SHKVAL for tracking.
8. Set HMS (Helmet Mounted Sight) switch ON (FWD) and set Laser Mode Selector to MANUAL.
   - Take note that the Laser Mode Selector switch does not affect Vikhr employment.



Laser Mode Selector
- Laser Designator (STDBY)
- Laser Rangefinder (MANUAL)





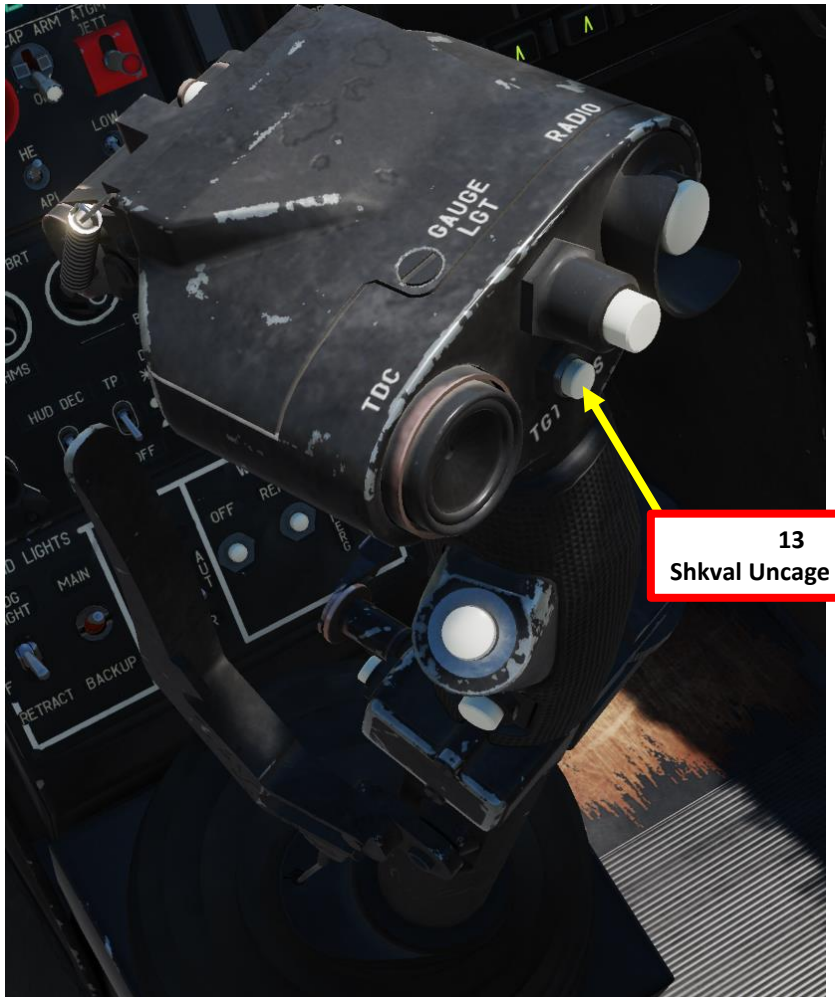


VIKHR AIR-TO-GROUND MISSILE TUTORIAL

9. Your Helmet Mounted Sight will be used to designate the target.
10. Master Arm switch ON (UP)
11. Weapon Launch Mode: Manual
    - NOTE: I recommend using MANUAL (DOWN) since it allows you to fire to targets that are farther than what you can reach in AUTO.
12. Weapon Burst Length
    - SHORT = 1 / MED-LONG = 2

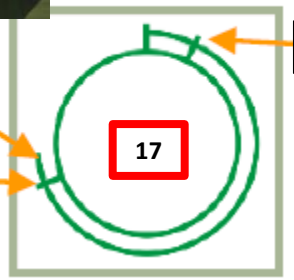
VIKHR AIR-TO-GROUND MISSILE TUTORIAL

13. Move your head to place the HMS (Helmet Mounted Sight) cross on the target, then uncage SHKVAL by pressing “O” or using custom binding.

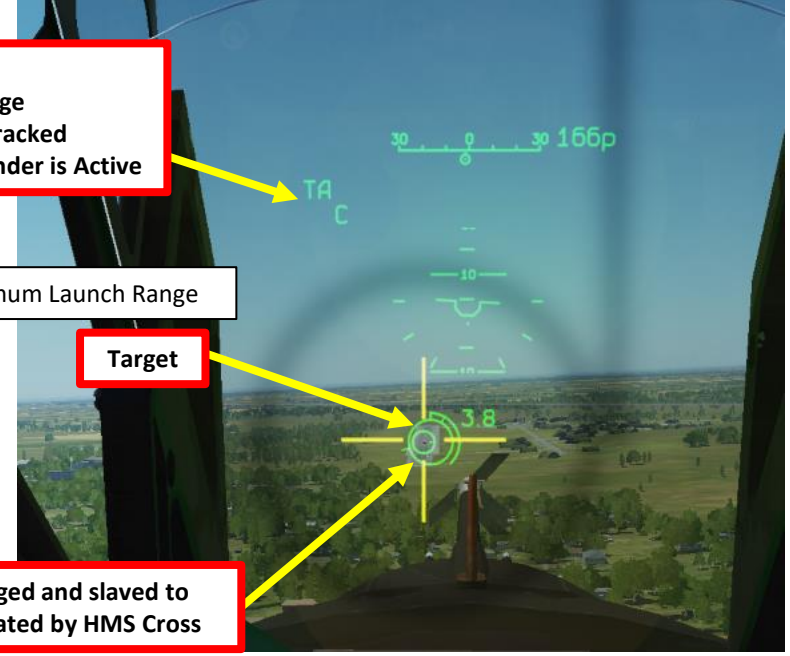


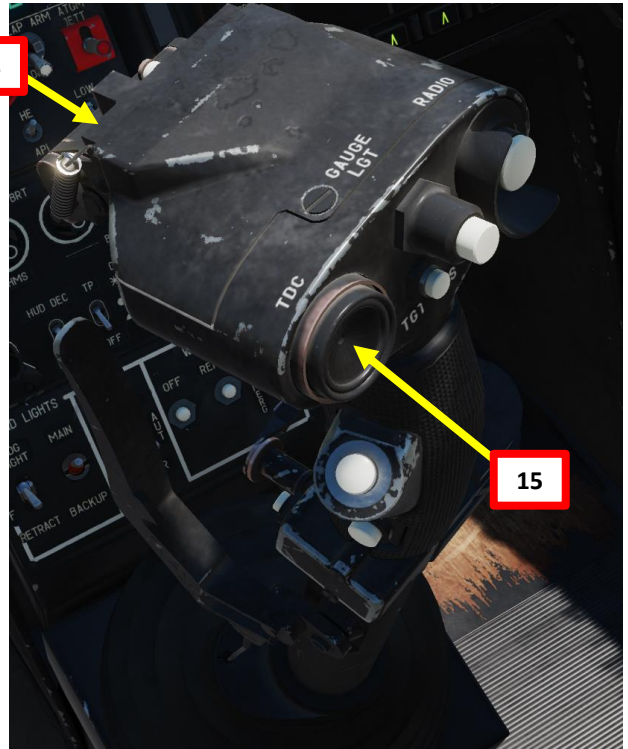
VIKHR AIR-TO-GROUND MISSILE TUTORIAL

14. Change SHKVAL FOV to either NARROW 7X or WIDE 23X using "+" or "-" or custom key binding.
15. Slew SHKVAL reticle to desired target using KU-31 Slew UP/DOWN/LEFT/RIGHT controls "," "." "/"and ";"
16. Lock target ("Enter" key) using the Shkval Target Acquisition & Lock button.
17. Make sure the "C" (In Range to Target) and "TA" (Target is being tracked) indication are visible on the Heads-Up Display and SHKVAL display. Verify that you are within acceptable launch range (less then 8 km).
18. Launch VIKHR missile using the Release Weapons Trigger (RAlt+Spacebar). Keep the trigger pressed until the missile has launched; this usually takes about one full second.

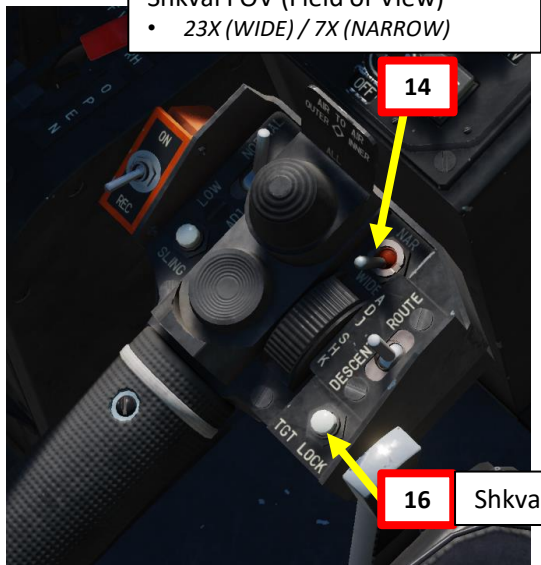


17
"C": In Range
"ТД": Target Tracked
Д-ИД: Laser Range Finder is Active



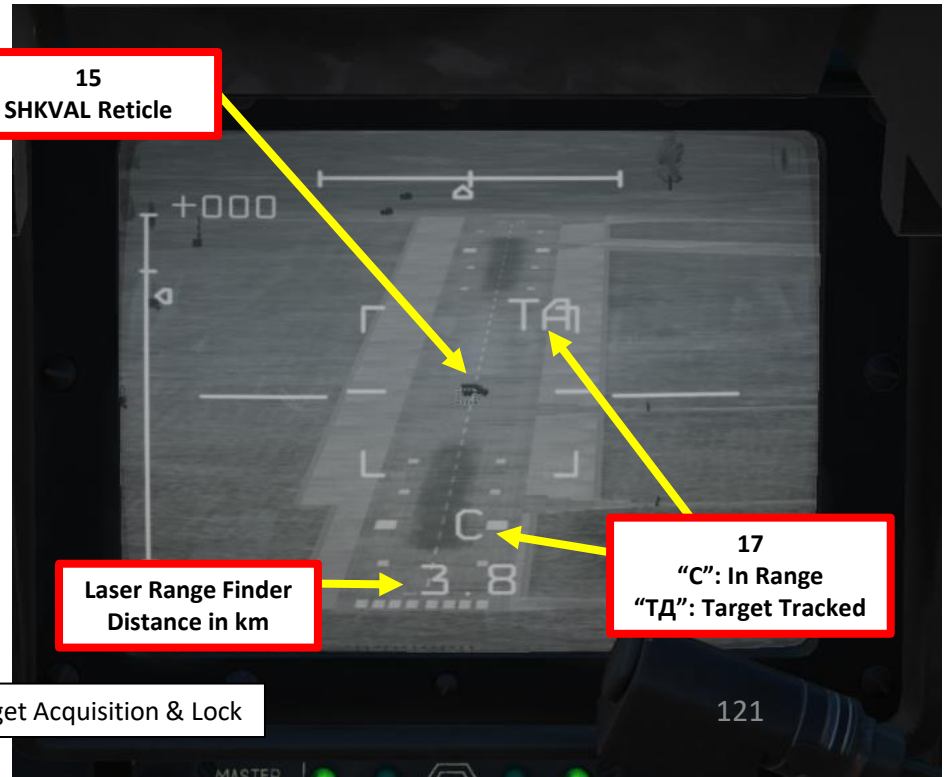


Shkval FOV (Field of View)
- *23X (WIDE) / 7X (NARROW)*



16 Shkval Target Acquisition & Lock

15
SHKVAL Reticle



Laser Range Finder Distance in km

17
"C": In Range
"ТД": Target Tracked

VIKHR AIR-TO-GROUND MISSILE TUTORIAL

19. When the weapon release button is pressed, the missile laser-beam control channel is automatically activated. The Vikhr will track the laser and home on the target. While the Vikhr missile is in flight, maintain the helicopter's current heading such that it does not exceed the Shkval's angular gimbal limits. Try to avoid high angular velocity that can cause missile to lose the laser-guidance beam.

VIKHR AIR-TO-GROUND MISSILE TUTORIAL

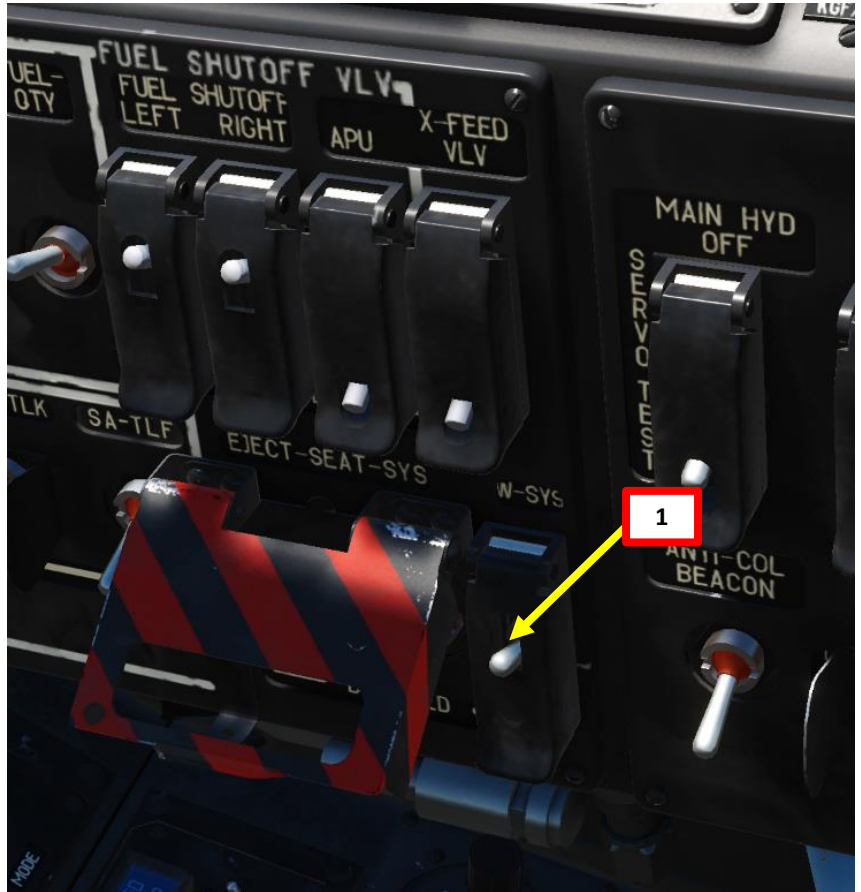
VIKHR AIR-TO-GROUND MISSILE TUTORIAL

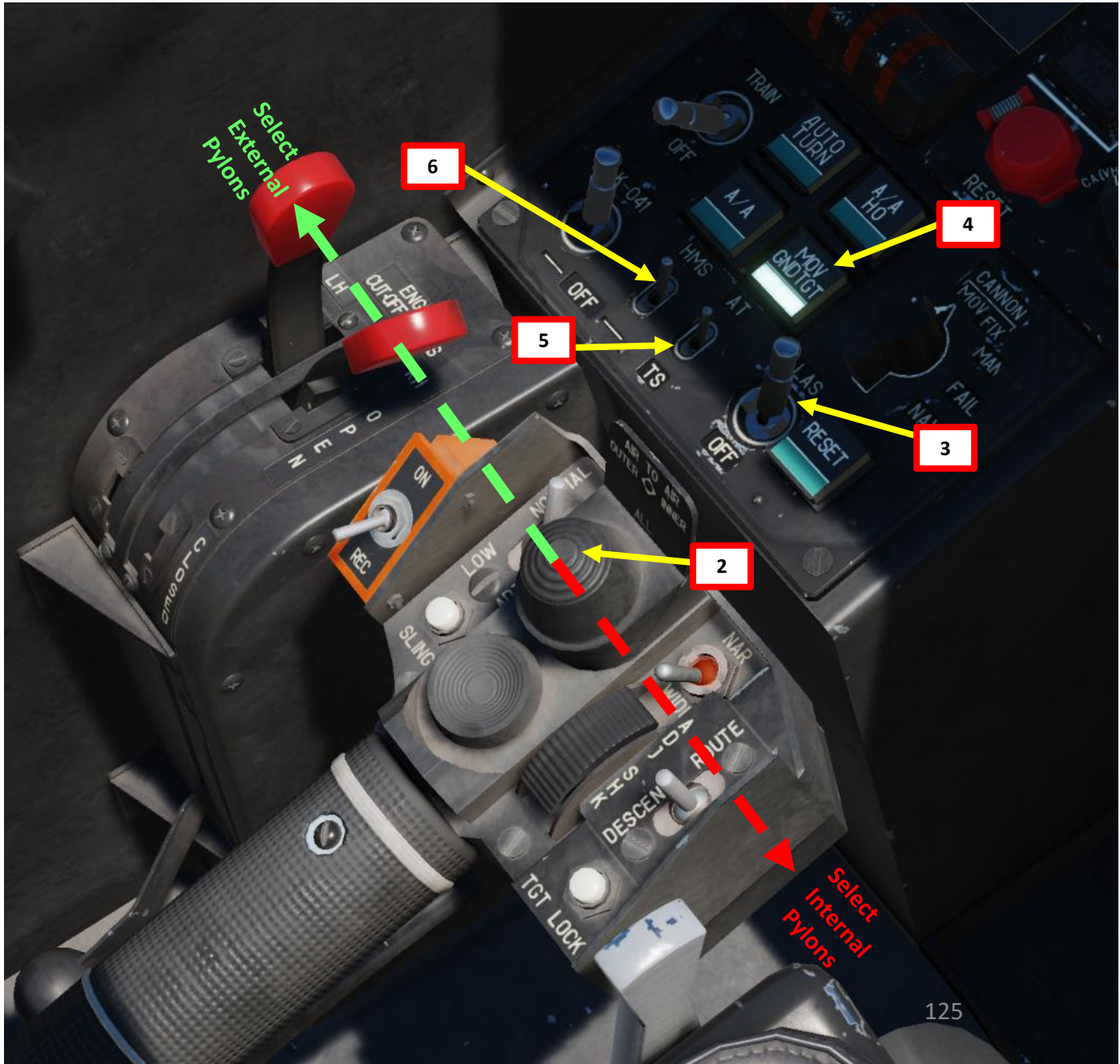
Vikhr ATGM Employment Parameters

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

UNGUIDED ROCKETS/GUNPOD TUTORIAL

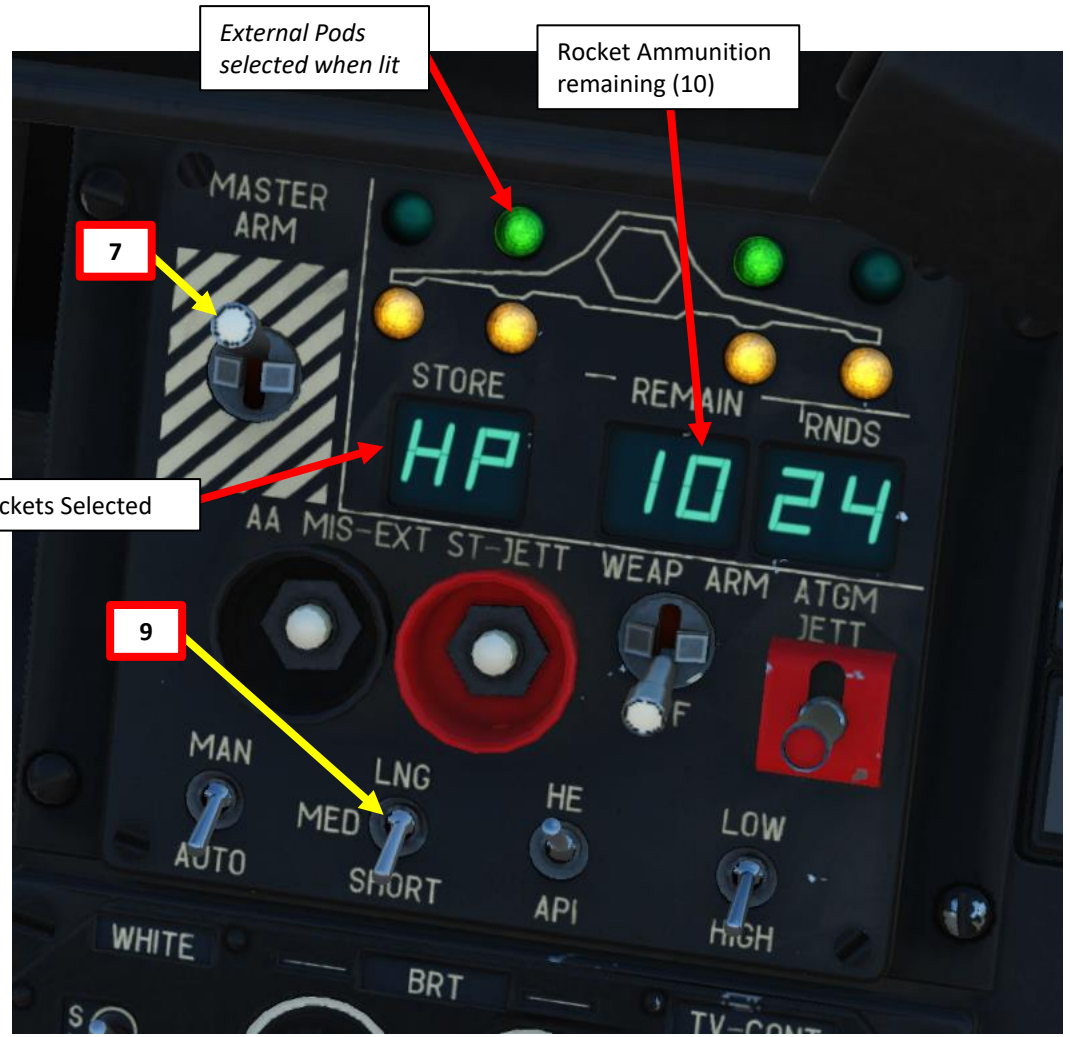
1. Weapons Power switch ON
   - Flip cover UP, switch UP, flip cover DOWN.
2. Set collective weapon hat switch to the RIGHT to select rocket pods (inner pylons if equipped as such)
3. Laser Power switch ON (FWD)
4. Select “MOVING GROUND TARGET” button if tracking a moving target
5. Select AUTO TRACKING (FWD) mode if using the SHKVAL for tracking.
6. Set HMS (Helmet Mounted Sight) switch ON (FWD)





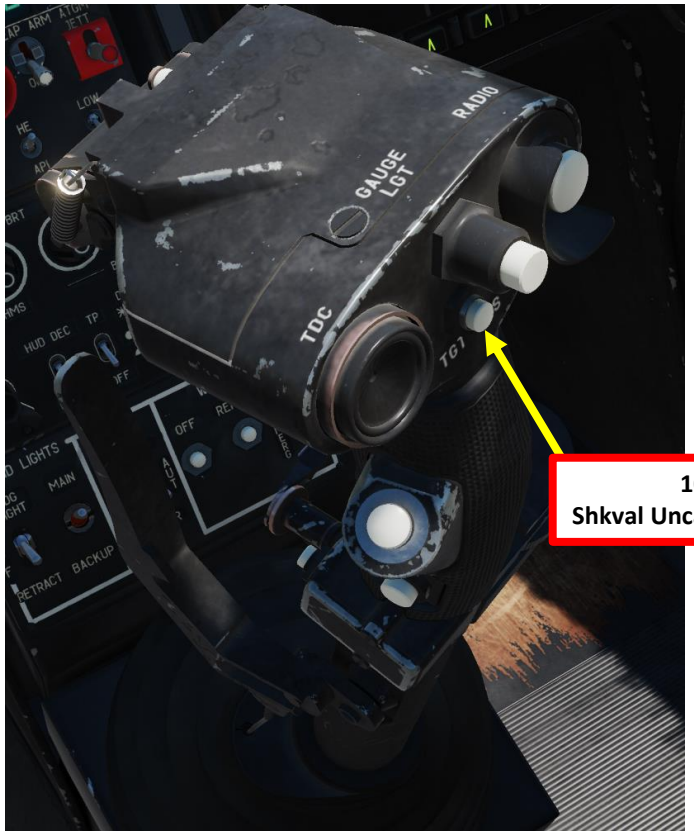
UNGUIDED ROCKETS/GUNPOD TUTORIAL

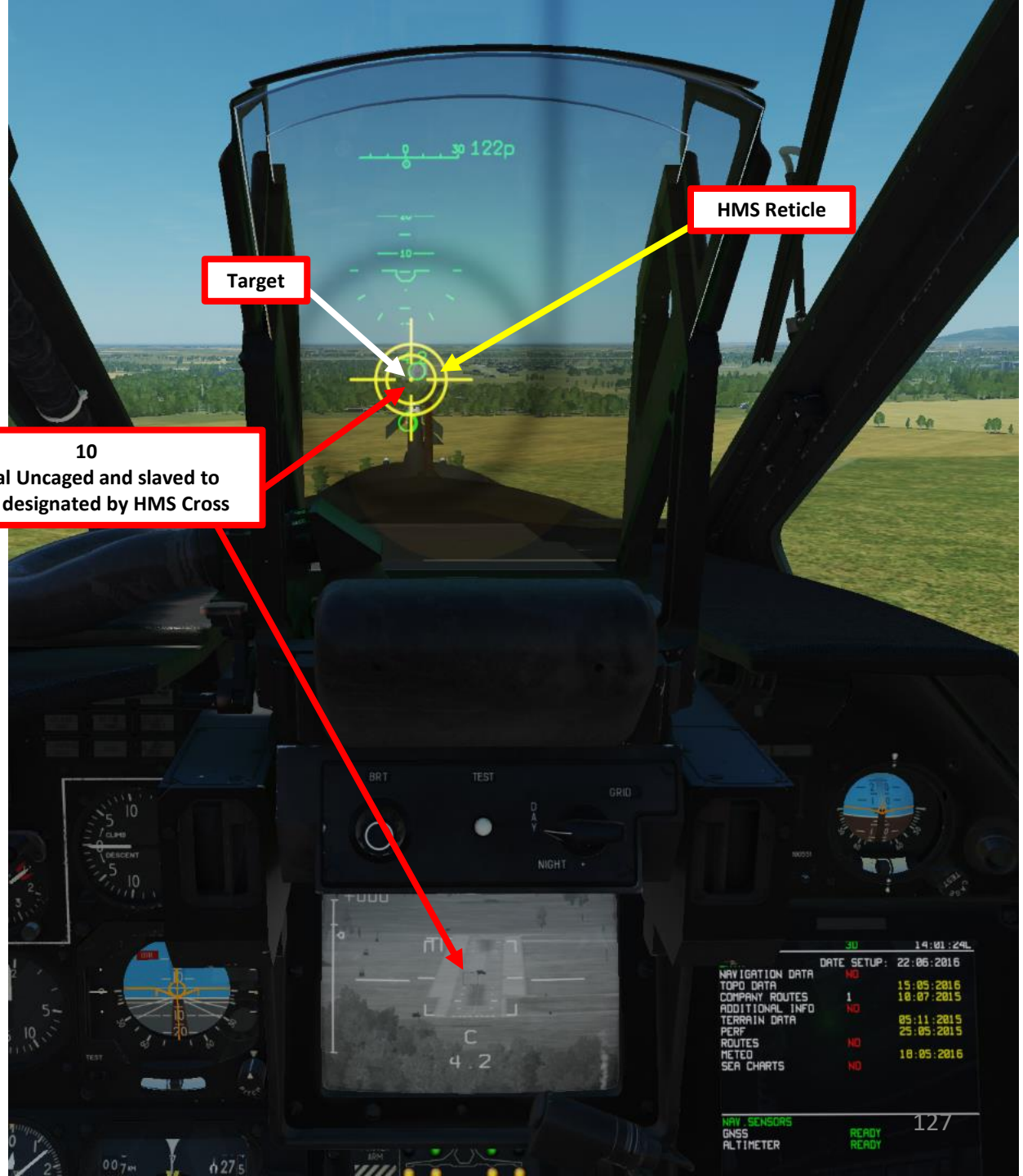
7. Master Arm switch ON (UP)
8. Select rocket type
   - 0: S-8KOM rockets with AT /AP warhead
   - 1: S-8TsM rockets (smoke warhead)
   - 2: S-13 rockets
   - 3: S-24 heavy rockets (not implemented in DCS)
   - 4: S-8M HE rockets
   - 5: UPK-23 gun pods, twin 23mm
9. Select Weapon Burst Length
   - SHORT = 1 pair / MED = 5 pairs / LONG = 10 pairs



UNGUIDED ROCKETS/GUNPOD TUTORIAL

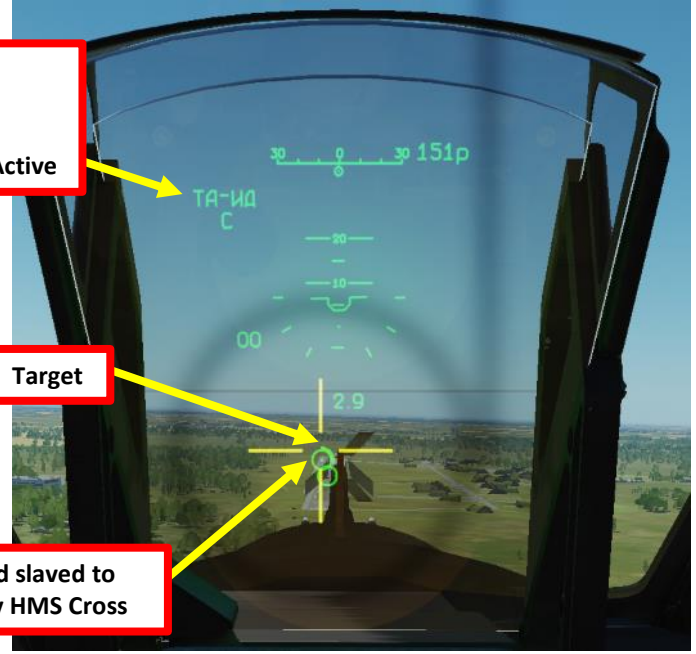
10. Move your head to place the HMS (Helmet Mounted Sight) cross on the target, then uncage SHKVAL by pressing “O” or using custom binding.

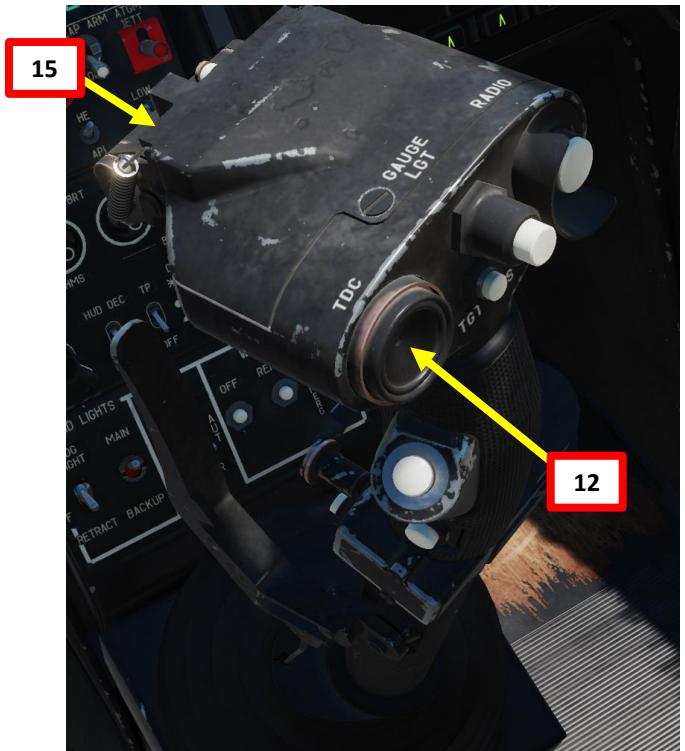


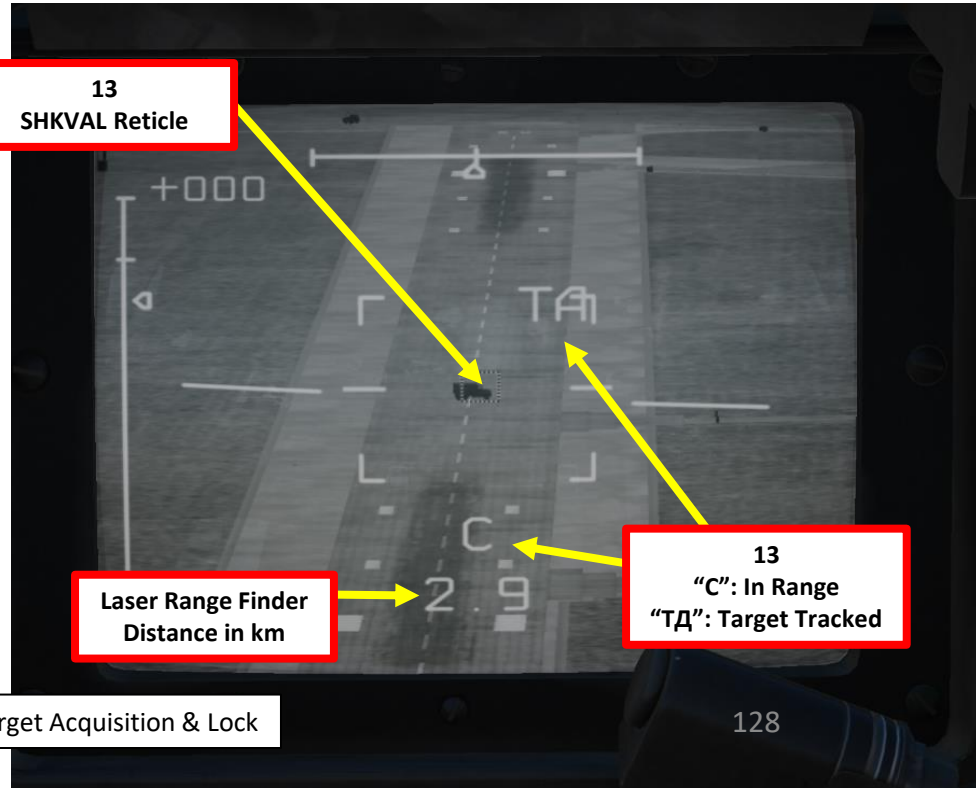


UNGUIDED ROCKETS/GUNPOD TUTORIAL

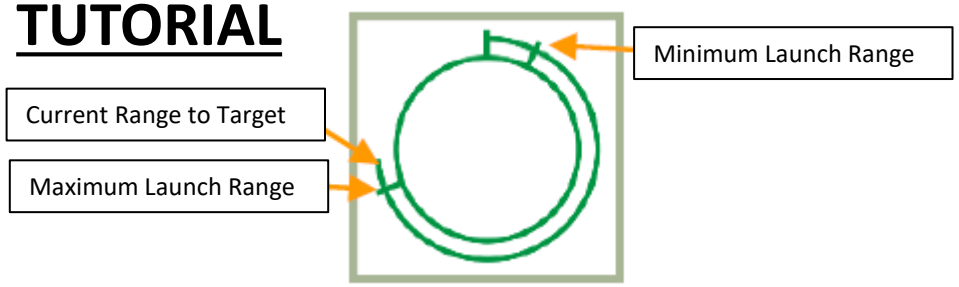
11. Change SHKVAL FOV to either NARROW 7X or WIDE 23X using "+" or "-" or custom key binding.
12. Slew SHKVAL reticle to desired target using KU-31 Slew UP/DOWN/LEFT/RIGHT controls "," "." "/"and ";"
13. Lock target ("Enter" key) using the Shkval Target Acquisition & Lock button.
14. Fly towards target and fire when the two circles on the HUD are aligned.
15. Launch rockets using the Release Weapons Trigger (RAlt+Spacebar). Keep the trigger pressed until the rocket has launched; this usually takes about one full second.

