DCS GUIDE
Mi-24P HIND

By Chuck

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Special thanks to “French Baguette” for providing valuable help with research and to Paul "Goldwolf" Whittingham for creating the guide icons.

There is something special about helicopters. I don't know if it's the thrill of taming a new wild beast, or the sense of awe when a flight of them flies low enough to mow someone's lawn… but I get incredibly excited whenever I hear a developer is working on a simulation of a rotorcraft. This time, we're in for a treat.

Few helicopters are as iconic and unique as the **Mil Mi-24** (Russian: Миль Ми-24). NATO codenamed it the "Hind", the media dubbed it the "Crocodile", Mujahideens nicknamed it "Satan's Chariot", DCS BLUFOR players call it "Not-an-Apache"… but Russian pilots call their flying tank none of those things. They simply call it… "Mi-24".

During the early 1960s, the Cold War was rapidly escalating between the USSR and NATO. As the United States became involved in the Vietnam war, soviet observers reported how helicopters became an integral part of a modern, highly mobile army. It became apparent to Soviet designer Mikhail Mil that the trend towards ever-increasing battlefield mobility would result in the creation of flying infantry fighting vehicles (IFV), which could be used to perform both fire support and infantry transport missions, which were traditionally separate roles.

The first expression of this concept was a mock-up unveiled in 1966 in the experimental shop of the Ministry of Aircraft's factory number 329, where Mil was head designer. The mock-up designated V-24 was based on another project, the V-22 utility helicopter (which never flew). The V-24 had an uncommon design: a central infantry compartment that could hold eight troops sitting back to back, and a set of small wings positioned to the top rear of the passenger cabin, capable of holding up to six missiles or rockets and a twin-barreled GSh-23L cannon fixed to the landing skid.

Mil proposed the design to the heads of the Soviet armed forces. He was opposed by several more senior members of the armed forces, who believed that conventional weapons were a better use of resources. However, he had the support of a number of strategists who saw potential in the idea. Despite the opposition, Mil managed to persuade the defence minister's first deputy Marshal Andrey A. Grechko to convene an expert panel to look into the matter. The panel's opinions were mixed, but eventually a request for design proposals for a battlefield support helicopter was issued. The development and use of gunships and attack helicopters by the US Army during the Vietnam War convinced the Soviets of the advantages of armed helicopter ground support, and fostered support for the development of the Mi-24.

Mikhail Leontyevich Mil
Михаи́л Лео́нтьевич Миль
(1909-1970)

The first iteration of the Mi-24’s design was heavily inspired by the Mi-8 and Mi-14 in order to accelerate development time and minimize costs. This meant that many components were re-used from other helicopters (which created lots of headaches in the integration phase), range-finders and even aiming sights taken from amphibious armored scout cars like the ASP-17. The engines were almost identical to the Klimov/Isotov TV3-117s powering the Mi-8.

The V-24 (which eventually became the Mi-24A) had the Pilot and Co-Pilot sit in a green-house style canopy, which created a number of problems. Eventually, design changes were made, changing the seat configuration with the Co-Pilot/Gunner at the front and the Pilot-Commander at the rear, which provided much better visibility. The wings were also redesigned with an anhedral angle to provide better lateral stability at high speeds. One of the great engineering challenges was to integrate the 9K114 “Shturm” (AT-6 “Spiral”) missile system with the helicopter, which had to be guided with a periscope from the co-pilot/gunner’s seat. The 23 mm cannon was eventually changed with a flexible rapid-fire heavy machine gun mounted in a chin turret. The story of the Mi-24’s design alone is fascinating.

A number of variants brought improvements to the **Mi-24** and **Mi-24A**. The **Mi-24D (Hind D)** was designed to be a more pure gunship than the earlier variants and entered production in 1973. The Mi-24D has a redesigned forward fuselage, with two separate cockpits for the pilot and gunner. It is armed with a single 12.7 mm four-barrel Yak-B machine-gun under the nose. It can also carry four 57 mm rocket pods, four SACLOS 9M17 Phalanga anti-tank missiles (a significant enhancement compared to the MCLOS system found on the Mi-24A). The **Mi-24V (Hind E)** entered production in 1976 and was one of the most widely produced variants. It was armed with a chin flexible turret and the more advanced 9M114 Shturm (AT-6 Spiral). Eight of these missiles are mounted on four outer wing pylons. The **Mi-35** became the export version of the Mi-24V. The **Mi-24P (Hind F)** is an improved gunship version, which replaced the 12.7 mm flexible machine-gun turret with a fixed side-mounted 30mm GSh-30-2K twin-barrel autocannon… which is the one we have in DCS. There are plenty of other variants, but I’ll let you do some research on your own.

The Mi-24 fuselage is armored and can resist impacts from 12.7 mm (0.50 in) rounds from all angles. The titanium rotor blades are resistant to 12.7 mm rounds. The cockpit is protected by ballistic-resistant windscreens and a titanium-armored tub. The cockpit and crew compartment are pressurized to protect the crew in NBC (Nuclear, Biological and Chemical Warfare) conditions… which is a very rare feature for a helicopter. You will even find in the front seat a radiation dosimeter; don’t spend too much time counting those Roentgens!

Mi-24A Variant

The Mi-24 was operated extensively during the Soviet–Afghan War, mainly against Mujahideen fighters. Despite being theoretically able to carry 8 passengers, the troop transport role was given to the Mi-8 instead. Operating at high altitudes in the mountains proved to significantly reduce available engine power and any excess weight was detrimental to the survival chances of the crew. Mi-24 pilots preferred being lighter and not having to carry passengers (including the third crew member, the Flight Engineer) in order to stay more agile and manoeuverable. Therefore, the Hind became used primarily as an attack helicopter. Flights flew mostly in pairs and were sent on hunter-killer missions, escort missions or fire support missions.

Despite facing strong resistance from Afghan rebels, the Mi-24 proved to be very destructive and was popular with Soviet ground troops since it could stay on the battlefield and provide fire support as needed, while fast movers (strike jets) could only stay for a short time before heading back to base to refuel. The Mi-24's favored munition was the 80 mm S-8 rocket, the 57 mm S-5 having proven too light to be effective. Extra rounds of rocket ammunition were often carried internally so that the crew could land and self-reload in the field. The armored fuselage was quite effective at protecting the rotorcraft’s crew against small arms fire… but the Mi-24 was not indestructible by any means. The environment itself, dusty and often hot, was rough on the machines; dusty conditions led to the development of the PZU air intake filters.

Initially, the attack doctrine of the Mi-24 was to approach its target from high altitude and dive downwards. When the U.S. supplied heat-seeking Stinger missiles to the Mujahideen, the Soviet Mi-8 and Mi-24 helicopters proved to be high value targets for the rebels. Flying through the Afghanistan valleys became a dilemma for pilots, as flying high left them vulnerable against IR-seeking missiles while flying low left them vulnerable against ground fire. The doctrine changed to "nap of the earth" flying, where pilots approached very low to the ground and engaged more laterally, popping up to only about 60 m (200 ft) in order to aim rockets or cannons. Flares and missile warning systems would be installed on all Soviet Mil Mi-2, Mi-8, and Mi-24 helicopters, giving pilots a chance to evade missiles fired at them. Infrared suppression devices were also fitted on engine exhausts to decrease the Mi-24's heat signature. Tactical and doctrinal changes were introduced to make it harder for the Afghan rebels to deploy these weapons effectively. These reduced the Stinger threat, but did not eliminate it.

Mi-24s were also used to shield jet transports flying in and out of Kabul from Stingers. The gunships carried flares to blind the heat-seeking missiles. The crews called themselves "Mandatory Matrosovs", after a Soviet soldier of World War II who threw himself across a German machine gun to let his comrades break through.

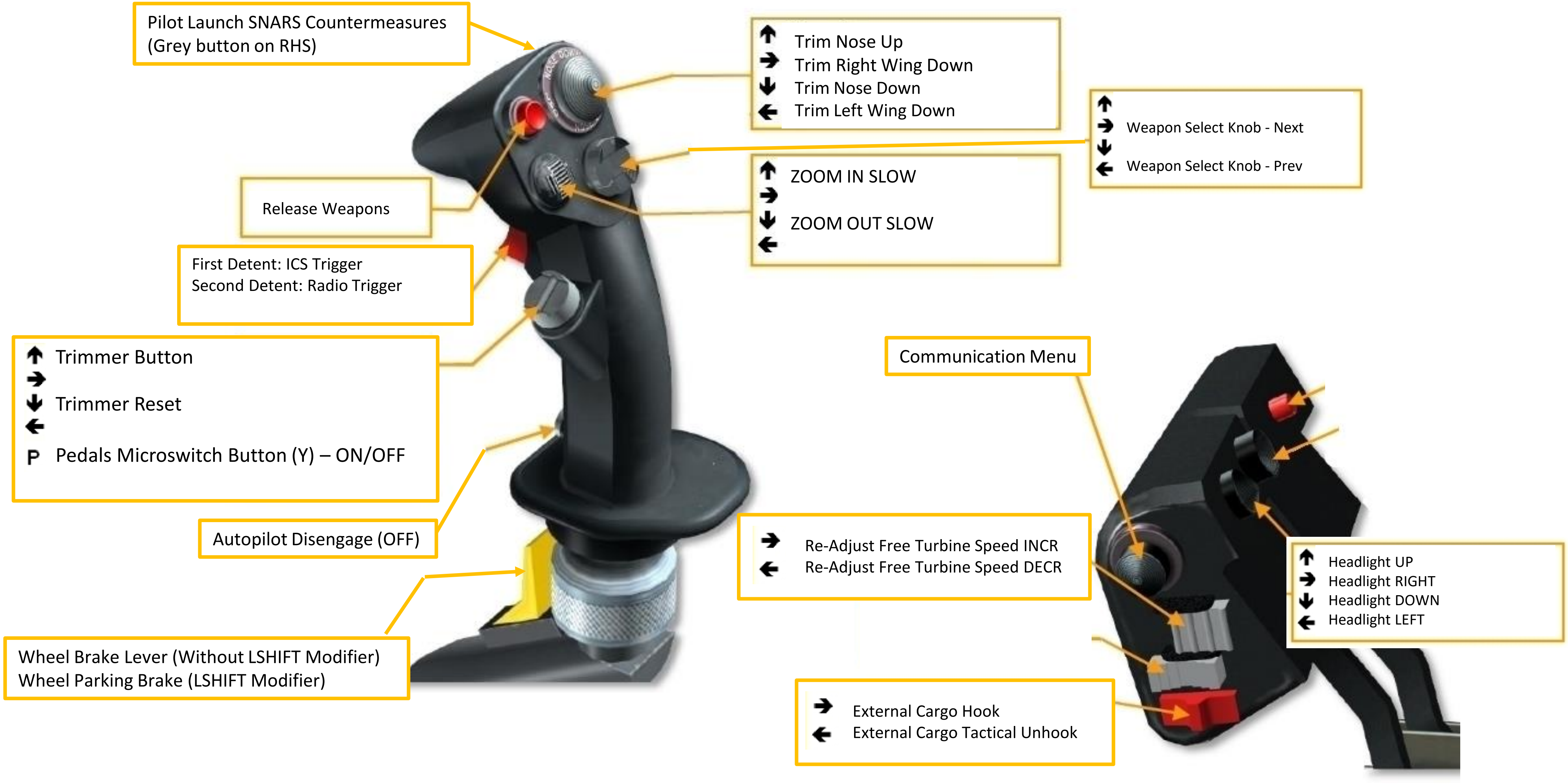
Flying the Hind is a strange feeling. Its cockpit is remarkably roomy, and there is a certain sense of safety behind all that armor. You can take remarkable amounts of punishment from small arms fire, but this false sense of security quickly vanishes once you start dodging high caliber rounds or IR missiles. You will command a helicopter that is meant to be flown fast and aggressively. This isn’t your average attack helicopter that hides behind trees to lob long-range missiles; it’s a ship that’s flown using pop-up attack profiles, wreak havoc and get the hell out before the opposition has any chance to react.

A well-trained Mi-24’s crew can perform wonders if communicating efficiently and working together. Don’t let the analog “steam” gauges or the weird-looking periscope fool you; you will have a very capable machine within your hands. All you need to do is fly it for missions it was meant to perform with air cover to keep the skies clear.

Needless to say, the story of the Mi-24 is a crazy tale of ingenuity and derring-do. It’s an unconventional machine that ended up being widely exported due to its affordable cost, rugged construction, predictable handling, smart design decisions and excellent performance. Its adversaries feared it, and rightfully so. The Mi-24 is a rotary monster packed with unreasonable amounts of dakka… and it is in my humble opinion a solid addition to DCS World.

I hope you enjoy reading this guide. Taming this russian bird is no easy task… but that exhilarating moment when you laugh like a lunatic after a successful attack run is worth the effort. Get your thinking cap on and let’s learn this flying murder bus together.

Pilot-Commander Controls



Pilot-Commander Controls

BIND THE FOLLOWING AXES:

MI-24P PILOT MENU:

- CYCLIC PITCH (DEADZONE AT 3, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 0)
- CYCLIC ROLL (DEADZONE AT 3, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 0)
- RUDDER/ANTI-TORQUE (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 0)
- COLLECTIVE (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 0)
- THROTTLE (COLLECTIVE) – CONTROLS ENGINE RPM

NOTES ABOUT CONTROLS

If you are more familiar with airplanes than 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. Anti-torque 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. Anti-torque pedals are used to modify your tail rotor's propeller pitch: the amount of lateral thrust generated by your rotor is in direct relationship with the horizontal/lateral orientation of your helicopter. 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.

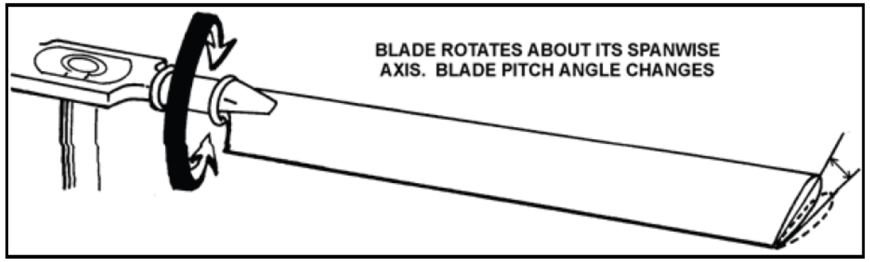
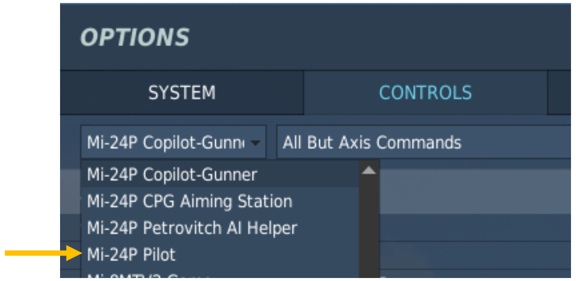
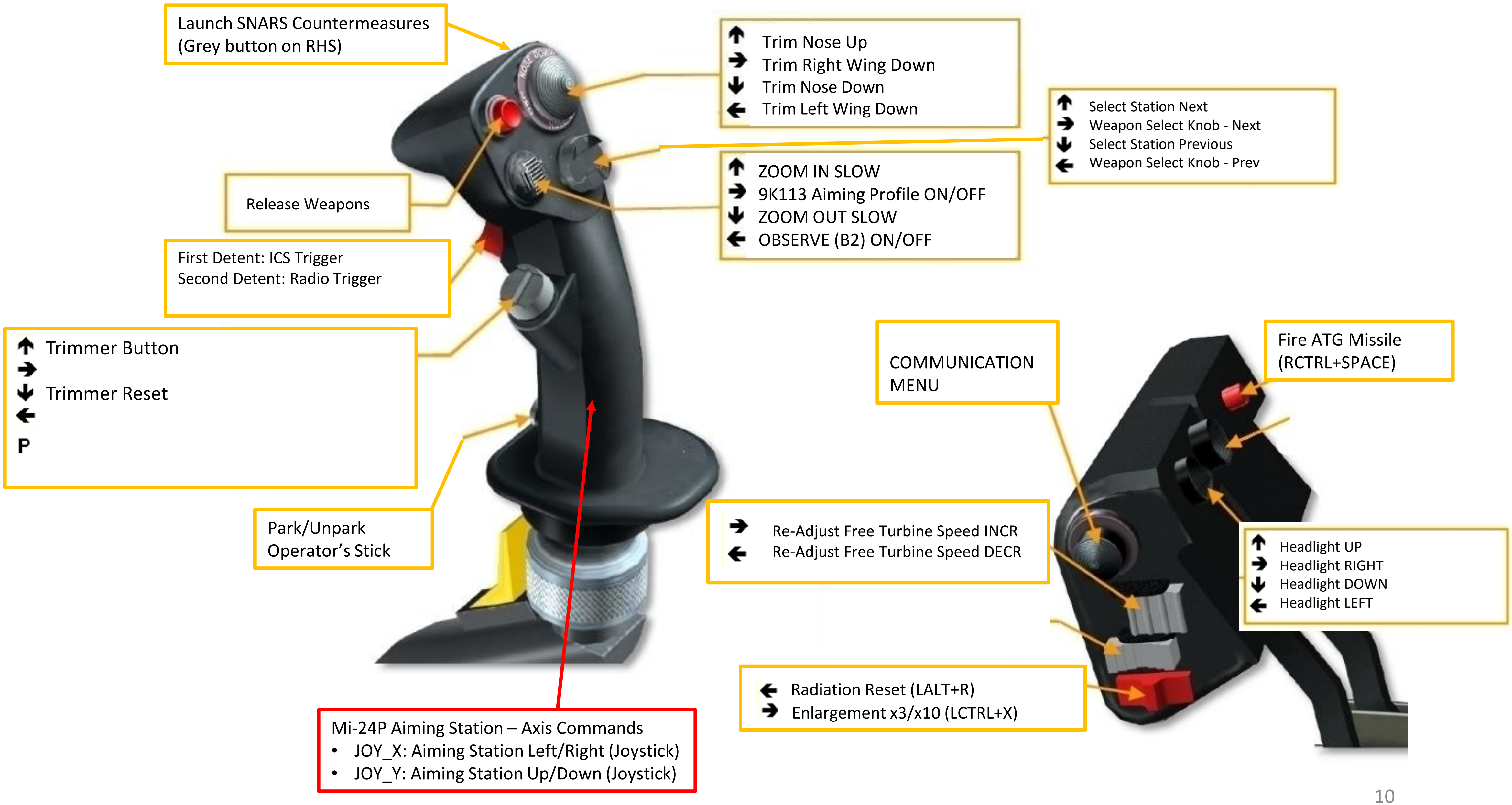


Figure 1-17. Feathering



Co-Pilot/Gunner Controls



Co-Pilot/Gunner Controls

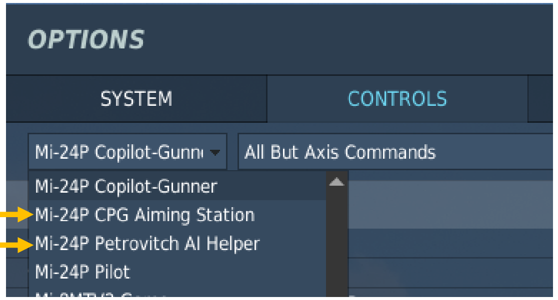
BIND THE FOLLOWING AXES:

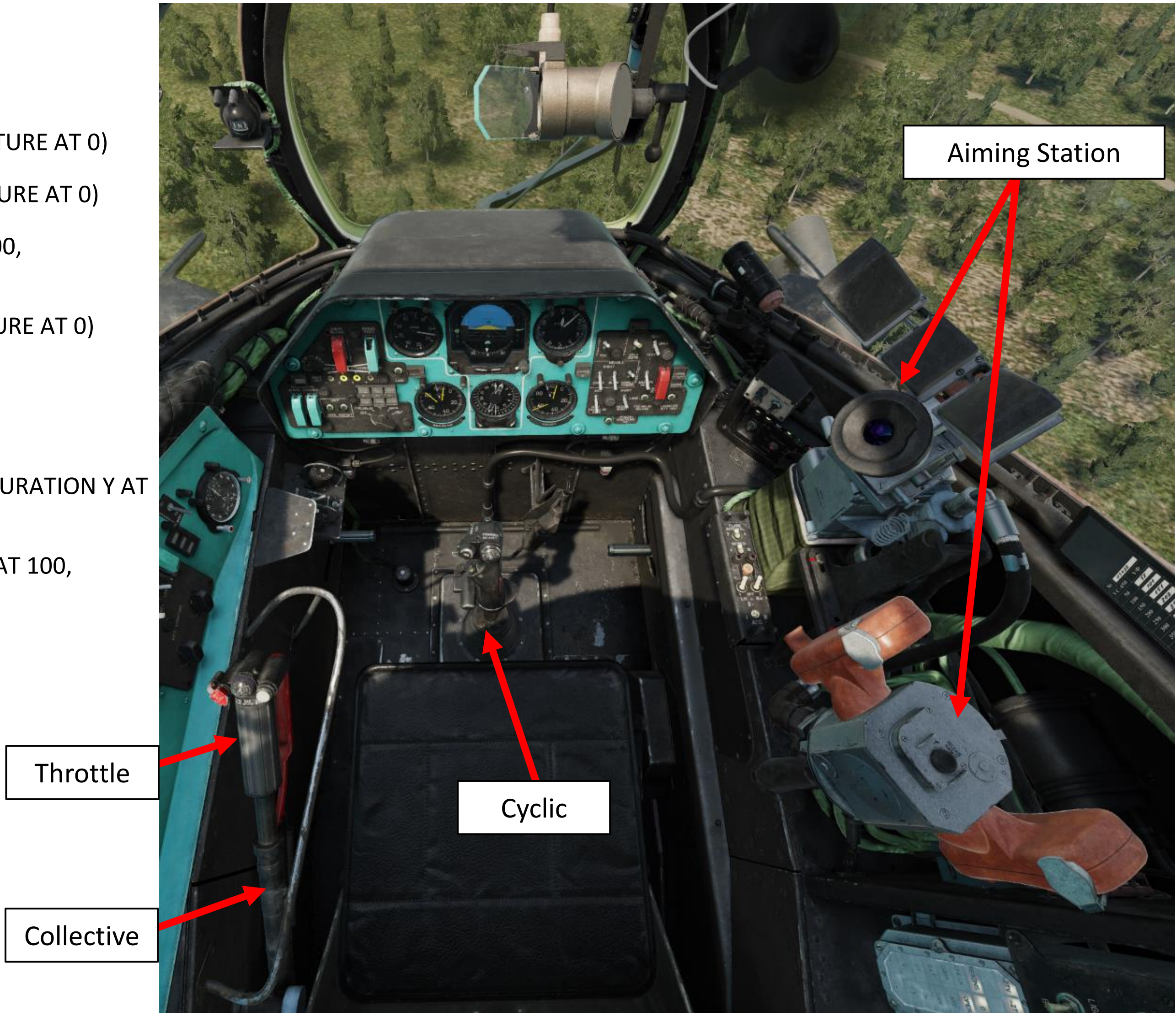
MI-24P COPILOT-GUNNER MENU:

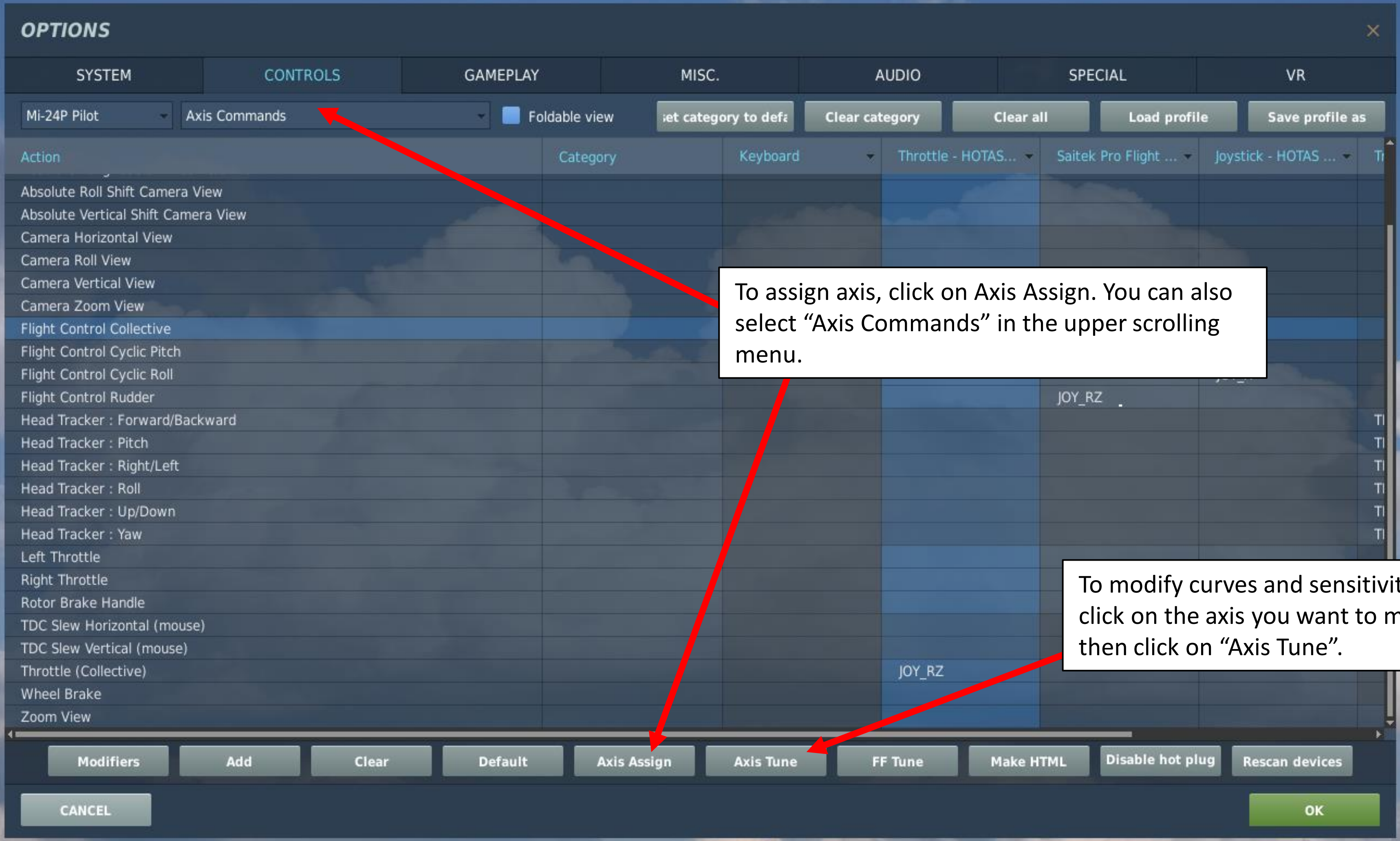
- CYCLIC PITCH (DEADZONE AT 3, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 0)
- CYCLIC ROLL (DEADZONE AT 3, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 0)
- RUDDER/ANTI-TORQUE (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 0)
- COLLECTIVE (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 0)
- THROTTLE (COLLECTIVE) – CONTROLS ENGINE RPM

MI-24P CPG AIMING STATION MENU:

- AIMING STATION LEFT/RIGHT (JOYSTICK) (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 0)
- AIMING STATION UP/DOWN(JOYSTICK) CYCLIC ROLL (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 0)





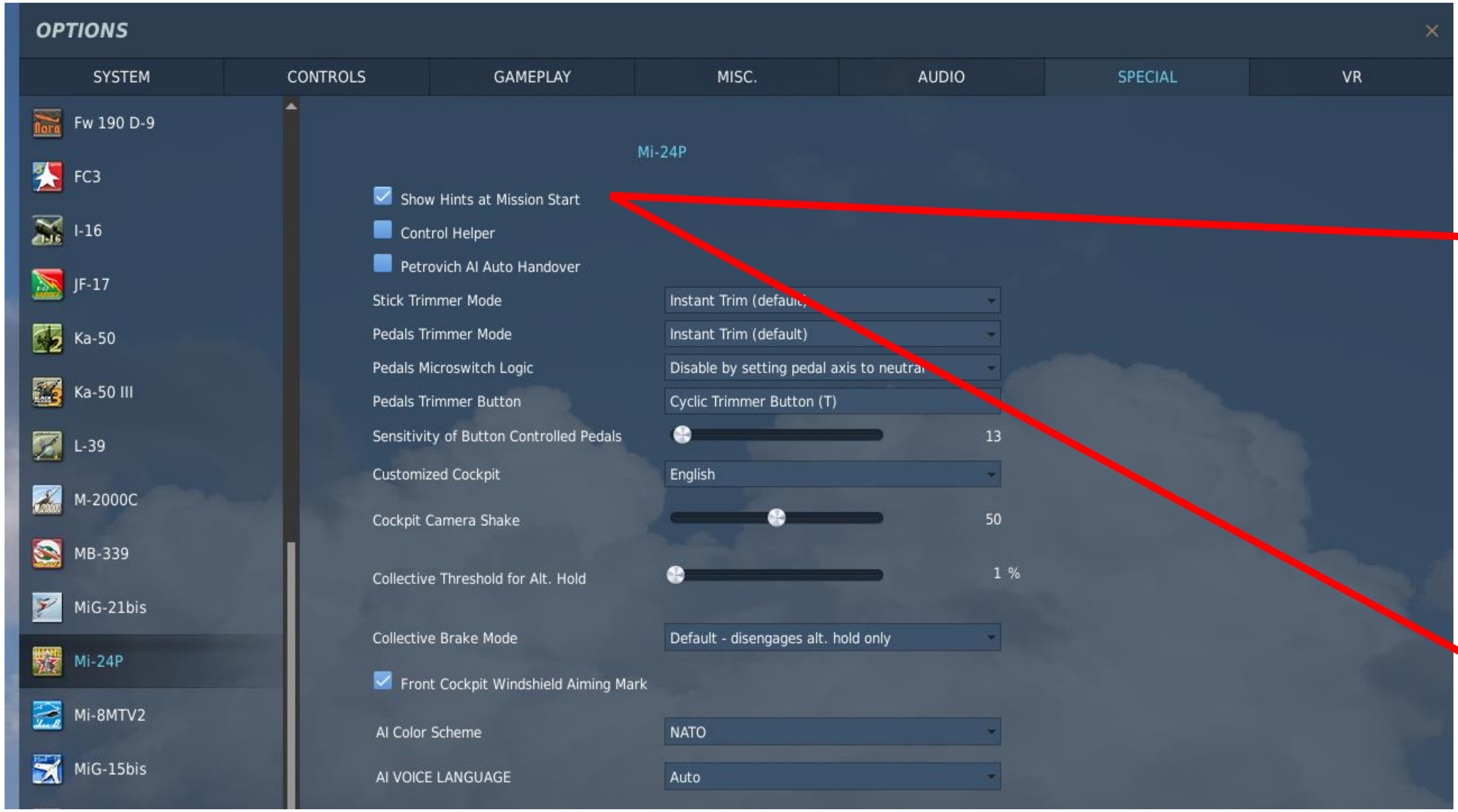


To assign axis, click on Axis Assign. You can also select “Axis Commands” in the upper scrolling menu.

To modify curves and sensitivities of axes, click on the axis you want to modify and then click on “Axis Tune”.

CONTROLS FOR GUNNERS, CREW & INTERFACE MANAGEMENT

- OCCUPY PILOT SEAT — SWITCHES TO PILOT SEAT (“1” BY DEFAULT)
- OCCUPY CO-PILOT/OPERATOR SEAT — SWITCHES TO COPILOT (OPERATOR) SEAT (“2” BY DEFAULT)
- SET GUNNER SEAT — SWITCHES TO GUNNER SEAT (“3” BY DEFAULT)
- SHOW CONTROLS INDICATOR — TOGGLE CONTROL INDICATOR INTERFACE (RCTRL+ENTER)



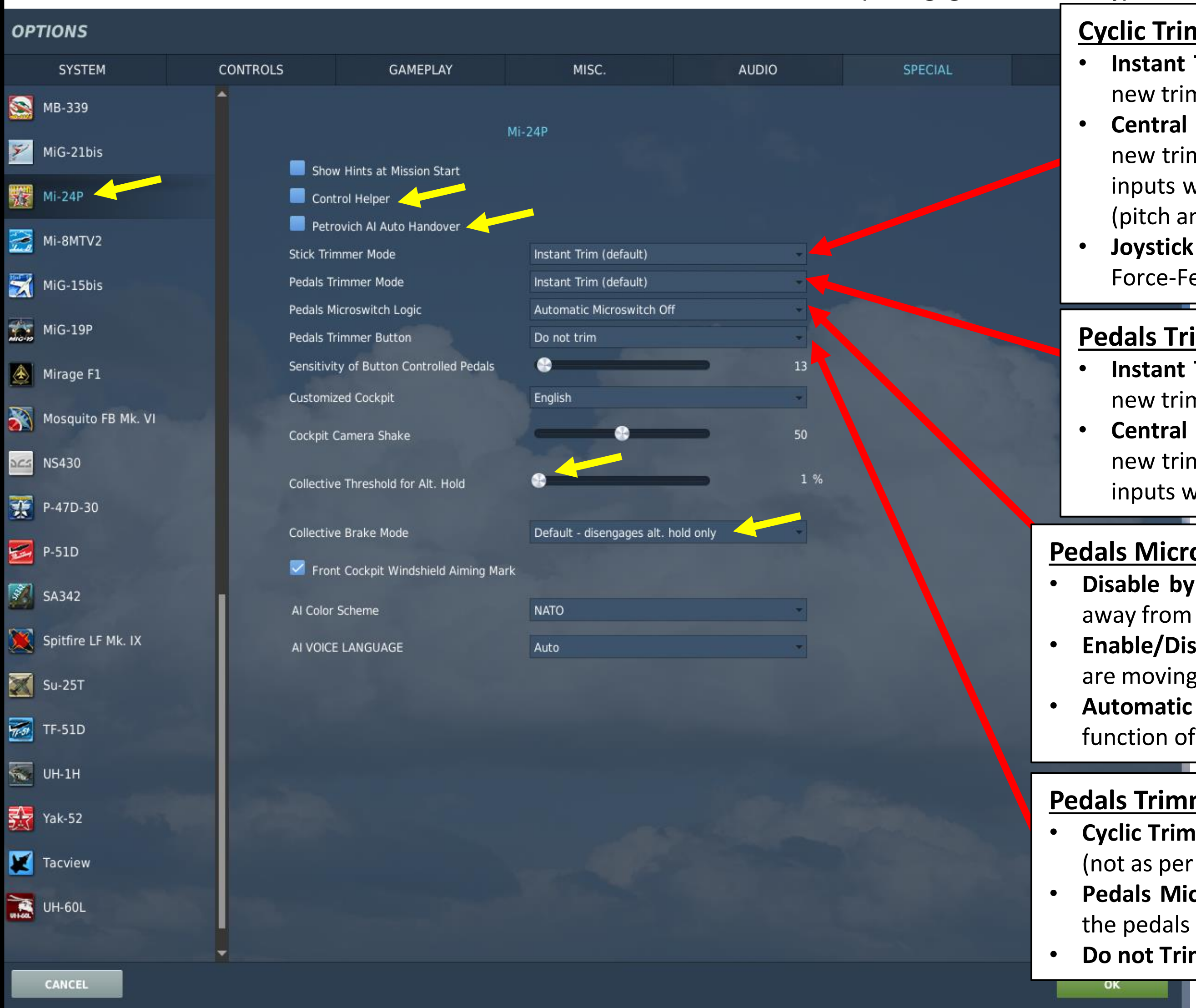
NOTE: These labels are visible if you have the “Show Hints at Mission Start” option ticked in the “SPECIAL – MI-24P” Options tab. Alternatively, you can toggle them with “RCTRL+ENTER”.

CONTROLS FOR GUNNERS, CREW & INTERFACE MANAGEMENT

In the “Special” tab, make sure CONTROL HELPER is OFF (not ticked), and that the CUSTOMIZED COCKPIT: ENGLISH option is selected/ticked!

- I recommend setting Stick Trimmer Mode and Pedals Trimmer Mode to “Instant Trim”, and to have the Pedals Microswitch Logic to “Automatic Microswitch OFF”.
- I also recommend setting Pedals Trimmer Button to “Do Not Trim” in order to have as much pedal authority as possible when flying.

As a personal preference, I like to set the **Petrovich AI Auto Handover Not Selected (not ticked)**, the **Trimmer Mode to Default**, the **Collective Move Threshold for the Altitude Hold Reset to 1 %** of collective travel, and the **Collective Brake Mode to Default (disengages alt hold only)**. The front cockpit windshield aiming mark can be useful in some situations.



Cyclic Trimmer Modes:

- **Instant Trim (FFB Friendly)** – As soon as the Force Trim Release button (trimmer) is released, the new trimmed position of the player’s stick will be applied immediately.
- **Central Position Trimmer Mode** – After the Force Trim Release button (trimmer) is released, the new trimmed position of the player’s stick will be applied immediately; however any further control inputs will only be applied in each axis after the stick is returned to the neutral position in that axis (pitch and roll are read separately).
- **Joystick Without Springs and FFB** – This option is used for joysticks lacking any spring resistance or Force-Feedback (FFB).

Pedals Trimmer Modes:

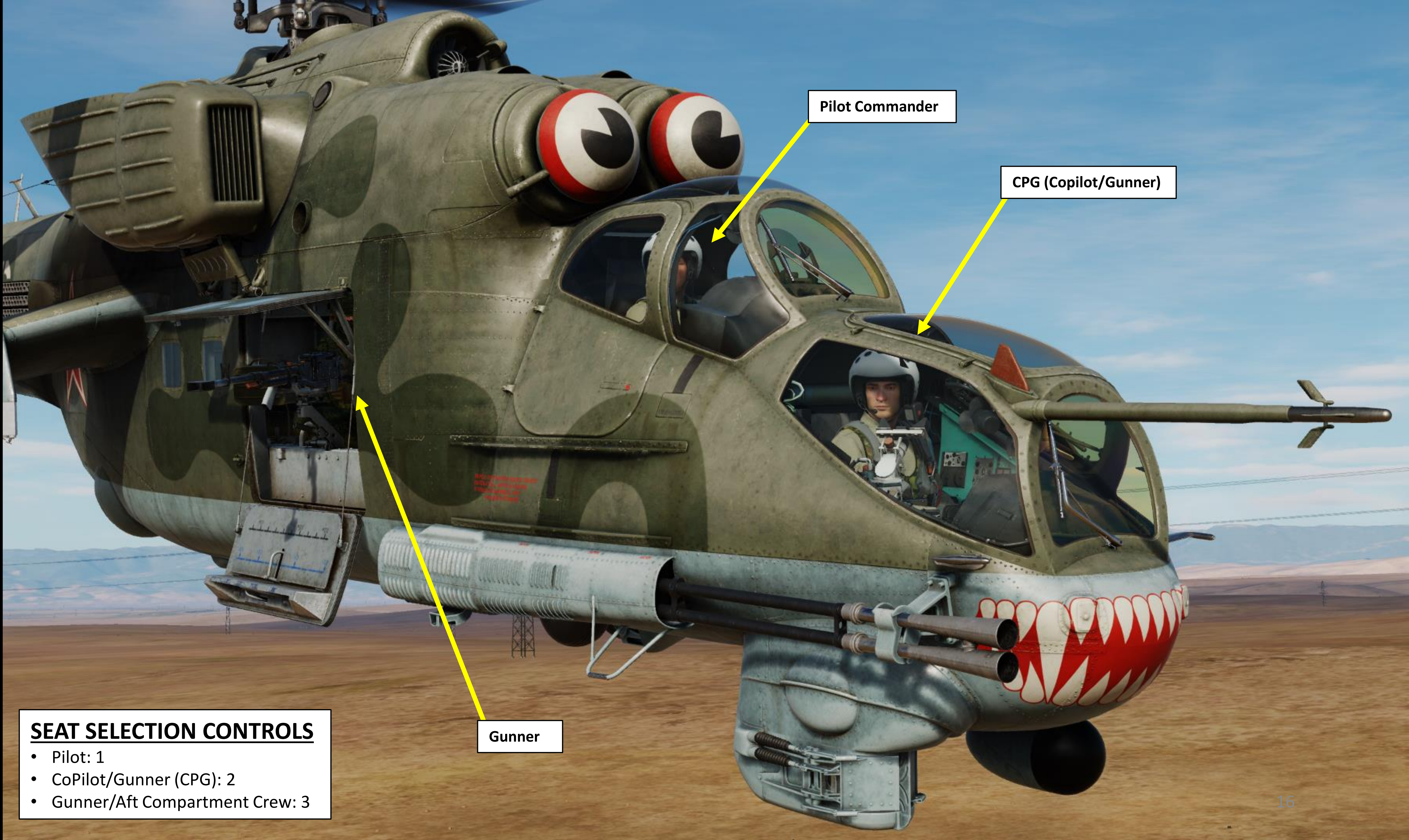
- **Instant Trim (FFB Friendly)** – As soon as the Force Trim Release button (trimmer) is released, the new trimmed position of the player’s pedals will be applied immediately.
- **Central Position Trimmer Mode** – After the Force Trim Release button (trimmer) is released, the new trimmed position of the player’s pedals will be applied immediately; however any further pedal inputs will only be applied after the pedals are returned to the neutral position.

Pedals Microswitch Logic:

- **Disable by setting pedal axis to neutral** – Microswitch is enabled by moving the anti-torque pedals away from the neutral position and disengaged when pedals are returned back to the neutral position.
- **Enable/Disable by presence/absence of pedal movement** – Microswitch is enabled only when pedals are moving and disabled when pedals are not moving.
- **Automatic Microswitch OFF** – Disables Microswitch logic from your pedals; Microswitch is instead a function of a fictional control binding that allows you to enable/disable it at will.

Pedals Trimmer Button:

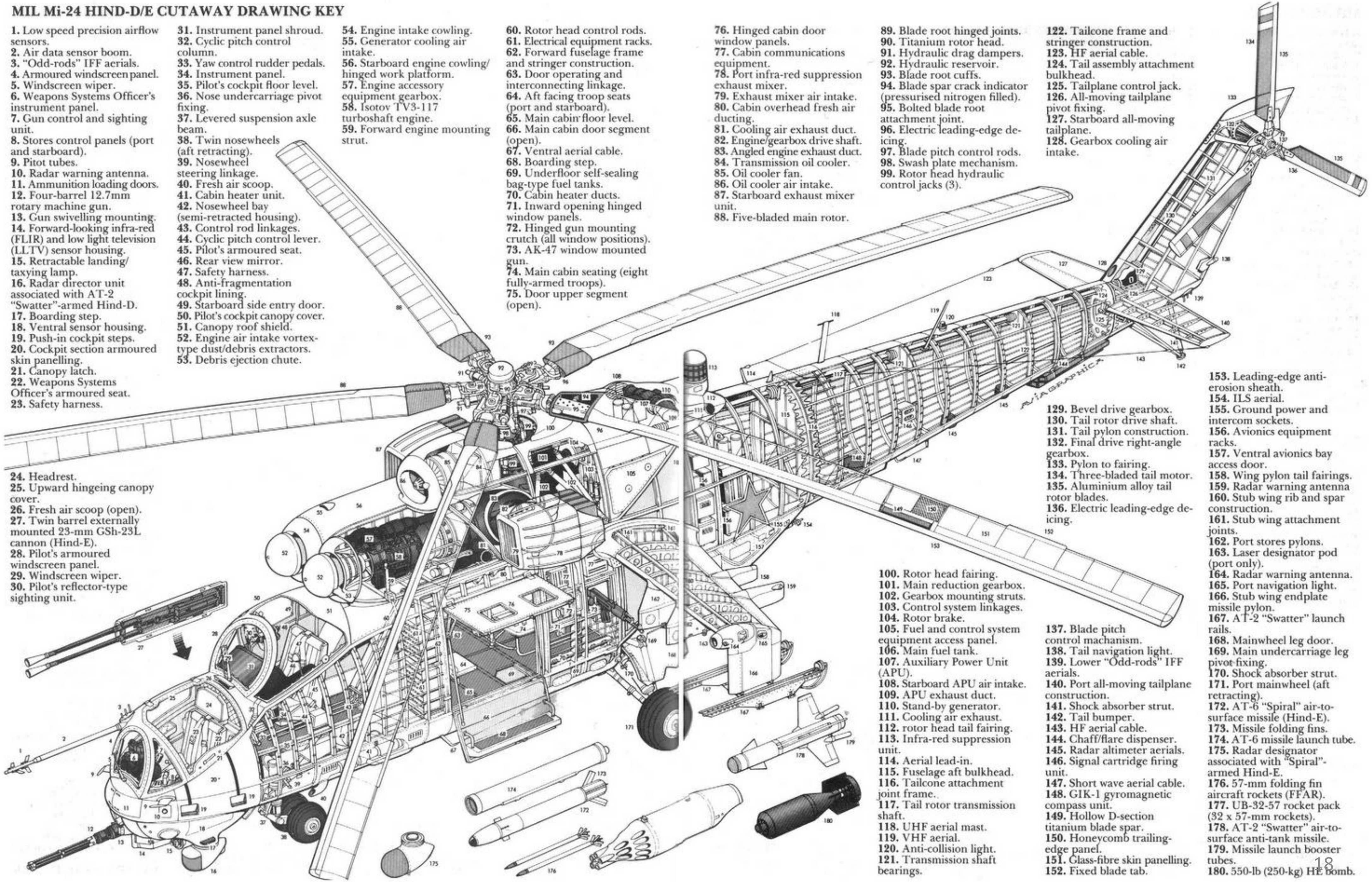
- **Cyclic Trimmer Button (T)** – Pedals are automatically trimmed when pressing the cyclic trimmer button (not as per aircraft)
- **Pedals Microswitch Button (Y)** – Pedals are trimmed separately from cyclic trimmer button by using the pedals microswitch logic or Microswitch control binding (as per aircraft)
- **Do not Trim** – Anti-Torque pedals are not trimmed at all.



SEAT SELECTION CONTROLS

- Pilot: 1
- CoPilot/Gunner (CPG): 2
- Gunner/Aft Compartment Crew: 3

MIL Mi-24 HIND-D/E CUTAWAY DRAWING KEY



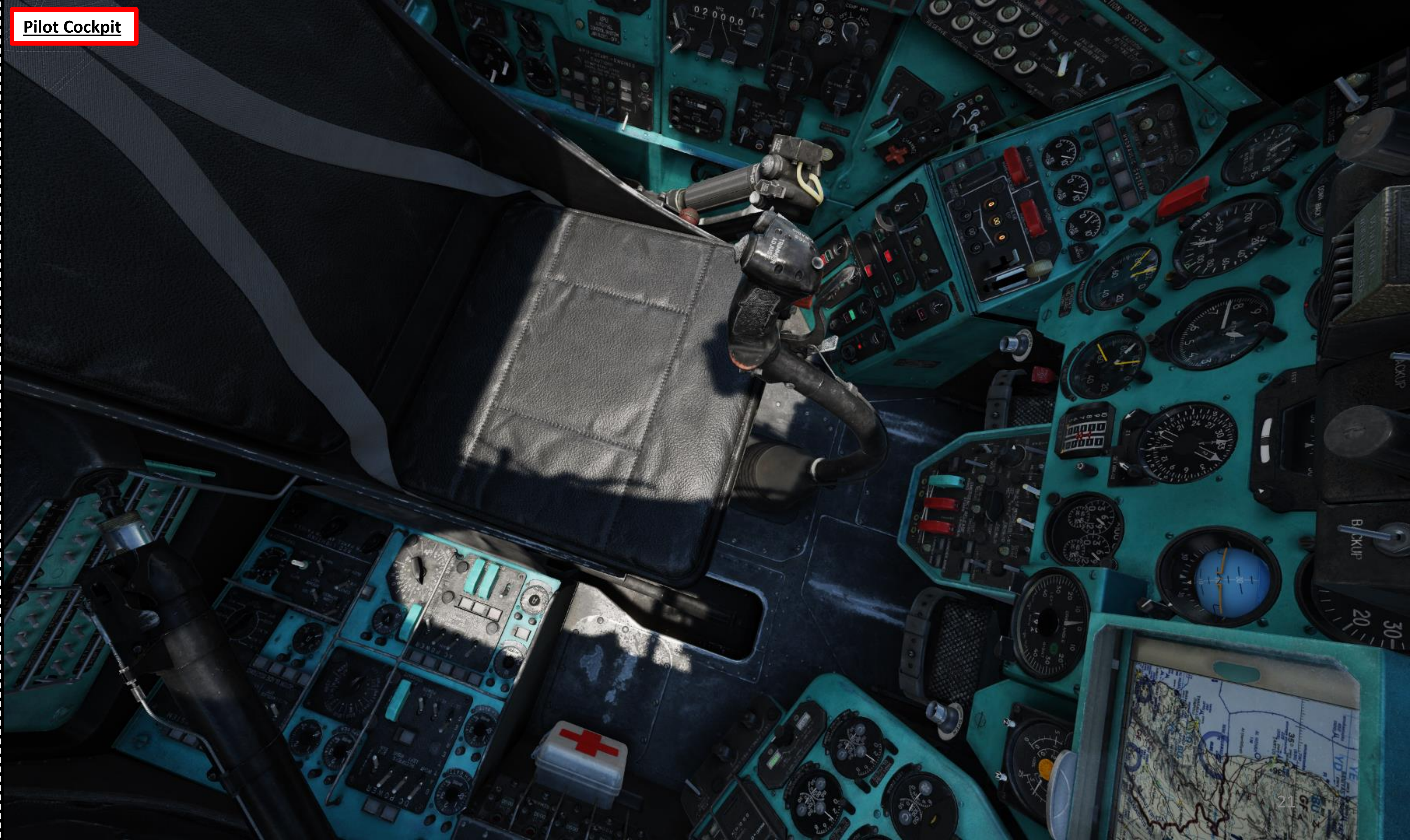
1. Low speed precision airflow sensors.
2. Air data sensor boom.
3. "Odd-rods" IFF aerials.
4. Armoured windscreen panel.
5. Windscreen wiper.
6. Weapons Systems Officer's instrument panel.
7. Gun control and sighting unit.
8. Stores control panels (port and starboard).
9. Pitot tubes.
10. Radar warning antenna.
11. Ammunition loading doors.
12. Four-barrel 12.7mm rotary machine gun.
13. Gun swivelling mounting.
14. Forward-looking infra-red (FLIR) and low light television (LLTV) sensor housing.
15. Retractable landing/taxying lamp.
16. Radar director unit associated with AT-2 "Swatter"-armed Hind-D.
17. Boarding step.
18. Ventral sensor housing.
19. Push-in cockpit steps.
20. Cockpit section armoured skin panelling.
21. Canopy latch.
22. Weapons Systems Officer's armoured seat.
23. Safety harness.
24. Headrest.
25. Upward hingeing canopy cover.
26. Fresh air scoop (open).
27. Twin barrel externally mounted 23-mm GSh-23L cannon (Hind-E).
28. Pilot's armoured windscreen panel.
29. Windscreen wiper.
30. Pilot's reflector-type sighting unit.
31. Instrument panel shroud.
32. Cyclic pitch control column.
33. Yaw control rudder pedals.
34. Instrument panel.
35. Pilot's cockpit floor level.
36. Nose undercarriage pivot fixing.
37. Levered suspension axle beam.
38. Twin nosewheels (aft retracting).
39. Nosewheel steering linkage.
40. Fresh air scoop.
41. Cabin heater unit.
42. Nosewheel bay (semi-retracted housing).
43. Control rod linkages.
44. Cyclic pitch control lever.
45. Pilot's armoured seat.
46. Rear view mirror.
47. Safety harness.
48. Anti-fragmentation cockpit lining.
49. Starboard side entry door.
50. Pilot's cockpit canopy cover.
51. Canopy roof shield.
52. Engine air intake vortex-type dust/debris extractors.
53. Debris ejection chute.
54. Engine intake cowling.
55. Generator cooling air intake.
56. Starboard engine cowling/hinged work platform.
57. Engine accessory equipment gearbox.
58. Isotov TV3-117 turboshaft engine.
59. Forward engine mounting strut.
60. Rotor head control rods.
61. Electrical equipment racks.
62. Forward fuselage frame and stringer construction.
63. Door operating and interconnecting linkage.
64. Aft facing troop seats (port and starboard).
65. Main cabin floor level.
66. Main cabin door segment (open).
67. Ventral aerial cable.
68. Boarding step.
69. Underfloor self-sealing bag-type fuel tanks.
70. Cabin heater ducts.
71. Inward opening hinged window panels.
72. Hinged gun mounting crutch (all window positions).
73. AK-47 window mounted gun.
74. Main cabin seating (eight fully-armed troops).
75. Door upper segment (open).
76. Hinged cabin door window panels.
77. Cabin communications equipment.
78. Port infra-red suppression exhaust mixer.
79. Exhaust mixer air intake.
80. Cabin overhead fresh air ducting.
81. Cooling air exhaust duct.
82. Engine/gearbox drive shaft.
83. Angled engine exhaust duct.
84. Transmission oil cooler.
85. Oil cooler fan.
86. Oil cooler air intake.
87. Starboard exhaust mixer unit.
88. Five-bladed main rotor.
89. Blade root hinged joints.
90. Titanium rotor head.
91. Hydraulic drag dampers.
92. Hydraulic reservoir.
93. Blade root cuffs.
94. Blade spar crack indicator (pressurised nitrogen filled).
95. Bolted blade root attachment joint.
96. Electric leading-edge de-icing.
97. Blade pitch control rods.
98. Swash plate mechanism.
99. Rotor head hydraulic control jacks (3).
100. Rotor head fairing.
101. Main reduction gearbox.
102. Gearbox mounting struts.
103. Control system linkages.
104. Rotor brake.
105. Fuel and control system equipment access panel.
106. Main fuel tank.
107. Auxiliary Power Unit (APU).
108. Starboard APU air intake.
109. APU exhaust duct.
110. Stand-by generator.
111. Cooling air exhaust.
112. rotor head tail fairing.
113. Infra-red suppression unit.
114. Aerial lead-in.
115. Fuselage aft bulkhead.
116. Tailcone attachment joint frame.
117. Tail rotor transmission shaft.
118. UHF aerial mast.
119. VHF aerial.
120. Anti-collision light.
121. Transmission shaft bearings.
122. Tailcone frame and stringer construction.
123. HF aerial cable.
124. Tail assembly attachment bulkhead.
125. Tailplane control jack.
126. All-moving tailplane pivot fixing.
127. Starboard all-moving tailplane.
128. Gearbox cooling air intake.
129. Bevel drive gearbox.
130. Tail rotor drive shaft.
131. Tail pylon construction.
132. Final drive right-angle gearbox.
133. Pylon to fairing.
134. Three-bladed tail motor.
135. Aluminium alloy tail rotor blades.
136. Electric leading-edge de-icing.
137. Blade pitch control machanism.
138. Tail navigation light.
139. Lower "Odd-rods" IFF aerials.
140. Port all-moving tailplane construction.
141. Shock absorber strut.
142. Tail bumper.
143. HF aerial cable.
144. Chaff/flare dispenser.
145. Radar altimeter aerials.
146. Signal cartridge firing unit.
147. Short wave aerial cable.
148. GIK-1 gyromagnetic compass unit.
149. Hollow D-section titanium blade spar.
150. Honeycomb trailing-edge panel.
151. Glass-fibre skin panelling.
152. Fixed blade tab.
153. Leading-edge anti-erosion sheath.
154. ILS aerial.
155. Ground power and intercom sockets.
156. Avionics equipment racks.
157. Ventral avionics bay access door.
158. Wing pylon tail fairings.
159. Radar warning antenna
160. Stub wing rib and spar construction.
161. Stub wing attachment joints.
162. Port stores pylons.
163. Laser designator pod (port only).
164. Radar warning antenna.
165. Port navigation light.
166. Stub wing endplate missile pylon.
167. AT-2 "Swatter" launch rails.
168. Mainwheel leg door.
169. Main undercarriage leg pivot fixing.
170. Shock absorber strut.
171. Port mainwheel (aft retracting).
172. AT-6 "Spiral" air-to-surface missile (Hind-E).
173. Missile folding fins.
174. AT-6 missile launch tube.
175. Radar designator associated with "Spiral"-armed Hind-E.
176. 57-mm folding fin aircraft rockets (FFAR).
177. UB-32-57 rocket pack (32 x 57-mm rockets).
178. AT-2 "Swatter" air-to-surface anti-tank missile.
179. Missile launch booster tubes.
180. 550-lb (250-kg) HE bomb.

Pilot Cockpit

Pilot Cockpit

Tip: Pilot body can be toggled on/off by pressing “RSHIFT+P”

Pilot Cockpit



Pilot Cockpit

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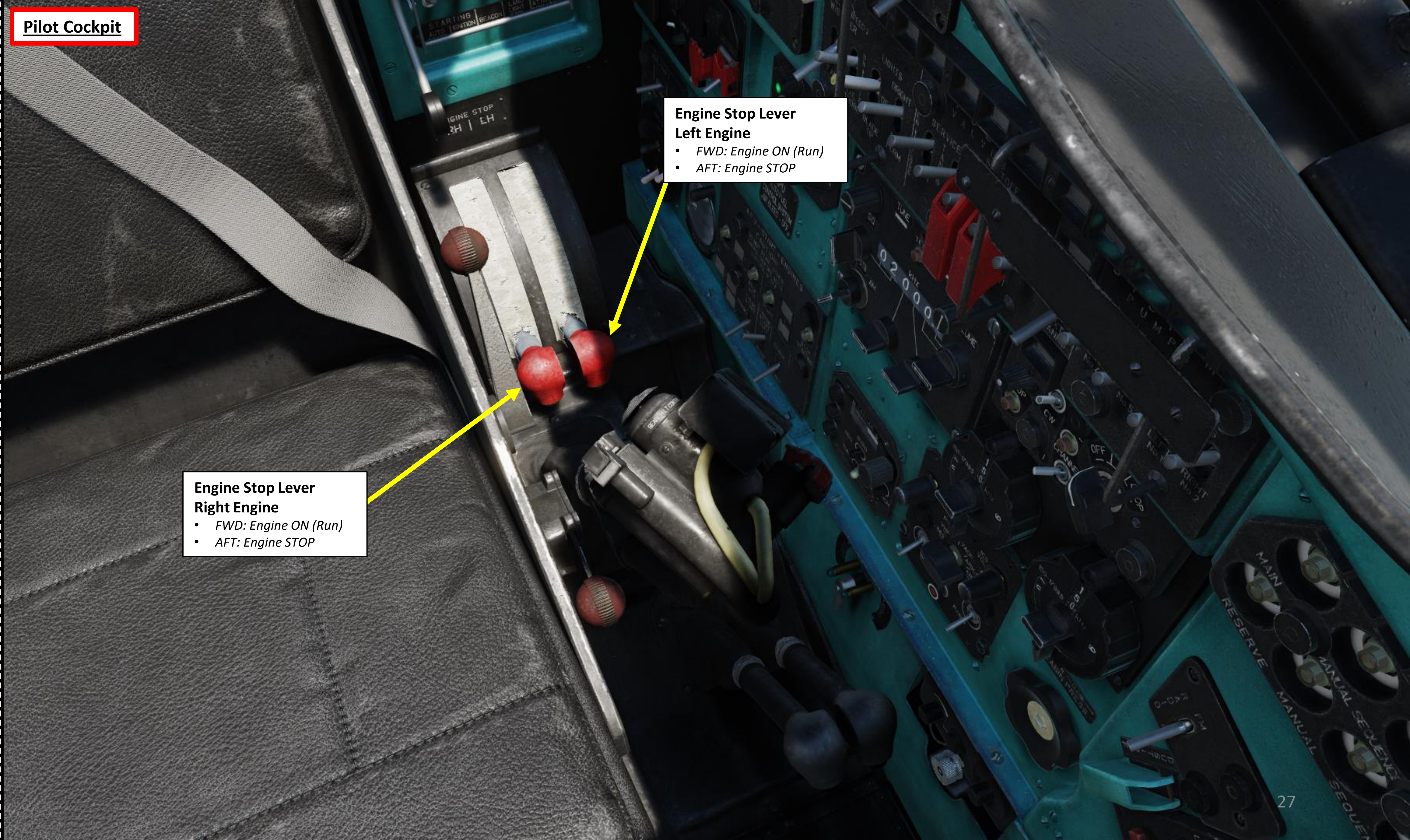
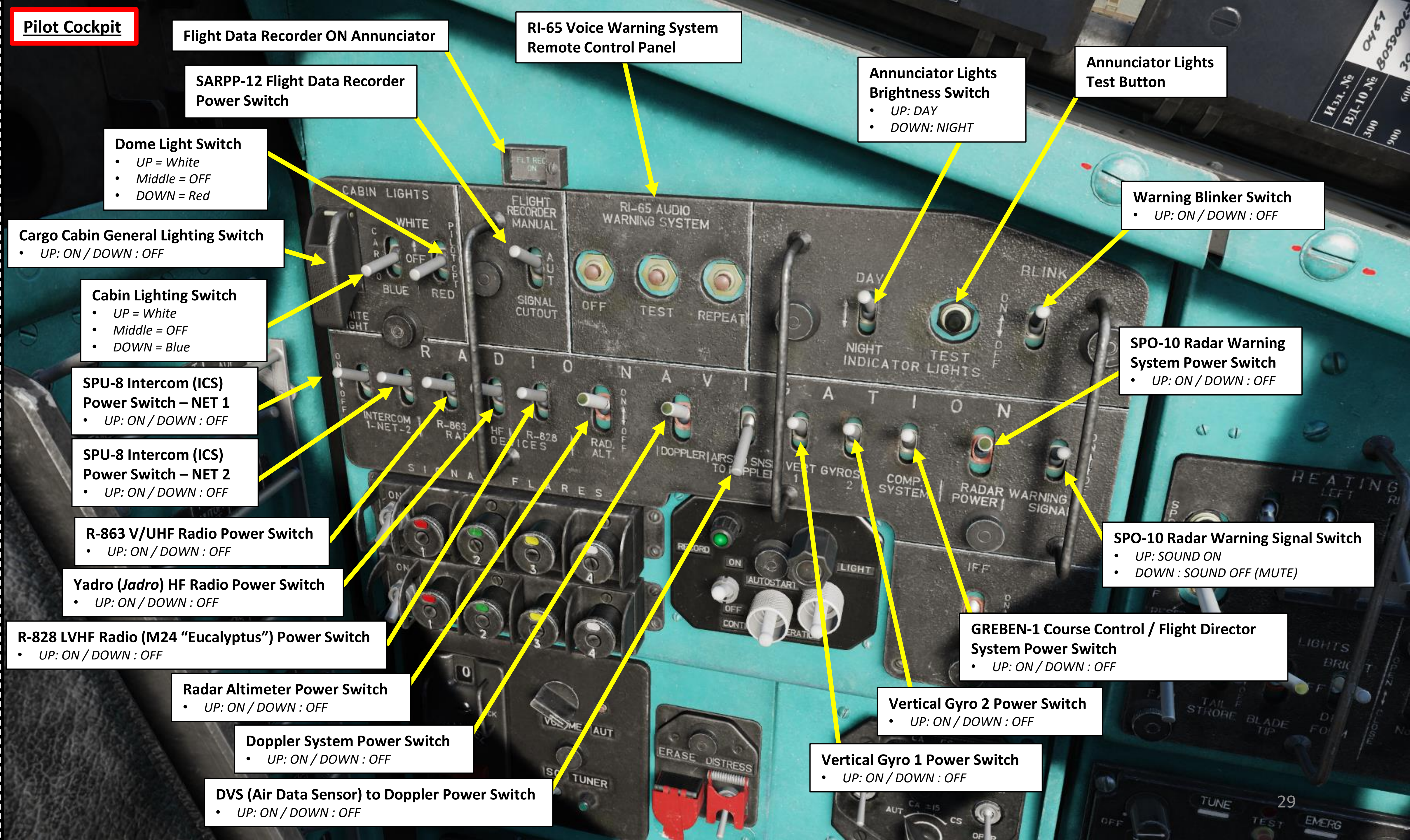
Pilot Cockpit



Pilot Cockpit


Pilot Cockpit
Flight Data Recorder ON Annunciator
RI-65 Voice Warning System Remote Control Panel
SARPP-12 Flight Data Recorder Power Switch
Annunciator Lights Brightness Switch
• UP: DAY
• DOWN: NIGHT
Annunciator Lights Test Button
Dome Light Switch
• UP = White
• Middle = OFF
• DOWN = Red
Cargo Cabin General Lighting Switch
• UP: ON / DOWN : OFF
Warning Blinker Switch
• UP: ON / DOWN : OFF
Cabin Lighting Switch
• UP = White
• Middle = OFF
• DOWN = Blue
SPO-10 Radar Warning System Power Switch
• UP: ON / DOWN : OFF
SPU-8 Intercom (ICS) Power Switch – NET 1
• UP: ON / DOWN : OFF
SPU-8 Intercom (ICS) Power Switch – NET 2
• UP: ON / DOWN : OFF
R-863 V/UHF Radio Power Switch
• UP: ON / DOWN : OFF
SPO-10 Radar Warning Signal Switch
• UP: SOUND ON
• DOWN : SOUND OFF (MUTE)
Yadro (*Jadro*) HF Radio Power Switch
• UP: ON / DOWN : OFF
R-828 LVHF Radio (M24 “Eucalyptus”) Power Switch
• UP: ON / DOWN : OFF
GREBEN-1 Course Control / Flight Director System Power Switch
• UP: ON / DOWN : OFF
Radar Altimeter Power Switch
• UP: ON / DOWN : OFF
Vertical Gyro 2 Power Switch
• UP: ON / DOWN : OFF
Doppler System Power Switch
• UP: ON / DOWN : OFF
Vertical Gyro 1 Power Switch
• UP: ON / DOWN : OFF
DVS (Air Data Sensor) to Doppler Power Switch
• UP: ON / DOWN : OFF

Pilot Cockpit

MC-61 CVR (Cockpit Voice Recorder) Light Brightness Control Knob

Laryngophone Switch
- *UP: ON / DOWN : OFF*

MC-61 CVR (Cockpit Voice Recorder) RECORDING Light

IFF (Identify-Friend-or-Foe) System Power Switch
- *UP: ON / DOWN : OFF*

MC-61 CVR (Cockpit Voice Recorder) Power Switch
- *UP: ON / DOWN : OFF*

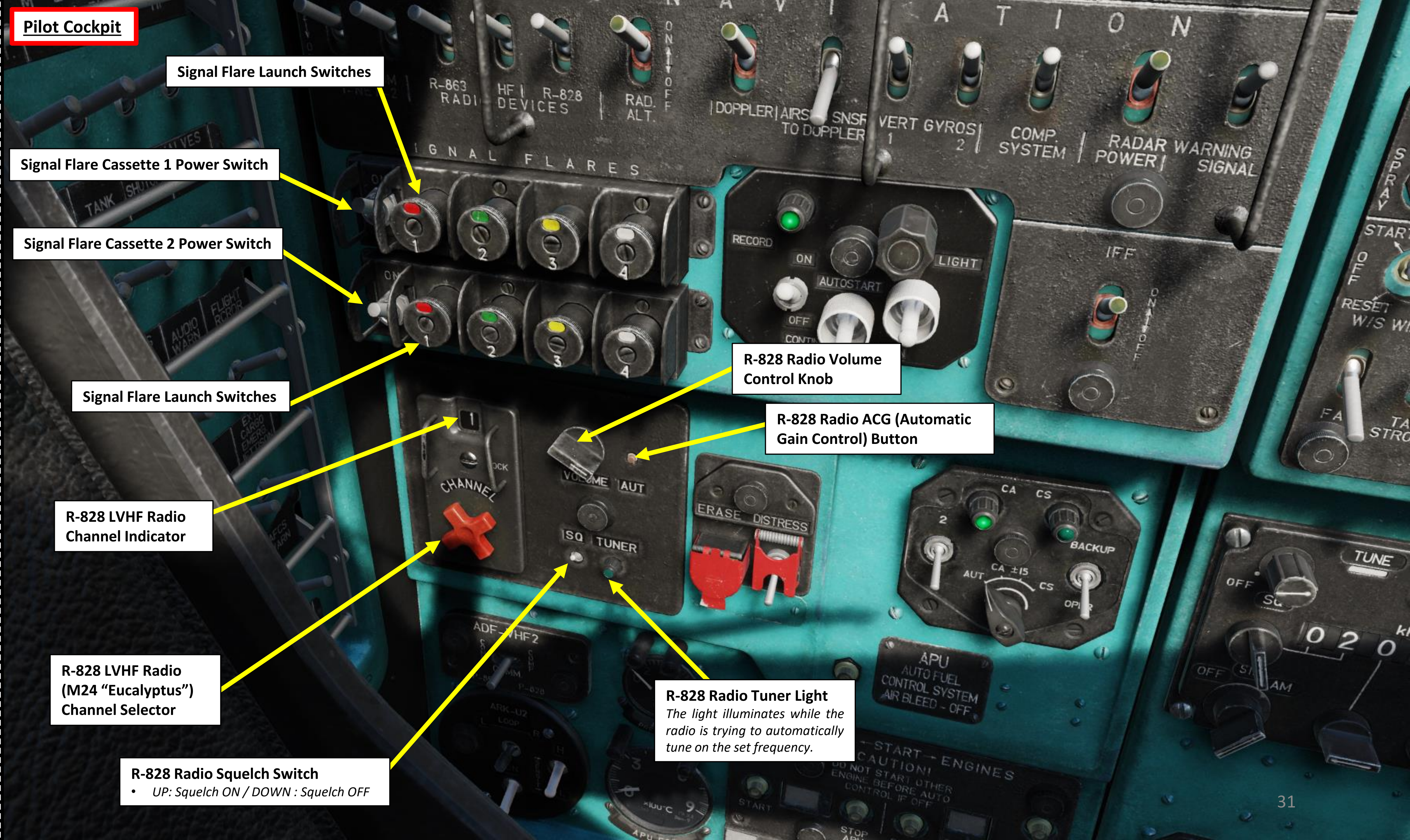
MC-61 CVR (Cockpit Voice Recorder) Mode Selector Switch
- *UP: Automatic*
- *DOWN : Continuous Operation*

IFF (Identify-Friend-or-Foe) Erase (Self-Destruct) Switch

IFF (Identify-Friend-or-Foe) Distress Mode Switch
- *UP: Distress Mode ON. "Distress mode" turns the IFF transponder into an emergency beacon.*
- *DOWN: Distress Mode OFF.*