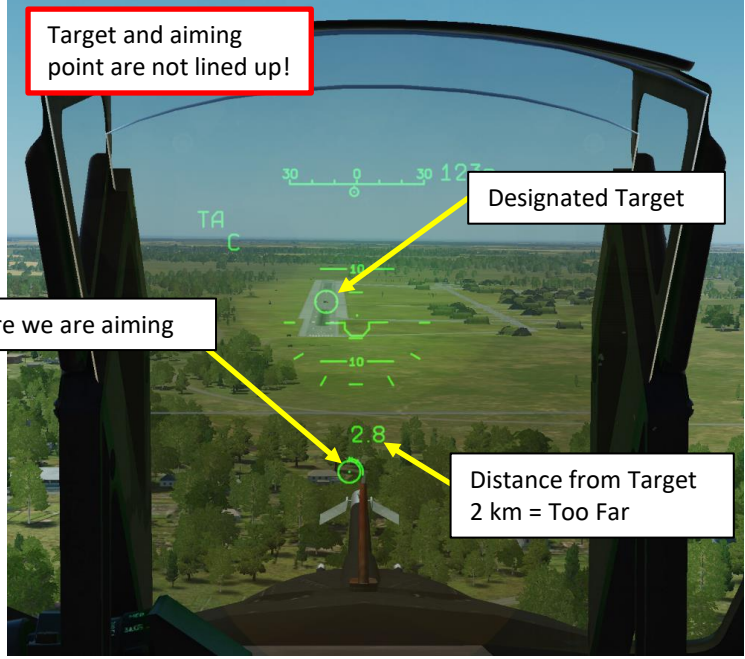


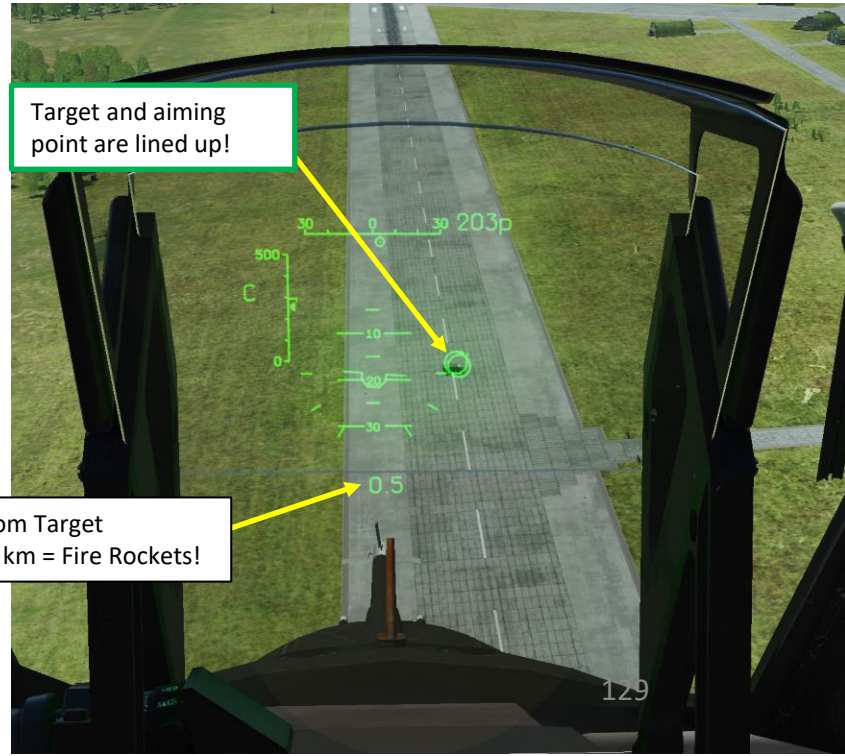




UNGUIDED ROCKETS/GUNPOD TUTORIAL





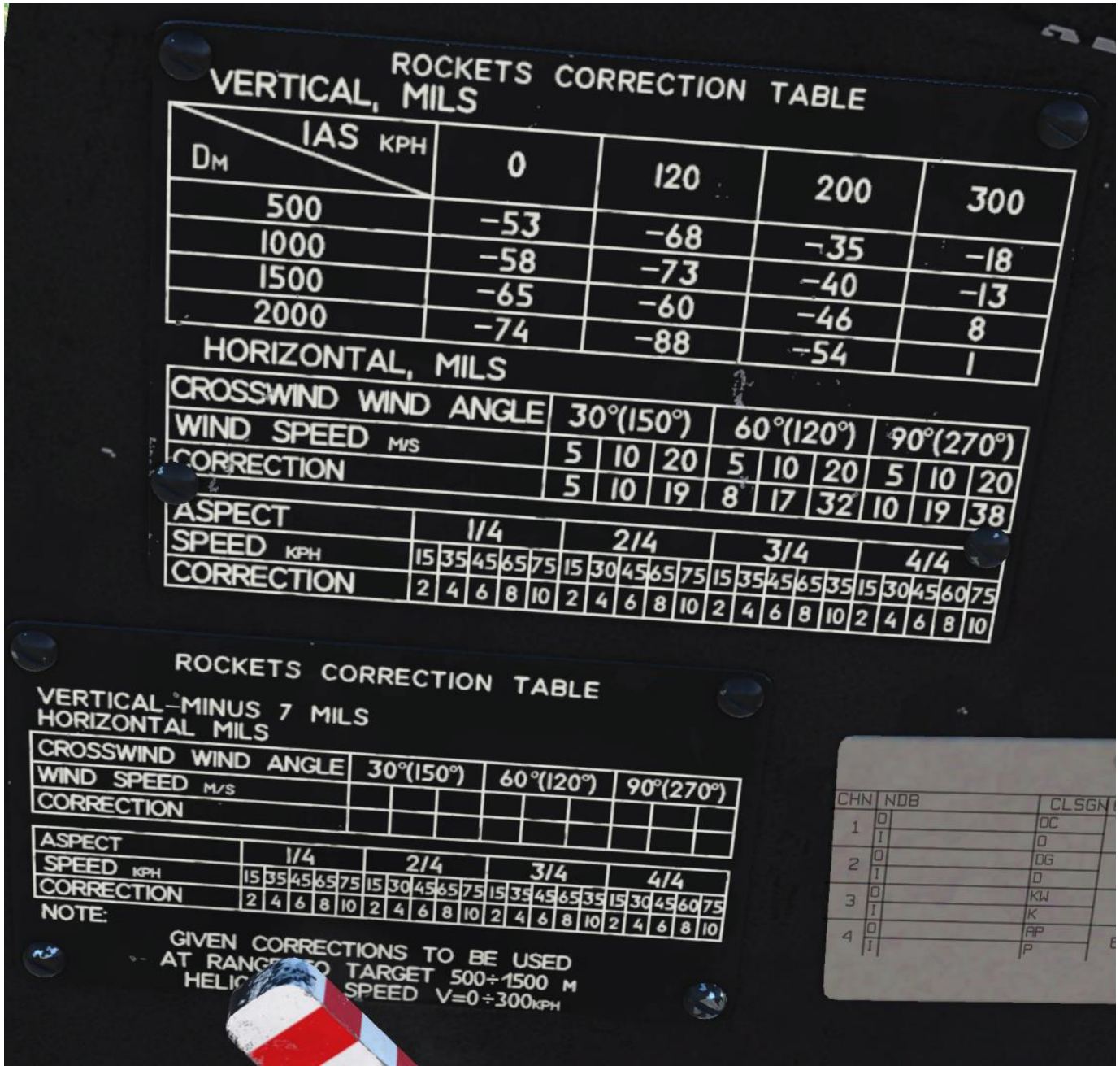


KA-50
BLACK SHARK

PART 11 – WEAPONS & COUNTERMEASURES

UNGUIDED ROCKETS/GUNPOD TUTORIAL

UNGUIDED ROCKETS/GUNPOD TUTORIAL



ROCKETS CORRECTION TABLE
VERTICAL, MILS

DM \ IAS KPH	0	120	200	300
500	-53	-68	-35	-18
1000	-58	-73	-40	-13
1500	-65	-60	-46	8
2000	-74	-88	-54	1

HORIZONTAL, MILS

CROSSWIND WIND ANGLE	30°(150°)			60°(120°)			90°(270°)		
WIND SPEED M/S	5	10	20	5	10	20	5	10	20
CORRECTION	5	10	19	8	17	32	10	19	38

ASPECT	1/4					2/4					3/4					4/4				
SPEED KPH	15	35	45	65	75	15	30	45	65	75	15	35	45	65	35	15	30	45	60	75
CORRECTION	2	4	6	8	10	2	4	6	8	10	2	4	6	8	10	2	4	6	8	10

ROCKETS CORRECTION TABLE
VERTICAL-MINUS 7 MILS
HORIZONTAL MILS

CROSSWIND WIND ANGLE	30°(150°)			60°(120°)			90°(270°)		
WIND SPEED M/S									
CORRECTION									

ASPECT	1/4					2/4					3/4					4/4				
SPEED KPH	15	35	45	65	75	15	30	45	65	75	15	35	45	65	35	15	30	45	60	75
CORRECTION	2	4	6	8	10	2	4	6	8	10	2	4	6	8	10	2	4	6	8	10

NOTE:
GIVEN CORRECTIONS TO BE USED
AT RANGE TO TARGET 500÷1500 M
HELI SPEED V=0÷300KPH

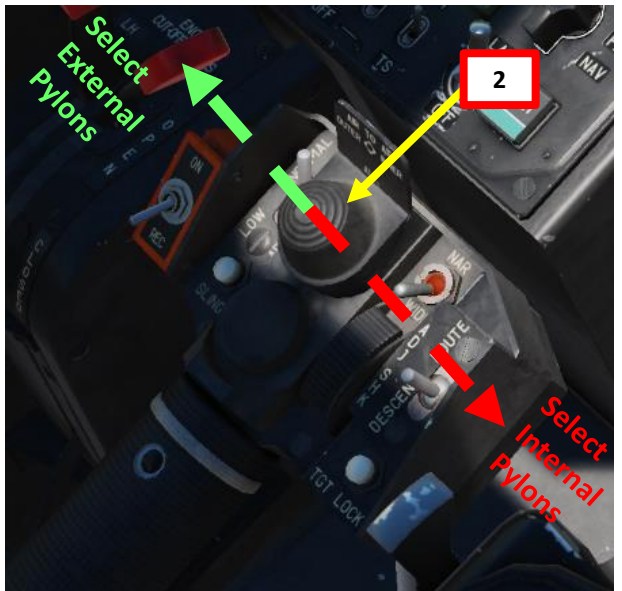
CHN	NDB	CLSGN
1	0	OC
	1	O
2	0	DG
	1	D
3	0	KW
	1	K
4	0	AP
	1	P

KMGU-2 SUB-MUNITION DISPENSER/BOMB TUTORIAL

1. Weapons Power switch ON
   - Flip cover UP, switch UP, flip cover DOWN.
2. Set collective weapon hat switch to the RIGHT to select bomb hardpoints (inner pylons if equipped as such)
3. Master Arm switch ON (UP)
4. Hold Release Weapons button and release to drop ordnance (RAlt+Spacebar)

Weapon Readiness Indicator Light
Green = store attached to a hardpoint is ready to fire

Store Type Field Display
- АБ = bombs



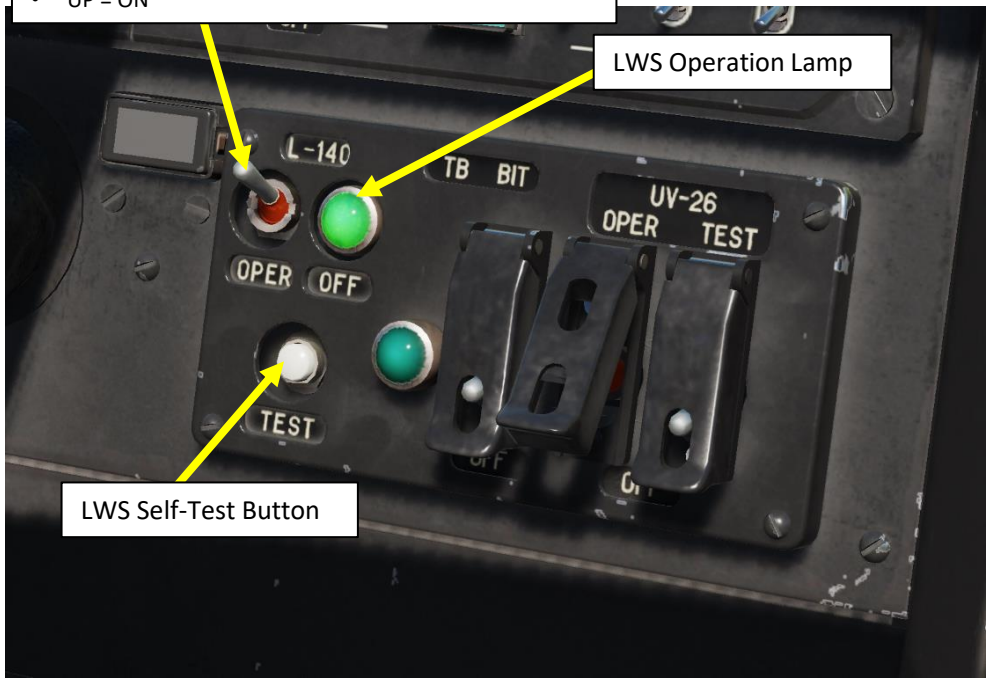

BLACK SHARK

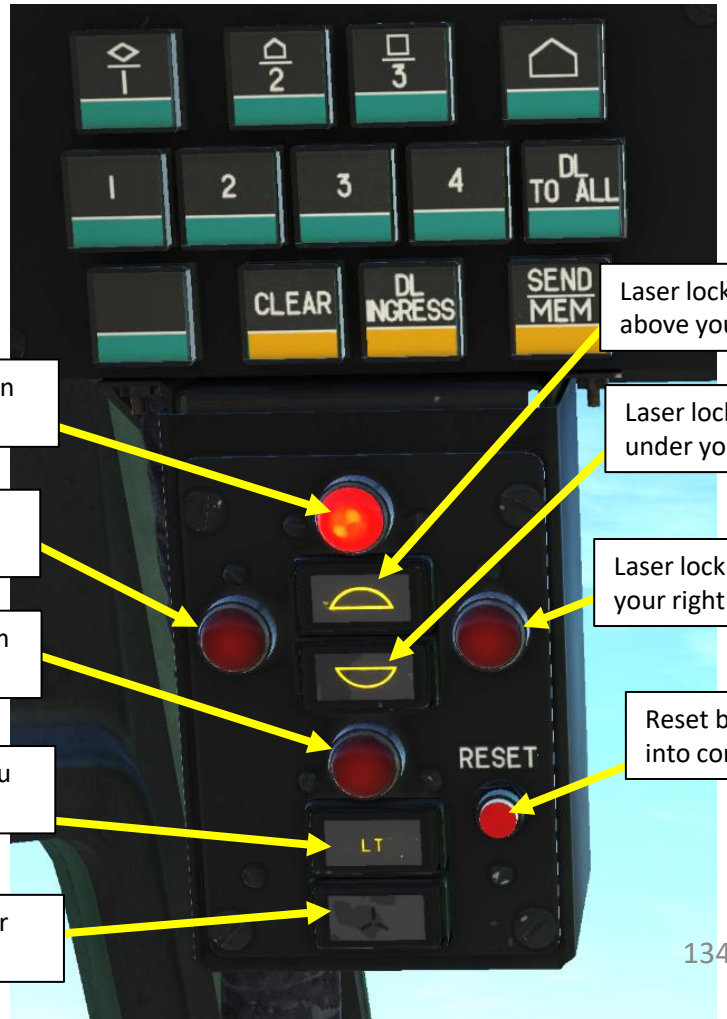
L-140 OTKLIK LASER WARNING SYSTEM (LWS)

The **L-140 Otklik laser detection system** detects laser range finders and laser guidance systems. You can think of it as a RWR (radar warning receiver) but for lasers.

- The system is powered on using the L-140 LWS Power Switch.
- The Laser Lock Lights will give you an indication of the direction of the laser.
- An aural warning is also audible "Warning, Under Attack!" when being lased.
- Main battle tanks and other combat ground vehicles will often use their laser range finders to input accurate target range data into their fire control systems before firing. A warning on the LWR is a sure indication that a ground vehicle or other helicopter is targeting you.
- Note that tank crews of many armed forces are trained to use their main guns as an anti-helicopter weapon and will engage you if you are within 1,500 meters and present them a non-crossing target. Other vehicles, such as ATGM (Air-to-Ground Missile) launchers, will also engage you but at even longer ranges. Additionally, many vehicles have secondary machine guns that they will use to engage you when in close range.

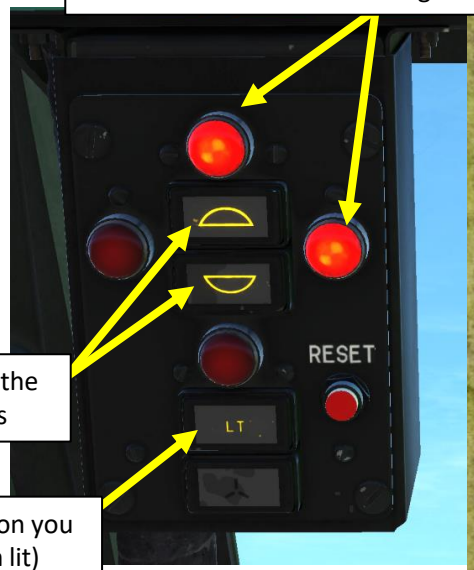
L-140 LWS (Laser Warning System) Power Switch
- UP = ON

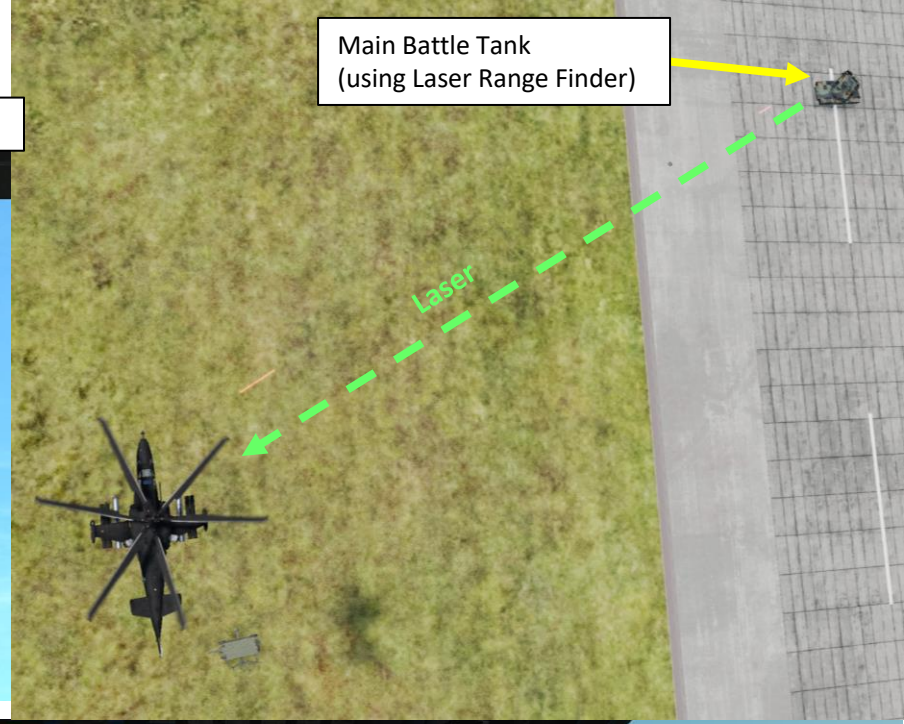


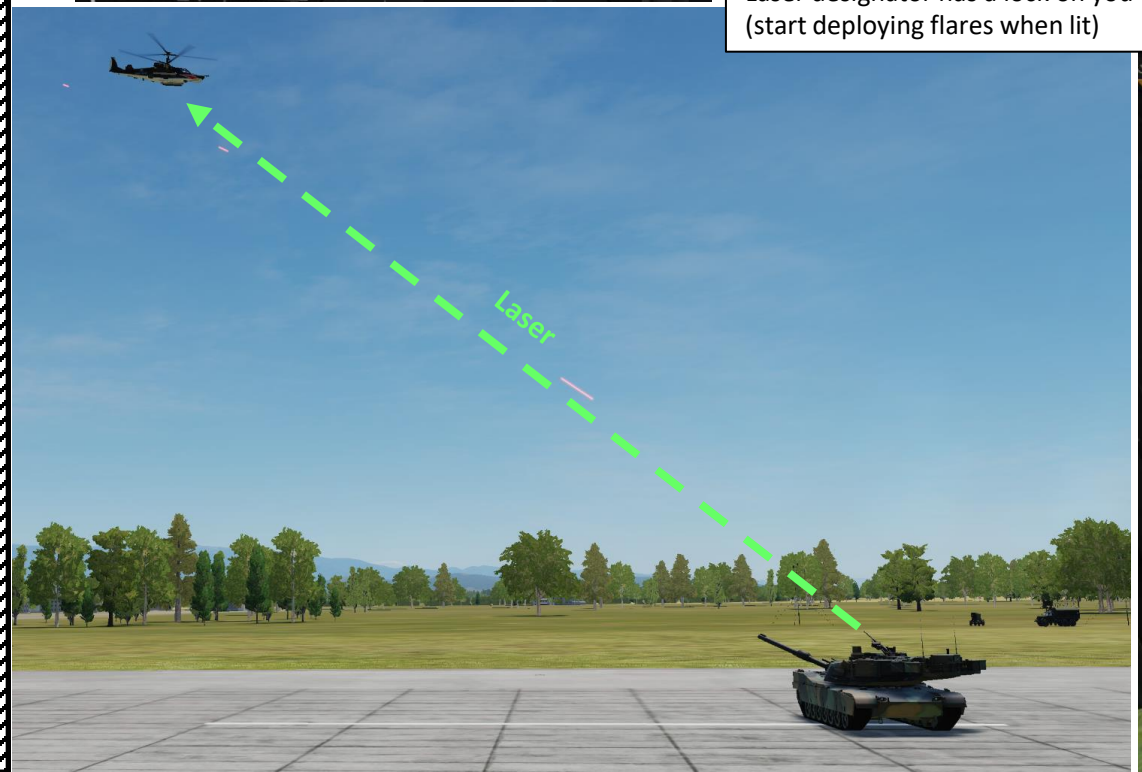


LASER WARNING SYSTEM EXAMPLE

In this example, a tank is using its laser range finder to fire its machinegun. The tank is at our front right, roughly at the same altitude since we are flying very close to the ground. The general rule of thumb when seeing/hearing a LWS warning is to perform evasive actions and pop flares. A missile will head your way soon after.







COUNTERMEASURES (FLARES)

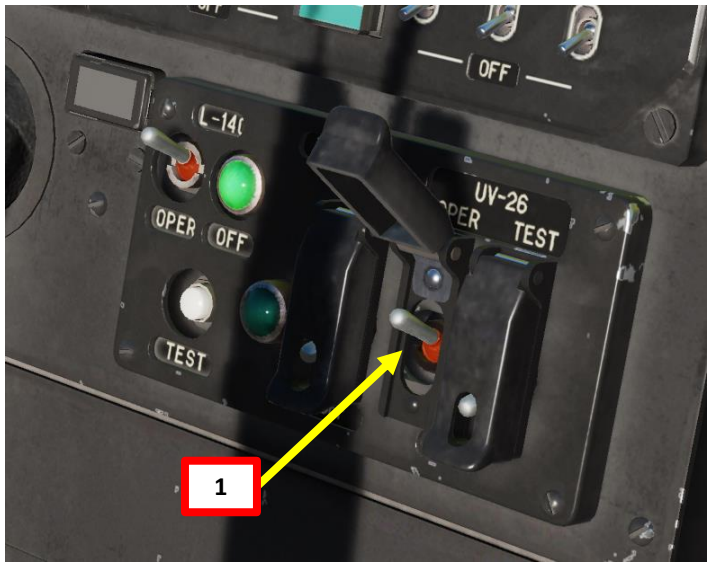
The UV-26 system is used to dispense infrared flare decoys and dipole reflectors are carried in two 26 mm cartridge pods that are fixed to the wing tips. Each pod contains 64 cartridges.

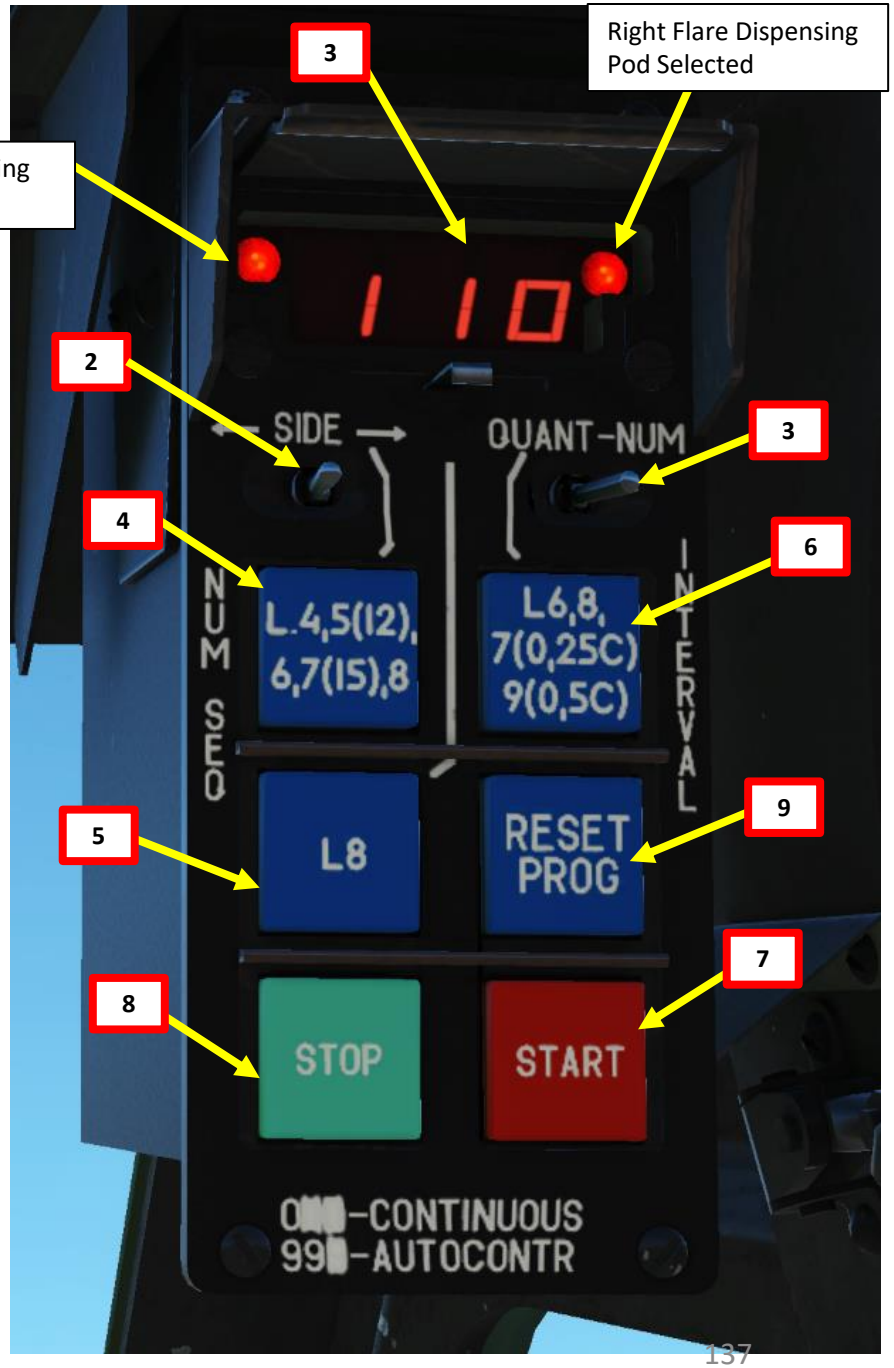
Countermeasure Programming Panel

COUNTERMEASURES (FLARES)

To program and deploy flares:

1. Power on UV-26 system (UP)
2. Select which flare pod side you will deploy your flares from (Left, Middle (both sides) or Right)
3. Check Remaining Flare Quantity (left) and then Select Program Number (right)
   - First Number: Number of flare dispensing sequences per program
   - Second Number: Number of flares per dispensing sequence
   - Third Number: Number of seconds between sequences
4. Press NUM to cycle between number of flare dispensing sequences per program (first number). Exceptions: changing NUM to “5” will in fact do “12” sequences and NUM to “7” will in fact do “15” sequences, as written on the button itself
5. Press SAL to cycle between number of flares per dispensing sequence (second number)
6. Press INTERVAL to cycle between number of seconds between dispensing sequences (third number). Changing NUM to “7” will in fact set a “0.25 sec” delay and NUM to “9” will in fact set a“0.5 sec” delay, as written on the button itself
7. Dispense flares by pressing the CMD START button (“Insert” key binding or custom binding for “UV-26 Start Dispense”).
8. (Optional) You can interrupt flare program by pressing CMD STOP button (“Delete” key binding or custom binding for “UV-26 Stop Dispense”)
9. (Optional) You can reset program by pressing the RES PROG button.





COUNTERMEASURES (FLARES)

Example of Program 333:

- 3 flares dropped per pod, 3 sequences, 3 seconds between each sequence

WHAT IS DATALINK?

The Data Link uses the R-800 radio to transmit and receive information from one helicopter to another. This means that if you want to use the Data Link in multiplayer with other players, your **R-800 radio needs to be on the same channel frequency as your wingmen** **(SEE RADIO TUTORIAL SECTION)**. Think of Data Link as a fancy cell phone that you can communicate on and exchange various information on.

WHAT IS DATALINK?

6-32: Data link control panel

The control panel consists of three rows of buttons that allow you to send and receive targeting information. Buttons include:

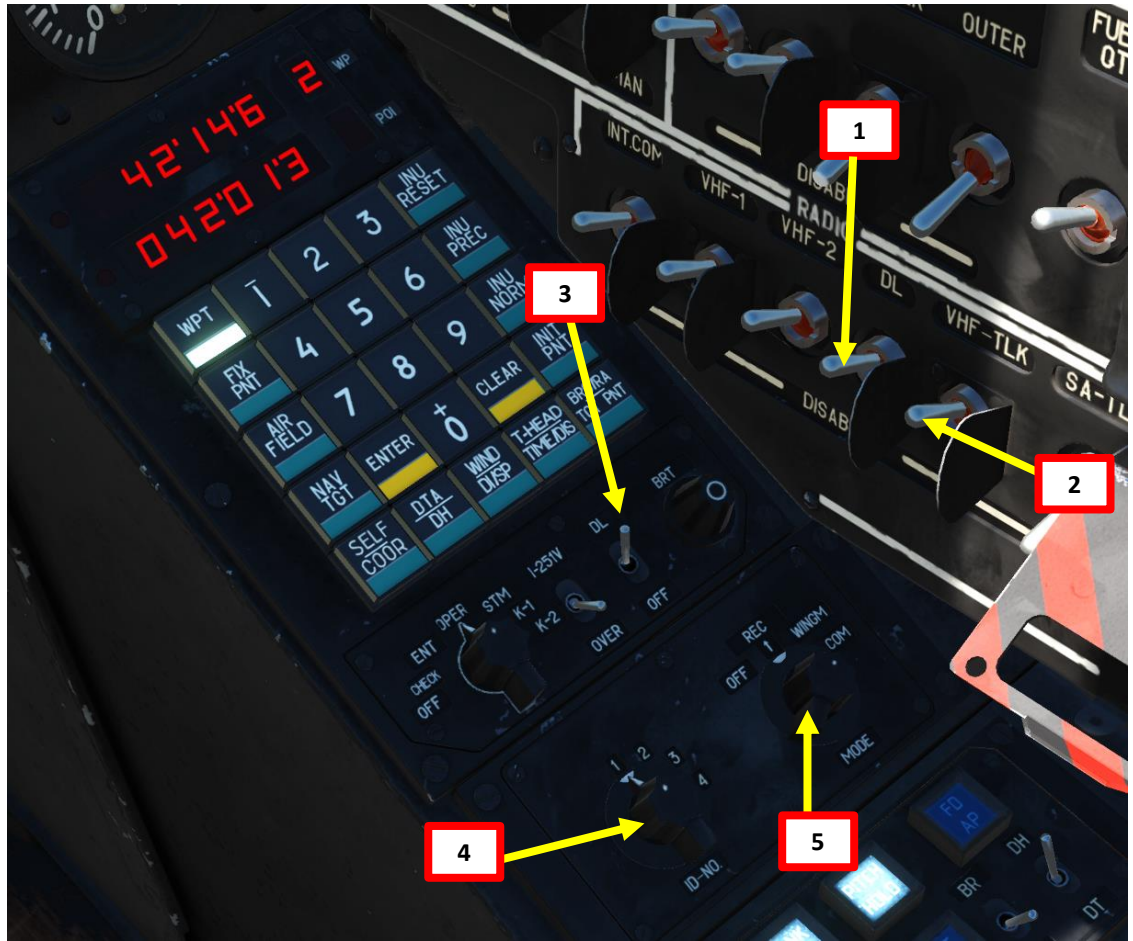
1. **DLINK target #1 as vehicle type.** Indicates the target to send or received from a wingman is a vehicle type of target. [LSHIFT + 1]
2. **DLINK target #2 as SAM or AAA type.** Indicates the target to send or received from a wingman is an air defense target. [LSHIFT + 2]
3. **DLINK to Wingman 1.** Elects to send the data link target to wingman 1. [LCTRL + 1]
4. **DLINK to Wingman 2.** Elects to send the data link target to wingman 2. [LCTRL + 2]
5. **DLINK to Wingman 3.** Elects to send the data link target to wingman 3. [LCTRL + 3]
6. **"СТИР"** button: Clear DLIN. After a target type and target receiver has been entered, this button can be pressed to clear the information. [LSHIFT + T]
7. **DLINK** target #3 as type Other. Indicates the target to send or received from a wingman is a target other than vehicle or air defense. [LSHIFT + 3]
8. **DLINK Initial point.** Like vehicles, air defenses and other, you may send and receive an initial point to and from wingmen via the data link. This can be useful for communicating a battle position or ambush point. [LSHIFT + 4]
9. **DLINK to Wingman 4.** Elects to send the data link target to wingman 4. [LCTRL + 4]

10. **"ВСЕМ"** button: DLINK to All. In addition to sending targeting information to a specific wingman, you may also press this button to send the data to the entire flight. [LCTRL + 5]
11. **"ВЫХОД"** button: DLINK automatic ingress to target. This button activates functionality to automatically point the aircraft in the direction of the assigned data linked target. [LSHIFT + Y]
12. **"ПРД/ПАМ"** button: DLINK send/memory. After you have selected the target type and a data link receiver, you may press this button to send the information over the data link. Additionally, when you receive data link data from another flight member, pressing this button will accept the data/assignment. [LSHIFT + U]

Richard Cole's Datalink Tutorial
https://www.youtube.com/watch?v=U1CFOcTsvGI

DATALINK SETUP

1. Set Data Link Power switch – ON (UP)
2. Set VHF TLK – ON (UP)
3. Set Data Link switch – ON (FWD)
4. Set your own Identification Number (ID 1 for flight leader, 2, 3 or 4 for wingmen)
5. Set Data Link mode to COM (Commander) if you are the flight lead or WINGM (Wingman) if you are a wingman.
6. Set ABRIS to the NAV page
7. Laser power switch – ON (FWD)



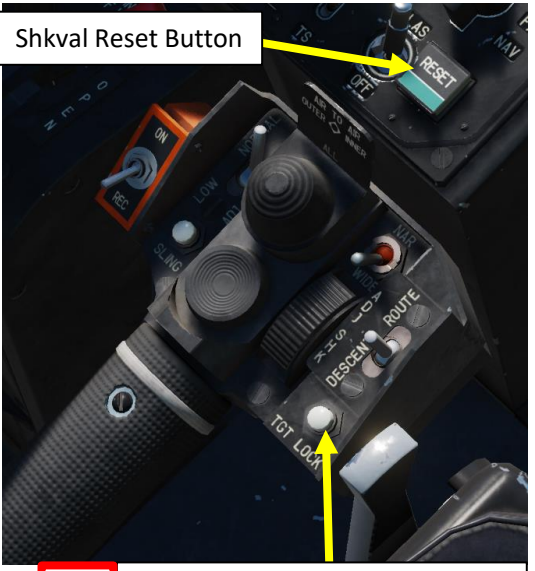
TRANSMITTING DATA

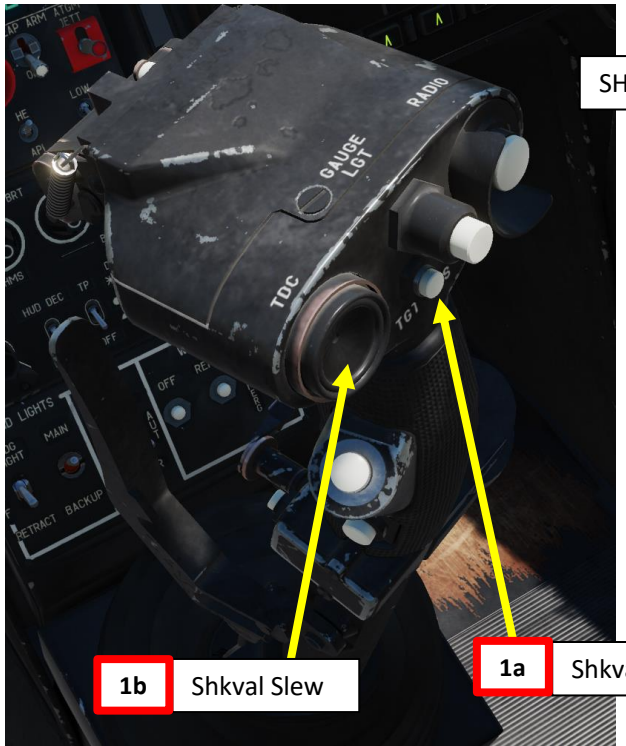
If you ever have a juicy target and want to let your buddies know about it, you can use the Datalink to send your wingmen that information. This is done in three steps:

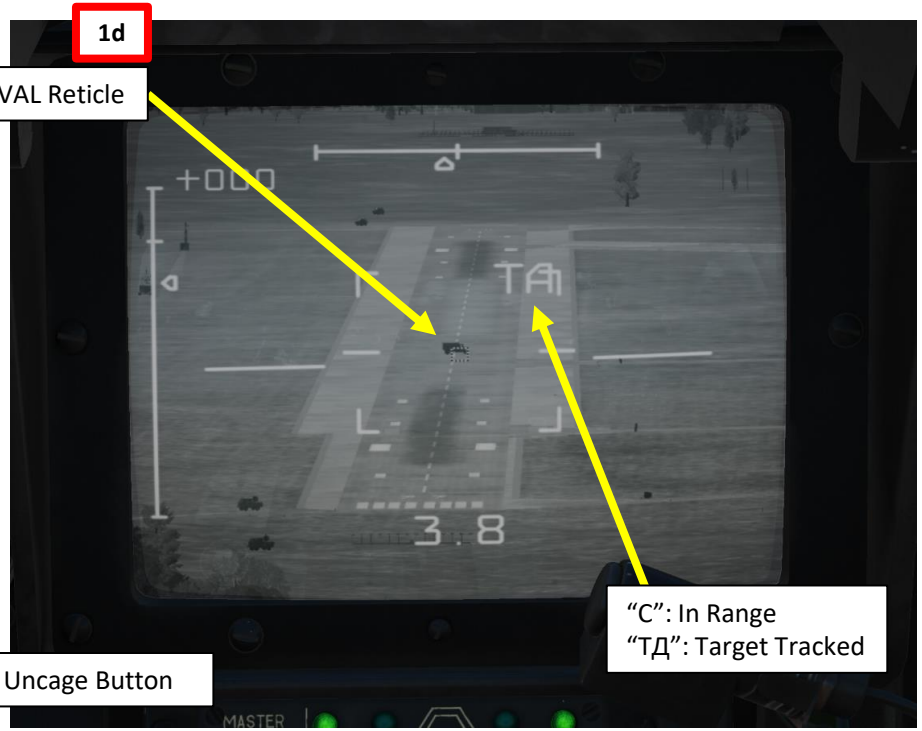
- Acquire target with the Shkval and store its information in the ABRIS
- Reset Shkval Targeting System
- Send target information to your wingmen through the Datalink network

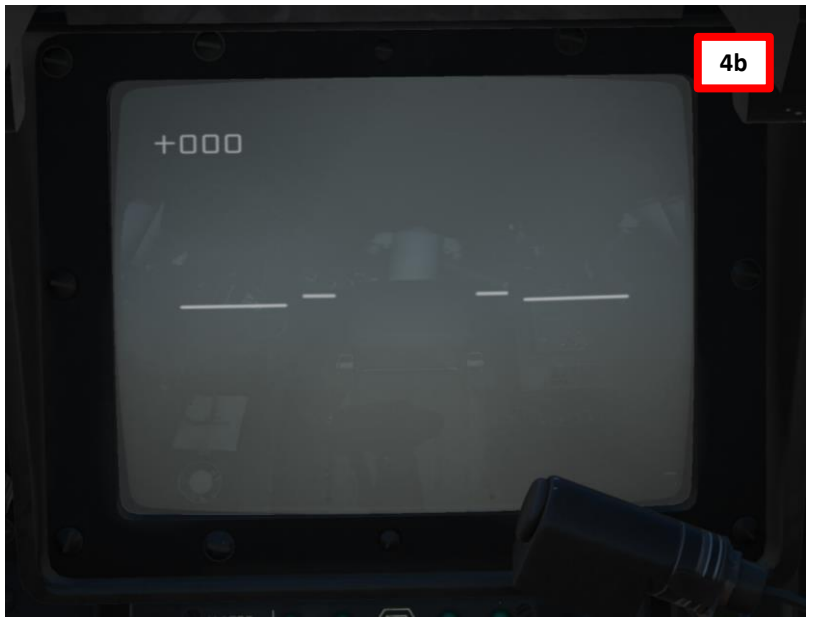
To send information:

1. Find a target using the SHKVAL (see previous section), select VIKHR missile and lock your target using the Shkval Target Acquisition & Lock button ("Enter"). For this example, we'll take a truck.
2. Press the appropriate Target Type button (which will be flashing).
3. Press the SEND-MEM button to store the target in your ABRIS system.
4. Press the Shkval Reset Button. The Shkval screen will go blank.









TRANSMITTING DATA

To send information:

5. Press the appropriate Target Type button (which will be flashing) to cycle through stored targets. The target icon will be flashing on the ABRIS screen.
6. Select who you want to send this information to (middle row). I recommend sending it to ALL. You can also send it individually.
7. Press the SEND-MEM button to send the information to your wingmen. They will have a notification in their own ABRIS that a new target can be stored in their ABRIS.

NOTE: the SEND-MEM button will flash if your wingman has not received the transmission properly.

RECEIVING DATA – "WATCH EKRAN! = YOU'VE GOT MAIL!"

When you receive information from someone, you will see two buttons flash on the datalink panel and hear Betty say "watch EKRAN!". The top row is the target type (as seen previously, in this case we have a vehicle) and the second row is who sends you this information (wingman #2). You can store multiple targets of a same type. Each time you press on a Target Type button, you will cycle through the different targets you have stored in your ABRIS (the target icon will flash on the ABRIS screen).

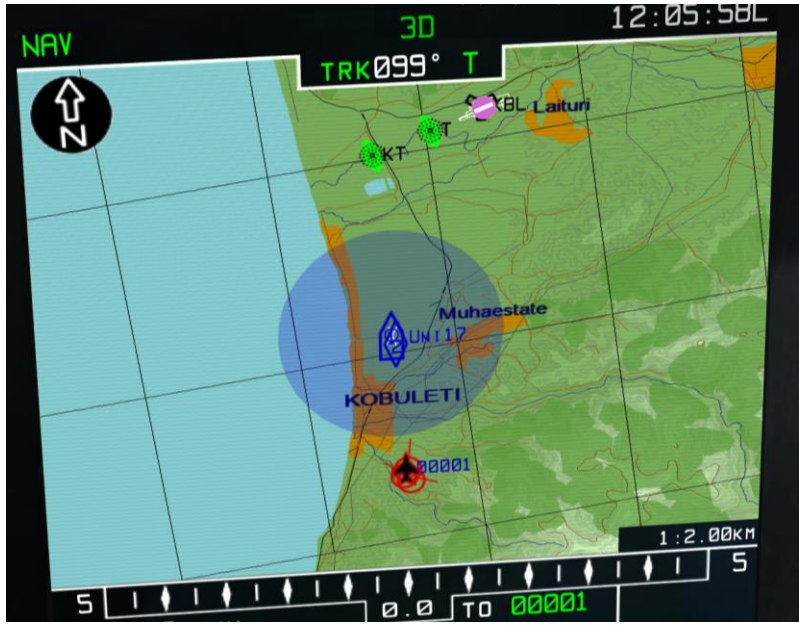
1. To store information:

A. Press the SEND-MEM button to store the target in your ABRIS system.

2. To delete information:

A. Press on the flashing target type button (top row) until you select the desired target (check on ABRIS)

B. Press the CLEAR button to delete the target from your ABRIS system.

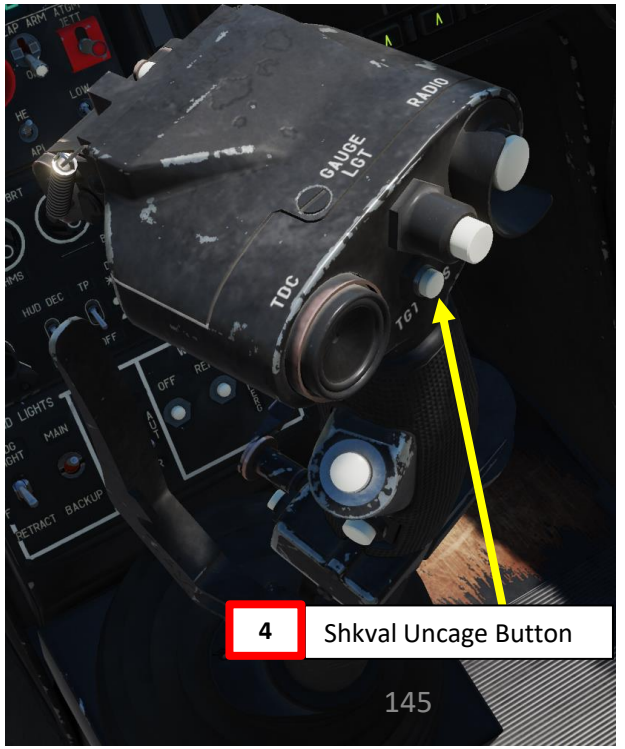


I HAVE TARGET COORDINATES STOCKED… NOW WHAT?

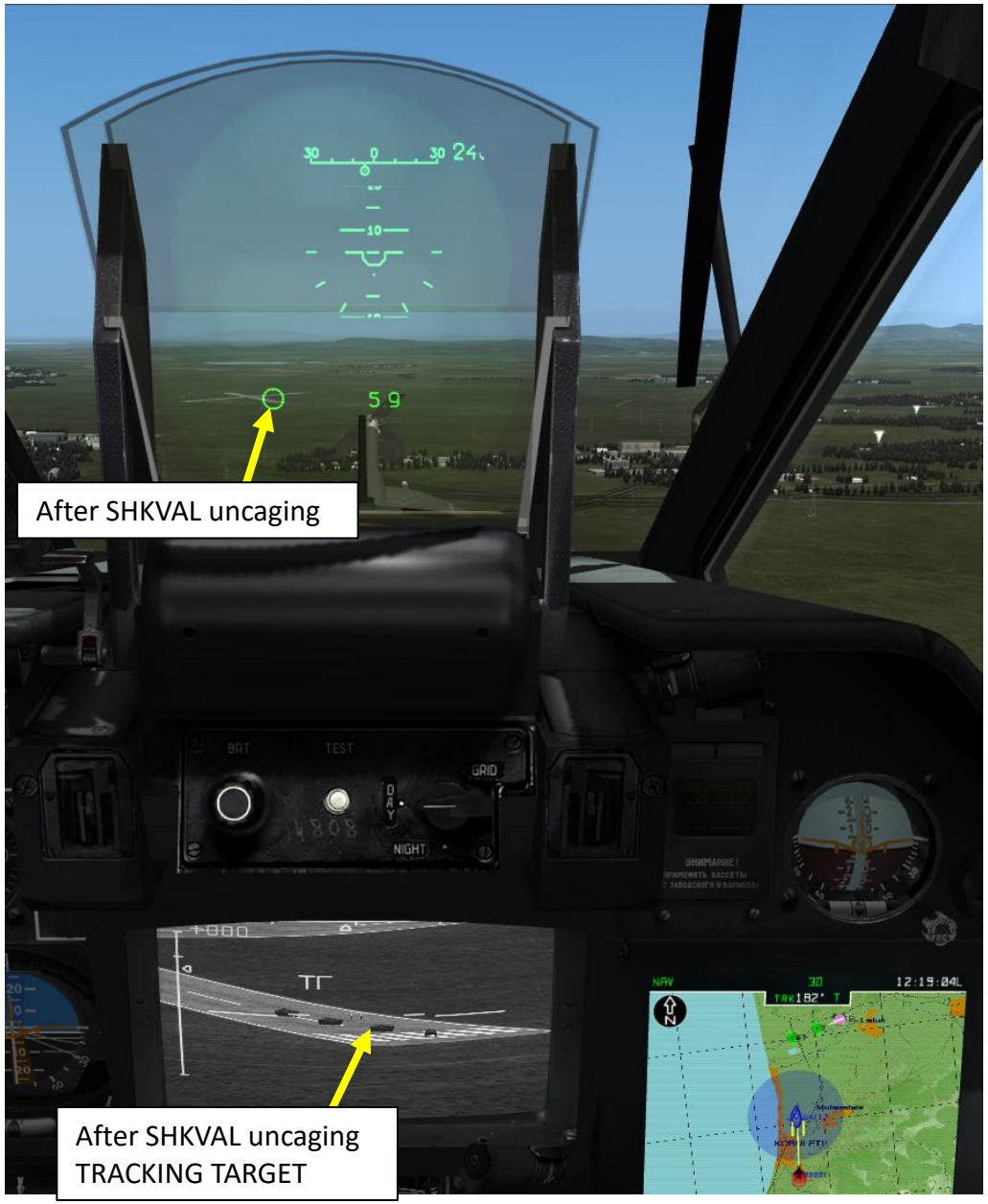
Once you have received information on different targets (which are GPS coordinates), you can actually slew your SHKVAL and lock a target! Your wingmen can do the same with the information you send them.

To lock a target stocked in Data Link:

1. Press the Targeting Mode Reset button.
2. Press the appropriate Target Type button (which will be flashing) as many times as it takes to cycle through the targets stocked in your ABRIS system. Use your ABRIS icons to figure out which target you are selecting.
3. Press the DL-INGRESS button to select this Datalink target. Button will light up once pressed.
4. Uncage SHKVAL by pressing "O" and your SHKVAL will be automatically slewed to the target selected.
5. Make slewing adjustments with your SHKVAL to select the right coordinates (sometimes they are a bit off target) as shown in previous section.
6. Lock target using "Enter" and fire VIKHR missiles as shown in previous section.




Before SHKVAL uncaging
Before SHKVAL uncaging
SHKVAL NOT TRACKING ANYTHING


After SHKVAL uncaging
After SHKVAL uncaging
TRACKING TARGET

RADIO SYSTEM OVERVIEW

You have two radios you can use:

- The **R-800L1 VHF/UHF radio** control system (VHF-2) is used for air-to-air communications and ATC calls.
- The **R-828 VHF-1** radio control system is used for FAC (Forward Air Controller) and ground unit communications.
- The **SPU-9 intercom** panel allows you to select which radio you want to transmit on.

Radio Set	Frequency Range
R-800L1 VHF/UHF (VHF-2)	VHF: 100-149.975 MHz UHF: 220 to 399.975 MHz
R-828 VHF-1	20 to 59.975 MHz

DCS Table of Frequencies

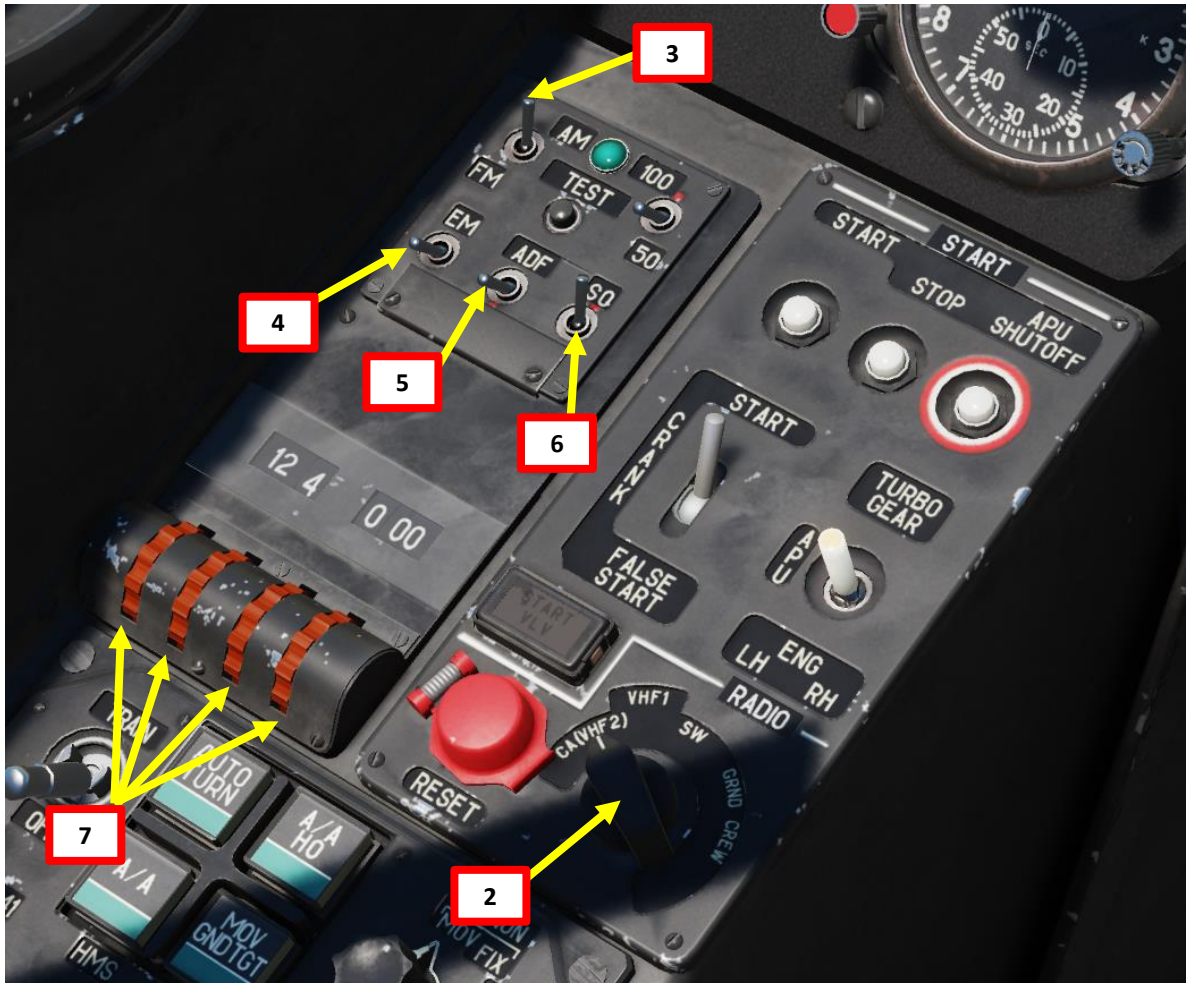
Airfield	ICAO Code	Reference	Runway(s)	Tower	ID	Alt	ILS	TACAN
Anapa	URKA	04°59'36"N, 37°20'19"E	04-22; 2900m	121.0	01	04		
Batumi	UGSB	41°36'58"N, 41°35'31"E	13-31; 2400m	131.0	11	13	**13**, 110.3	16X BTM (135.90 MHz)
Beslan	URMO	43°12'26"N, 44°35'19"E	10-28; 3000m	141.0	21	17		
Gelendzhik	URKG	44°33'54"N, 38°00'25"E	04-22; 1800m	126.0	06	03		
Gudauta	UG23	43°06'09"N, 40°34'01"E	15-33; 2500m	130.0	10	09		
Kobuleti	UG5X	41°55'36"N, 41°51'05"E	07-25; 2400m	133.0	13	12	**07**, 111.5	67X KBL (134.00 MHz)
Kutaisi	UGKO	42°10'30"N, 42°28'05"E	08-26; 2500m	134.0	14	12	**08**, 109.75	44X KTS (110.70 MHz)
Krasnodar C	URKI	45°05'03"N, 38°57'34"E	09-27; 2500m	122.0	02	08		
Krasnodar PKK	URKK	45°01'52"N, 39°08'38"E	05-23R; 3100m 05-23L; 2300m	128.0	08	02		
Krymsk	URKW	44°58'27"N, 38°00'37"E	04-22; 2600m	124.0	04	03		
Maykop	URKH	44°41'22"N, 40°03'08"E	04-22; 3200m	125.0	05	05		
Mineral'nye Vody	URMM	44°12'58"N, 43°06'13"E	12-30; 3900m	135.0	15	16	**12**, 111.7 **30**, 109.3	
Mozdok	XRMF	43°47'26"N, 44°34'44"E	08-27; 3100m	137.0	17	21		
Nalchik	URMN	43°30'29"N, 43°37'30"E	06-24; 2300m	136.0	16	15	**24**, 110.5	
Novoross.	URKN	44°39'36"N, 37°46'25"E	04-22; 1780m	123.0	03	06		
Senaki	UGKS	42°14'31"N, 42°02'08"E	09-27; 2400m	132.0	12	14	**09**, 108.90	31X TSK (109.40 MHz)
Sochi	URSS	43°06'17"N, 40°35'26"E	06-24; 3100m	127.0	07	10	**06**, 111.1	
Soganlug	UG24	41°39'26"N, 44°55'48"E	14-32; 2400m	139.0	19	18		
Sukhumi	UGSS	42°51'21"N ,41°09'17"E	12-30, 2500m	129.0	09	10		
Tblisi	UGTB	41°40'37"N, 44°56'37"E	13-31L; 3000m 13-31R; 2500m	138.0	18	20	**13**, 110.3 **31**, 108.9	
Vaziani	UG27	41°37'09"N, 45°02'10"E	14-32; 2500m	140.0	20	19	**14**, 108.75	22X VAS (108.50 MHz)

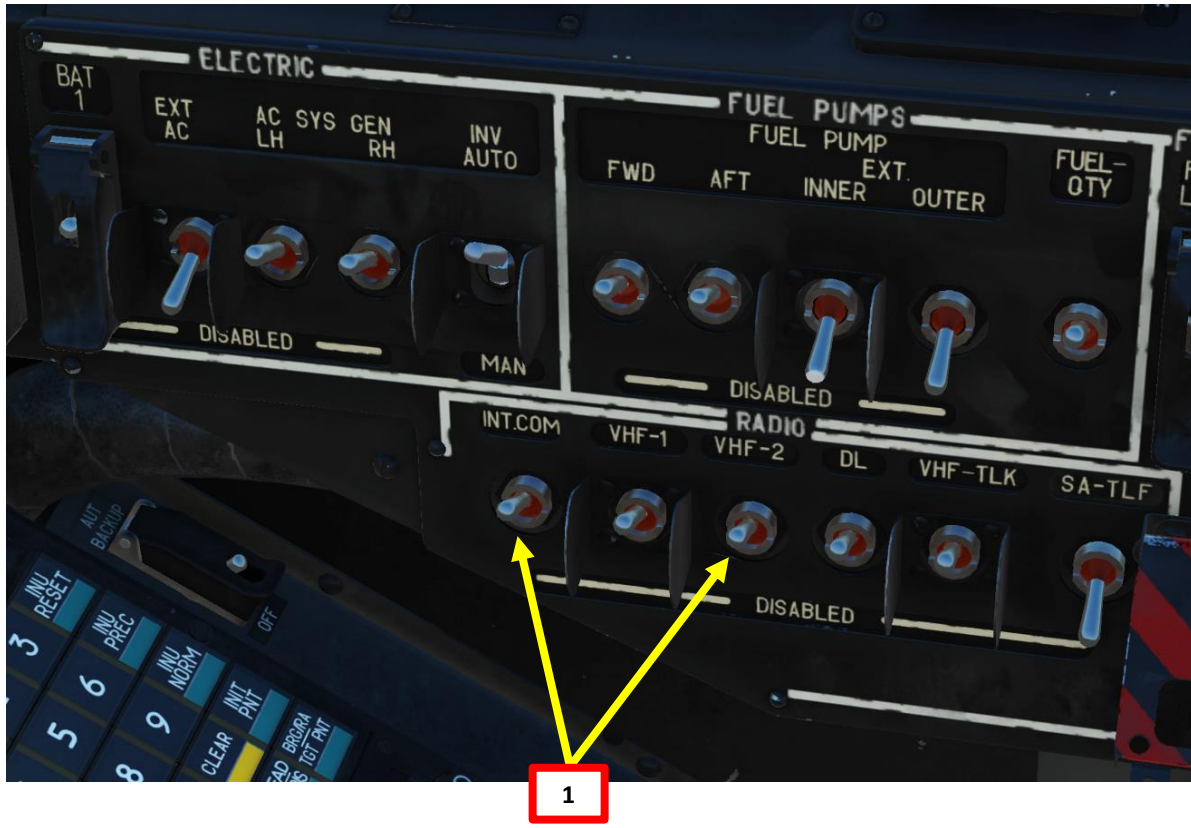
Runway = runway designations, west to east; runway length in meters
Alt = nearest alternate airfield ID
ILS = **runway designation**, ILS frequency
Credits: Shu77; HiJack; vJaBoG32

R-800L1 VHF/UHF COMMAND RADIO SET (VHF-2)

1. INT-COM and VHF-2 switches – ON (UP)
2. On Intercomm panel, select VHF-2 radio.
3. On R-800 control panel, set AM/FM switch to desired position (AM generally used for Control Towers since FM is 108 MHz or lower)
4. On R-800 control panel, set Guard (Emergency) Channel to OFF (DOWN) position.
5. On R-800 control panel, set ADF to OFF (DOWN) position.
6. On R-800 control panel, set Squelch to ON (UP) position.
7. Select desired channel with the four thumb wheels.
8. Use “Communication Menu” key binding “/” to communicate.

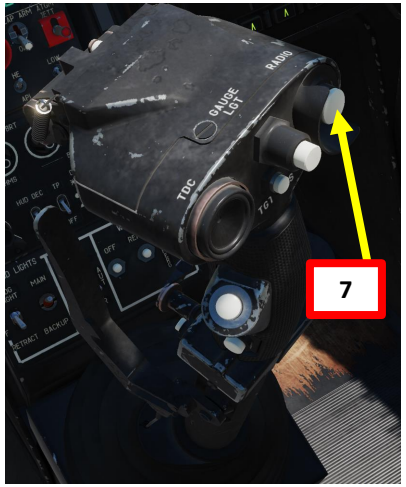
NOTE:
If you want to communicate with ground crews (to change loadout for instance), make sure the Intercomm panel described in step 2 is set to GRND CREW. You will communicate with the wired telephone outside your cockpit.

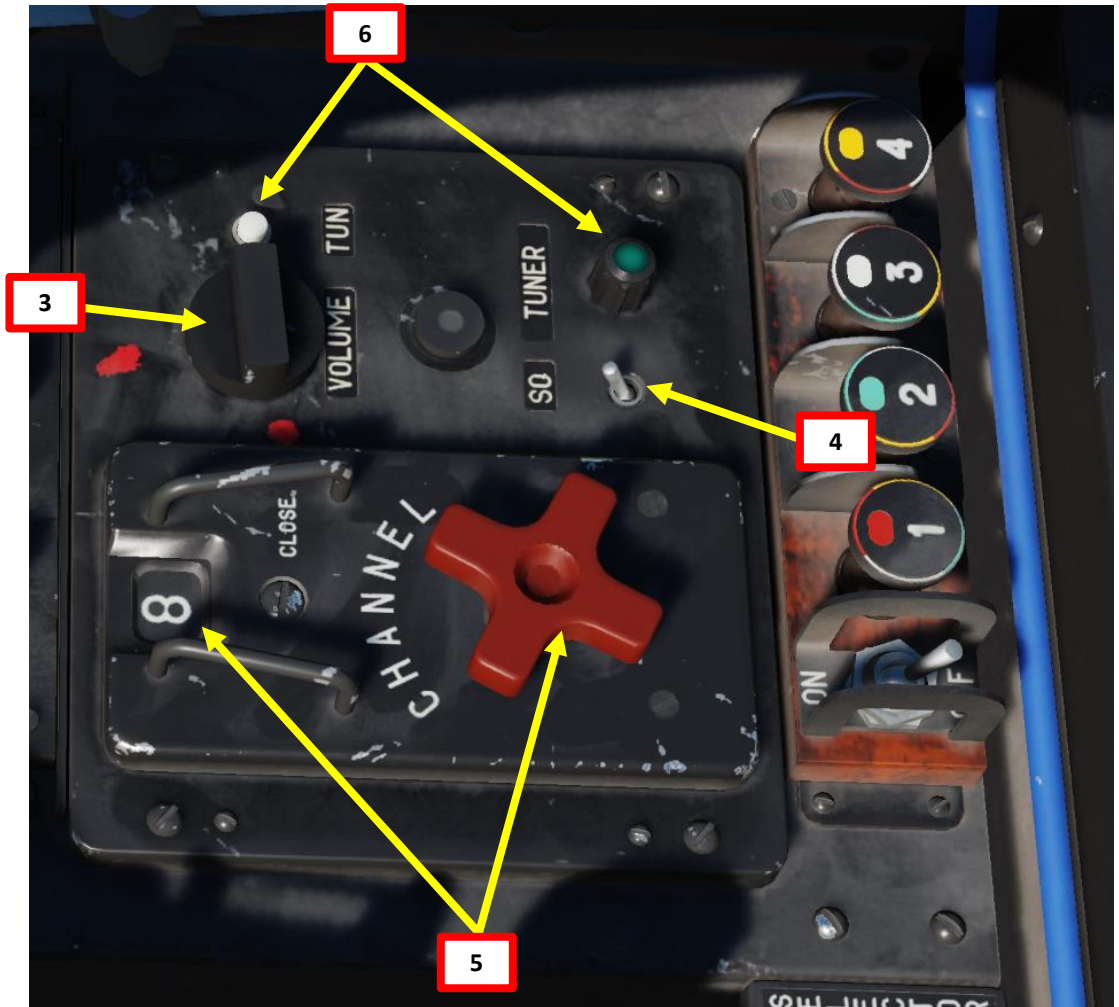


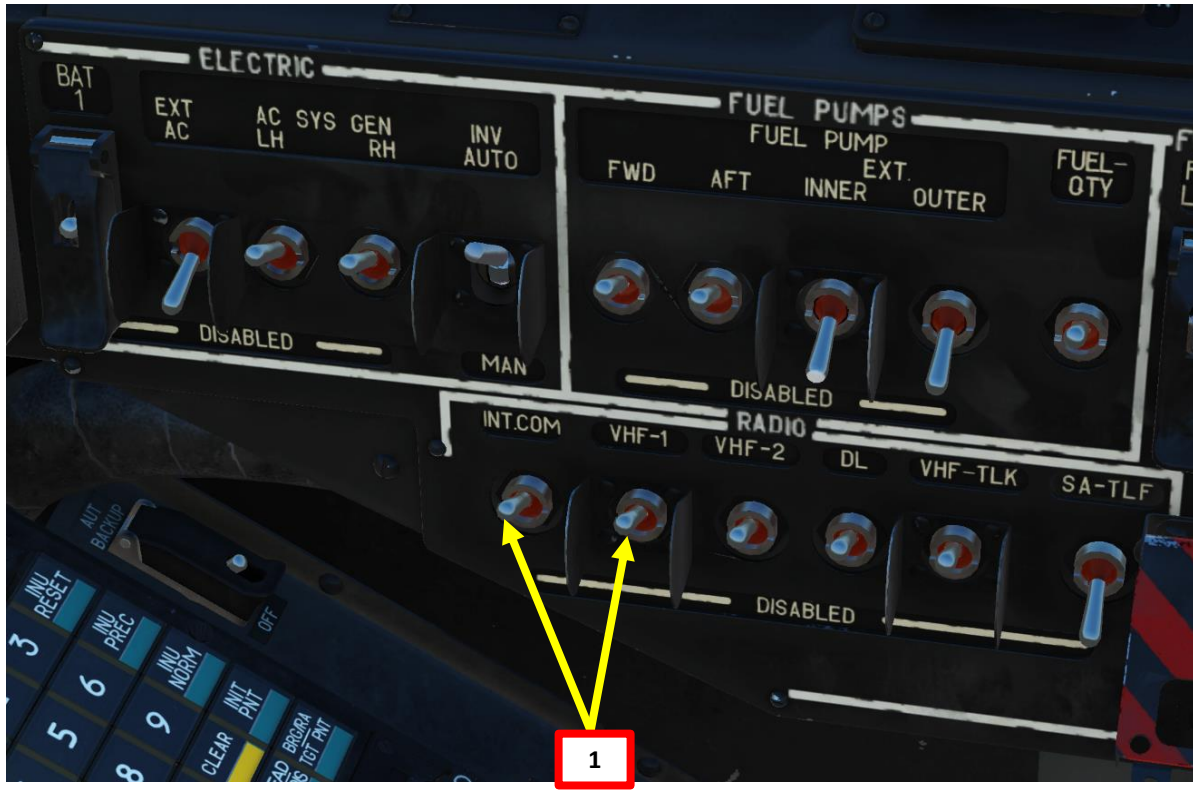


R-828 VHF-1 RADIO SET

1. INT-COM and VHF-1 switches – ON (UP)
2. On Intercomm panel, select VHF-1 radio.
3. On R-828 control panel, set volume to maximum.
4. On R-828 control panel, set Squelch to ON (FWD) position.
5. On R-828 control panel, select desired preset channel.
6. On R-828 control panel, press Automatic Tuner button. TUNING light will illuminate once radio is set.
7. Use “Communication Menu” key binding “/” to communicate.







SECTION STRUCTURE

- 1 – Introduction to Navigation in the Ka-50

- 2 – ABRIS AMMS (Advanced Moving Map System)
    - 2.1 – ABRIS Summary
    - 2.2 – Main Menu
    - 2.3 – Navigation (NAV) Menu
    - 2.4 – HSI (Horizontal Situation Indicator) Menu
    - 2.5 – ARC (Automatic Radio-Compass) Menu
    - 2.6 – PLAN (Flight Plan) Menu

- 3 – PVI-800 Navigation System

- 4 – HSI (Horizontal Situation Indicator)

- 5 – Navigation Point Types

- 6 – Waypoint Navigation
    - 6.1 – Waypoint Navigation
    - 6.2 – Add, Edit or Remove a Reference Point

- 7 – Target Points
    - 7.1 – Target Point Creation
    - 7.2 – Using Target Points

- 8 – ADF (Automatic Direction Finding) Navigation

1 – INTRODUCTION TO NAVIGATION IN THE KA-50

Navigating in the Ka-50 may appear daunting at first, but there are plenty of tools to help you find your way around.