IFF (Identify-Friend-or-Foe) Transponder Control Panel

Pilot Cockpit



Pilot Cockpit

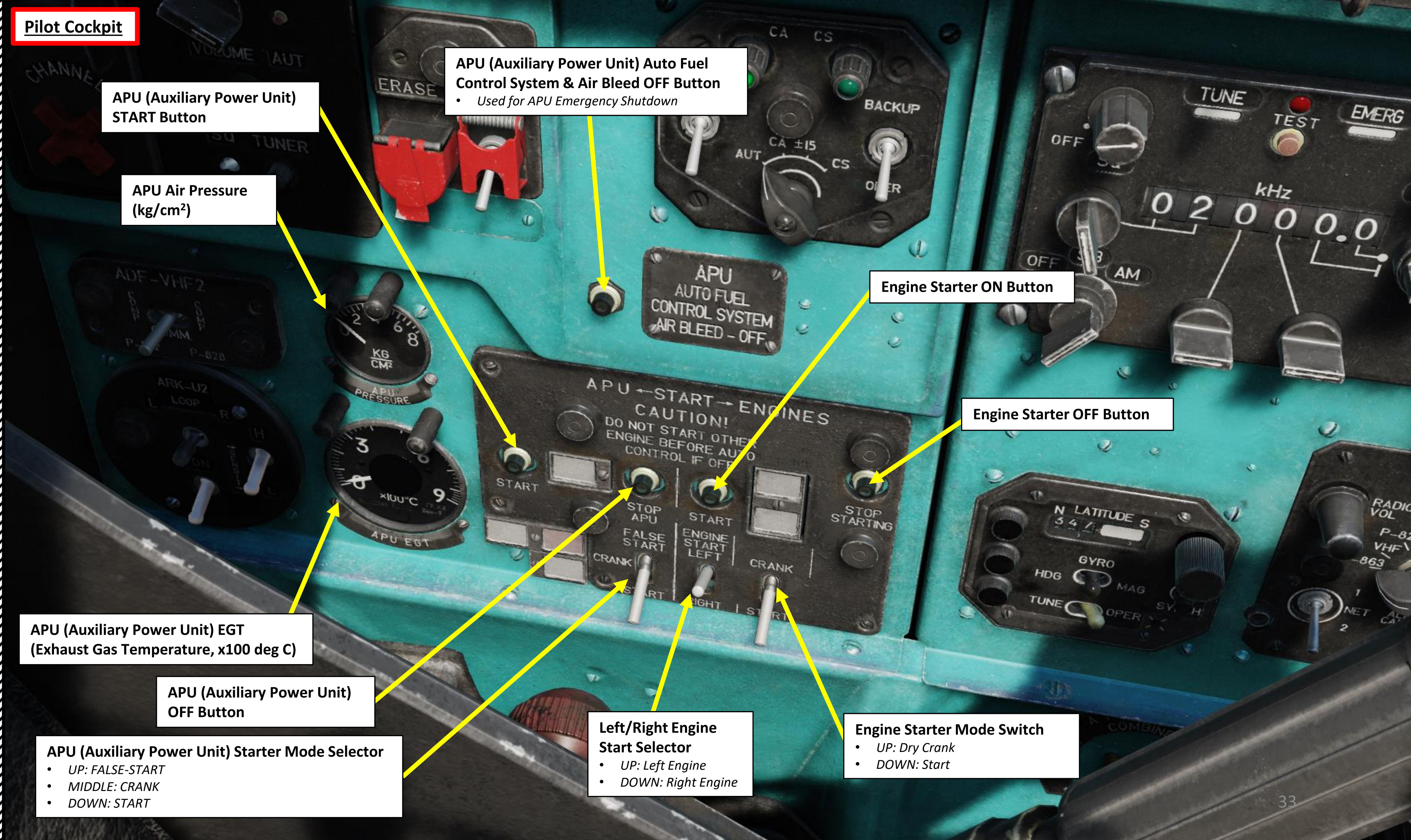
ADF-VHF 2 Source Selector
- *AFT: R-852 Radio Compass*
- *MIDDLE: Communication*
- *FWD: R-828 Radio Compass*

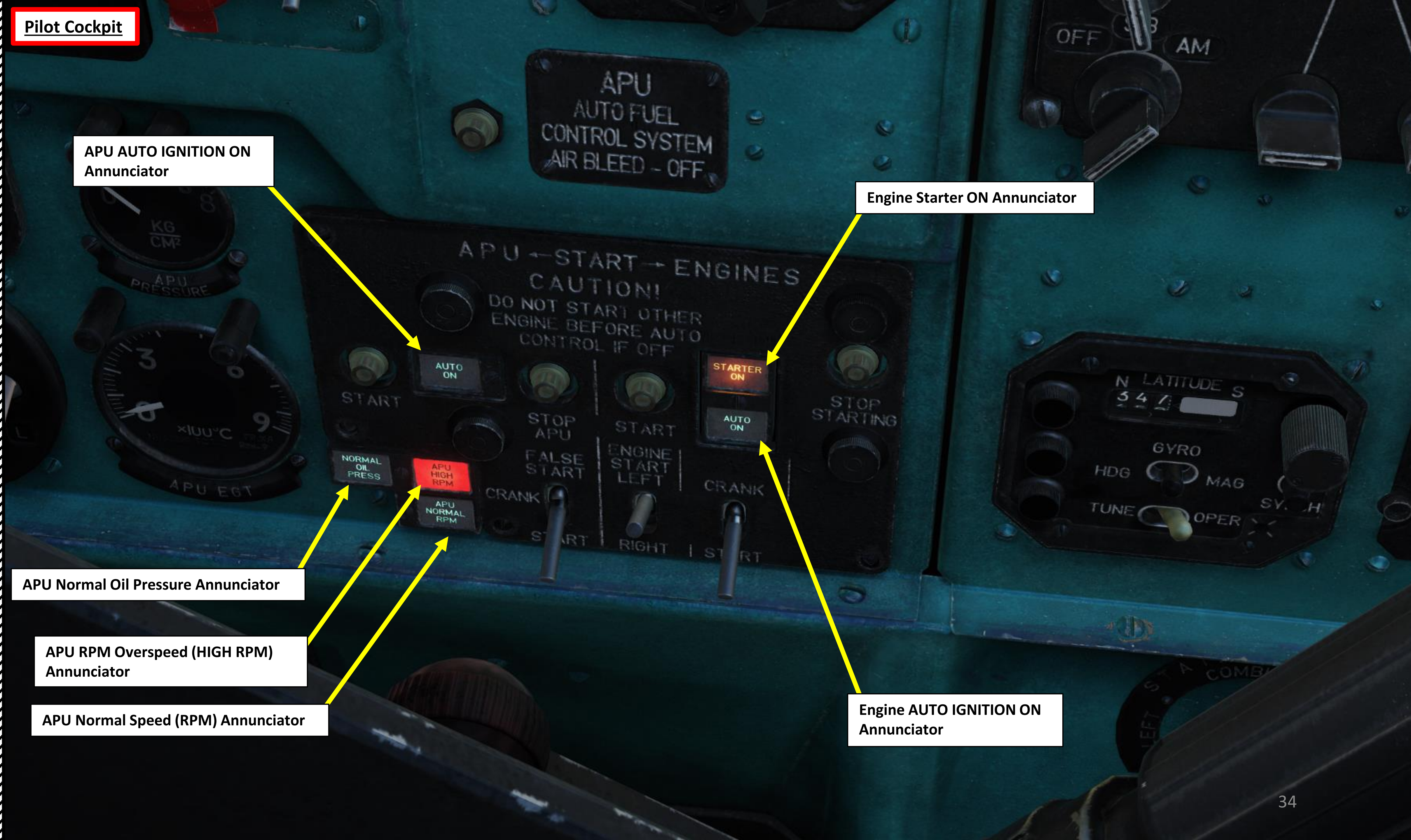
ARK-U2 Homing Set Loop Antenna Control Switch
- *AFT: Left*
- *FWD: Right*

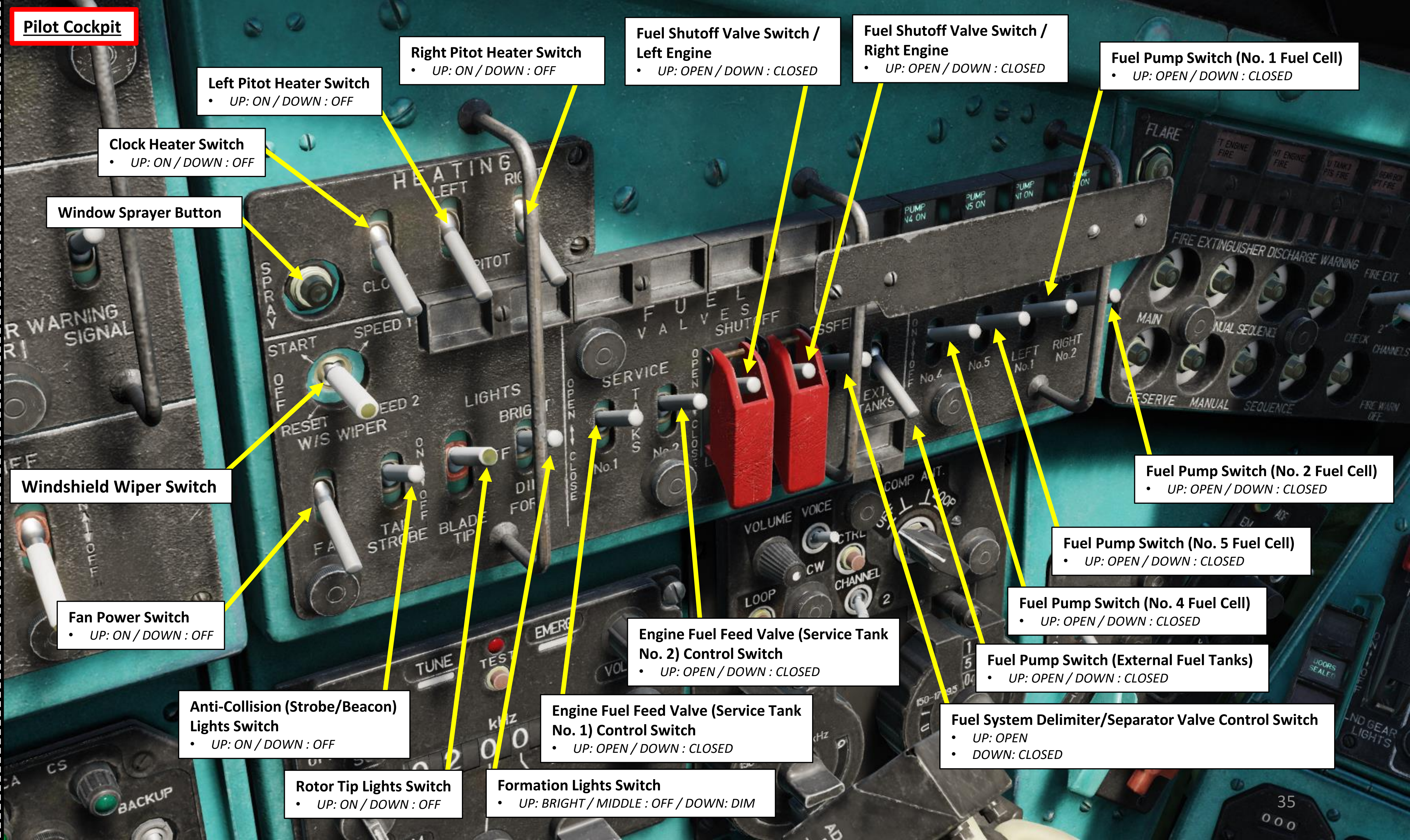
ARK-U2 Homing Set Power Switch
- *UP: ON*
- *DOWN: OFF*

ARK-U2 Homing Set Sensitivity Switch
- *UP: High Sensitivity*
- *DOWN: Low Sensitivity*

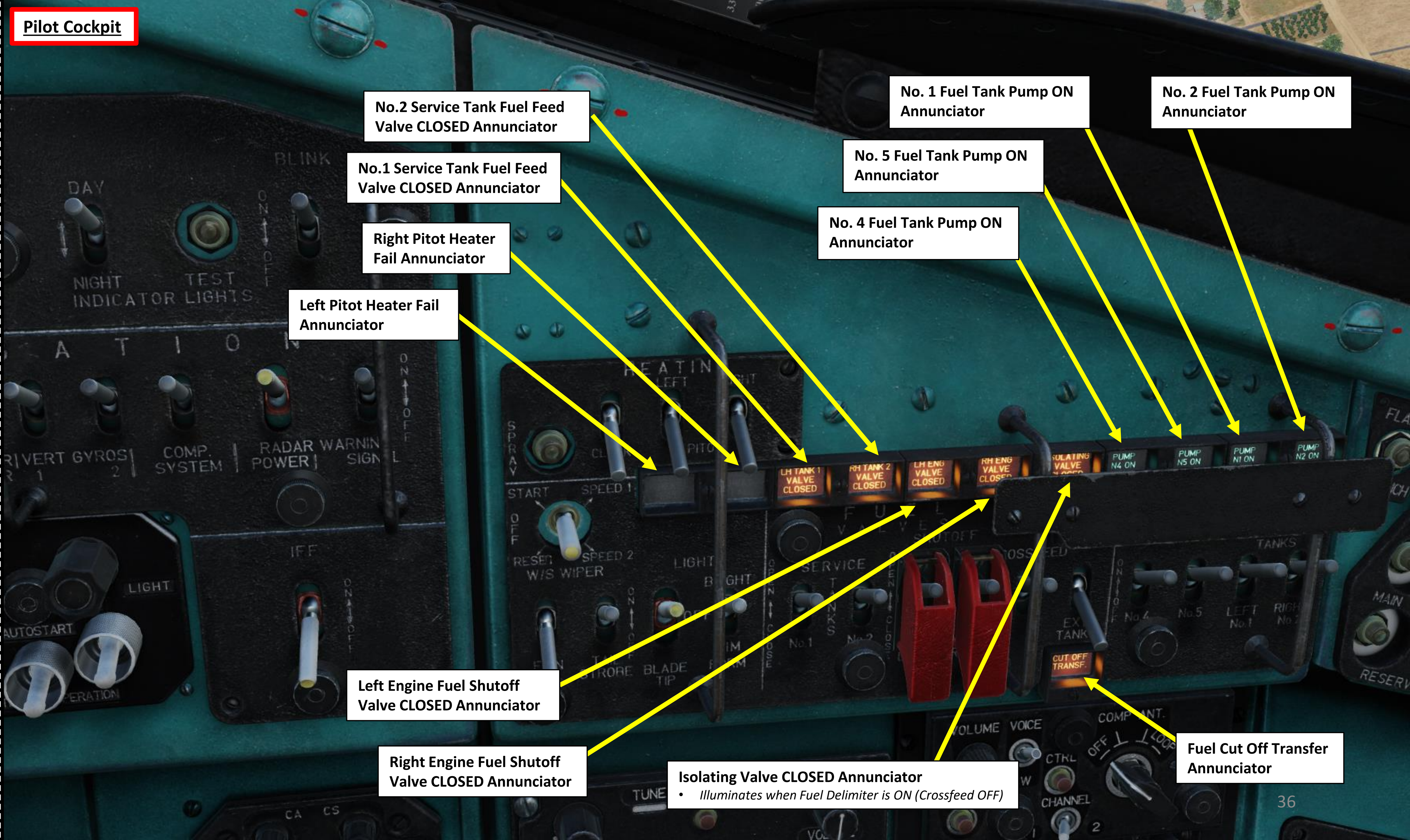
Pilot Cockpit

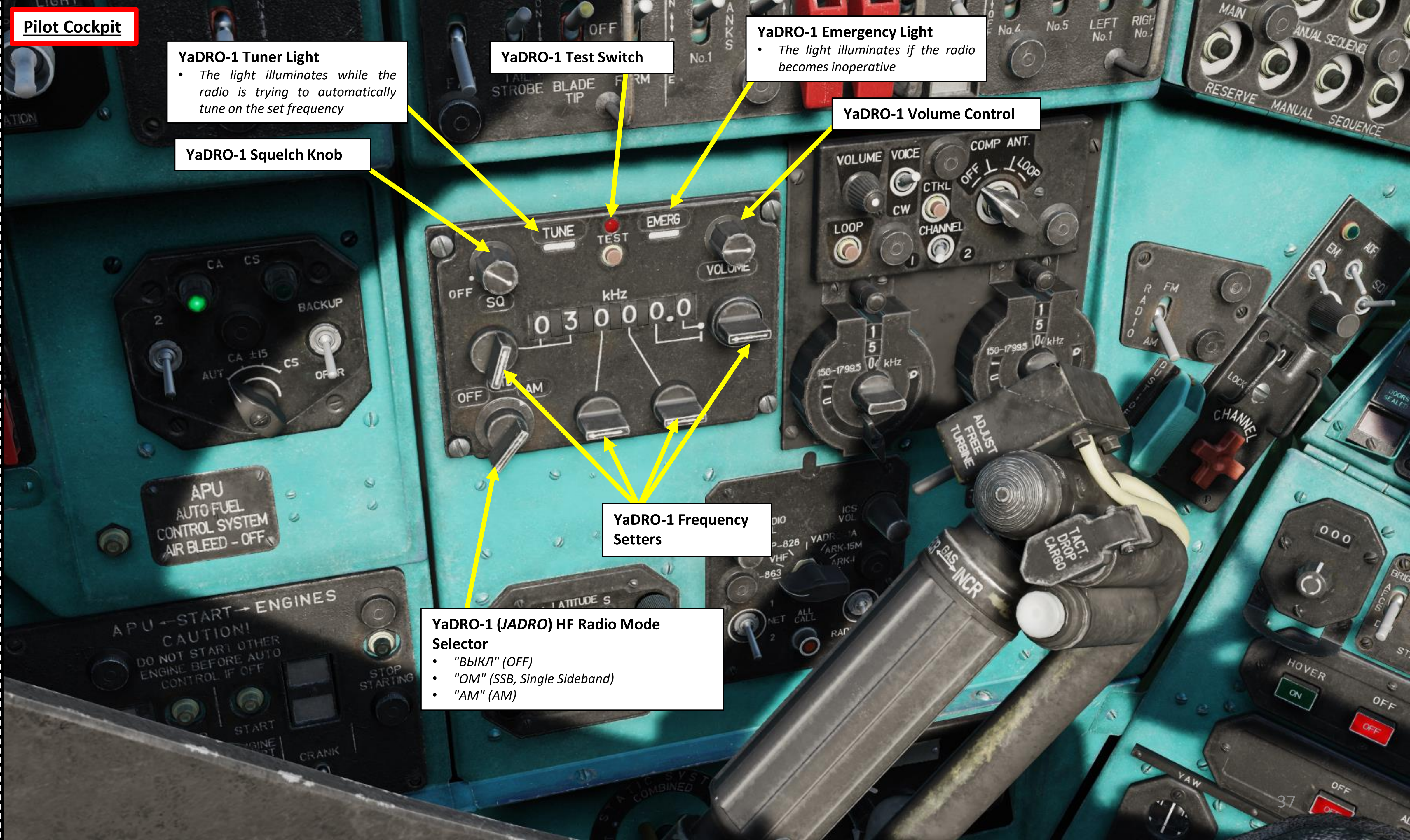


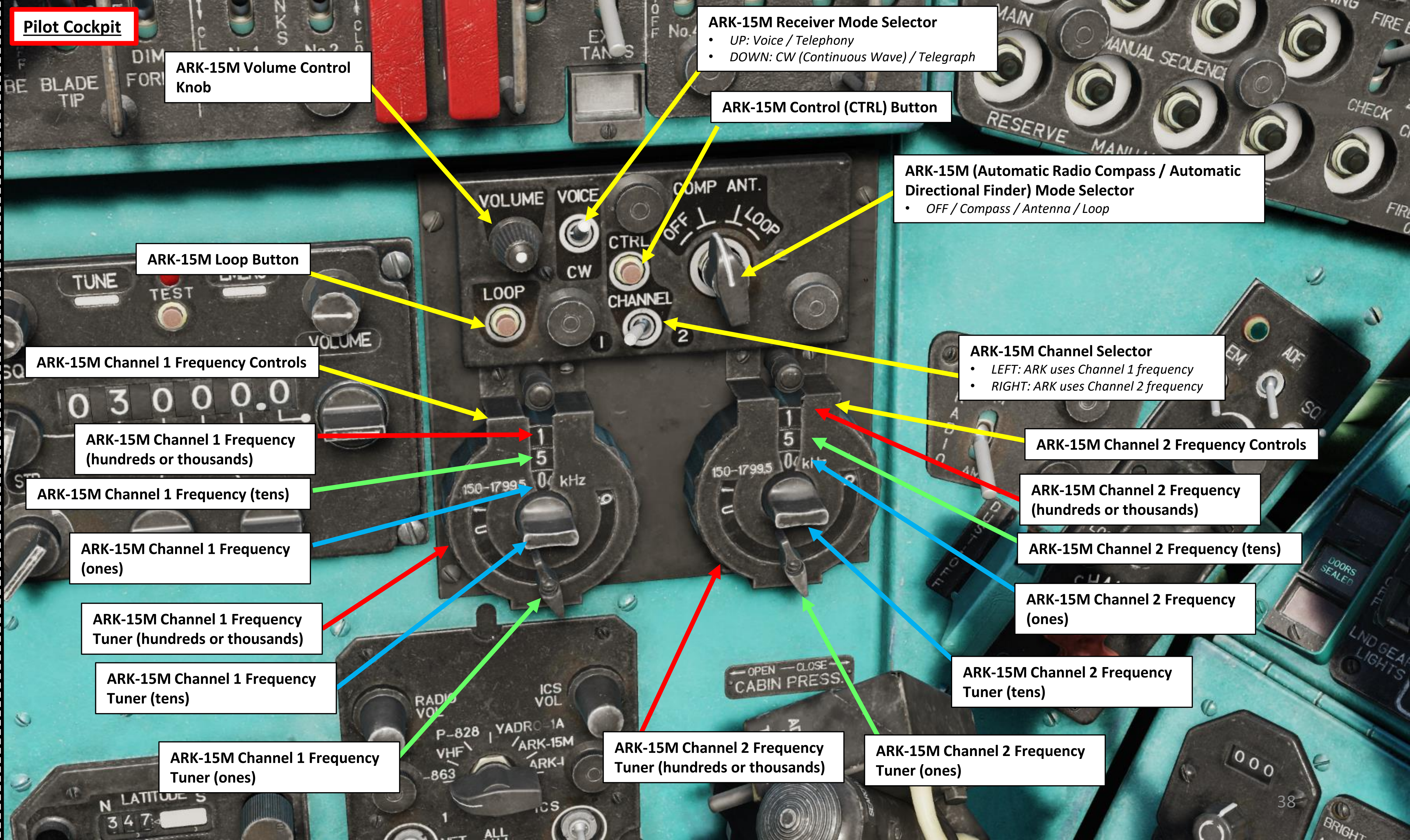

Pilot Cockpit
APU AUTO IGNITION ON Annunciator
Engine Starter ON Annunciator
APU Normal Oil Pressure Annunciator
APU RPM Overspeed (HIGH RPM) Annunciator
APU Normal Speed (RPM) Annunciator
Engine AUTO IGNITION ON Annunciator
APU AUTO FUEL CONTROL SYSTEM AIR BLEED - OFF
APU ← START → ENGINES
CAUTION! DO NOT START OTHER ENGINE BEFORE AUTO CONTROL IF OFF

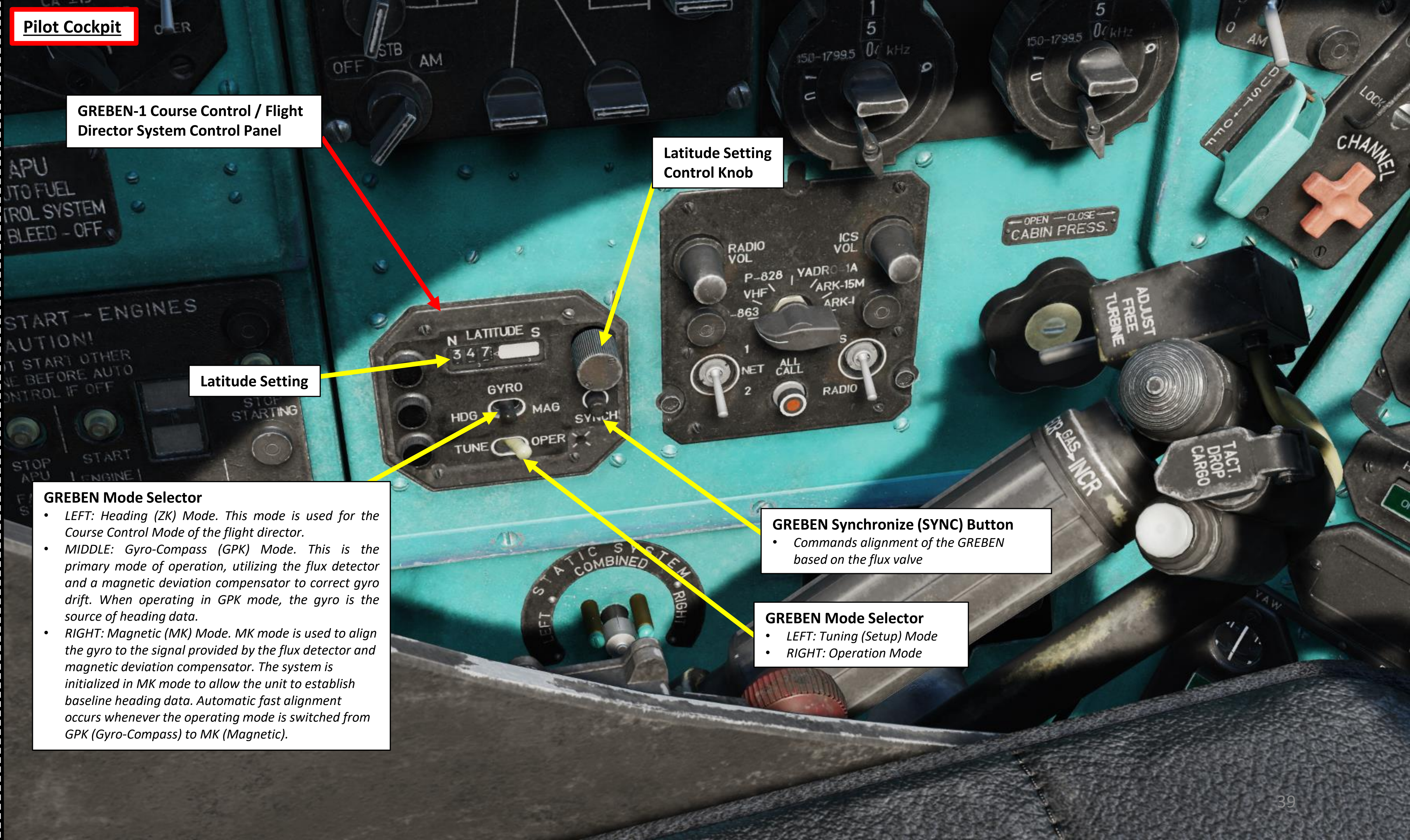

Pilot Cockpit
Left Pitot Heater Switch
• UP: ON / DOWN : OFF
Right Pitot Heater Switch
• UP: ON / DOWN : OFF
Fuel Shutoff Valve Switch / Left Engine
• UP: OPEN / DOWN : CLOSED
Fuel Shutoff Valve Switch / Right Engine
• UP: OPEN / DOWN : CLOSED
Fuel Pump Switch (No. 1 Fuel Cell)
• UP: OPEN / DOWN : CLOSED
Clock Heater Switch
• UP: ON / DOWN : OFF
Window Sprayer Button
Windshield Wiper Switch
Fan Power Switch
• UP: ON / DOWN : OFF
Anti-Collision (Strobe/Beacon) Lights Switch
• UP: ON / DOWN : OFF
Rotor Tip Lights Switch
• UP: ON / DOWN : OFF
Formation Lights Switch
• UP: BRIGHT / MIDDLE : OFF / DOWN: DIM
Engine Fuel Feed Valve (Service Tank No. 1) Control Switch
• UP: OPEN / DOWN : CLOSED
Engine Fuel Feed Valve (Service Tank No. 2) Control Switch
• UP: OPEN / DOWN : CLOSED
Fuel Pump Switch (No. 2 Fuel Cell)
• UP: OPEN / DOWN : CLOSED
Fuel Pump Switch (No. 5 Fuel Cell)
• UP: OPEN / DOWN : CLOSED
Fuel Pump Switch (No. 4 Fuel Cell)
• UP: OPEN / DOWN : CLOSED
Fuel Pump Switch (External Fuel Tanks)
• UP: OPEN / DOWN : CLOSED
Fuel System Delimiter/Separator Valve Control Switch
• UP: OPEN
• DOWN: CLOSED

Pilot Cockpit




Pilot Cockpit
YaDRO-1 Tuner Light
• The light illuminates while the radio is trying to automatically tune on the set frequency
YaDRO-1 Test Switch
YaDRO-1 Emergency Light
• The light illuminates if the radio becomes inoperative
YaDRO-1 Volume Control
YaDRO-1 Squelch Knob
YaDRO-1 Frequency Setters
YaDRO-1 (JADRO) HF Radio Mode Selector
• "ВЫКЛ" (OFF)
• "ОМ" (SSB, Single Sideband)
• "AM" (AM)
TUNE
TEST
EMERG
VOLUME
OFF
SQ
kHz
0 3 0 0 0.0
AM
APU
AUTO FUEL
CONTROL SYSTEM
AIR BLEED – OFF
APU ← START → ENGINES
CAUTION!
DO NOT START OTHER
ENGINE BEFORE AUTO
CONTROL IF OFF
STOP
STARTING
CRANK
VOLUME
VOICE
CTRL
CW
COMP
ANT.
LOOP
CHANNEL
ADJUST
FREE
TURBINE
TACT.
DROP
CARGO
INCR
HOVER
ON
OFF
YAW


Pilot Cockpit
ARK-15M Volume Control Knob
ARK-15M Receiver Mode Selector
• UP: Voice / Telephony
• DOWN: CW (Continuous Wave) / Telegraph
ARK-15M Control (CTRL) Button
ARK-15M (Automatic Radio Compass / Automatic Directional Finder) Mode Selector
• OFF / Compass / Antenna / Loop
ARK-15M Loop Button
ARK-15M Channel 1 Frequency Controls
ARK-15M Channel Selector
• LEFT: ARK uses Channel 1 frequency
• RIGHT: ARK uses Channel 2 frequency
ARK-15M Channel 2 Frequency Controls
ARK-15M Channel 1 Frequency (hundreds or thousands)
ARK-15M Channel 1 Frequency (tens)
ARK-15M Channel 1 Frequency (ones)
ARK-15M Channel 2 Frequency (hundreds or thousands)
ARK-15M Channel 2 Frequency (tens)
ARK-15M Channel 2 Frequency (ones)
ARK-15M Channel 1 Frequency Tuner (hundreds or thousands)
ARK-15M Channel 1 Frequency Tuner (tens)
ARK-15M Channel 1 Frequency Tuner (ones)
ARK-15M Channel 2 Frequency Tuner (tens)
ARK-15M Channel 2 Frequency Tuner (hundreds or thousands)
ARK-15M Channel 2 Frequency Tuner (ones)
VOLUME
VOICE
CW
CTRL
COMP
ANT.
OFF
LOOP
CHANNEL
TUNE
TEST
150-1799.5
kHz
OPEN CLOSE
CABIN PRESS.
ICS VOL
YADRO-1A
ARK-15M
RESERVE
MANUAL SEQUENCE
CHECK



Pilot Cockpit

GREBEN-1 Course Control / Flight Director System Control Panel

Latitude Setting Control Knob

Latitude Setting

GREBEN Mode Selector

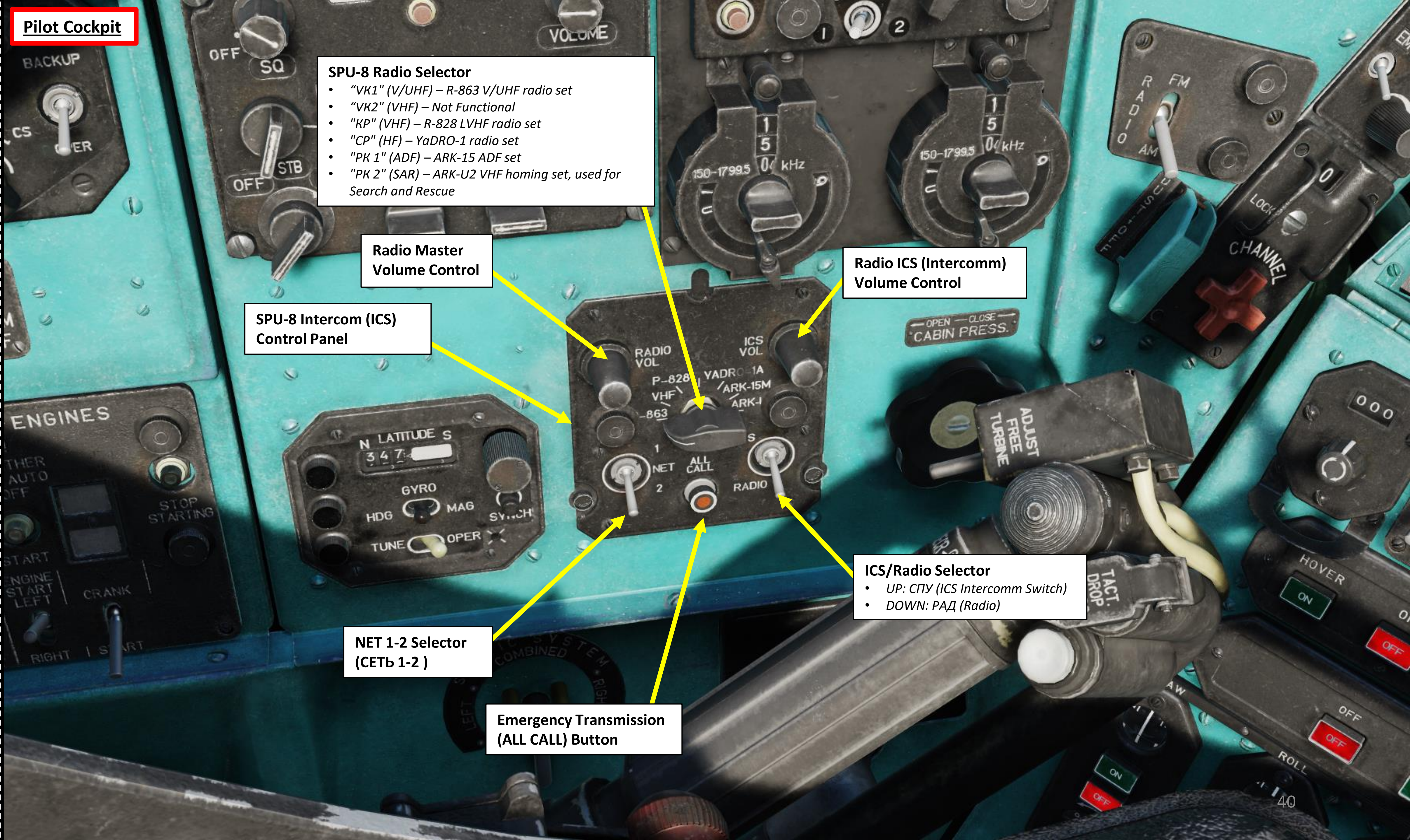
- *LEFT: Heading (ZK) Mode. This mode is used for the Course Control Mode of the flight director.*
- *MIDDLE: Gyro-Compass (GPK) Mode. This is the primary mode of operation, utilizing the flux detector and a magnetic deviation compensator to correct gyro drift. When operating in GPK mode, the gyro is the source of heading data.*
- *RIGHT: Magnetic (MK) Mode. MK mode is used to align the gyro to the signal provided by the flux detector and magnetic deviation compensator. The system is initialized in MK mode to allow the unit to establish baseline heading data. Automatic fast alignment occurs whenever the operating mode is switched from GPK (Gyro-Compass) to MK (Magnetic).*

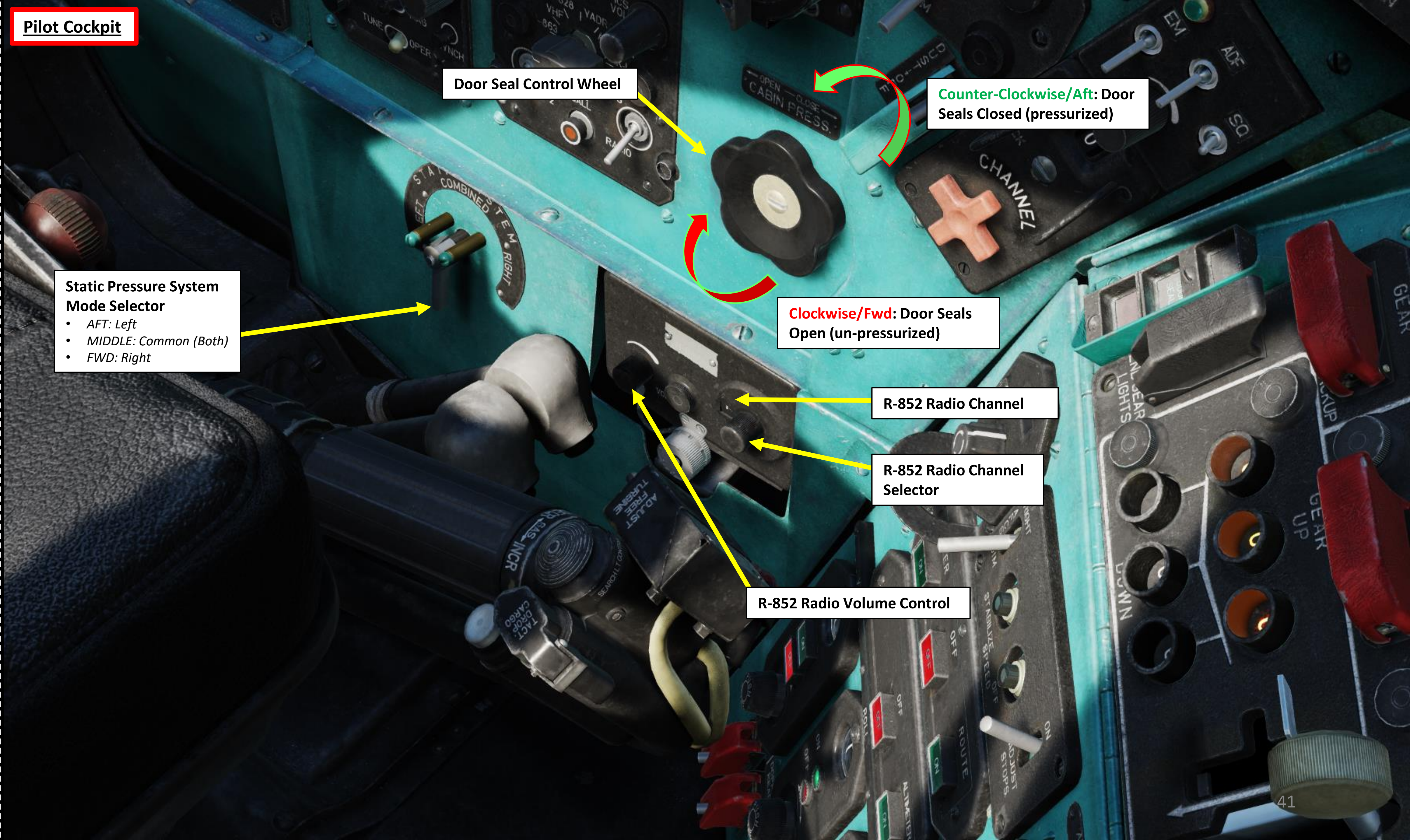
GREBEN Synchronize (SYNC) Button

- *Commands alignment of the GREBEN based on the flux valve*

GREBEN Mode Selector

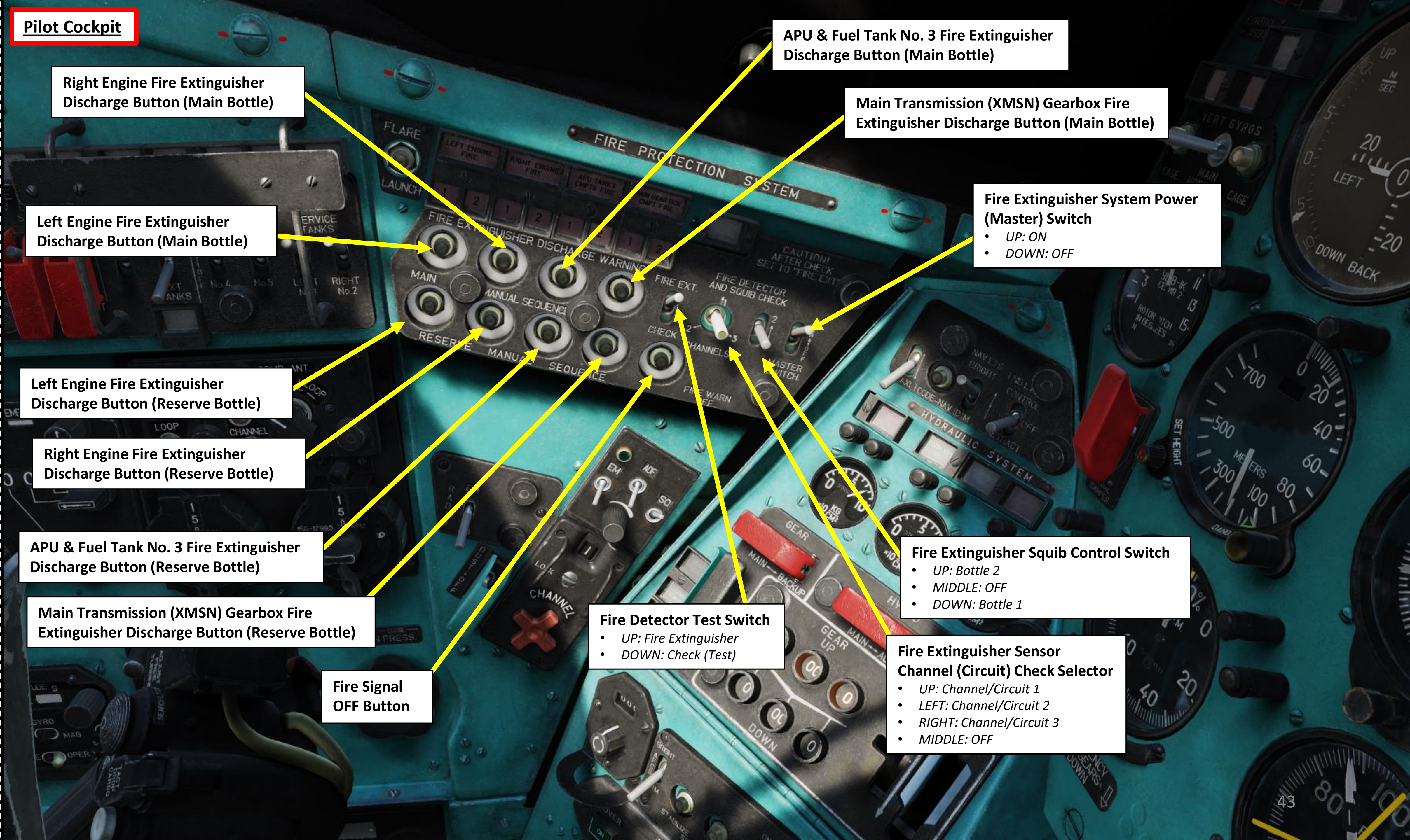
- *LEFT: Tuning (Setup) Mode*
- *RIGHT: Operation Mode*


Pilot Cockpit
SPU-8 Radio Selector
• “VK1" (V/UHF) – R-863 V/UHF radio set
• “VK2" (VHF) – Not Functional
• "KP" (VHF) – R-828 LVHF radio set
• "CP" (HF) – YaDRO-1 radio set
• "PK 1" (ADF) – ARK-15 ADF set
• "PK 2" (SAR) – ARK-U2 VHF homing set, used for Search and Rescue
Radio Master Volume Control
SPU-8 Intercom (ICS) Control Panel
Radio ICS (Intercomm) Volume Control
ICS/Radio Selector
• UP: СПУ (ICS Intercomm Switch)
• DOWN: РАД (Radio)
NET 1-2 Selector (СЕТЬ 1-2)
Emergency Transmission (ALL CALL) Button

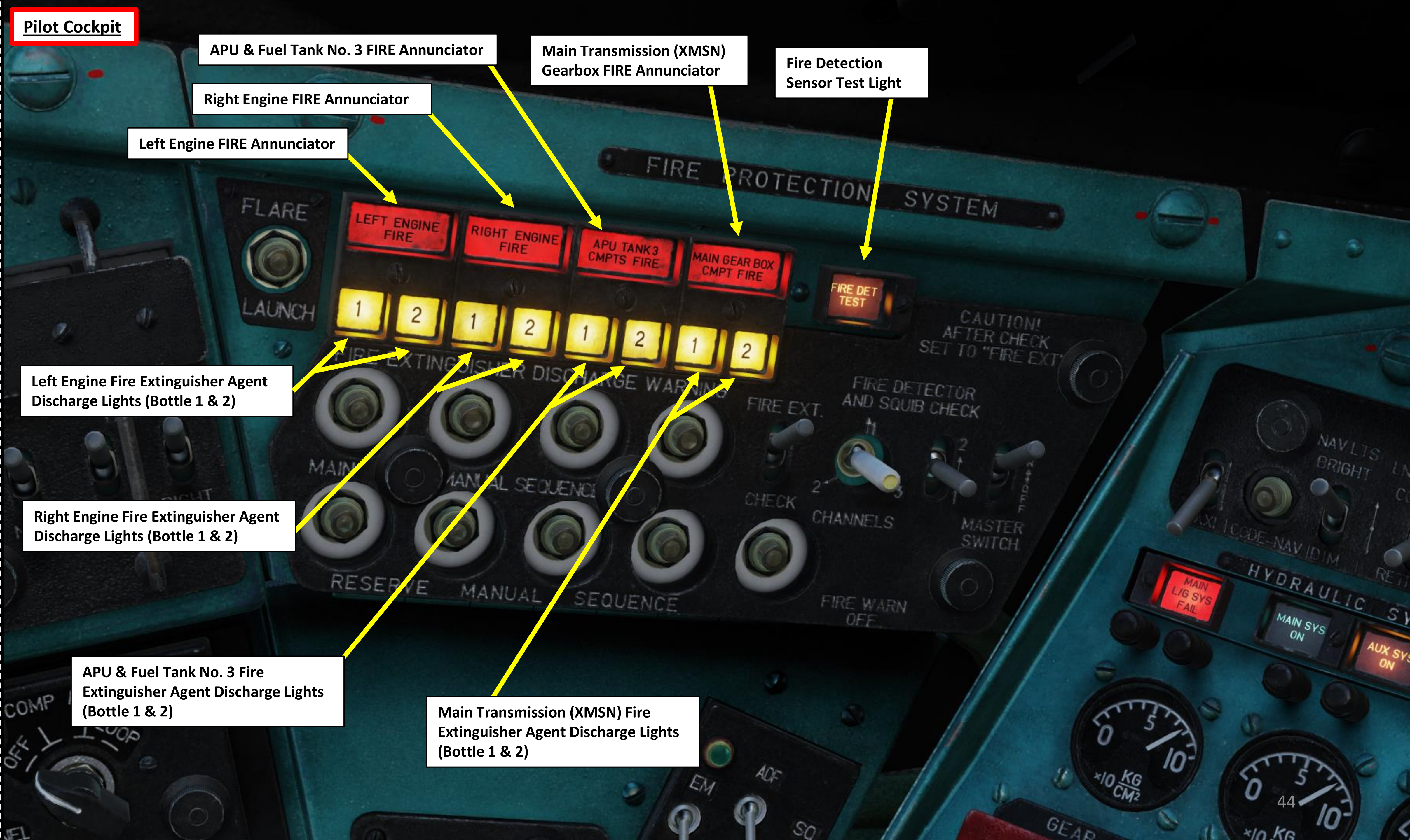

Pilot Cockpit
Door Seal Control Wheel
Counter-Clockwise/Aft: Door Seals Closed (pressurized)
Clockwise/Fwd: Door Seals Open (un-pressurized)
Static Pressure System Mode Selector
• AFT: Left
• MIDDLE: Common (Both)
• FWD: Right
R-852 Radio Channel
R-852 Radio Channel Selector
R-852 Radio Volume Control

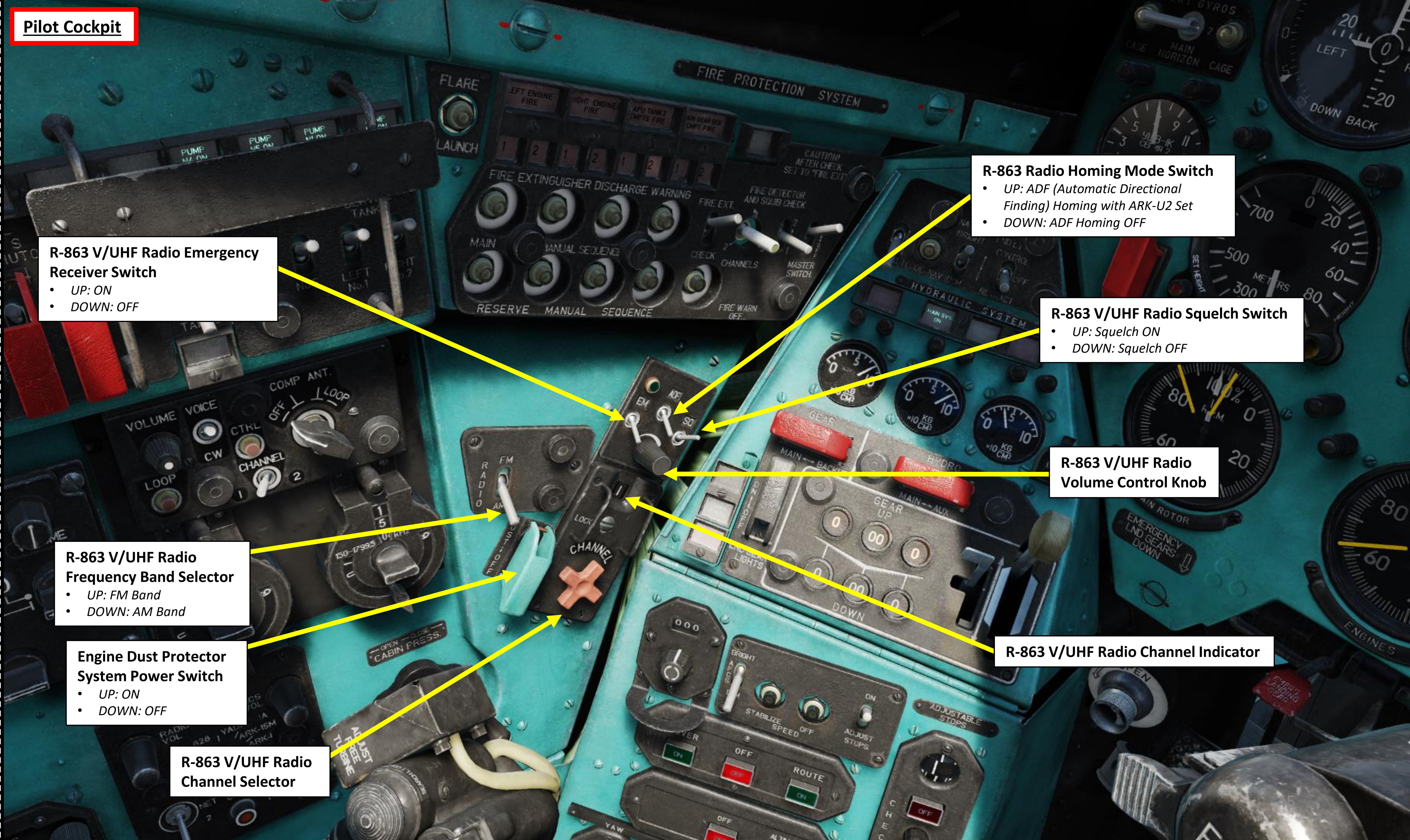
Pilot Cockpit

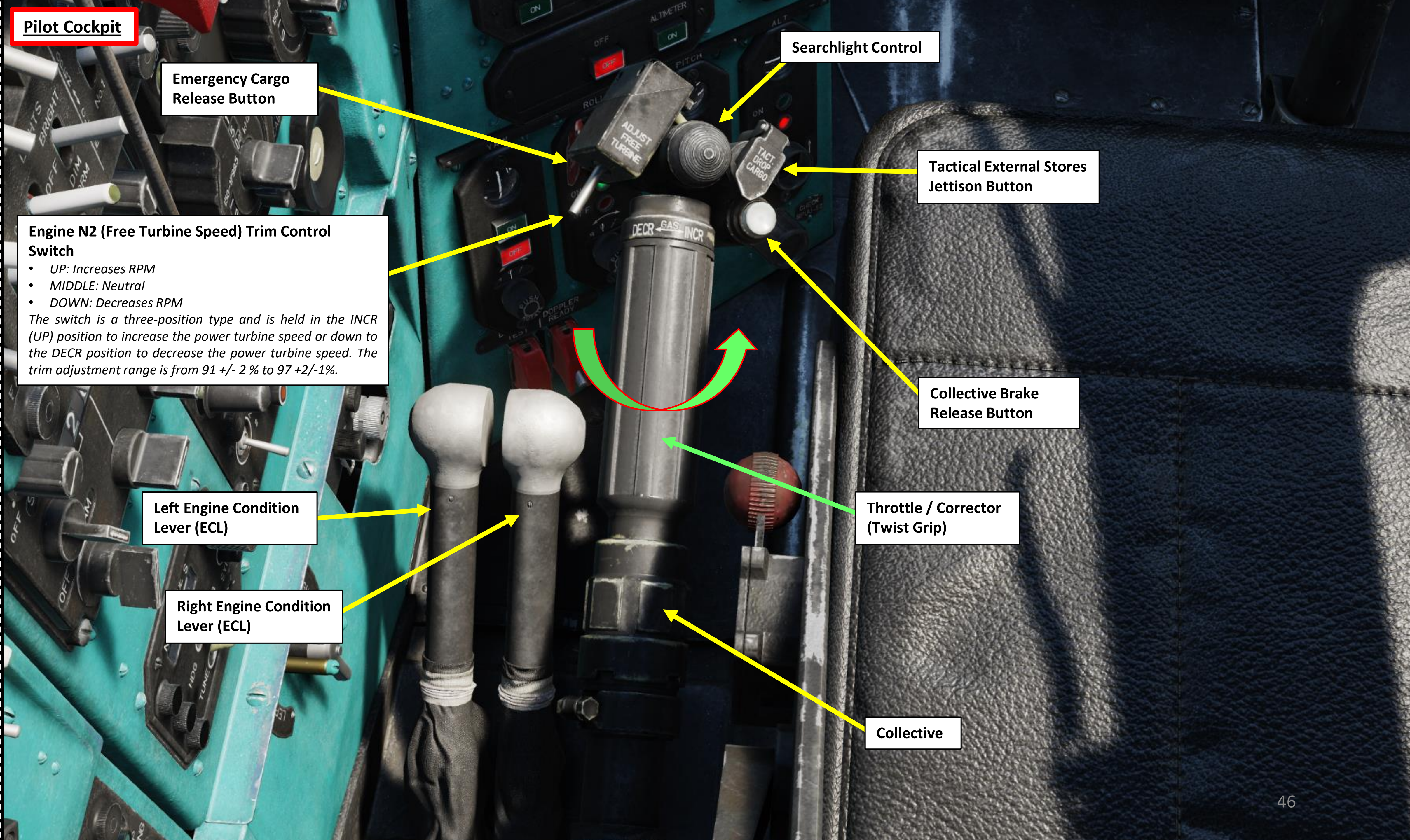
Pilot Cockpit



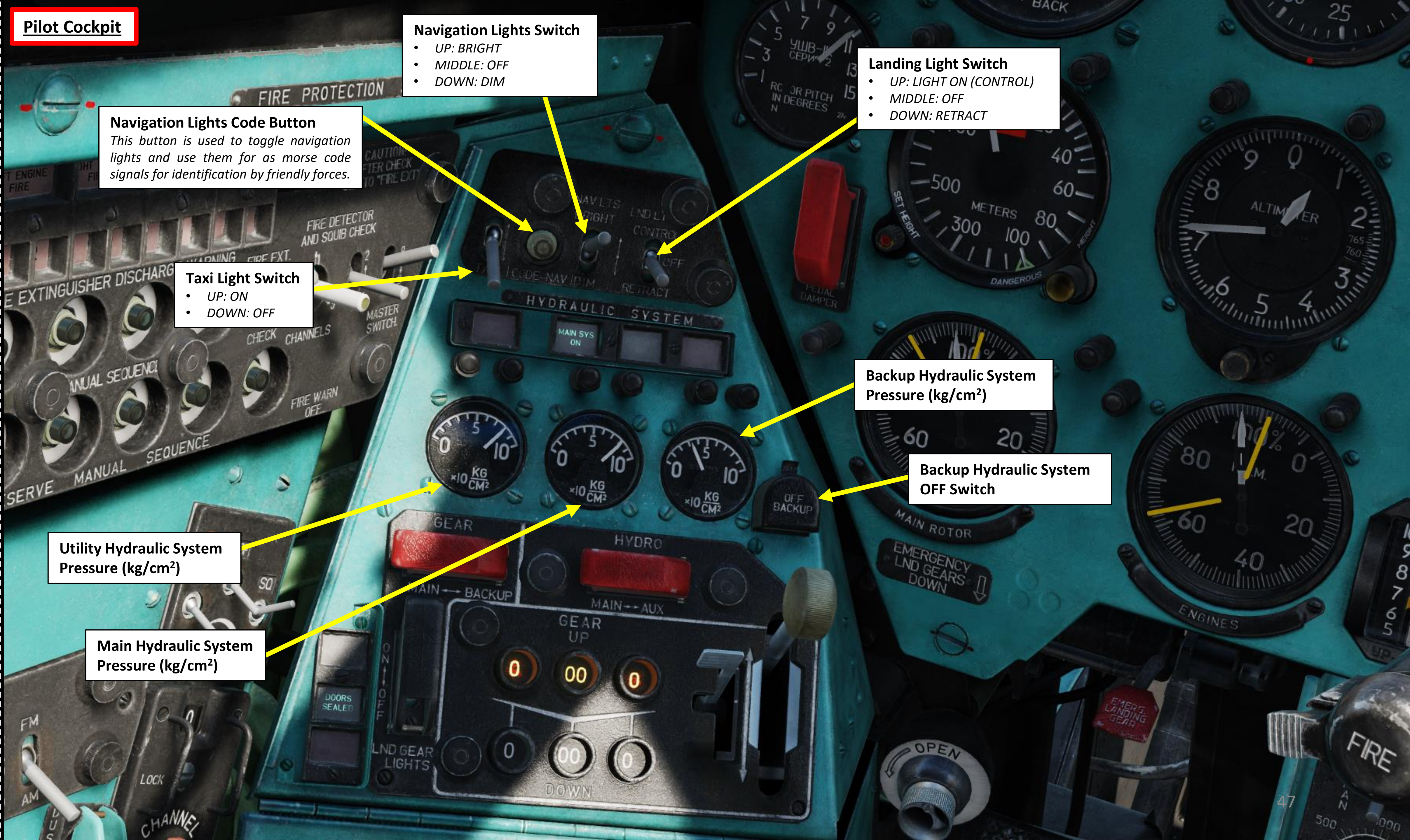
Pilot Cockpit




Pilot Cockpit
R-863 V/UHF Radio Emergency Receiver Switch
• UP: ON
• DOWN: OFF
R-863 Radio Homing Mode Switch
• UP: ADF (Automatic Directional Finding) Homing with ARK-U2 Set
• DOWN: ADF Homing OFF
R-863 V/UHF Radio Squelch Switch
• UP: Squelch ON
• DOWN: Squelch OFF
R-863 V/UHF Radio Volume Control Knob
R-863 V/UHF Radio Frequency Band Selector
• UP: FM Band
• DOWN: AM Band
Engine Dust Protector System Power Switch
• UP: ON
• DOWN: OFF
R-863 V/UHF Radio Channel Indicator
R-863 V/UHF Radio Channel Selector


Pilot Cockpit
Emergency Cargo Release Button
Searchlight Control
Tactical External Stores Jettison Button
Engine N2 (Free Turbine Speed) Trim Control Switch
• UP: Increases RPM
• MIDDLE: Neutral
• DOWN: Decreases RPM
The switch is a three-position type and is held in the INCR (UP) position to increase the power turbine speed or down to the DECR position to decrease the power turbine speed. The trim adjustment range is from 91 +/- 2 % to 97 +2/-1%.
Collective Brake Release Button
Throttle / Corrector (Twist Grip)
Left Engine Condition Lever (ECL)
Right Engine Condition Lever (ECL)
Collective

Pilot Cockpit



Navigation Lights Switch

- *UP: BRIGHT*
- *MIDDLE: OFF*
- *DOWN: DIM*

Landing Light Switch

- *UP: LIGHT ON (CONTROL)*
- *MIDDLE: OFF*
- *DOWN: RETRACT*

Navigation Lights Code Button

This button is used to toggle navigation lights and use them for as morse code signals for identification by friendly forces.

Taxi Light Switch

- *UP: ON*
- *DOWN: OFF*

Backup Hydraulic System Pressure (kg/cm²)

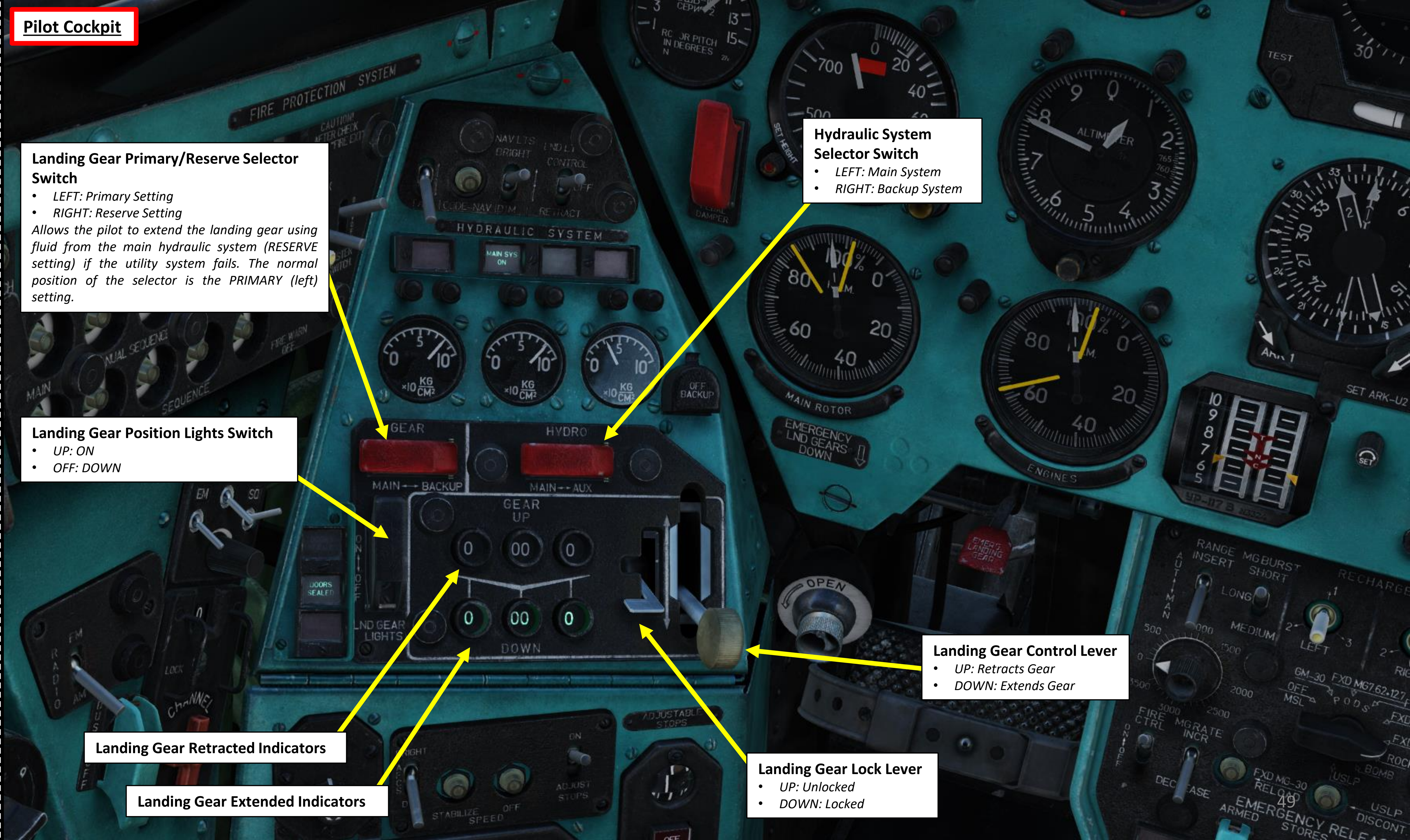
Backup Hydraulic System OFF Switch

Utility Hydraulic System Pressure (kg/cm²)

Main Hydraulic System Pressure (kg/cm²)


Pilot Cockpit
Backup Hydraulic System ON Annunciator
Backup Hydraulic System Failure Annunciator
Utility Hydraulic System Failure Annunciator
Main Hydraulic System ON Annunciator
DOORS UNSEALED Annunciator
DOORS SEALED Annunciator
WHEEL BRAKE APPLIED Annunciator

Pilot Cockpit



Landing Gear Primary/Reserve Selector Switch

- *LEFT: Primary Setting*
- *RIGHT: Reserve Setting*

Allows the pilot to extend the landing gear using fluid from the main hydraulic system (RESERVE setting) if the utility system fails. The normal position of the selector is the PRIMARY (left) setting.