The ABRIS works pretty much like a satellite GPS (global positioning system). It is designed to supplement other onboard navigation systems and to accomplish aerial navigation through: route preparation and planning, map support in all the sortie phases, processing of information from the navigational sensors, output of information to interfaced systems, navigation calculations, tactical situation display, and data link of target coordinates.

The PVI-800 works in parallel with the ABRIS navigation system, but whereas the ABRIS uses satellite navigation system inputs, the PVI-800 uses data from the Inertial Navigation Unit (INU). 6 waypoints (WP) and 10 target points (TP) can be stored in the PVI-800 navigation system. Each WP and TP coordinate is loaded into the navigation computer from the Mission Editor or manually while in flight.

We will see together how to use these systems to navigate, but more in-depth features are explained in the original Eagle Dynamics Black Shark flight manual (see references).

PRODUCER'S NOTES TUTORIALS:

ABRIS

PART 1: https://www.youtube.com/watch?v=-7Pt-xeag74
PART 2: https://www.youtube.com/watch?v=a2gSw1ACDsQ

NAVIGATION WITH THE PVI-800

PART 1: https://www.youtube.com/watch?v=Fy3U2KtqBhM
PART 2: https://www.youtube.com/watch?v=XH7eIR3r1BQ
PART 3: https://www.youtube.com/watch?v=WCYCMX1_Z_M

2.1 – ABRIS AMMS (ADVANCED MOVING MAP SYSTEM)

The ABRIS is designed to supplement other onboard navigation systems, like the PVI-800, and to accomplish aerial navigation through: route preparation and planning, map support in all the sortie phases, processing of information from the navigational sensors, output of information to interfaced systems, navigation calculations, tactical situation display, and data link of target coordinates.

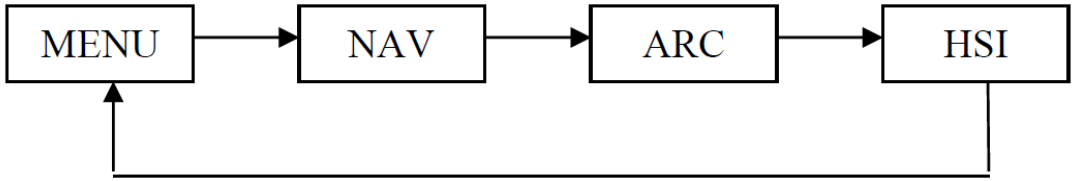
The ABRIS provides:

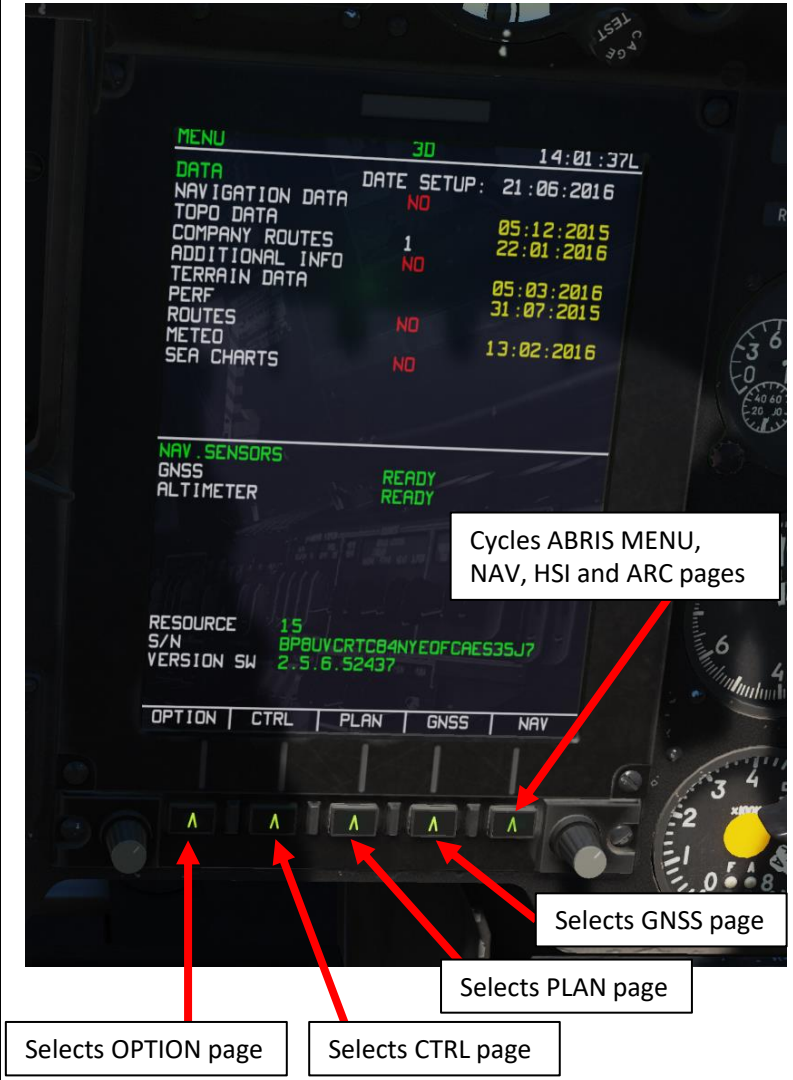
- Storage and presentation of electronic, topographic maps on the color display and the ability to electronically update and reload multiple map data-sets.
- Continuous determination of ownship “ACFT” position coordinates and display of the ACFT position on the moving map (on a scale suitable for the operator).
- Creation and display of flight plan information for tasks in different sortie phases.
- Creation of a flight route, the recording of the route in the database, and being able to load a route from the database.
- Ability to quickly modify a route while in-flight.
- The reception and display of information from interfaced systems and the output of information to other interfaced systems.

2.1 – ABRIS AMMS (ADVANCED MOVING MAP SYSTEM)

The ABRIS has four main pages (and other less important pages) that you can cycle through by pressing the rightmost button: the MAIN MENU, NAV (navigation), HSI and ARC.

We will not go through these pages in detail since the Black Shark manual already does it much better than I ever could.





Pages	Description
MAIN	Main Menu data
NAV (Navigation)	Navigation data
ARC (Automatic Radio-Compass)	Automatic Radio-Compass data
HSI (Horizontal Situation Indicator)	Horizontal Situation Indicator data
OPTION (sub-mode)	Sets options and affects all the modes of ABRIS operation and is stored in non-volatile memory. In the OPTION sub-mode, there are five sub-modes that can be displayed by pressing the SETUP button. • MAIN – Main options • UNITS –Set the type of measurement units that are displayed • PERF – Enter aircraft parameters in the non-volatile memory • SIGNAL – Adjust time intervals for alert generation alarms • CHARTS – Adjust map display content
CTRL (sub-mode)	From the CONTROL sub-mode page you can switch to the following sub-modes: MSG (messages), K-041 (targeting system), and DTB (database).
PLAN (sub-mode)	The PLAN sub-mode is used for route planning and correction and is a useful tool for when you need to modify the flight plan after new intelligence on enemy positions becomes available.
GNSS (sub-mode)	The Global Navigation Satellite System (GNSS) sub-mode of the MENU operating mode is intended to assess the status of the satellite navigational system (number of tracked and processed satellites, geometric factor, signal/noise ratio for each of the processed satellites, etc.).

2.1 – ABRIS AMMS (ADVANCED MOVING MAP SYSTEM)

OPTION page

CTRL page

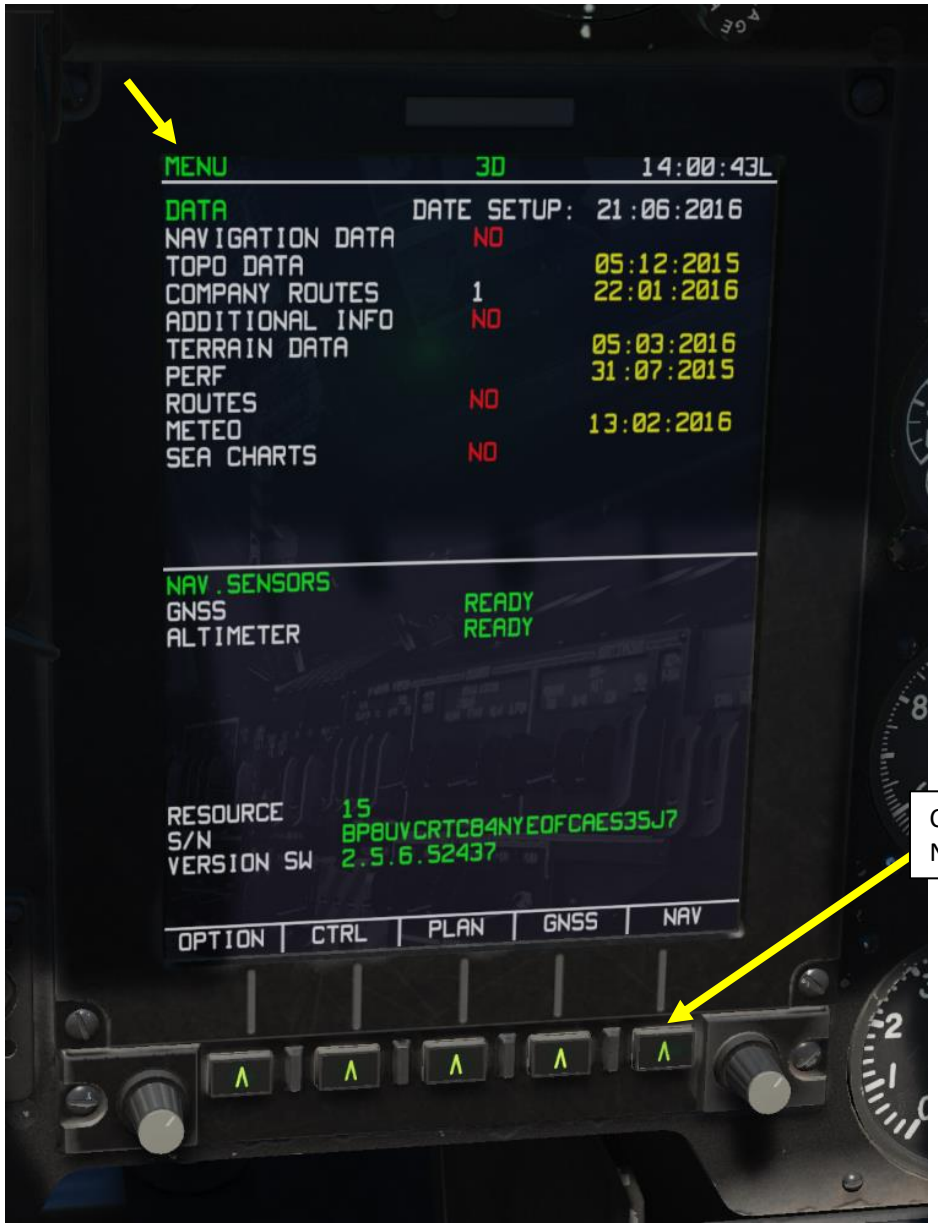
2.1 – ABRIS AMMS (ADVANCED MOVING MAP SYSTEM)

PLAN page

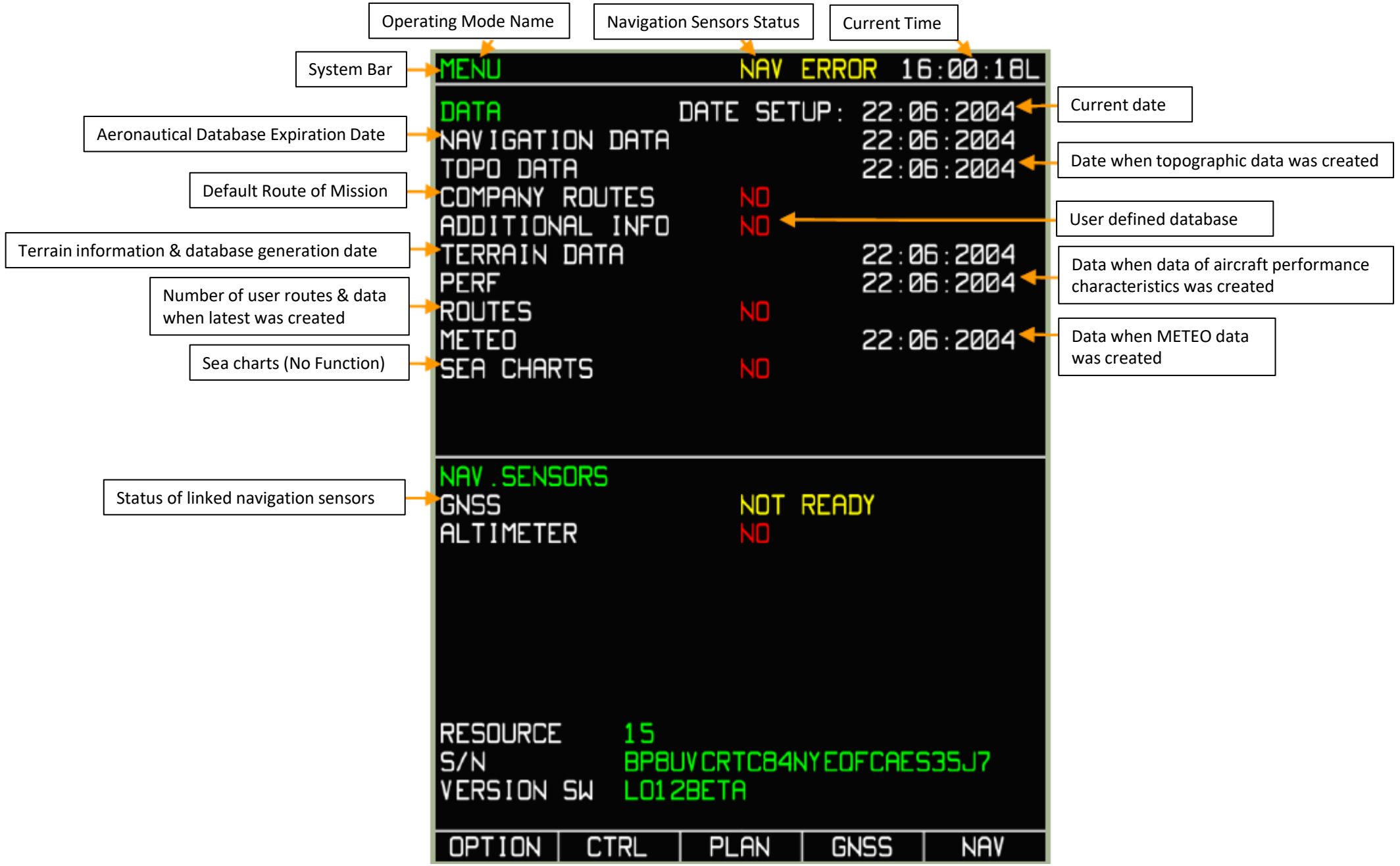
GNSS page

2.2 – ABRIS MAIN MENU

The MAIN MENU page is accessed by cycling pages with the lower right FSK (Function Select Key).



2.2 – ABRIS MAIN MENU



2.3 – ABRIS NAVIGATION (NAV) MENU

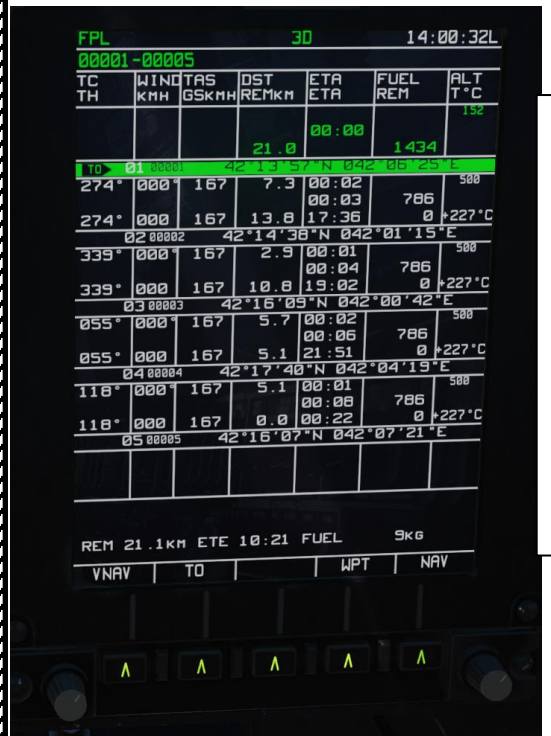
The NAV MENU page is accessed by cycling pages with the lower right FSK (Function Select Key).

MAP FSK (Function Select Key)

- Allows you to scale up or down (zoom) the map and display information and ERBL (Estimated Range & Bearing Line)

SEARCH FSK (Function Select Key)

- Searches navigation points through database



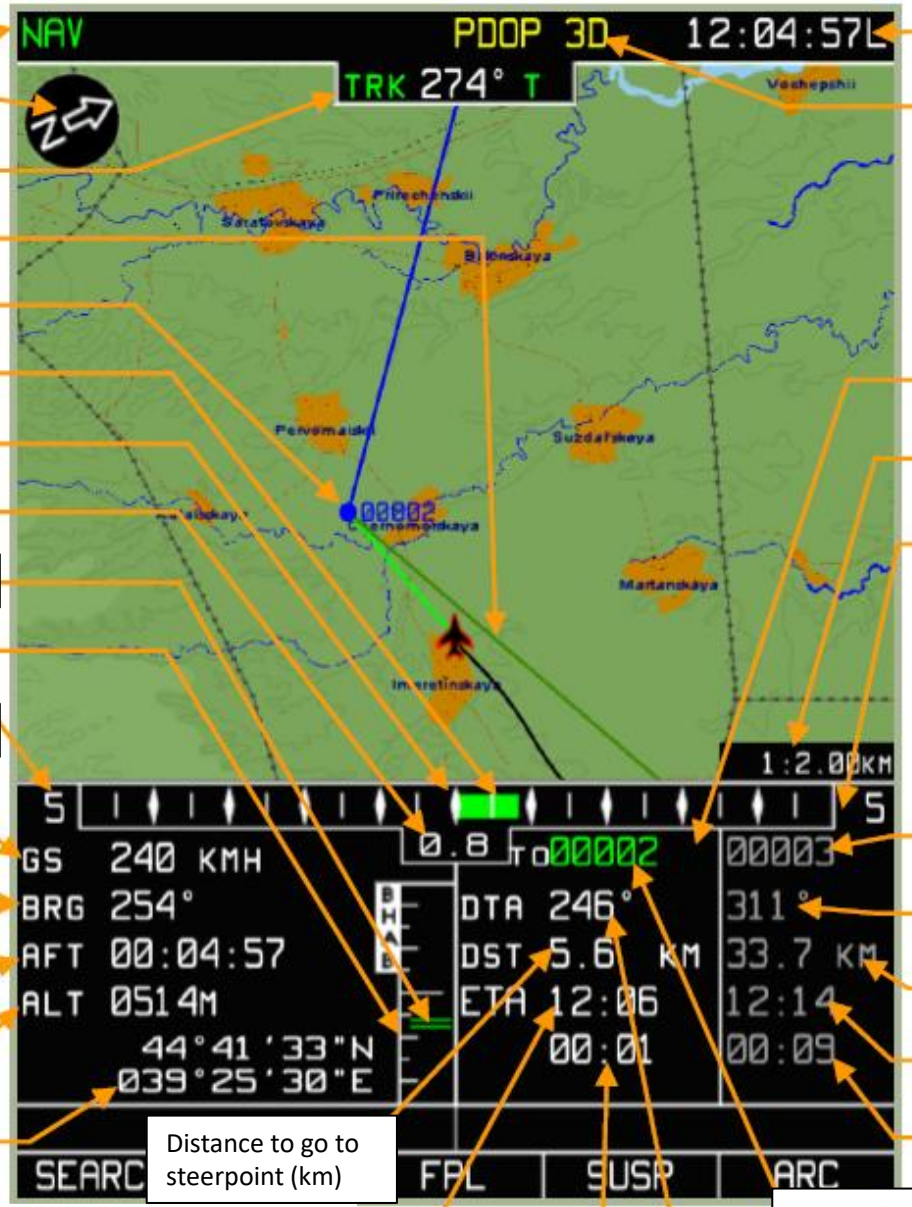
Flight Plan (FPL) sub-mode displays flight information in a tabular form, provided there is an active route loaded. In addition to viewing a route, this sub-mode enables re-targeting of the aircraft to a specified waypoint. The FPL page displays the following information:

- Waypoint name
- Waypoint coordinate
- DTK/DMTK/MC (Desired Track, Desired Magnetic Track, Magnetic Course) of the route leg
- Route leg length
- WPT OVER altitude
- WPT ETO
- Estimate flight time of each leg
- Comments for each leg

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.

Cycles ABRIS MENU, NAV, HSI and ARC pages

2.3 – ABRIS NAVIGATION (NAV) MENU



Operating Mode Name

North Arrow

Current Track/Heading (T = True, M = Magnetic)

Desired Track (DTK) Angle

Steerpoint (Selected Waypoint)

Representation of lateral cross-track error (XTE)

XTE scale center point (on course)

Digital XTE level

Representation of altitude deviation from flight plan

Vertical navigation scale

XTE (Cross-Track Error) Scale

Ground Speed (km/h)

Bearing to Steerpoint

Flight Time

Current Altitude (meters)

Current geographic coordinates

Current Time

GNSS Status

Current Route leg combined data field

Map Scale

Next Route leg combined data field

Next Steerpoint callsign

Desired Track Angle (DTA) of next steerpoint

Next steerpoint Leg Distance (km)

Next steerpoint estimated time of arrival (ETA)

Time left before reaching next steerpoint (minutes:seconds)

Distance to go to steerpoint (km)

Steerpoint estimated time of arrival (ETA)

Time late before reaching next steerpoint

Desired Track Angle (DTA)

Steerpoint Callsign

2.3 – ABRIS NAVIGATION (NAV) MENU

ERBL (Estimated Range/Bearing Line) Function

The ERBL function is a sub-function of the ABRIS NAV menu. Its main use is to… err… estimate the range and bearing of a point in relationship to your aircraft or another point in space. Kind of self-explanatory, eh?

1. Select NAV page of the ABRIS
2. Select MAP function of the NAV page
3. Press on the FSK (Function Select Key) under INFO
4. Press on the FSK under ERBL

2.3 – ABRIS NAVIGATION (NAV) MENU

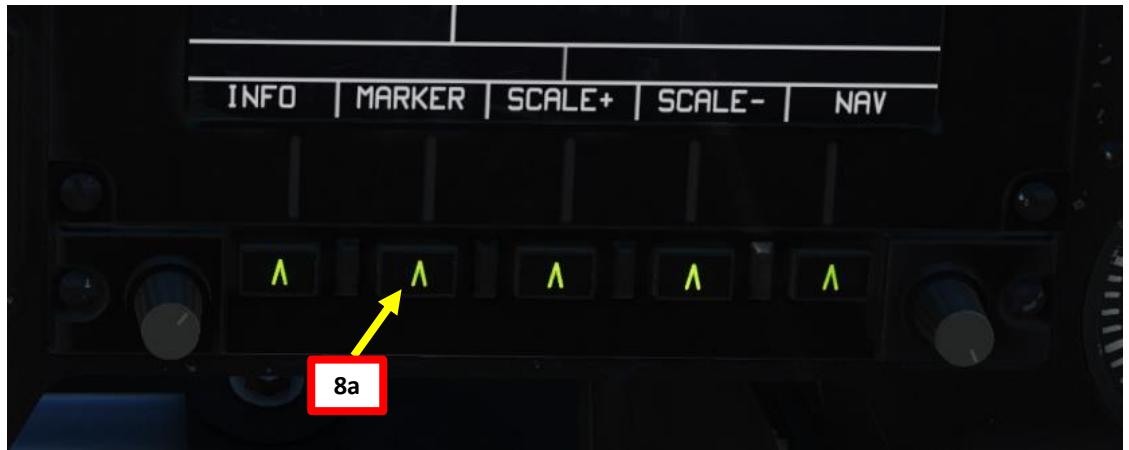
ERBL (Estimated Range/Bearing Line) Function

5. A red cursor will appear on the moving map.
6. You can move the cursor by:
    - Horizontally: scrolling the mousewheel over the Cursor knob
    - Vertically: scrolling the mousewheel over the Cursor knob while holding the right mouse button.
7. The Estimated Range/Bearing Line will be drawn between you and the cursor. The following information will be displayed:
    - ERB: Marker (Cursor in our case) coordinates
    - BRG: Bearing to the measured leg beginning point, set initially to the aircraft position
    - DST: Distance from leg beginning to the current marker position (Cursor in our case)
    - ALT: Altitude
    - MVR: Magnetic Declination Value for the area where the active marker (Cursor in our case) is positioned

2.3 – ABRIS NAVIGATION (NAV) MENU

ERBL (Estimated Range/Bearing Line) Function

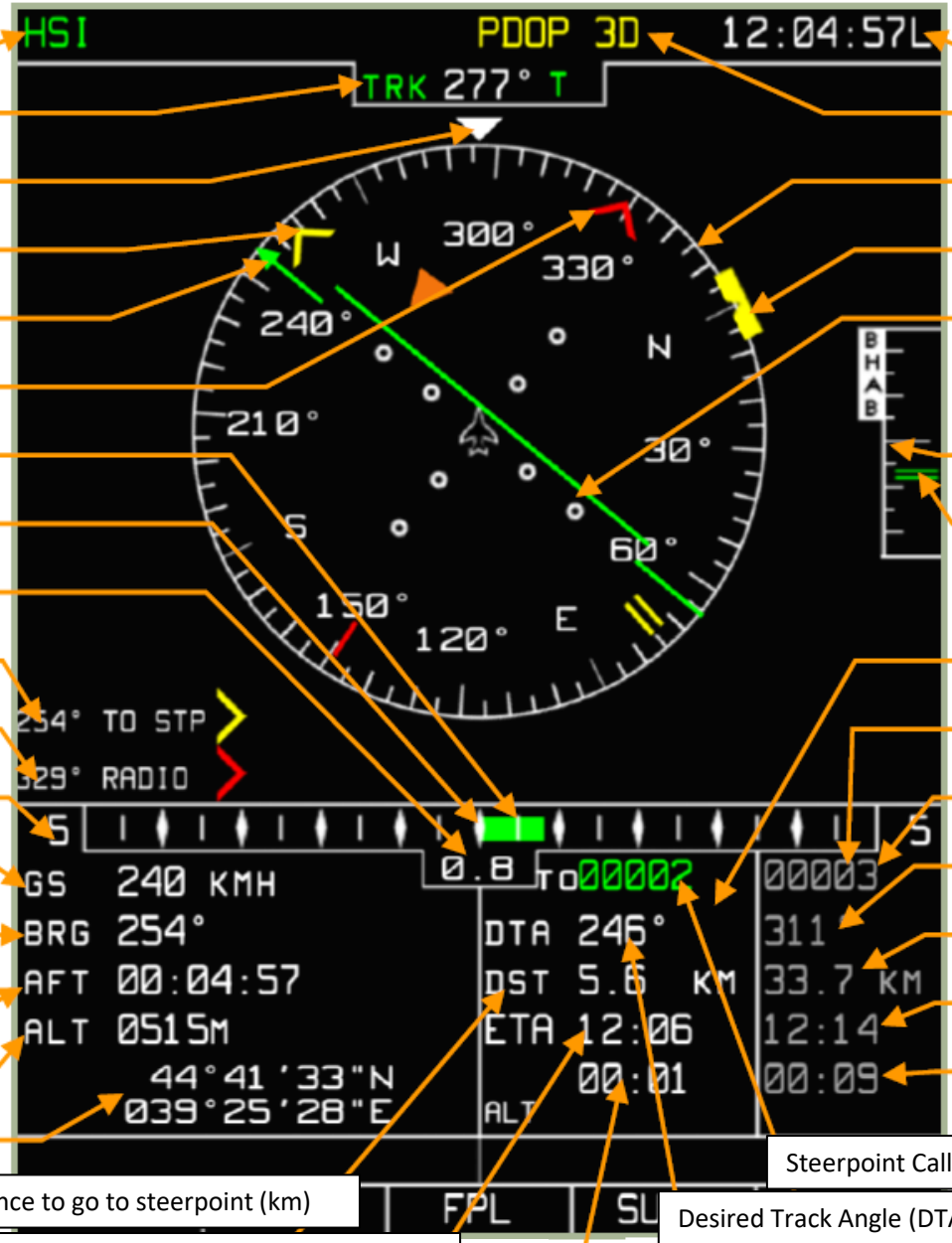
8. If you press the FSK under “MARKER”, a marker will be drawn on your current Cursor position.
9. If you move the Cursor using the Cursor knob controls, the Estimated Range/Bearing Line will be drawn between the previous cursor location (marker) and the new cursor location.
10. Information on the ERBL and the marker (MRK) will be displayed.
11. To exit the ERBL function, press the FSK under NAV.



2.4 – ABRIS HSI (HORIZONTAL SITUATION INDICATOR) MENU

The HSI MENU page is accessed by cycling pages with the lower right FSK (Function Select Key).

2.4 – ABRIS HSI (HORIZONTAL SITUATION INDICATOR) MENU



Operating Mode Name

Current Track/Heading (T = True, M = Magnetic)

Actual Track Angle Caret

RMI-1 – Bearing to steerpoint (in this example)

Desired Track (DTK) Angle

RMI-2 – Bearing of ADF radio beacon (in this example)

Representation of cross-track error (XTE)

XTE scale center point (no cross track error)

Digital XTE (cross track error) value

RMI-1 – Bearing to Steerpoint (in this example)

RMI-2 – Bearing to ADF radio beacon (in this example)

XTE (Cross Track Error) Scale

Ground Speed (km/h)

Bearing to Steerpoint

Flight Time

Current Altitude (meters)

Current geographic coordinates

Distance to go to steerpoint (km)

Steerpoint estimated time of arrival (ETA)

Time late before reaching next steerpoint

Desired Track Angle (DTA)

Steerpoint Callsign

Current Time

GPS Status

Heading Compass

Desired course mark

Representation of cross track error (XTE)

Vertical navigation scale

Graphic indicator of vertical deviation from flight plan leg

Current route leg combined data field

Next route leg combined data field

Next Steerpoint callsign

Desired Track Angle (DTA) of next steerpoint

Next steerpoint Leg Distance (km)

Next steerpoint estimated time of arrival (ETA)

Time left before reaching next steerpoint (minutes:seconds)

2.5 – ABRIS ARC (AUTOMATIC RADIO-COMPASS) MENU

The ARC MENU page is accessed by cycling pages with the lower right FSK (Function Select Key).

2.5 – ABRIS ARC (AUTOMATIC RADIO-COMPASS) MENU

Operating Mode Name

Current Track/Heading (T = True, M = Magnetic)

Actual Track Angle Caret

RMI-1 – Bearing to steerpoint (in this example)

Desired Track (DTK) Angle

RMI-2 – Bearing of ADF radio beacon (in this example)

Representation of cross-track error (XTE)

XTE scale center point (no cross track error)

Digital XTE (cross track error) value

RMI-1 – Bearing to Steerpoint (in this example)

RMI-2 – Bearing to ADF radio beacon (in this example)

XTE (Cross Track Error) Scale

Ground Speed (km/h)

Bearing to Steerpoint

Flight Time

Current Altitude (meters)

Current geographic coordinates

GPS Status

Vertical navigation scale

Graphic indicator of vertical deviation from flight plan leg

Next Steerpoint callsign

Desired Track Angle (DTA) of next steerpoint

Next steerpoint Leg Distance (km)

Next steerpoint estimated time of arrival (ETA)

Time left before reaching next steerpoint (minutes:seconds)

Desired Track Angle (DTA)

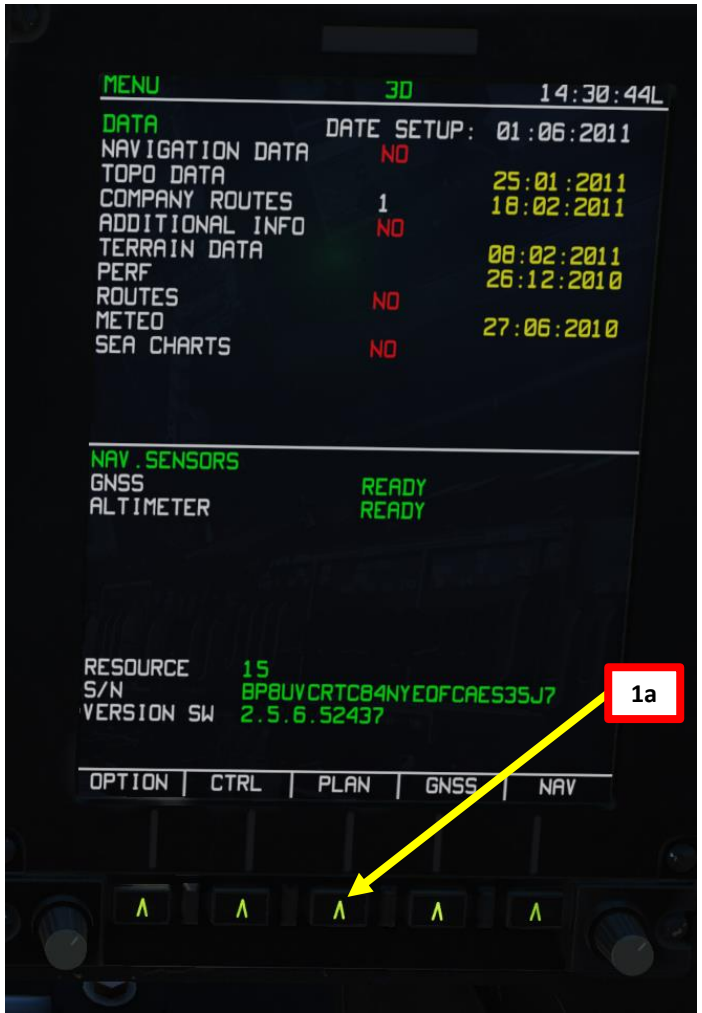
Steerpoint Callsign

2.6 – ABRIS FLIGHT PLAN MENU

Flight Plan Creation Function

Creating a Flight Plan can be useful to link waypoints together and make a coherent mission plan.