Hydraulic System Selector Switch

- *LEFT: Main System*
- *RIGHT: Backup System*

Landing Gear Position Lights Switch

- *UP: ON*
- *OFF: DOWN*

Landing Gear Control Lever

- *UP: Retracts Gear*
- *DOWN: Extends Gear*

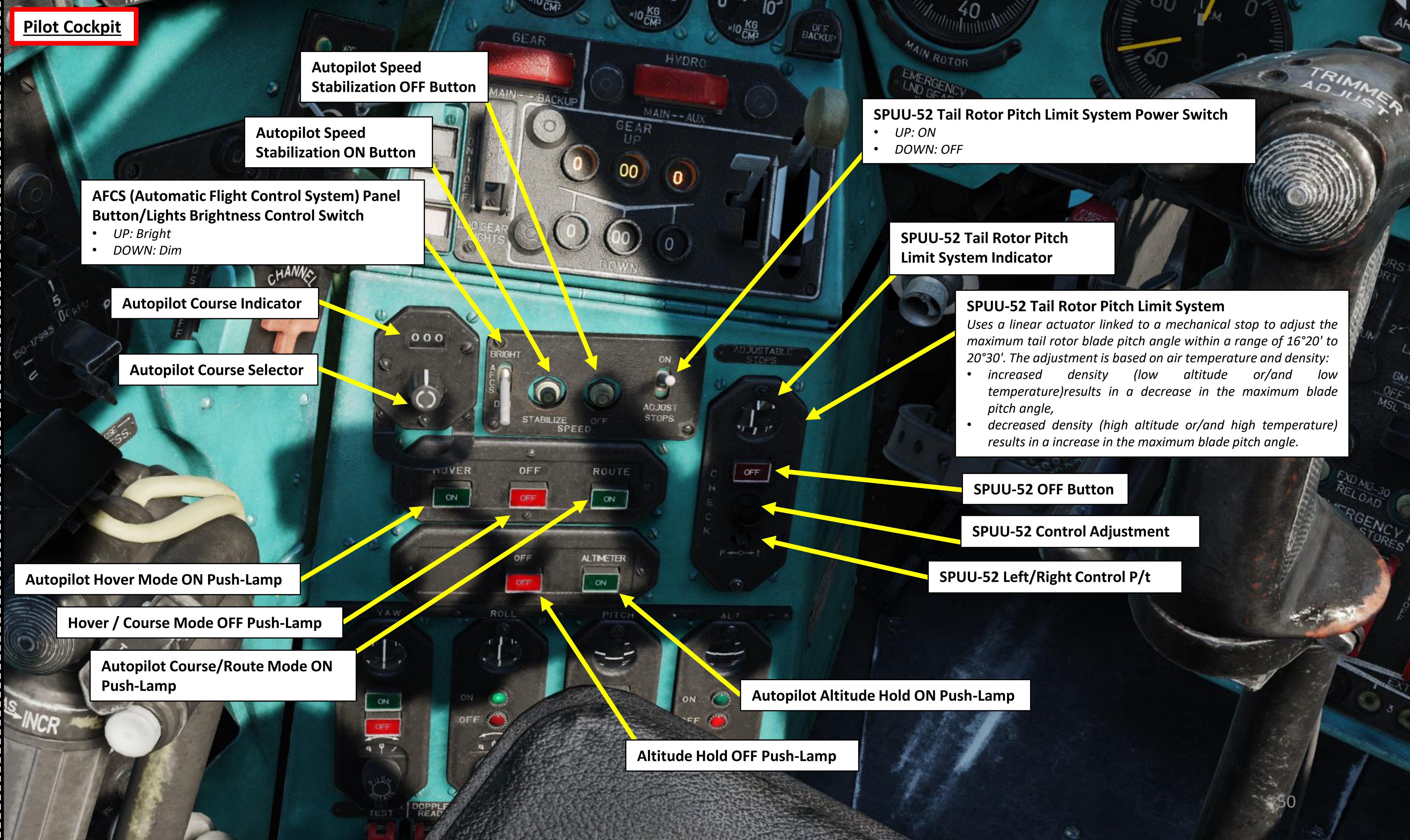
Landing Gear Retracted Indicators

Landing Gear Extended Indicators

Landing Gear Lock Lever

- *UP: Unlocked*
- *DOWN: Locked*

Pilot Cockpit



Autopilot Speed Stabilization OFF Button

Autopilot Speed Stabilization ON Button

AFCS (Automatic Flight Control System) Panel Button/Lights Brightness Control Switch
- *UP: Bright*
- *DOWN: Dim*

Autopilot Course Indicator

Autopilot Course Selector

Autopilot Hover Mode ON Push-Lamp

Hover / Course Mode OFF Push-Lamp

Autopilot Course/Route Mode ON Push-Lamp

SPUU-52 Tail Rotor Pitch Limit System Power Switch
- *UP: ON*
- *DOWN: OFF*

SPUU-52 Tail Rotor Pitch Limit System Indicator

SPUU-52 Tail Rotor Pitch Limit System

Uses a linear actuator linked to a mechanical stop to adjust the maximum tail rotor blade pitch angle within a range of 16°20' to 20°30'. The adjustment is based on air temperature and density:
- *increased density (low altitude or/and low temperature)results in a decrease in the maximum blade pitch angle,*
- *decreased density (high altitude or/and high temperature) results in a increase in the maximum blade pitch angle.*

SPUU-52 OFF Button

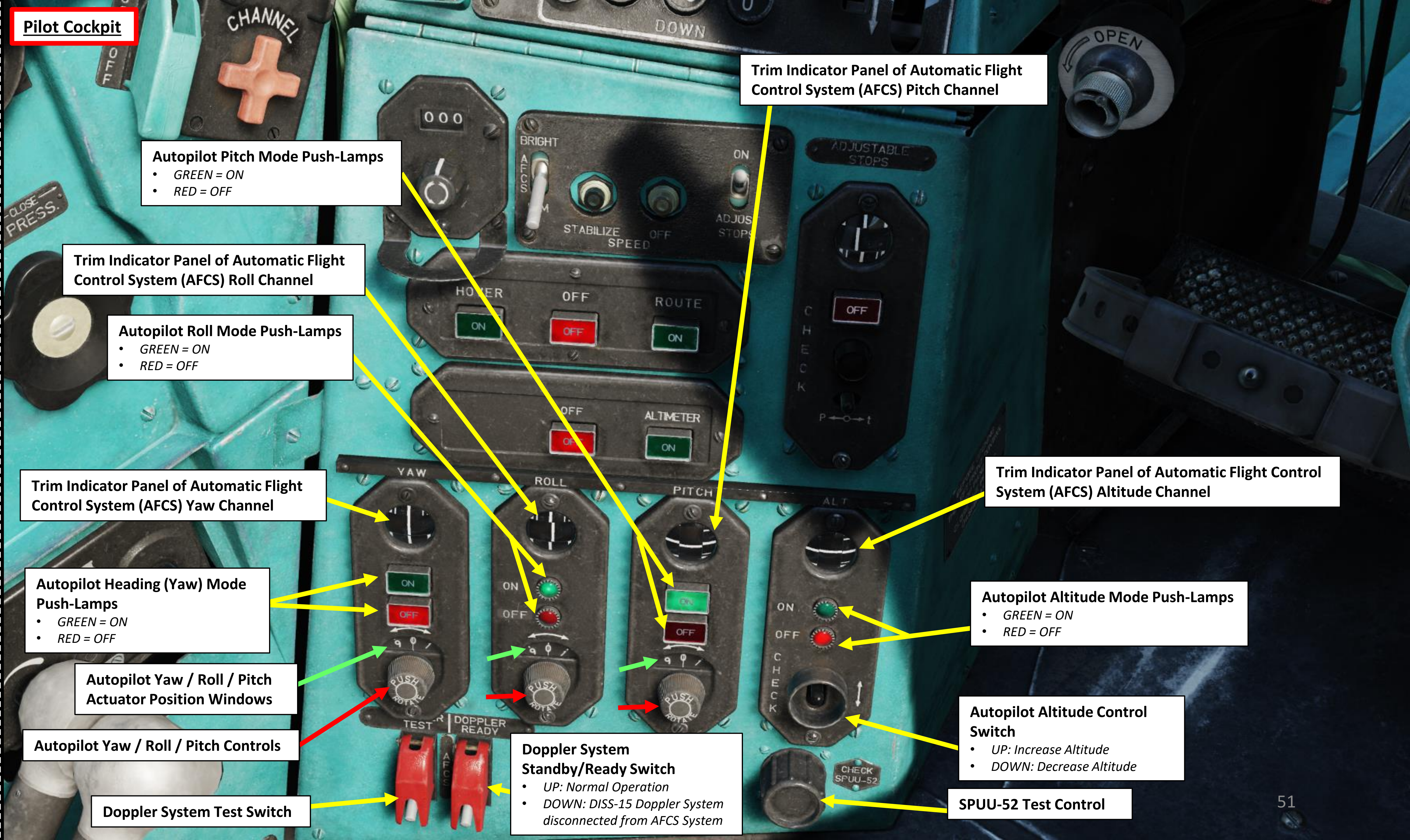
SPUU-52 Control Adjustment

SPUU-52 Left/Right Control P/t

Autopilot Altitude Hold ON Push-Lamp

Altitude Hold OFF Push-Lamp

Pilot Cockpit



Autopilot Pitch Mode Push-Lamps
- *GREEN = ON*
- *RED = OFF*

Trim Indicator Panel of Automatic Flight Control System (AFCS) Roll Channel

Autopilot Roll Mode Push-Lamps
- *GREEN = ON*
- *RED = OFF*

Trim Indicator Panel of Automatic Flight Control System (AFCS) Yaw Channel

Autopilot Heading (Yaw) Mode Push-Lamps
- *GREEN = ON*
- *RED = OFF*

Autopilot Yaw / Roll / Pitch Actuator Position Windows

Autopilot Yaw / Roll / Pitch Controls

Doppler System Test Switch

Doppler System Standby/Ready Switch
- *UP: Normal Operation*
- *DOWN: DISS-15 Doppler System disconnected from AFCS System*

Trim Indicator Panel of Automatic Flight Control System (AFCS) Pitch Channel

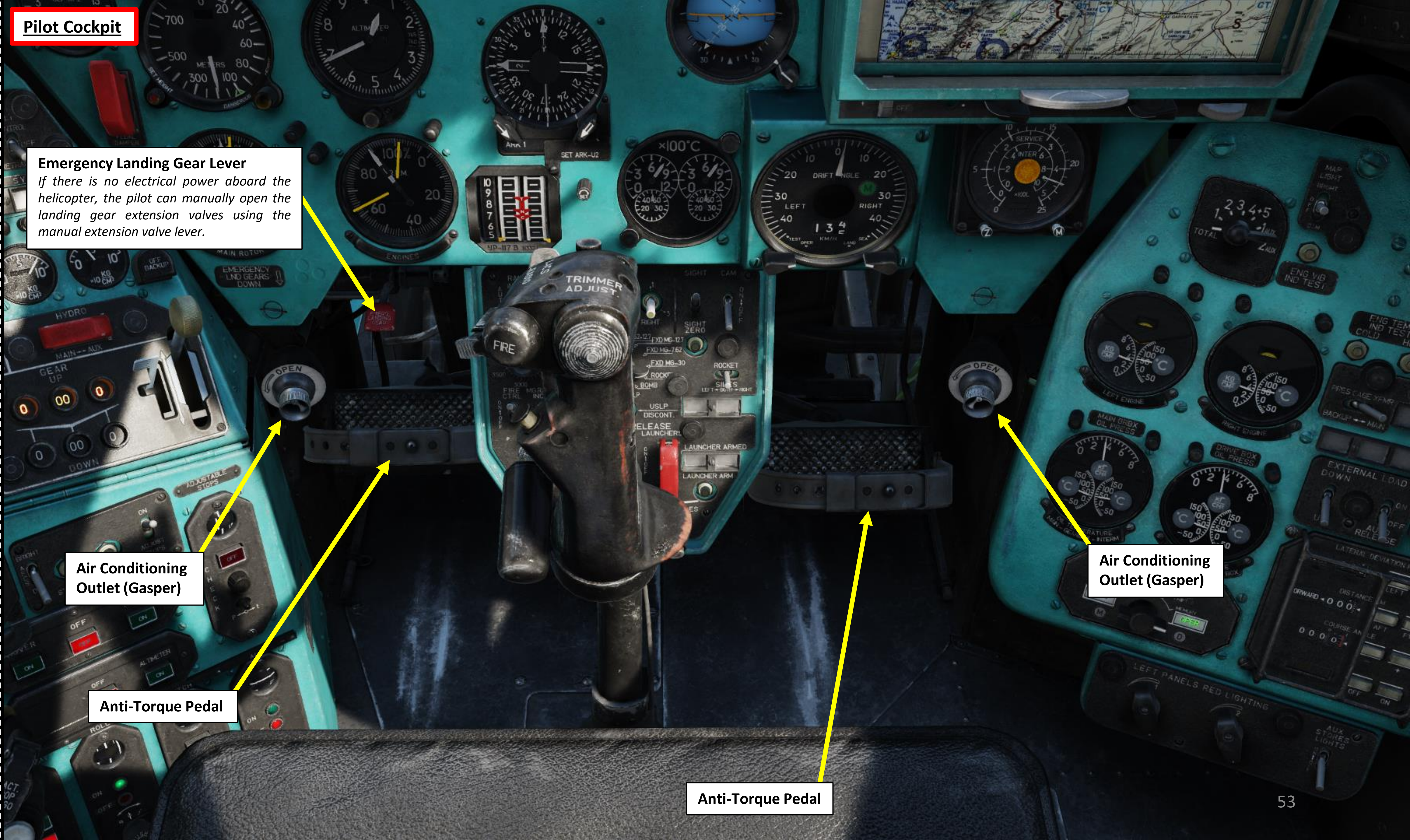
Trim Indicator Panel of Automatic Flight Control System (AFCS) Altitude Channel

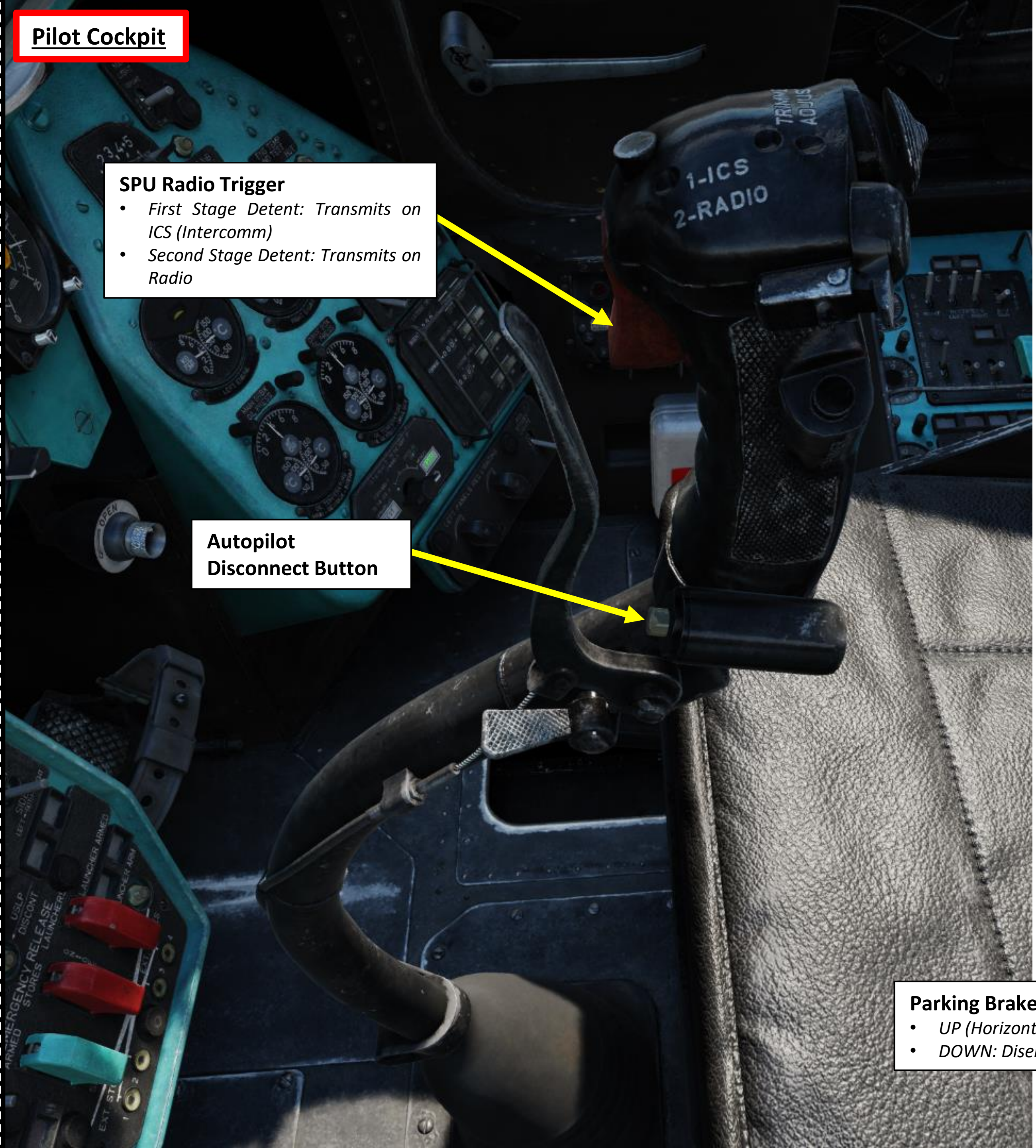
Autopilot Altitude Mode Push-Lamps
- *GREEN = ON*
- *RED = OFF*

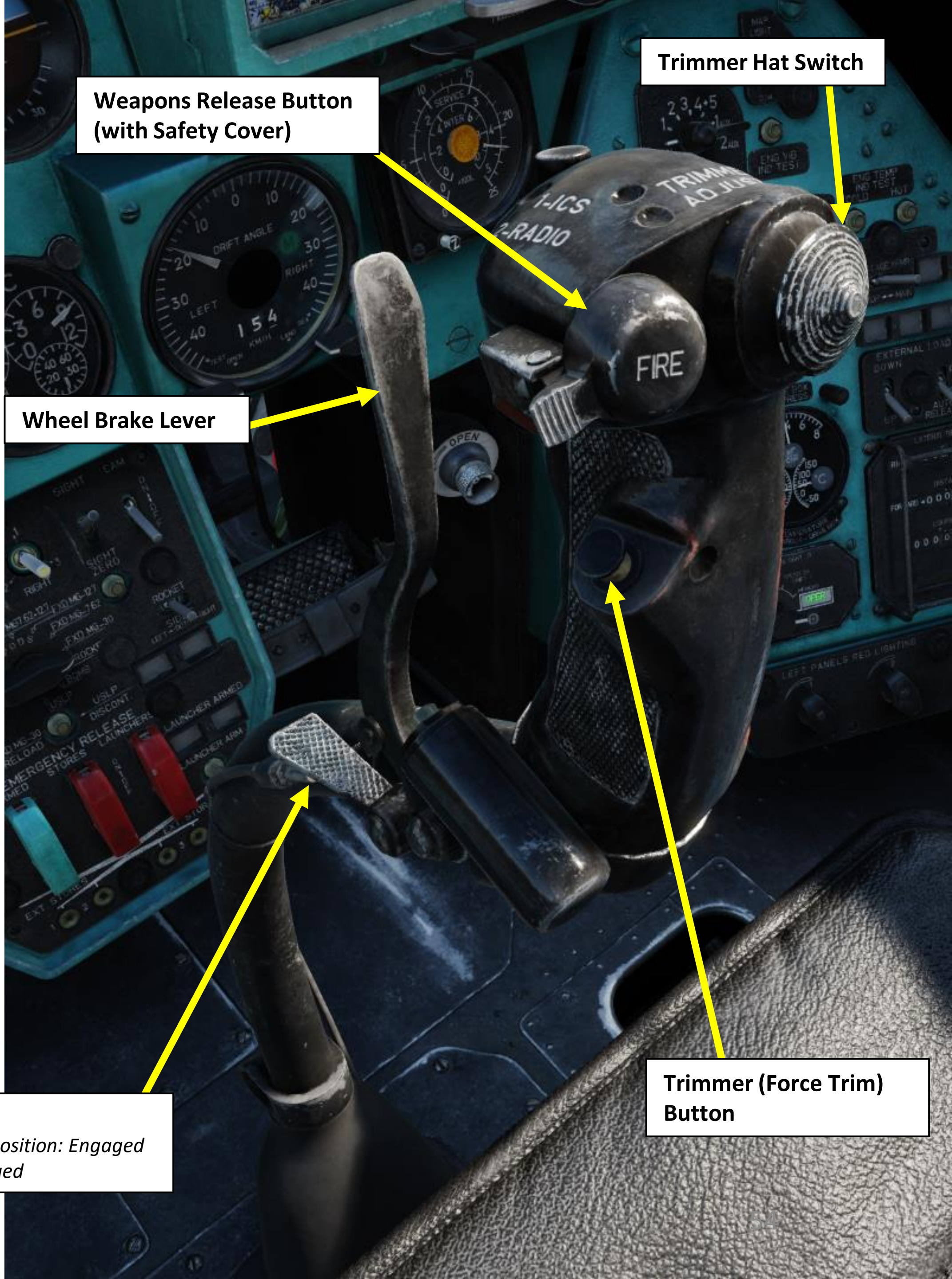
Autopilot Altitude Control Switch
- *UP: Increase Altitude*
- *DOWN: Decrease Altitude*

SPUU-52 Test Control

Pilot Cockpit


Pilot Cockpit
Emergency Landing Gear Lever
If there is no electrical power aboard the helicopter, the pilot can manually open the landing gear extension valves using the manual extension valve lever.
Air Conditioning Outlet (Gasper)
Anti-Torque Pedal
Air Conditioning Outlet (Gasper)
Anti-Torque Pedal


Pilot Cockpit
SPU Radio Trigger
• First Stage Detent: Transmits on ICS (Intercomm)
• Second Stage Detent: Transmits on Radio
Autopilot Disconnect Button
1-ICS
2-RADIO


Trimmer Hat Switch
Weapons Release Button (with Safety Cover)
Wheel Brake Lever
FIRE
Parking Brake
• UP (Horizontal) Position: Engaged
• DOWN: Disengaged
Trimmer (Force Trim) Button

Pilot Cockpit


Pilot Cockpit
Minimum Acceleration
Current Acceleration
Accelerometer (G)
Maximum Acceleration
Accelerometer Reset Button
SPO-10 RWR (Radar Warning Receiver)
Clock
Clock Left Button
• Left Click: Press knob to start/stop/reset knob flight timer.
• Right Click & Scroll Mousewheel: Pull out knob and turn to set time.
Clock Right Button
• Scroll Mousewheel: Turn knob 45 degrees to stop/start the clock.
• Left Click: Press knob to start/stop/reset the stopwatch.

Pilot Cockpit

Pilot/CPG Flight Controls Handover (Control Assume) Switch

- *UP: Normal Operation*
- *DOWN: Co-Pilot/Gunner Cyclic & Collective Control is disconnected and Pilot-Commander assumes cyclic and collective control.*

Vertical Gyro 1 Caging Button

Primary Gyroscope Selector Switch

- *LEFT: Gyro 1*
- *RIGHT: Gyro 2*

Selecting Gyro 1 selects Gyro 2 for the backup ADI (Attitude Director Indicator), while selecting Gyro 2 disables the backup ADI.

Vertical Gyro 2 Caging Button

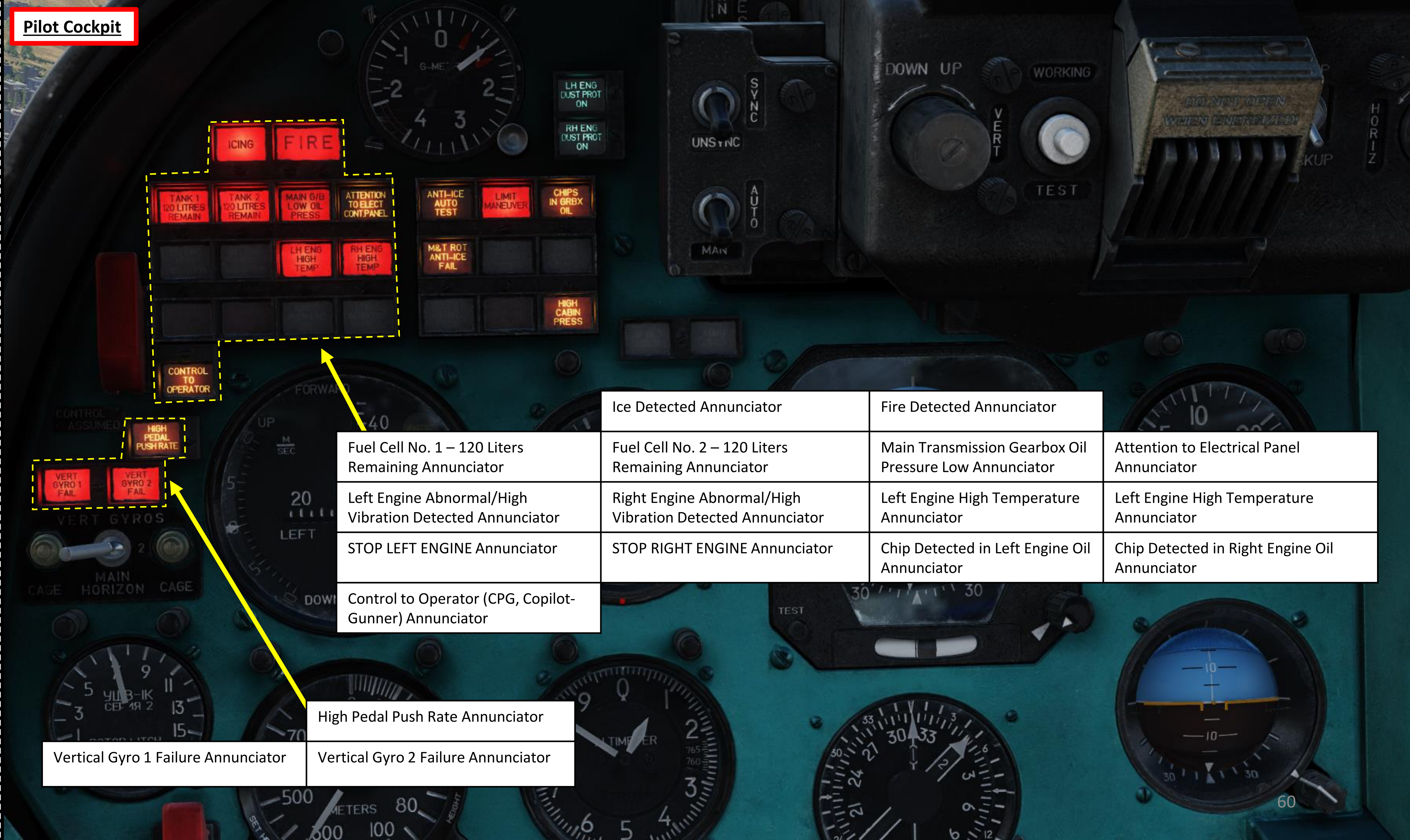
Pedal Damper Switch

The pilot can disengage the pedal damper if the pedals are too heavy (DOWN). The normal operating position is ON (UP).

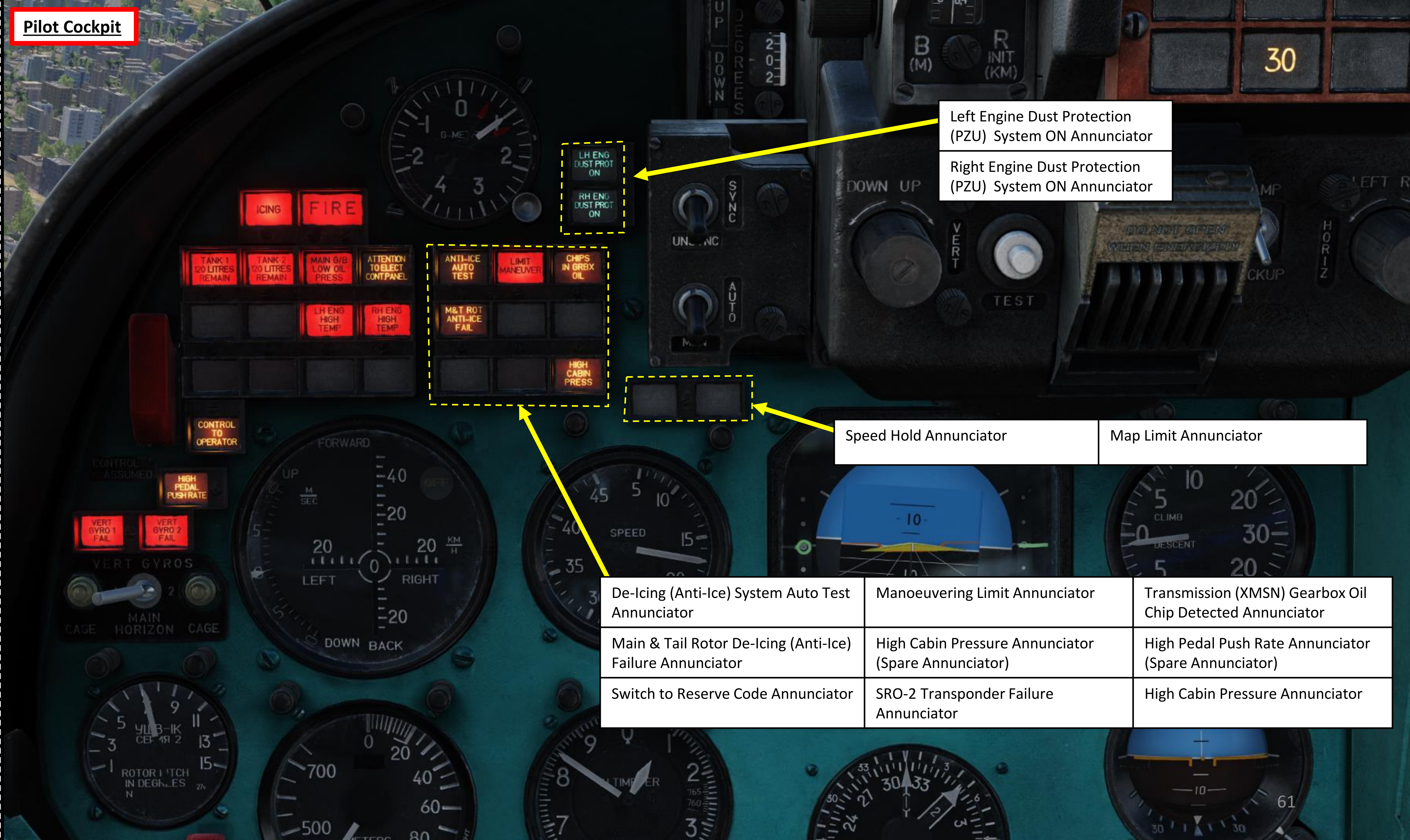
Pilot Cockpit


Pilot Cockpit
PKP-72M ADI (Attitude Director Indicator)
ADI Zero Pitch Trim Knob
ADI Bank Angle (deg)
Vertical Velocity Indicator (m/s)
Turn & Slip Indicator
SAI (Standby Attitude Indicator)
SAI Caging Knob
HSI (Horizontal Situation Indicator)
EPR: Engine Pressure Ratio
• Amber Index: Current Power Setting
• O (T) Index: Takeoff Power Setting
• H (N) Index: Nominal Power Setting
• K (C) Index: Cruise Power Setting
Doppler System Ground Speed & Drift Indicator
PTIT (Power Turbine Inlet Temperature) Indicator (x100 deg C)

Pilot Cockpit



Pilot Cockpit



Left Engine Dust Protection (PZU) System ON Annunciator

Right Engine Dust Protection (PZU) System ON Annunciator

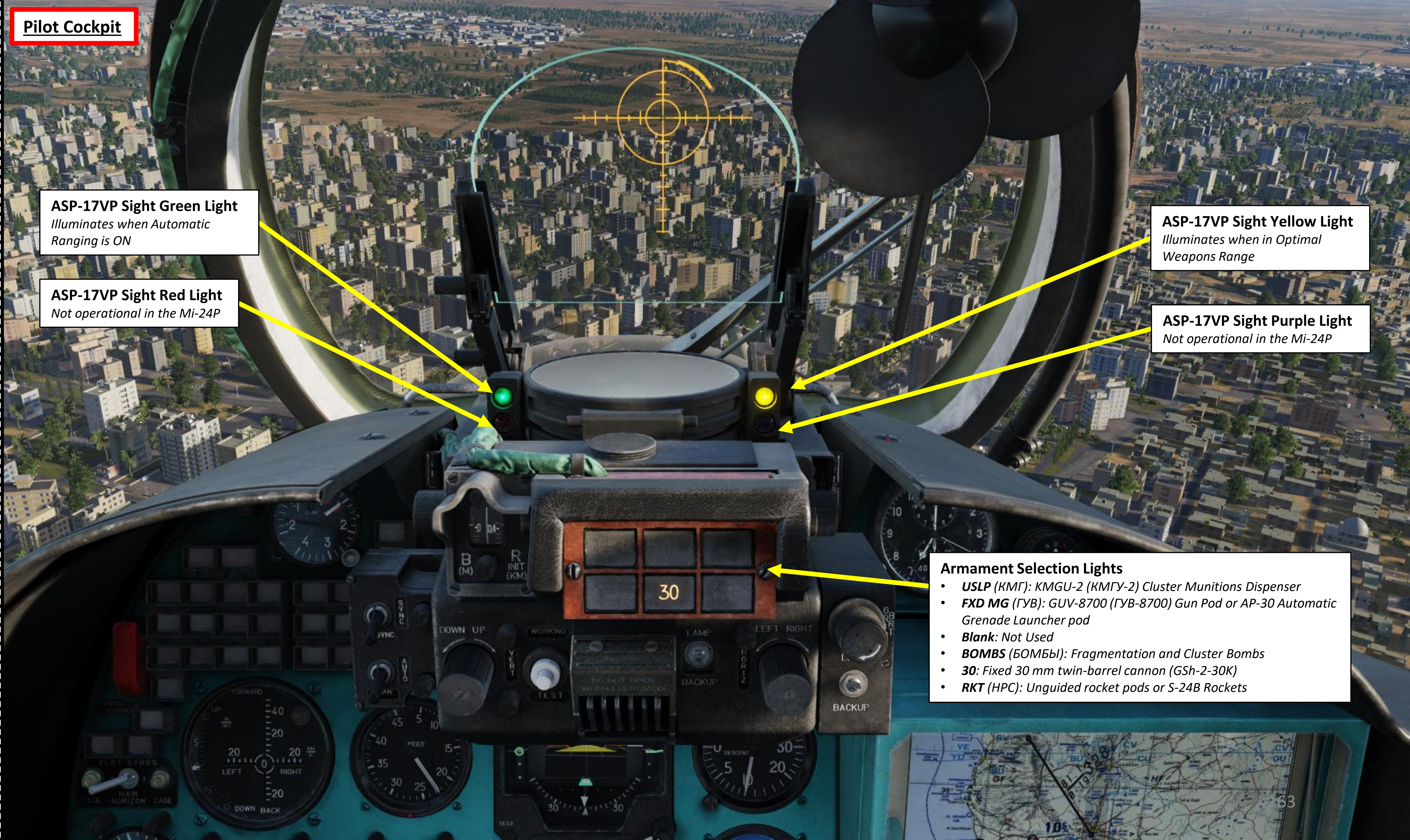
Speed Hold Annunciator

Map Limit Annunciator

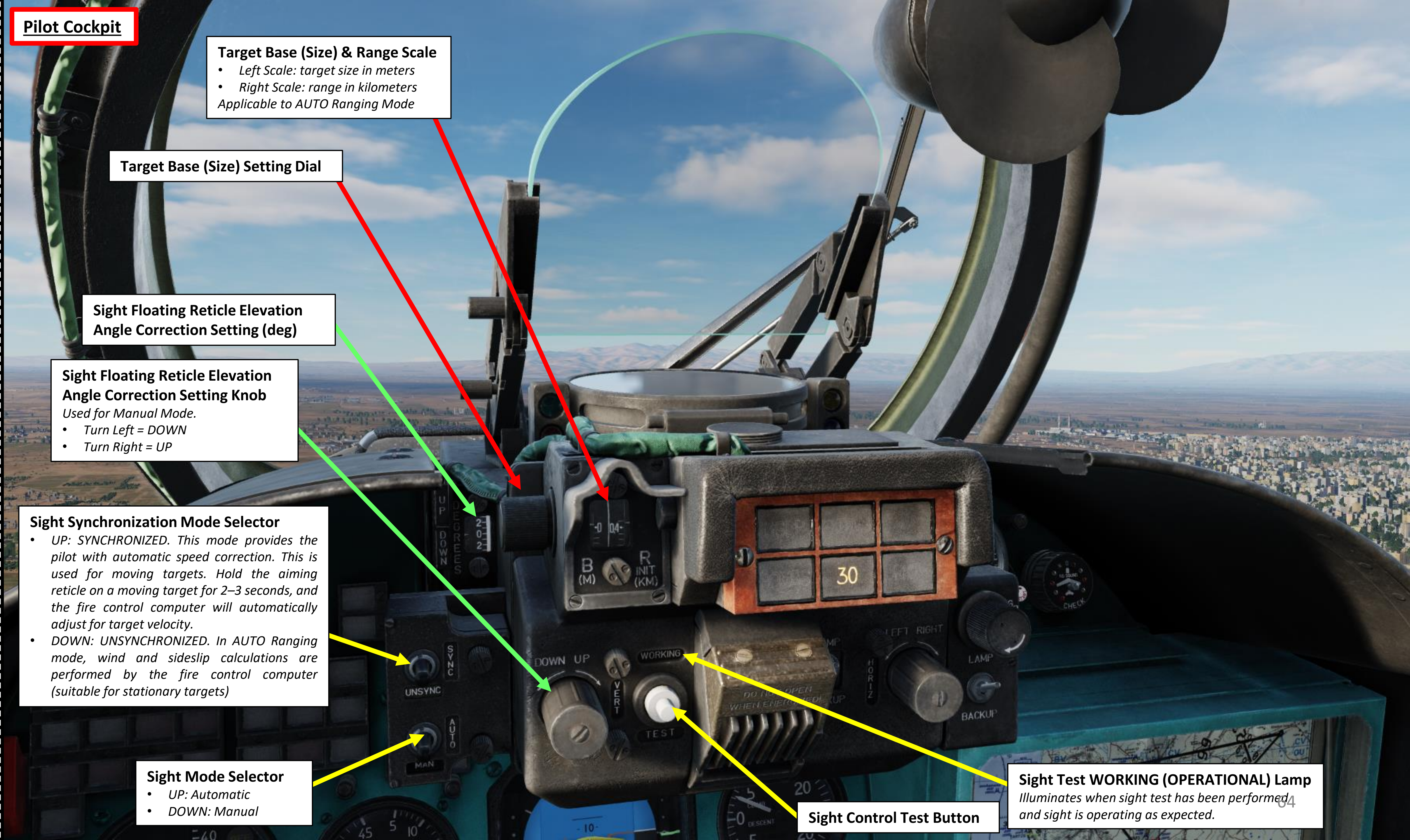
De-Icing (Anti-Ice) System Auto Test Annunciator	Manoeuvering Limit Annunciator	Transmission (XMSN) Gearbox Oil Chip Detected Annunciator
Main & Tail Rotor De-Icing (Anti-Ice) Failure Annunciator	High Cabin Pressure Annunciator (Spare Annunciator)	High Pedal Push Rate Annunciator (Spare Annunciator)
Switch to Reserve Code Annunciator	SRO-2 Transponder Failure Annunciator	High Cabin Pressure Annunciator


Pilot Cockpit
ASP-17VP Sight
Fixed Aiming Reticle (Net)
Floating Aiming Reticle
Sight Reflector Glass Control Lever
• *UP: Sight Unlocked*
• *DOWN: Sight Locked*
When lever is unlocked (UP), scroll mousewheel to adjust reflector glass position as desired

Pilot Cockpit



Pilot Cockpit



Target Base (Size) & Range Scale
- *Left Scale: target size in meters*
- *Right Scale: range in kilometers*

Applicable to AUTO Ranging Mode

Target Base (Size) Setting Dial

Sight Floating Reticle Elevation Angle Correction Setting (deg)

Sight Floating Reticle Elevation Angle Correction Setting Knob

Used for Manual Mode.
- *Turn Left = DOWN*
- *Turn Right = UP*

Sight Synchronization Mode Selector
- *UP: SYNCHRONIZED. This mode provides the pilot with automatic speed correction. This is used for moving targets. Hold the aiming reticle on a moving target for 2–3 seconds, and the fire control computer will automatically adjust for target velocity.*
- *DOWN: UNSYNCHRONIZED. In AUTO Ranging mode, wind and sideslip calculations are performed by the fire control computer (suitable for stationary targets)*

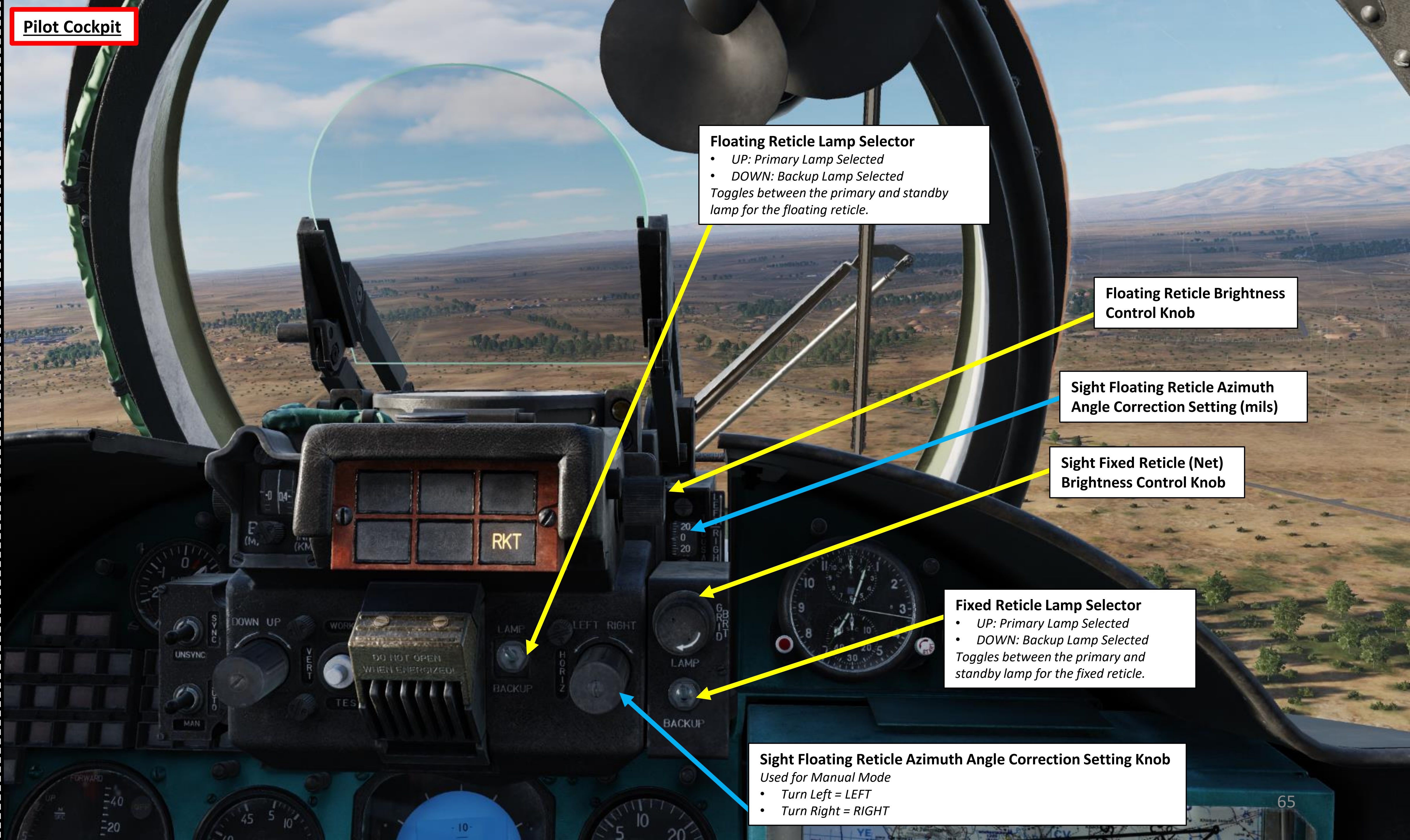
Sight Mode Selector
- *UP: Automatic*
- *DOWN: Manual*

Sight Control Test Button

Sight Test WORKING (OPERATIONAL) Lamp

Illuminates when sight test has been performed and sight is operating as expected.

Pilot Cockpit



Floating Reticle Lamp Selector

- *UP: Primary Lamp Selected*
- *DOWN: Backup Lamp Selected*

Toggles between the primary and standby lamp for the floating reticle.

Floating Reticle Brightness Control Knob

Sight Floating Reticle Azimuth Angle Correction Setting (mils)

Sight Fixed Reticle (Net) Brightness Control Knob

Fixed Reticle Lamp Selector

- *UP: Primary Lamp Selected*
- *DOWN: Backup Lamp Selected*

Toggles between the primary and standby lamp for the fixed reticle.

Sight Floating Reticle Azimuth Angle Correction Setting Knob

Used for Manual Mode

- *Turn Left = LEFT*
- *Turn Right = RIGHT*

Pilot Cockpit

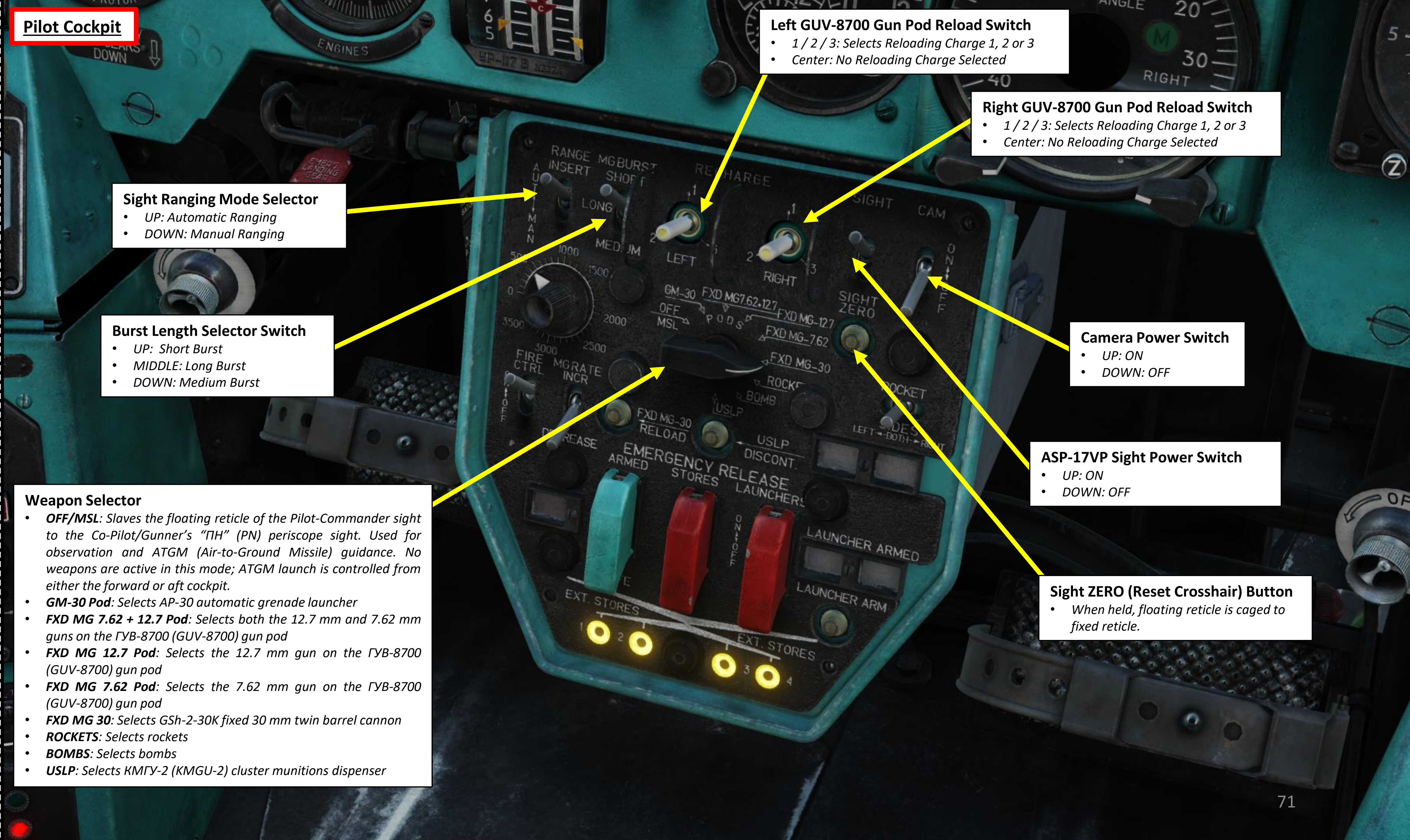
Pilot Cockpit


Pilot Cockpit
Dome Light

Pilot Cockpit

Pilot Cockpit

Pilot Cockpit



Left GUV-8700 Gun Pod Reload Switch
- *1 / 2 / 3: Selects Reloading Charge 1, 2 or 3*
- *Center: No Reloading Charge Selected*

Right GUV-8700 Gun Pod Reload Switch
- *1 / 2 / 3: Selects Reloading Charge 1, 2 or 3*
- *Center: No Reloading Charge Selected*

Sight Ranging Mode Selector
- *UP: Automatic Ranging*
- *DOWN: Manual Ranging*

Burst Length Selector Switch
- *UP: Short Burst*
- *MIDDLE: Long Burst*
- *DOWN: Medium Burst*

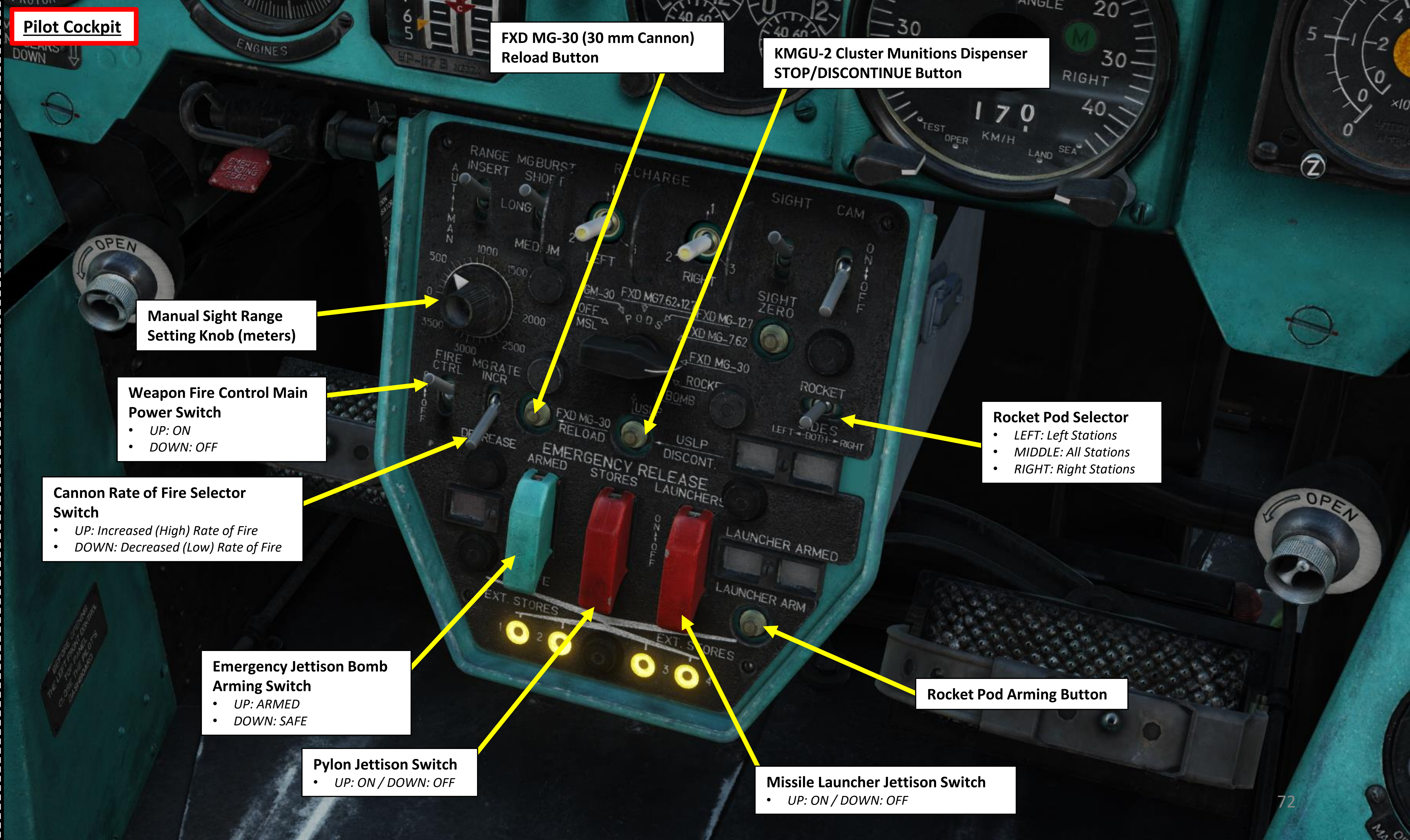
Camera Power Switch
- *UP: ON*
- *DOWN: OFF*

ASP-17VP Sight Power Switch
- *UP: ON*
- *DOWN: OFF*

Weapon Selector
- ***OFF/MSL**: Slaves the floating reticle of the Pilot-Commander sight to the Co-Pilot/Gunner's "ПН" (PN) periscope sight. Used for observation and ATGM (Air-to-Ground Missile) guidance. No weapons are active in this mode; ATGM launch is controlled from either the forward or aft cockpit.*
- ***GM-30 Pod**: Selects AP-30 automatic grenade launcher*
- ***FXD MG 7.62 + 12.7 Pod**: Selects both the 12.7 mm and 7.62 mm guns on the ГУВ-8700 (GUV-8700) gun pod*
- ***FXD MG 12.7 Pod**: Selects the 12.7 mm gun on the ГУВ-8700 (GUV-8700) gun pod*
- ***FXD MG 7.62 Pod**: Selects the 7.62 mm gun on the ГУВ-8700 (GUV-8700) gun pod*
- ***FXD MG 30**: Selects GSh-2-30K fixed 30 mm twin barrel cannon*
- ***ROCKETS**: Selects rockets*
- ***BOMBS**: Selects bombs*
- ***USLP**: Selects КМГУ-2 (KMGU-2) cluster munitions dispenser*

Sight ZERO (Reset Crosshair) Button
- *When held, floating reticle is caged to fixed reticle.*

Pilot Cockpit



FXD MG-30 (30 mm Cannon) Reload Button

KMGU-2 Cluster Munitions Dispenser STOP/DISCONTINUE Button

Manual Sight Range Setting Knob (meters)

Weapon Fire Control Main Power Switch
- *UP: ON*
- *DOWN: OFF*

Cannon Rate of Fire Selector Switch
- *UP: Increased (High) Rate of Fire*
- *DOWN: Decreased (Low) Rate of Fire*

Rocket Pod Selector
- *LEFT: Left Stations*
- *MIDDLE: All Stations*
- *RIGHT: Right Stations*

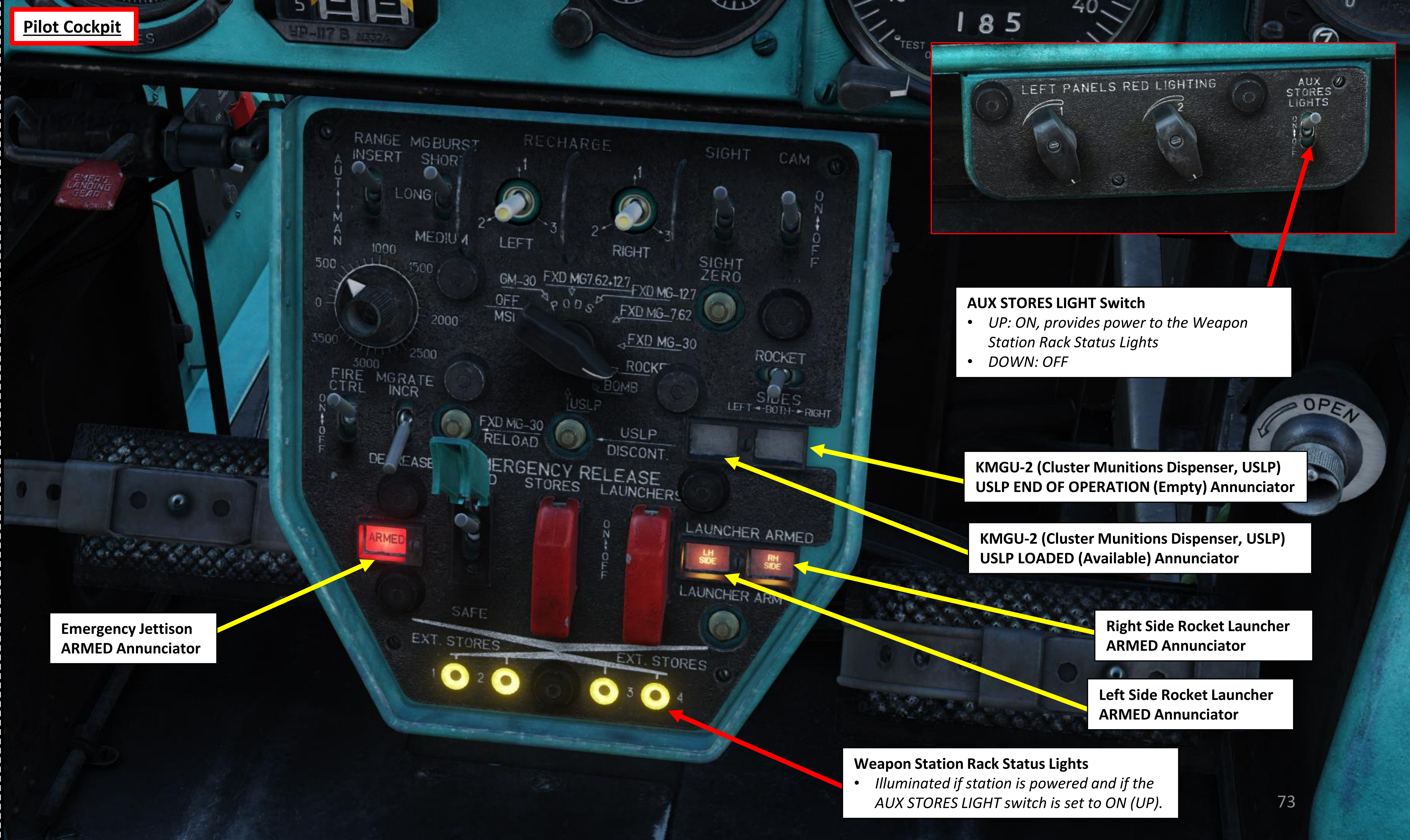
Rocket Pod Arming Button

Emergency Jettison Bomb Arming Switch
- *UP: ARMED*
- *DOWN: SAFE*

Pylon Jettison Switch
- *UP: ON / DOWN: OFF*

Missile Launcher Jettison Switch
- *UP: ON / DOWN: OFF*

Pilot Cockpit



AUX STORES LIGHT Switch
- *UP: ON, provides power to the Weapon Station Rack Status Lights*
- *DOWN: OFF*

KMGU-2 (Cluster Munitions Dispenser, USLP) USLP END OF OPERATION (Empty) Annunciator

KMGU-2 (Cluster Munitions Dispenser, USLP) USLP LOADED (Available) Annunciator

Right Side Rocket Launcher ARMED Annunciator

Left Side Rocket Launcher ARMED Annunciator

Emergency Jettison ARMED Annunciator

Weapon Station Rack Status Lights
- *Illuminated if station is powered and if the AUX STORES LIGHT switch is set to ON (UP).*

Pilot Cockpit

Map

Helicopter Position Indicator

- *The Position Indicator is moved on the map by the DISS-15 Doppler Navigation System.*
- *The helicopter's position can accumulate error/drift over time. The Position Indicator can be adjusted with the Vertical Position and Horizontal Position Adjustment Control thumbwheels.*

Vertical Position Adjustment Control Thumbwheel

Map Power Switch

- *UP: ON*
- *DOWN: OFF*

Map Scale Selector Switch

- *UP: Scale 1*
- *DOWN: Scale 2*

Horizontal Position Adjustment Control Thumbwheel

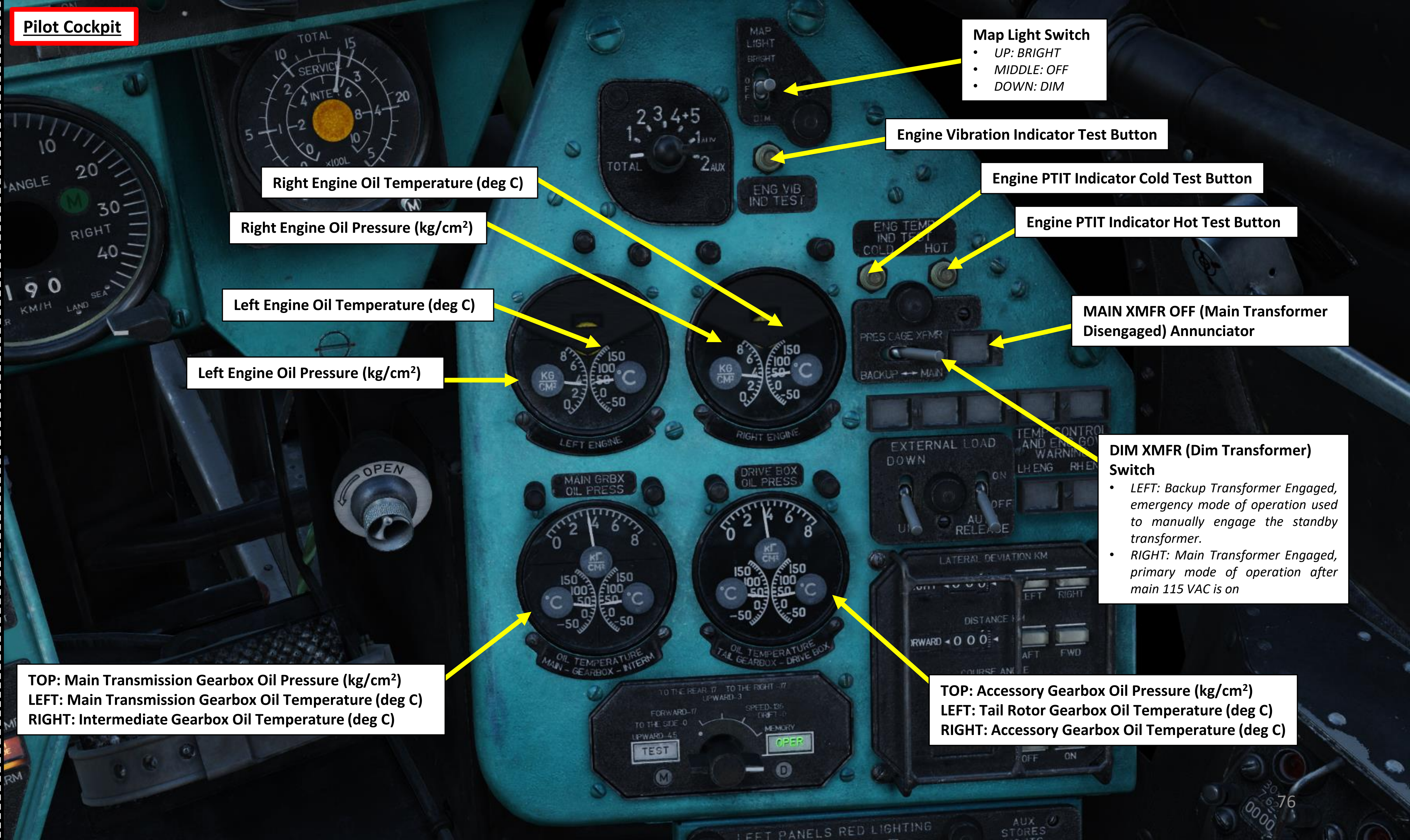
Pilot Cockpit

Fuel Quantity Indicator (x100 L)

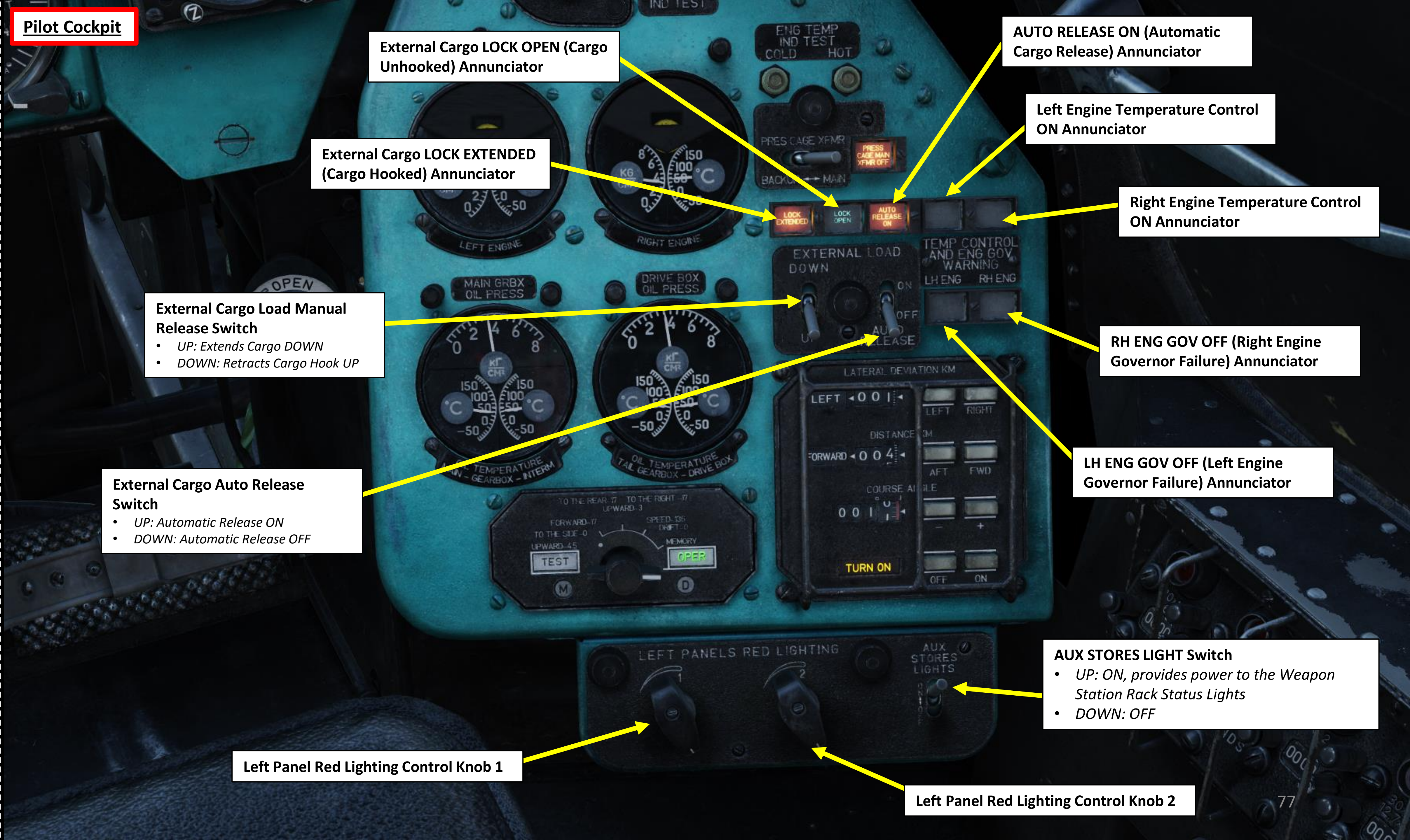
- ***External Outer Scale****: Displays combined quantity of fuel in cells No. 1, 2, 3, 4 and 5 when selector is set to the TOTAL position.*
- ***External Inside Scale****: Displays quantity of fuel in each cell individually when the selector is set to the 1, 2 or 3 position.*
- ***Inner Scale****:*
    - *Selector to 4+5 position: Displays the combined fuel quantity in cells No. 4 and 5.*
    - *Selector to AUX 1: Displays fuel quantity in internal auxiliary tank No. 6*
    - *Selector to AUX 2: Displays fuel quantity in internal auxiliary tank No. 7*

Fuel Quantity Content Selector

- TOTAL
- ***1****: Fuel Cell No. 1*
- ***2****: Fuel Cell No. 2*
- ***3****: Fuel Cell No. 3*
- ***4+5****: Fuel Cells No. 4 + No. 5*
- ***1 AUX****: Internal Auxiliary Fuel Tank No. 6*
- ***2 AUX****: Internal Auxiliary Fuel Tank No. 7*


Pilot Cockpit
Map Light Switch
• UP: BRIGHT
• MIDDLE: OFF
• DOWN: DIM
Engine Vibration Indicator Test Button
Engine PTIT Indicator Cold Test Button
Engine PTIT Indicator Hot Test Button
Right Engine Oil Temperature (deg C)
Right Engine Oil Pressure (kg/cm²)
Left Engine Oil Temperature (deg C)
Left Engine Oil Pressure (kg/cm²)
MAIN XMFR OFF (Main Transformer Disengaged) Annunciator
DIM XMFR (Dim Transformer) Switch
• LEFT: Backup Transformer Engaged, emergency mode of operation used to manually engage the standby transformer.
• RIGHT: Main Transformer Engaged, primary mode of operation after main 115 VAC is on
TOP: Main Transmission Gearbox Oil Pressure (kg/cm²)
LEFT: Main Transmission Gearbox Oil Temperature (deg C)
RIGHT: Intermediate Gearbox Oil Temperature (deg C)
TOP: Accessory Gearbox Oil Pressure (kg/cm²)
LEFT: Tail Rotor Gearbox Oil Temperature (deg C)
RIGHT: Accessory Gearbox Oil Temperature (deg C)

Pilot Cockpit



External Cargo LOCK OPEN (Cargo Unhooked) Annunciator

AUTO RELEASE ON (Automatic Cargo Release) Annunciator

Left Engine Temperature Control ON Annunciator

External Cargo LOCK EXTENDED (Cargo Hooked) Annunciator

Right Engine Temperature Control ON Annunciator

External Cargo Load Manual Release Switch
- *UP: Extends Cargo DOWN*
- *DOWN: Retracts Cargo Hook UP*

RH ENG GOV OFF (Right Engine Governor Failure) Annunciator

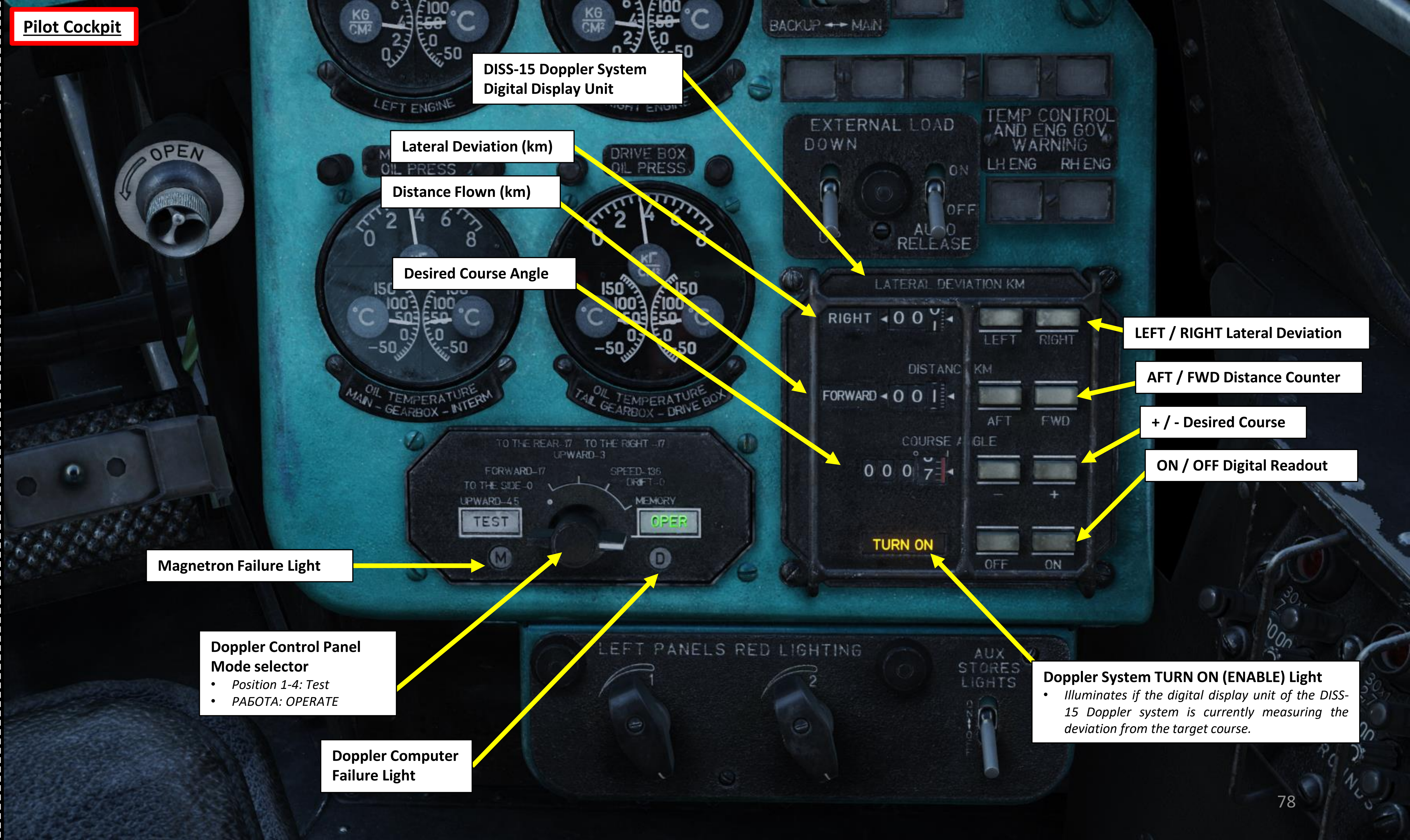
LH ENG GOV OFF (Left Engine Governor Failure) Annunciator

External Cargo Auto Release Switch
- *UP: Automatic Release ON*
- *DOWN: Automatic Release OFF*

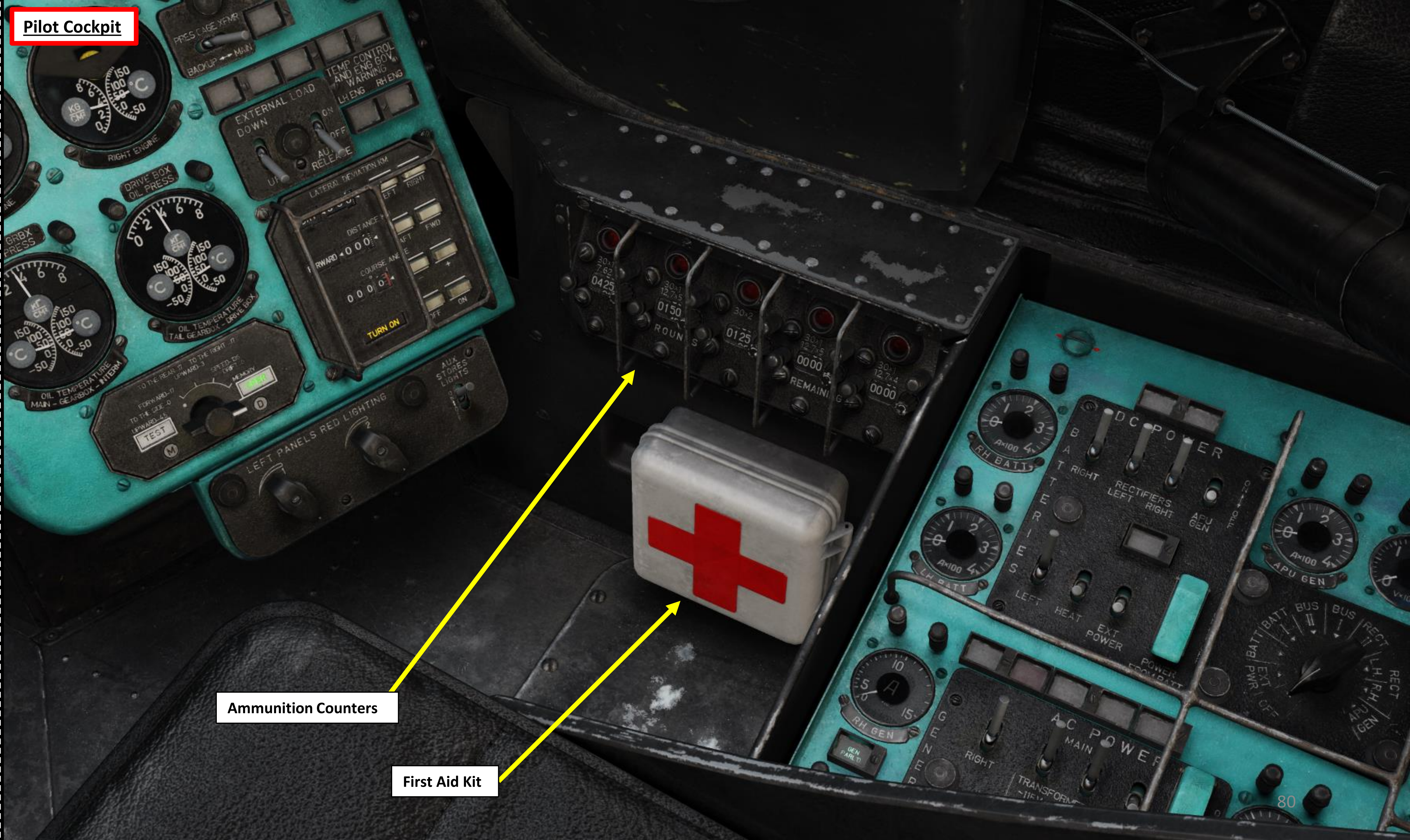
AUX STORES LIGHT Switch
- *UP: ON, provides power to the Weapon Station Rack Status Lights*
- *DOWN: OFF*

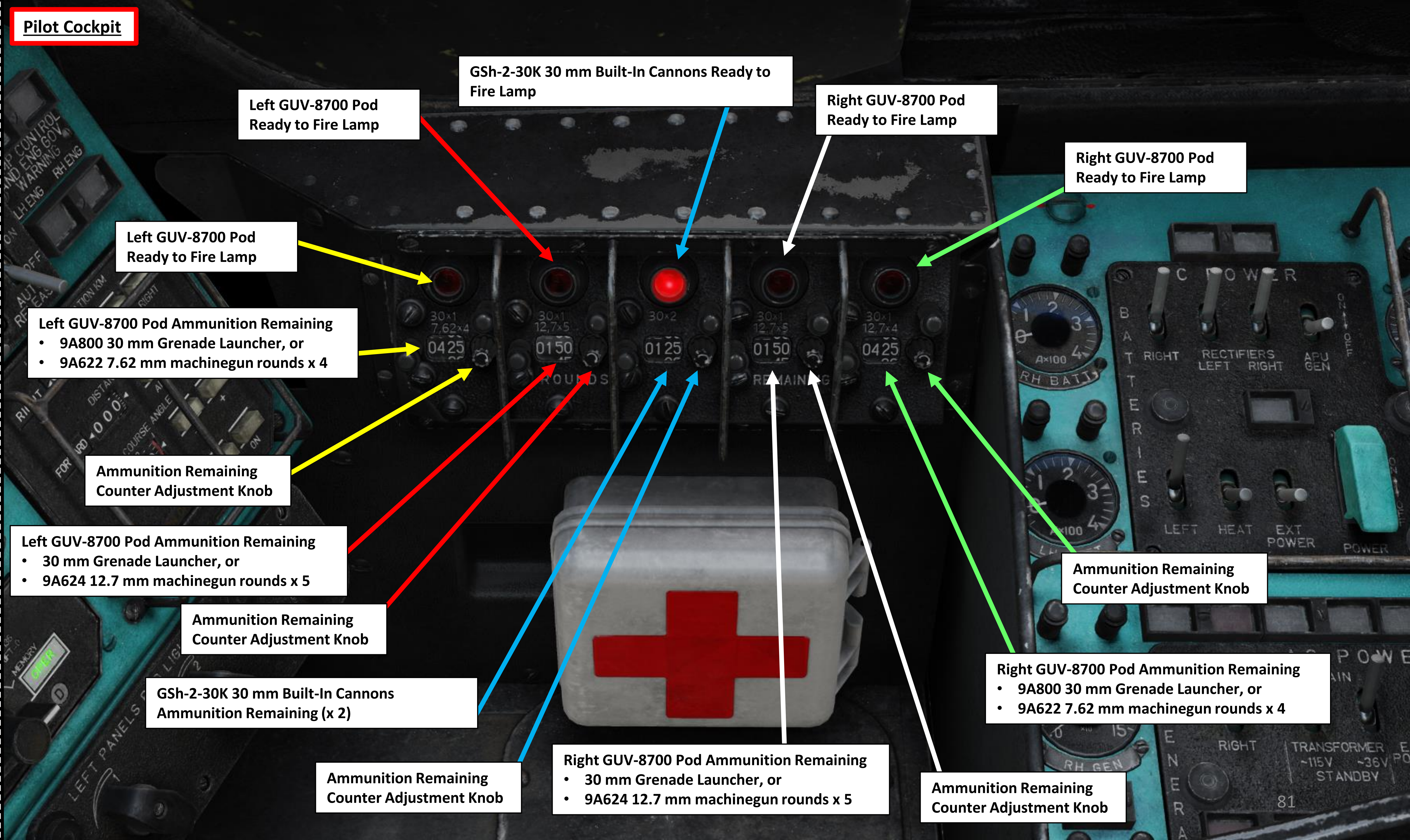
Left Panel Red Lighting Control Knob 1

Left Panel Red Lighting Control Knob 2


Pilot Cockpit
DISS-15 Doppler System Digital Display Unit
Lateral Deviation (km)
Distance Flown (km)
Desired Course Angle
Magnetron Failure Light
Doppler Control Panel Mode selector
• Position 1-4: Test
• РАБОТА: OPERATE
Doppler Computer Failure Light
LEFT / RIGHT Lateral Deviation
AFT / FWD Distance Counter
+ / - Desired Course
ON / OFF Digital Readout
Doppler System TURN ON (ENABLE) Light
• Illuminates if the digital display unit of the DISS-15 Doppler system is currently measuring the deviation from the target course.