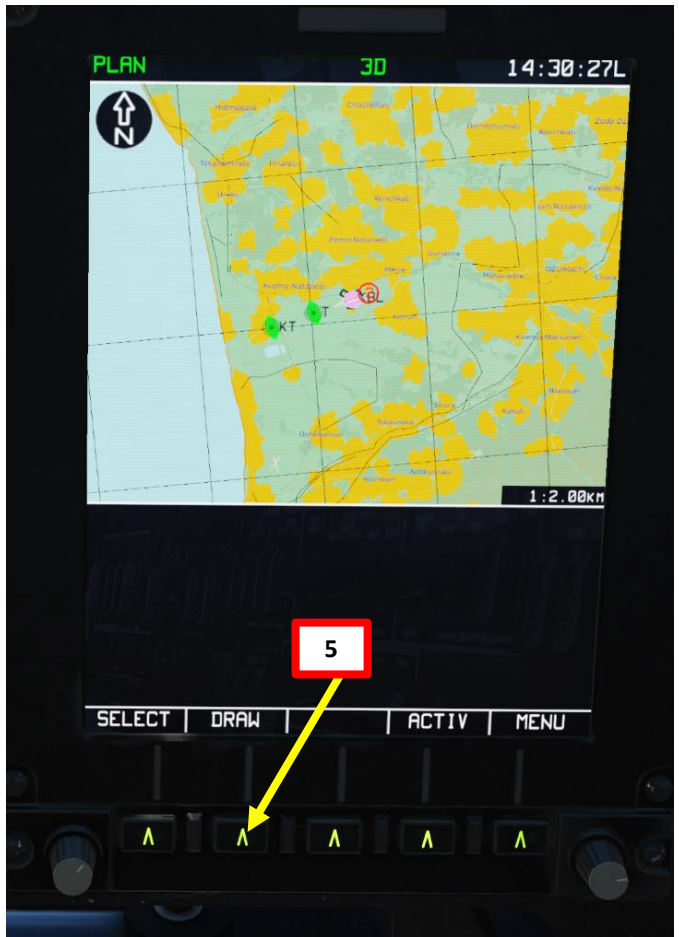
1. From the MAIN MENU, select PLAN page of the ABRIS
2. Press on the FSK (Function Select Key) under SELECT
3. Scroll mousewheel over the ABRIS Cursor knob to set the white selection box over UNLOAD.
4. Right Click (Push) on the ABRIS Cursor knob to unload the current flight plan.

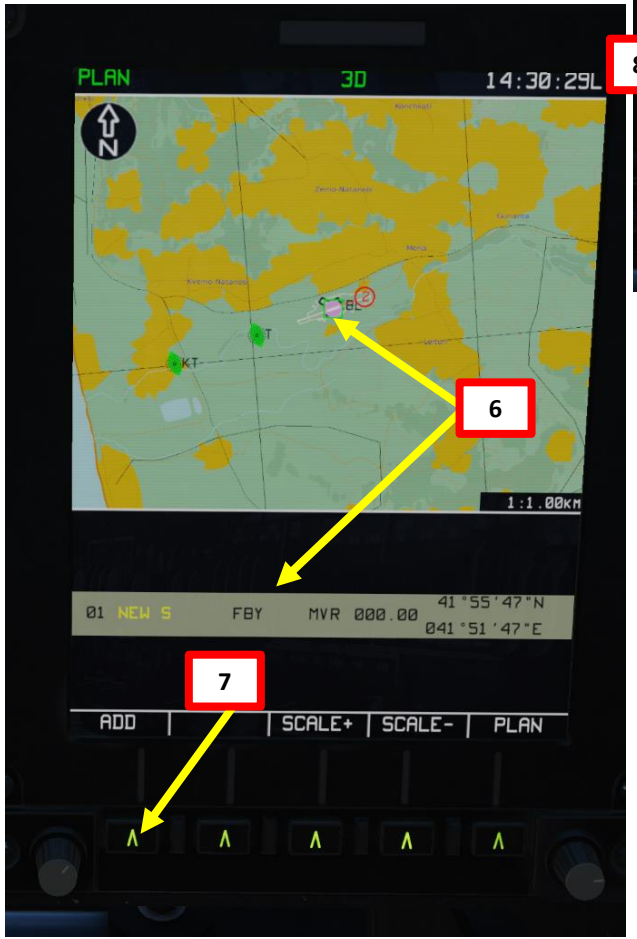


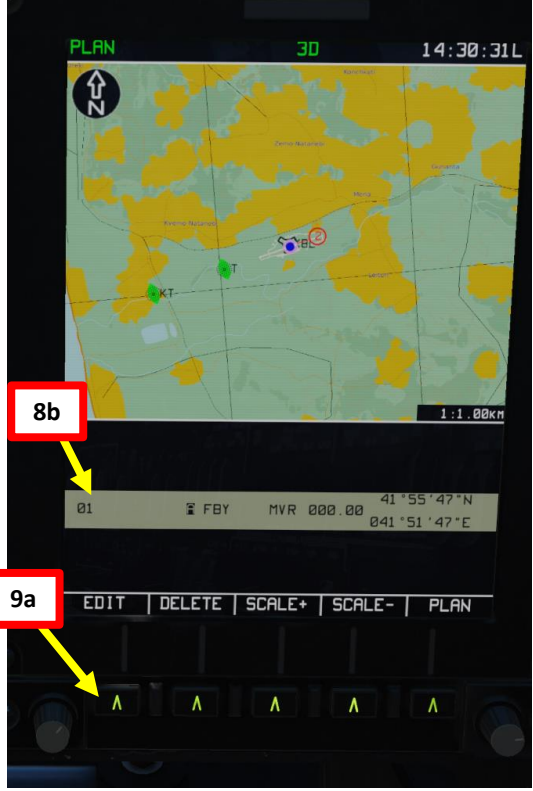
2.6 – ABRIS FLIGHT PLAN MENU

Flight Plan Creation Function

5. Press on the FSK (Function Select Key) under DRAW.
6. A Waypoint will automatically be created on the current aircraft location.
7. Press on the FSK under ADD to add this waypoint to the Flight Plan.
8. You can name the waypoint as you want using the ABRIS Cursor knob, but we will use the automatically generated waypoint name for now. Press on the FSK under ENTER.
9. Press on the FSK under EDIT, then press it a second time to select INSERT.







2.6 – ABRIS FLIGHT PLAN MENU

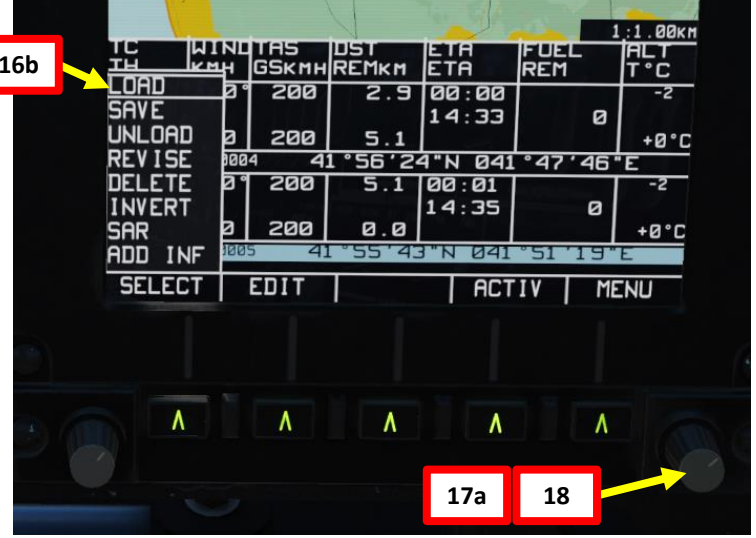
Flight Plan Creation Function

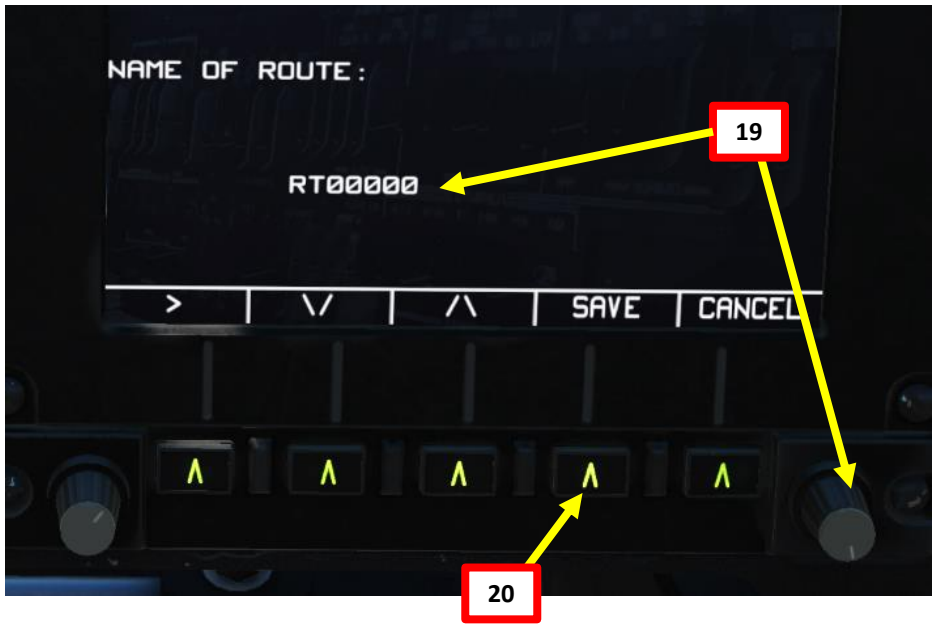
10. A green cursor will appear on the moving map. This represents your desired waypoint location.
11. You can move the cursor by:
    - Horizontally: scrolling the mousewheel over the Cursor knob
    - Vertically: push the Cursor knob (right click), then scrolling the mousewheel over the Cursor knob.
12. Once you are satisfied with the waypoint location, press on the FSK under ADD to add this waypoint to the Flight Plan.
13. Press on the FSK under ENTER.
14. Repeat previous steps to add more waypoints.

2.6 – ABRIS FLIGHT PLAN MENU

Flight Plan Creation Function

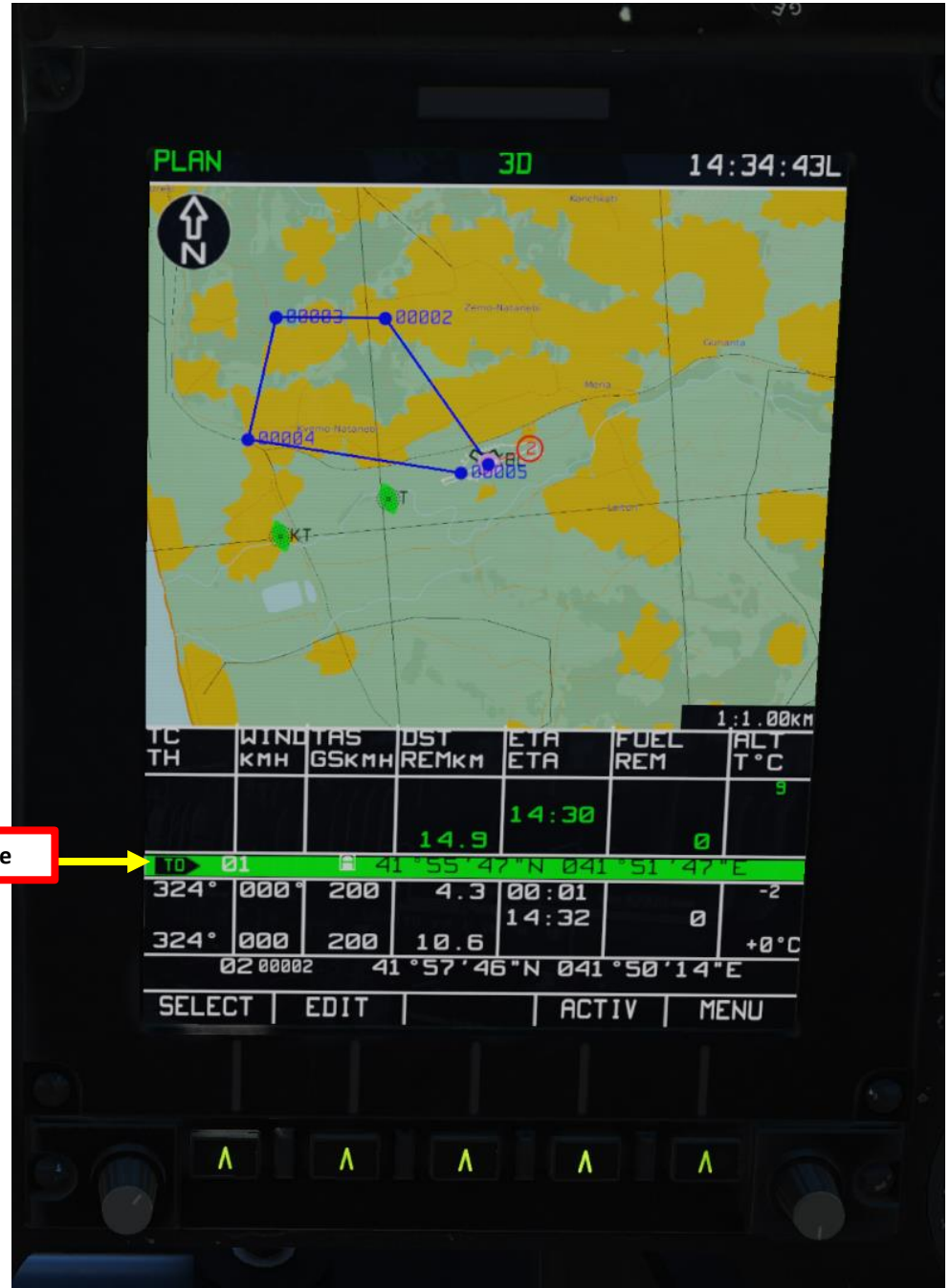
15. Once you are satisfied with your flight plan, press FSK (Function Select Key) under PLAN to return to the Flight Plan page.
16. Press FSK under SELECT.
17. Scroll mousewheel over the ABRIS Cursor knob to set the white selection box over SAVE.
18. Right Click (Push) on the ABRIS Cursor knob to enter the Route Name menu.
19. Use ABRIS Cursor knob to set the Route Name as desired. We will leave it as is.
20. Press FSK under SAVE to save the flight plan.





2.6 – ABRIS FLIGHT PLAN MENU

Flight Plan Creation Function



3 – PVI-800 NAVIGATION SYSTEM

Missions are generally planned using waypoints (implemented via the Mission Editor itself, even if you can manually set them if you so wish). In the PVI-800, a number of navigation reference points are stocked: Waypoints, Fixed Points, Airfields, and Navigation Targets. The information stocked in the PVI-800 system can be displayed on the ABRIS display.

3 – PVI-800 NAVIGATION SYSTEM

PVI-800 Keypad
- 1 to 9 / ENTER / CLEAR

PVI-800 Upper Display Window

Selected Waypoint (WP) Display

POI (Point of Interest) Display
- Airfield number, fixed point, target point, or correction point display

PVI-800 Lower Display Window

INU RESET Button
- Inertial Navigation Unit reset for in-flight alignment (no function).

WPT Button
- Waypoint Mode selects a waypoint from the flight plan

INU PREC Button
- Inertial Navigation Unit precise alignment. Alignment takes about 30 minutes to complete.

FIX PNT Button
- Selects a reference point for an INU (Inertial Navigation Unit) update

INU NORM Button
- Inertial Navigation Unit normal alignment function.

AIRFIELD Button
- Selects an airfield for RTB (Return to Base) mode and displays the coordinates of one of two airfields. Airfield 1 is your takeoff location and airfield 2 is your landing location.

INIT PNT Button
- Displays initial coordinate point and allows you to enter a new one.

NAV TGT Button
- Selects a target point (TP) for ingress and allows you to enter coordinates for new TPs. Up to 10 TPs can be saved.

SELF COOR Button
- Displays Ownship coordinates

BRG/RA / TGT PNT Button
- Indication of bearing and range to target point in the Ingress mode.

DTA/DH Button
- Indication of DTA (Desired Track Angle) or DH (Desired Heading), time and distance to current waypoint in the Waypoint, Reference Airfield, and Target navigation modes.

T-HEAD / TIME/DIS Button
- Indication of True Heading, Time and Distance to final waypoint in the Waypoint, reference, airfield and target modes.

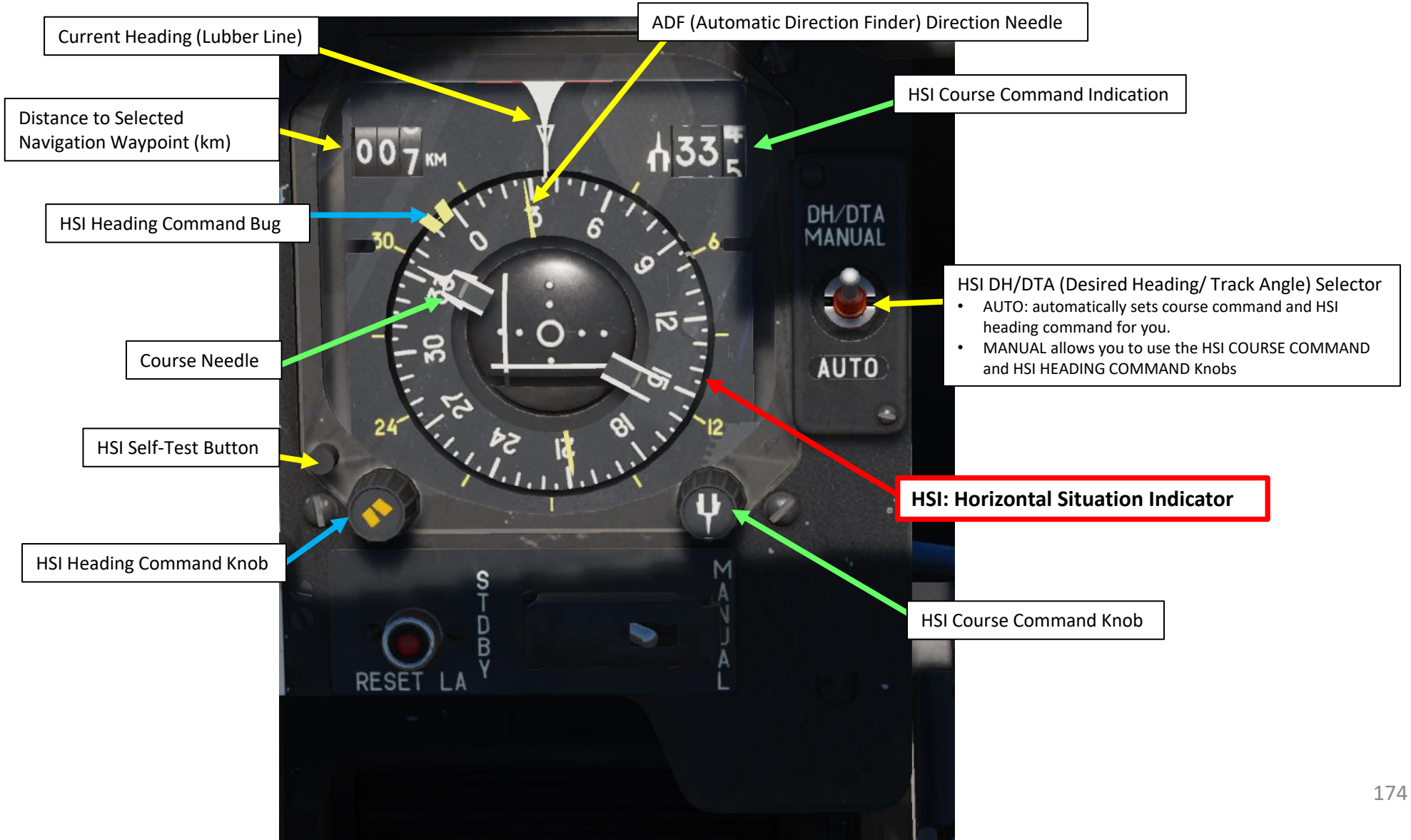
PVI-800 Navigation Master Mode
- OFF: PVI-800 OFF
- CHECK: Verification of entered data.
- ENT/EDIT: Edits/Enters waypoint coordinates, wind conditions, and other data.
- OPER: Normal Operation
- STM: Simulation Training Mode Flight
- K1: Non-Functional programming mode
- K2: Non-Functional programming mode

WIND DI/SP Button
- Indication of wind direction (FROM) and wind speed (m/s).

PVI-800 INU (Inertial Navigation Unit) operation mode
- I-251V / INU: Correction with SHKVAL optics
- OVER / UPDATE: Correction by flying over a reference point

4 – HSI (HORIZONTAL SITUATION INDICATOR)

The Horizontal Situation Indicator (HSI) displays aircraft heading, offset from the assigned flight path, and position relative to a selected navigation reference that may be a steerpoint, fixed point, radio beacon, or airfield. Although primary navigation data may be displayed on the HUD, the HSI provides additional information for precise navigation.



5 – NAVIGATION POINT TYPES

Missions are generally planned using waypoints (implemented via the Mission Editor itself, even if you can manually set them if you so wish). In the PVI-800 navigation system, a number of navigation reference points are stocked in the PVI-800 system, and can be displayed on the ABRIS display.

- **Waypoints**
  - Waypoints are pre-planned navigational points of reference for you to follow on route to your area of operation. You can create new ones, edit their coordinates and create flight plans with them. It is important to understand that any waypoint can be set as the current steerpoint.

- **Steerpoint**
  - A Steerpoint is the waypoint currently selected for navigation.

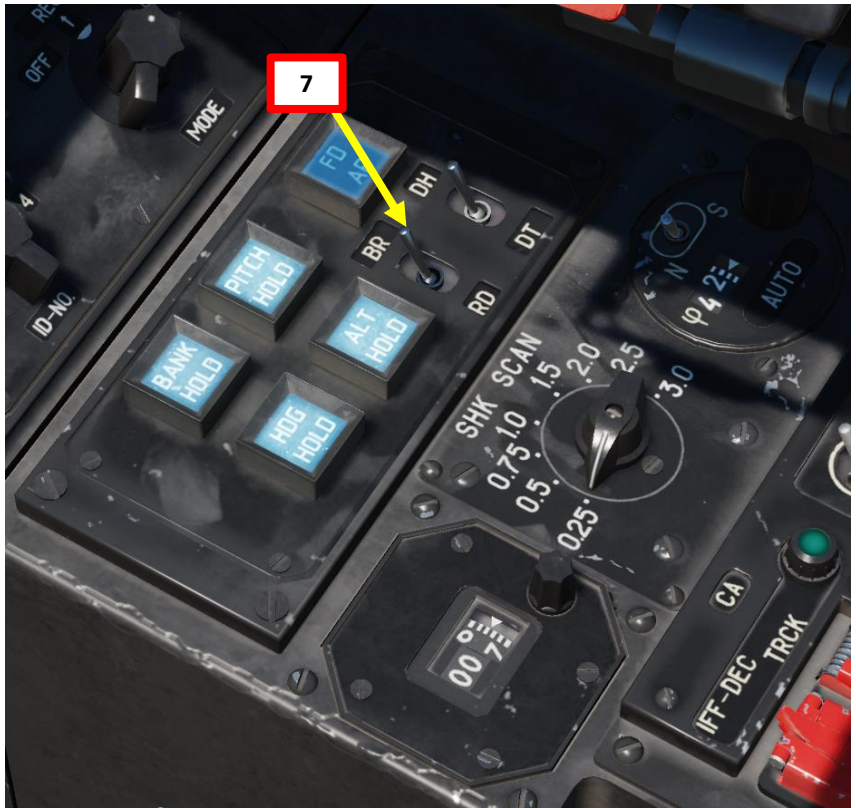
- **Target Points / Navigation Targets**
  - Target points are similar to markpoints, which are used to "mark" a point of interest, whether flying over an interesting area or an enemy sighting. You can create up to 10 target points.

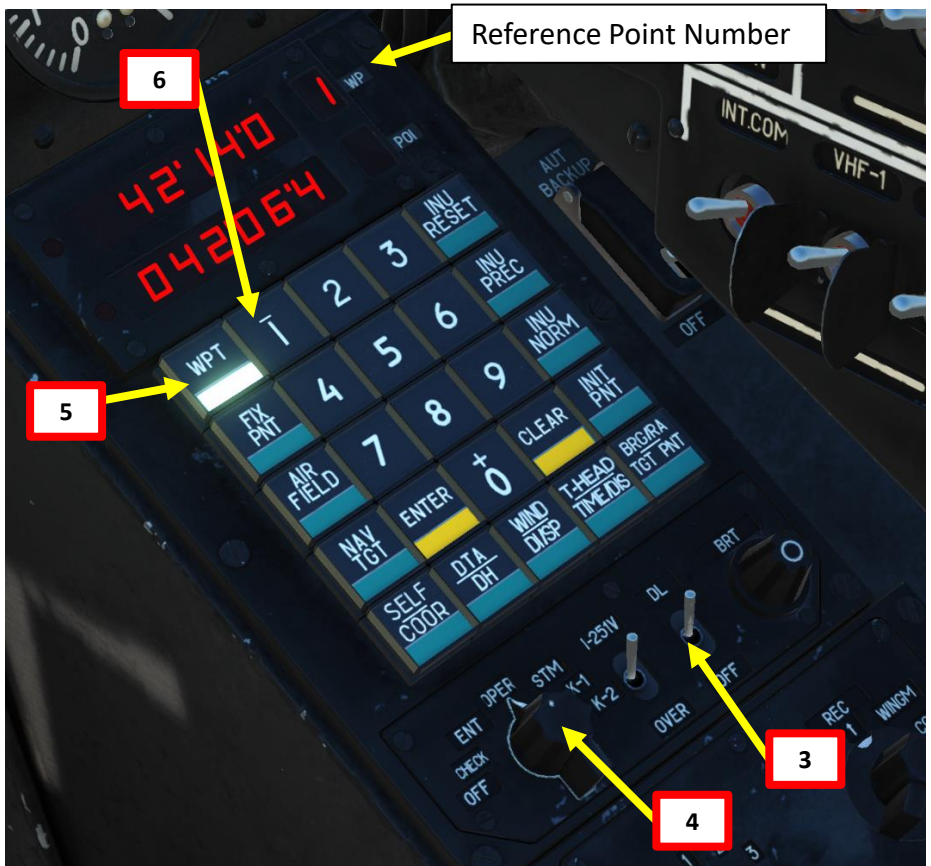
- **Fixed Points**
  - Fixed points (also called “fix”) are reference points used to re-align your INU (Inertial Navigation Unit), which accumulates error/drift over time.

6.1 – WAYPOINT NAVIGATION (+ AUTOPILOT USAGE)

1. Turn on INU system power switch (UP)
2. Set GYRO mode (middle position)
3. Turn PVI-800 system ON (FWD)
4. Set PVI-800 mode to OPER to select a desired waypoint
5. Select desired waypoint type (in our case, we will select WPT to select a waypoint)
6. Select preset waypoint number (in our case we will select Waypoint 1)
7. Select BR (Barometric) if you are flying 300 m or higher. Select RD (Radar Altimeter) if you are flying at 50 m or lower.

NOTE: You can navigate towards Target Points, Fixed Points or Airfields if you want. You just need to select the right reference point type.

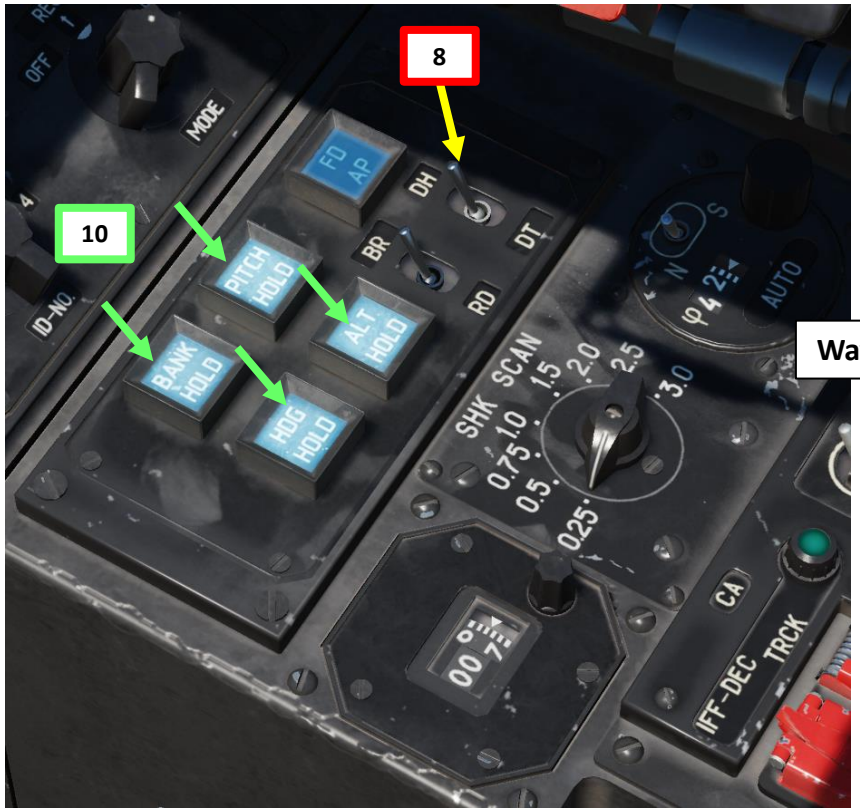


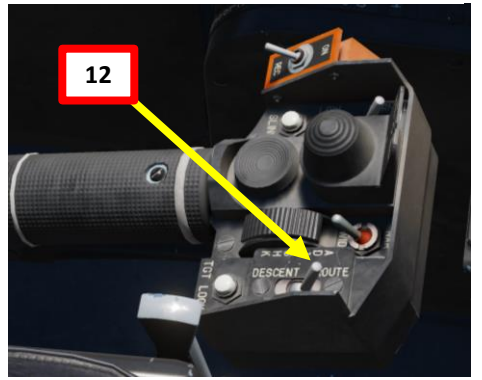


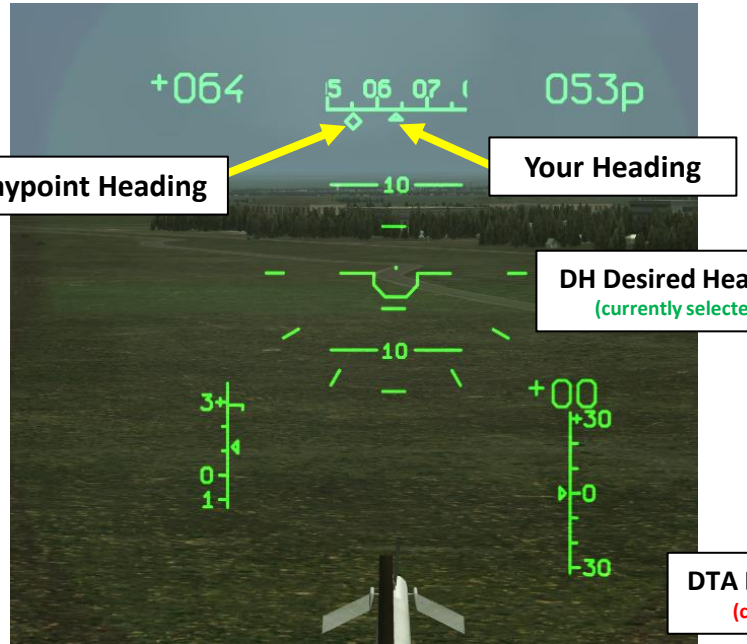
6.1 – WAYPOINT NAVIGATION (+ AUTOPILOT USAGE)

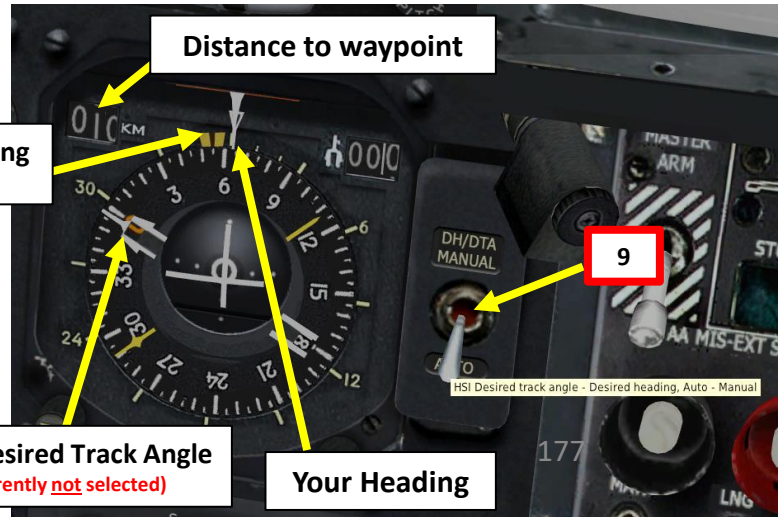
8. Select DH (Desired Heading) if you want the autopilot to steer straight to the waypoint or DT (Desired Tracking) if you prefer the auto-pilot to steer you towards the tracking line to the waypoint.
9. Set DH/DTA to AUTO (DOWN).
10. Push the desired "autopilot" modes to help you during the flight (Bank Hold + Pitch Hold + Heading/Yaw Hold). ALT HOLD can be used if you want to maintain a set altitude. Take note that the "autopilot" are in fact used as "dampers".
11. Fly towards the waypoint until you have a decent airspeed, press the TRIM switch to maintain constant airspeed. You can use the HUD heading indicator or the HSI to help you. Align yourself at + or – 15 degrees from desired heading.
12. Engage Route Mode on your collective (Shortcut: "R" for Route and/or "D" for Descent) to engage autopilot. Aircraft will steer itself to the selected waypoint.
13. Once you have reached a waypoint, the autopilot will automatically steer the helicopter towards the next stocked waypoint on the list.
14. Disengage Route Mode on collective by pressing "R" to disengage autopilot (should be in middle position).

EXAMPLE: DESIRED TRACKING VS DESIRED HEADING TOWARDS WAYPOINT 2



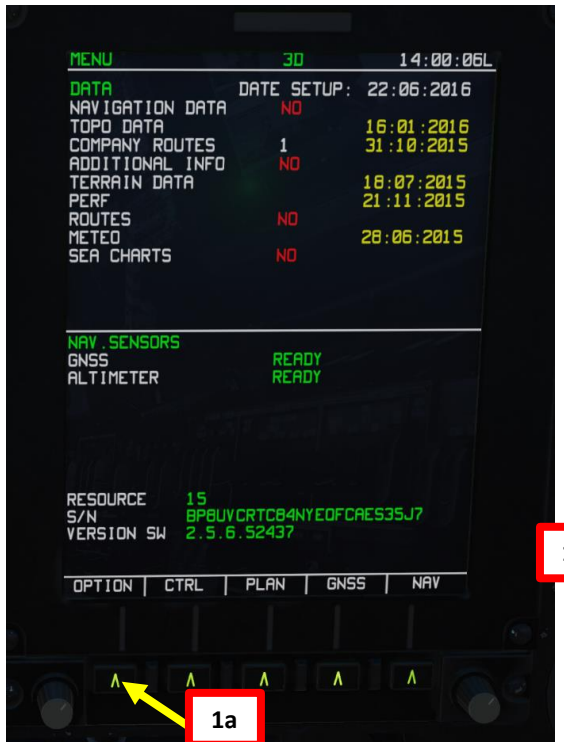


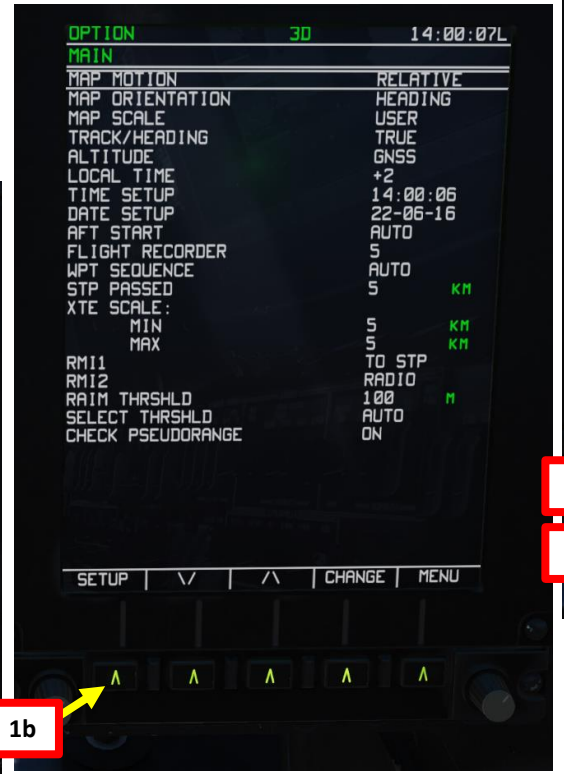


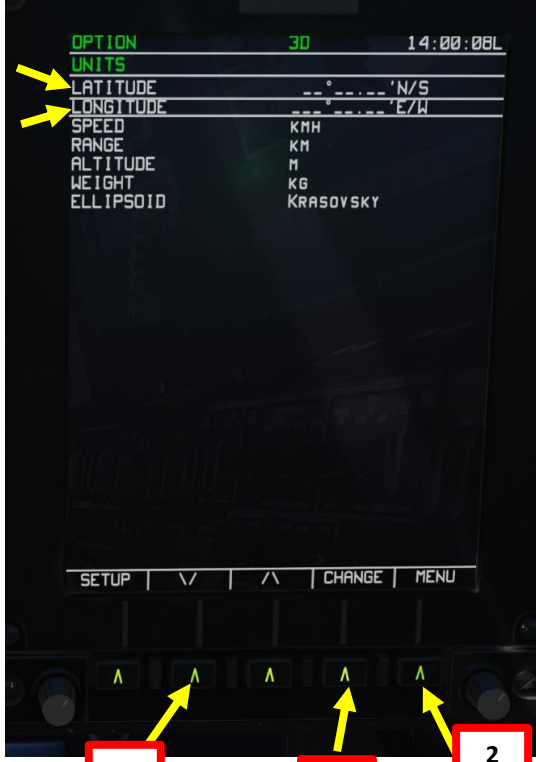


6.2 – HOW TO ADD, EDIT OR REMOVE A REFERENCE POINT (WAYPOINT)

1. In ABRIS Options –> Setup page, select UNITS menu and set LATITUDE and LONGITUDE to DECIMAL system as shown on pictures.
2. Go back to ABRIS main menu and go to NAV menu.
3. Select “Edit” mode for the PVI-800.