Pilot Cockpit


Pilot Cockpit
Ammunition Counters
First Aid Kit

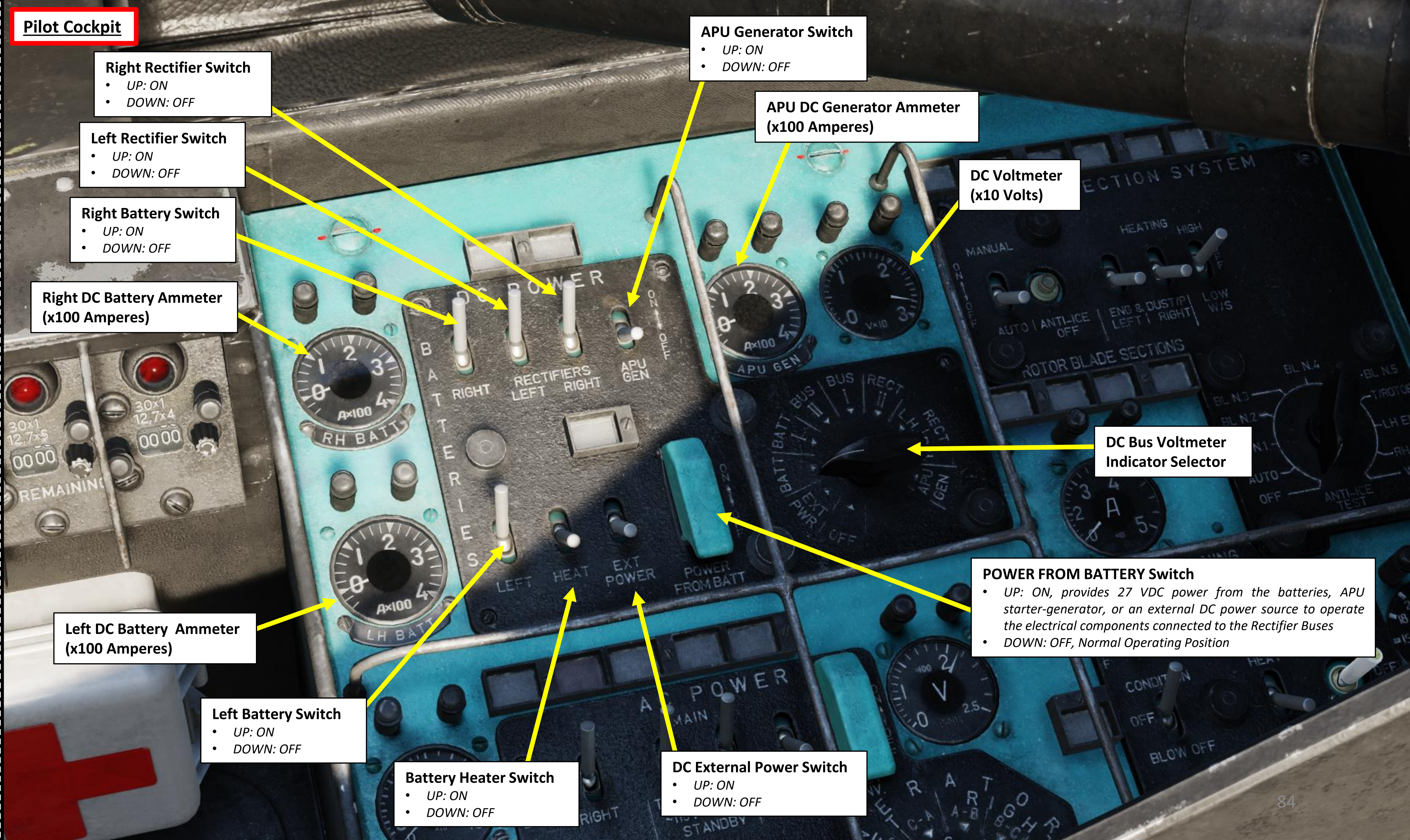

Pilot Cockpit
Left GUV-8700 Pod Ready to Fire Lamp
GSh-2-30K 30 mm Built-In Cannons Ready to Fire Lamp
Right GUV-8700 Pod Ready to Fire Lamp
Right GUV-8700 Pod Ready to Fire Lamp
Left GUV-8700 Pod Ready to Fire Lamp
Left GUV-8700 Pod Ammunition Remaining
• 9A800 30 mm Grenade Launcher, or
• 9A622 7.62 mm machinegun rounds x 4
Ammunition Remaining Counter Adjustment Knob
Left GUV-8700 Pod Ammunition Remaining
• 30 mm Grenade Launcher, or
• 9A624 12.7 mm machinegun rounds x 5
Ammunition Remaining Counter Adjustment Knob
GSh-2-30K 30 mm Built-In Cannons Ammunition Remaining (x 2)
Ammunition Remaining Counter Adjustment Knob
Right GUV-8700 Pod Ammunition Remaining
• 30 mm Grenade Launcher, or
• 9A624 12.7 mm machinegun rounds x 5
Ammunition Remaining Counter Adjustment Knob
Right GUV-8700 Pod Ammunition Remaining
• 9A800 30 mm Grenade Launcher, or
• 9A622 7.62 mm machinegun rounds x 4
Ammunition Remaining Counter Adjustment Knob

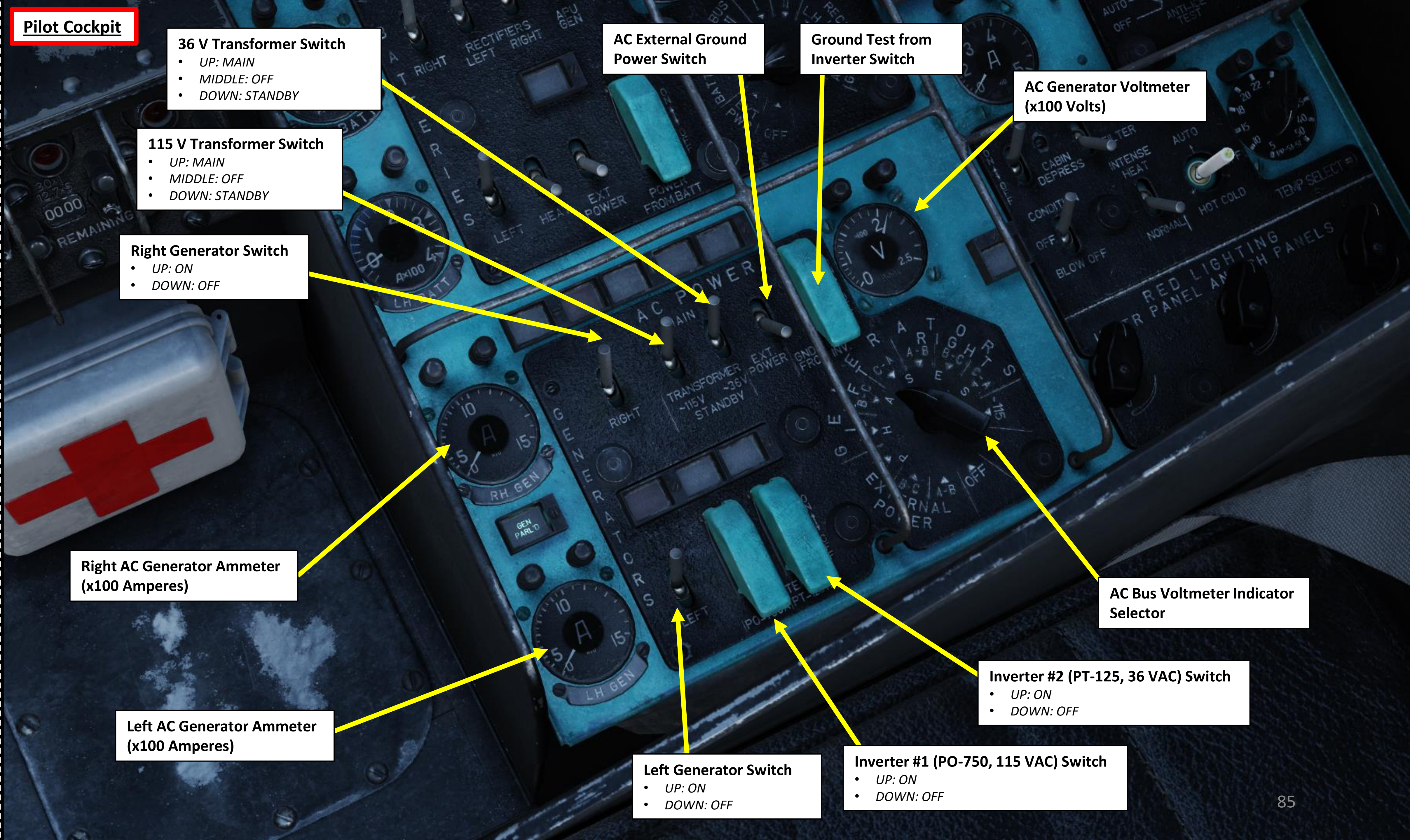
Pilot Cockpit

Rotor Brake Lever

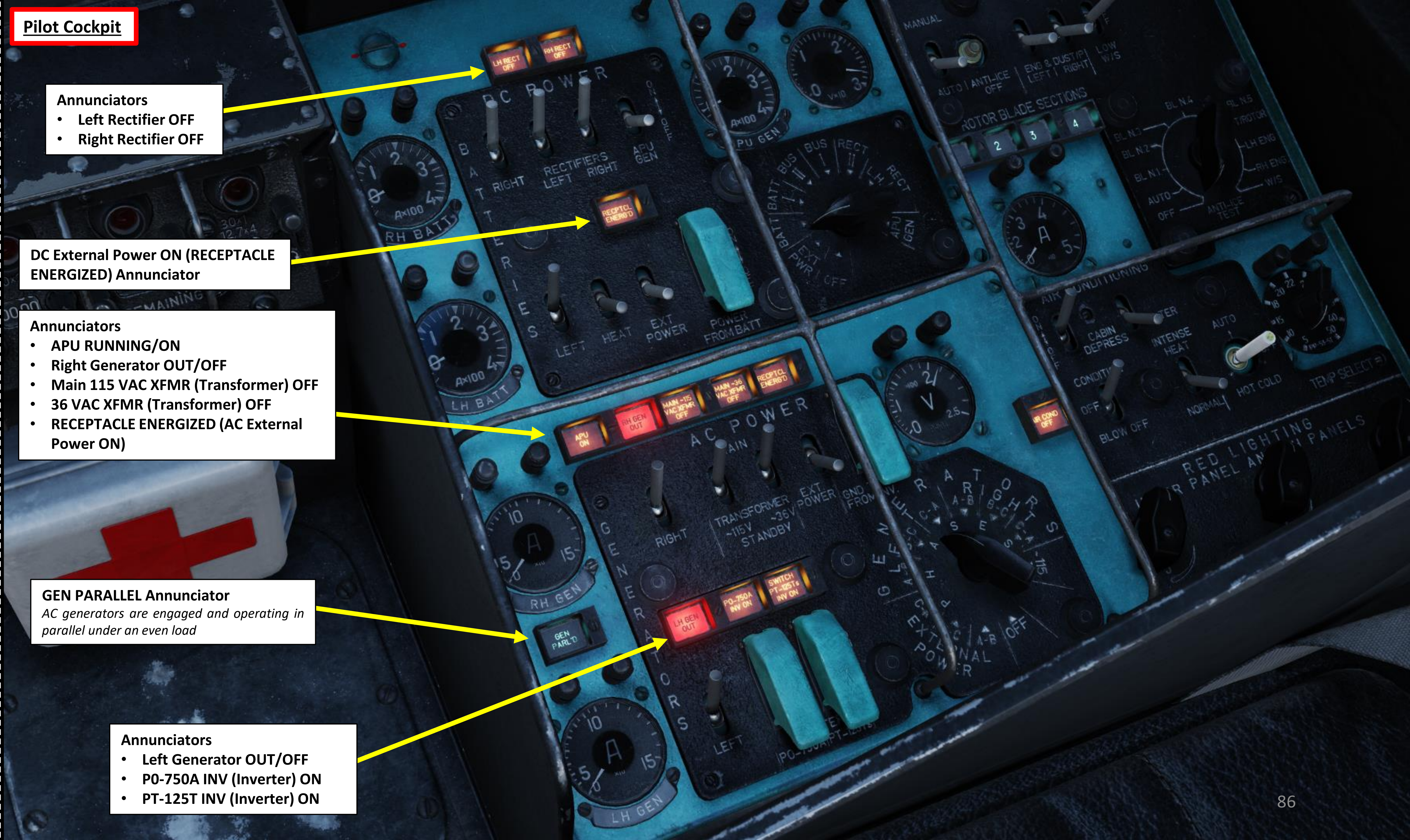
- *UP: Rotor Brake Engaged (Engine Start is inhibited)*
- *DOWN: Rotor Brake Disengaged*

Pilot Cockpit


Pilot Cockpit
Right Rectifier Switch
• UP: ON
• DOWN: OFF
Left Rectifier Switch
• UP: ON
• DOWN: OFF
Right Battery Switch
• UP: ON
• DOWN: OFF
Right DC Battery Ammeter (x100 Amperes)
Left DC Battery Ammeter (x100 Amperes)
Left Battery Switch
• UP: ON
• DOWN: OFF
Battery Heater Switch
• UP: ON
• DOWN: OFF
DC External Power Switch
• UP: ON
• DOWN: OFF
APU Generator Switch
• UP: ON
• DOWN: OFF
APU DC Generator Ammeter (x100 Amperes)
DC Voltmeter (x10 Volts)
DC Bus Voltmeter Indicator Selector
POWER FROM BATTERY Switch
• UP: ON, provides 27 VDC power from the batteries, APU starter-generator, or an external DC power source to operate the electrical components connected to the Rectifier Buses
• DOWN: OFF, Normal Operating Position


Pilot Cockpit
36 V Transformer Switch
• UP: MAIN
• MIDDLE: OFF
• DOWN: STANDBY
115 V Transformer Switch
• UP: MAIN
• MIDDLE: OFF
• DOWN: STANDBY
Right Generator Switch
• UP: ON
• DOWN: OFF
AC External Ground Power Switch
Ground Test from Inverter Switch
AC Generator Voltmeter (x100 Volts)
Right AC Generator Ammeter (x100 Amperes)
Left AC Generator Ammeter (x100 Amperes)
AC Bus Voltmeter Indicator Selector
Inverter #2 (PT-125, 36 VAC) Switch
• UP: ON
• DOWN: OFF
Inverter #1 (PO-750, 115 VAC) Switch
• UP: ON
• DOWN: OFF
Left Generator Switch
• UP: ON
• DOWN: OFF

Pilot Cockpit



Annunciators
- Left Rectifier OFF
- Right Rectifier OFF

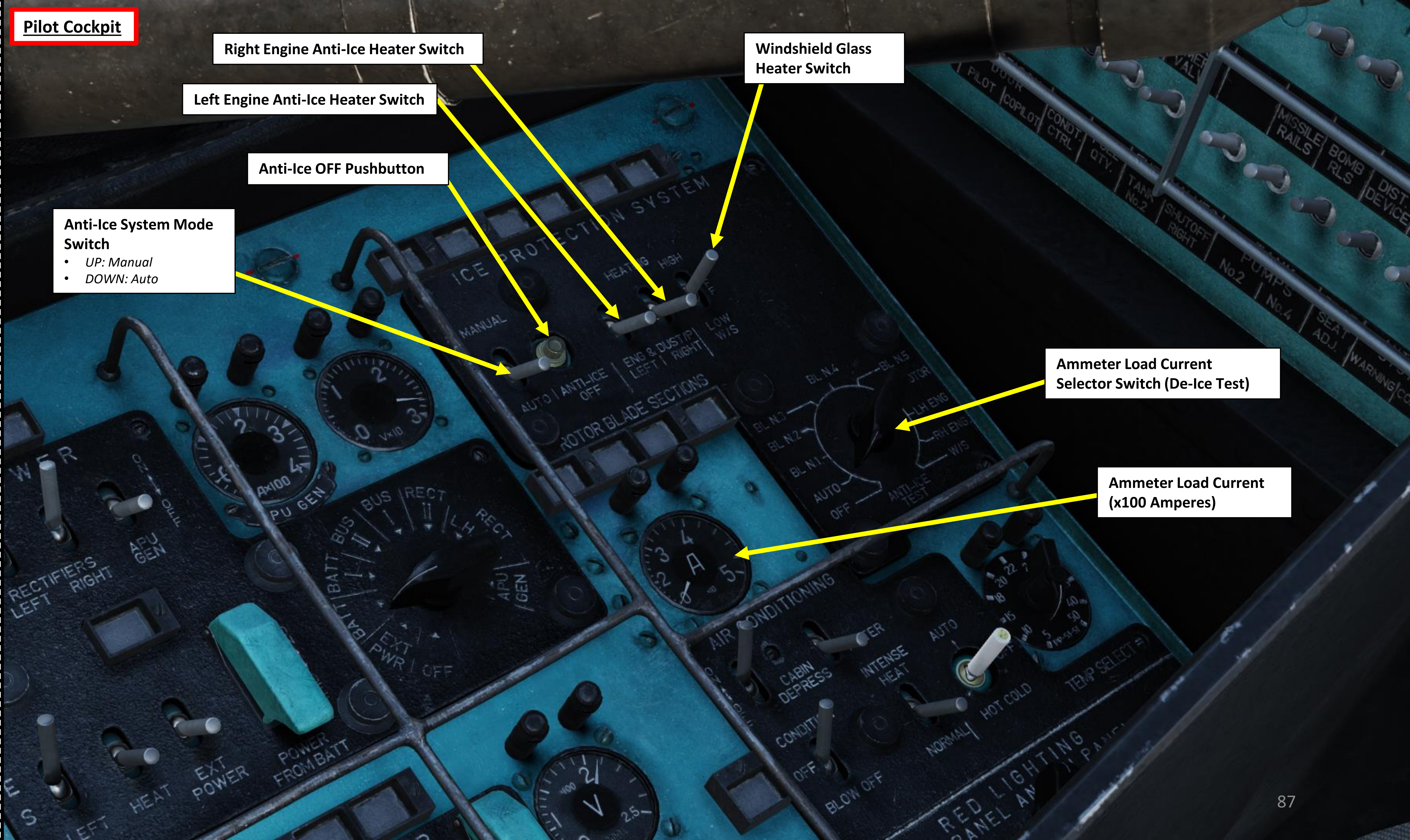
DC External Power ON (RECEPTACLE ENERGIZED) Annunciator

Annunciators
- APU RUNNING/ON
- Right Generator OUT/OFF
- Main 115 VAC XFMR (Transformer) OFF
- 36 VAC XFMR (Transformer) OFF
- RECEPTACLE ENERGIZED (AC External Power ON)

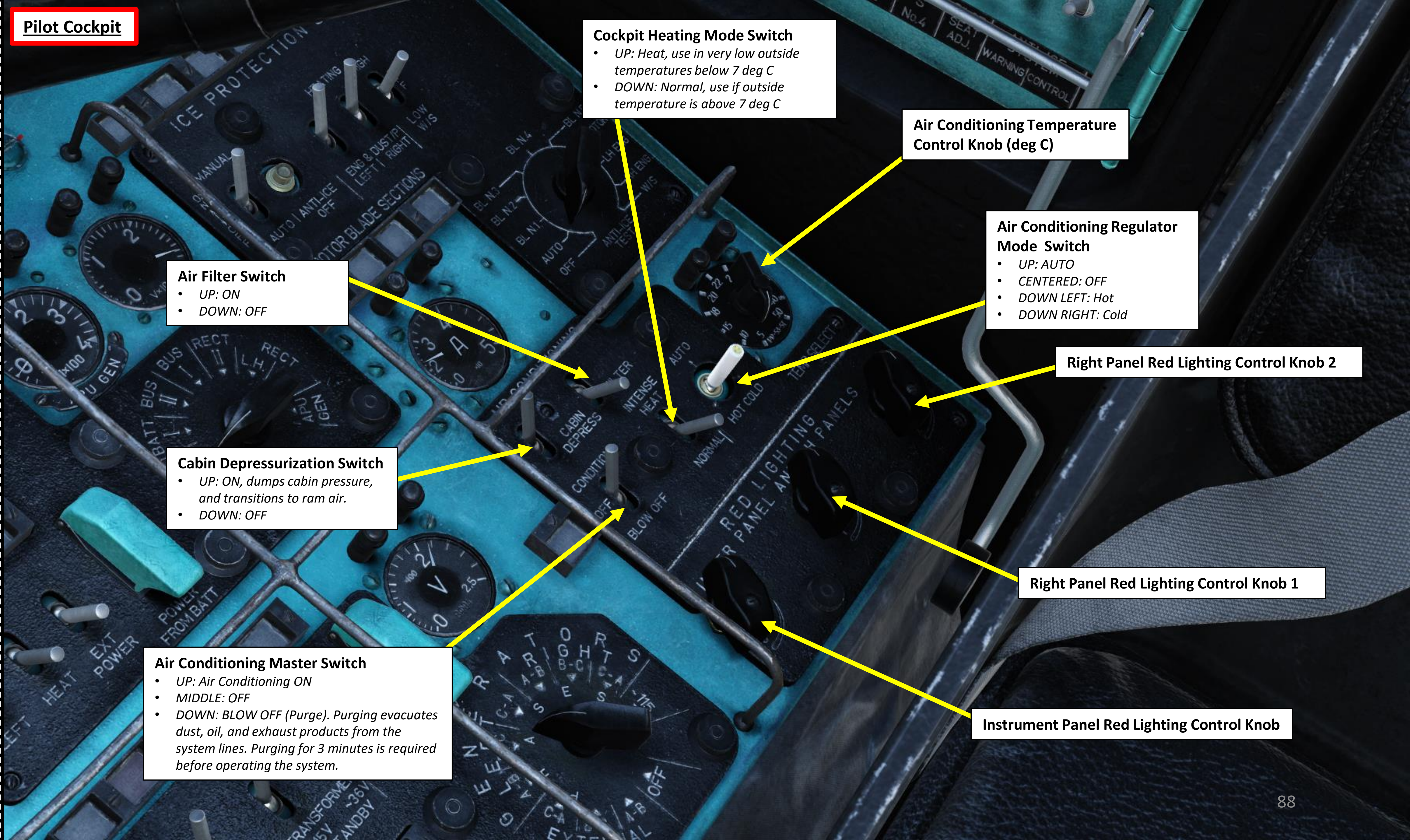
GEN PARALLEL Annunciator
AC generators are engaged and operating in parallel under an even load

Annunciators
- Left Generator OUT/OFF
- P0-750A INV (Inverter) ON
- PT-125T INV (Inverter) ON

Pilot Cockpit



Pilot Cockpit



Cockpit Heating Mode Switch
- *UP: Heat, use in very low outside temperatures below 7 deg C*
- *DOWN: Normal, use if outside temperature is above 7 deg C*

Air Conditioning Temperature Control Knob (deg C)

Air Conditioning Regulator Mode Switch
- *UP: AUTO*
- *CENTERED: OFF*
- *DOWN LEFT: Hot*
- *DOWN RIGHT: Cold*

Right Panel Red Lighting Control Knob 2

Air Filter Switch
- *UP: ON*
- *DOWN: OFF*

Cabin Depressurization Switch
- *UP: ON, dumps cabin pressure, and transitions to ram air.*
- *DOWN: OFF*

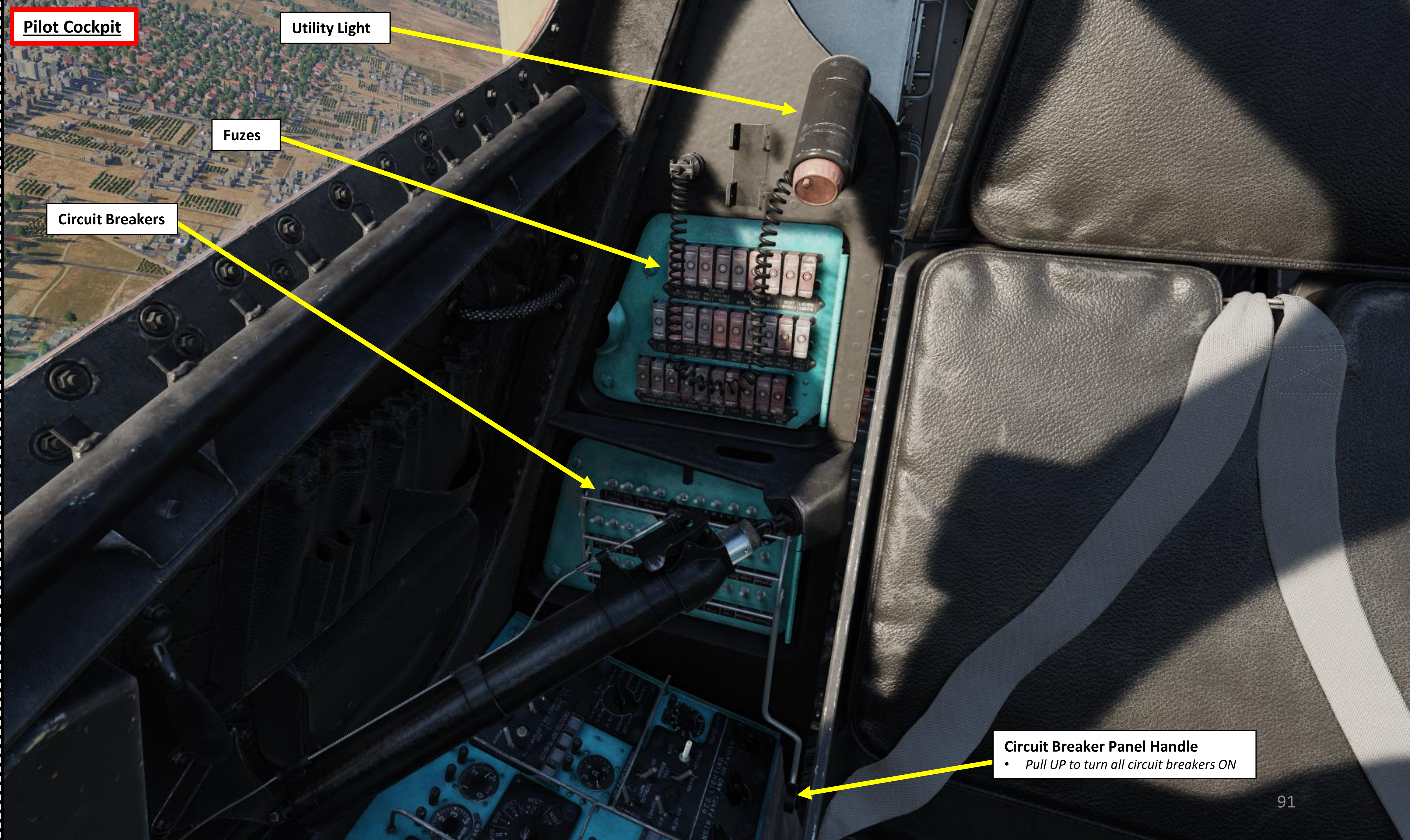
Right Panel Red Lighting Control Knob 1

Air Conditioning Master Switch
- *UP: Air Conditioning ON*
- *MIDDLE: OFF*
- *DOWN: BLOW OFF (Purge). Purging evacuates dust, oil, and exhaust products from the system lines. Purging for 3 minutes is required before operating the system.*

Instrument Panel Red Lighting Control Knob


Pilot Cockpit
Annunciators
• Anti-Ice ON
• Left Engine Anti-Ice ON
• Right Engine Anti-Ice ON
• Left Dust Protector (Particle Separator) ON
• Right Dust Protector (Particle Separator) ON
• Ice Detector Heater ON
Anti-Ice Section Test Annunciators
Indicates the section of the main rotor blade Anti-Icing system being tested.
• Section 1
• Section 2
• Section 3
• Section 4
AIR COND OFF (Air Conditioning OFF) Annunciator
ICE PROTECTION SYSTEM
ROTOR BLADE SECTIONS
AIR CONDITIONING
DC POWER
AC POWER
RED LIGHTING

Pilot Cockpit


Pilot Cockpit
Utility Light
Fuzes
Circuit Breakers
Circuit Breaker Panel Handle
• Pull UP to turn all circuit breakers ON

Pilot Cockpit

R-60 Missile Fuze Activation Mode Switch
- *UP: Air-to-Air Mode*
- *DOWN: Air-to-Ground Mode*

R-60 Missile Launcher Rack Selector
- *1: Left Rack*
- *2: Right Rack*
- *3: Not used*
- *4: Not used*

R-60 Missile Power Light

R-60 Missile Lock On Light

R-60 Missile Seeker Operational Light

R-60 Missile Power Switch
- *UP: R-60M missile is powered ON*
- *DOWN: R-60M missile is unpowered*


Pilot Cockpit
Computer Cabinet for Raduga-Sh Complex

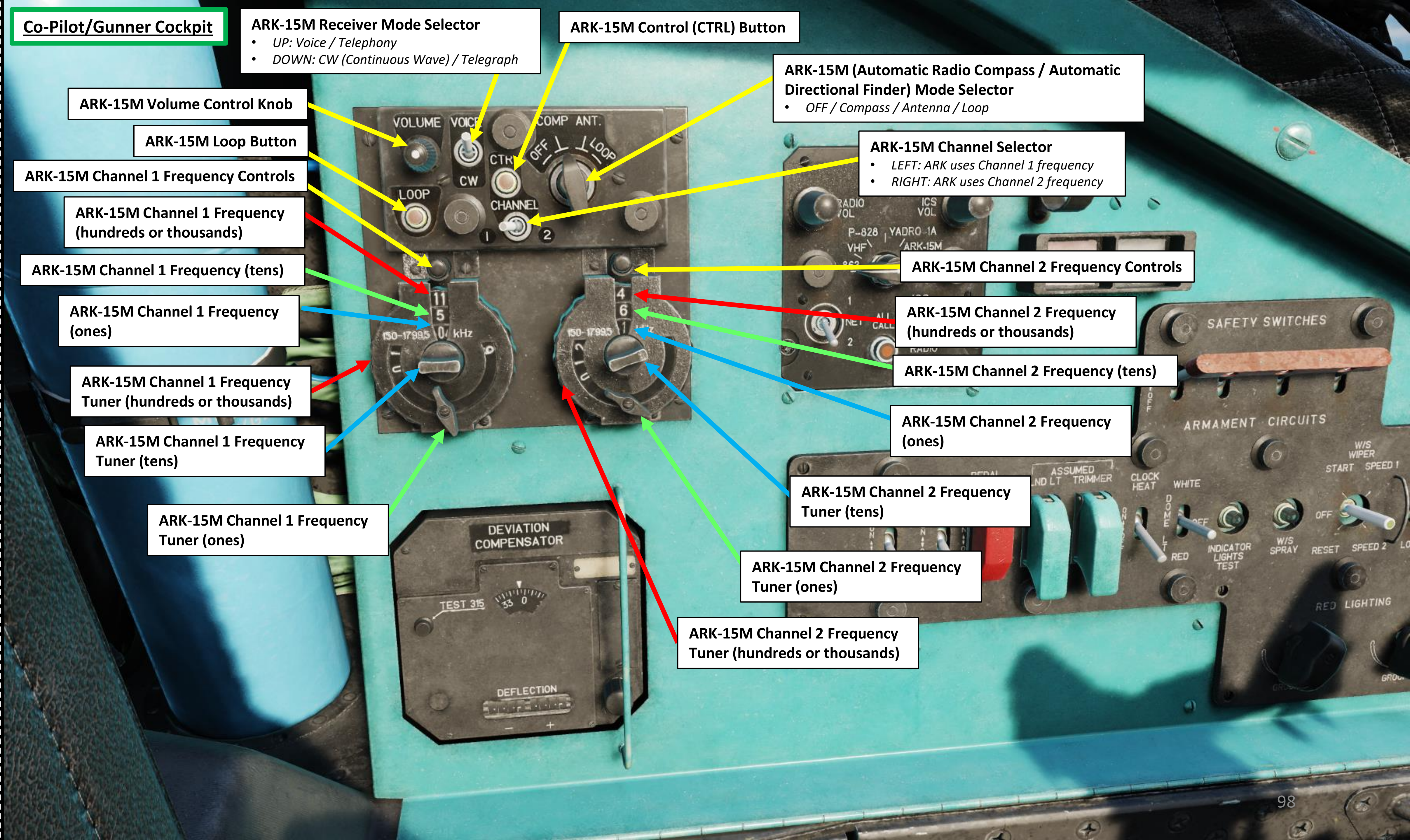
Co-Pilot/Gunner Cockpit

Co-Pilot/Gunner Cockpit

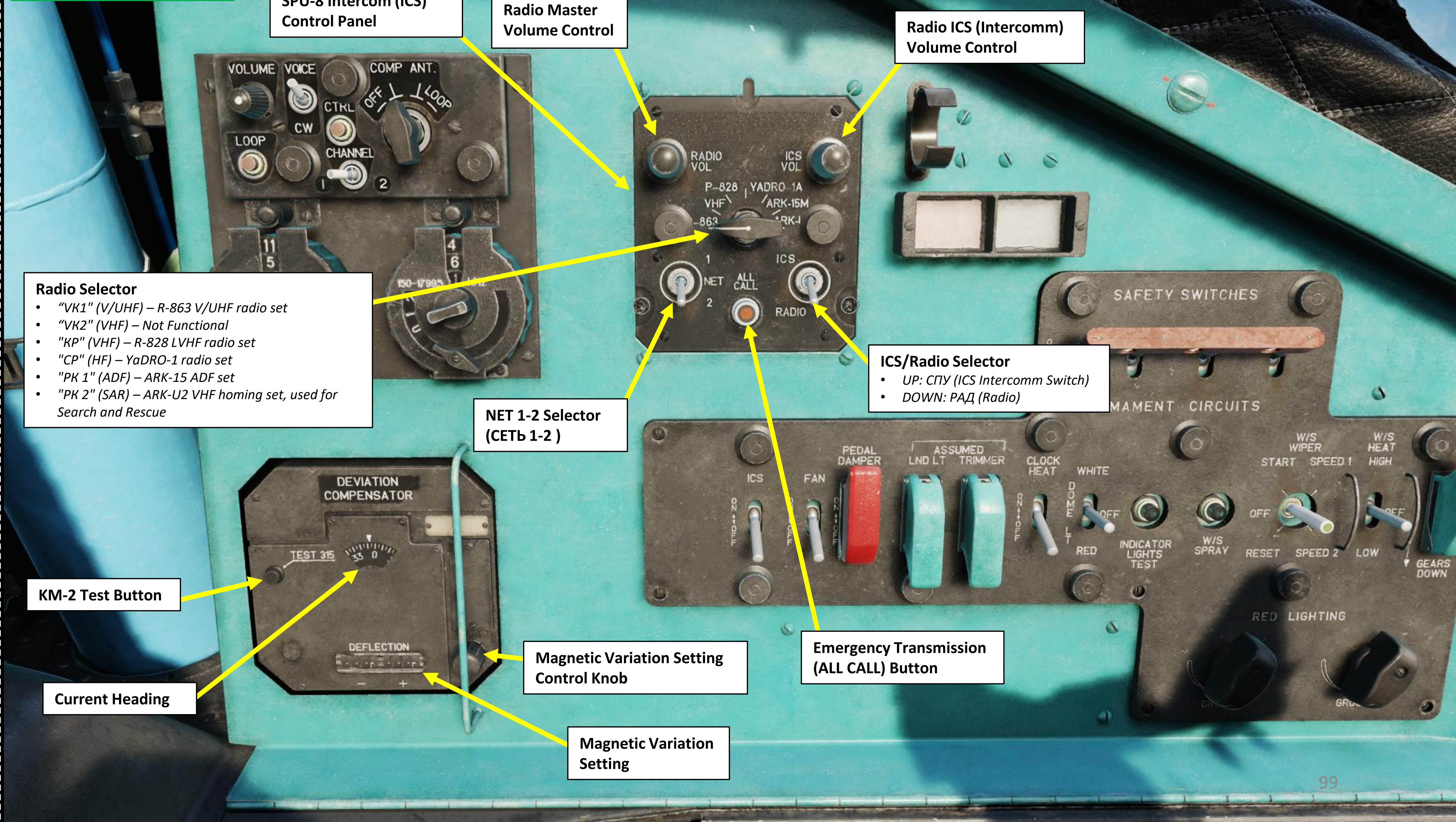
Tip: Co-Pilot body can be toggled on/off by pressing “RSHIFT+P”

Co-Pilot/Gunner Cockpit

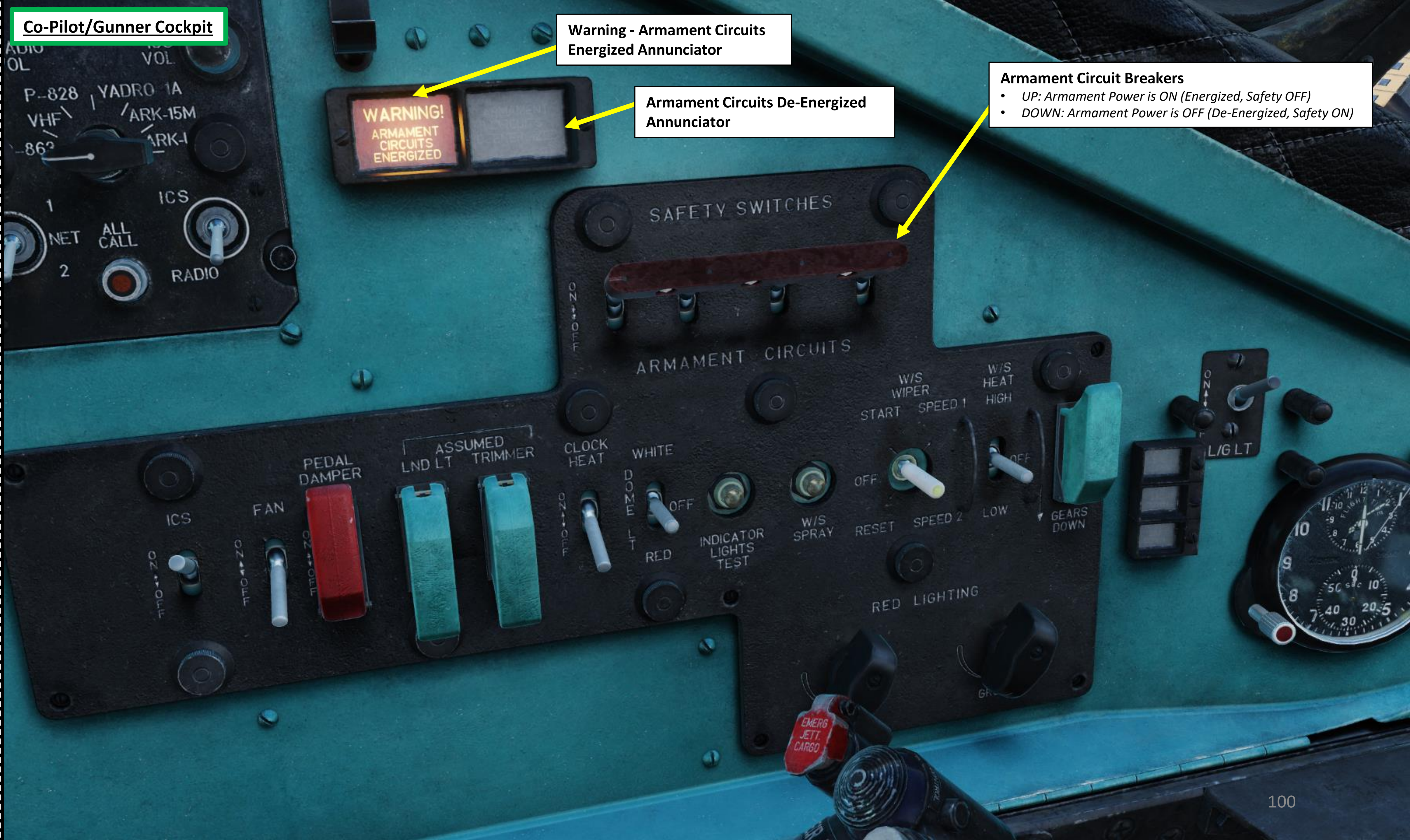
Co-Pilot/Gunner Cockpit


Co-Pilot/Gunner Cockpit
ARK-15M Receiver Mode Selector
• UP: Voice / Telephony
• DOWN: CW (Continuous Wave) / Telegraph
ARK-15M Control (CTRL) Button
ARK-15M (Automatic Radio Compass / Automatic Directional Finder) Mode Selector
• OFF / Compass / Antenna / Loop
ARK-15M Volume Control Knob
ARK-15M Loop Button
ARK-15M Channel 1 Frequency Controls
ARK-15M Channel 1 Frequency (hundreds or thousands)
ARK-15M Channel 1 Frequency (tens)
ARK-15M Channel 1 Frequency (ones)
ARK-15M Channel 1 Frequency Tuner (hundreds or thousands)
ARK-15M Channel 1 Frequency Tuner (tens)
ARK-15M Channel 1 Frequency Tuner (ones)
ARK-15M Channel Selector
• LEFT: ARK uses Channel 1 frequency
• RIGHT: ARK uses Channel 2 frequency
ARK-15M Channel 2 Frequency Controls
ARK-15M Channel 2 Frequency (hundreds or thousands)
ARK-15M Channel 2 Frequency (tens)
ARK-15M Channel 2 Frequency (ones)
ARK-15M Channel 2 Frequency Tuner (tens)
ARK-15M Channel 2 Frequency Tuner (ones)
ARK-15M Channel 2 Frequency Tuner (hundreds or thousands)
VOLUME
VOICE
CW
COMP
ANT.
OFF
LOOP
CTRL
CHANNEL
DEVIATION COMPENSATOR
TEST 315
DEFLECTION
SAFETY SWITCHES
ARMAMENT CIRCUITS

Co-Pilot/Gunner Cockpit



Co-Pilot/Gunner Cockpit



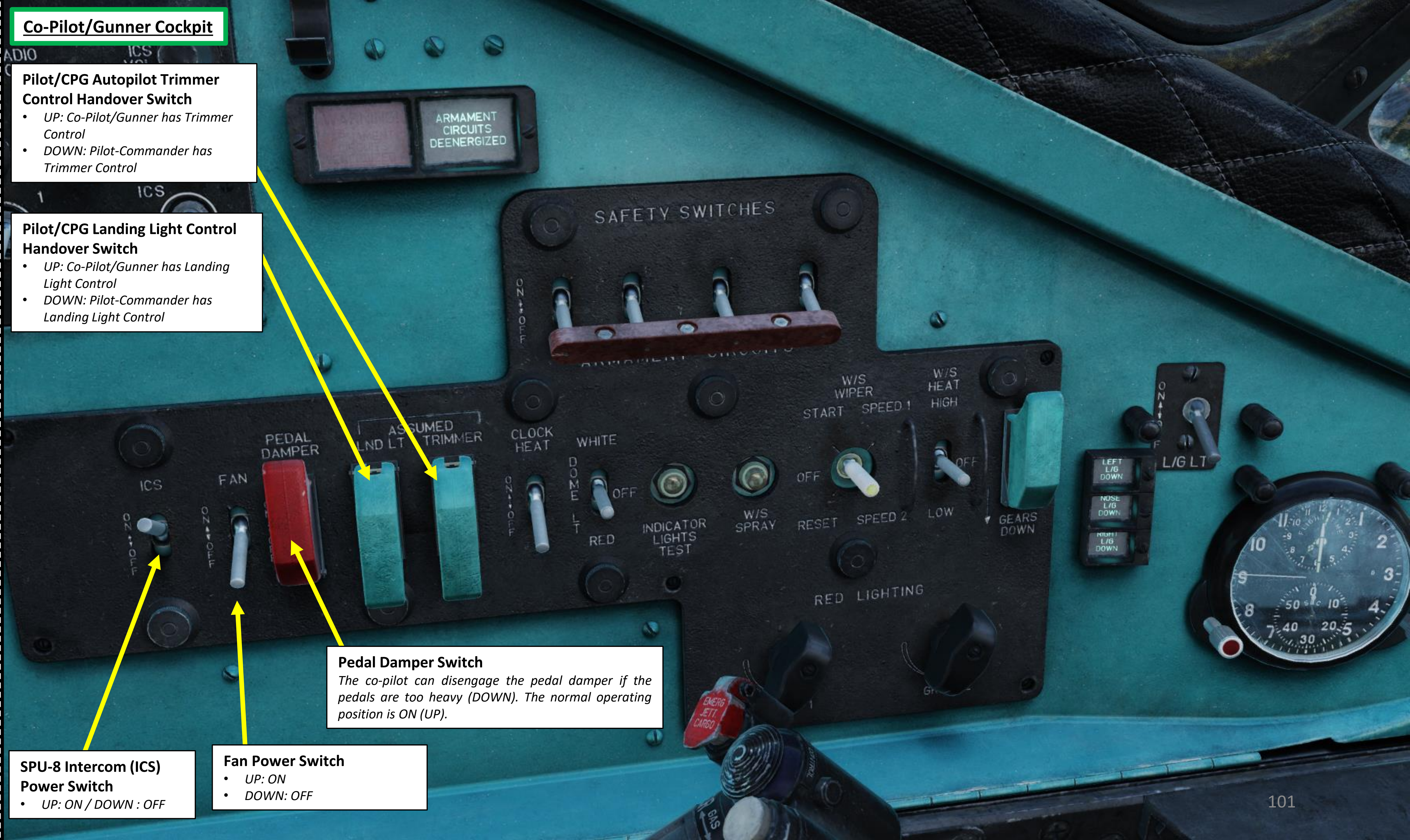
Warning - Armament Circuits Energized Annunciator

Armament Circuits De-Energized Annunciator

Armament Circuit Breakers

- *UP: Armament Power is ON (Energized, Safety OFF)*
- *DOWN: Armament Power is OFF (De-Energized, Safety ON)*

Co-Pilot/Gunner Cockpit



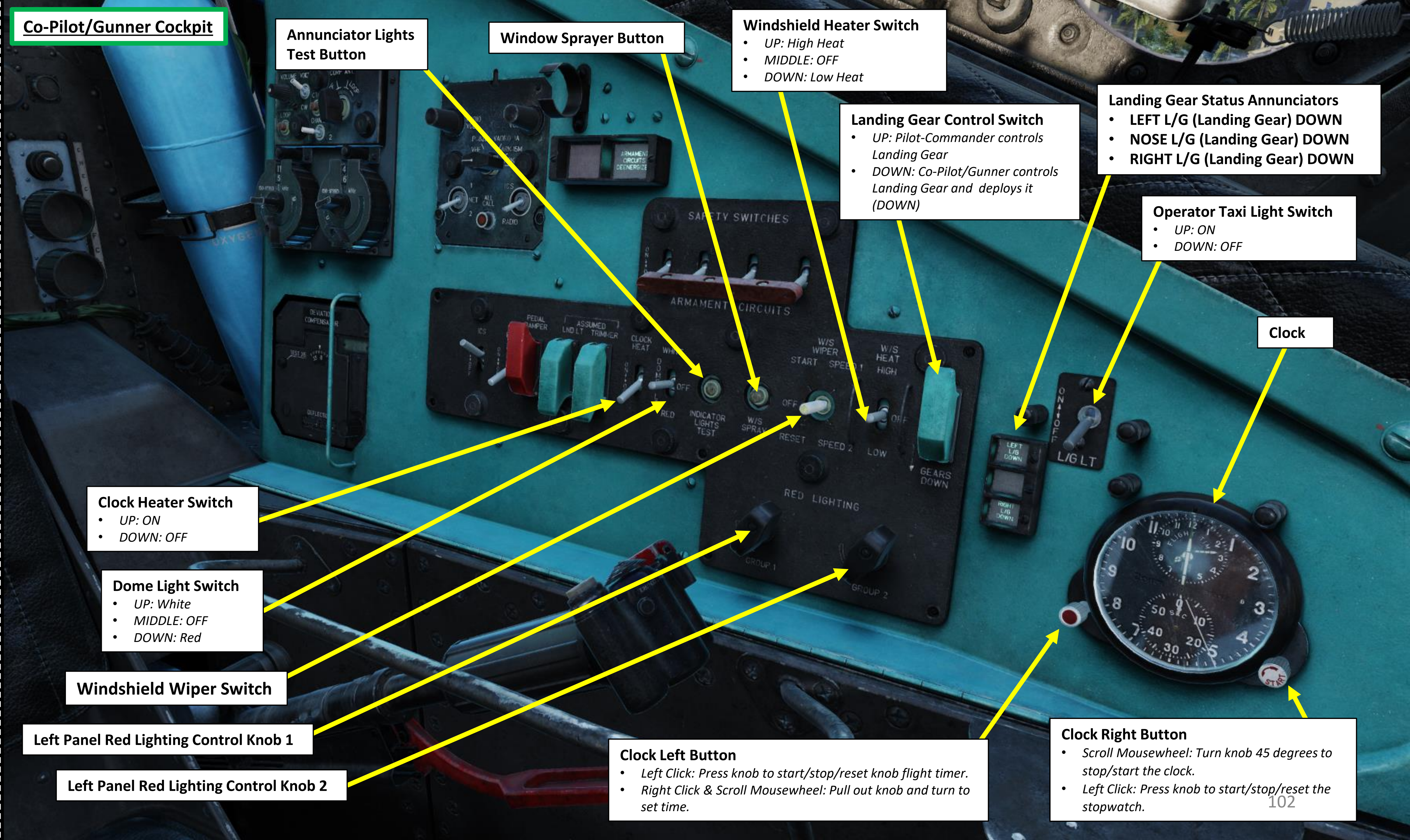
Pilot/CPG Autopilot Trimmer Control Handover Switch
- *UP: Co-Pilot/Gunner has Trimmer Control*
- *DOWN: Pilot-Commander has Trimmer Control*

Pilot/CPG Landing Light Control Handover Switch
- *UP: Co-Pilot/Gunner has Landing Light Control*
- *DOWN: Pilot-Commander has Landing Light Control*

Pedal Damper Switch
The co-pilot can disengage the pedal damper if the pedals are too heavy (DOWN). The normal operating position is ON (UP).

SPU-8 Intercom (ICS) Power Switch
- *UP: ON / DOWN : OFF*

Fan Power Switch
- *UP: ON*
- *DOWN: OFF*



Co-Pilot/Gunner Cockpit

Annunciator Lights Test Button

Window Sprayer Button

Windshield Heater Switch
- *UP: High Heat*
- *MIDDLE: OFF*
- *DOWN: Low Heat*

Landing Gear Control Switch
- *UP: Pilot-Commander controls Landing Gear*
- *DOWN: Co-Pilot/Gunner controls Landing Gear and deploys it (DOWN)*

Landing Gear Status Annunciators
- **LEFT L/G (Landing Gear) DOWN**
- **NOSE L/G (Landing Gear) DOWN**
- **RIGHT L/G (Landing Gear) DOWN**

Operator Taxi Light Switch
- *UP: ON*
- *DOWN: OFF*

Clock

Clock Heater Switch
- *UP: ON*
- *DOWN: OFF*

Dome Light Switch
- *UP: White*
- *MIDDLE: OFF*
- *DOWN: Red*

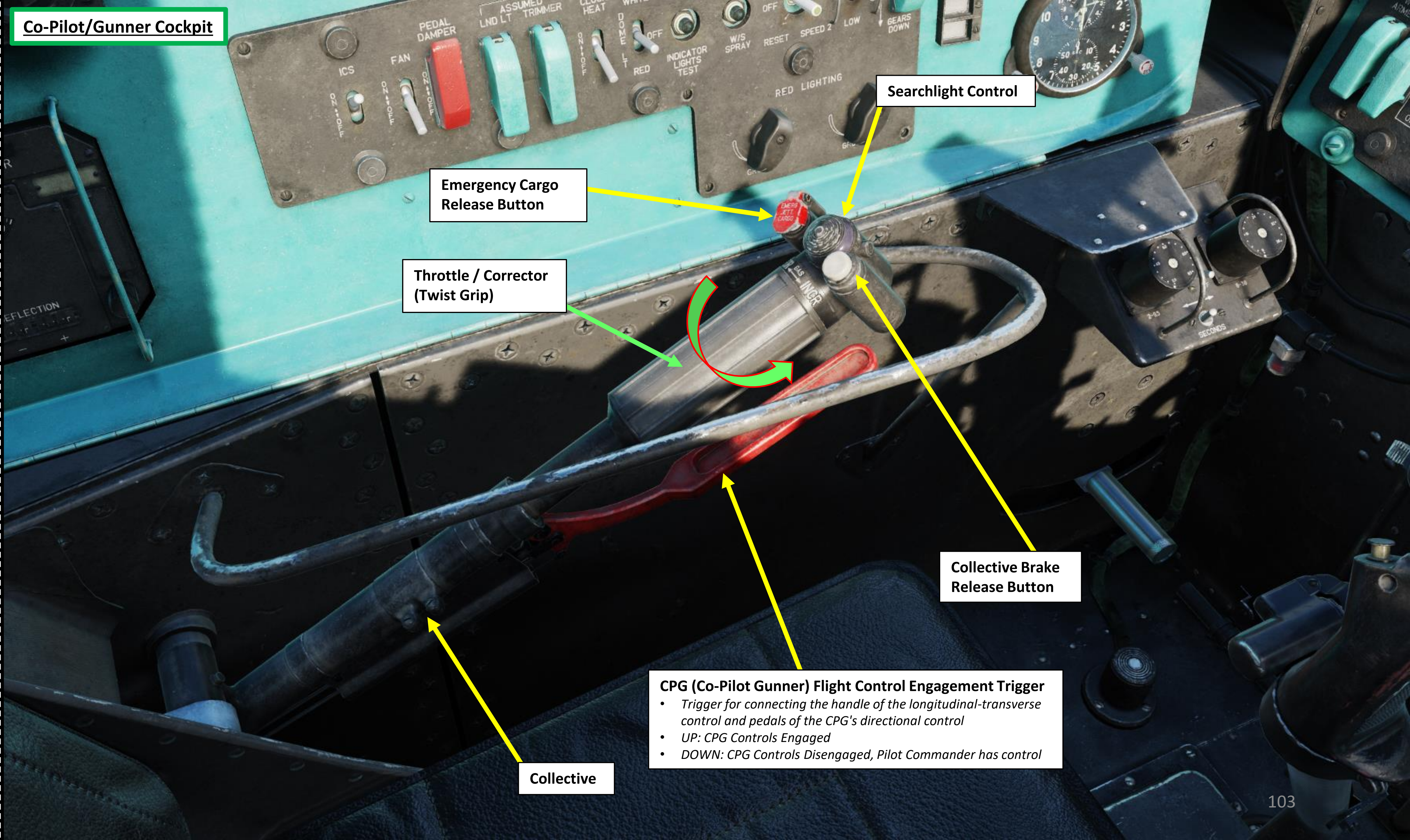
Windshield Wiper Switch

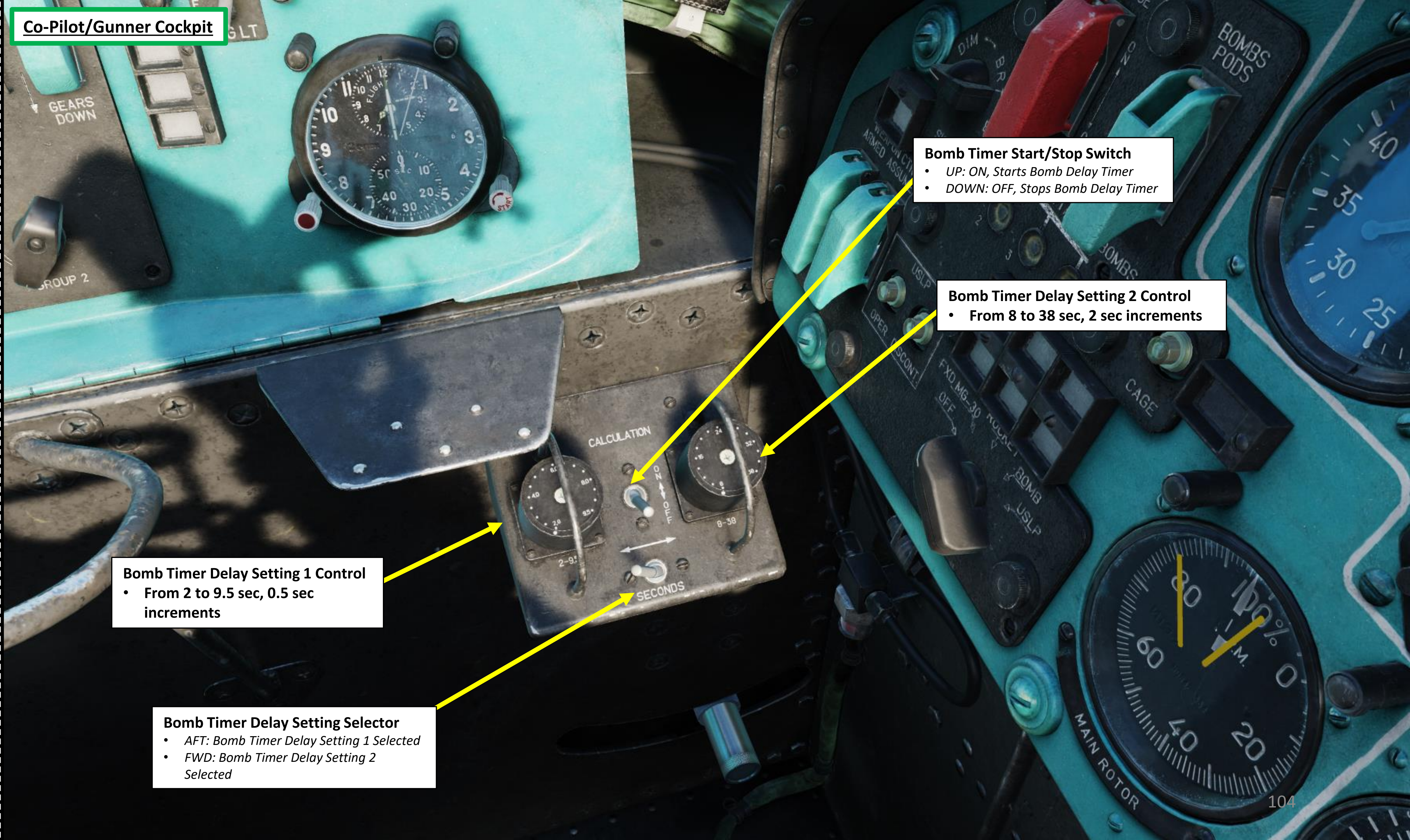
Left Panel Red Lighting Control Knob 1

Left Panel Red Lighting Control Knob 2

Clock Left Button
- *Left Click: Press knob to start/stop/reset knob flight timer.*
- *Right Click & Scroll Mousewheel: Pull out knob and turn to set time.*

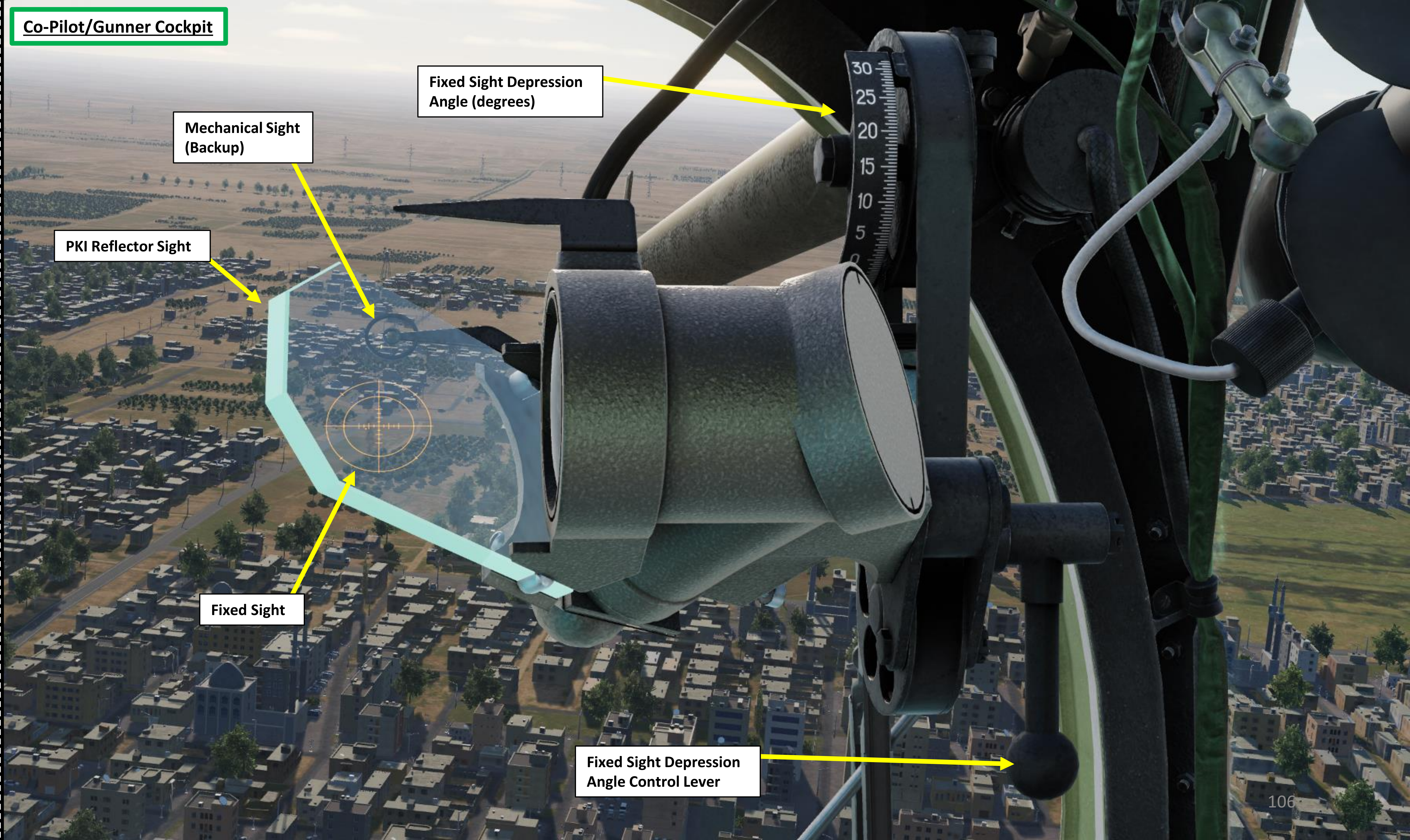
Clock Right Button
- *Scroll Mousewheel: Turn knob 45 degrees to stop/start the clock.*
- *Left Click: Press knob to start/stop/reset the stopwatch.*


Co-Pilot/Gunner Cockpit
Searchlight Control
Emergency Cargo Release Button
Throttle / Corrector (Twist Grip)
Collective Brake Release Button
CPG (Co-Pilot Gunner) Flight Control Engagement Trigger
• Trigger for connecting the handle of the longitudinal-transverse control and pedals of the CPG's directional control
• UP: CPG Controls Engaged
• DOWN: CPG Controls Disengaged, Pilot Commander has control
Collective

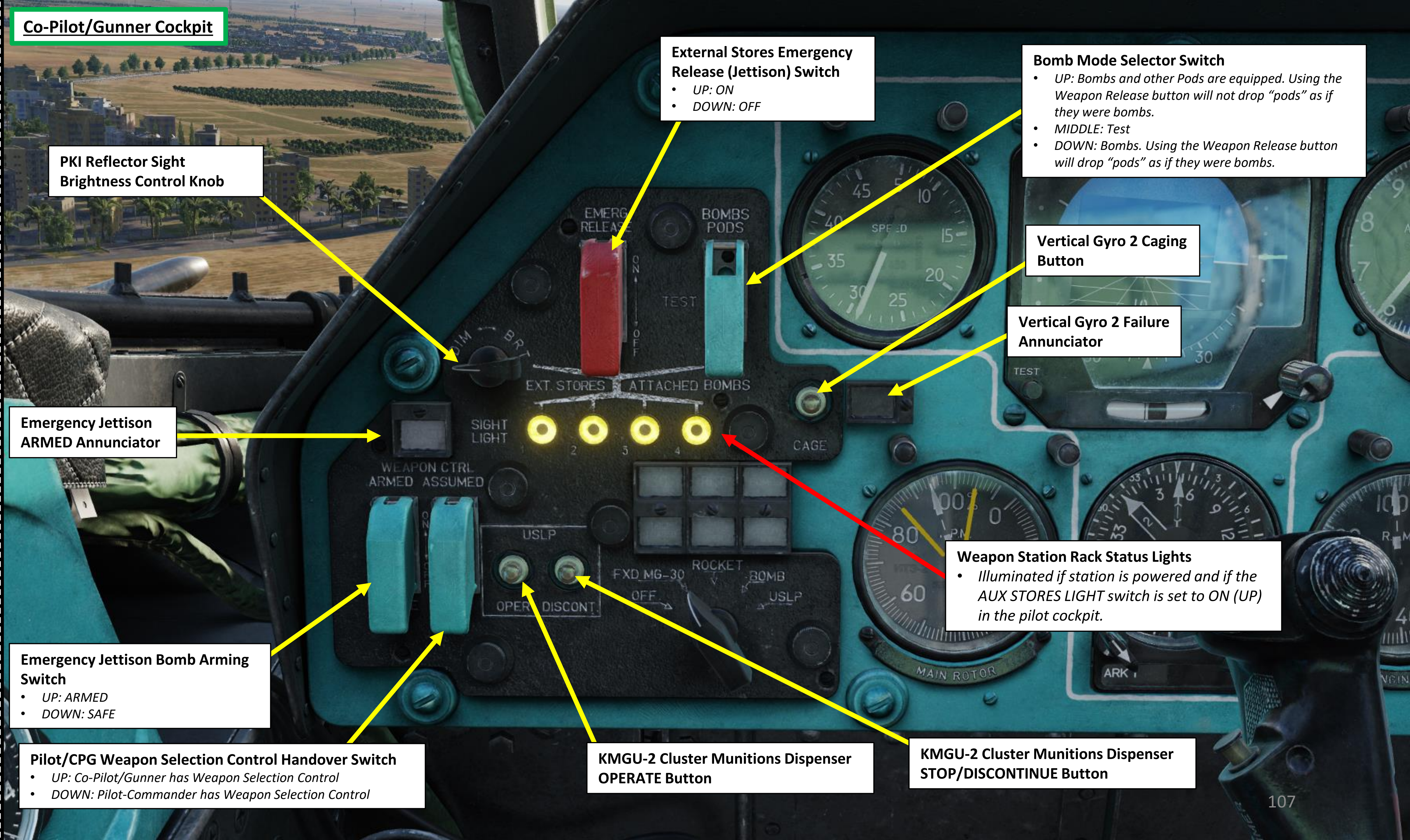

Co-Pilot/Gunner Cockpit
Bomb Timer Start/Stop Switch
• UP: ON, Starts Bomb Delay Timer
• DOWN: OFF, Stops Bomb Delay Timer
Bomb Timer Delay Setting 2 Control
• From 8 to 38 sec, 2 sec increments
Bomb Timer Delay Setting 1 Control
• From 2 to 9.5 sec, 0.5 sec increments
Bomb Timer Delay Setting Selector
• AFT: Bomb Timer Delay Setting 1 Selected
• FWD: Bomb Timer Delay Setting 2 Selected
CALCULATION
SECONDS
GEARS DOWN
BOMBS PODS
CAGE
MAIN ROTOR

Co-Pilot/Gunner Cockpit

Co-Pilot/Gunner Cockpit



Co-Pilot/Gunner Cockpit



External Stores Emergency Release (Jettison) Switch
- *UP: ON*
- *DOWN: OFF*

Bomb Mode Selector Switch
- *UP: Bombs and other Pods are equipped. Using the Weapon Release button will not drop "pods" as if they were bombs.*
- *MIDDLE: Test*
- *DOWN: Bombs. Using the Weapon Release button will drop "pods" as if they were bombs.*

PKI Reflector Sight Brightness Control Knob

Vertical Gyro 2 Caging Button

Vertical Gyro 2 Failure Annunciator

Emergency Jettison ARMED Annunciator

Weapon Station Rack Status Lights
- *Illuminated if station is powered and if the AUX STORES LIGHT switch is set to ON (UP) in the pilot cockpit.*

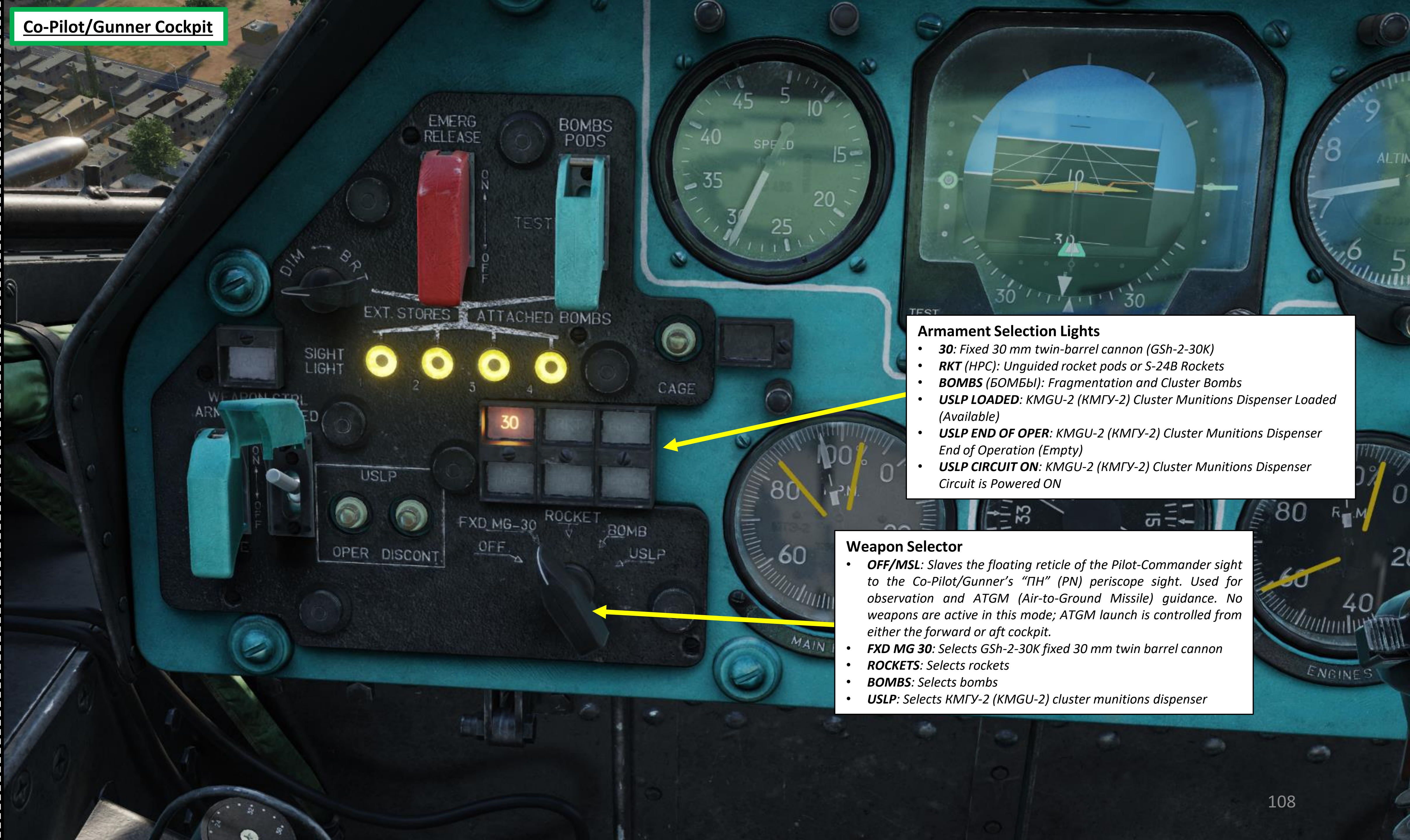
Emergency Jettison Bomb Arming Switch
- *UP: ARMED*
- *DOWN: SAFE*

Pilot/CPG Weapon Selection Control Handover Switch
- *UP: Co-Pilot/Gunner has Weapon Selection Control*
- *DOWN: Pilot-Commander has Weapon Selection Control*

KMGU-2 Cluster Munitions Dispenser OPERATE Button

KMGU-2 Cluster Munitions Dispenser STOP/DISCONTINUE Button

Co-Pilot/Gunner Cockpit



Armament Selection Lights

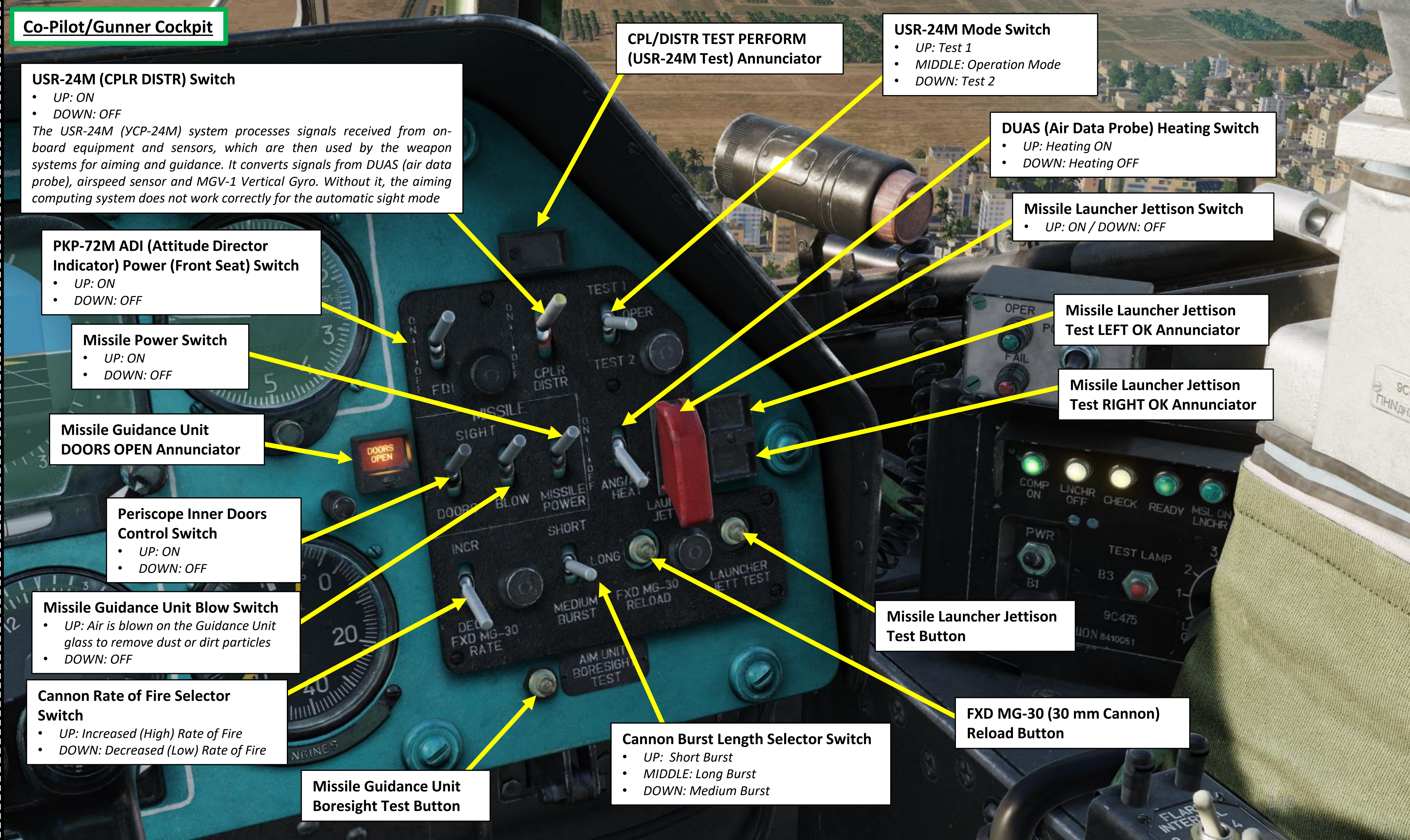
- ***30***: *Fixed 30 mm twin-barrel cannon (GSh-2-30K)*
- ***RKT*** *(НРС): Unguided rocket pods or S-24B Rockets*
- ***BOMBS*** *(БОМБЫ): Fragmentation and Cluster Bombs*
- ***USLP LOADED***: *KMGU-2 (КМГУ-2) Cluster Munitions Dispenser Loaded (Available)*
- ***USLP END OF OPER***: *KMGU-2 (КМГУ-2) Cluster Munitions Dispenser End of Operation (Empty)*
- ***USLP CIRCUIT ON***: *KMGU-2 (КМГУ-2) Cluster Munitions Dispenser Circuit is Powered ON*

Weapon Selector

- ***OFF/MSL***: *Slaves the floating reticle of the Pilot-Commander sight to the Co-Pilot/Gunner's "ПН" (PN) periscope sight. Used for observation and ATGM (Air-to-Ground Missile) guidance. No weapons are active in this mode; ATGM launch is controlled from either the forward or aft cockpit.*
- ***FXD MG 30***: *Selects GSh-2-30K fixed 30 mm twin barrel cannon*
- ***ROCKETS***: *Selects rockets*
- ***BOMBS***: *Selects bombs*
- ***USLP***: *Selects КМГУ-2 (KMGU-2) cluster munitions dispenser*


Co-Pilot/Gunner Cockpit
PKP-72M ADI (Attitude Director Indicator)
• This ADI is supplied by vertical gyro 2. If gyro 2 is elected as main source by the pilot, attitude information is disabled.
ADI Zero Pitch Trim Knob
Barometric Altimeter
• Short needle: 1000 m
• Long needle: 100 m
Airspeed Indicator (x10 km/h)
ADI Bank Angle (deg)
Turn & Slip Indicator
Main Rotor Tachometer (% max RPM)
HSI (Horizontal Situation Indicator)
Engine N1 (Gas Turbine/Compressor Speed) Indicator (% max RPM)
• Needle 1: Left Engine
• Needle 2: Right Engine

Co-Pilot/Gunner Cockpit



USR-24M (CPLR DISTR) Switch
- *UP: ON*
- *DOWN: OFF*

The USR-24M (УСР-24М) system processes signals received from on-board equipment and sensors, which are then used by the weapon systems for aiming and guidance. It converts signals from DUAS (air data probe), airspeed sensor and MGV-1 Vertical Gyro. Without it, the aiming computing system does not work correctly for the automatic sight mode

CPL/DISTR TEST PERFORM (USR-24M Test) Annunciator

USR-24M Mode Switch
- *UP: Test 1*
- *MIDDLE: Operation Mode*
- *DOWN: Test 2*

DUAS (Air Data Probe) Heating Switch
- *UP: Heating ON*
- *DOWN: Heating OFF*

Missile Launcher Jettison Switch
- *UP: ON / DOWN: OFF*

PKP-72M ADI (Attitude Director Indicator) Power (Front Seat) Switch
- *UP: ON*
- *DOWN: OFF*

Missile Power Switch
- *UP: ON*
- *DOWN: OFF*

Missile Launcher Jettison Test LEFT OK Annunciator

Missile Launcher Jettison Test RIGHT OK Annunciator

Missile Guidance Unit DOORS OPEN Annunciator

Periscope Inner Doors Control Switch
- *UP: ON*
- *DOWN: OFF*

Missile Guidance Unit Blow Switch
- *UP: Air is blown on the Guidance Unit glass to remove dust or dirt particles*
- *DOWN: OFF*

Missile Launcher Jettison Test Button

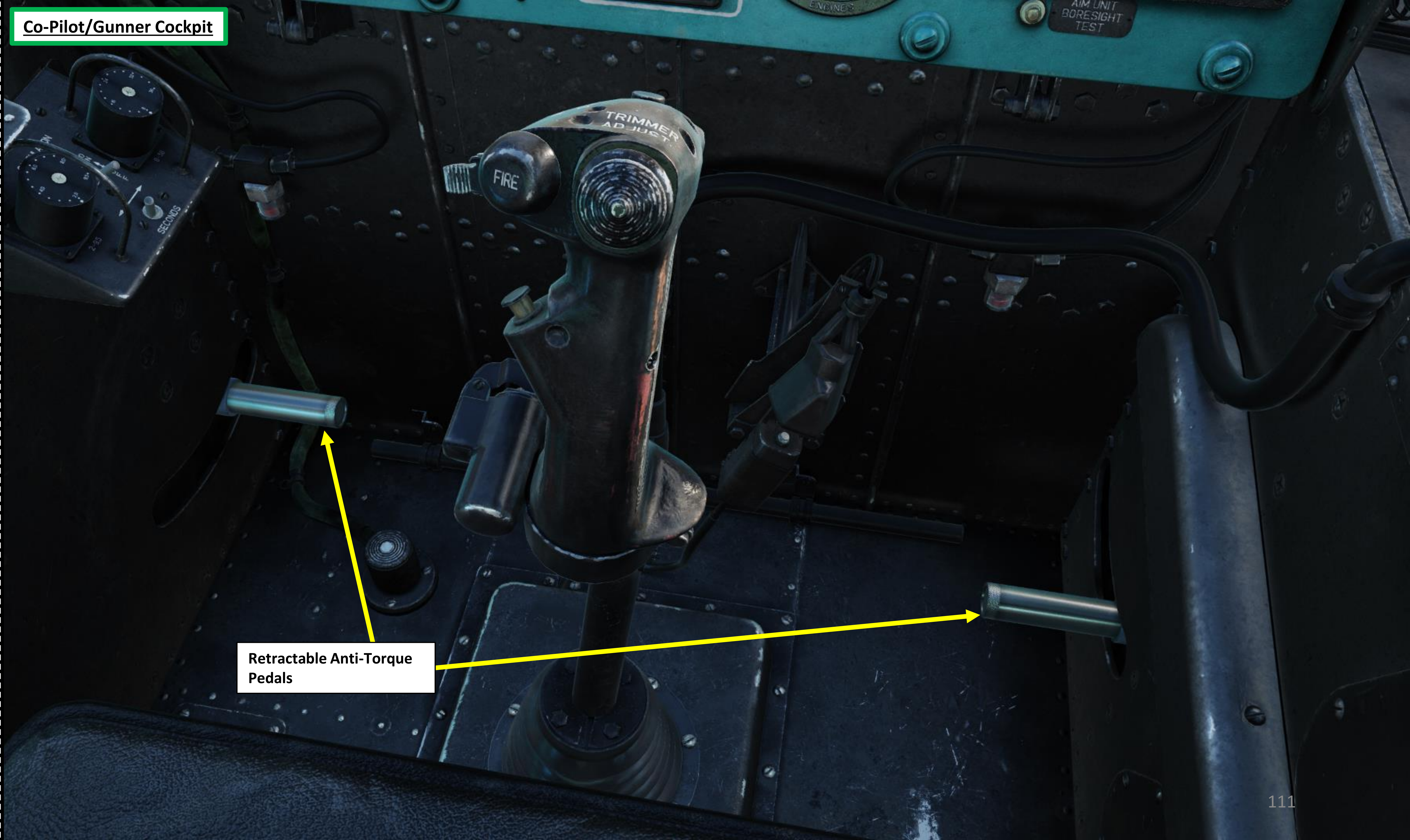
Cannon Rate of Fire Selector Switch
- *UP: Increased (High) Rate of Fire*
- *DOWN: Decreased (Low) Rate of Fire*

FXD MG-30 (30 mm Cannon) Reload Button

Cannon Burst Length Selector Switch
- *UP: Short Burst*
- *MIDDLE: Long Burst*
- *DOWN: Medium Burst*

Missile Guidance Unit Boresight Test Button

Co-Pilot/Gunner Cockpit



Co-Pilot/Gunner Cockpit

CPG (Co-Pilot Gunner) Controls Locking Case

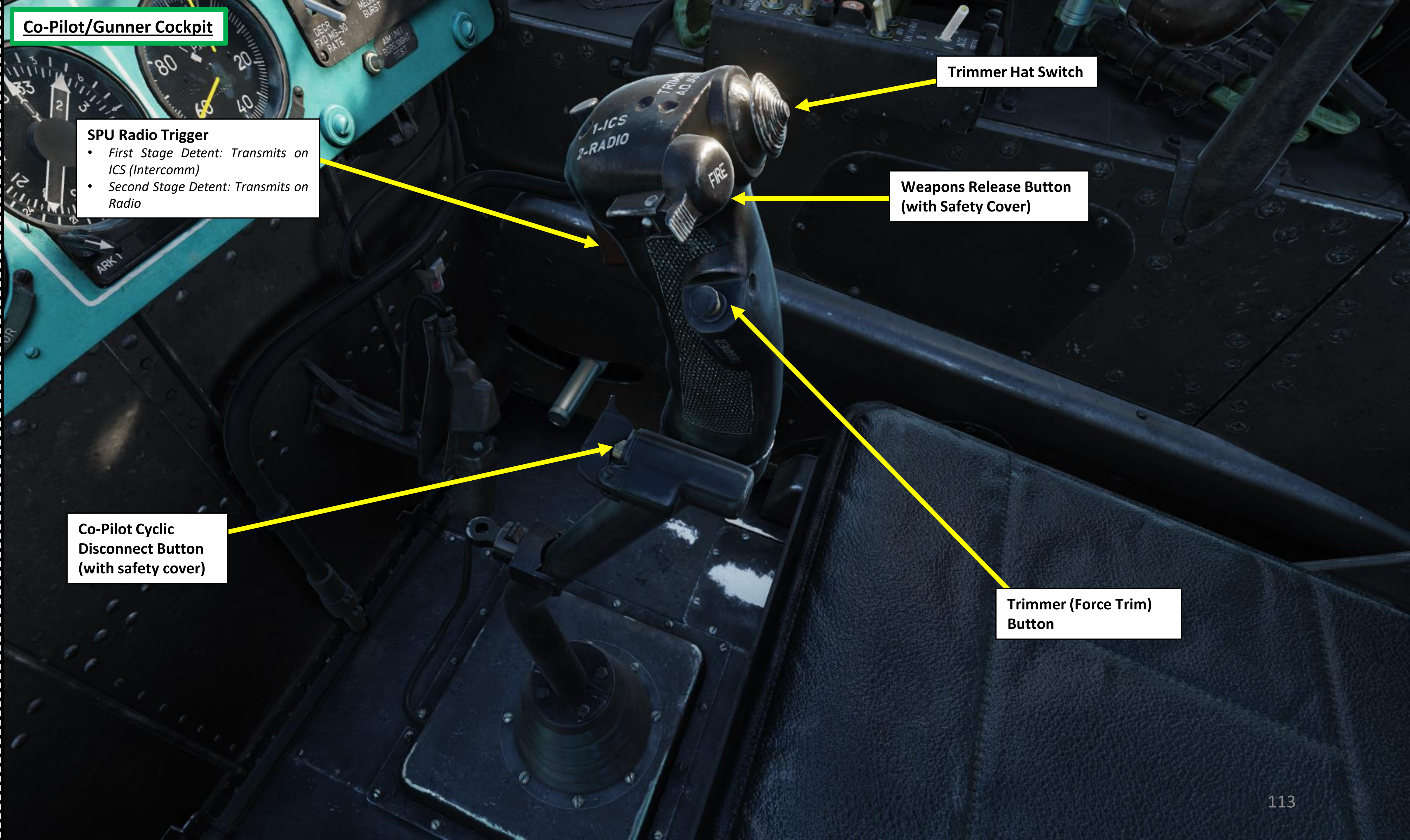
CPG (Co-Pilot Gunner) Controls Locking Mechanism (shown unlocked, CPG controls can be moved freely)

- *Control lock is toggled using the "C" multicrew binding to request aircraft control.*

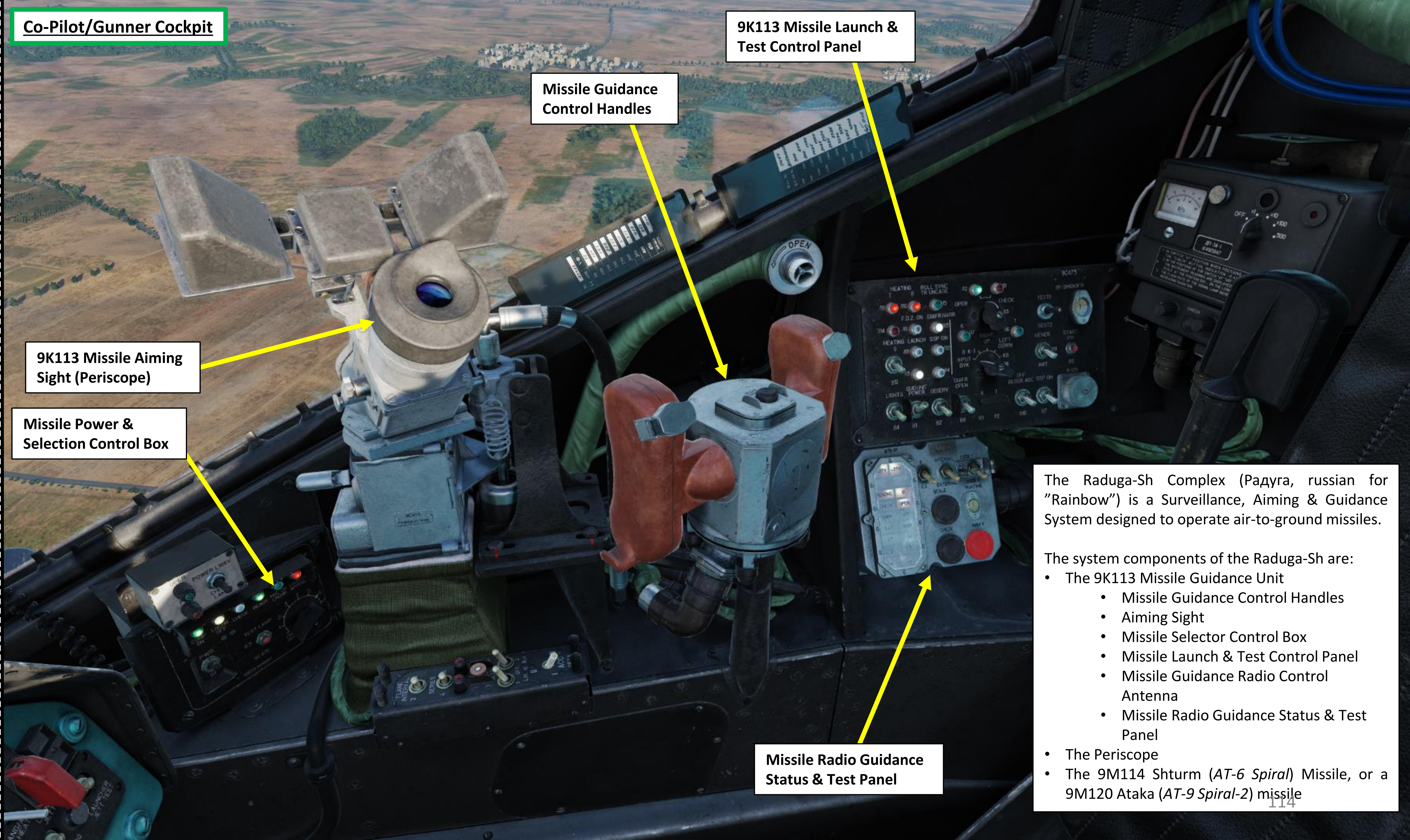
CPG (Co-Pilot Gunner) Controls Locking Mechanism (shown locked, CPG controls cannot be moved freely)

- *Control lock is toggled using the "C" multicrew binding to request aircraft control.*

Co-Pilot/Gunner Cockpit



Co-Pilot/Gunner Cockpit



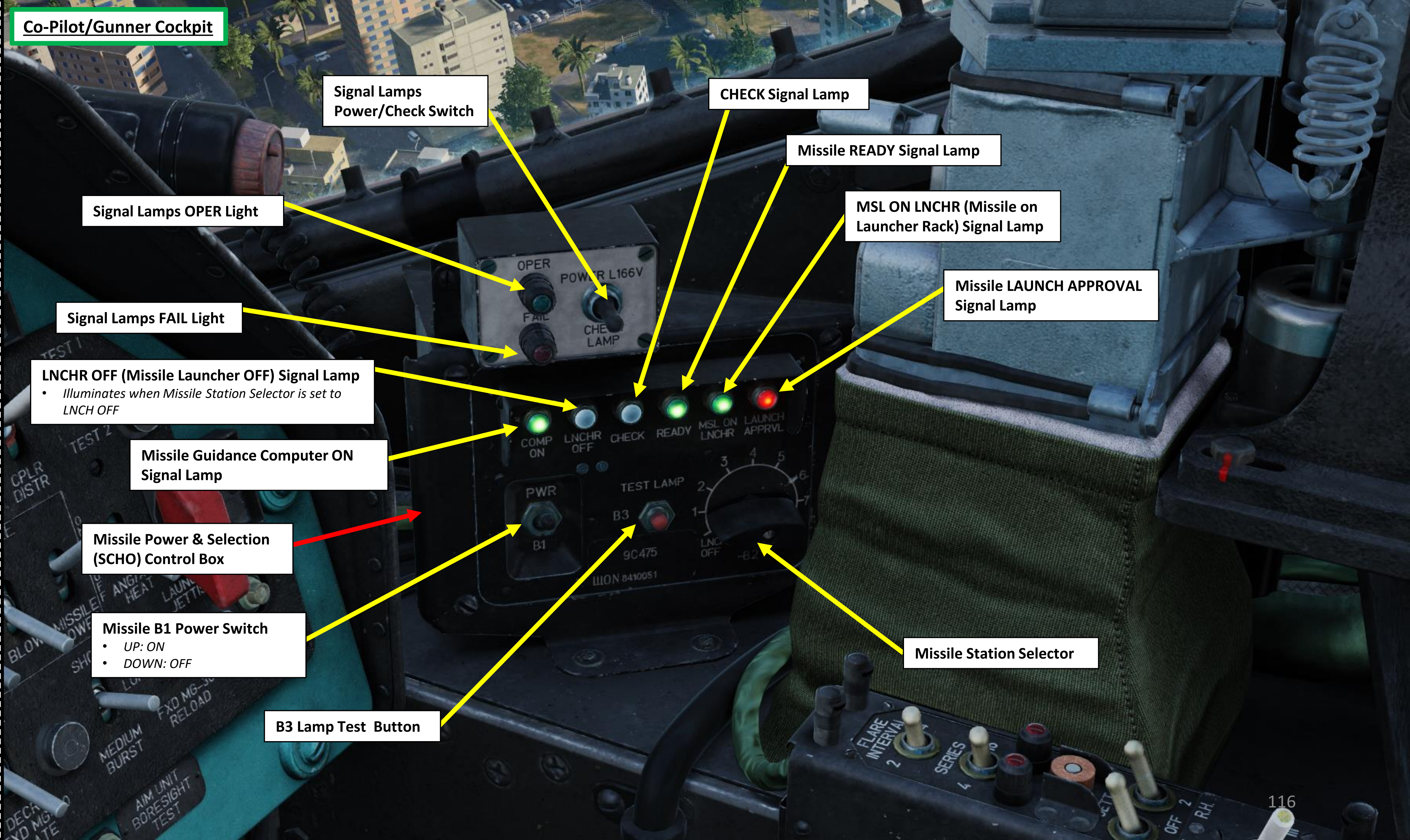
The Raduga-Sh Complex (Радуга, russian for "Rainbow") is a Surveillance, Aiming & Guidance System designed to operate air-to-ground missiles.

The system components of the Raduga-Sh are:

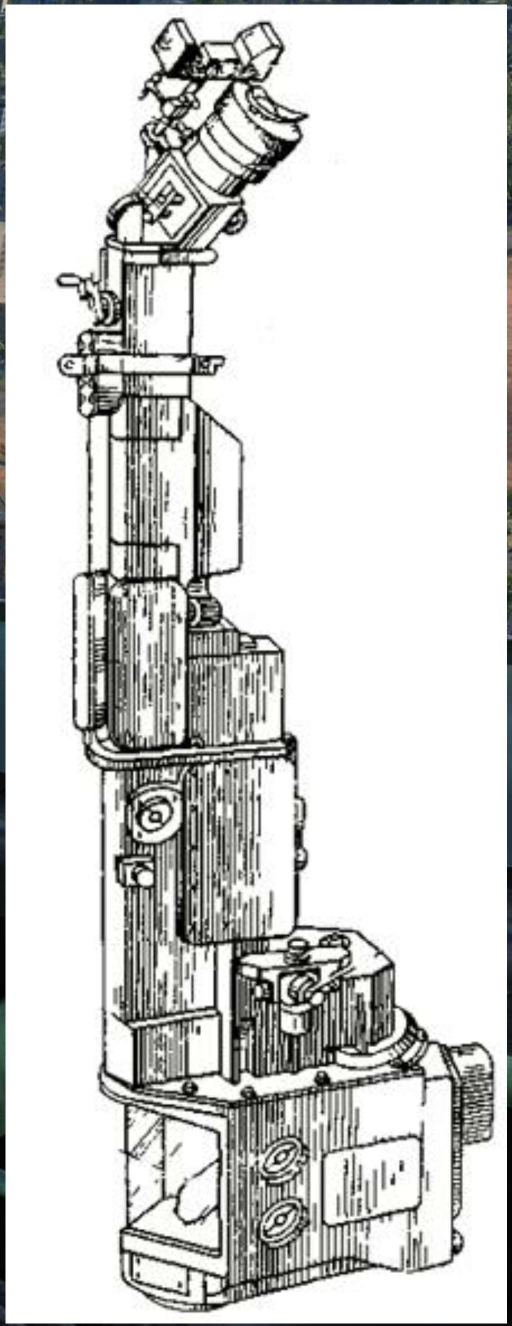
- The 9K113 Missile Guidance Unit
  - Missile Guidance Control Handles
  - Aiming Sight
  - Missile Selector Control Box
  - Missile Launch & Test Control Panel
  - Missile Guidance Radio Control Antenna
  - Missile Radio Guidance Status & Test Panel
- The Periscope
- The 9M114 Shturm (*AT-6 Spiral*) Missile, or a 9M120 Ataka (*AT-9 Spiral-2*) missile

Co-Pilot/Gunner Cockpit

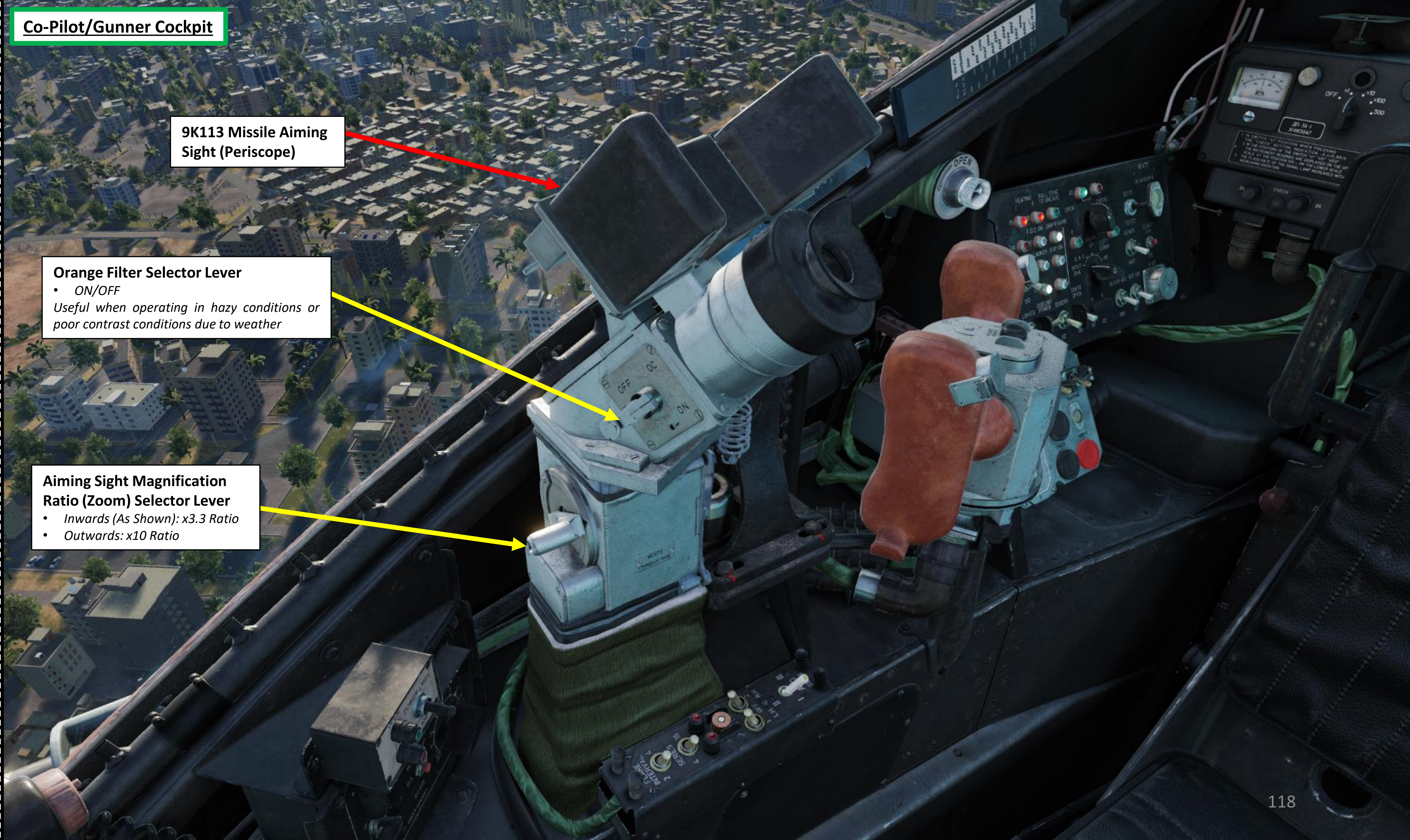
Co-Pilot/Gunner Cockpit



Co-Pilot/Gunner Cockpit



Co-Pilot/Gunner Cockpit



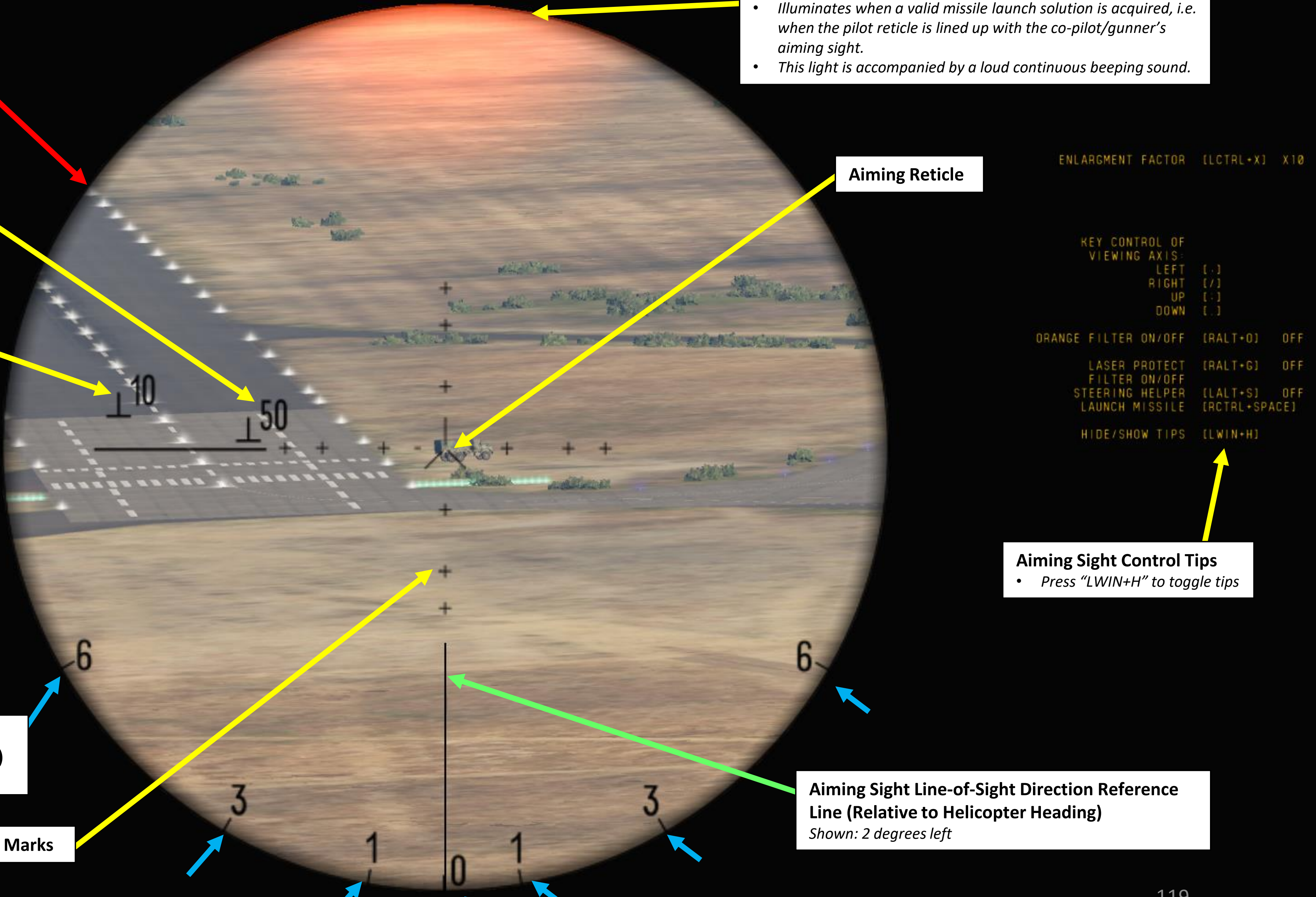
Co-Pilot/Gunner Cockpit

9K113 Missile Aiming Sight (x10 Magnification)

"50" Reference Mark
Indicates a range of 5000 m when the target (with a height of 2.5 m) is located between the horizontal line and the bottom of the line "50" marks, touching both lines.

"10" Reference Mark
Indicates a range of 1000 m when the target (with a height of 2.5 m) is located between the horizontal line and the bottom of the line "10" marks, touching both lines.

Missile Launch Authorization Light
- *Illuminates when a valid missile launch solution is acquired, i.e. when the pilot reticle is lined up with the co-pilot/gunner's aiming sight.*
- *This light is accompanied by a loud continuous beeping sound.*



Aiming Reticle

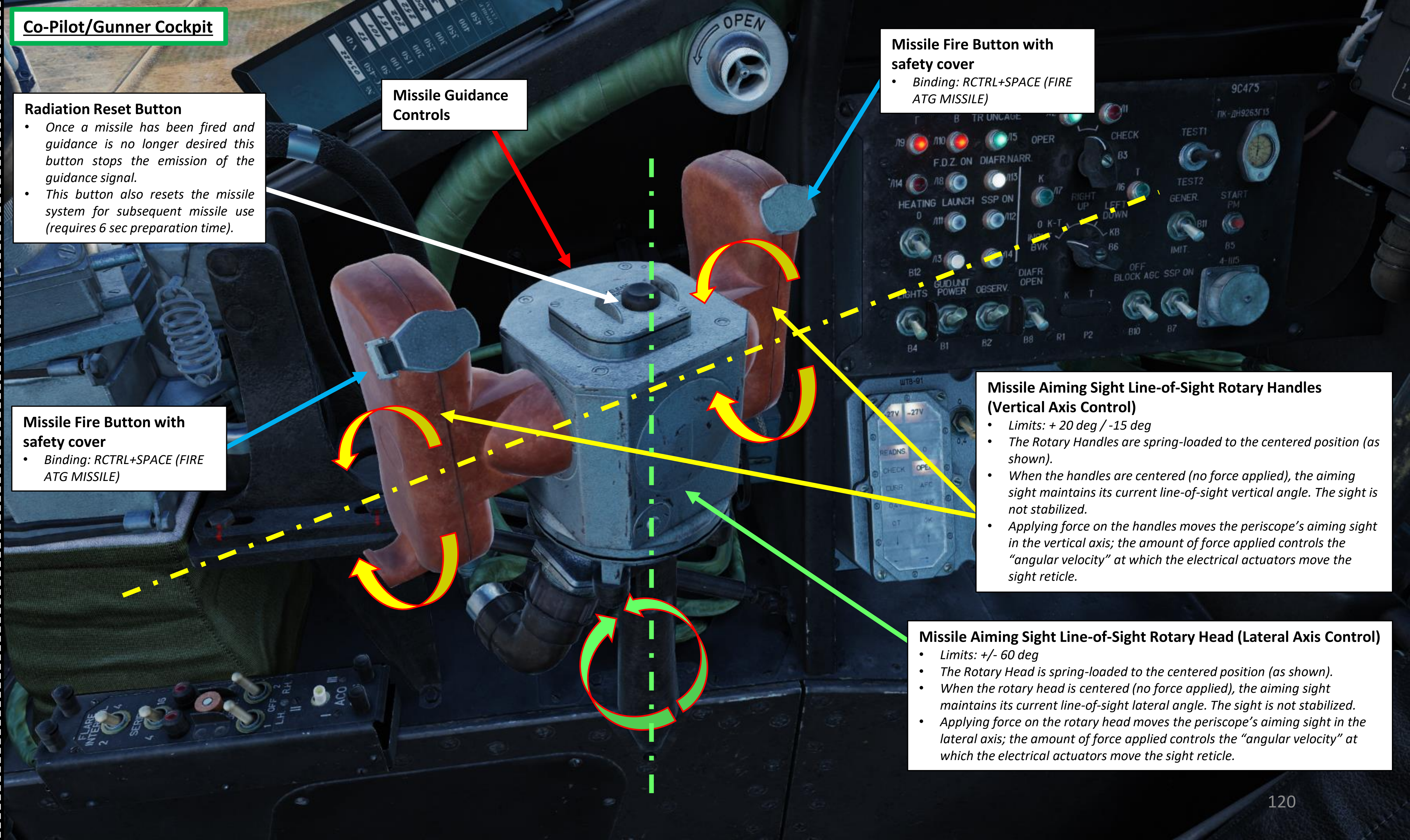
Aiming Sight Control Tips
- *Press "LWIN+H" to toggle tips*

Aiming Sight Line-of-Sight Direction Scale (Relative to Helicopter Heading)
- *Marks on 60, 30, 10 and 0 deg*

Range Finder Marks

Aiming Sight Line-of-Sight Direction Reference Line (Relative to Helicopter Heading)
Shown: 2 degrees left

Co-Pilot/Gunner Cockpit



Missile Guidance Controls

Radiation Reset Button

- *Once a missile has been fired and guidance is no longer desired this button stops the emission of the guidance signal.*
- *This button also resets the missile system for subsequent missile use (requires 6 sec preparation time).*

Missile Fire Button with safety cover

- *Binding: RCTRL+SPACE (FIRE ATG MISSILE)*

Missile Fire Button with safety cover

- *Binding: RCTRL+SPACE (FIRE ATG MISSILE)*

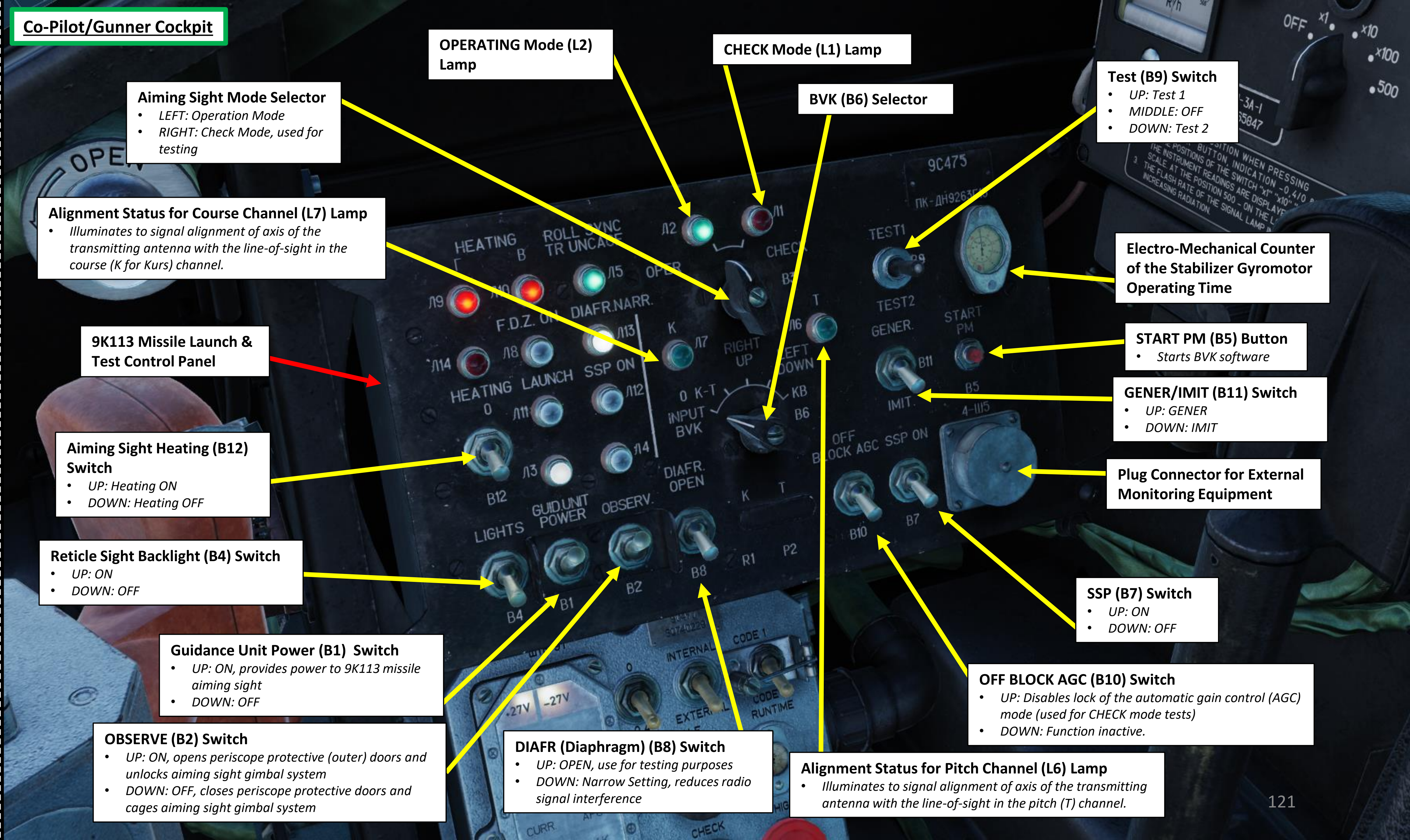
Missile Aiming Sight Line-of-Sight Rotary Handles (Vertical Axis Control)

- *Limits: + 20 deg / -15 deg*
- *The Rotary Handles are spring-loaded to the centered position (as shown).*
- *When the handles are centered (no force applied), the aiming sight maintains its current line-of-sight vertical angle. The sight is not stabilized.*
- *Applying force on the handles moves the periscope's aiming sight in the vertical axis; the amount of force applied controls the "angular velocity" at which the electrical actuators move the sight reticle.*

Missile Aiming Sight Line-of-Sight Rotary Head (Lateral Axis Control)

- *Limits: +/- 60 deg*
- *The Rotary Head is spring-loaded to the centered position (as shown).*
- *When the rotary head is centered (no force applied), the aiming sight maintains its current line-of-sight lateral angle. The sight is not stabilized.*
- *Applying force on the rotary head moves the periscope's aiming sight in the lateral axis; the amount of force applied controls the "angular velocity" at which the electrical actuators move the sight reticle.*

Co-Pilot/Gunner Cockpit



OPERATING Mode (L2) Lamp

CHECK Mode (L1) Lamp

BVK (B6) Selector

Aiming Sight Mode Selector
- *LEFT: Operation Mode*
- *RIGHT: Check Mode, used for testing*

Test (B9) Switch
- *UP: Test 1*
- *MIDDLE: OFF*
- *DOWN: Test 2*

Alignment Status for Course Channel (L7) Lamp
- *Illuminates to signal alignment of axis of the transmitting antenna with the line-of-sight in the course (K for Kurs) channel.*

Electro-Mechanical Counter of the Stabilizer Gyromotor Operating Time

9K113 Missile Launch & Test Control Panel

START PM (B5) Button
- *Starts BVK software*

GENER/IMIT (B11) Switch
- *UP: GENER*
- *DOWN: IMIT*

Aiming Sight Heating (B12) Switch
- *UP: Heating ON*
- *DOWN: Heating OFF*

Plug Connector for External Monitoring Equipment

Reticle Sight Backlight (B4) Switch
- *UP: ON*
- *DOWN: OFF*

SSP (B7) Switch
- *UP: ON*
- *DOWN: OFF*

Guidance Unit Power (B1) Switch
- *UP: ON, provides power to 9K113 missile aiming sight*
- *DOWN: OFF*

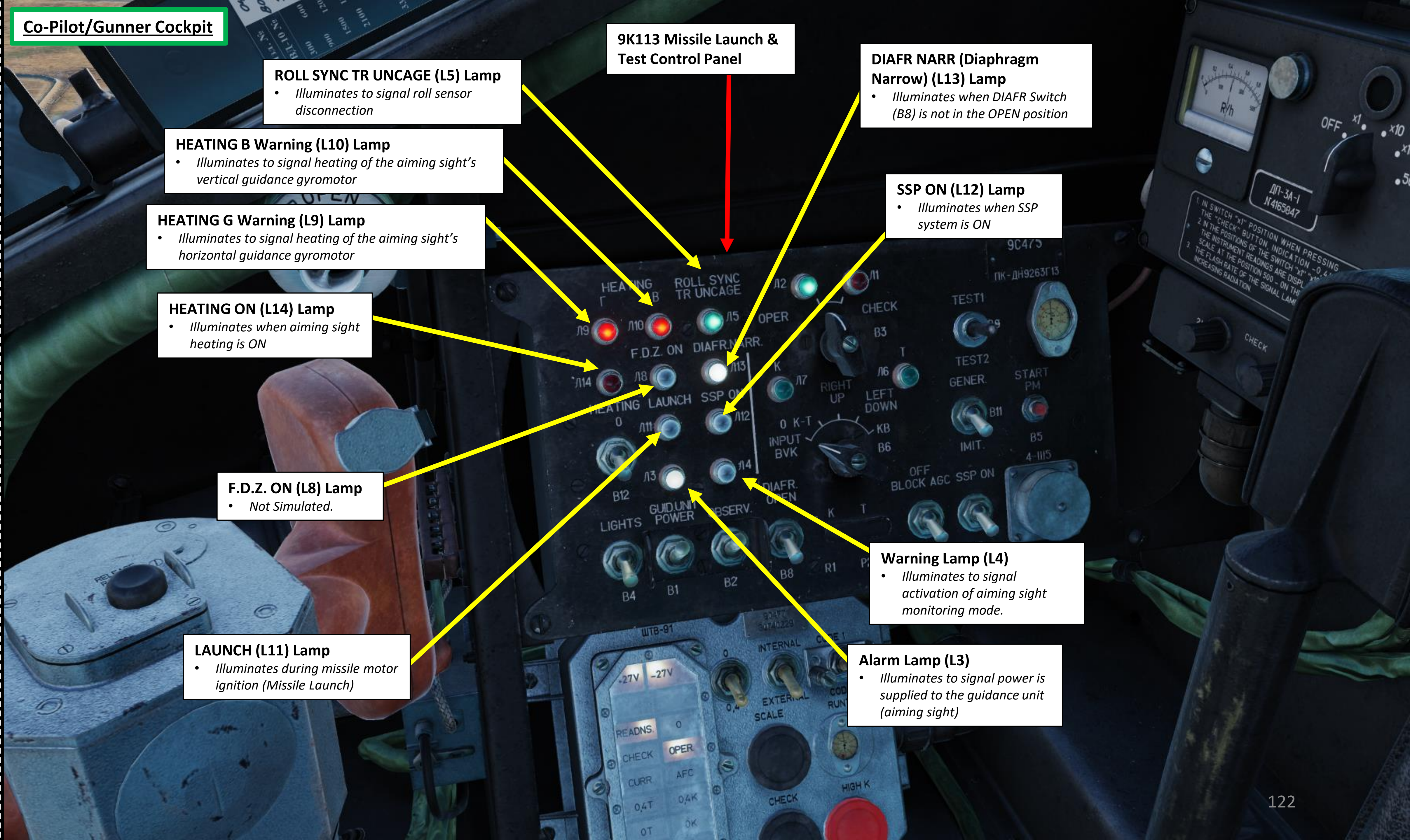
OFF BLOCK AGC (B10) Switch
- *UP: Disables lock of the automatic gain control (AGC) mode (used for CHECK mode tests)*
- *DOWN: Function inactive.*

OBSERVE (B2) Switch
- *UP: ON, opens periscope protective (outer) doors and unlocks aiming sight gimbal system*
- *DOWN: OFF, closes periscope protective doors and cages aiming sight gimbal system*

DIAFR (Diaphragm) (B8) Switch
- *UP: OPEN, use for testing purposes*
- *DOWN: Narrow Setting, reduces radio signal interference*

Alignment Status for Pitch Channel (L6) Lamp
- *Illuminates to signal alignment of axis of the transmitting antenna with the line-of-sight in the pitch (T) channel.*

Co-Pilot/Gunner Cockpit



9K113 Missile Launch & Test Control Panel

ROLL SYNC TR UNCAGE (L5) Lamp
- *Illuminates to signal roll sensor disconnection*

HEATING B Warning (L10) Lamp
- *Illuminates to signal heating of the aiming sight's vertical guidance gyromotor*

HEATING G Warning (L9) Lamp
- *Illuminates to signal heating of the aiming sight's horizontal guidance gyromotor*

HEATING ON (L14) Lamp
- *Illuminates when aiming sight heating is ON*

F.D.Z. ON (L8) Lamp
- *Not Simulated.*

LAUNCH (L11) Lamp
- *Illuminates during missile motor ignition (Missile Launch)*

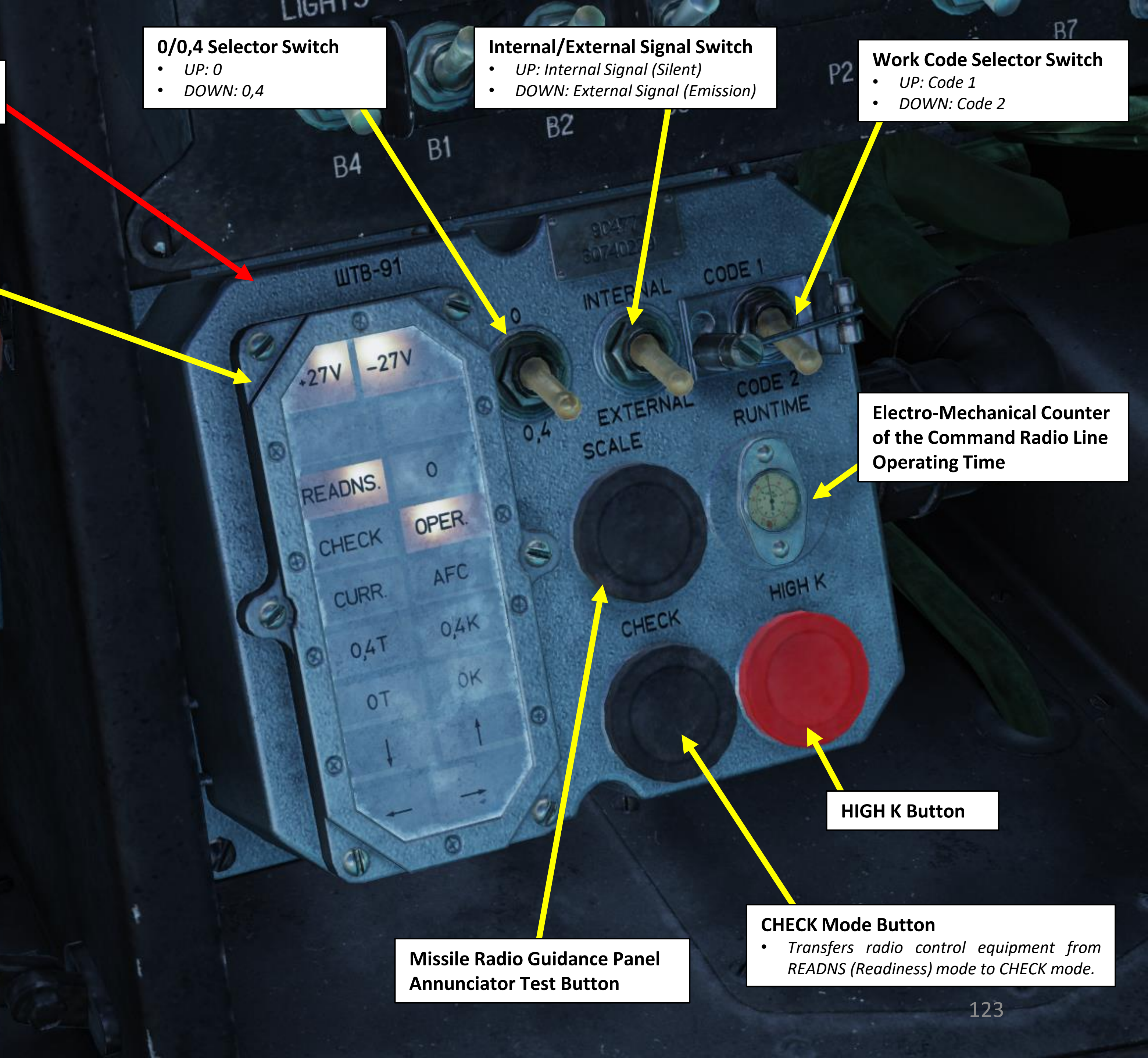
DIAFR NARR (Diaphragm Narrow) (L13) Lamp
- *Illuminates when DIAFR Switch (B8) is not in the OPEN position*

SSP ON (L12) Lamp
- *Illuminates when SSP system is ON*

Warning Lamp (L4)
- *Illuminates to signal activation of aiming sight monitoring mode.*

Alarm Lamp (L3)
- *Illuminates to signal power is supplied to the guidance unit (aiming sight)*

Co-Pilot/Gunner Cockpit



Missile Radio Guidance Status & Test Panel

+27V Annunciator	**-27V Annunciator**
READNS Annunciator *Indicates aiming sight readiness when stabilizer gyro motors are spinning.*	**0 Annunciator**
CHECK Annunciator *Check Mode Selected*	**OPER Annunciator** *Operation Mode Selected*
CURR Annunciator	**AFC Annunciator**
0,4 T Annunciator	**0,4 K Annunciator**
0 T Annunciator	**0 K Annunciator**
DOWN Annunciator *Aiming sight line-of-sight has reached the maximum downward gimbal limit.*	**UP Annunciator** *Aiming sight line-of-sight has reached the maximum upward gimbal limit.*
LEFT Annunciator *Aiming sight line-of-sight has reached the maximum leftward gimbal limit.*	**RIGHT Annunciator** *Aiming sight line-of-sight has reached the maximum rightward gimbal limit.*

0/0,4 Selector Switch
- *UP: 0*
- *DOWN: 0,4*

Internal/External Signal Switch
- *UP: Internal Signal (Silent)*
- *DOWN: External Signal (Emission)*

Work Code Selector Switch
- *UP: Code 1*
- *DOWN: Code 2*

Electro-Mechanical Counter of the Command Radio Line Operating Time

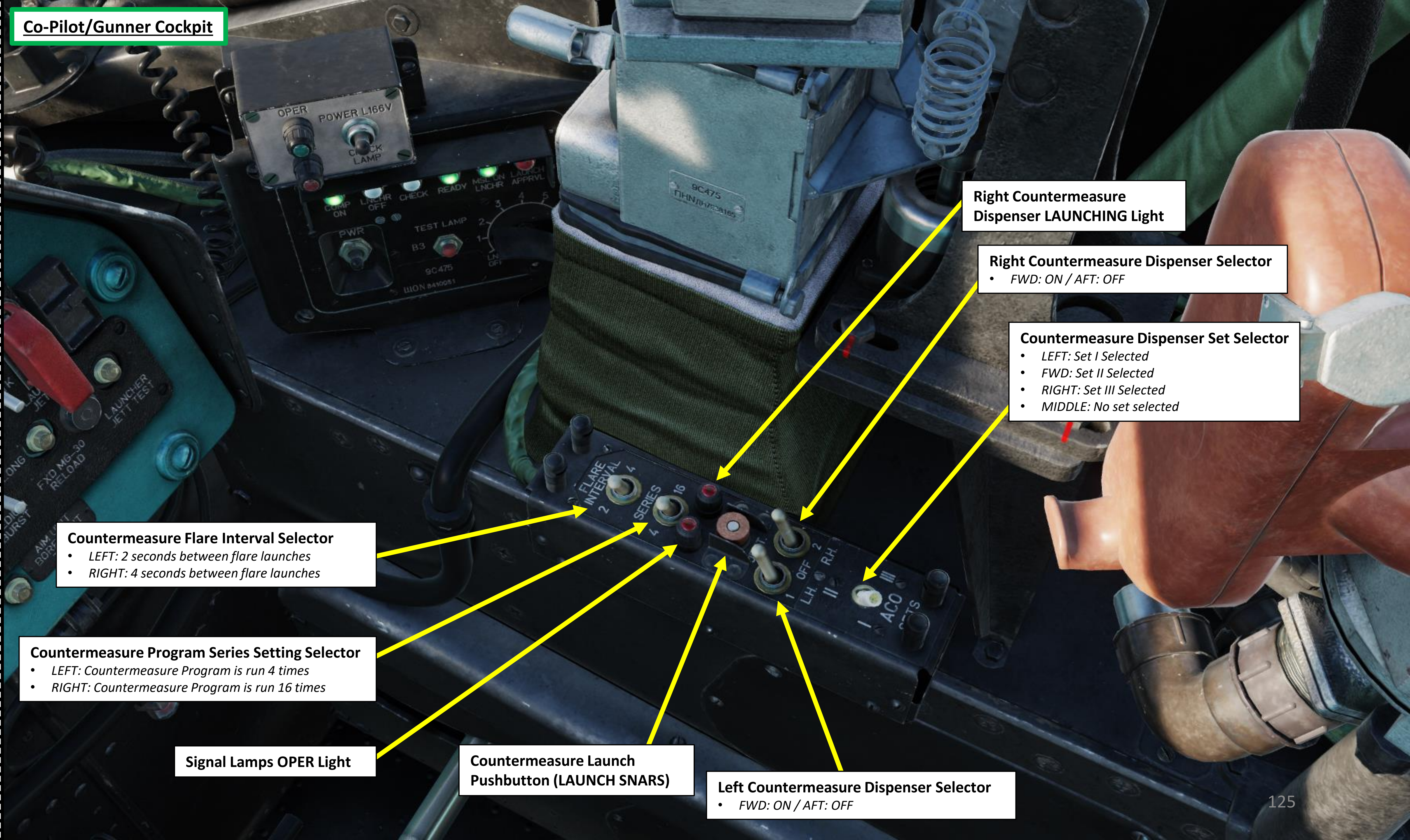
HIGH K Button

CHECK Mode Button
- *Transfers radio control equipment from READNS (Readiness) mode to CHECK mode.*

Missile Radio Guidance Panel Annunciator Test Button

Co-Pilot/Gunner Cockpit

Co-Pilot/Gunner Cockpit



Right Countermeasure Dispenser LAUNCHING Light

Right Countermeasure Dispenser Selector
- *FWD: ON / AFT: OFF*

Countermeasure Dispenser Set Selector
- *LEFT: Set I Selected*
- *FWD: Set II Selected*
- *RIGHT: Set III Selected*
- *MIDDLE: No set selected*

Countermeasure Flare Interval Selector
- *LEFT: 2 seconds between flare launches*
- *RIGHT: 4 seconds between flare launches*

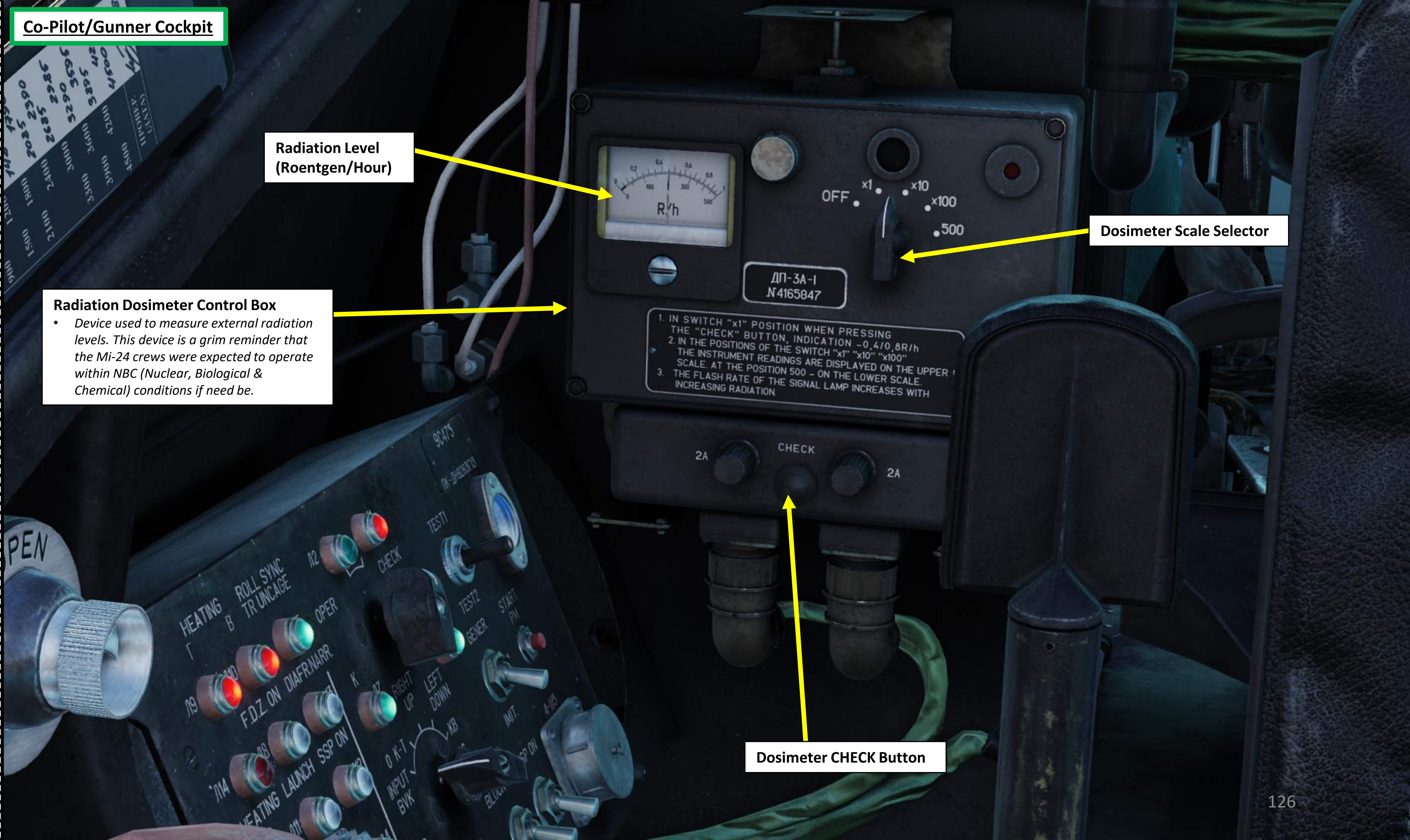
Countermeasure Program Series Setting Selector
- *LEFT: Countermeasure Program is run 4 times*
- *RIGHT: Countermeasure Program is run 16 times*

Signal Lamps OPER Light

Countermeasure Launch Pushbutton (LAUNCH SNARS)

Left Countermeasure Dispenser Selector
- *FWD: ON / AFT: OFF*

Co-Pilot/Gunner Cockpit



Radiation Level (Roentgen/Hour)

Dosimeter Scale Selector

Radiation Dosimeter Control Box

- *Device used to measure external radiation levels. This device is a grim reminder that the Mi-24 crews were expected to operate within NBC (Nuclear, Biological & Chemical) conditions if need be.*

Dosimeter CHECK Button

Co-Pilot/Gunner Cockpit

Co-Pilot/Gunner Cockpit

Aft Compartment

Aft Compartment

Aft Compartment

Aft Compartment


GSh-2-30K 30 mm Dual Barrel Cannon
(250 rounds)


9M114 Shturm (*AT-6 Spiral*)
Air-to-Ground Missile
Missile Radio Guidance
Control Unit Antenna
Raduga-Sh Complex Periscope
Protection Doors (Shown Open)
• *Note: There are two sets of doors.*
Raduga-Sh Complex
Periscope Sight (ПН / PN)


GUV 8700 Pod
Variant 9A800
(30 mm AP-30 Grenade Launcher)
GUV 8700 Pod
Variant 9A624/9A622
(1 x 12.7 mm + 2 x 7.62 mm four-barrel Gatling machineguns)

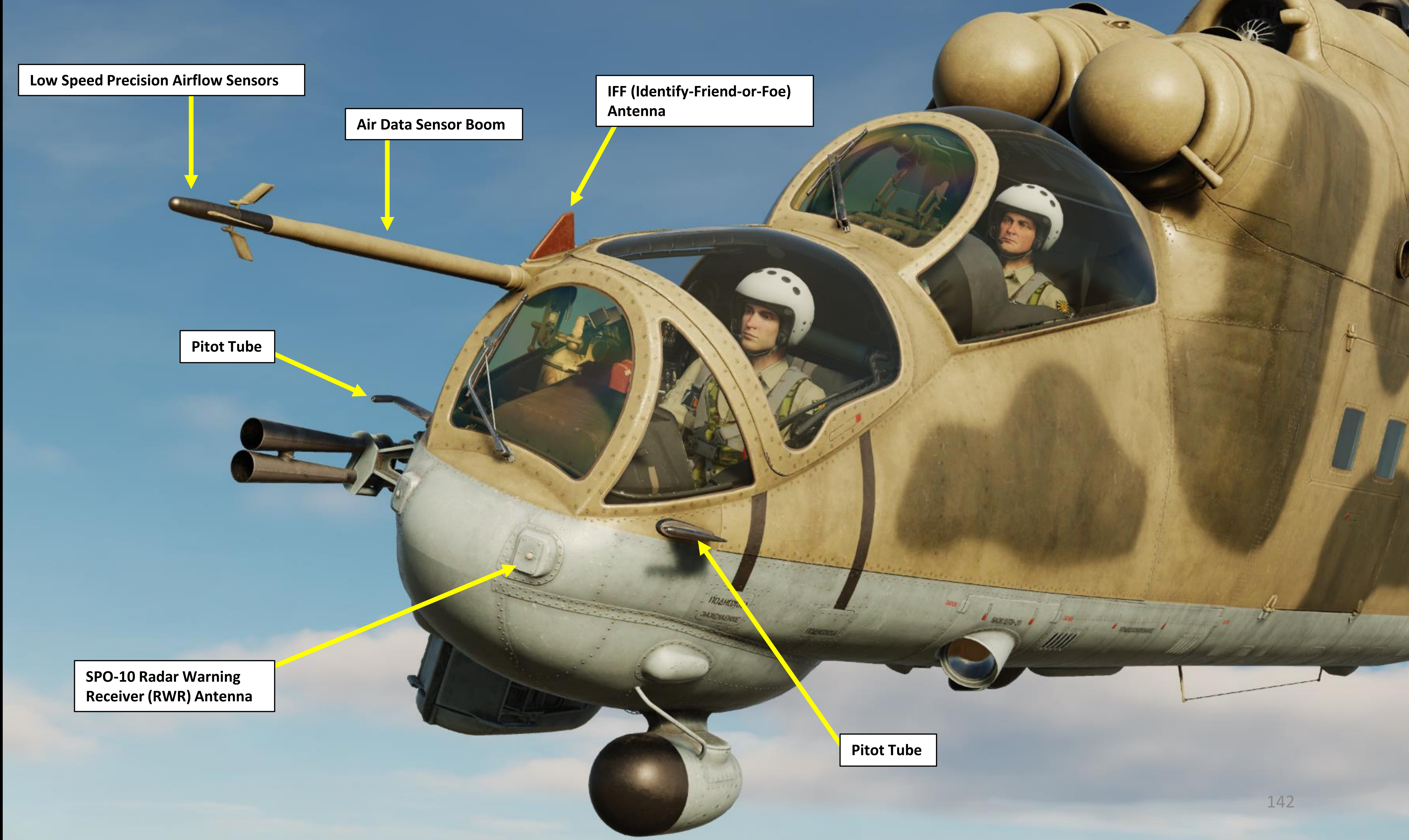

B-8V2OA Rocket Pod
(20 x S-8KOM 80 mm Unguided Rockets)
FAB-250 Bomb


S-24B Rocket
(240 mm Unguided Rocket)
BL-13L1 Rocket Pod
(5 x S-13OF 122 mm
Unguided Rockets)


UB-32 Rocket Pod
(32 x S-5KO 57 mm Unguided Rockets)


KMGU-2 (USLP) Cluster Munitions Dispensers
(96 x AO-2.5RT Cluster Bombs)


R-60M Air-to-Air
Infrared Missiles

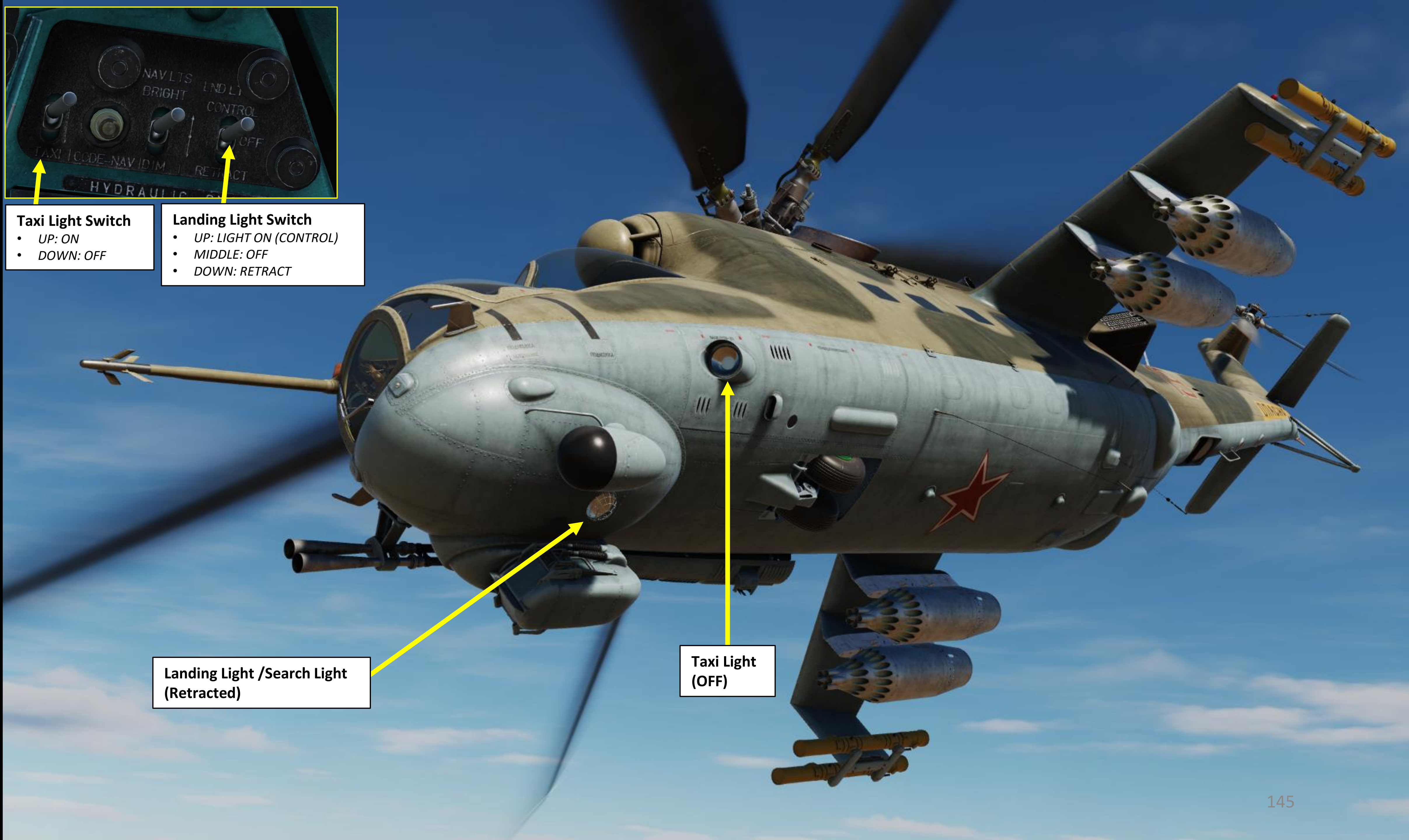

Low Speed Precision Airflow Sensors
Air Data Sensor Boom
IFF (Identify-Friend-or-Foe) Antenna
Pitot Tube
SPO-10 Radar Warning Receiver (RWR) Antenna
Pitot Tube

DOOR CONTROLS

Cockpit Door: LCTRL + C
Left (Crew Compartment) Door: RCTRL + LSHIFT + C
Right (Crew Compartment) Door: RCTRL + RSHIFT + C

DOOR CONTROLS

Cockpit Door: LCTRL + C
Left (Crew Compartment) Door: LCTRL + LSHIFT + C
Right (Crew Compartment) Door: RCTRL + RSHIFT + C


NAV LTS
BRIGHT
LND LT
CONTROL
OFF
TAXI
CODE-NAV
DIM
HYDRAULIC
Taxi Light Switch
• UP: ON
• DOWN: OFF
Landing Light Switch
• UP: LIGHT ON (CONTROL)
• MIDDLE: OFF
• DOWN: RETRACT
Landing Light /Search Light
(Retracted)
Taxi Light
(OFF)

Pilot/CPG Landing Light Control Handover Switch

- *UP: Co-Pilot/Gunner has Landing Light Control*
- *DOWN: Pilot-Commander has Landing Light Control*

Note:
The Landing Light is also used as a Search Light. This light is controlled with the Light Beam Control hat switch ("Pilot Headlight" or "Operator Headlight" bindings) on the collective (pilot & co-pilot).
The **Pilot/CPG Landing Light Control Handover Switch** determines if the pilot or of the co-pilot hat switch controls the light orientation.