6.2 – HOW TO ADD, EDIT OR REMOVE A REFERENCE POINT (WAYPOINT)

4. In the ABRIS NAV menu, click on “INFO” menu. You will obtain a red cursor that you can move by controlling horizontal movement with “using mousewheel to rotate knob” and vertical movement with “using mousewheel while right-clicking on knob”. Coordinates will be shown on the ABRIS.
5. **Alternatively**, you can also track Airports, VORs or NDBs. For example, to obtain the coordinates of an airport, click “Search” and scroll mousewheel on the knob to select desired sub-menu. Click on “search” again once desired menu has been selected. If we choose “Airport”, we can scroll down a list of airports using the same knob (and the mousewheel) and select for example Sukhumi-Barbushara by clicking the “Info” menu again. Coordinates will be shown on the ABRIS.

6.2 – HOW TO ADD, EDIT OR REMOVE A REFERENCE POINT (WAYPOINT)

6. Press WPT (or the type of reference point you want to enter) and the WPT number you want to change or add (in our case we will choose “WPT 2”).
7. Read the coordinates carefully and type them in. Here is how you should enter them:
   What you read: **42 51 6**7 **041 07 4**7
   What you must actually enter: 042 516 0 041074.
   <u>You can see that we didn’t include the two sevens since the PVI-800 doesn’t need this level of coordinate precision.</u>
8. Press “Enter” and you’re good to go! If you made a mistake, press “Reset” and start over.
9. OPTIONAL: You can click on “To” to let the ABRIS draw a path to the waypoint.

<u>Here are great tutorials by Banjo:</u>

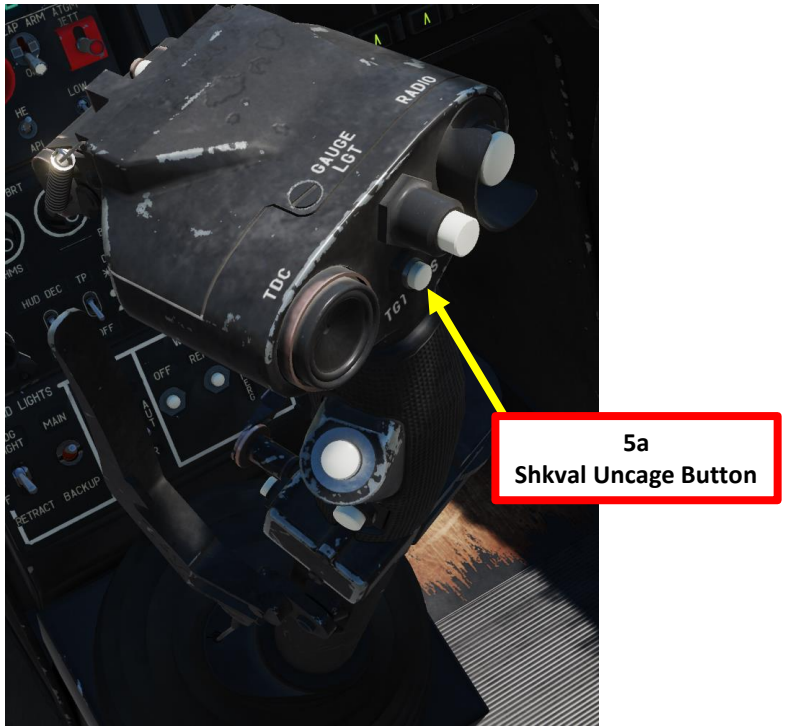
Creating/Editing Flight Plans:
https://www.youtube.com/watch?v=4pQEkjxl6aQ&index=10&list=PL-rNisMp5bxE2sOzdHPYoezq8zsSG9dr0

Creating Nav Targets:
https://www.youtube.com/watch?v=qv6lzVYQF98&list=PL-rNisMp5bxE2sOzdHPYoezq8zsSG9dr0&index=11

7.1 – TARGET POINT CREATION

7.1.1 – Fly-Over Method

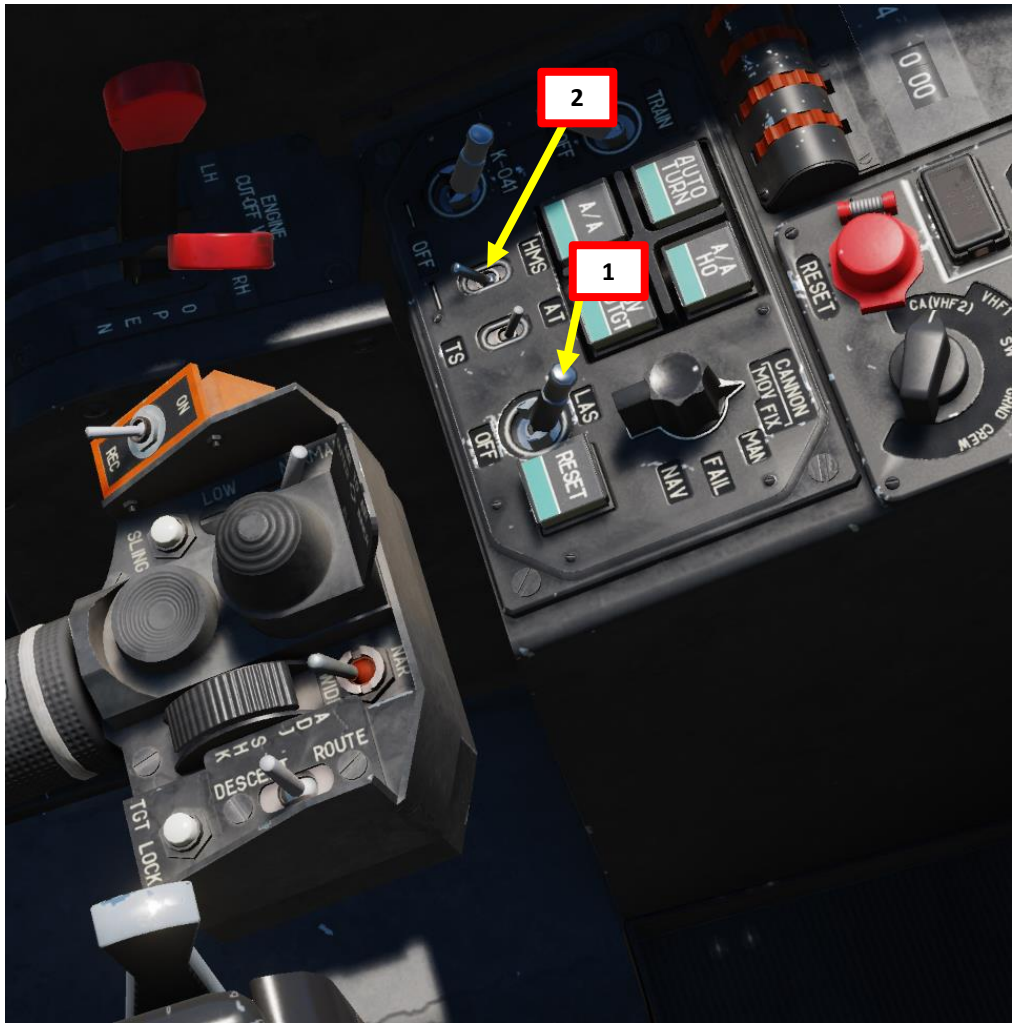
1. Set the Mode selector dial on the Navigation Control panel to the EDIT/ENTER position.
2. Set INU Operation Mode switch to the “OVER” (Over-fly) position.
3. Press NAV TGT (Target point) push-light.
4. Select the Target Point number you wish to assign from the key pad (1 to 10). We will choose Target Point 1.
5. Once above the target, press the “Uncage SHKVAL/Designate target” button on the cyclic and the helicopter’s coordinates will be appear on the Navigation Control panel display.
6. Press the ENTER button on the Navigation Control panel and the fly-over coordinates will be entered as a Target Point in the navigation system.
7. After creating the Target Point, set the Mode selector dial on the Navigation Control panel to the OPERATE position. Coordinates for the target point are now stored in NAV TGT / Target Point 1.

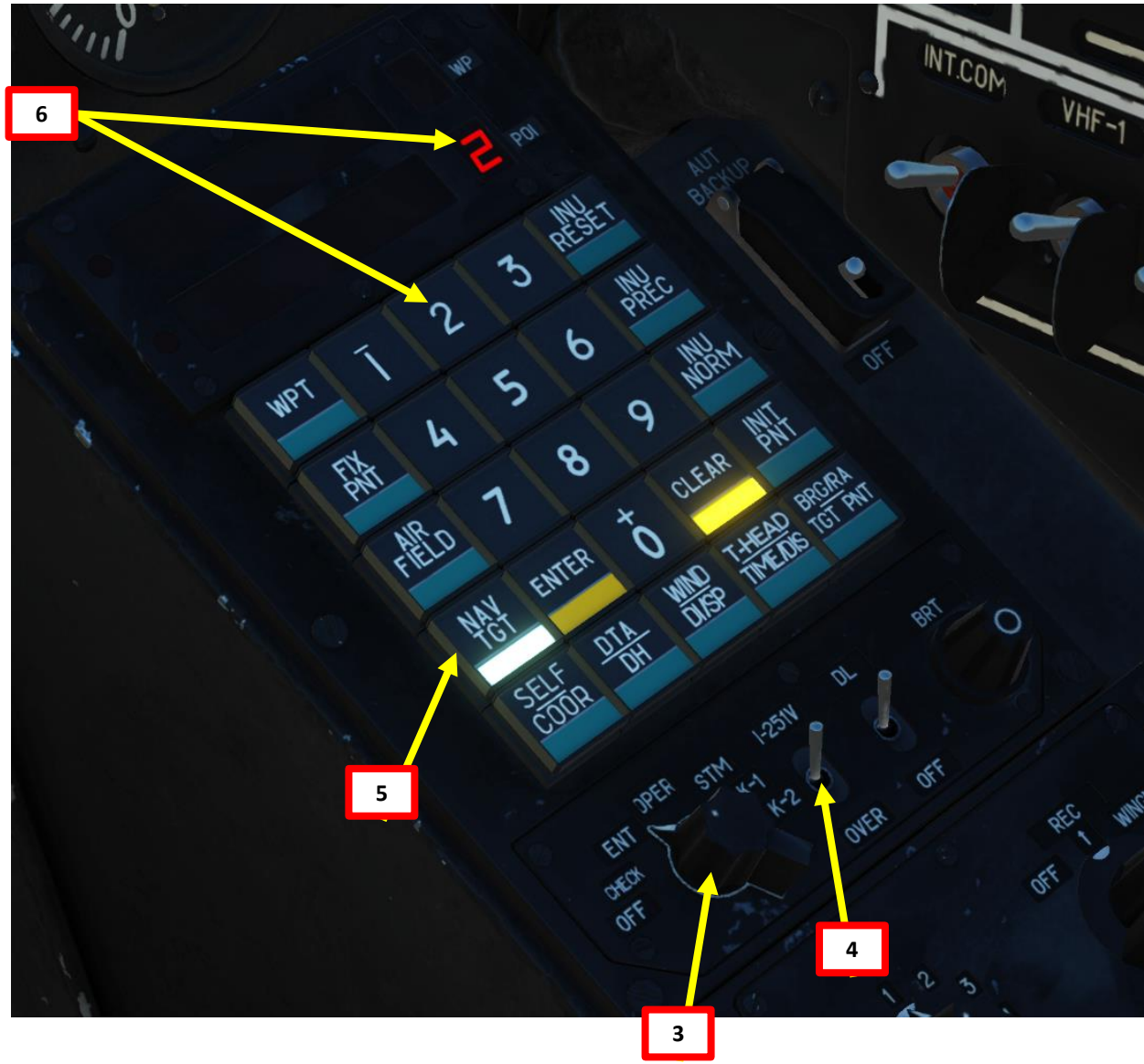


7.1 – TARGET POINT CREATION

7.1.2 – SHKVAL Designation Method

1. Laser Power switch ON (FWD)
2. Ensure the HMS (Head-Mounted Sight) switch is OFF.
3. Set the Mode selector dial on the Navigation Control panel to the EDIT/ENTER position.
4. Set INU Operation Mode switch to the “И-251В” (I-251V Shkval) position.
5. Press NAV TGT (Target point) push-light.
6. Select the Target Point number you wish to assign from the key pad (1 to 10). We will choose Target Point 2.

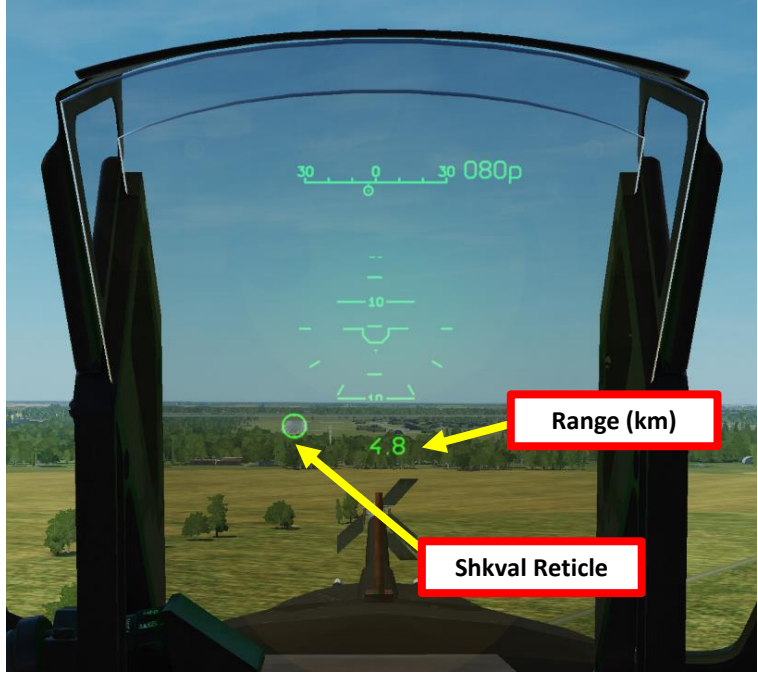


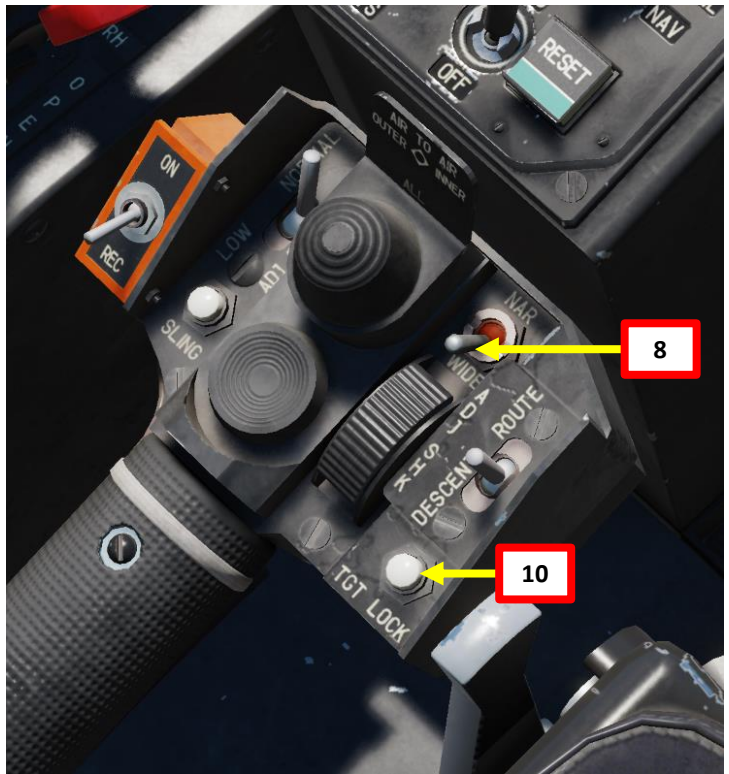


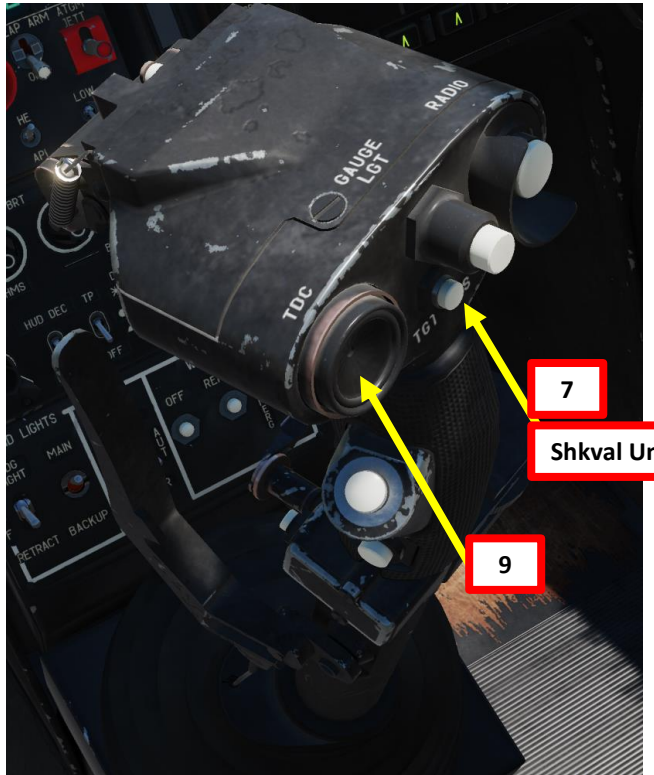
7.1 – TARGET POINT CREATION

7.1.2 – SHKVAL Designation Method

7. Press the “Uncage SHKVAL/Designate target” button on the cyclic
8. Change SHKVAL FOV to either NARROW 7X or WIDE 23X using “+“ or “-” or custom key binding
9. Slew SHKVAL reticle to desired target using KU-31 Slew UP/DOWN/LEFT/RIGHT controls “,” “.” “/”and “;”
10. Lock target (“Enter” key) using the Shkval Target Acquisition & Lock button.



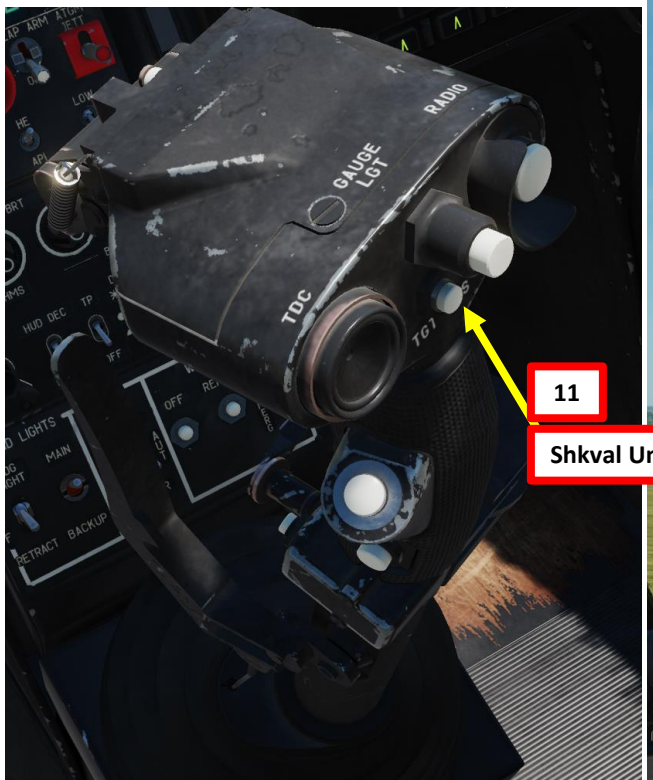


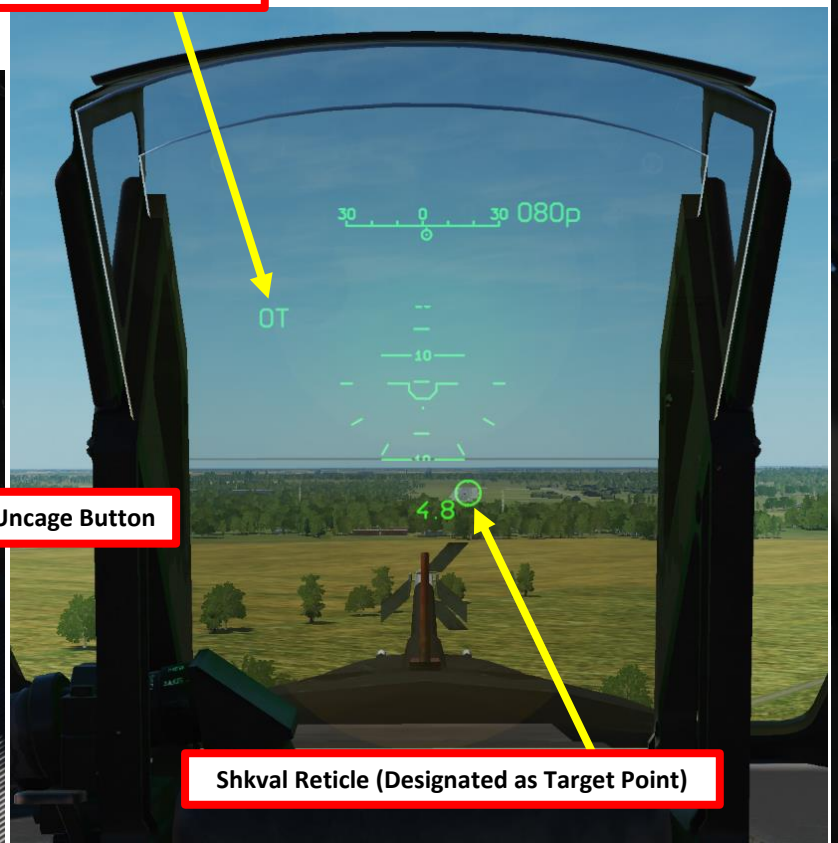


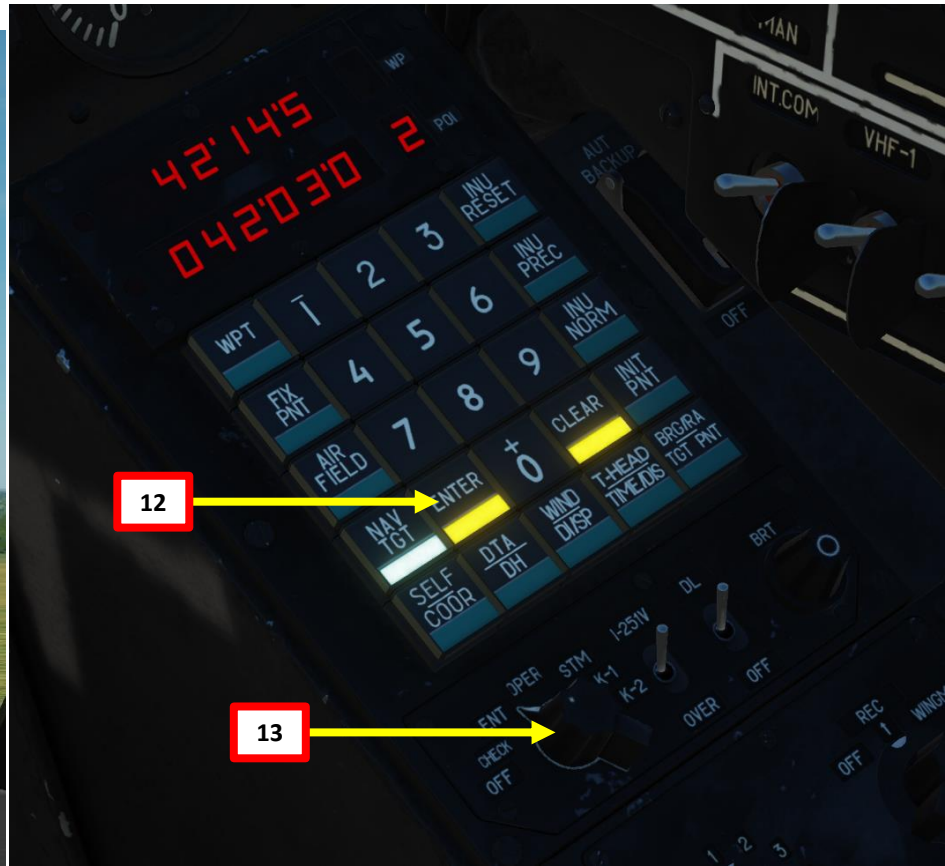
7.1 – TARGET POINT CREATION

7.1.2 – SHKVAL Designation Method

11. Press “Uncage SHKVAL/Designate target” button on the cyclic a second time and the target’s coordinates will appear on the Navigation Control panel display. The “OT” (Target point) symbol will display on the HUD.
12. Press the ENTER button on the Navigation Control panel and the derived coordinates will be entered as the Target Point coordinates in the navigation system. The “OT” (Target point) symbol on the HUD will go out.
13. After creating the Target Point, set the Mode selector dial on the Navigation Control panel to the OPERATE position. Coordinates for the target point are now stored in NAV TGT / Target Point 2.
14. On the Targeting Mode Controls panel, press the “СБРОС” (Targeting mode reset) button.

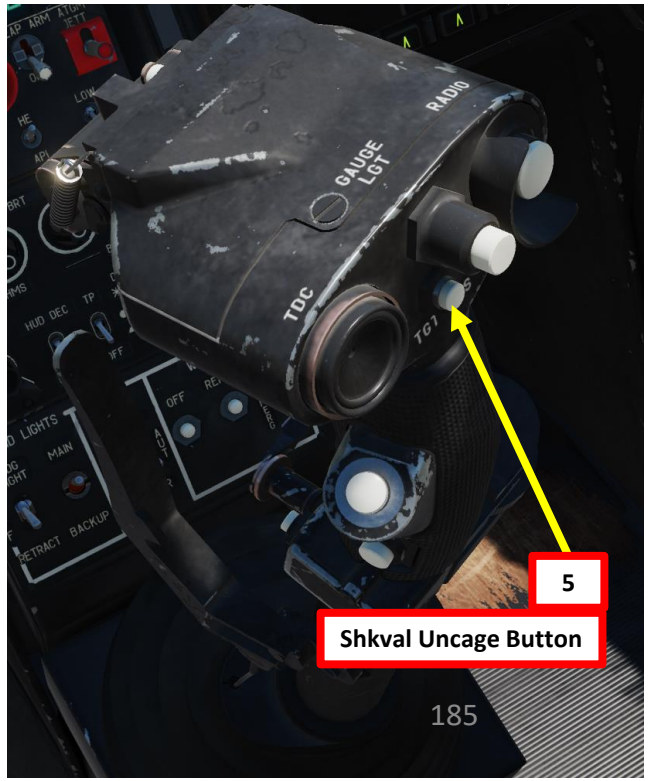






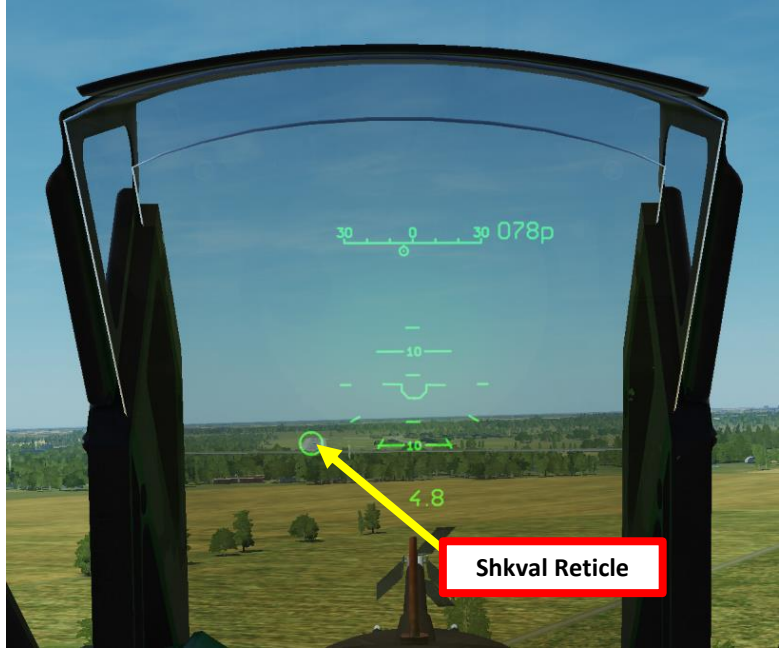
7.2 – USING TARGET POINTS

1. Set the Mode selector dial on the Navigation Control panel to the OPERATE position.
2. On the Targeting Mode Controls panel, press the “СБРОС” (Targeting mode reset) button.
3. Press NAV TGT (Target point) push-light.
4. Select the Target Point number you wish to use from the key pad (1 to 10). We will choose Target Point 2.
5. Press the “Uncage SHKVAL/Designate target” button on the cyclic
6. The SHKVAL will be slaved to the selected Target Point



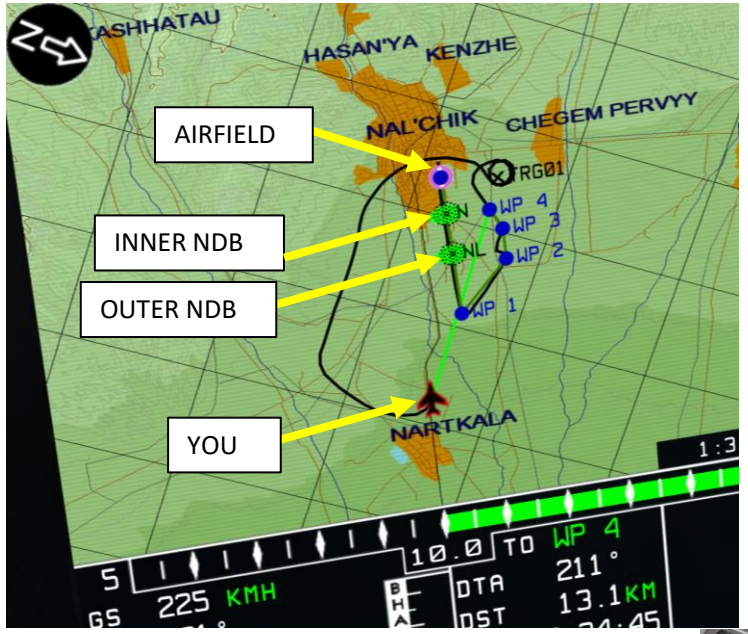
7.2 – USING TARGET POINTS

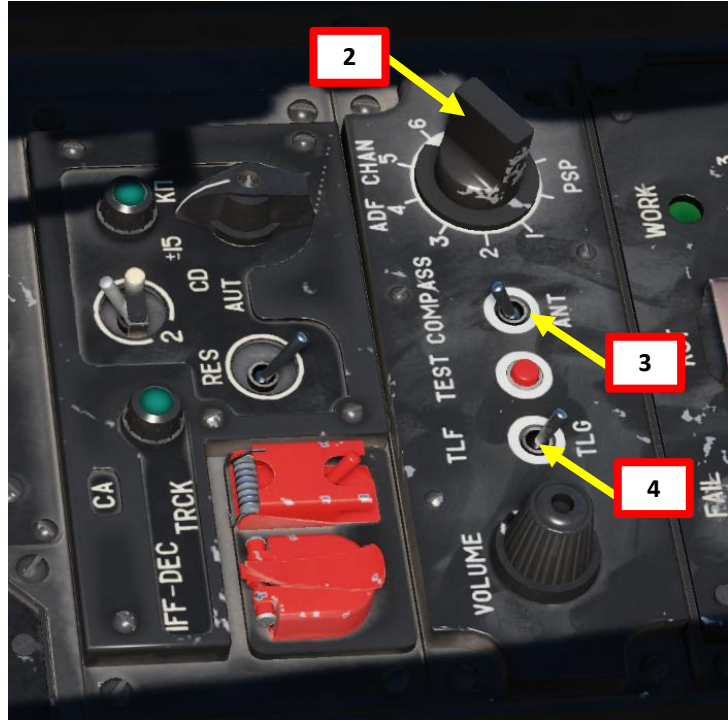
7. The Target Point selected will be visible on the Heads-Up Display, Shkval TV and on the ABRIS NAV page.

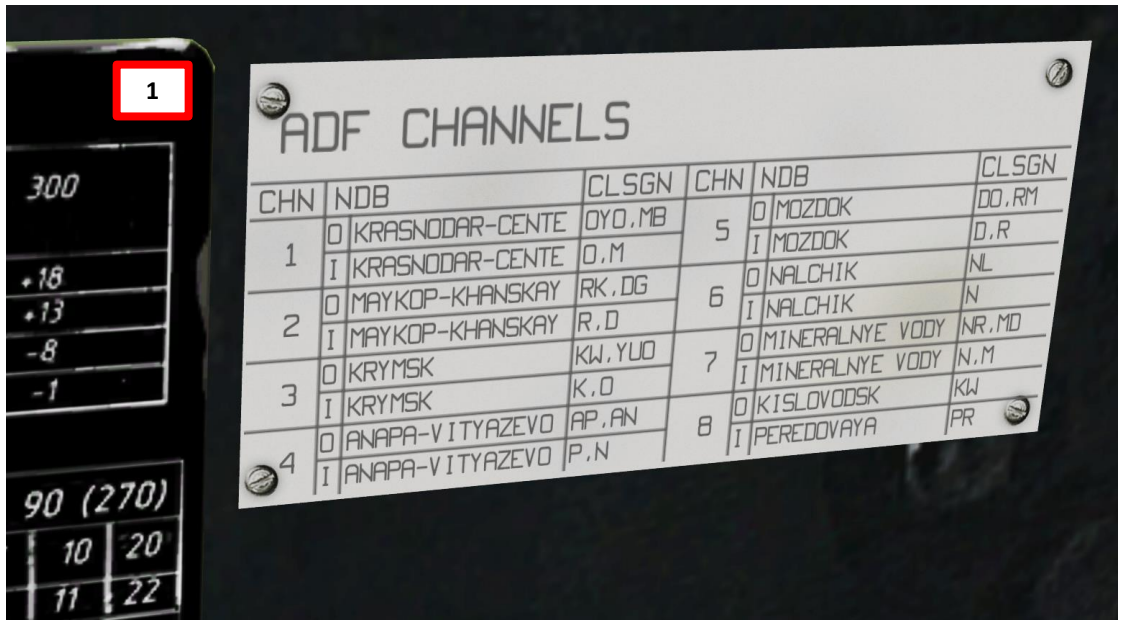


8 – ADF (AUTOMATIC DIRECTION FINDING) NAVIGATION

1. Find which NDB (Non-Directional Beacon) you want to navigate to by consulting the ADF (Automatic Directional Finder) Channels table on the right side of the cockpit. In this example, we will go to NALCHIK's outer NDB on ADF Channel 6, noted "NL" on the ABRIS screen. Take note that Outer NDBs (O) and Inner NDBs (I) are tracked separately.
2. Set desired ADF preset channel ("6" in our case).
3. Set ADF mode to COMPASS. ANTENNA mode can be used to make sure that you track the right NDB by hearing the morse code signal (each NDB has its own code).
4. Set ADF receiver mode to TLG (Telegraph). TLF (Telephony) is not used by any of the NDBs in-game.
5. Select ADF mode: INNER will track the inner NDB, while OUTER will select the outer NDB. "AUTO" will track the closest NDB.