Landing Light /Search Light

Taxi Light

Landing Light Switch

- *UP: LIGHT ON (CONTROL)*
- *MIDDLE: OFF*
- *DOWN: RETRACT*

Searchlight Control

Landing Light /Search Light (Slewed in CONTROL Mode)

Navigation Lights Code Button
This button is used to toggle navigation lights and use them for as morse code signals for identification by friendly forces.

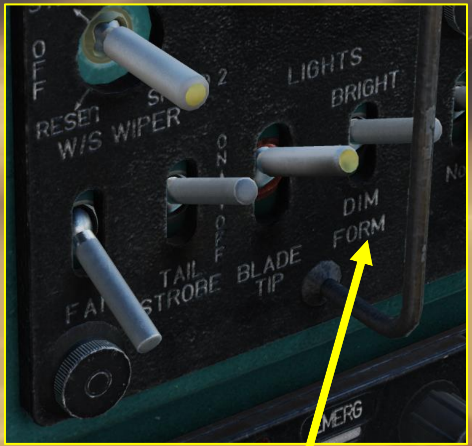
Navigation Lights Switch
- *UP: BRIGHT*
- *MIDDLE: OFF*
- *DOWN: DIM*

White Navigation Light

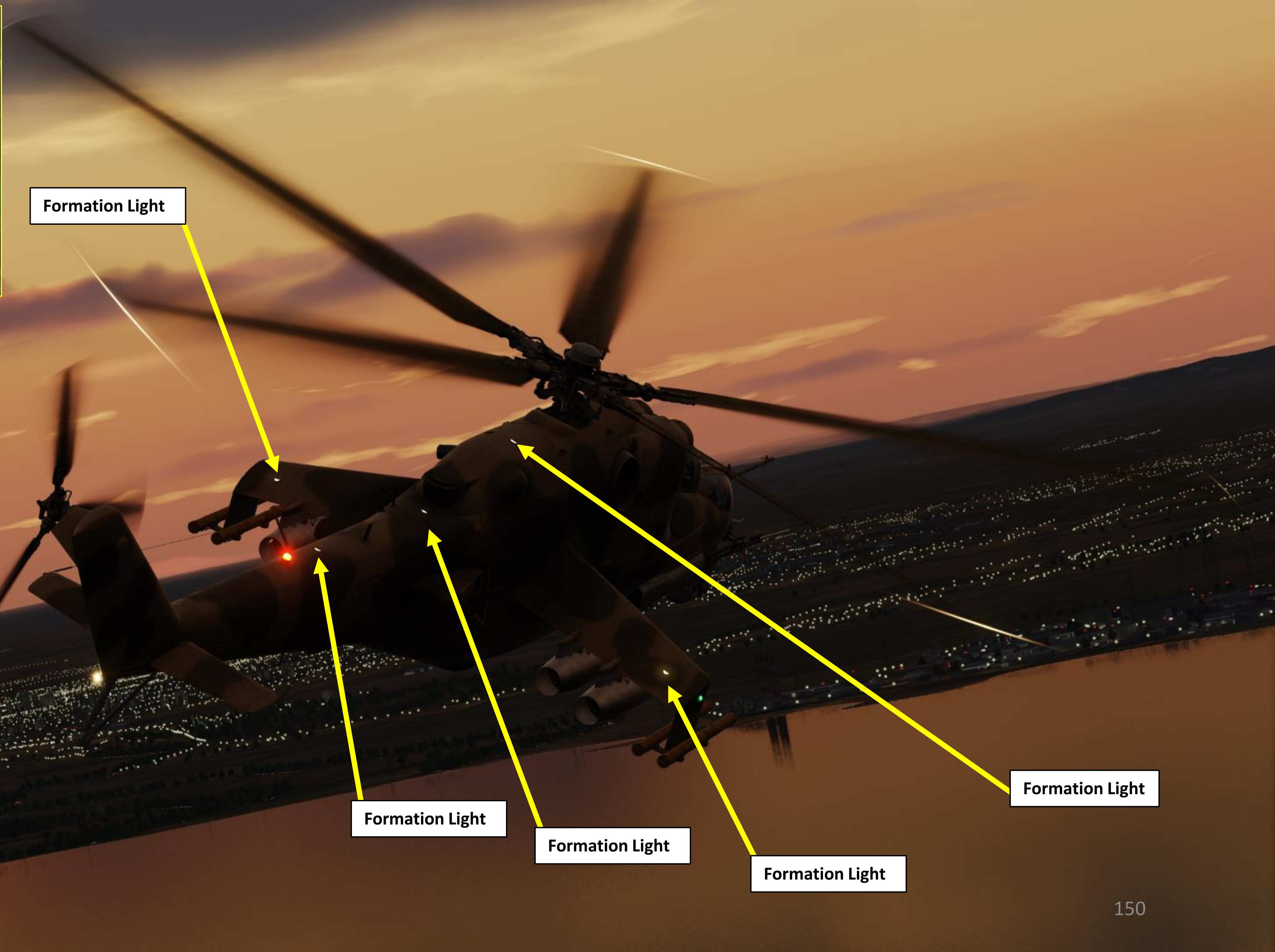
Red Navigation Light

Green Navigation Light


Rotor Tip Lights Switch
• UP: ON / DOWN : OFF
Anti-Collision (Strobe/Beacon) Lights Switch
• UP: ON / DOWN : OFF
Anti-Collision (Strobe) Light
Rotor Blade Tip Light
LIGHTS
BRIGHT
DIM
FORM
TAIL STROBE
BLADE TIP
W/S WIPER
RESET
OFF
EMERG



Formation Lights Switch
- *UP: BRIGHT*
- *MIDDLE : OFF*
- *DOWN: DIM*




Nose Landing Gear Light
• Light illuminates when landing gear is deployed
Main Landing Gear Lights
• Lights illuminate when landing gear is deployed


PZU
Engine Inlet & Particle Separator System (PSS), also known as Dust Protection Device (DPD)
Oil Cooler Fan


Engine Exhaust Infrared
Signature Suppressor


APU (Auxiliary Power Unit) Exhaust
ASO-2V Countermeasure Dispensers (Chaff & Flares)
Signal Flare Dispenser Cassettes
19

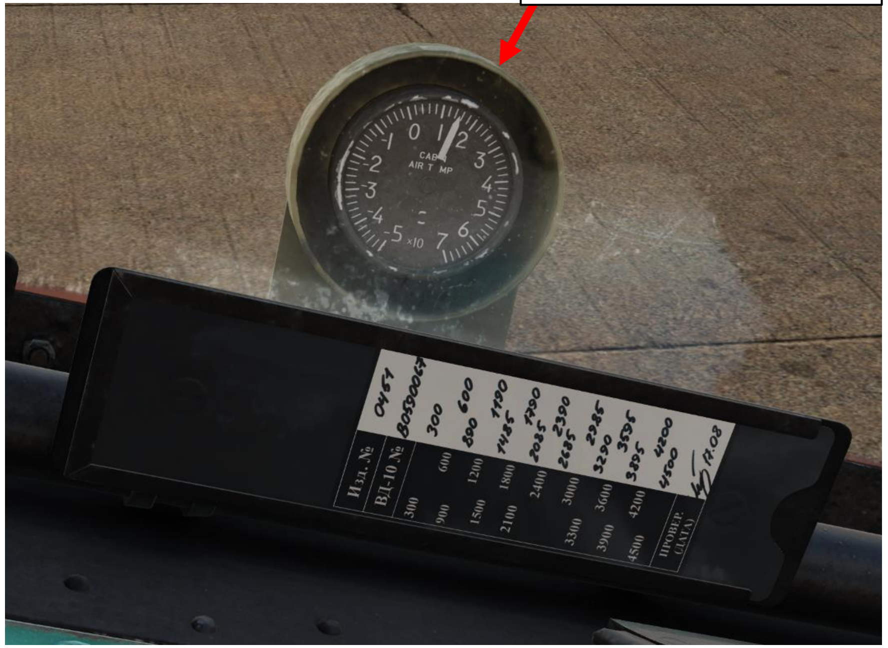

ОПАСНО
19
Tail Skid
DISS-15 Doppler Radar High Frequency Unit

BEFORE FLIGHT

Before flying, it is important to plan ahead. Your payload will depend on the free air temperature (FAT), the humidity and the pressure-altitude (H). The Pre-Flight planning is a tedious task and a good example is available in my UH-1H Huey guide. I recommend you check this out.

In the meantime, I will simply introduce you the general idea of the parameters you should take into account when flying the Mi-24.

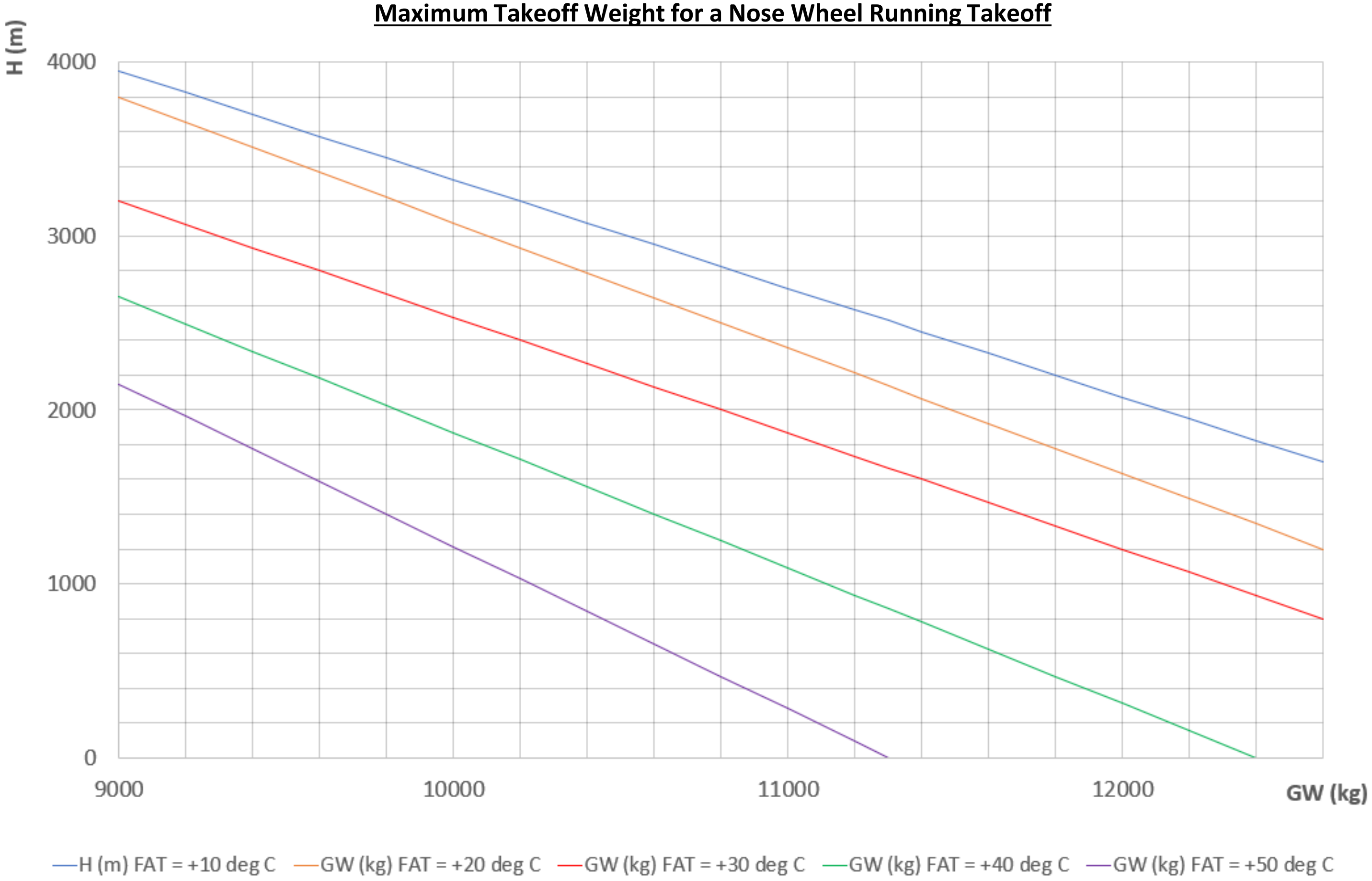
FAT: Free Air Temperature (deg C x 10)



The nose wheel running takeoff maximum takeoff weight chart can be used to determine the max takeoff gross weight (GW) for a nose wheel running takeoff.

Execute a test hover to verify correct maximum weight calculation prior to performing a nose wheel running takeoff. The takeoff can be performed if the helicopter is able to lift off the ground during the test hover. In all cases, the max takeoff weight should never exceed 11500 kg (Mi-24 maximum takeoff gross weight).

Maximum Takeoff Weight for a Nose Wheel Running Takeoff

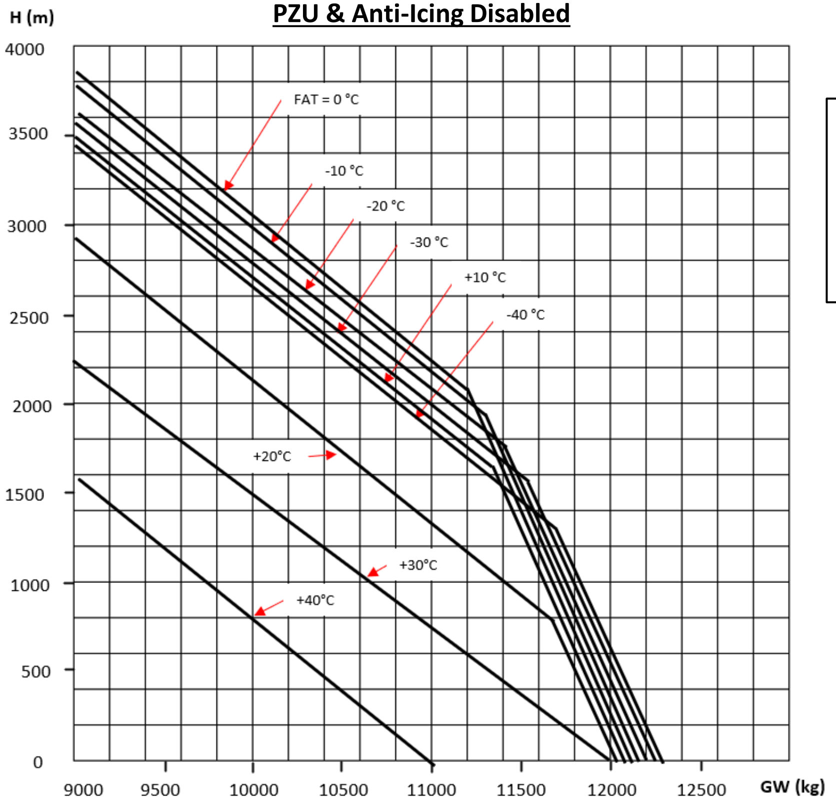


CALCULATING MAXIMUM TAKEOFF WEIGHT

Maximum takeoff weight for **out of ground effect (OGE)** vertical takeoff (landing) (**OGE** max hover weight) is displayed by **Chart B**. Maximum takeoff weight for **in ground effect (IGE)** vertical takeoff (landing) (**IGE** maximum hover weight) is displayed by **Chart C**.

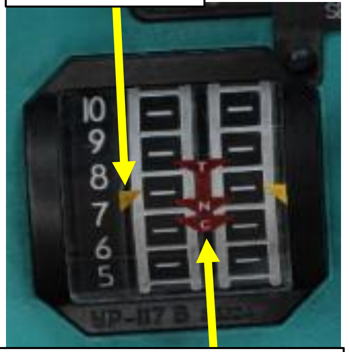
The max hover weight charts display max takeoff weight in relation to the pressure altitude of the landing field and free air temperature (FAT), assuming calm winds, 93 % main rotor RPM, disengaged PZU air inlet particle separator system, and disengaged anti-icing systems. During the hover test, do not exceed the Takeoff Power indication (O/T) on the EPR (Engine Pressure Ratio) gauge.

CHART B: OGE Maximum Hover Weight Chart (Hover Altitude 20 m)
PZU & Anti-Icing Disabled



With PZU system turned on, reduce max weight indicated in chart by 200 kg. With engine and rotor anti-ice systems turned ON, reduce max weight indicated in chart by 1000 kg.

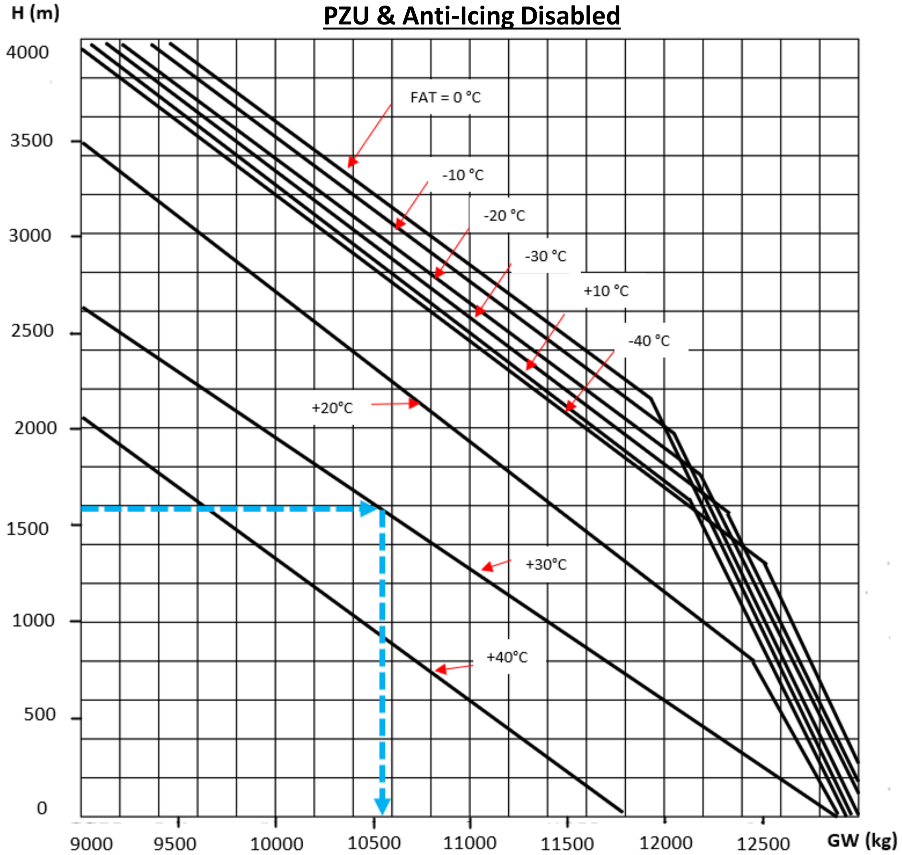
EPR Indicator



EPR: Engine Pressure Ratio Power Reference Marks

Amber Index: Current Power Setting
O (T) Index: Takeoff Power Setting
H (N) Index: Nominal Power Setting
K (C) Index: Cruise Power Setting

CHART C: IGE Maximum Hover Weight Chart (Hover Altitude 3 m)
PZU & Anti-Icing Disabled



Any headwind increases max takeoff weight: + 200 kg at 5 m/s; +1200 kg at 10 m/s.

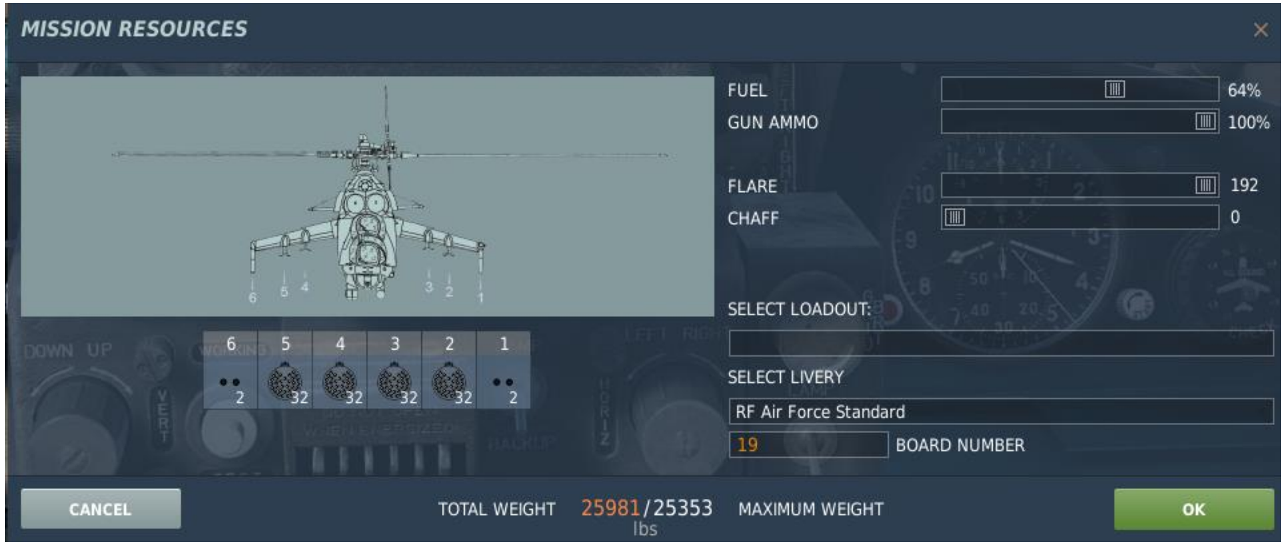
Crosswind up to 5 m/s reduces performance by affecting the tail rotor and increasing engine power requirements. Reduce max takeoff weight by 200 kg in the presence of a crosswind of up to 5 m/sec. At greater crosswind speeds, translational lift effects become more dominant.

Chart C includes a solution (blue arrows) to the following example problem: determine the maximum hover weight for vertical takeoff in ground effect from an airfield located at an altitude of 1,600 m and +30°C FAT.

SOLUTION:

Using the IGE maximum hover weight Chart C, enter the graph from the left at the point of the desired pressure altitude of 1,600 m. Draw a line horizontally to intersect the desired temperature of +30°C. From the intersection point, draw a vertical line down to find the maximum hover weight value, in this case 10,550 kg. To determine the maximum takeoff weight for a vertical takeoff out of ground effect, perform the same process using the OGE maximum hover weight Chart B.

PERFORMANCE DATA TABLE

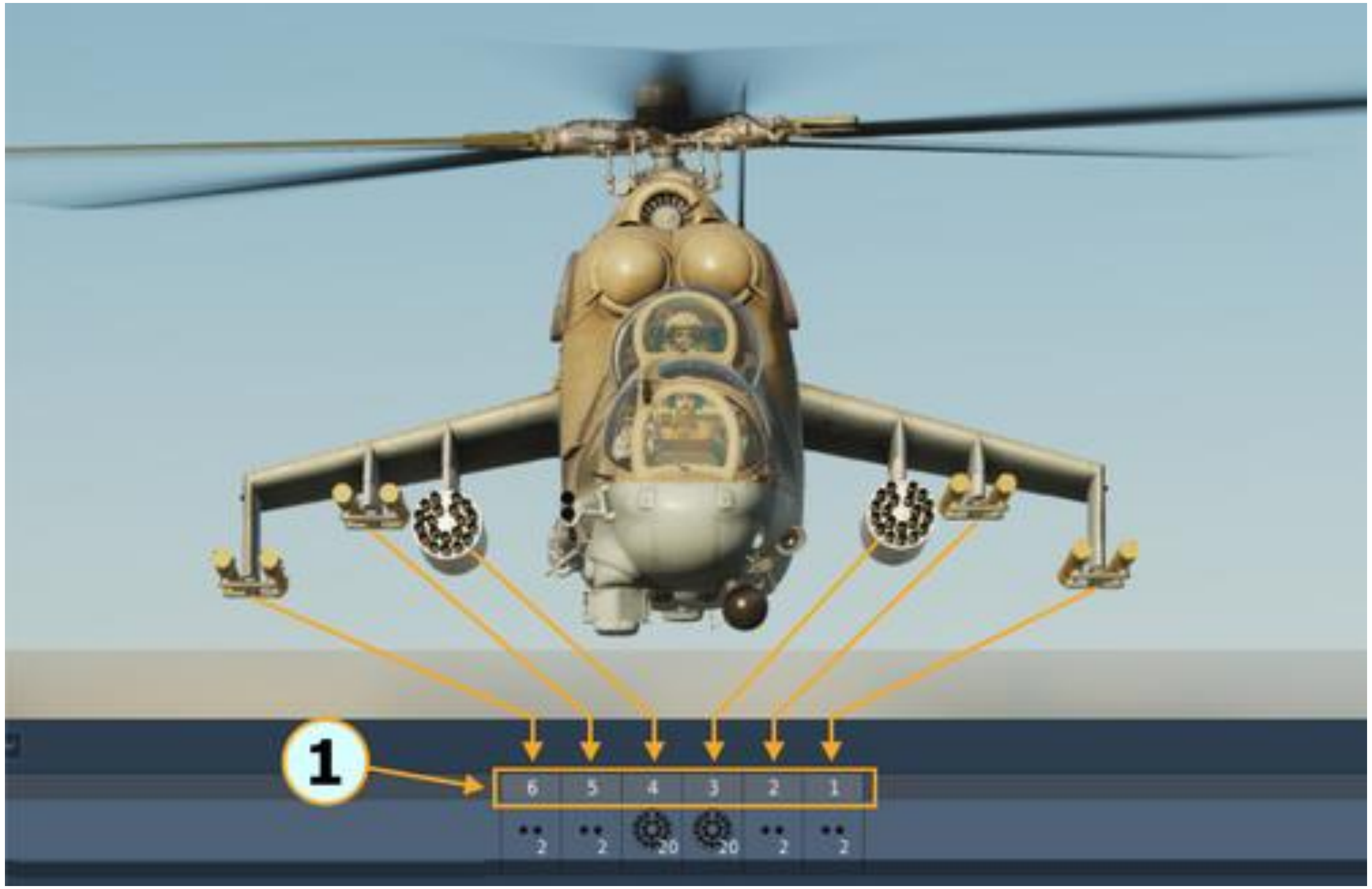


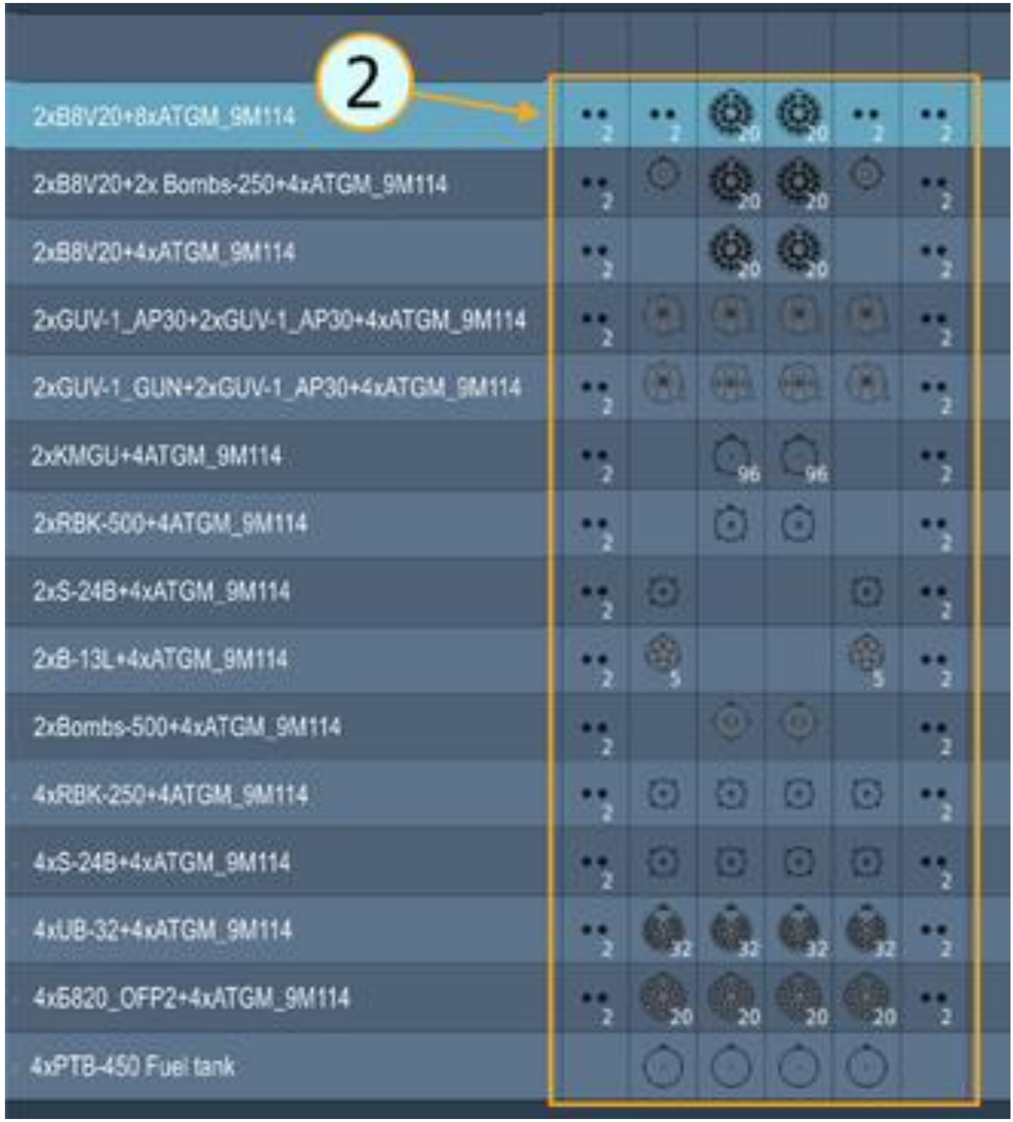
WEAPON LOADOUT CONSIDERATIONS

The Mi-24 weapon pylons only support certain specific loadouts. I highly recommend you use the preset loadouts available.

Failing to use one of the "allowable" configurations may result in incompatible mixed ordnance types and the inability to fire/deliver munitions.

Refer to [this section](#) for more details on compatible loadouts.





A - PRE-START

NOTE: Some steps from the real life checklist will be omitted to keep the procedure concise and practical. We will assume that your helicopter is in pristine condition and that the ground crew did their job properly.

- *Steps preceded by [PC] are performed by the Pilot-Commander.*
- *Steps preceded by [CPG] are performed by the Co-Pilot Gunner (or the Petrovich AI if no player is manning the operator station).*

1. *[PC]* If crew compartment doors are open, close them using:
   - RCTRL + LSHIFT + C for the left crew compartment door
   - RCTRL + RSHIFT + C for the right compartment door
2. *[PC]* Close Pilot Cockpit Door using LCTRL + C (or by clicking on the door handle).

DOOR CONTROLS

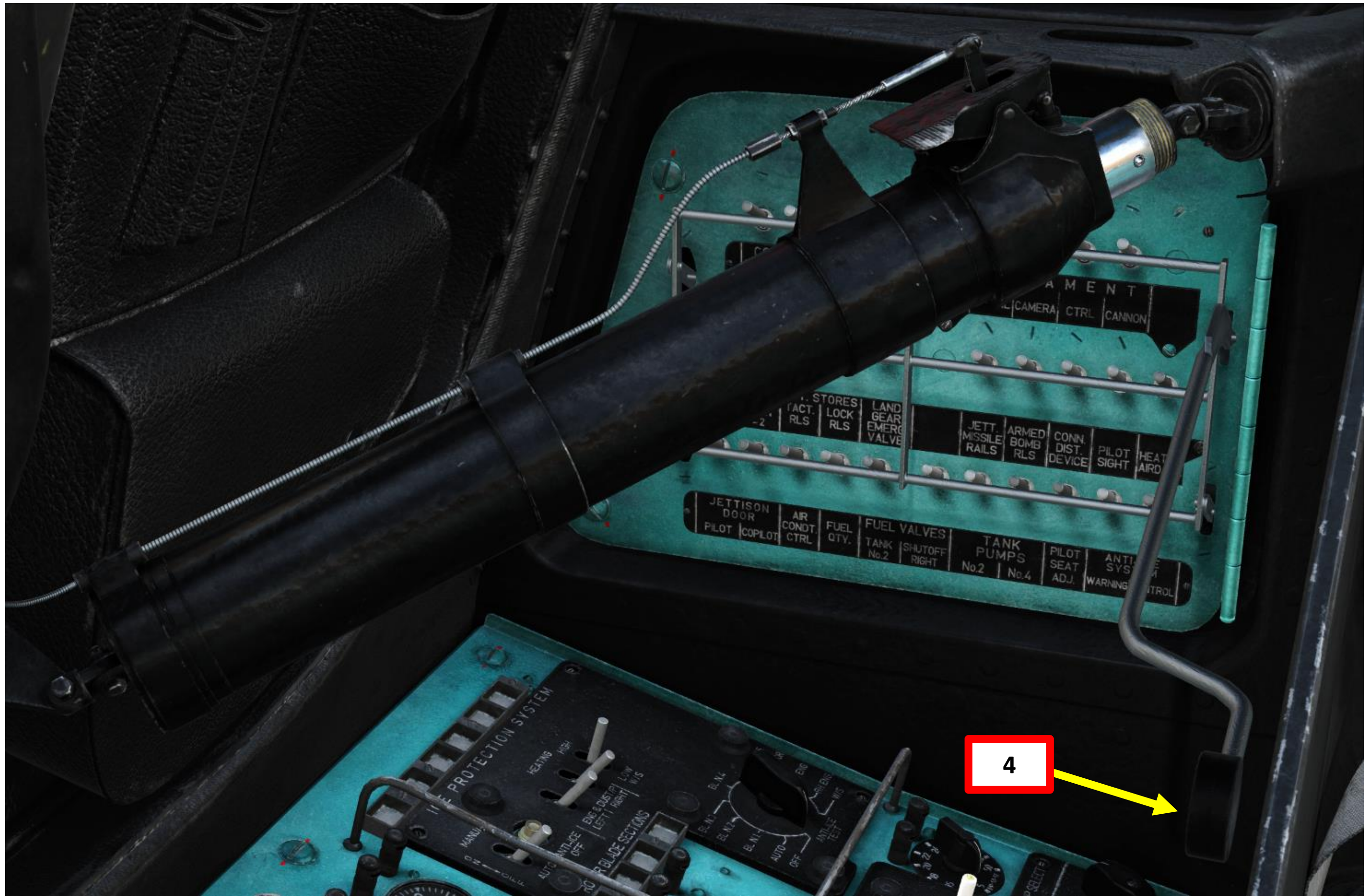
Cockpit Door: LCTRL + C
Left (Crew Compartment) Door: RCTRL + LSHIFT + C
Right (Crew Compartment) Door: RCTRL + RSHIFT + C

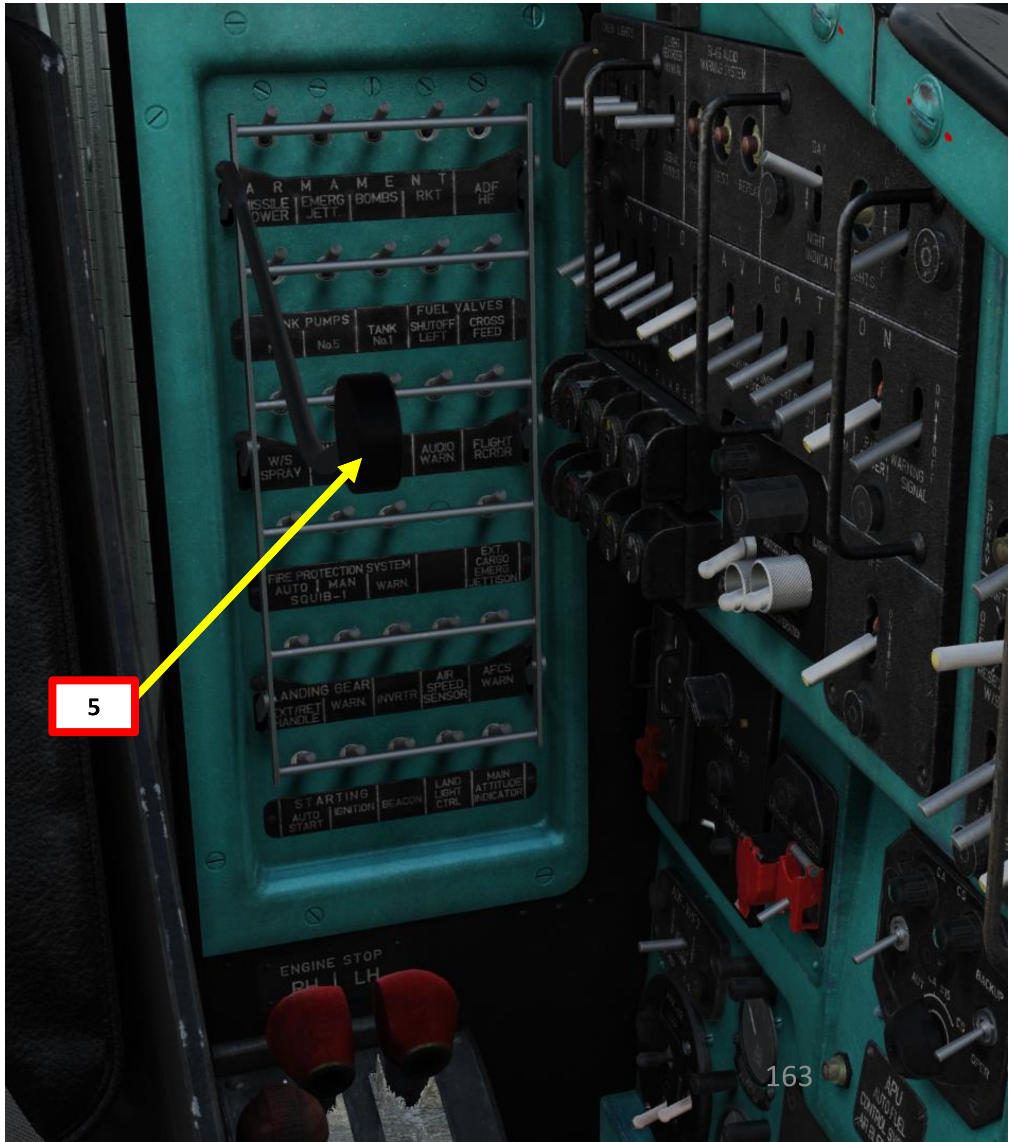
A - PRE-START

3. *[CPG]* Close Co-Pilot Cockpit Door using LCTRL + C (or by clicking on the door handle). Petrovich AI performs this step automatically.

A - PRE-START

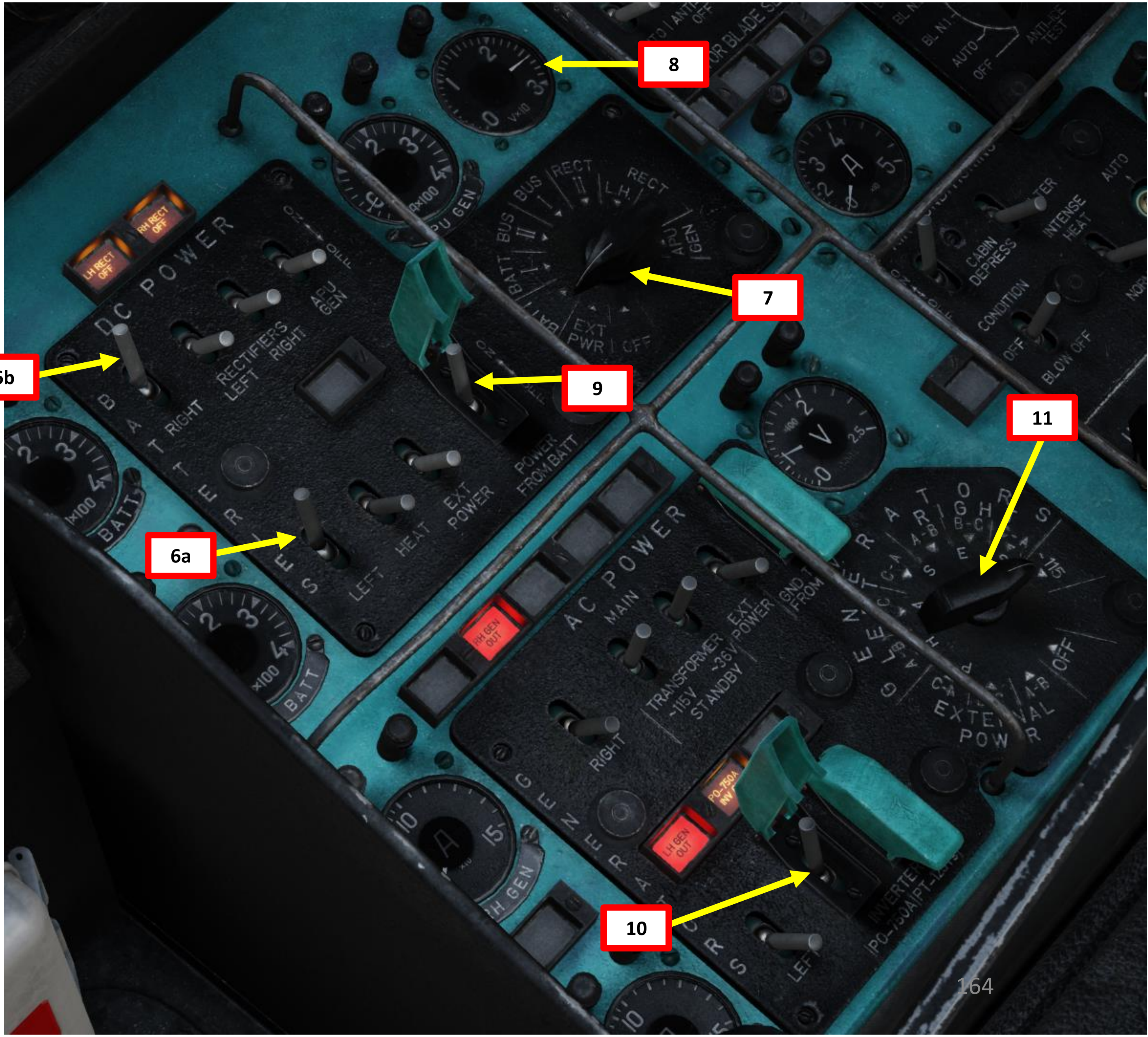
4. *[PC]* Raise Right Circuit Breaker Panel Handle. This will set all circuit breakers of the panel to the ON (UP) position.
5. *[PC]* Raise Left Circuit Breaker Panel Handle. This will set all circuit breakers of the panel to the ON (UP) position.





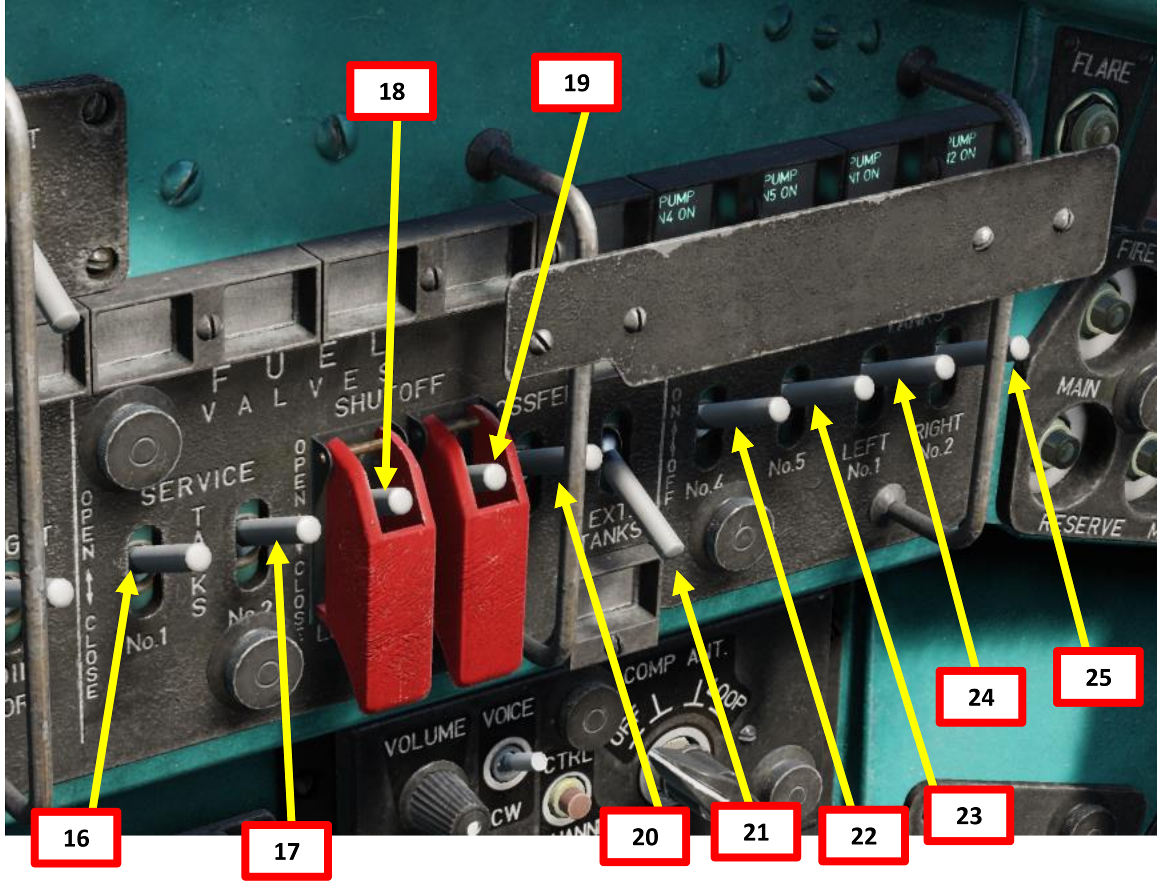
A - PRE-START

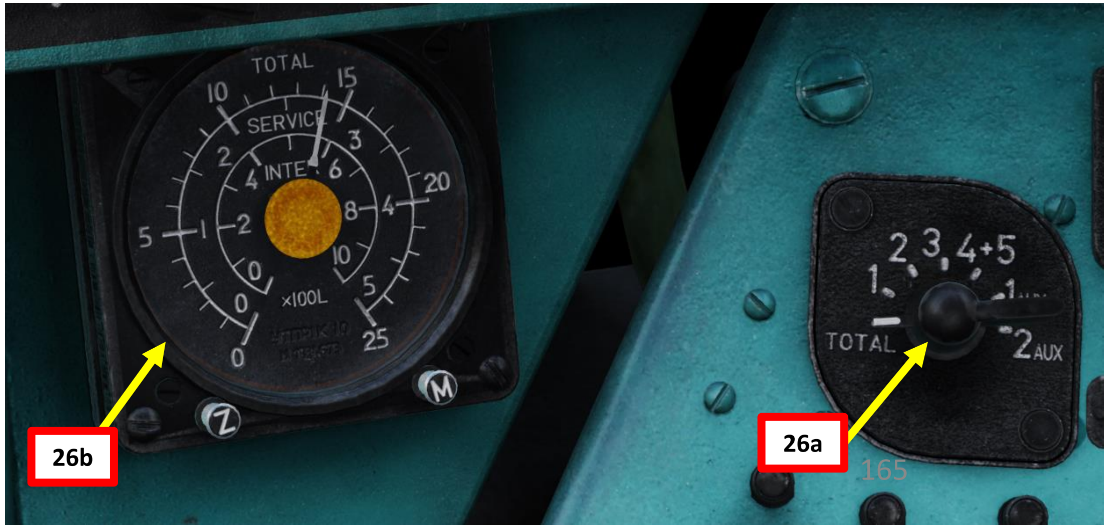
6. *[PC]* Set LEFT Battery and RIGHT Battery switches– ON (UP)
7. *[PC]* Set DC selector knob – BATT
8. *[PC]* DC voltmeter – Check (Not below 24V)
9. *[PC]* Flip Safety Cover and set POWER FROM BATTERY Switch – ON (UP)
10. *[PC]* Flip Safety Cover and set Inverter #1 (PO-750) Switch – ON (UP)
11. *[PC]* Set AC selector knob – 115 (Inverter)
12. *[PC]* As power is supplied to the aircraft, automated tests are triggered and aural warnings are audible.
13. *[PC]* To mute the RI-65 aural warnings (“Nadia”), press on the RI-65 OFF button.



A - PRE-START

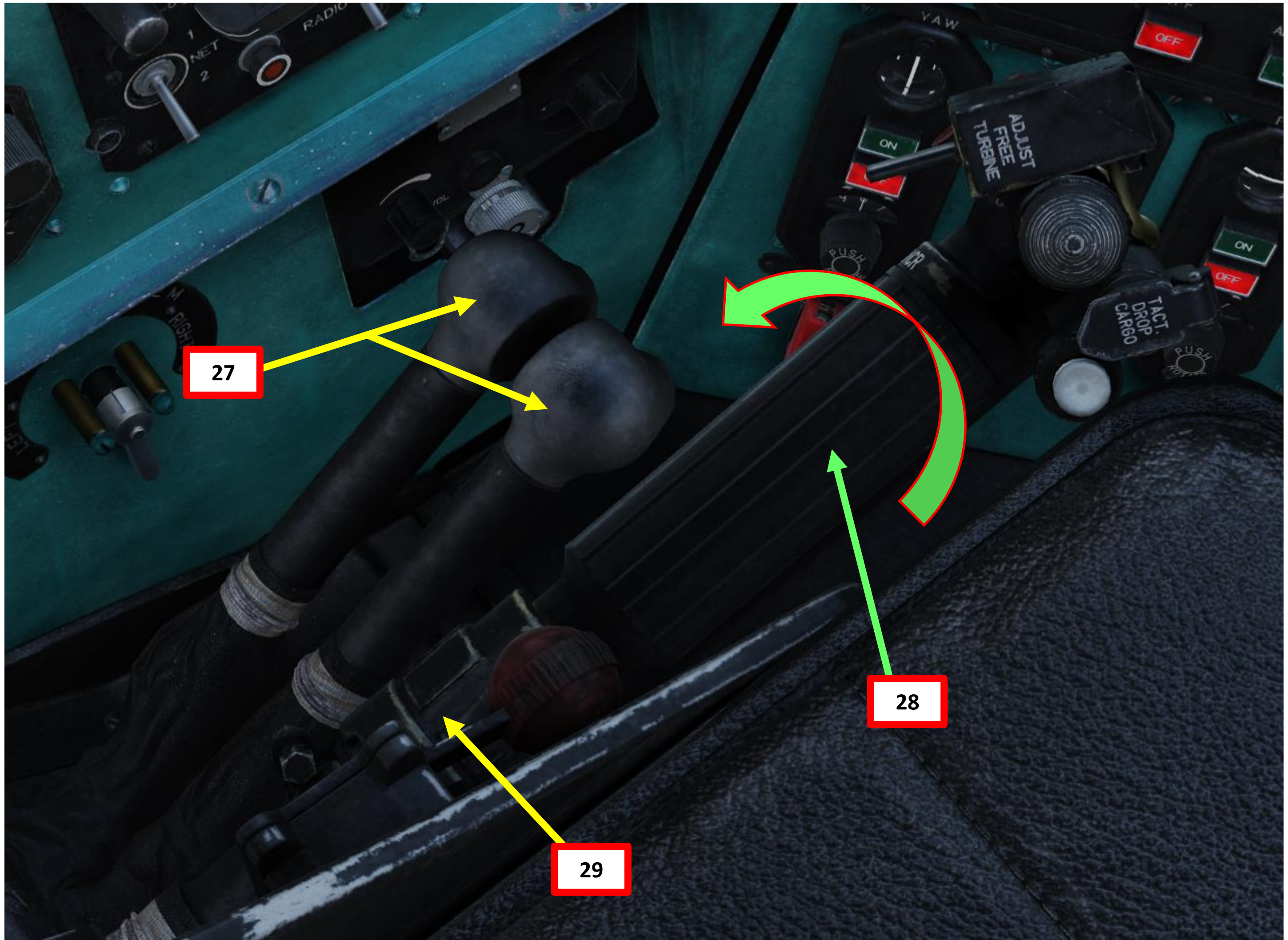
14. *[PC]* Set Fire Extinguisher System Power (Master) Switch – ON (UP)
15. *[PC]* Set Fire Detector Test Switch – ON (UP)
16. *[PC]* Set Engine Fuel Feed Valve (Service Tank No. 1) Control Switch – OPEN (UP)
17. *[PC]* Set Engine Fuel Feed Valve (Service Tank No. 2) Control Switch – OPEN (UP)
18. *[PC]* Set Left Engine Fuel Shutoff Valve Switch – OPEN (UP)
19. *[PC]* Set Right Engine Fuel Shutoff Valve Switch – OPEN (UP)
20. *[PC]* Set Fuel Delimiter (Crossfeed) Valve Control Switch – OPEN (UP)
21. *[PC]* If external fuel tanks are installed, set External Tanks Fuel Pump Switch – ON (UP). Otherwise, leave switch to OFF (DOWN) position.
22. *[PC]* Set Fuel Pump Switch (No. 4 Fuel Cell) – ON (UP)
23. *[PC]* Set Fuel Pump Switch (No. 5 Fuel Cell) – ON (UP)
24. *[PC]* Set Fuel Pump Switch (No. 1 Fuel Cell) – ON (UP)
25. *[PC]* Set Fuel Pump Switch (No. 2 Fuel Cell) – ON (UP)
26. *[PC]* Set Fuel Quantity Content Selector to "Total" and check fuel quantity.

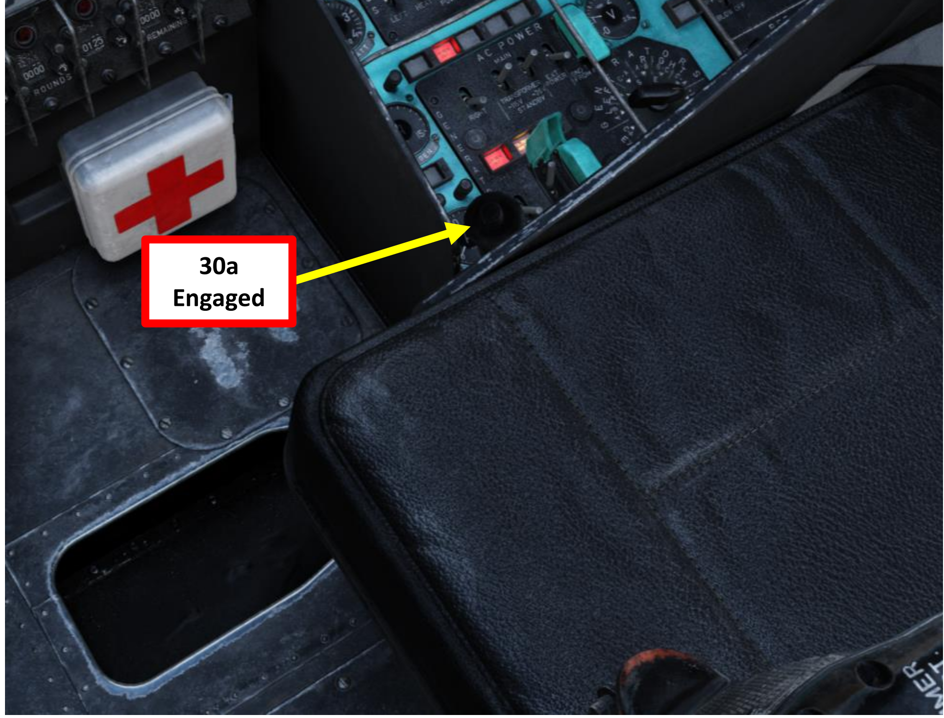


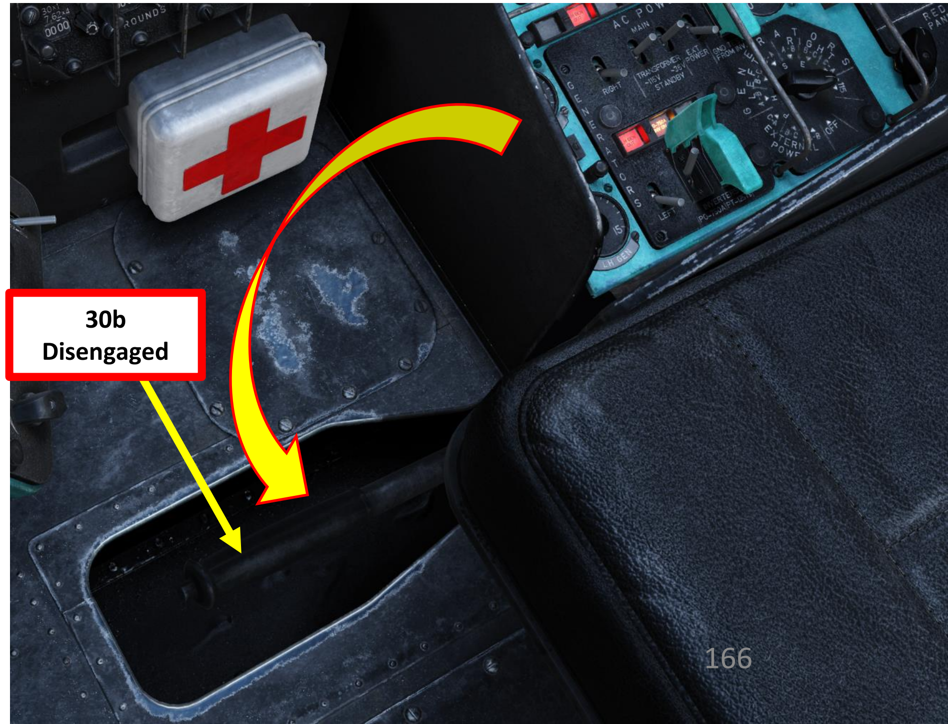


A - PRE-START

27. *[PC]* Engine control levers (ECL) – Check that levers are in the MIDDLE detent position
28. *[PC]* Throttle Twist Grip – FULL LEFT (“Page Down” binding)
29. *[PC]* Collective – FULLY DOWN
30. *[PC]* Disengage Rotor Brake Lever – OFF (FULLY DOWN)

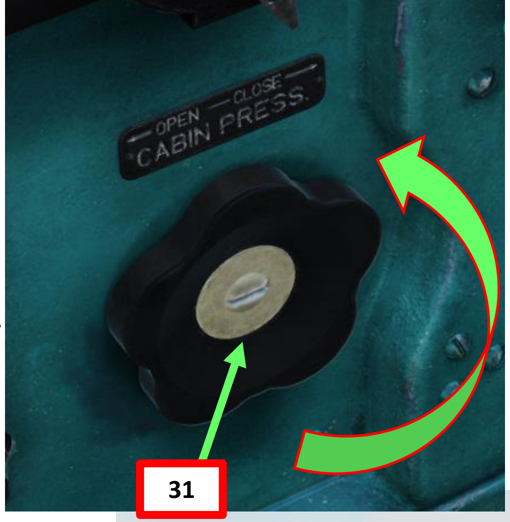


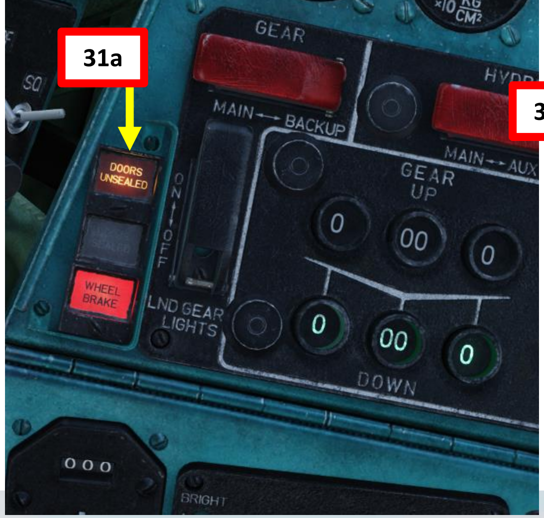


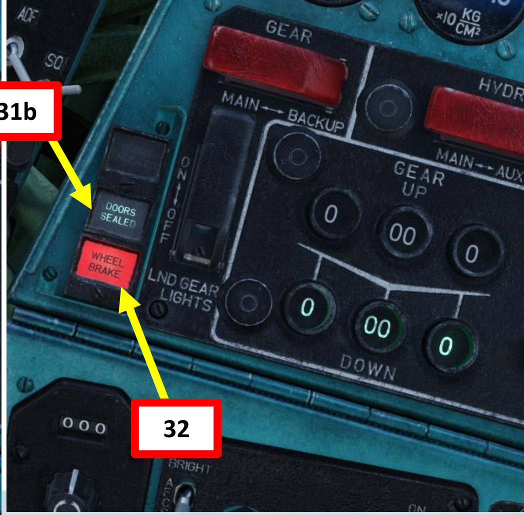


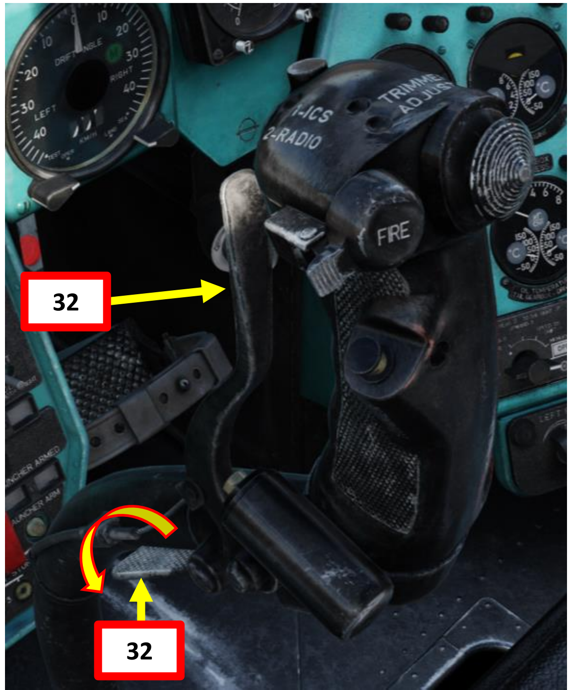
A - PRE-START

31. *[PC]* Turn Door Seal Control Wheel – Counter-Clockwise (AFT). This will pressurize the door seals; the process takes a few seconds.
    - Confirm that DOORS UNSEALED indication extinguishes.
    - Confirm that DOORS SEALED annunciator illuminates.
32. *[PC]* Engage Parking Brake (LSHIFT+W). Confirm that WHEEL BRAKE annunciator is illuminated.
33. *[PC]* Set Tail Strobe (Beacon) Switch – ON (UP)



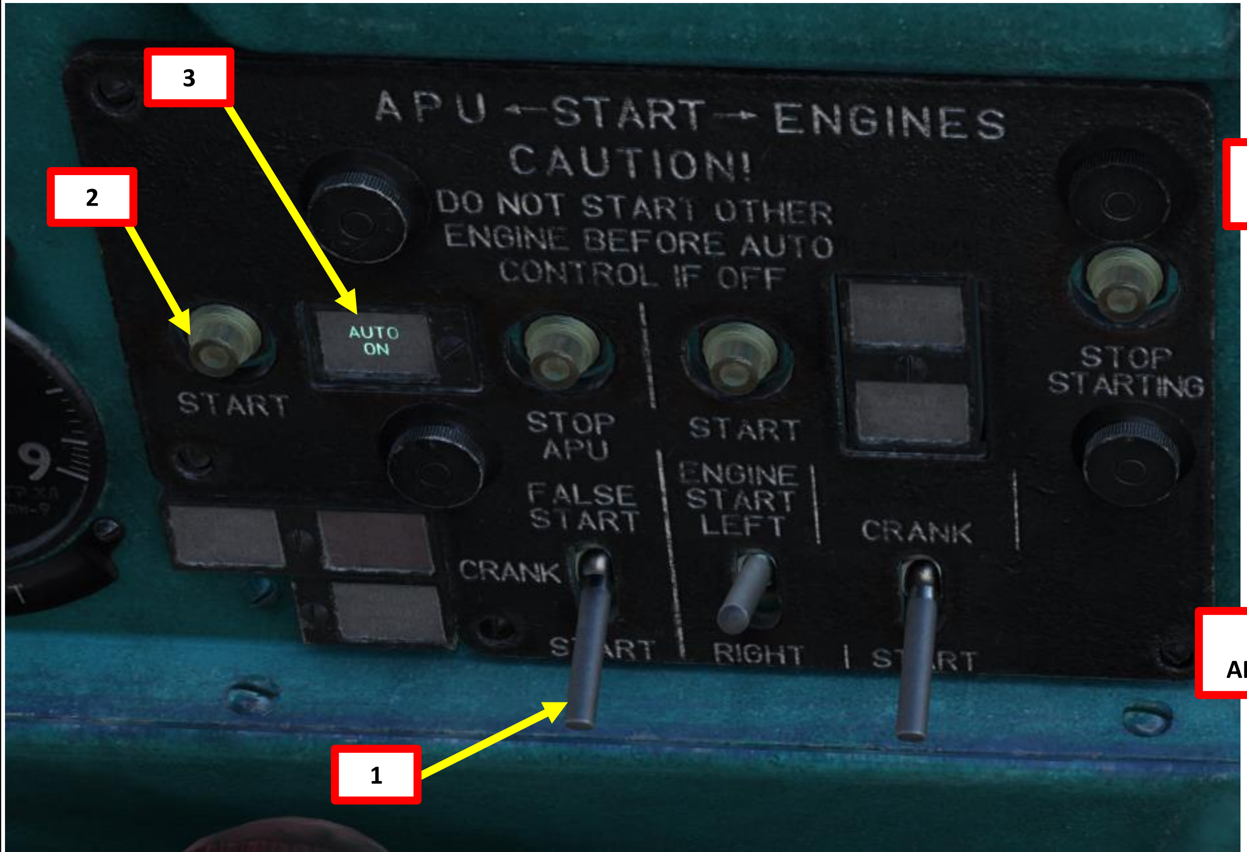


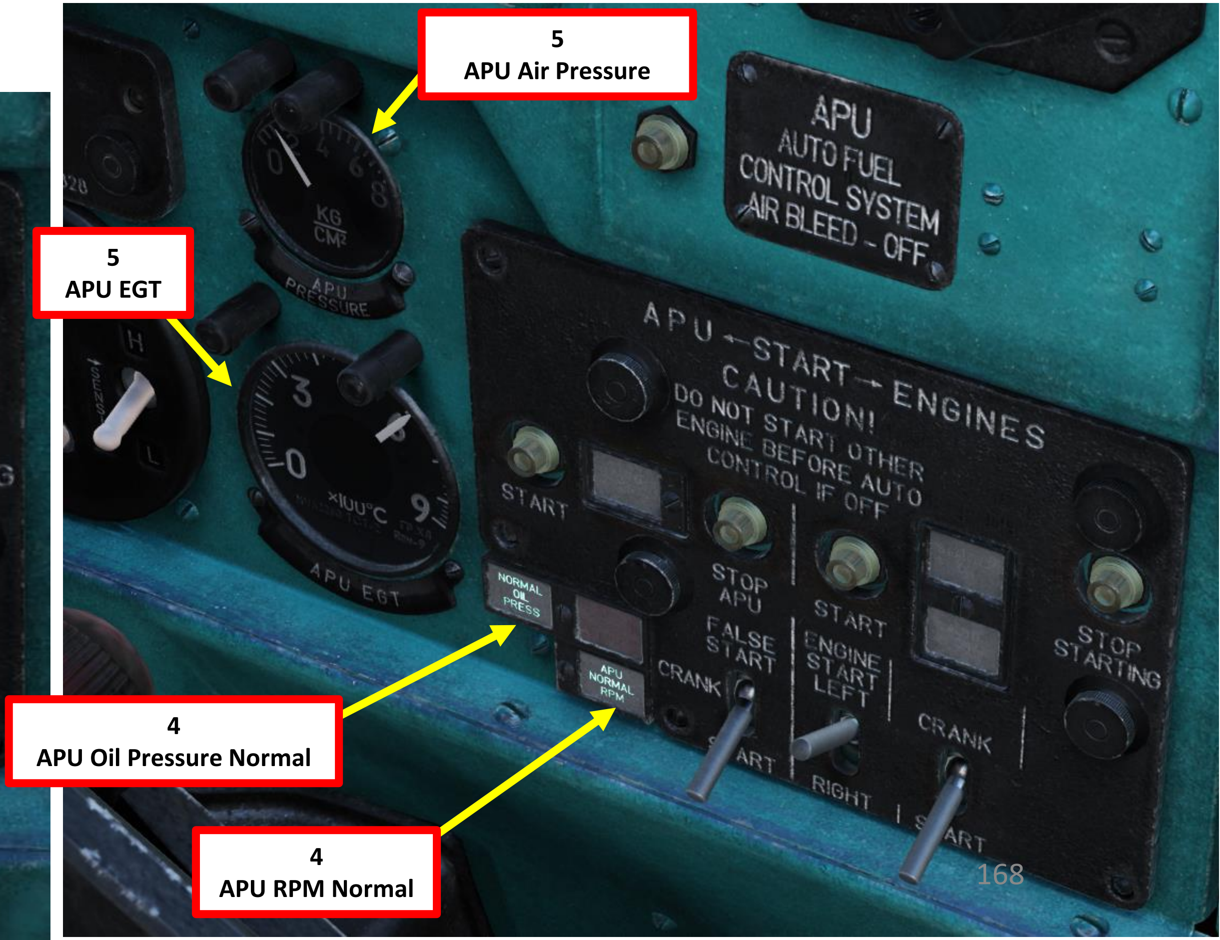




B - START-UP (APU START)

1. *[PC]* Set APU (Auxiliary Power Unit) Mode Switch – START (DOWN).
2. *[PC]* Press APU START button for about 4 sec.
3. *[PC]* Confirm that AUTO ON annunciator illuminates during APU start. This indicates a good APU start.
4. *[PC]* Make sure APU EGT (Exhaust Gas Temperature), Air Pressure and Oil Pressure (NORMAL OIL PRESS annunciator) are rising within 9 seconds.
5. *[PC]* Wait until APU EGT (Exhaust Gas Temperature) stabilizes below 720 deg C, APU air pressure stabilizes between 1.2 and 2.0 kg/cm², and APU RPM reaches IDLE Speed (APU NORMAL RPM annunciator). Process should take between 20 sec and 1 minute.
6. *[PC]* Now that the APU is started, the air pressure generated by it will be used to drive the engine pneumatic starter. Confirm that APU ON (RUNNING) annunciator is illuminated on the electrical panel.
7. *[PC]* The APU must run for a minimum of 1 minute before attempting to start the main engines.

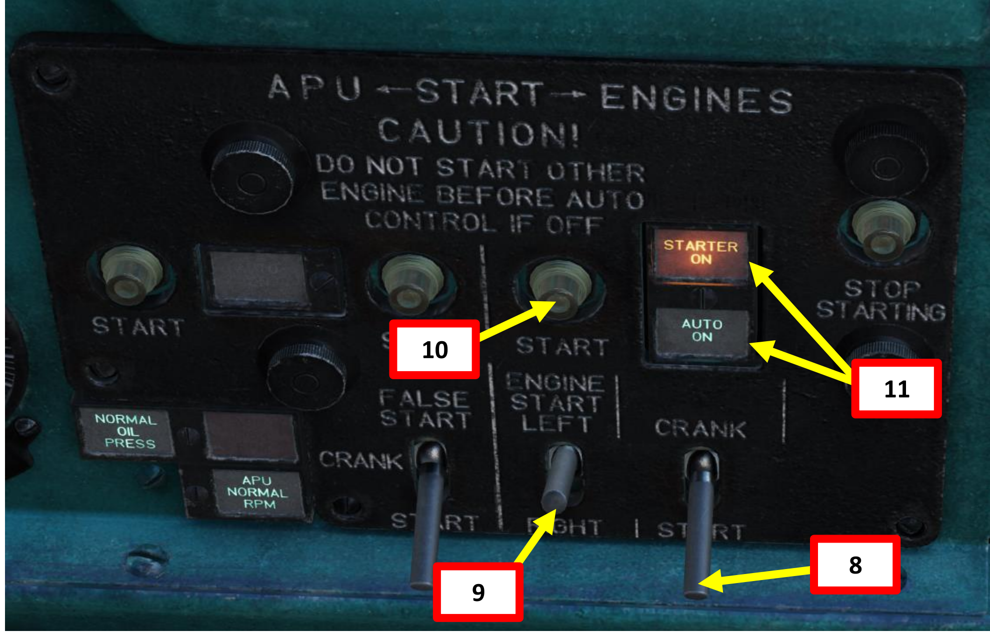


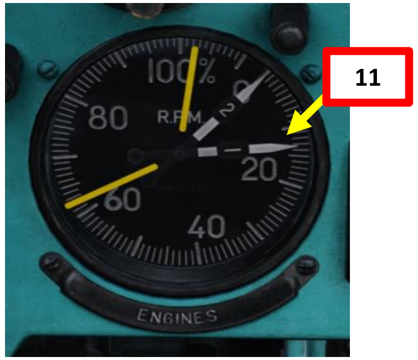


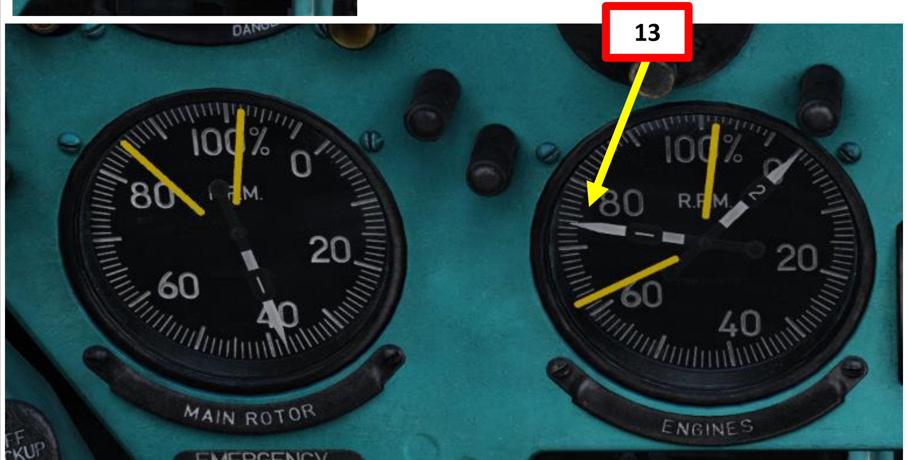
C - START-UP (LEFT ENGINE START)

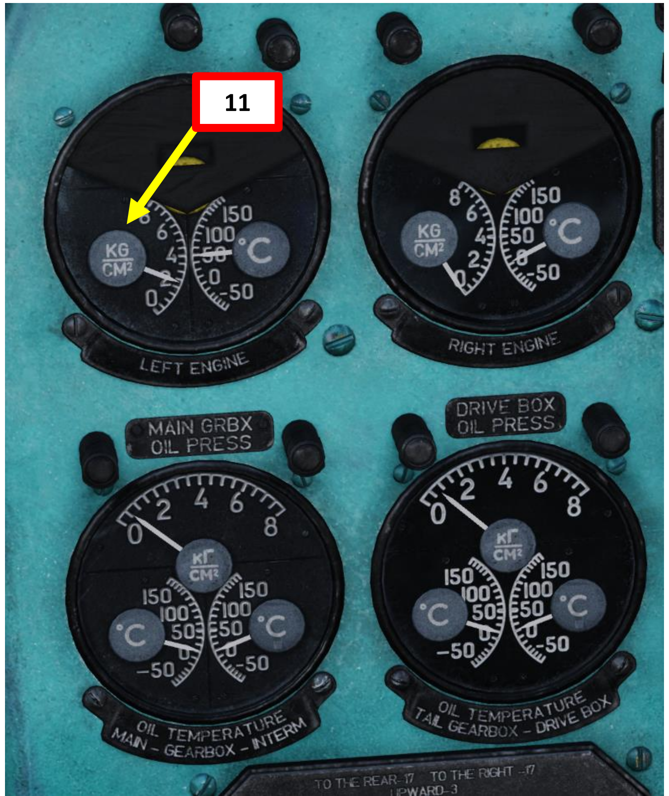
Note: Verify that the rotor brake is disengaged before attempting an engine start.

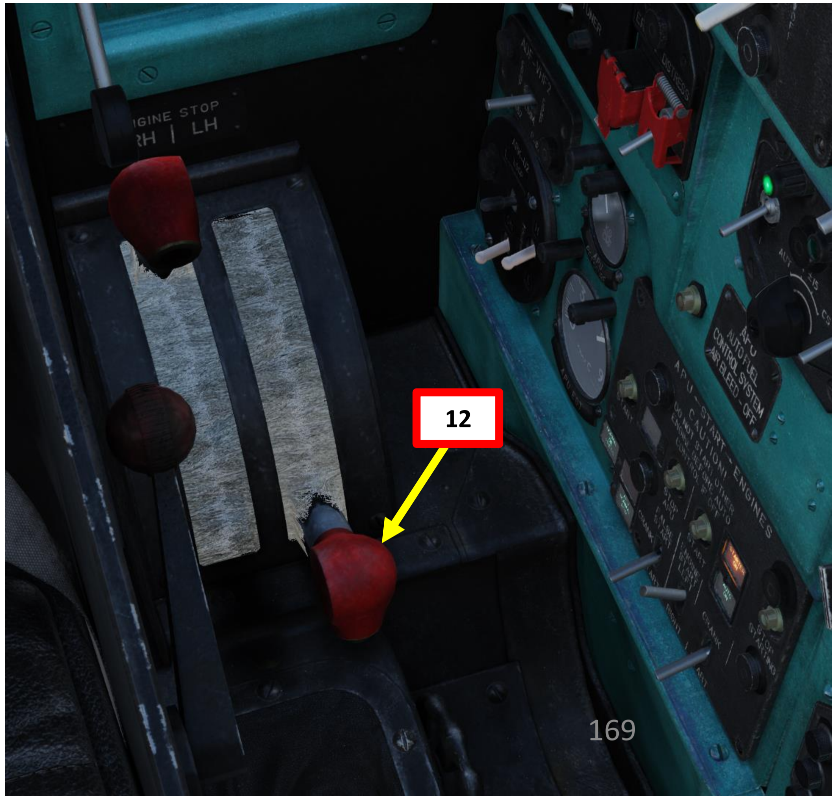
8. *[PC]* Select "START" (DOWN) starting mode.
9. *[PC]* Select Left Engine (or downwind engine first)
10. *[PC]* Press "START" button for 2 to 3 seconds to initiate start sequence.
11. *[PC]* Confirm good engine start: engine oil pressure should increase, and the AUTO ON and STARTER ON annunciators should be visible.
12. *[PC]* Once Engine N1 (Gas Turbine/Compressor Speed) increases, click on Left/Selected Engine Red Fuel Shutoff lever ("Engine Stop") to push it forward. Fuel flow will kick in and engine N1 will increase to IDLE speed.
    - STARTER ON annunciator should turn OFF at 60-65 % N1 RPM
    - AUTO ON annunciator should not remain illuminated for more than 33 sec
    - At 45 % N1 RPM, engine oil pressure should not be lower than 1 kg/cm^2
13. *[PC]* Once Left Engine reaches a N1 RPM of 70-75 % (IDLE speed), wait 1 minute for APU to cool down (optional).



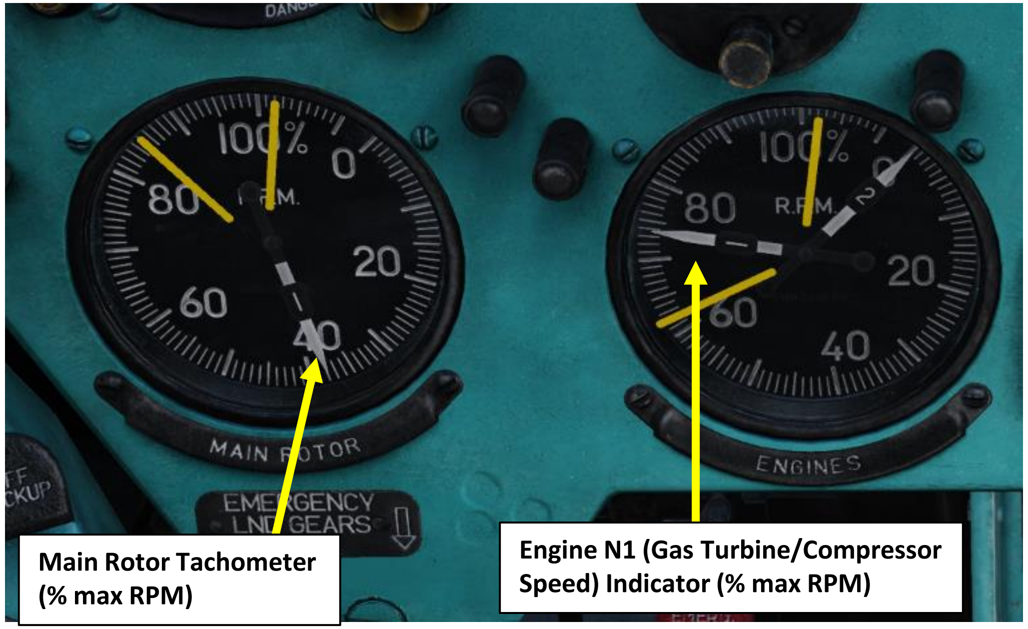


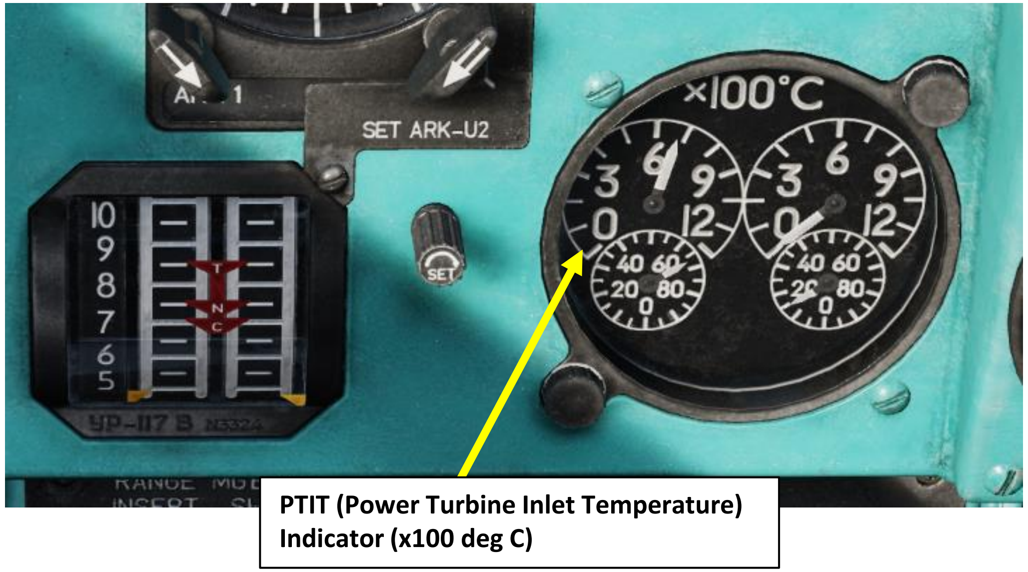


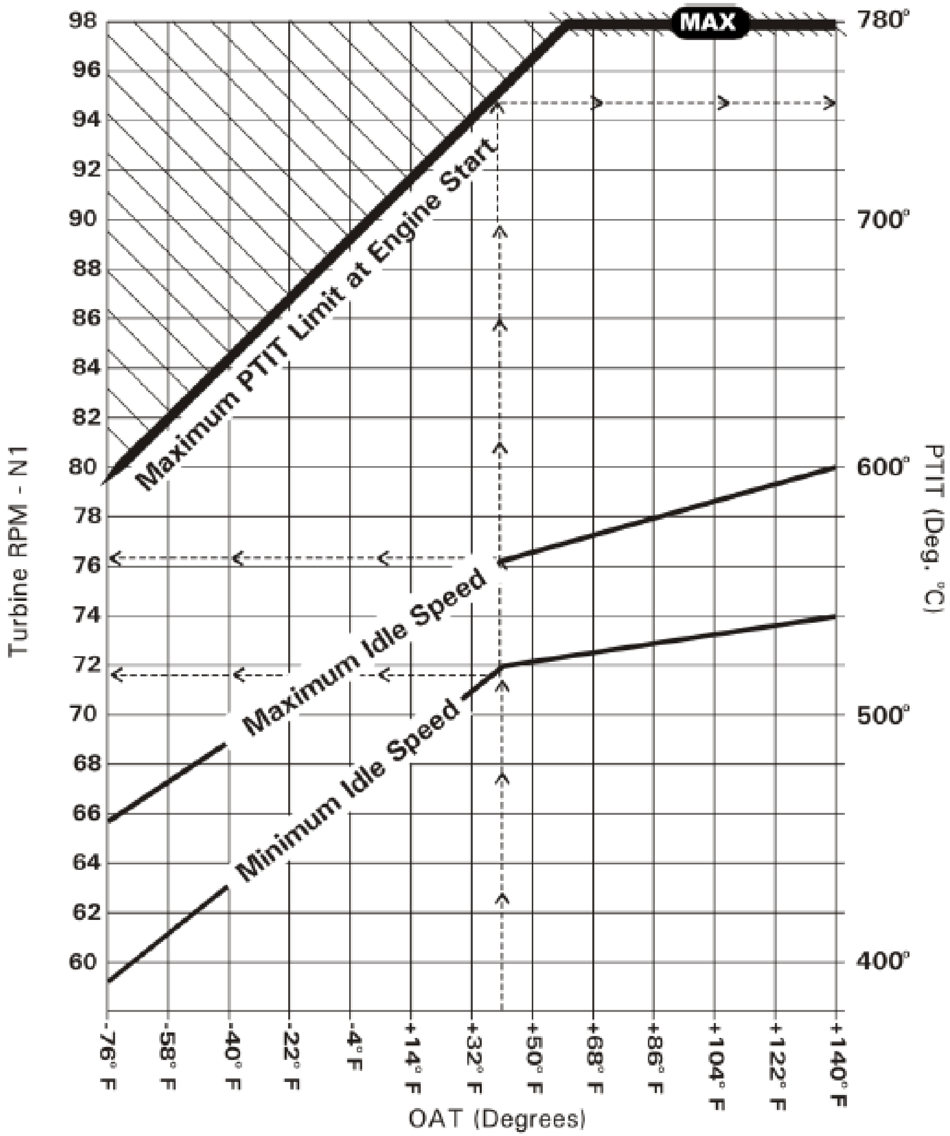




C - START-UP (LEFT ENGINE START)







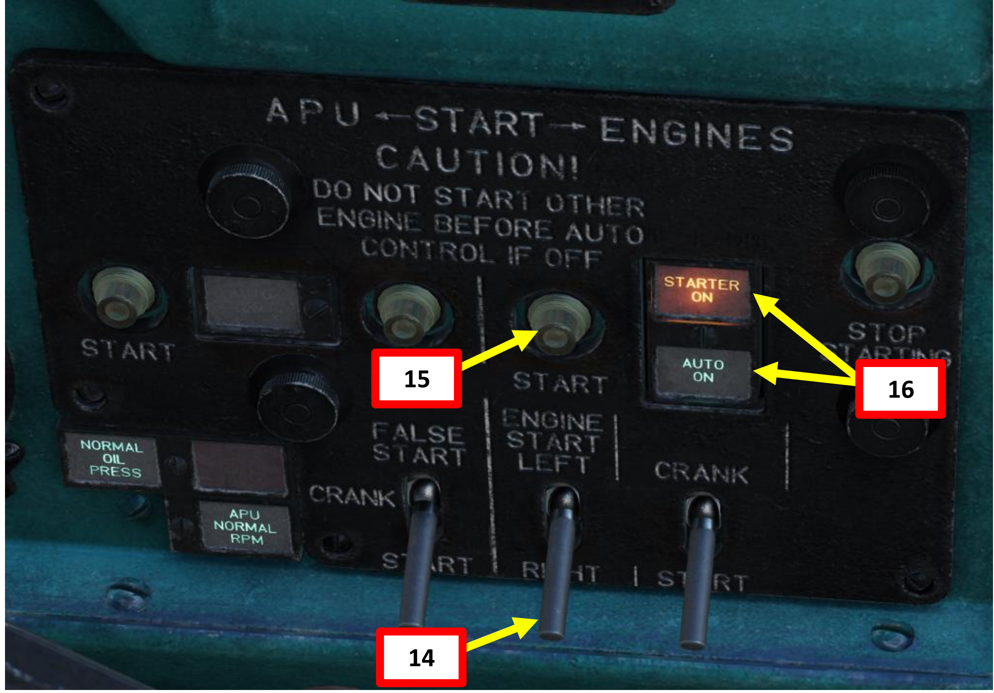
Example:

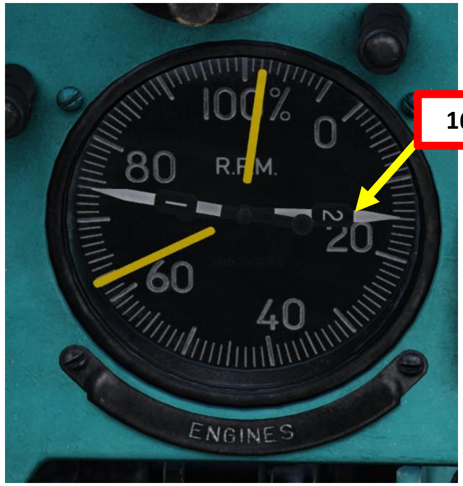
Enter the graph from the bottom, using the reported ambient temperature.
Ambient Temperature: +41° F
N1 Minimum = 72%
N1 Maximum = 76%
PTIT Maximum = 745° C

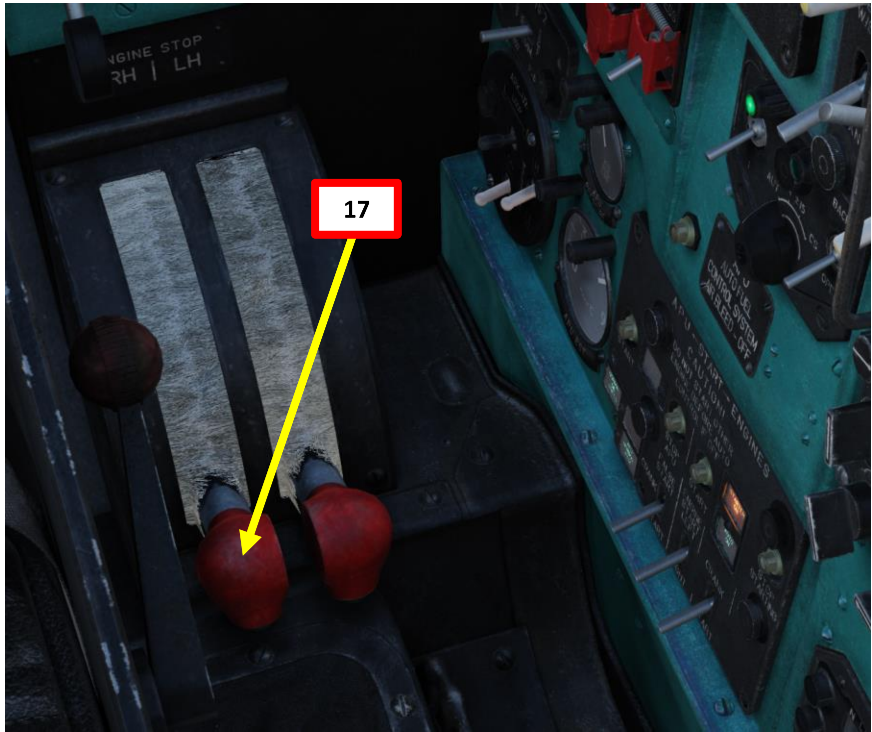
Maximum Idle N1/Starting Temperature

D - START-UP (RIGHT ENGINE START)

14. *[PC]* Select Right Engine
15. *[PC]* Press "START" button for 2 to 3 seconds to initiate start sequence.
16. *[PC]* Confirm good engine start: engine oil pressure should increase, and the AUTO ON and STARTER ON annunciators should be visible.
17. *[PC]* Once Engine N1 (Gas Turbine/Compressor Speed) increases, click on Right Engine Red Fuel Shutoff lever ("Engine Stop") to push it forward. Fuel flow will kick in and engine N1 will increase to IDLE speed.
    - STARTER ON annunciator should turn OFF at 60-65 % N1 RPM
    - AUTO ON annunciator should not remain illuminated for more than 33 sec
    - At 45 % N1 RPM, engine oil pressure should not be lower than 1 kg/cm²
18. *[PC]* When both engines reach IDLE RPM, Main Rotor Speed should be between 45 and 70 % RPM.

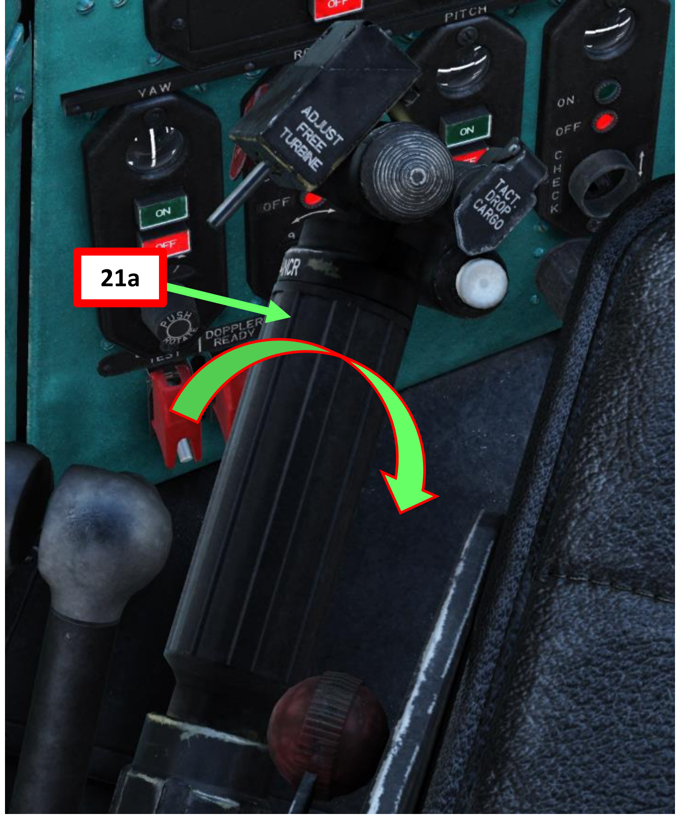


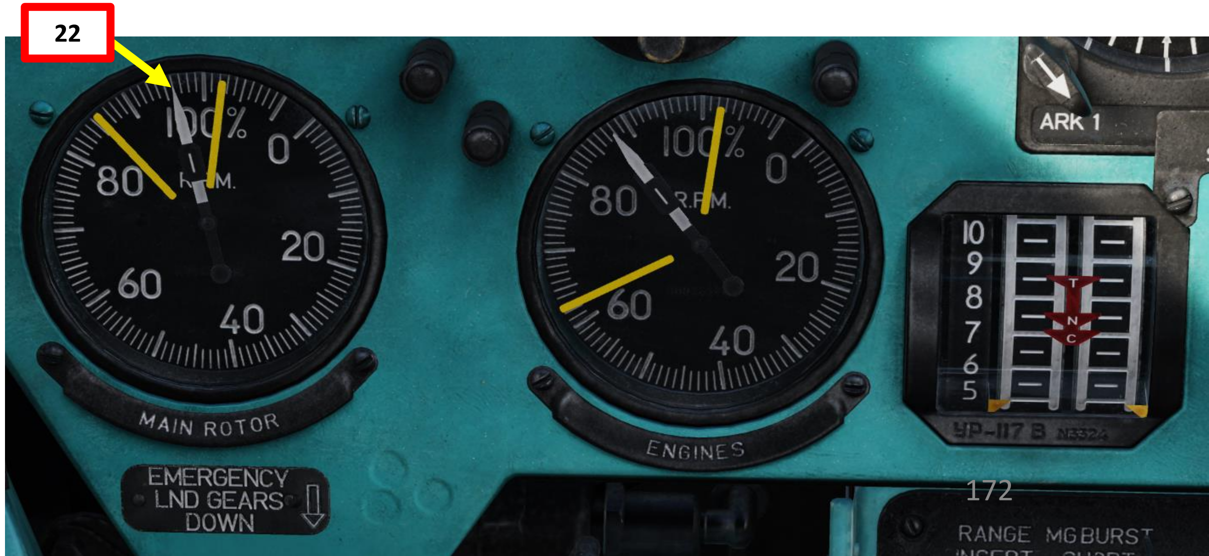




E - START-UP (ENGINE RUN-UP)

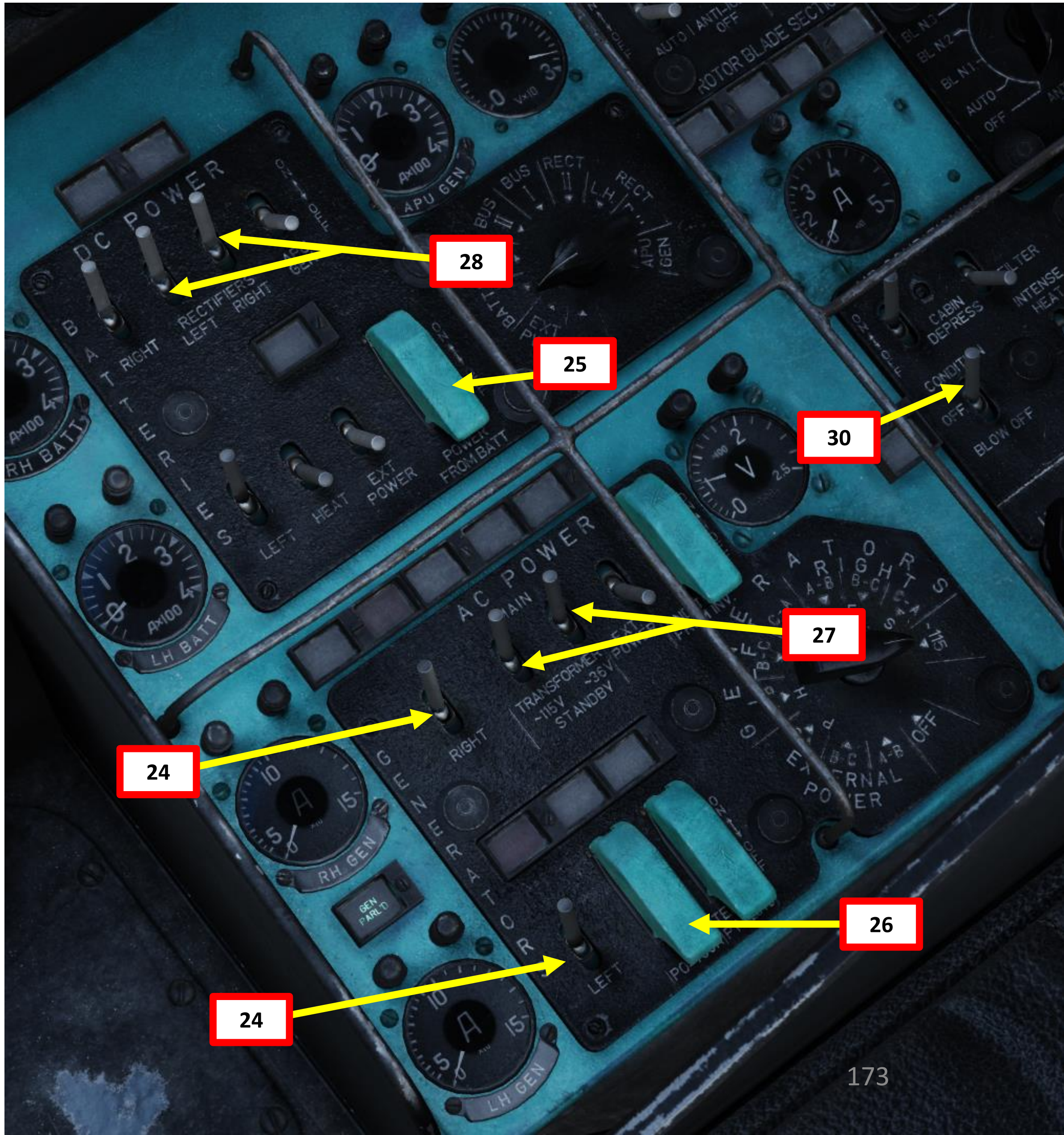
19. *[PC]* Set Engine Dust Protector System Power Switch – ON (UP)
20. *[PC]* Wait for the oil to warm up (roughly 1 minute).
    - Engine oil temperature should be above +30 deg C
    - Main Gearbox Temperature should be above -15 deg C
21. *[PC]* Increase engine power to Nominal Engine Power setting by turning the Twist Grip Fully Right (MAX) by using the "Page Up" binding.
    - It is forbidden to increase RPM until engine oil temperature reaches +30 deg C and main gearbox oil temperature
22. *[PC]* When the Twist Grip is set to MAX, it will engage the Governor system, which will maintain Main Rotor Speed to 95 % RPM.
23. *[PC]* Confirm Main Transmission Gearbox oil pressure and temperature have stabilized to nominal values. Also confirm that Intermediate Transmission Gearbox and Tail Transmission Gearbox oil temperatures have stabilized to nominal values.





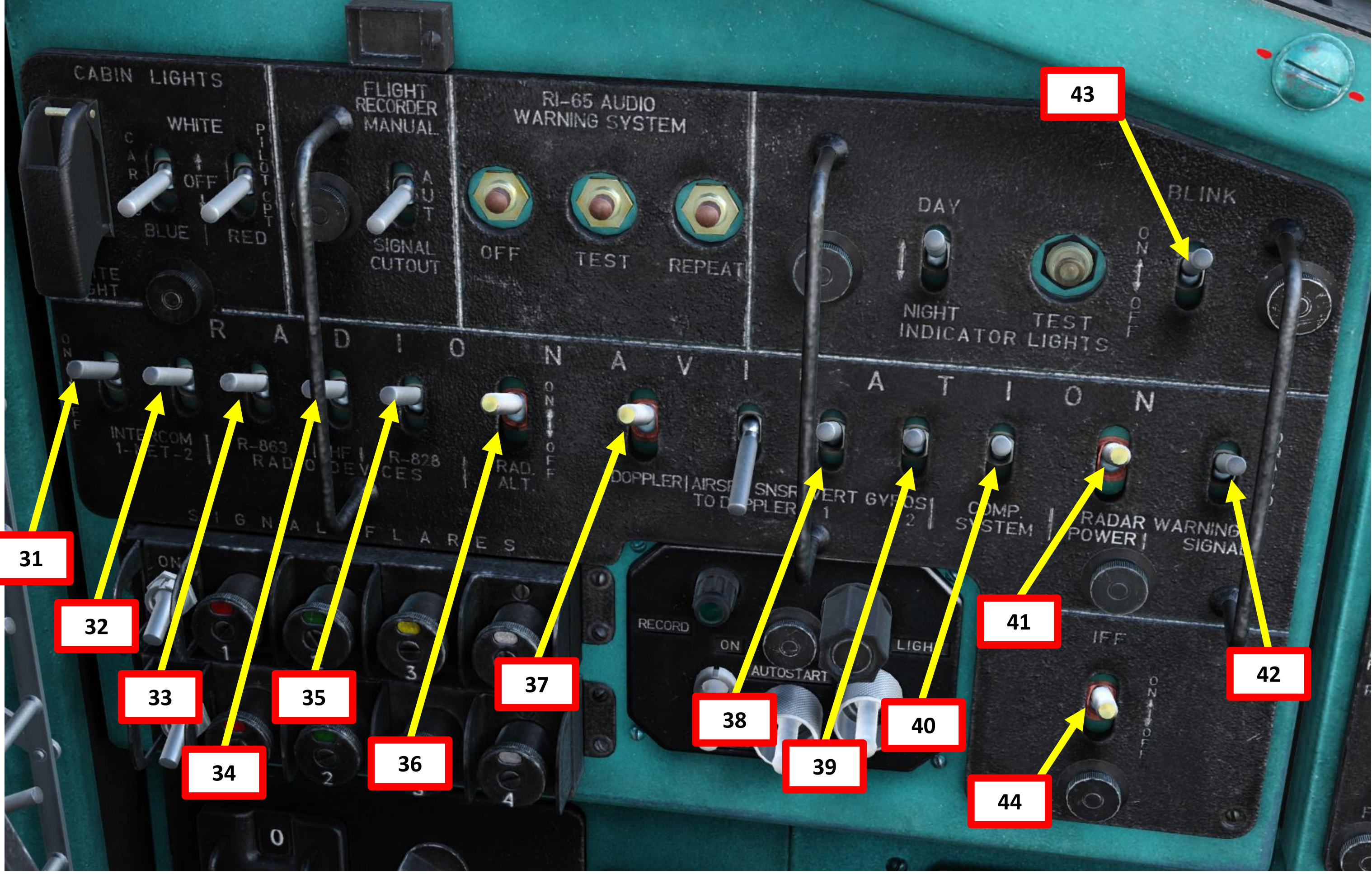
F - START-UP (ENGINE POST-START)

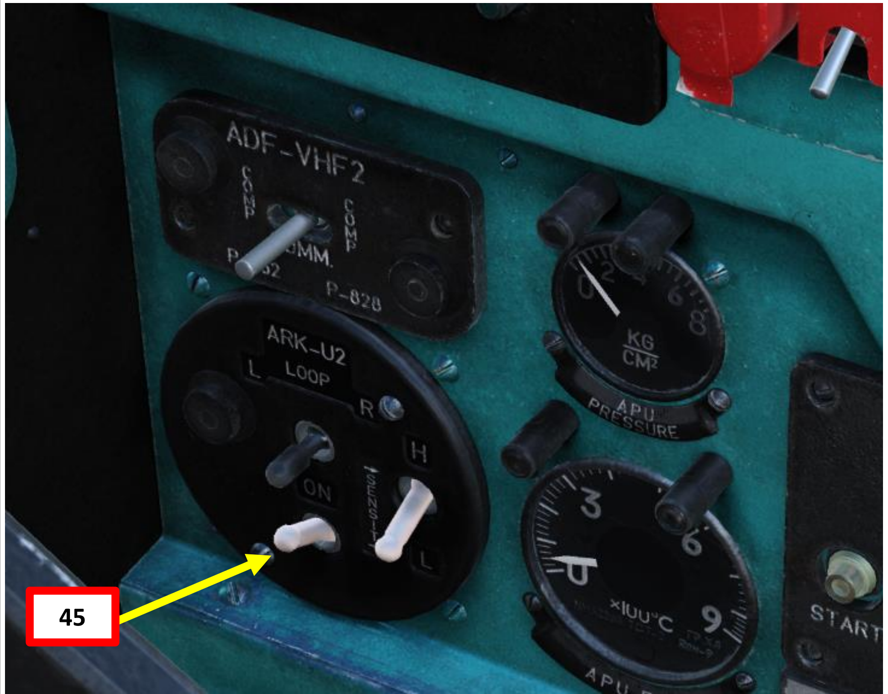
24. *[PC]* Set Left and Right Generator Switches – ON (UP)
    - Confirm that LH GEN OUT and RH GEN OUT annunciators extinguish and that GEN PARAL'D annunciator illuminates.
25. *[PC]* Set POWER FROM BATTERY Switch – OFF (DOWN)
26. *[PC]* Set Inverter #1 (PO-750) Switch – OFF (DOWN)
27. *[PC]* Set 36V & 115V Transformer Switches – MAIN (UP)
28. *[PC]* Set Left and Right Rectifier Switches – ON (UP).
    - Confirm that LH RECT OFF and RH RECT OFF annunciators extinguish.
29. *[PC]* Press APU OFF button
30. *[PC]* Switch Air Conditioner Mode Switch – CONDITION (UP)



F - START-UP (ENGINE POST-START)

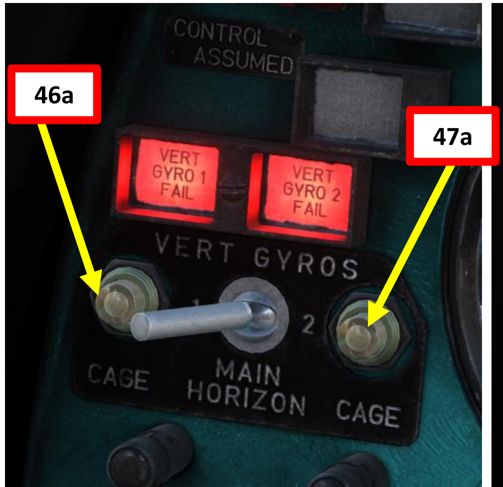
31. *[PC]* Set SPU-8 Intercom (ICS) Power Switch (NET 1) – ON (UP)
32. *[PC]* Set SPU-8 Intercom (ICS) Power Switch (NET 2) – ON (UP)
33. *[PC]* Set R-863 Radio Power Switch – ON (UP)
34. *[PC]* Set Yadro Radio Power Switch – ON (UP)
35. *[PC]* Set R-828 (M24 "Eucalyptus") Radio Power Switch – ON (UP)
36. *[PC]* Set Radar Altimeter Power Switch – ON (UP)
37. *[PC]* Set Doppler System Power Switch – ON (UP)
38. *[PC]* Set Vertical Gyro 1 Power Switch – ON (UP)
39. *[PC]* Set Vertical Gyro 2 Power Switch – ON (UP)
40. *[PC]* Set GREBEN-1 Course Control (COMP. SYSTEM) Power Switch – ON (UP)
41. *[PC]* Set SPO-10 Radar Warning System Power Switch – ON (UP)
42. *[PC]* Set SPO-10 Radar Warning Signal Switch – SOUND ON (UP)
43. *[PC]* Set Warning Blinker Switch – ON (UP)
44. *[PC]* Set IFF (Identify-Friend-or-Foe) Power Switch – ON (UP)
45. *[PC]* Set ARK-U2 Homing Set Power Switch – ON (UP)





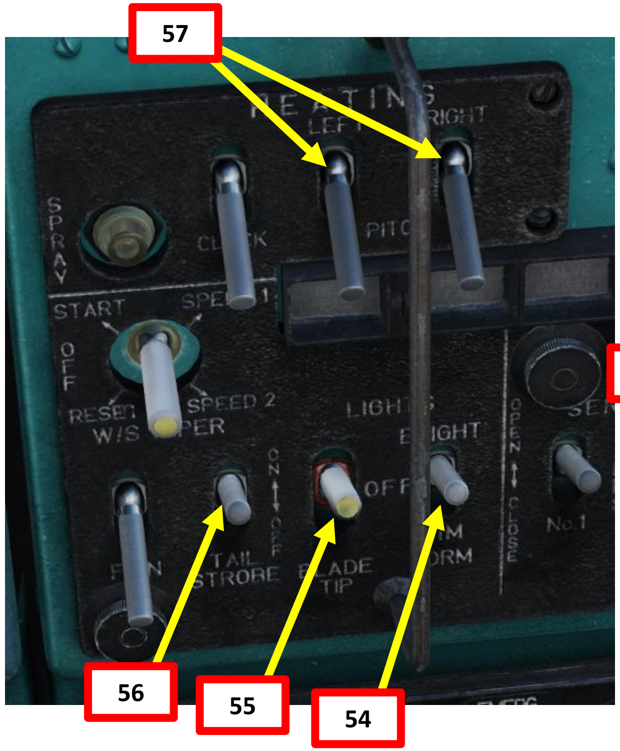
F - START-UP (ENGINE POST-START)

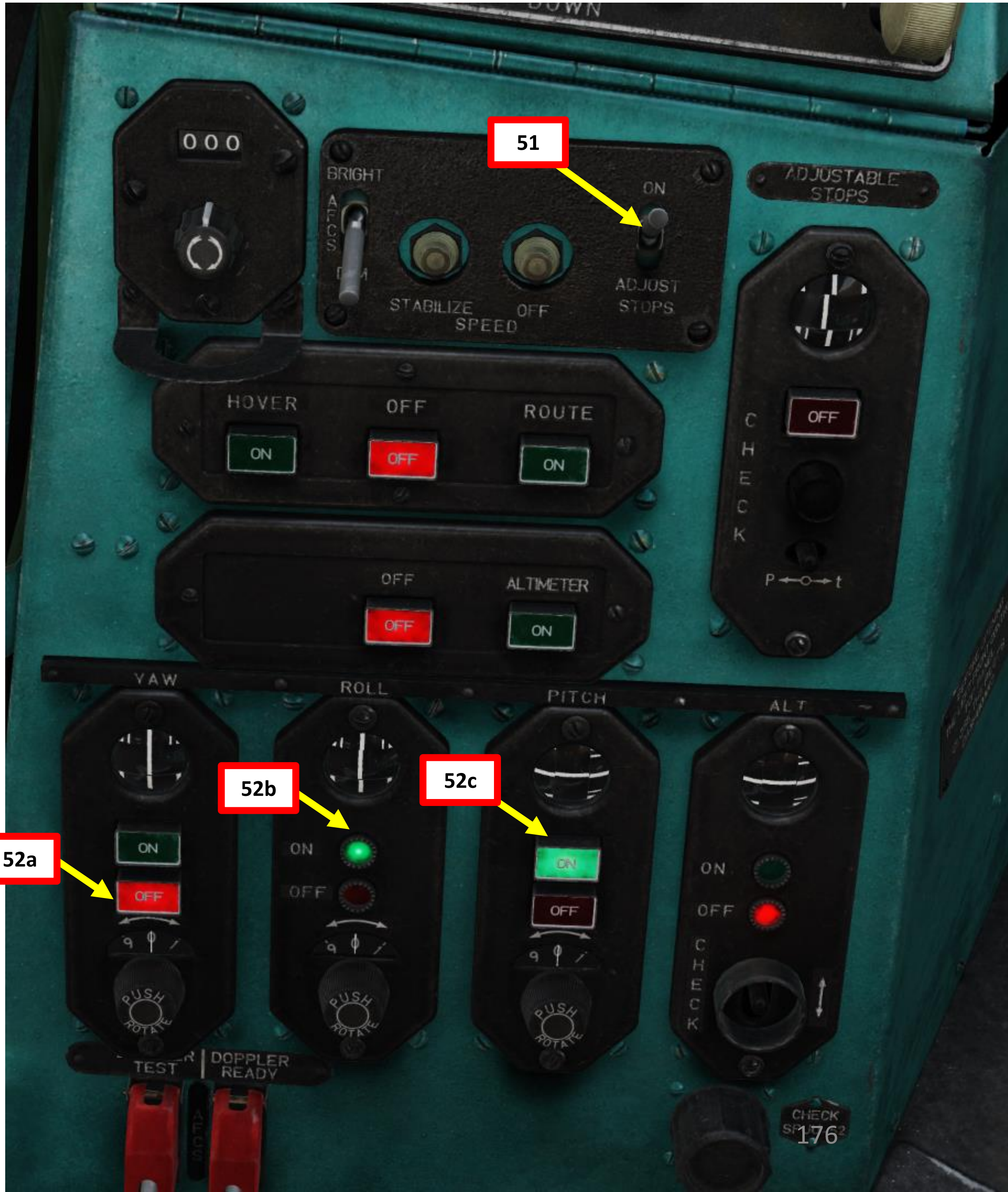
46. *[PC]* Press the Vertical Gyro 1 Caging Button for 2 seconds and confirm that the VERT GYRO 1 FAIL annunciator extinguishes.
47. *[PC]* Press the Vertical Gyro 2 Caging Button for 2 seconds and confirm that the VERT GYRO 2 FAIL annunciator extinguishes.
48. *[PC]* Check that red markers on the ADI (Attitude Director Indicator) are OFF.
49. *[PC]* Three minutes after the GREBEN-1 Course Control (COMP. SYSTEM) has been powered, set the GREBEN Mode selector to MAG (Magnetic), then depress the GREBEN SYNC (Synchronize) button for 3 seconds. This will align the GREBEN Course Control gyro to the signal provided by the flux detector and magnetic deviation compensator. The system is initialized in MAG (MK) mode to allow the unit to establish baseline heading data.
50. *[PC]* Set ARK-15M (Automatic Radio Compass / Automatic Directional Finder) Mode Selector – COMPASS.



F - START-UP (ENGINE POST-START)

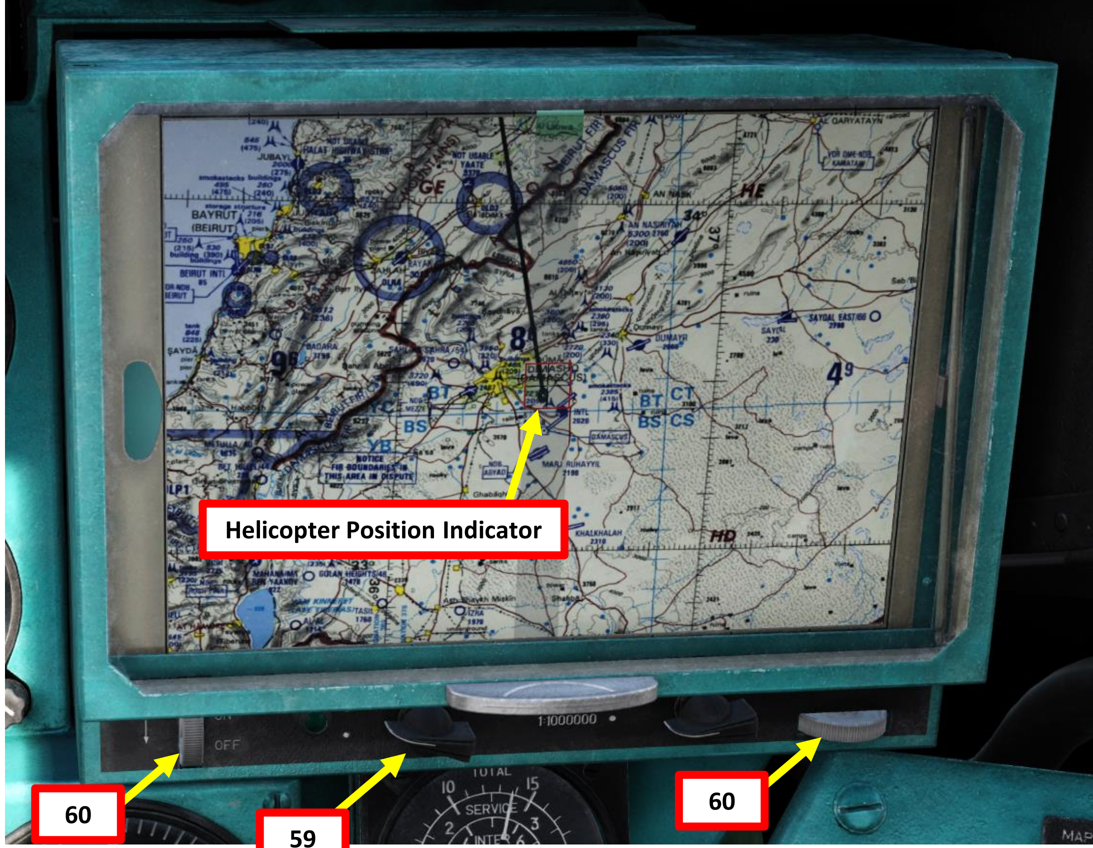
51. *[PC]* Set SPUU-52 Tail Rotor Pitch Limit System Power Switch – ON (UP)
52. *[PC]* Engage Roll and Pitch Autopilot Control Channels by depressing green ON buttons. Do not engage Yaw Control Channel.
    - If panel is difficult to access, press “Backspace” to remove/show the stick and seat.
53. *[PC]* Set Navigation Lights – ON (UP)
54. *[PC]* Formation Lights – ON (UP)
55. *[PC]* Set Blade Tip Lights – ON (UP)
56. *[PC]* Check Anti-Collision (Strobe) Light – ON (UP)
57. *[PC]* Set Pitot Heat switches – ON (UP) (as required)





F - START-UP (ENGINE POST-START)

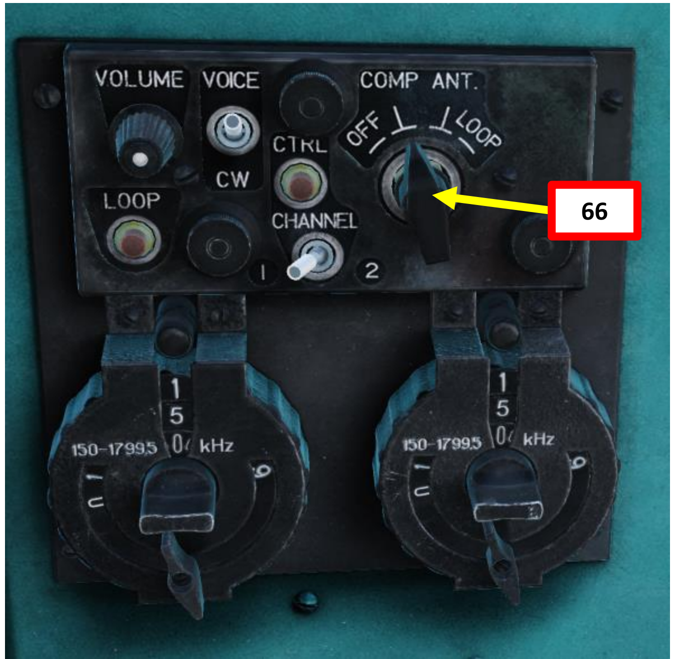
58. [PC] Set Doppler Control Panel Mode selector - OPER
59. [PC] Set Map Power Switch – ON (UP)
60. [PC] Adjust Helicopter Position Indicator if required using the Vertical Position Adjustment Control Thumbwheel and the Horizontal Position Adjustment Control Thumbwheel
61. [PC] Set AUX STORES LIGHT Switch – ON (UP)
62. [PC] Set ASP-17VP Sight Power Switch – ON (UP)

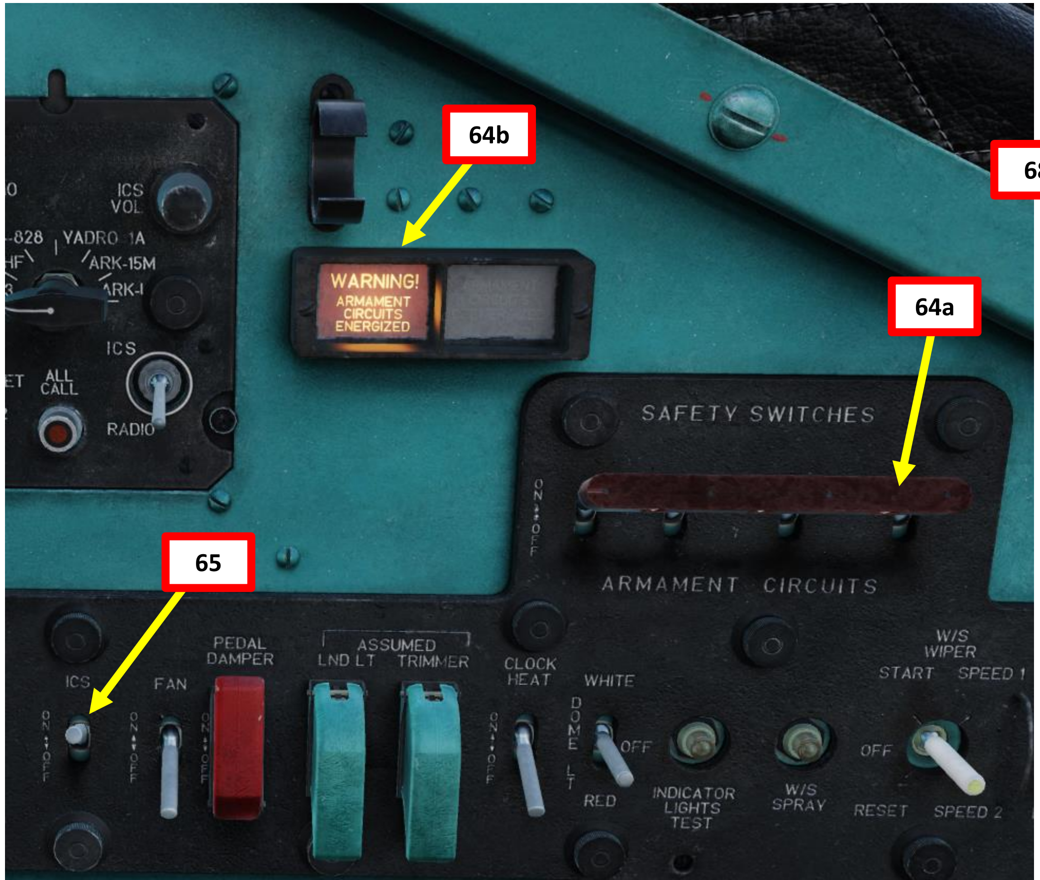


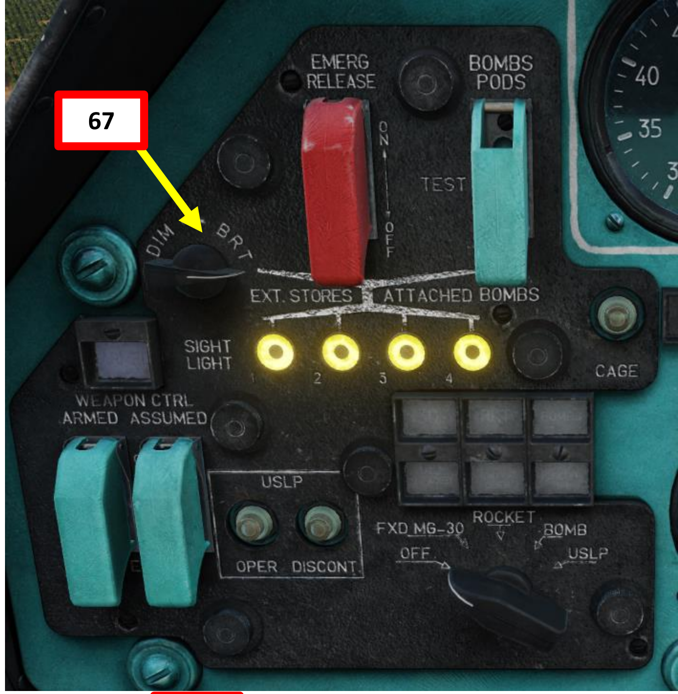
F - START-UP (ENGINE POST-START)

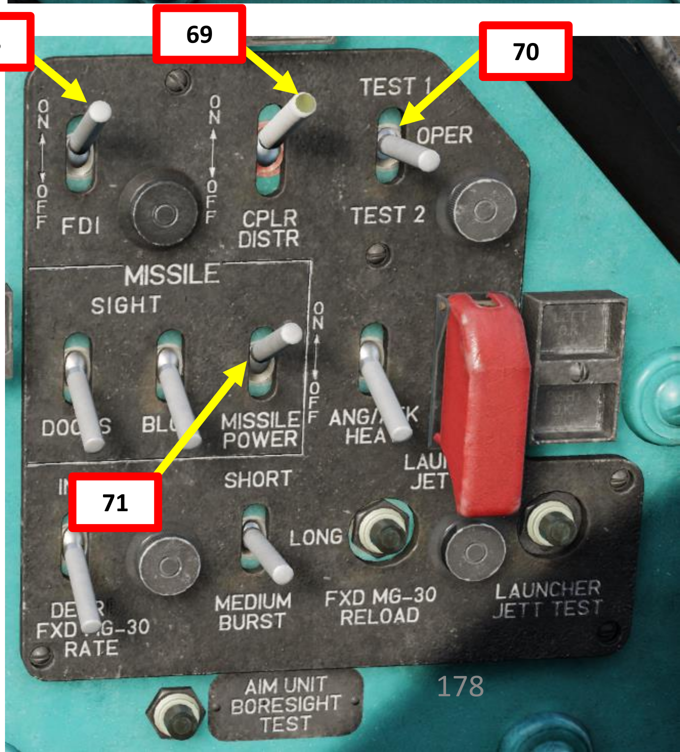
63. *[PC]* Request Petrovich AI to power up weapons and countermeasures (LCTRL+W). This process takes about 3 minutes. This procedure is explained in the following steps.
64. *[CPG]* Set Armament Circuit Breakers – ON (UP)
65. *[CPG]* Set SPU-8 Intercom (ICS) Power Switch – ON (UP)
66. *[CPG]* Set ARK-15M (Automatic Radio Compass / Automatic Directional Finder) Mode Selector – COMPASS.
67. *[CPG]* Set PKI Reflector Sight Brightness Control Knob – As required
68. *[CPG]* Set PKP-72M ADI (Attitude Director Indicator) Power Switch – ON (UP)
69. *[CPG]* Set USR-24M (CPLR DISTR) Switch – ON (UP)
70. *[CPG]* USR-24M Mode Switch - OPER
71. *[CPG]* Set Missile Power Switch – ON (UP)

Note:
In real life, powering on armament circuit breakers **should only be done while helicopter is in the air, <u>not on the ground</u>.** These steps were added for quick reference and simplification purposes.