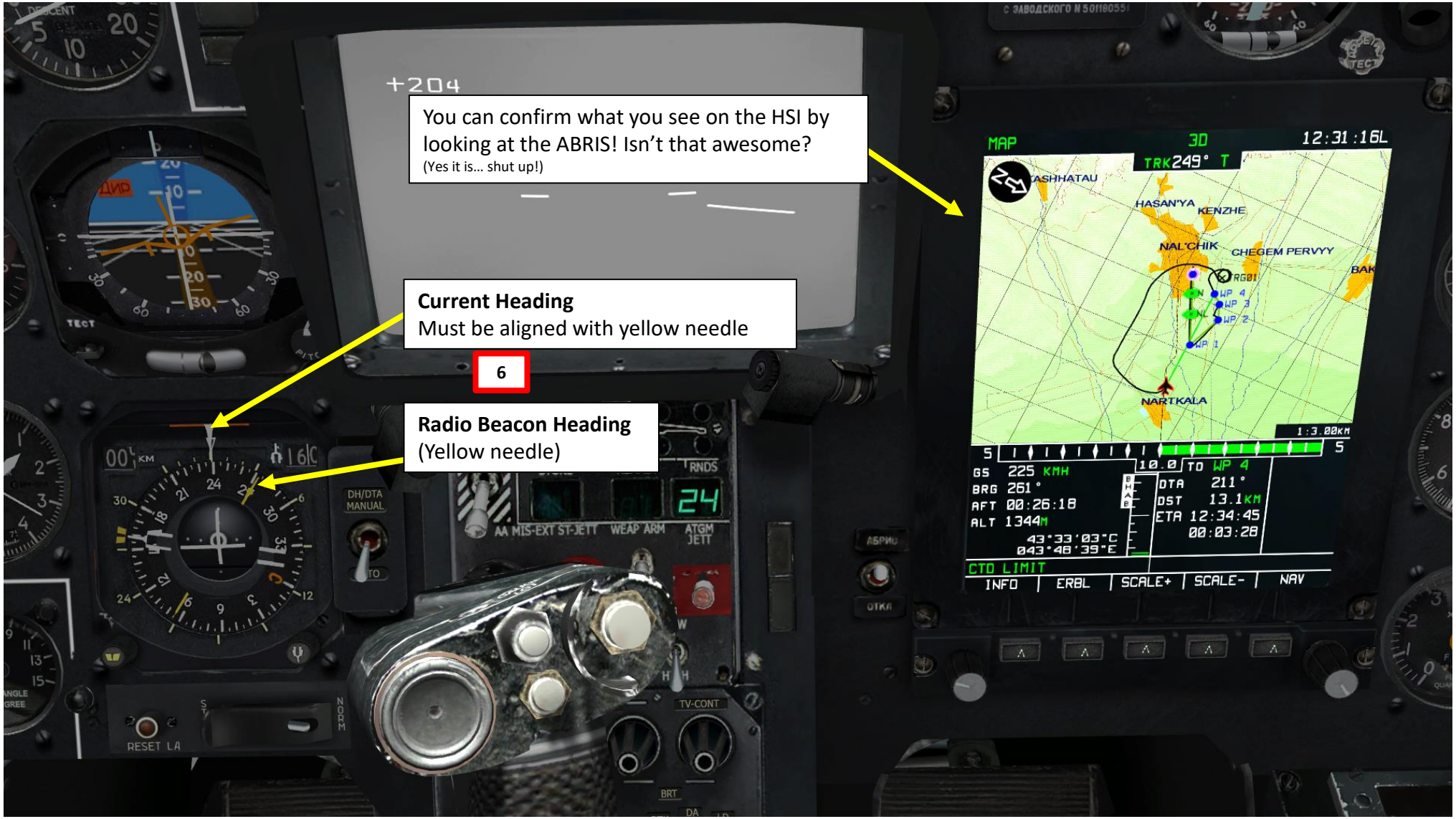






8 – ADF (AUTOMATIC DIRECTION FINDING) NAVIGATION

6. Steer the helicopter manually towards the NDB marker using the HSI (Horizontal Situation Indicator)



AUTOPILOT CHANNELS & CONTROLS

The autopilot has four push-lights that control their respective channels:

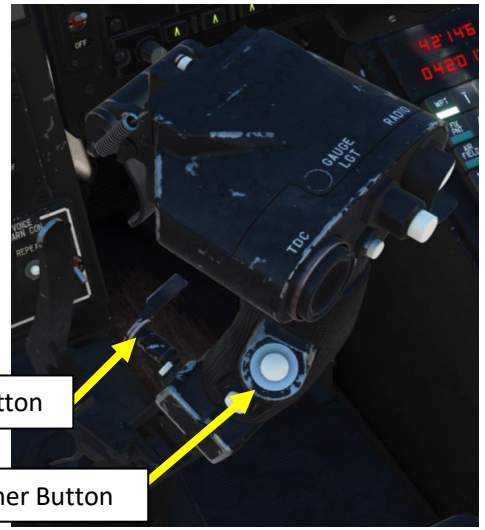
- Bank/Roll
- Pitch
- Heading
- Altitude

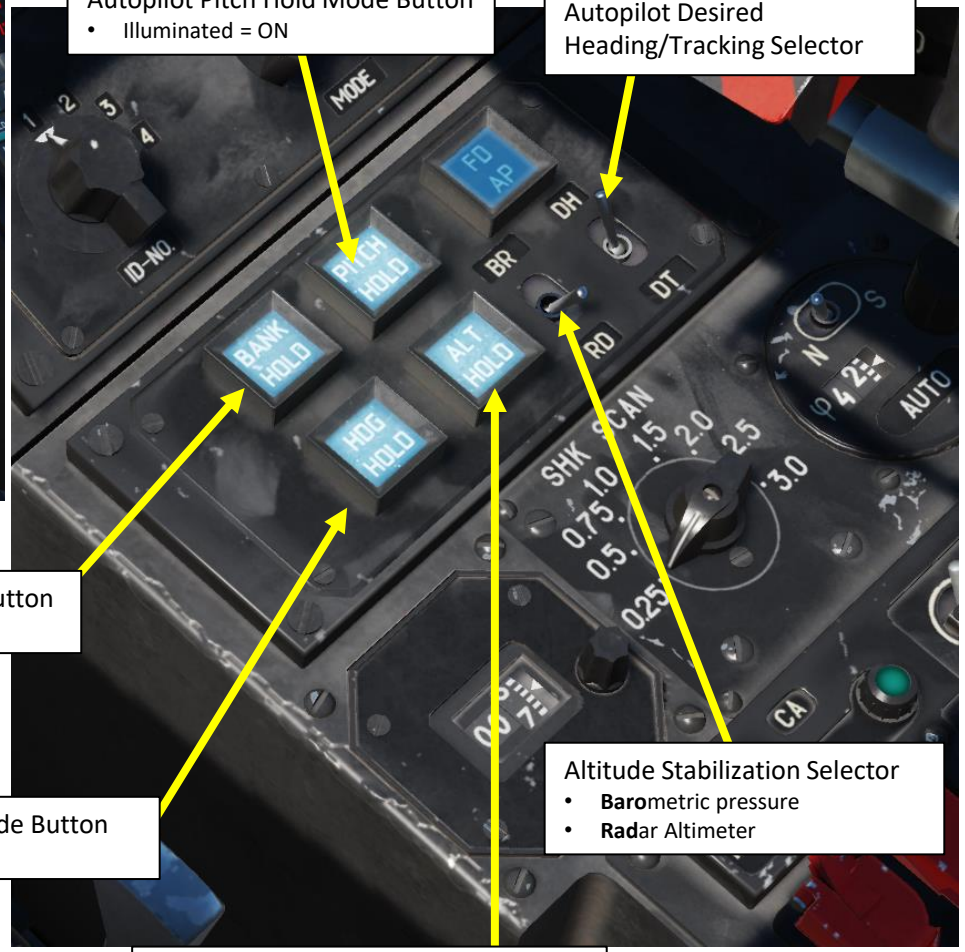
Autopilot modes themselves are selected with the Autopilot Modes Selector Switch on the collective.

The way to use the Trimmer button in conjunction with the autopilot channels:

1. Engage desired autopilot channels (typically you would pick BANK, PITCH and HDG)
2. Press and hold the Trimmer button
3. While maintaining the trimmer button, execute your maneuver
4. One you've reached steady state, let go the trimmer button.
5. The autopilot will attempt to keep the helicopter in the attitude when the trimmer button was released.

This prevents "fighting the Autopilot", reduces exerted force and removes the "sticky" feeling.





Auto-Hover Button

Trimmer Button

Autopilot Pitch Hold Mode Button
- Illuminated = ON

Autopilot Desired Heading/Tracking Selector

Autopilot Bank Hold Mode Button
- Illuminated = ON

Autopilot Heading Hold Mode Button
- Illuminated = ON

Altitude Stabilization Selector
- **Baro**metric pressure
- **Rad**ar Altimeter

Autopilot Modes Selector
- *DESCENT/OFF/ROUTE*

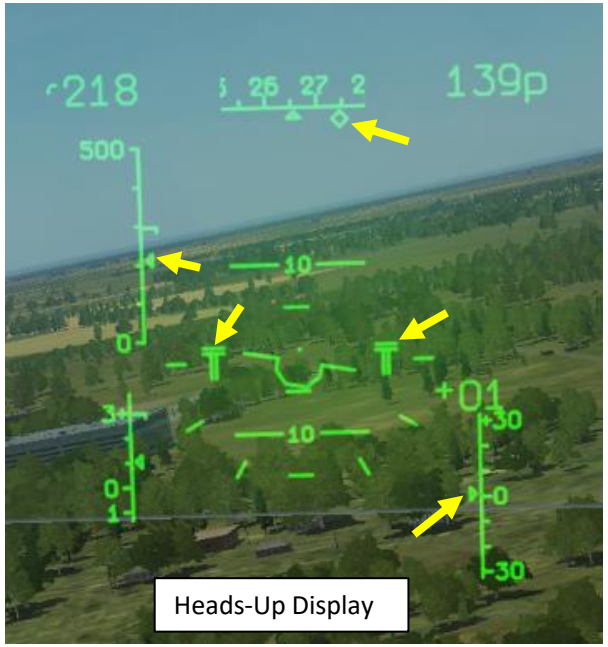
Autopilot Altitude Hold Mode Button
- Illuminated = ON

FLIGHT DIRECTOR

The Flight Director mode gives you steering commands on the Heads-Up Display and ADI (Attitude Director Indicator) in order to follow your selected flight plan / waypoint.

To activate the Flight Director, pre**ss the Autopilot Flight Director Push-Light** (active when illuminated).

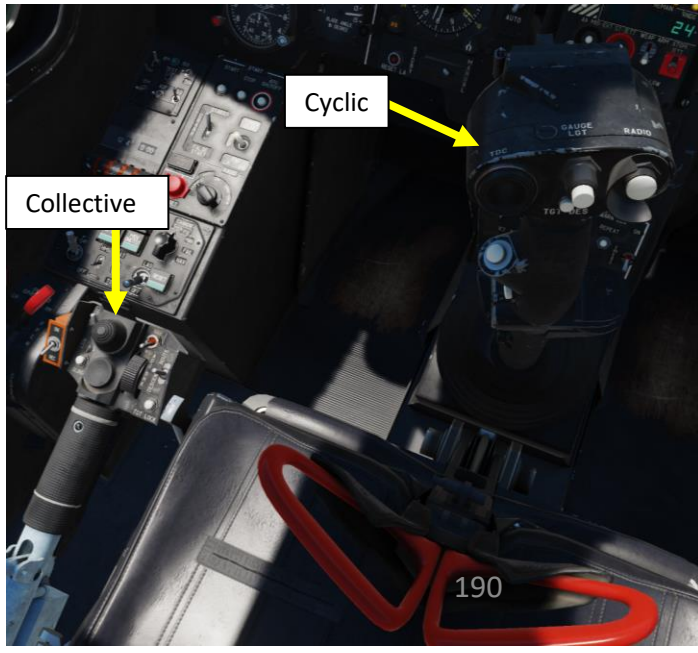
- The desired airspeed is maintained by changing the pitch angle (with cyclic)
- The desired altitude is changed by adjusting engine power (with collective).
- When flying with director control, it is necessary to set the pitch and bank angles with the cyclic in reference to the aircraft datum.
- Use collective pitch adjustments to decrease the altitude director to the minimum. If the altitude director is “increasing” up, it’s necessary to increase the collective pitch; if it’s going down, decrease it.



Heads-Up Display

Autopilot Flight Director Push-Light

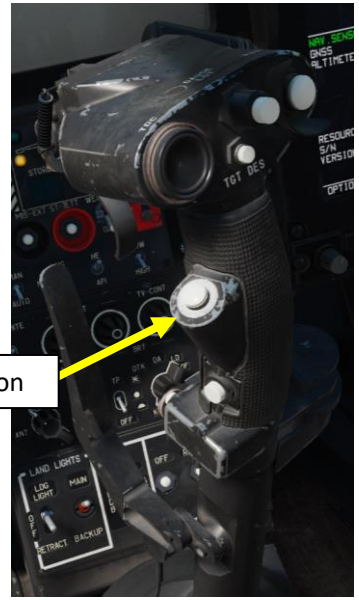
ADI (Attitude Director Indicator)

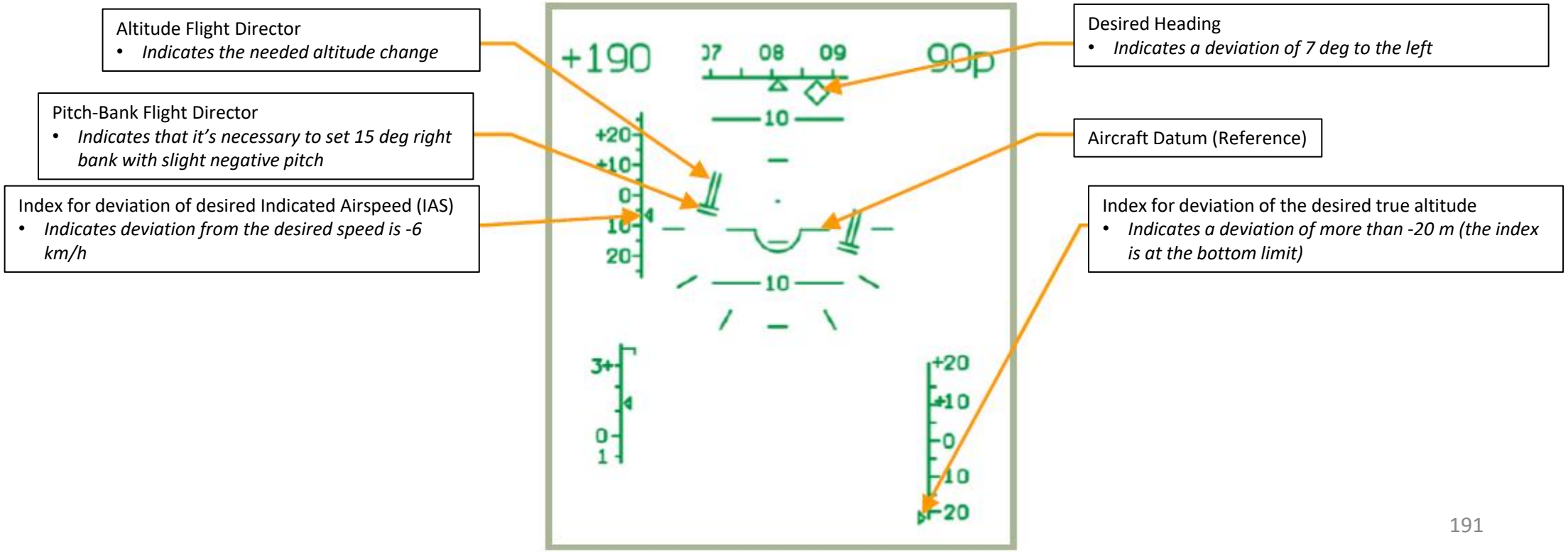


FLIGHT DIRECTOR

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

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





SUMMARY OF AUTOPILOT FUNCTIONS

1 – Route Mode

This mode makes the helicopter follow the active flight plan (series of waypoints).

2 – Hover Mode

To hover automatically over a ground-point after decelerating to near-zero airspeed, you can engage HOVER mode.

3 – Vertical Descent Mode

If while in HOVER mode it is necessary to decrease altitude, you can use the VERTICAL DESCENT mode.

4 – Altitude Hold / Collective Brake

Enables altitude hold. The altitude source depends on the position of the “Baro/Radar Altitude” switch. To change your altitude when in Altitude Hold mode, the collective brake lever is used.

5 – Autopilot Coupling with HMS (Helmet-Mounted Sight)

The AUTO TURN function can make the autopilot turn the helicopter towards a point designated by the HMS (Helmet-Mounted Sight).

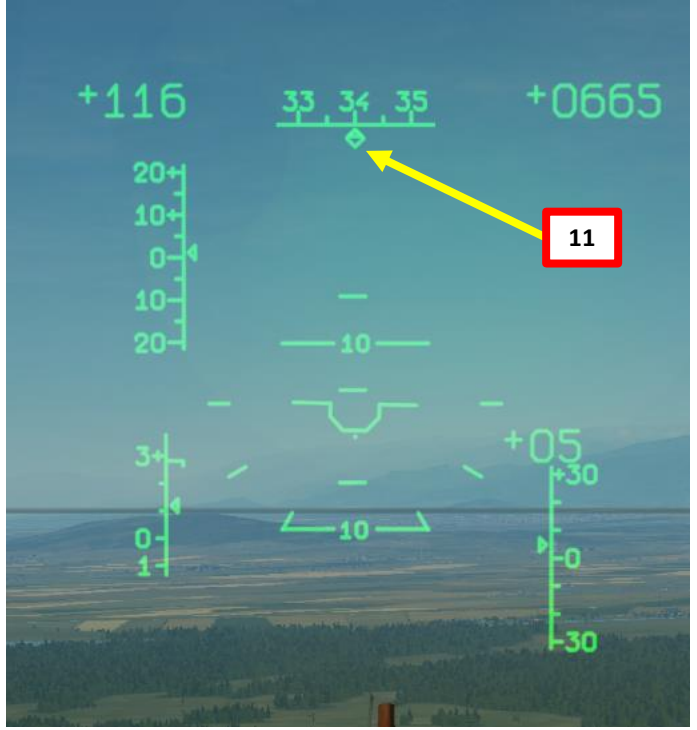
1 – ROUTE MODE

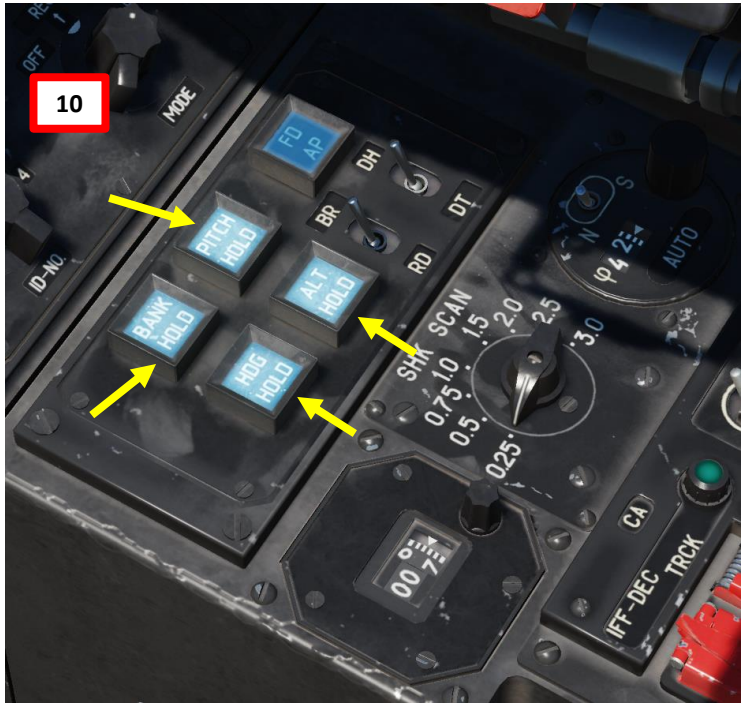
In this example, the autopilot will follow a route already programmed in the PVI-800 (see Navigation Section).

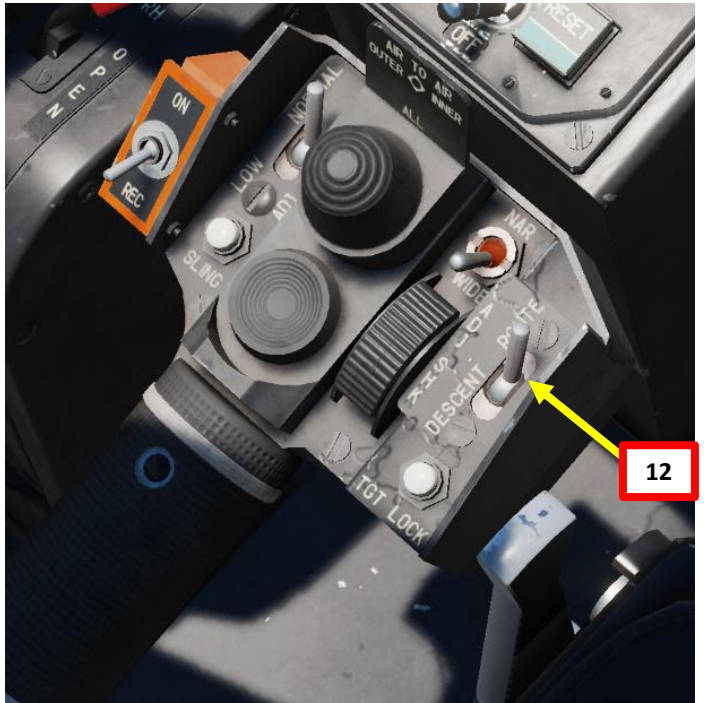
1. Turn on INU system power switch (UP)
2. Set GYRO mode (middle position)
3. Turn PVI-800 system ON (FWD)
4. Set PVI-800 mode to OPER to select a desired waypoint
5. Select desired waypoint type (in our case, we will select WPT to select a waypoint)
6. Select preset waypoint number (in our case we will select Waypoint 2)
7. Set Altitude Stabilization selector to BR (Barometric) if you are flying 300 m or higher. Select RD (Radar Altimeter) if you are flying at 50 m or lower.
    - Using barometric pressure ensures that the altitude is maintained regardless of terrain (but it means you could potentially crash into a hill if you do not watch your altitude).
    - Using radar altitude does not guarantee the helicopter will maintain a constant altitude, but it guarantees the helicopter will maintain a constant height above ground level.
8. Select DH (Desired Heading) if you want the autopilot to steer straight to the waypoint or DT (Desired Tracking) if you prefer the auto-pilot to steer you towards the tracking line to the waypoint.
9. Set DH/DTA to AUTO (DOWN).

1 – ROUTE MODE

10. Push the desired “autopilot” modes to help you during the flight (Bank Hold + Pitch Hold + Heading/Yaw Hold). ALT HOLD can be used if you want to maintain a set altitude. Take note that the “autopilot” are in fact used as “dampers”.
11. Fly towards the waypoint until you have a decent airspeed, press the Trimmer switch to maintain constant airspeed. You can use the HUD heading indicator or the HSI (Horizontal Situation Indicator) to help you. Align yourself at + or – 15 degrees from desired heading.
12. Engage Route Mode on your collective using the “ROUTE/DESCENT” switch (Shortcut: “R” for Route and/or “D” for Descent) to engage autopilot. The switch should be set Forward. The autopilot route mode will steer the helicopter automatically to initiate a turn to the first waypoint with a bank angle up to 15°.







1 – ROUTE MODE

13. The “ENR COURSE” light indicates route navigation with course following is enabled, the “ENR NAV ON” light indicates route navigation with direct flight to steerpoint is enabled, the “NEXT WP” light indicates a notification of passing one waypoint and advancing to the next.
14. Once you have reached a waypoint, the autopilot will automatically steer the helicopter towards the next stocked waypoint on the list.
15. 250 m before the last waypoint saved in the flight plan, the ROUTE END light will illuminate. 2 km after passing the last WP, the ROUTE Mode disengages, the ROUTE END light goes off, and the helicopter stabilizes on its current heading.
16. Disengage Route Mode on collective by pressing “R” to disengage autopilot (“ROUTE/DESCENT” switch should be in middle OFF position).

1 – ROUTE MODE

Note on using Route Mode without having a navigation task selected:

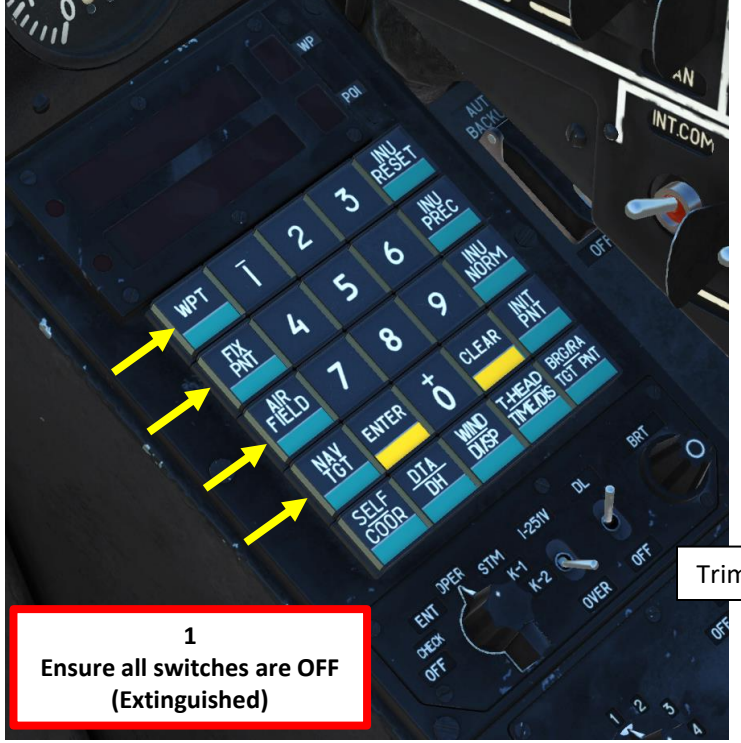
If a navigation task is not selected (meaning that no waypoint, target, or airfield is selected from the Navigation panel) it is possible to engage Route mode to maintain your current flight path. Thus, current flight path parameters like pitch, roll, yaw, and altitude are saved in the navigation system.

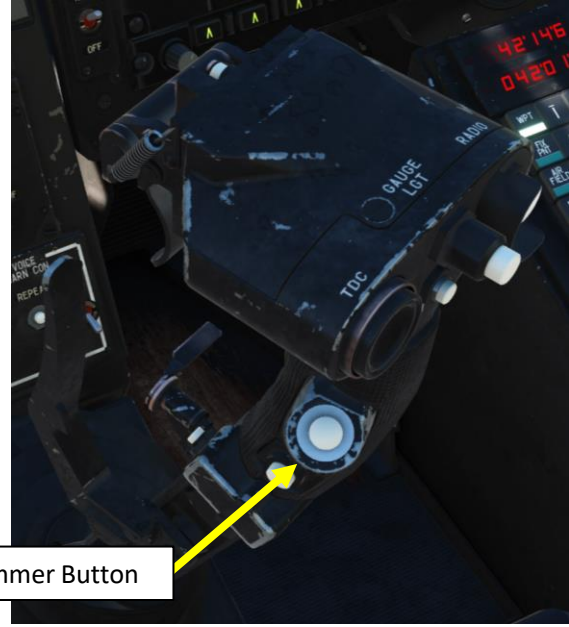
To engage Route mode without a task:

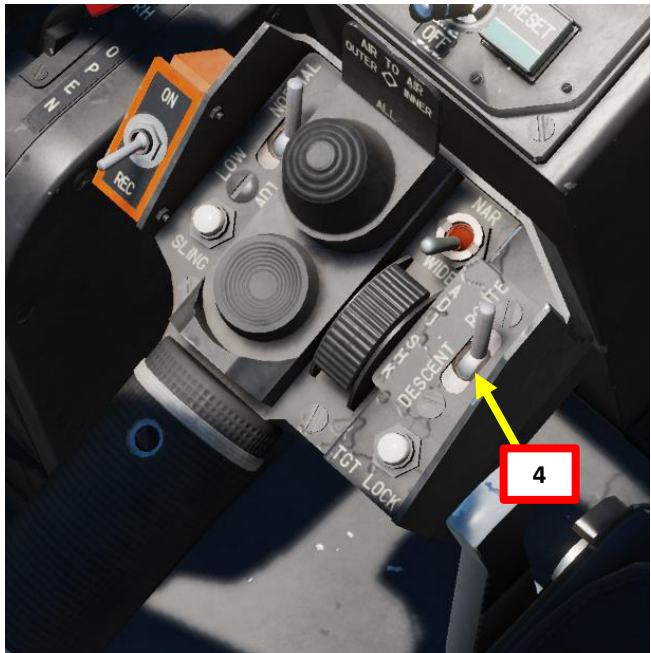
1. Switch off all task buttons on the Navigation panel: Waypoints, Targets, and Airfields.
2. The position of the Desired Heading – Desired Track Angle switch does not influence navigation.
3. Stabilize the helicopter in level flight with the desired speed.
4. Engage ROUTE mode by setting the “ROUTE/DESCENT” switch on the collective to the ROUTE position and the helicopter will hold current flight parameters and bearing.

For changing flight parameters it is necessary to:

a) Press and hold the Trimmer on the cyclic stick.
b) Set new flight input (bearing, pitch and speed).
c) Release the Trimmer button.



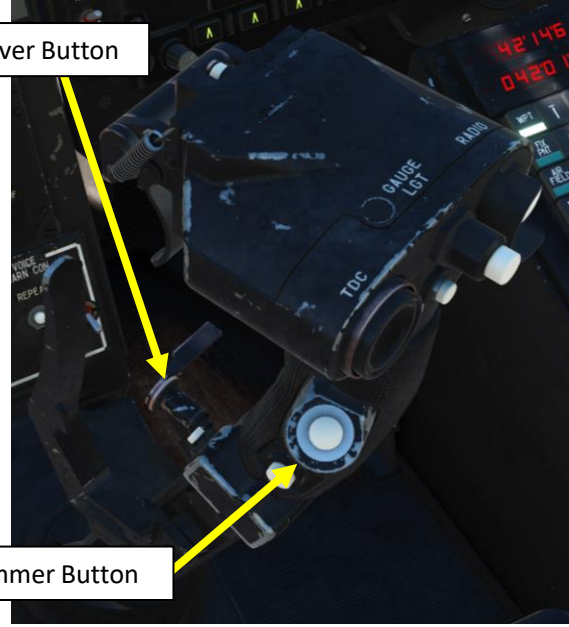


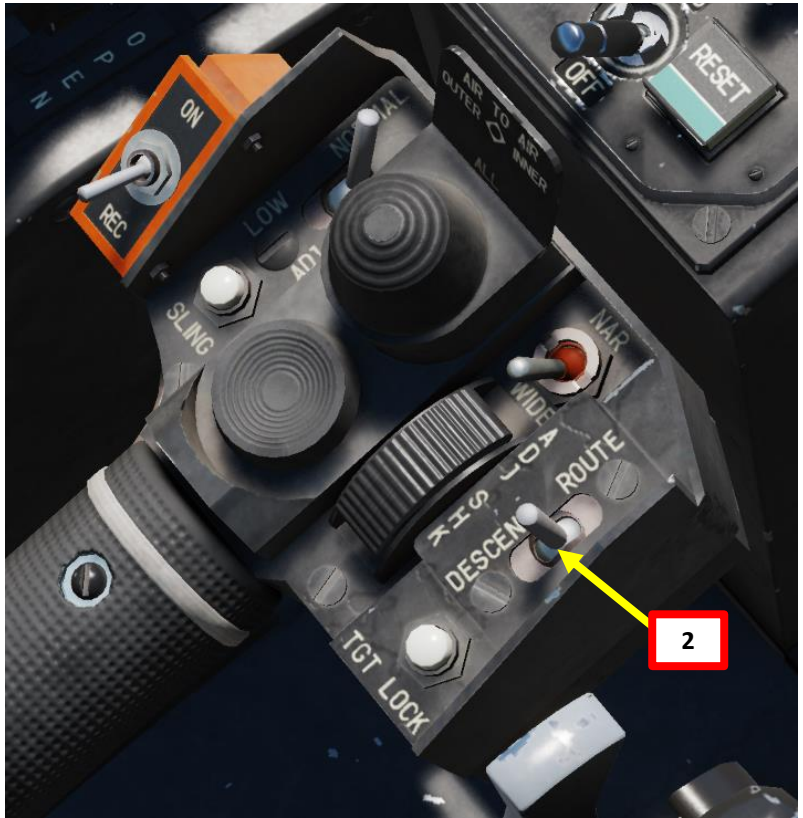


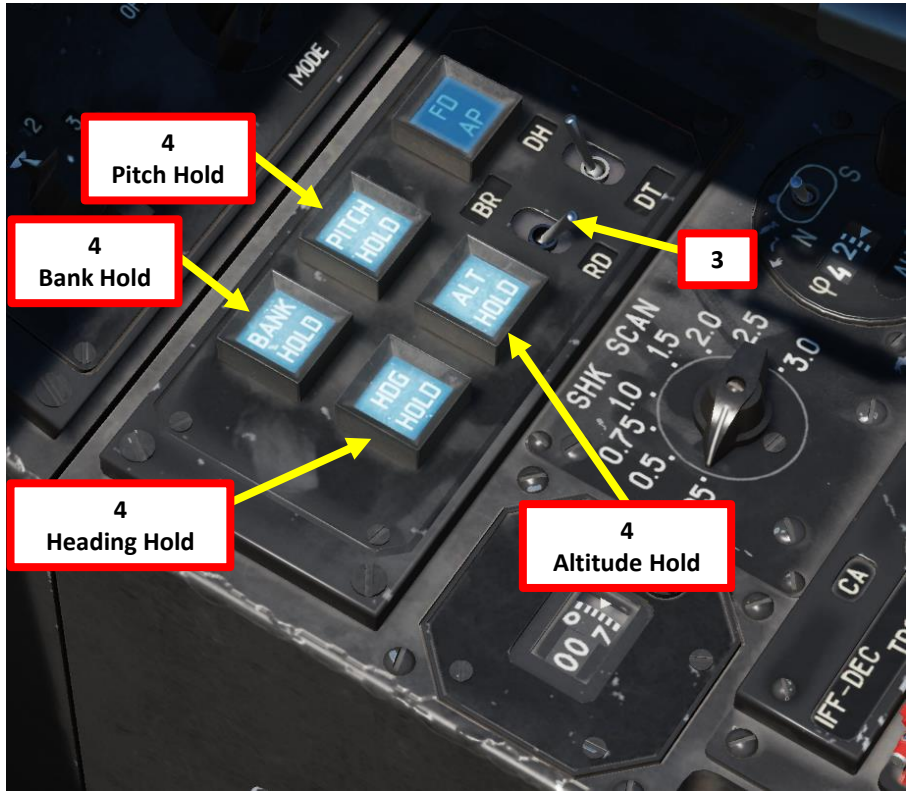
2 – HOVER MODE

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

1. To enter hover mode the aircraft must be travelling at no faster than 25-30 km/h. To lose airspeed pitch the aircraft up 10 degrees and trim the aircraft using the trimmer system ("T" key binding). Control your altitude using the collective as the new pitch will cause the aircraft to start climbing in altitude, keep the aircraft from climbing or from descending faster than 3 m/s.
2. Set the "ROUTE/DESCENT" switch on the collective to the neutral position (OFF).
3. Set Altitude Stabilization selector to RD (Radar Altimeter).
4. Push the desired "autopilot" modes to help you during the flight (Bank Hold + Pitch Hold + Heading/Yaw Hold + Altitude Hold).
5. Press the "HOVER" button on the cyclic and this will illuminate the HOVER light on the overhead panel. The helicopter will then stabilize above the hover point; radar altitude stabilization mode will engage; and the RALT HOLD light will illuminate on the overhead panel.
6. To change aircraft direction, disengage the Heading/Yaw Hold Autopilot Channel, use rudder pedals to steer the aircraft in the desired direction, then engage Heading/Yaw Hold Autopilot Channel again. The new aircraft heading will be used as a reference.
7. To disengage the Hover mode, press the HOVER button on the cyclic again and the HOVER light and all hover indications on the ADI, HSI, and HUD will be removed.





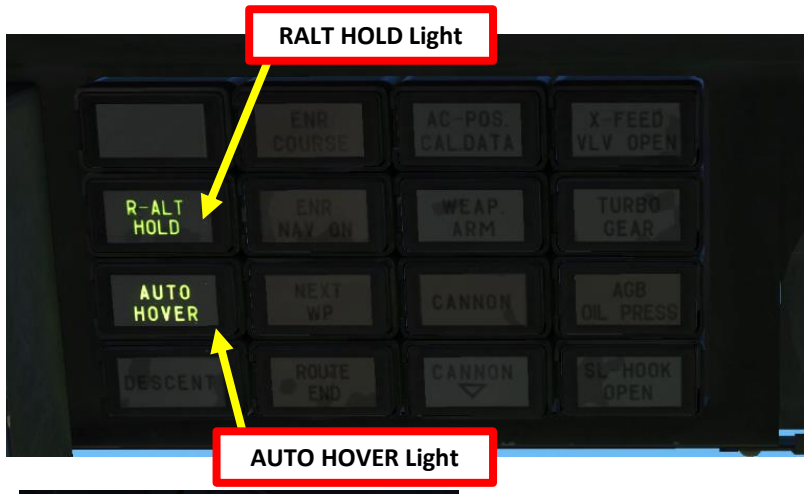


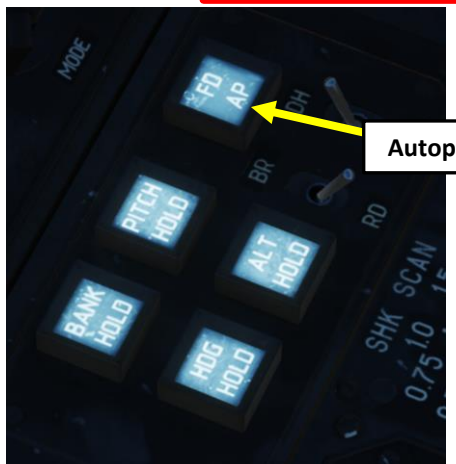
2 – HOVER MODE

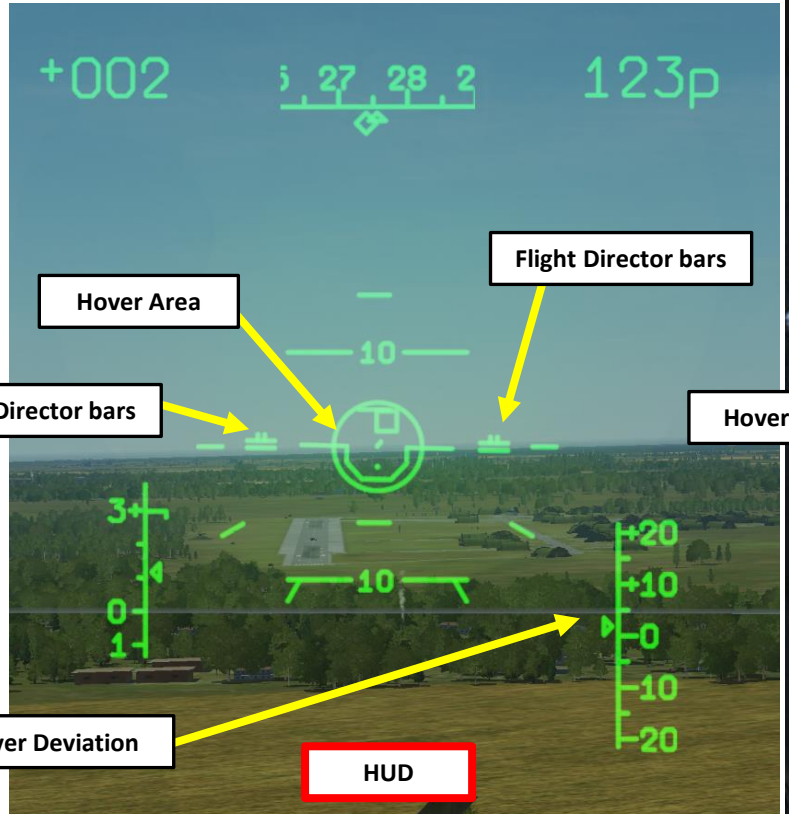
If there is any deviation from the initial hover point, the helicopter will automatically return to its initial position.

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

- On the Attitude and Director Indicator (ADI) – Deviation from the set altitude and lateral position at Hover initiation is indicated by the pitch and bank flight directors.
- On the Horizontal Situation Indicator (HSI) – Longitudinal and lateral deviation from the hover point is indicated.
- On the Heads-Up Display (HUD) – Hover area and hover symbol deviation from the set hover altitude; flight directors for bank, pitch and altitude; commands for return to the desired hover point at the desired altitude, and a ground speed vector in any direction are all provided.
    - Note: The FD AP push-light needs to be active for flight director symbology to be visible on the HUD.



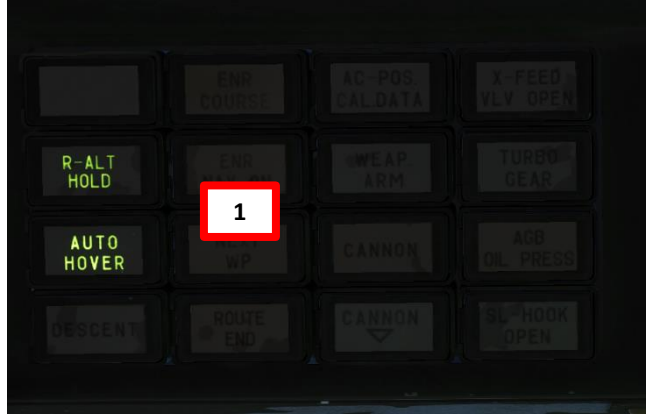


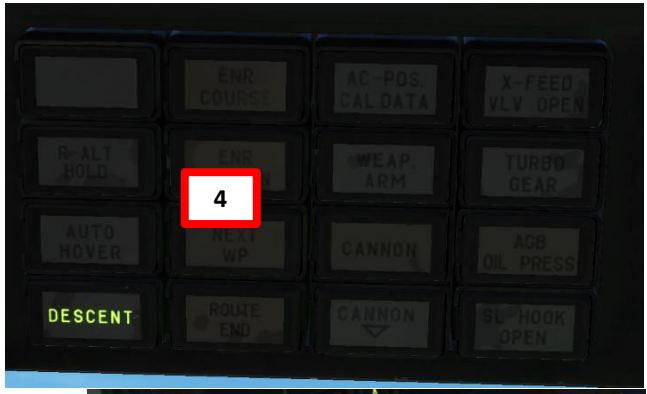


3 – VERTICAL DESCENT MODE

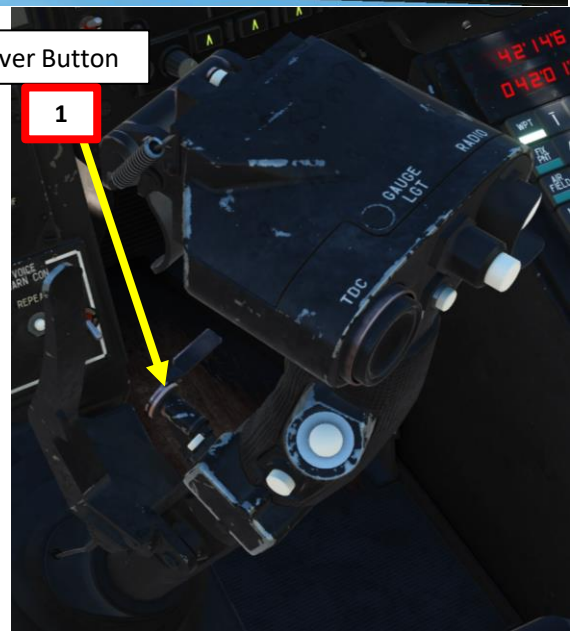
If while in HOVER mode it is necessary to decrease altitude, you can use the VERTICAL DESCENT mode.

1. Settle the aircraft in a hover and engage Auto-Hover has shown previously.
2. Disengage the ALT HOLD autopilot channel.
3. Press and hold the "ROUTE/DESCENT" switch on the collective in the DESCENT position ("D" binding).
4. When this is done, the HOVER light and the RALT HOLD light will go off and the DESCENT light will turn on.
5. The helicopter will initiate a vertical descent with a sink rate of up to 2 m/s while stabilizing its position at the hover point and keeping the hover indication.
6. Upon reaching the desired altitude, set the DESCENT push-button back to neutral and thus cease the descent. The DESCENT light will turn off, the HOVER and RALT HOLD lights will illuminate, and HOVER mode will be implemented at the new altitude.
7. If the push-button is still held in the DESCENT position, the helicopter will descend down to 4 m altitude above ground level; after that the descent is cancelled in order to avoid colliding with the ground.





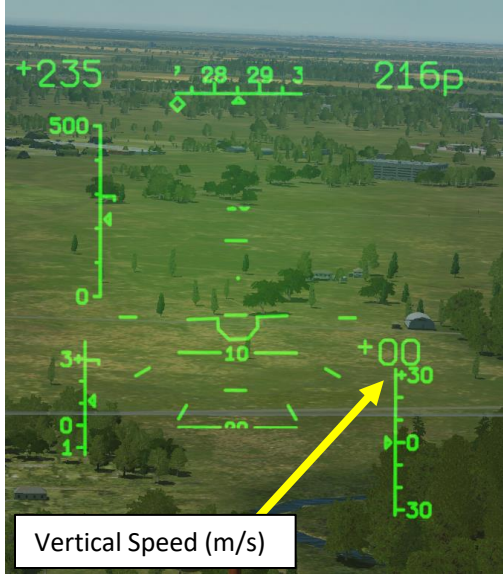
Auto-Hover Button

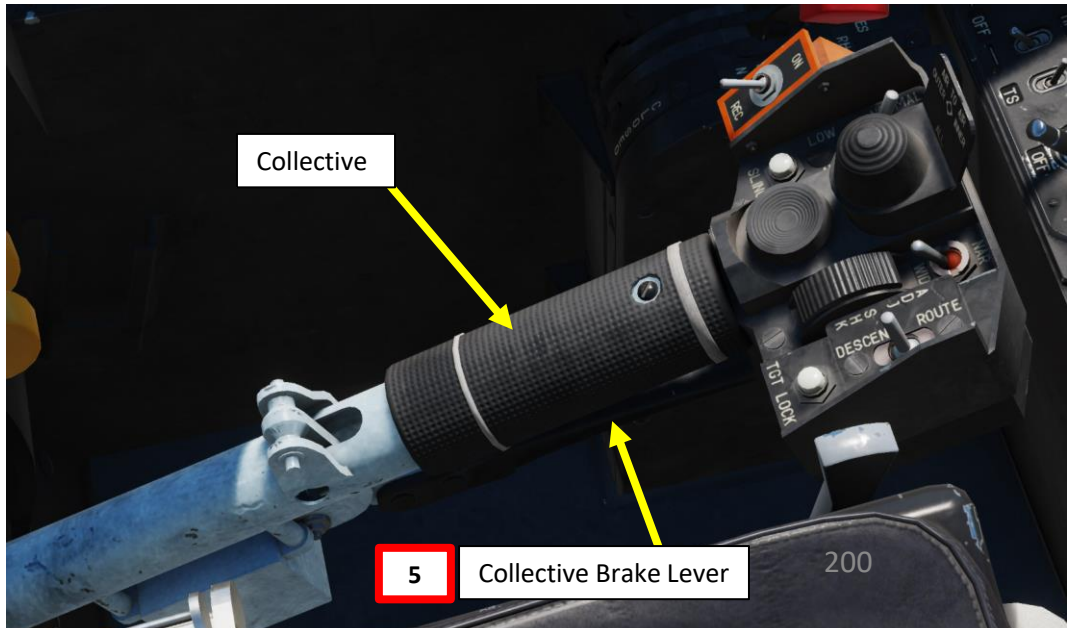


4 – ALTITUDE HOLD / COLLECTIVE BRAKE MODE

The autopilot allows you to hold your current altitude using the "ALT HOLD" button, which maintains the selected altitude at the time of autopilot activation.

1. Set Altitude Stabilization selector to BR (Barometric) if you are flying 300 m or higher. Select RD (Radar Altimeter) if you are flying at 50 m or lower.
   - Using barometric pressure ensures that the altitude is maintained regardless of terrain (but it means you could potentially crash into a hill if you do not watch your altitude).
   - Using radar altitude does not guarantee the helicopter will maintain a constant altitude, but it guarantees the helicopter will maintain a constant height above ground level.
   - The middle position of the BR/RD switch behaves like the last position (BR or RD) which was selected and had an altitude capture event (collective brake squeeze or altitude channel engagement). As an example, if you use RD and switch directly to center position it will act like RD.
2. Fly the helicopter at the desired altitude and reduce vertical speed as much as possible.
3. Press the ALT HOLD push-light. The autopilot will memorize the current altitude reference and try to maintain it based on the Altitude Stabilization mode selected (RD will maintain the height above ground level, which can cause altitude fluctuations in uneven terrain, and BR will use barometric pressure as a reference, which ensures a level flight but does not protect the helicopter from terrain).
4. If RD Altitude Stabilization is selected, the R ALT HOLD light will illuminate.
5. While ALT HOLD is engaged, you can modify the altitude reference by pressing the Collective Brake lever ("F" binding) , moving the collective to reach the new altitude reference, then releasing the collective brake lever.

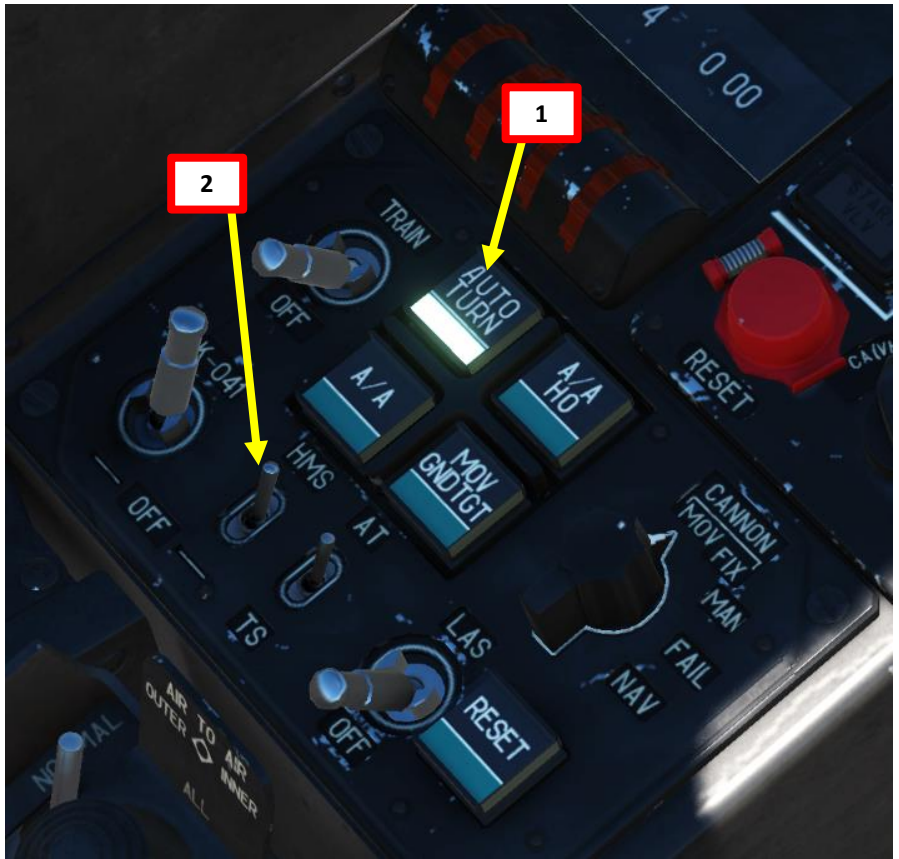


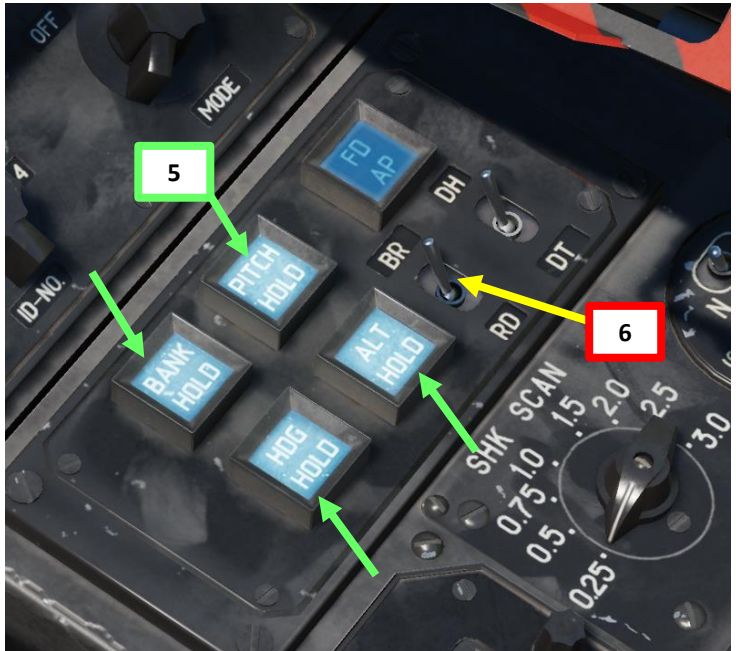


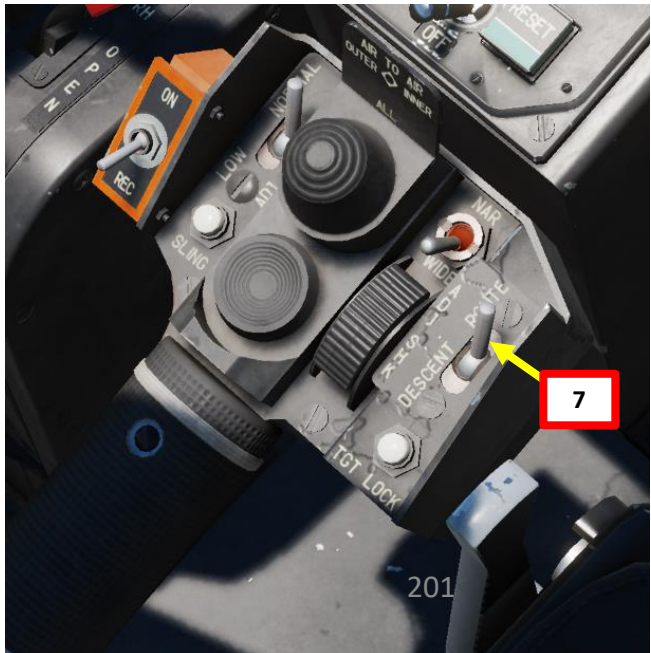
5 – AUTOPILOT COUPLING WITH HMS (HELMET-MOUNTED SIGHT)

The HMS (Helmet-Mounted Sight) can also be used by the autopilot to guide the helicopter.

1. Select “AUTO-TURN” button. This will allow the Ka-50 to automatically face the direction you are aiming with the HMS when Shkval is uncaged.
2. Set HMS (Helmet Mounted Sight) switch ON (FWD).
3. Switch off all task buttons on the Navigation panel: Waypoints, Targets, and Airfields.
4. Stabilize the helicopter in level flight with the desired speed.
5. Push the desired “autopilot” modes to help you during the flight (Bank Hold + Pitch Hold + Heading/Yaw Hold). ALT HOLD can be used if you want to maintain a set altitude. The one essential mode in our case is Heading/Yaw Hold.
6. If you are using the ALT HOLD mode, set Altitude Stabilization selector to BR (Barometric) if you are flying 300 m or higher. Select RD (Radar Altimeter) if you are flying at 50 m or lower.
7. Engage ROUTE mode by setting the “ROUTE/DESCENT” switch on the collective to the ROUTE position and the helicopter will hold current flight parameters and bearing.







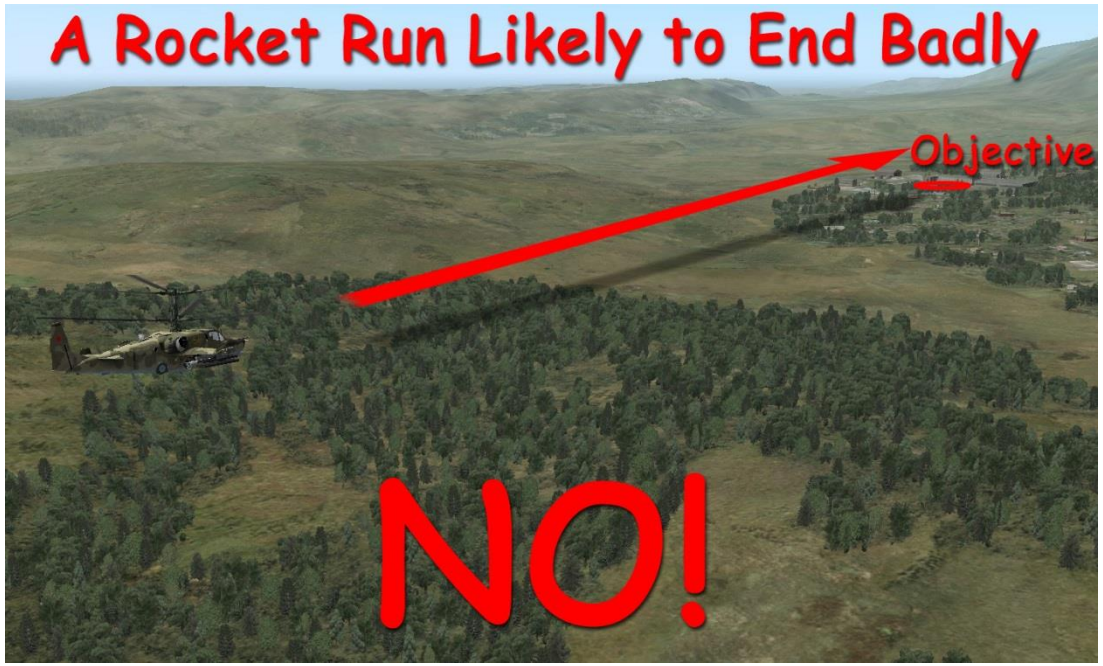
5 – AUTOPILOT COUPLING WITH HMS (HELMET-MOUNTED SIGHT)

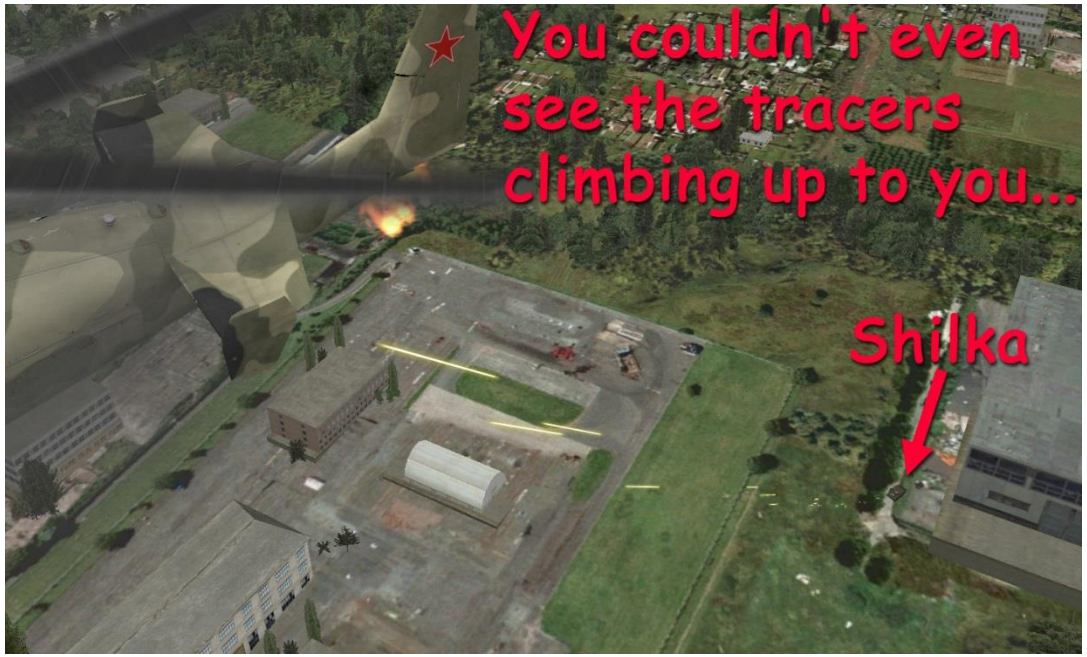
8. Move your head to place the HMS (Helmet Mounted Sight) cross on the point you want to fly to, then uncage SHKVAL by pressing “O” or using custom binding.
9. The autopilot will then steer the helicopter towards the point you just designated with the HMS.

COMBAT – WHAT DO YOU REALLY NEED TO KNOW?

Flying combat operations in the Ka-50 is an art. There are many, many resources at your disposal, but the main one I recommend is the "10 RULES TO LIVE BY: **DCS Black Shark Tactics Primer"** by Realandsimulatedwars. This is top quality, no-nonsense content and very useful.
Link: http://realandsimulatedwars.yolasite.com/dcs-black-shark-tactics-primer.php

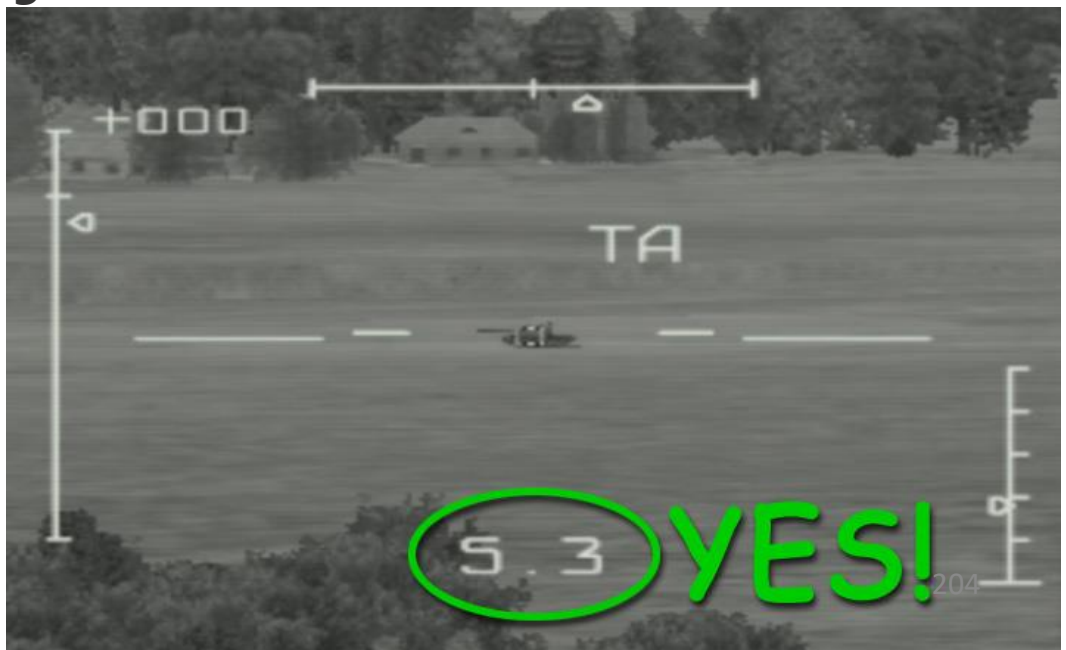
Rule #1: Never fly over the objective



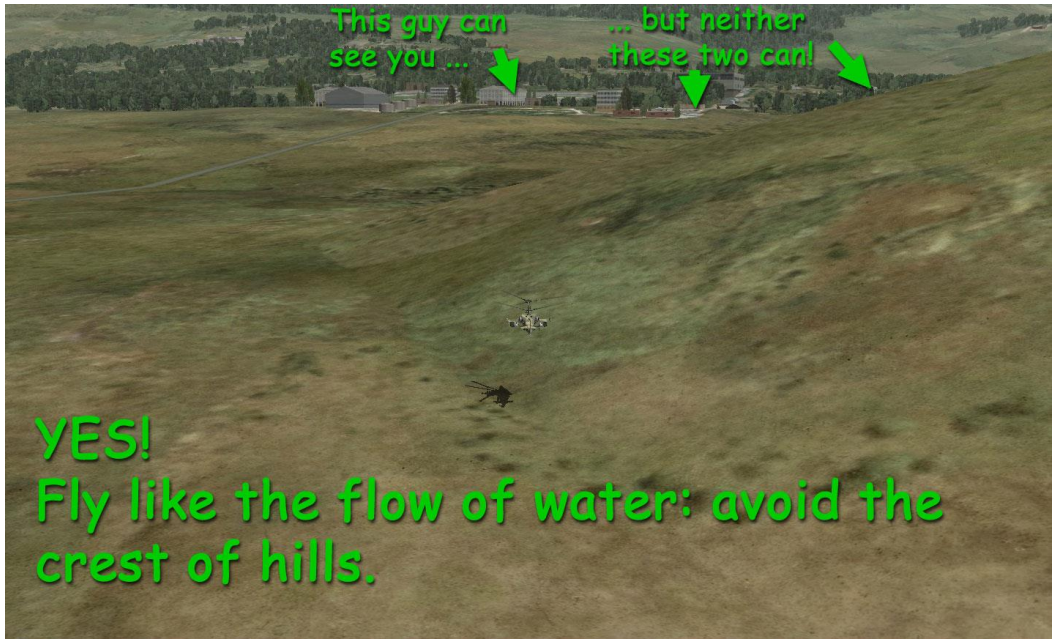


Rule #1: Never fly over the objective (cont'd)

Rule #2: Fire munitions from their maximum range



Rule #3: Avoid the "Dead Man's Zone"



Rule #4: New Area = DANGER ZONE!
Rule #5: There is no such thing as too much reconnaissance
Rule # 6: Identify your targets
Rule #7: Preserve ammunition
Rule #8: Know the operational situation
Rule #9: Attack the enemy from your maximum munition range and on its flanks
Rule #10: Lack of patience will kill you.

There are other great resources such as **KriegSimulation's "Nap-of-the-Earth" article**
http://kriegsimulation.blogspot.ca/2009/10/dcs-black-shark-nap-of-earth-noe-flying.html

Robdcamp's forum thread on SIMHQ is also enlightening to help you survive AAA threats:
http://simhq.com/forum/ubbthreads.php/topics/2915432/Guide_to_Surving_MANPADS_AAA_a.html#Post2915432

OTHER INTERESTING RESOURCES AND USEFUL STUFF

DCS KA-50 BLACK SHARK MANUAL
https://drive.google.com/open?id=0B-uSpZROuEd3TW03aEx3TmpxUnM

FAA HELICOPTER FLYING HANDBOOK
http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/helicopter_flying_handbook/

FAA MANUAL CHAPTER 15: NAVIGATION
http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/media/PHAK%20-%20Chapter%2015.pdf

BLACK SHARK WIKI
http://en.wiki.eagle.ru/wiki/DCS_KA-50_BlackShark_(1/2)_Guides,_Tutorials_and_Reference_Documents

BLACK SHARK PRODUCER'S NOTES (COVER YOUR EYES, 480p RESOLUTION)
https://www.youtube.com/playlist?list=PL0CFA7EA40064EAE4

FROOGLE'S YOUTUBE CHANNEL
https://www.youtube.com/watch?v=nWoad9Qolr4

BUNYAP'S YOUTUBE CHANNEL
https://www.youtube.com/playlist?list=PLoiMNu5jyFzTKgp045y5ibDtS4ST9lz9z

BANJO'S YOUTUBE CHANNEL – SHORT, CONCISE AND MEANINGFUL TUTORIALS FOR THE BLACK SHARK
https://www.youtube.com/playlist?list=PL-rNisMp5bxE2sOzdHPYoezq8zsSG9dr0

TEACH YOURSELF DCS YOUTUBE CHANNEL
https://www.youtube.com/playlist?list=PLpWui61PBlo2_RfPRrWVQk1jtIlBSE-FO

THANK YOU TO ALL MY PATRONS

Creating these guides is no easy task, and I would like to take the time to properly thank every single one of my Patreon supporters. The following people have donated a very generous amount to help me keep supporting existing guides and work on new projects as well:

- Jake Gunter
- Dfpoor
- ChazFlyz

DCS digital combat series

Ka50 BLACK SHARK 2

- INSTANT ACTION
- CREATE FAST MISSION
- TRAINING
- MISSION
- CAMPAIGN
- REPLAY
- MULTIPLAYER
- MISSION EDITOR
- CAMPAIGN BUILDER
- ENCYCLOPEDIA
- OPTIONS
- LOGBOOK
- MODULE MANAGER
- EXIT

A-10C	Bf 109 K-4	C-101EB	CA	F-86F	FC3	Fw 190 D-9	Hawk	Ka-50	Mi-8MTV2	MiG-15bis	MiG-21Bis	P-40F	P-51D	Su-25T	TF-51D	UH-1H
1.2.16	1.2.16 beta	1.2.16.1 Beta	1.2.16	1.2.16 beta	1.2.16	1.2.16	1.2.16 Beta	1.2.16	1.2.16 beta	1.2.16 beta	1.2.15	1.2.16 Beta	1.2.16	1.2.16	1.2.16	1.2.16

THE FIGHTER COLLECTION

Eagle Dynamics

Version: 1.2.16.43180