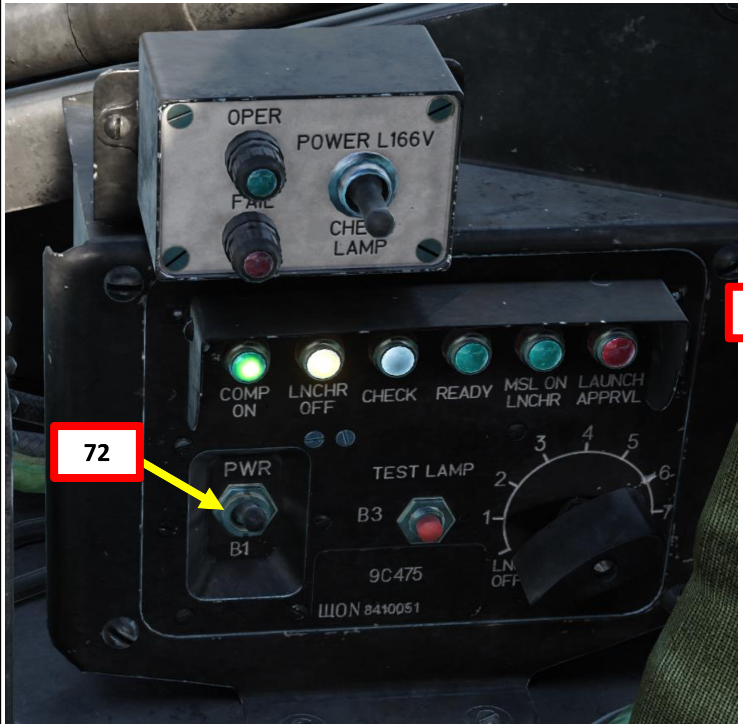


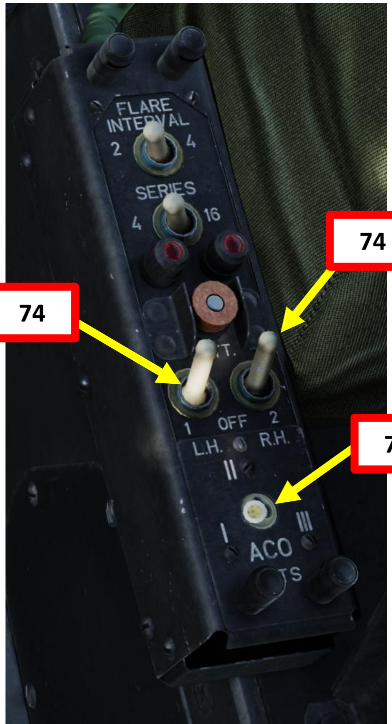




F - START-UP (ENGINE POST-START)

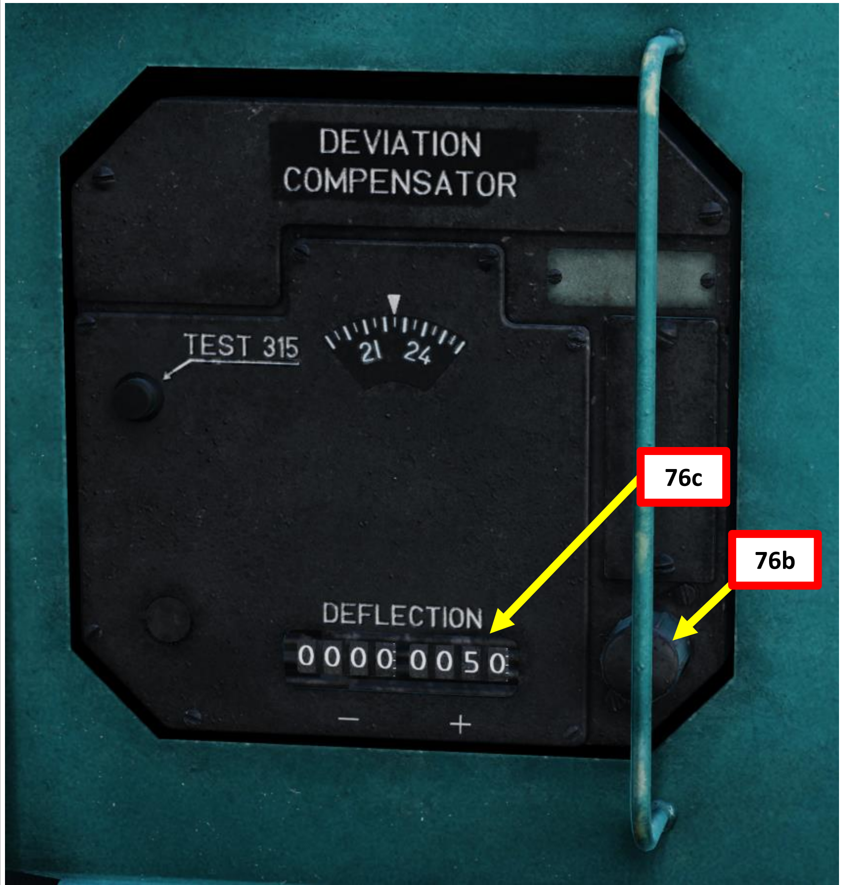
72. *[CPG]* Set Missile B1 Power Switch – ON (UP)
73. *[CPG]* Set Guidance Unit Power (B1) Switch – ON (UP)
74. *[CPG]* Set Left and Right Countermeasure Dispenser Selectors – ON (FWD)
75. *[CPG]* Set Countermeasure Dispenser Set Selector – I, II or III

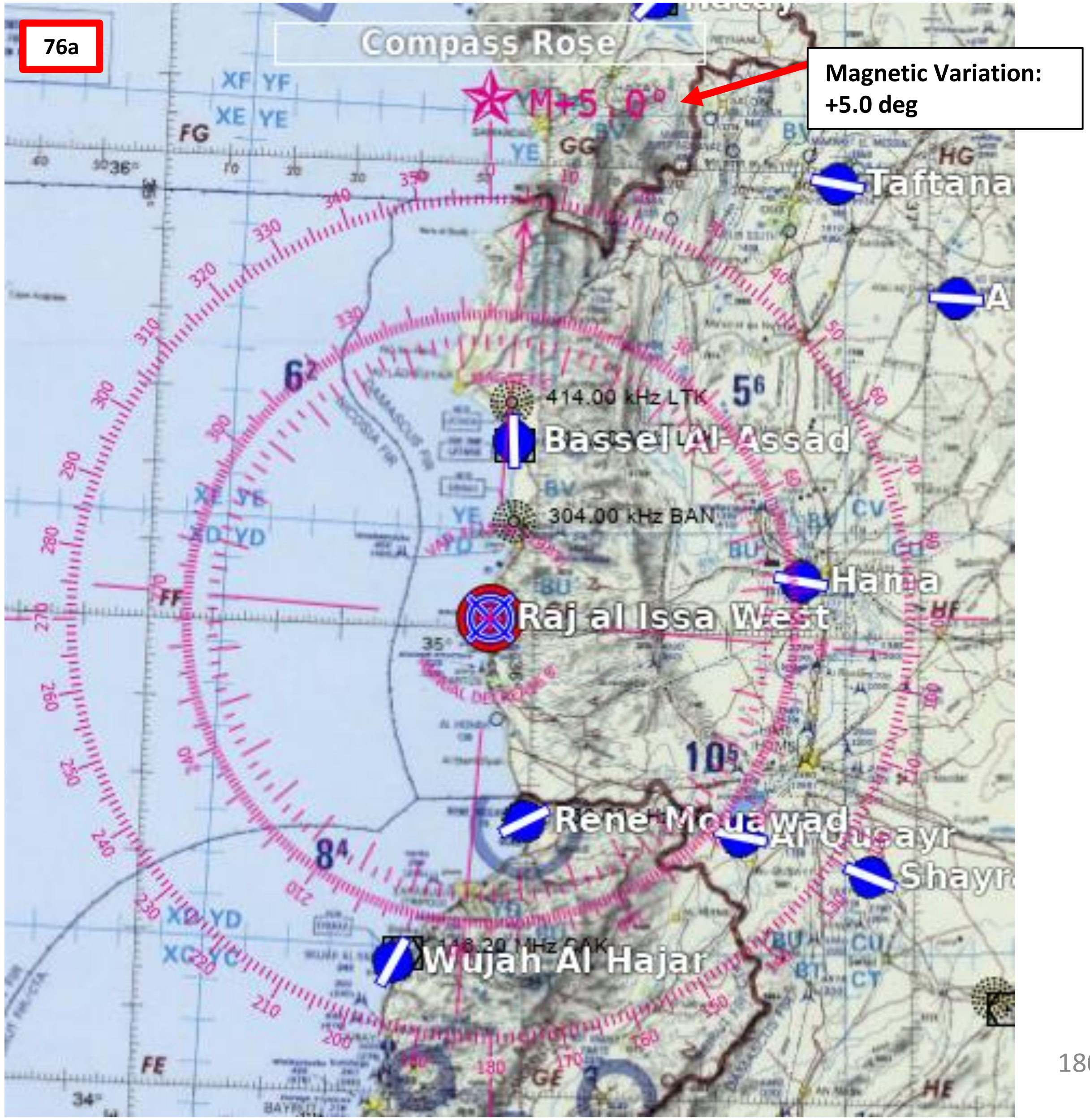




F - START-UP (ENGINE POST-START)

76. *[CPG]* Set KM-2 Magnetic Variation using the Magnetic Variation Setting Control Knob. The Magnetic Variation is available on the F10 map Compass Rose. Turn knob left for negative variation or right for positive variation.
    - +6.4 deg for Caucasus
    - +14.2 deg for Nevada.
    - +1.3 deg for Persian Gulf
    - -5 deg for Normandy
    - +0.2 deg for the English Channel
    - +5.0 deg for Syria





REARMING

To contact the ground crew to rearm the Mi-24 in DCS, you should preferably set the ICS/Radio Selector on the SPU-8 panel to the "ICS“ (Intercom) position (UP).

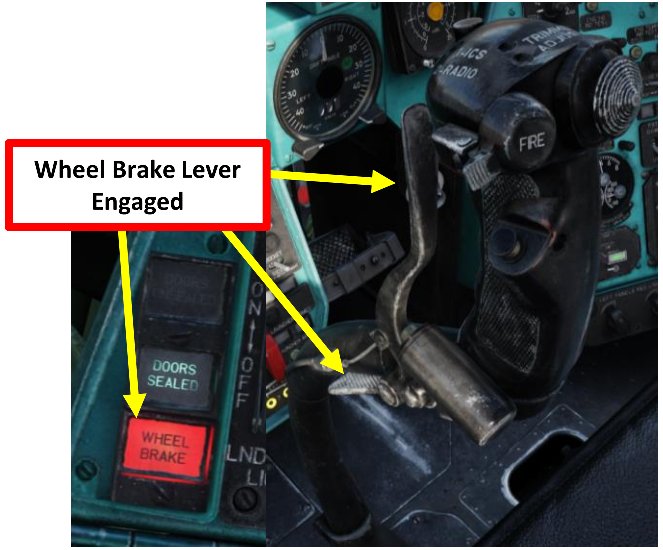
To contact the tower, the ICS/Radio Selector should be in the “RADIO” position (DOWN).

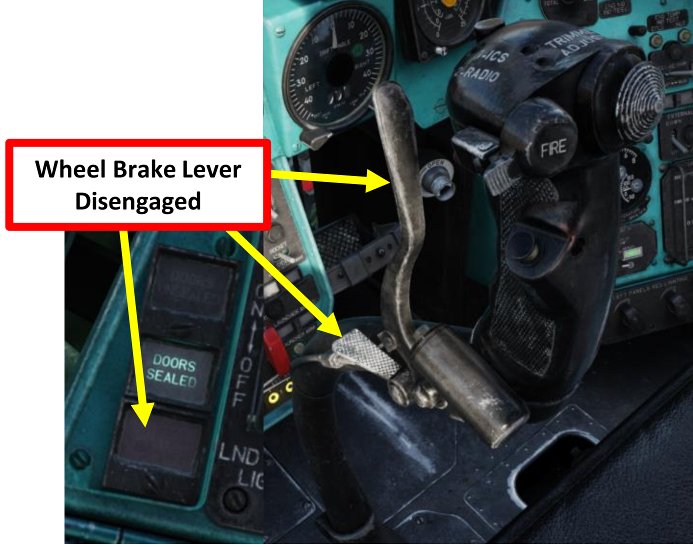
ICS/Radio Selector
- *UP: СПУ (ICS Intercom Switch)*
- *DOWN: РАД (Radio)*

TAXI

Taxiing in the Mi-24 is very simple:

1. Release parking brake by tapping the Wheel Brake lever.
2. Gently tilt the cyclic forward while increasing the pitch of the main rotor with the collective. The helicopter will start moving forward.
3. Once the aircraft is moving, bring the collective back down.
4. Steer the helicopter on the ground with anti-torque pedals in the direction of turn.
5. Keep taxi speed below 20 km/h with inputs to the cyclic and the wheel brakes.





HOW TO HOVER

1. Apply right pedal to stay centered and avoid drifting.
2. Use cyclic to remain straight and level (right & aft input).
3. Raise collective very gently to initiate a hover.
4. Hovering is hard at first. Failure to predict the helicopter's reaction after cyclic input will often result in you dancing the French Cancan for a long long time. Think of it like doing plate-spinning: you need to put yourself in a position of equilibrium, so you always need to think one step ahead.
5. Hold the "TRIMMER" button (on your cyclic) and your stick will remember that "hover" position. Keep in mind that trim works a bit differently from a plane's trimming.
6. Anticipate the rotorcraft's reaction when you trim.

Hover and Low Speed Control Indicator

- *Vertical Speed: m/s*
- *Horizontal Speed: km/h*

TAKING OFF

NOTE: There are many ways to takeoff in a Mi-24. The best way is generally a function of your loadout, weight and mission.

1. Check that all your engine and transmission gauges (pressure & temperature) are within safe operation range.
2. Check to see if all your flight instruments all set up properly.
3. If operating from a paved runway, set Engine Dust Protector System Power Switch – OFF (DOWN). This will ensure maximum power is available to takeoff. Keep to ON if taking off from a dusty environment.
4. Once you have performed a hover check and are maintaining a 3 m hover, you can taxi to the runway. In the Mi-24, you do not need to hover in order to taxi: just push your cyclic forward to force the front wheel to touch the ground, very gently raise the collective to move forward and use your brake lever and anti-torque pedals to steer the helicopter on the ground.
5. When lined up, ensure that the main rotor RPM is not less than 93%.
6. Push cyclic slightly forward to start gaining horizontal speed.
7. Once rolling at 20-30 km/h, increase collective power while observing the EPR gauge, then pull back slightly on the cyclic. The helicopter will lift off.
8. Apply further acceleration in a gradual climb so that the airspeed reaches 50 km/h at an altitude of 10 meters.
9. 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.
10. NORMAL TAKEOFF: Keep accelerating and you will start generating more and more translational lift, naturally climbing. Try to maintain an airspeed of 120 km/h when climbing.

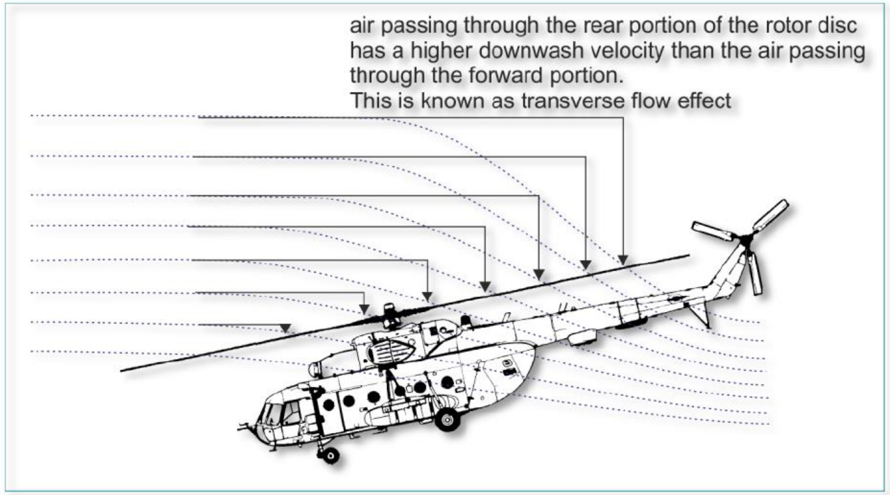
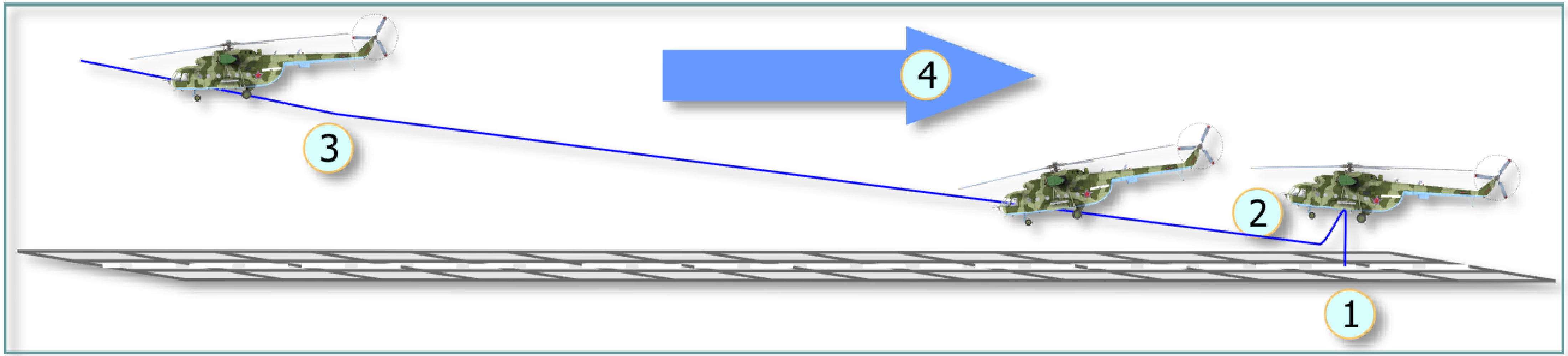


Fig. 3.16. Translational lift

Translational Lift



Vertical Takeoff with Acceleration In Ground Effect

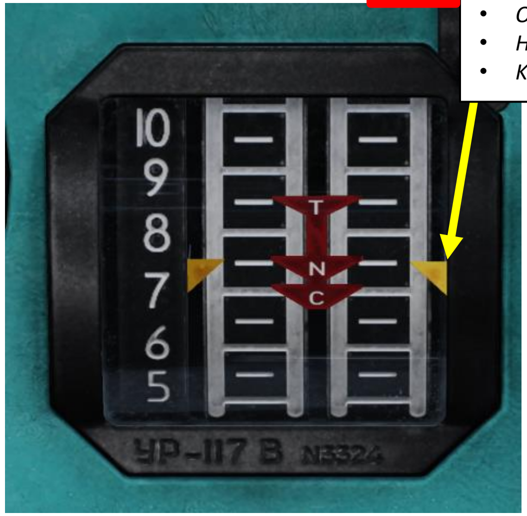
TAKING OFF

10. Once an airspeed of 70 km/h is reached, at an altitude of at least 15 meters, raise the landing gear.
11. After taking off, lower collective to reduce engine power to cruise setting.
12. Turn off the Dust Protection switches (if not already done).

11

EPR: Engine Pressure Ratio

- *Amber Index: Current Power Setting*
- *O (T) Index: Takeoff Power Setting*
- *H (N) Index: Nominal Power Setting*
- *K (C) Index: Cruise Power Setting*

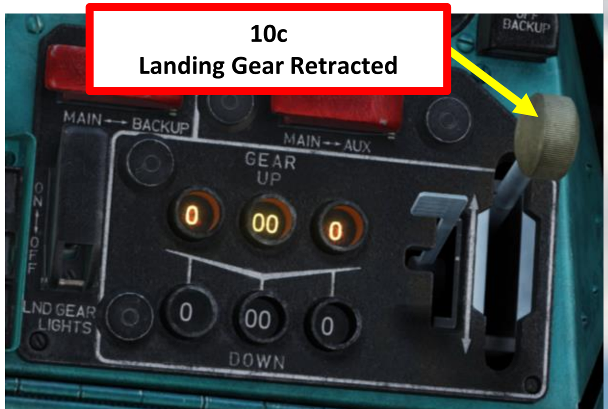


12

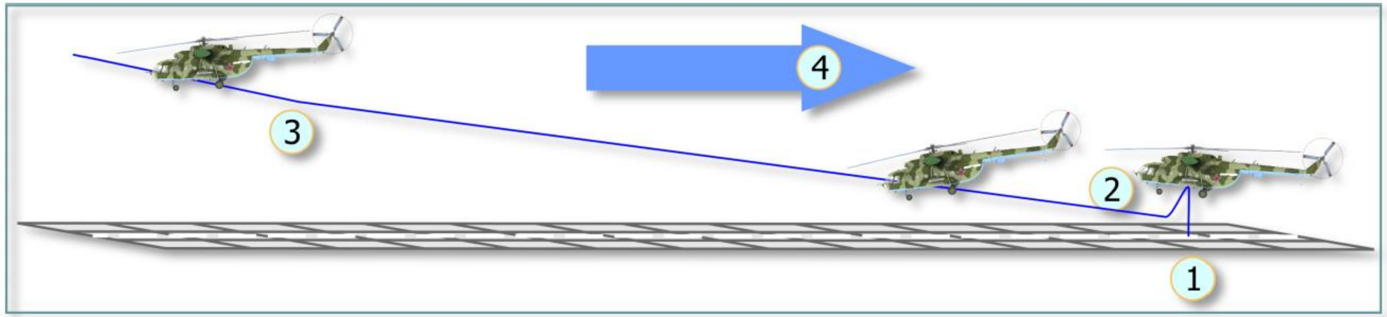
10a
Landing Gear Extended

10b
Landing Gear In Transition

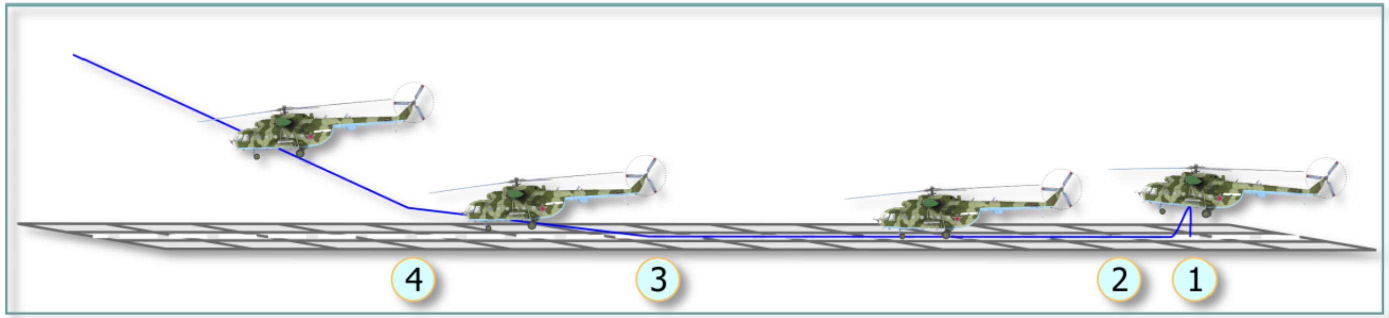
10c
Landing Gear Retracted



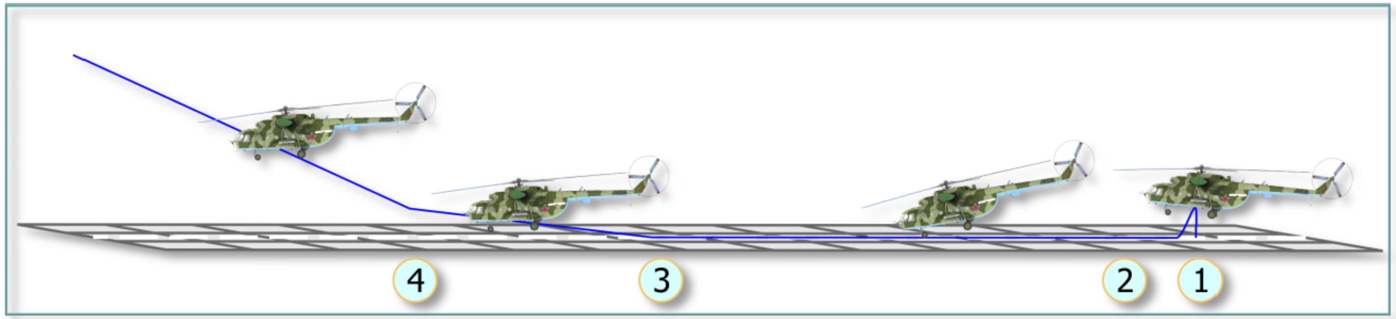
TAKING OFF



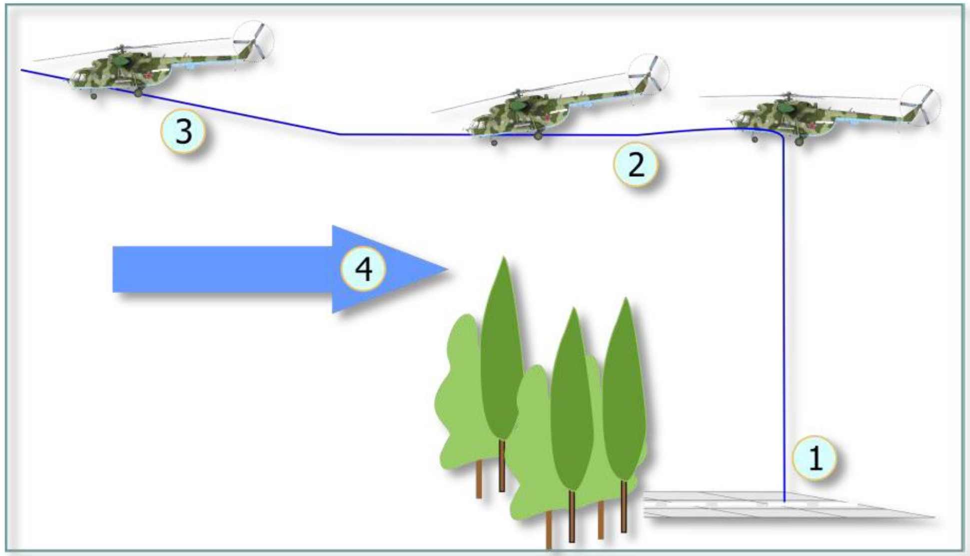
Vertical Takeoff with Acceleration In Ground Effect



Running Takeoff



Running Nose Gear Takeoff



Vertical Takeoff with Acceleration Out of Ground Effect


ОПАСНО
19

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.

One peculiarity of the Mi-24 is that it's a helicopter that does not decelerate easily. Slowing down the helicopter can be done with collective and cyclic inputs, but keep in mind that lowering the collective too much can potentially increase the descent rate to a point where the helicopter enters VRS (Vortex Ring State) if descent rate exceeds 4 m/s. Also, pulling too much on the cyclic can pitch the helicopter in un-recoverable attitudes. Slowing down quickly and safely in the Mi-24 is best done by performing turns, as shown in the next pattern diagrams.

1. Start descent from 500 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 50 km/h). VRS is further explained in Part 9: Principles of Helicopter Flight.
2. Use collective and cyclic input to maintain 120 km/h for a descent rate between 3-5 m/s
3. Reduce speed to 70 km/h when you are at 100 m AGL: you will start feeling excess lift being generated by ground effect. Adjust collective to keep a straight trajectory towards your reference point while reducing airspeed.
4. Deploy Landing Gear and turn on the Dust Protection switch.
5. You should reach your reference point in a 3 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).
6. Once you have come to a full stop in a 3 m hover, 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.

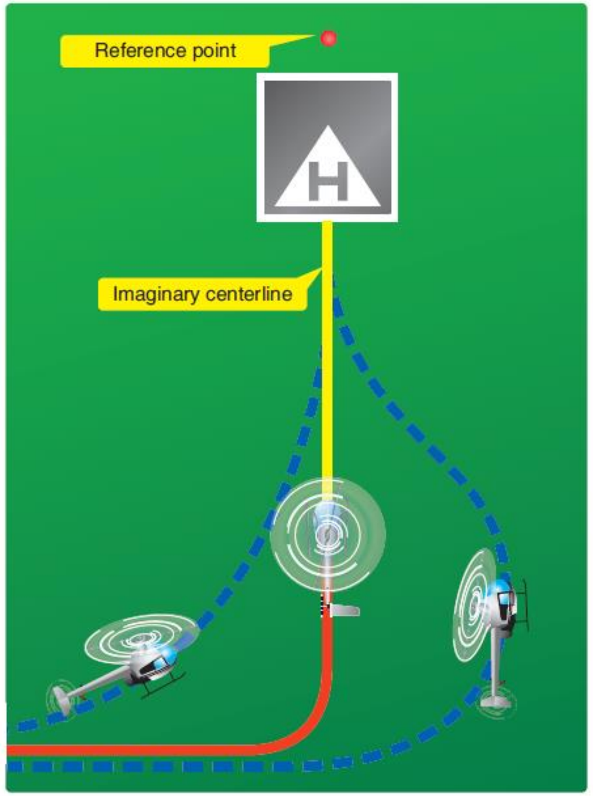
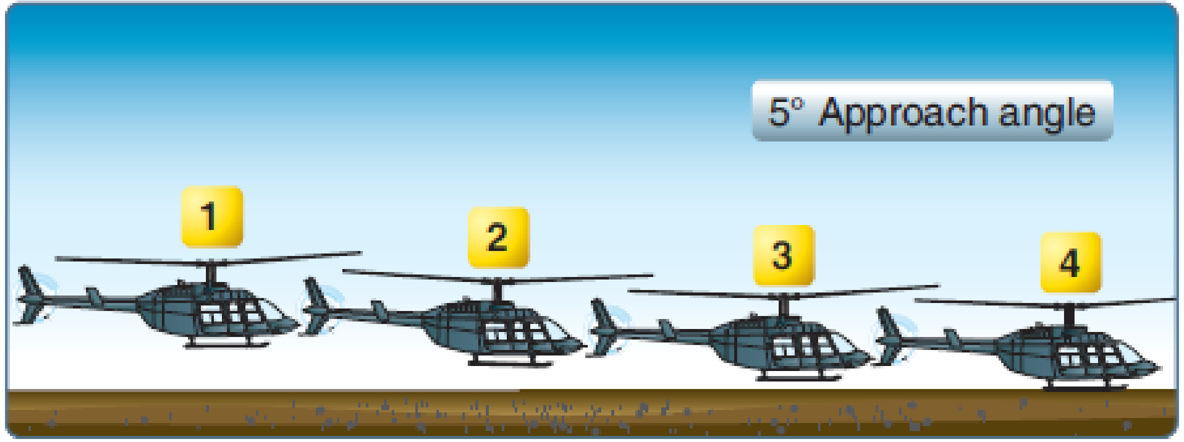
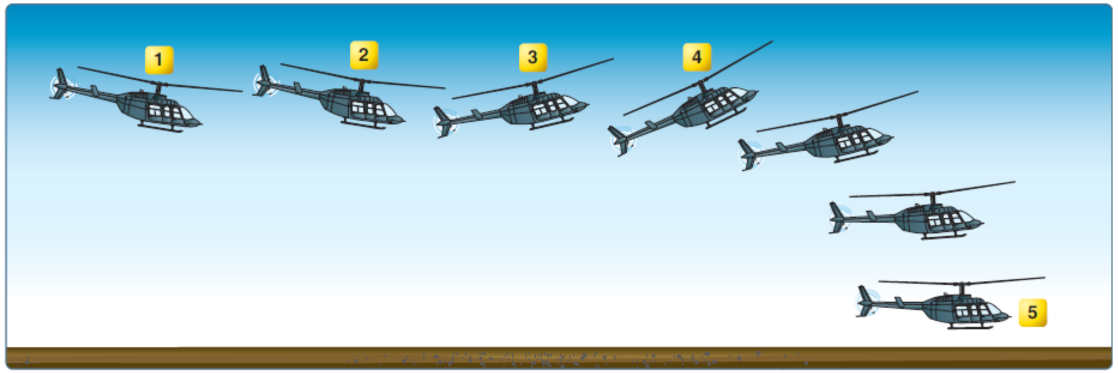


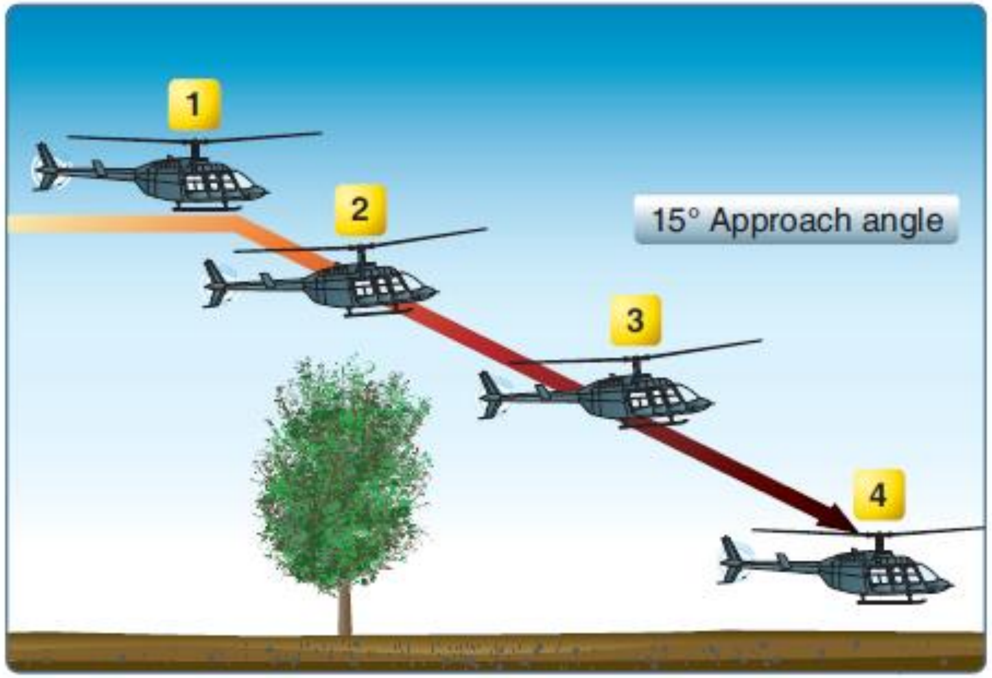
Figure 9-20. *Plan the turn to final so the helicopter rolls out on an imaginary extension of the centerline for the final approach path. This path should neither angle to the landing area, as shown by the helicopter on the left, nor require an S-turn, as shown by the helicopter on the right.*



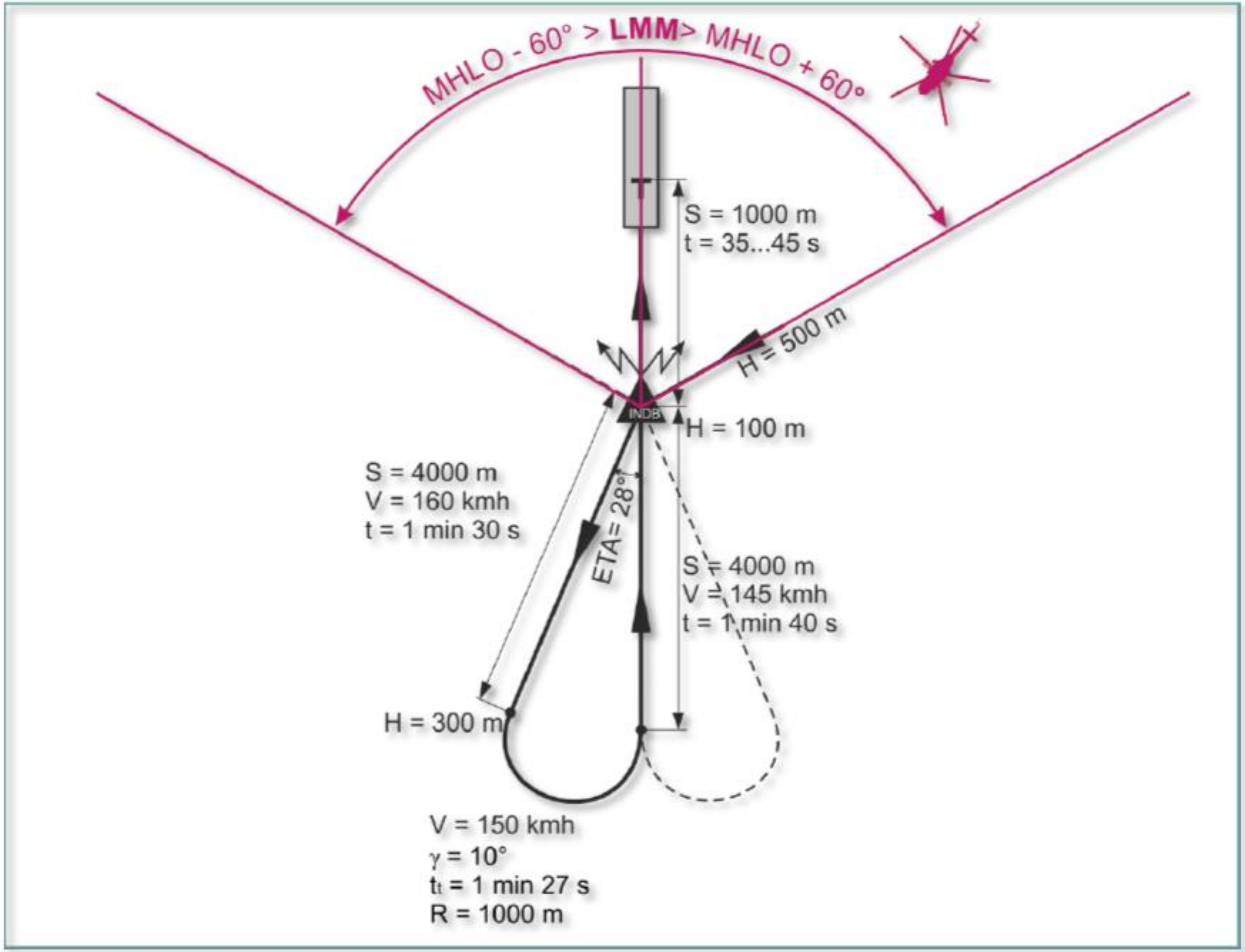
Shallow Approach & Running Landing



Rapid Deceleration or a Quick Stop



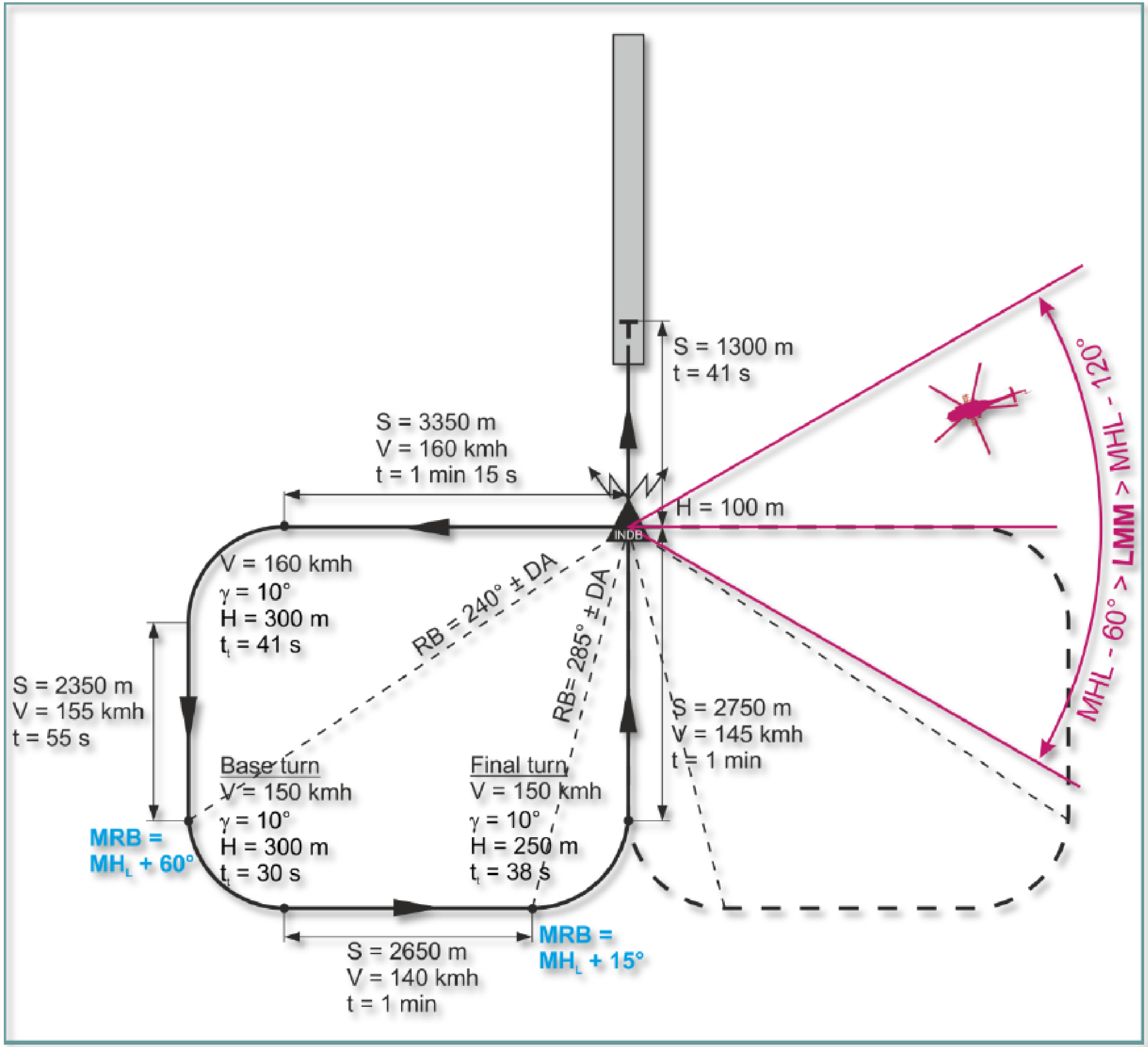
Steep Approach to a Hover



Straight In Approach with a Teardrop Procedure Turn Diagram

V_{GS} (Ground Speed) = 160 km/h
V_S (Vertical Speed) = 2-3 m/s
Approach Ground Speed (AGS) = 150 km/h
Roll Angle = 10 deg

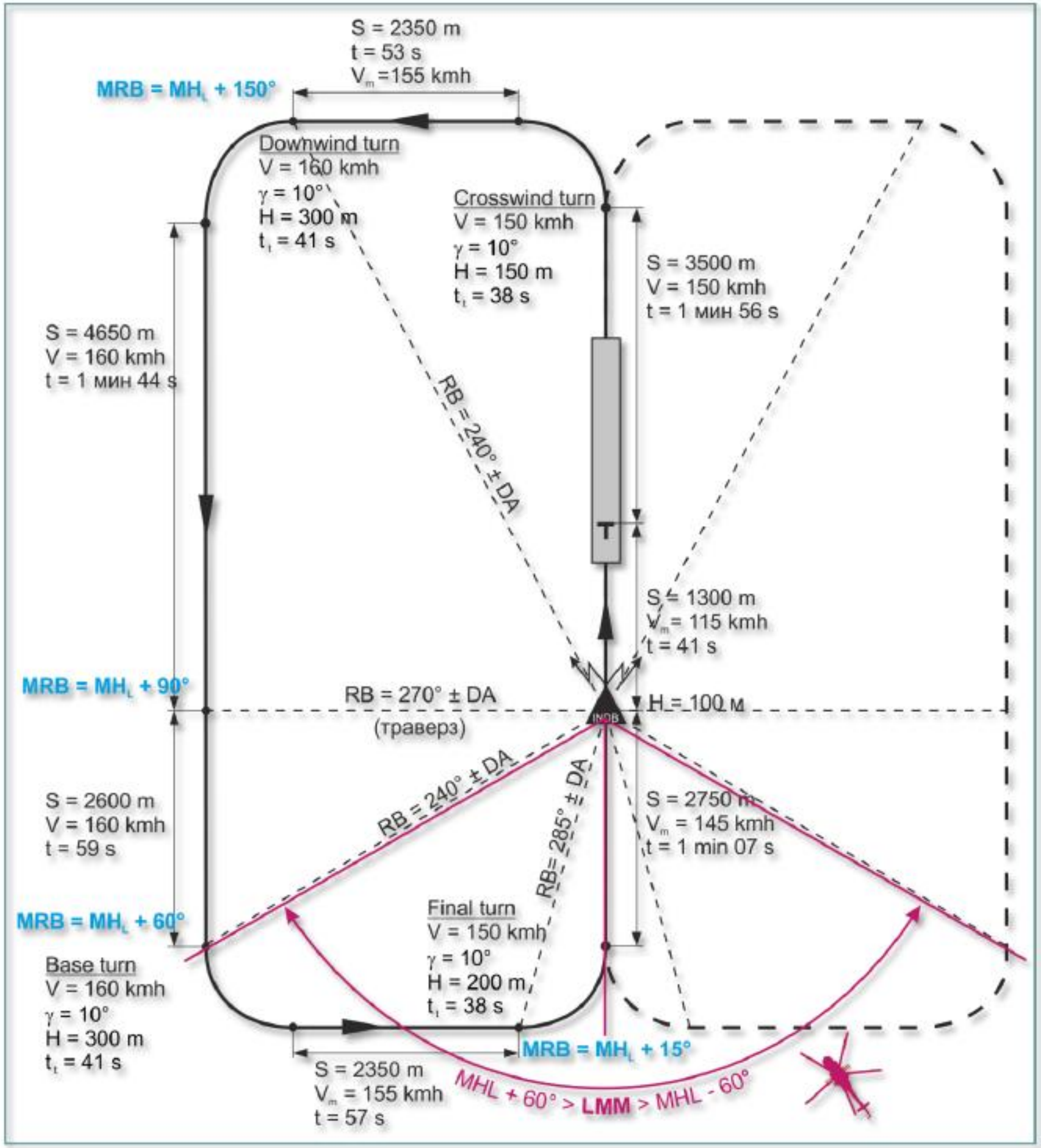
S - Distance
V – Airspeed
H – Altitude
γ - Bank angle
t – Time
t_t – Turn time
RB – NDB radio bearing
DA – Drift angle
MRB – Magnetic radio bearing to beacon
MH_L – Magnetic landing heading
FD – Flight direction



S - Distance
V – Airspeed
H – Altitude
γ - Bank angle
t – Time
t_t – Turn time

RB – NDB radio bearing
DA – Drift angle
MRB – Magnetic radio bearing to beacon
MH_L – Magnetic landing heading
FD – Flight direction

Tight Rectangle Pattern Diagram



Wide Rectangle Pattern Diagram

S - Distance
V – Airspeed
H – Altitude
γ - Bank angle
t – Time
t_t – Turn time

RB – NDB radio bearing
DA – Drift angle
MRB – Magnetic radio bearing to beacon
MH_L – Magnetic landing heading
FD – Flight direction

SECTION SUMMARY

POWERPLANT – TV3-117VMA ENGINE INTRODUCTION

The Mi-24P helicopter powerplant consists of two Klimov TV3-117VMA free-turbine turboshaft engines, assisted with the AI-9V APU (Auxiliary Power Unit). The engines are installed on the fuselage deck in a common nacelle with the oil cooler fan of the air cooling system.

The "VMA" in TV3-117**VMA** stands for "high altitude, modernized“. It was initially designed for the Mi-28 helicopter, and later installed also on Mi-8MT/Mi-17 models. This engine features an automatic switch to emergency power.

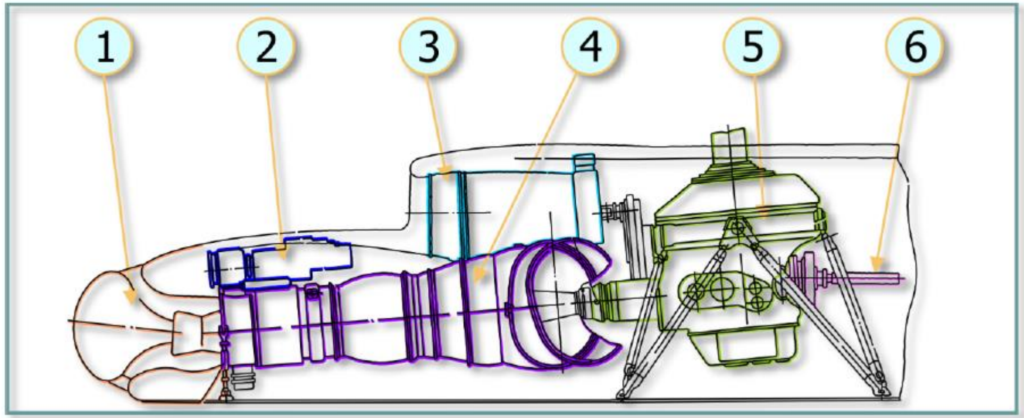
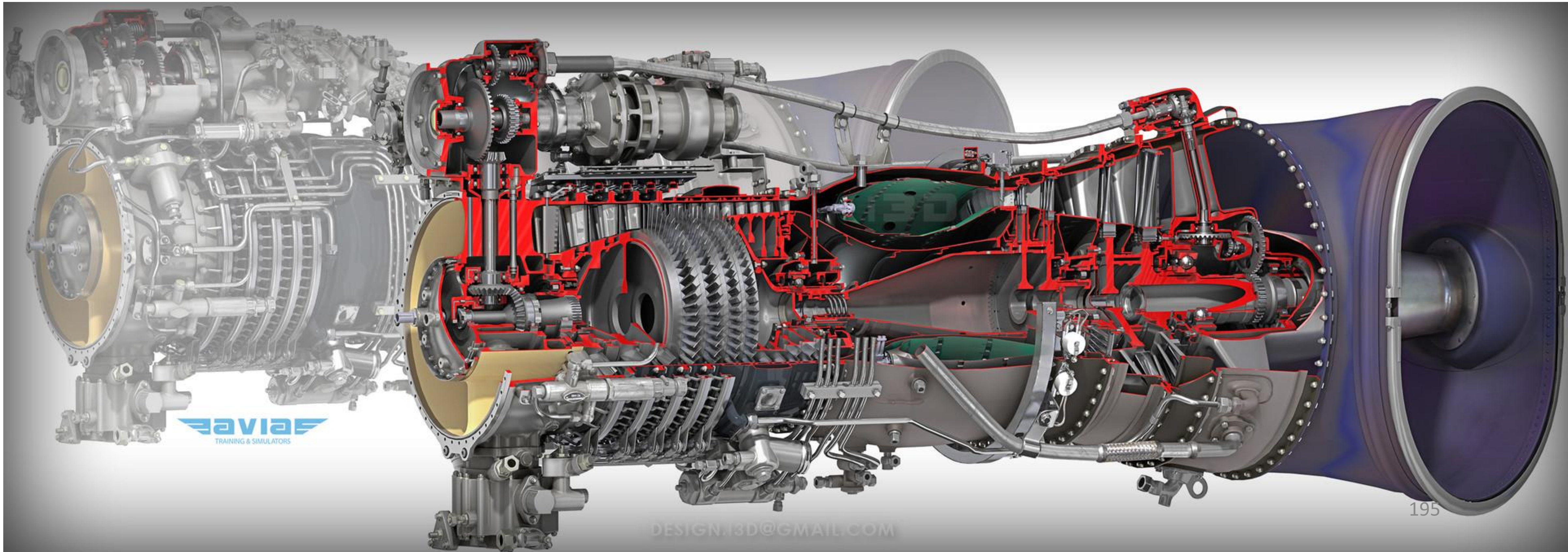


Fig. 4.2. Powertrain system diagram (side view)

1. Engine inlet and particle separator head ("PZU");
4. TV3-117VM engine;
5. VR-14 main transmission;



POWERPLANT – ENGINE CONTROLS

Joint engine operation is controlled using the twist grip throttle control on the pilot or copilot collective sticks. The engines are controlled individually by the pilot's engine condition levers (ECLs). If one engine fails when the engines are operating at power settings above flight idle, as long as the collective pitch remains unchanged, the droop compensator will engage and automatically bring the operating engine to MAX RATED (or Emergency) Power Setting to maintain the main rotor RPM. If the automatic control systems fail, the engine power setting can be controlled by manual adjustment of the twist grip throttle, the collective pitch, and the engine condition levers to maintain the main rotor RPM.

Engine control is mostly automated and the pilot typically adjusts power settings with the collective while the throttle twist grip is rarely used at all unless in emergency situations.

Engine N2 (Free Turbine Speed) Trim Control Switch

- *UP: Increases RPM*
- *MIDDLE: Neutral*
- *DOWN: Decreases RPM*

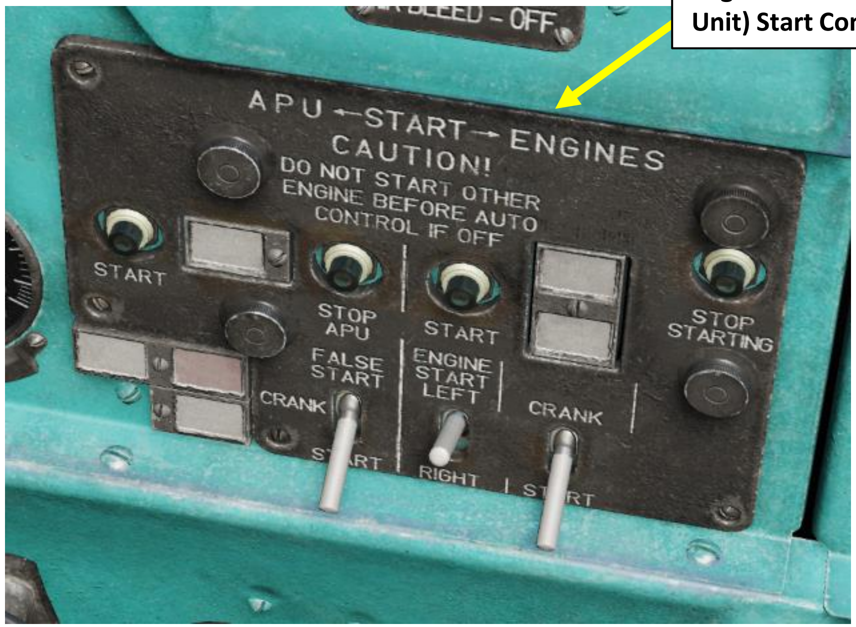
The engine control system includes a manual adjustment for N2 RPM. The pilot introduces trim changes with the INCR-DECR switch on the collective stick.

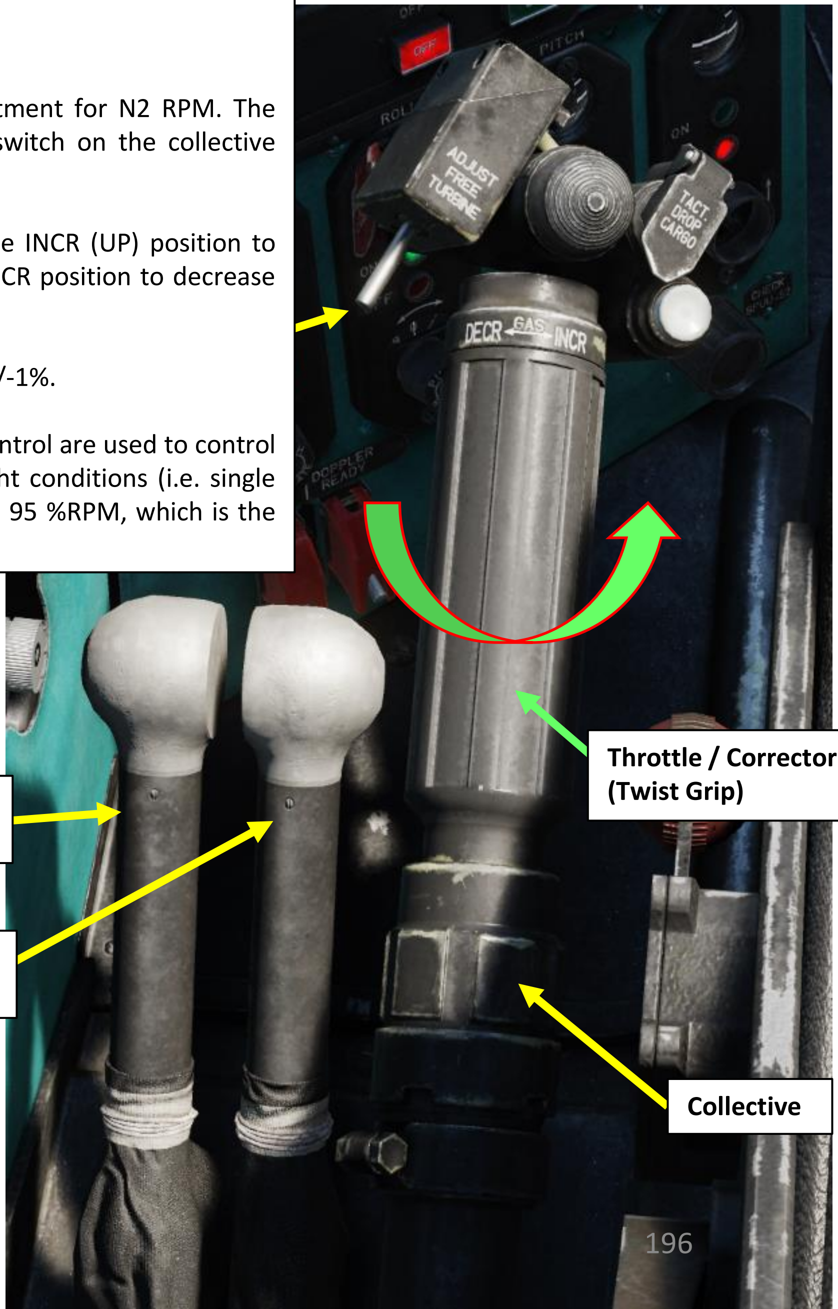
The switch is a three-position type and is held in the INCR (UP) position to increase the power turbine speed or down to the DECR position to decrease the power turbine speed.

The trim adjustment range is from 91 +/- 2 % to 97 +2/-1%.

The Engine Condition Levers (ECL) and manual trim control are used to control engines during engine testing and during special flight conditions (i.e. single engine failure) to adjust the Main Rotor RPM (NR) to 95 %RPM, which is the nominal value it should be running at.

Engine & APU (Auxiliary Power Unit) Start Control Panel





Left Engine Condition Lever (ECL)

- *Middle: Normal Operation*

Right Engine Condition Lever (ECL)

- *Middle: Normal Operation*

Throttle / Corrector (Twist Grip)

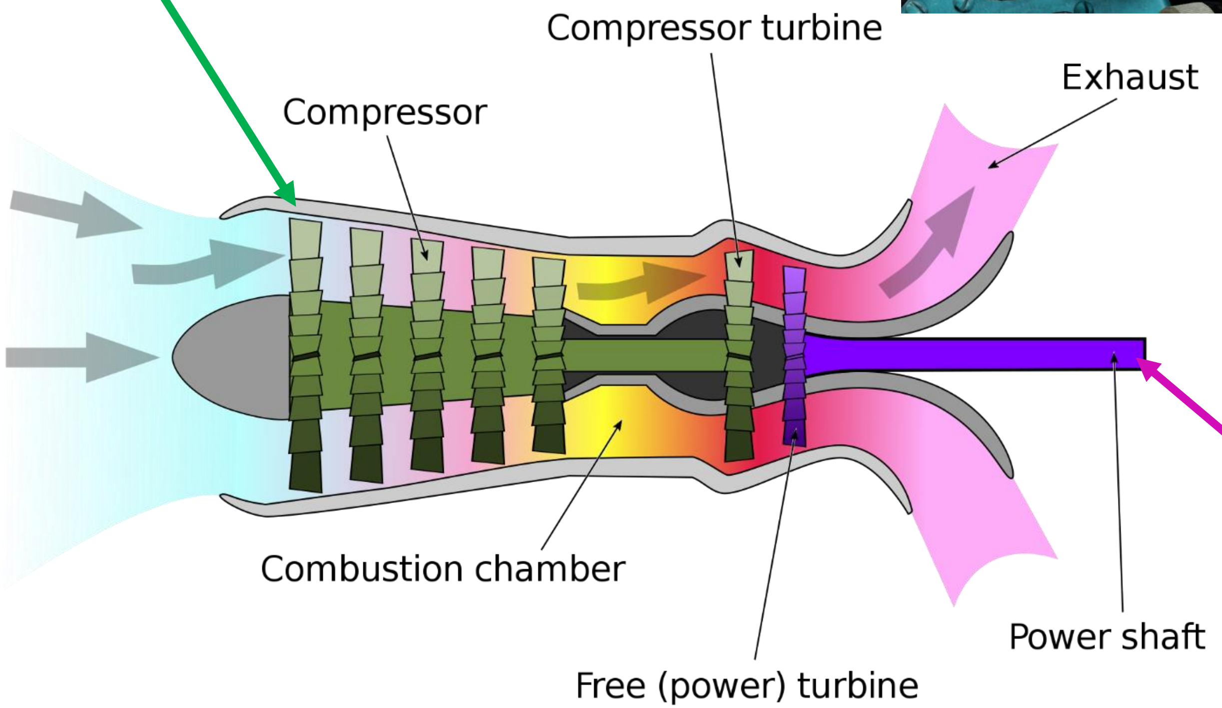
Collective

POWERPLANT – ENGINE INDICATIONS

The four engine indications you should keep an eye on at all times are:

- N1 (Gas Turbine Speed) – used to monitor health and power setting of the engine
- NR (Main Rotor Speed) – used to monitor rotor overspeed or underspeed
- EPR (Engine Pressure Ratio) – used to define reference power settings for different phases of flight
- PTIT (Power Turbine Inlet Temperature) – must be monitored to prevent engine overheat

N1 (Gas Turbine / Compressor Rotation Speed in %RPM)

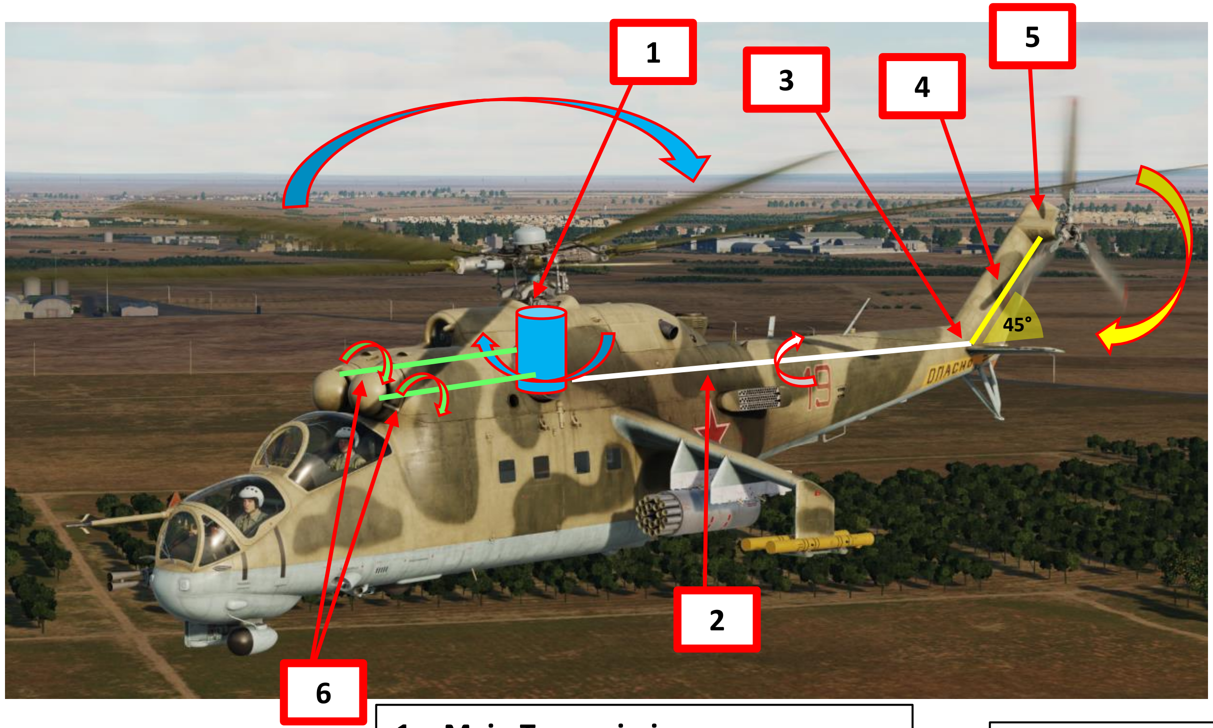


N2 (Free Power Turbine Rotation Speed in %RPM)

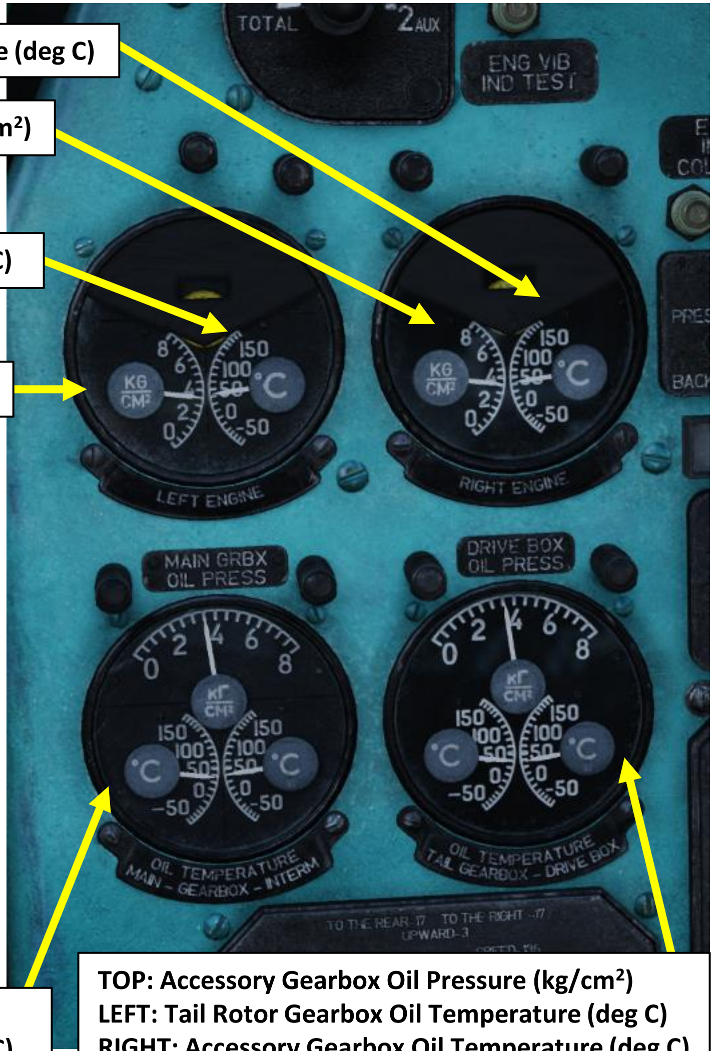
Incidentally, since the Power Turbine drives the Main Rotor shaft, in normal operation N2 is equal to the Main Rotor Speed (**NR**, in %RPM)

POWERPLANT – ENGINE INDICATIONS

Additionally, engine oil and various transmission gearbox oil indicators must be monitored once in a while to watch for oil leaks (which are often fatal issues if not found quickly, resulting in degraded transmission performance or even catastrophic transmission failure).



1. Main Transmission
2. Tail Rotor Driveshaft
3. Intermediate Gearbox
4. Rear Tail Rotor Driveshaft Section
5. Tail Rotor Gearbox
6. TV3-117VMA Engine Driveshafts



Right Engine Oil Temperature (deg C)

Right Engine Oil Pressure (kg/cm²)

Left Engine Oil Temperature (deg C)

Left Engine Oil Pressure (kg/cm²)

TOP: Main Transmission Gearbox Oil Pressure (kg/cm²)
LEFT: Main Transmission Gearbox Oil Temperature (deg C)
RIGHT: Intermediate Gearbox Oil Temperature (deg C)

TOP: Accessory Gearbox Oil Pressure (kg/cm²)
LEFT: Tail Rotor Gearbox Oil Temperature (deg C)
RIGHT: Accessory Gearbox Oil Temperature (deg C)

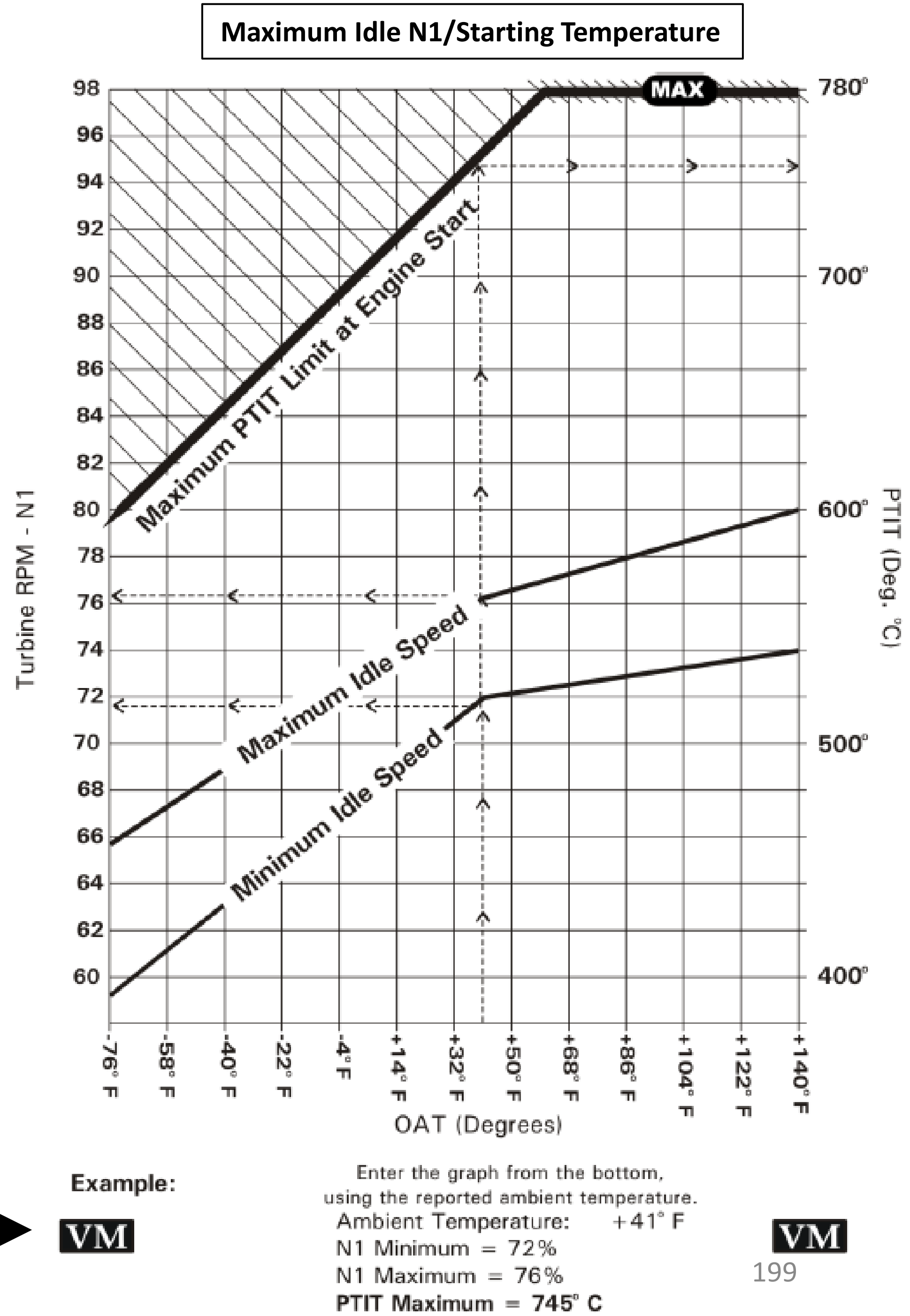
POWERPLANT – ENGINE OPERATION LIMITS

Data from DCS Mi-8MTV2 Manual (TV3-117VM Powerplant)

Mi-24P Performance Limitations	
Max Takeoff Weight	12,000 kg
Max Speed	335 km/h
Max Main Rotor Speed	101 % for no more than 20 seconds
Max PTIT (Power Turbine Inlet Temperature)	880 deg C Normal Operation between 720-750 deg C)
Min Main Rotor Speed	88 % for no more than 30 seconds
Min Main Rotor Speed During Autorotation	85 %

TV3-117VMA Engine Maximum Operating Range Limits

Power Setting	MAX PTIT (Power Turbine Inlet Temperature) Deg C	Max N1 % RPM
Max Rated	990	101.0
Takeoff	990	101.0
Max Limited Cruise	955	99.0
Limited Cruise	910	97.5
Cruise	870	95.5
Idle	780	Max Idle N1 Table Value



POWERPLANT – ENGINE OPERATION LIMITS

Data from DCS Mi-8MTV2 Manual (TV3-117VM Powerplant)

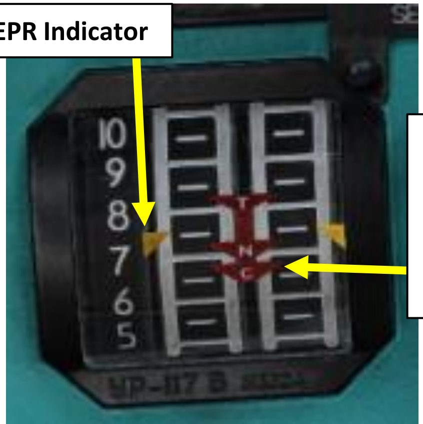
TV3-117VMA Engine Operating Range Table

Power Setting	RPM			Oil Pressure (kg/cm^2)	Engine Oil Temperature (deg C)				MAX Time Allowed (Minutes)
	N1	NR							
		One Engine Operating	Two Engines Operating		MAX	Recommended	Min Oil Temp Continuous Operation	Min Initial Oil Temp	
IDLE	Maximum Idle N1/Starting Temperature Table	40-55	55-70	>2	-	-	-	-	20
CRUISE	N1 must not exceed: • EPR Power Setting Index for desired power setting • Maximum Operating Range Limits (see previous page)	95 ± 2		3.5±0.5	150	80-140	70	30	No Limit
LIMITED CRUISE		95 ± 2		3.5±0.5	150	80-140	70	30	No Limit
MAX LIMITED CRUISE		95 ± 2		3.5±0.5	150	80-140	70	30	60
TAKEOFF		93 ± 1		3.5±0.5	150	80-140	70	30	6
MAX RATED		93 ± 1	-	3.5±0.5	150	80-140	70	30	See NOTE A

Note A - MAX RATED Allowed Time
Exceeding 6 minutes of operating time in the EMER (MAX RATED) /Take Off settings or the time limits for other power settings, will result in a reduction in engine service life.

Note B – One Engine Operating
When one engine has failed, the operating engine automatically elevates power to MAX Rated available. MAX Rated Power operating mode can not be activated for both engines simultaneously.

In other words, MAX Rated Power operating mode one of two engine can be activated only when the other engine failure (i.e. any action of the crew with (for) two simultaneously operating engines can not be set MAX Rated Power).



EPR: Engine Pressure Ratio Power Reference Marks
Amber Index: Current Power Setting
O (T) Index: Takeoff Power Setting
H (N) Index: Nominal Power Setting
K (C) Index: Cruise Power Setting

POWERPLANT – ENGINE OPERATION LIMITS

CHART A: N1 Limits (%) Adjusted for Ambient Temperature

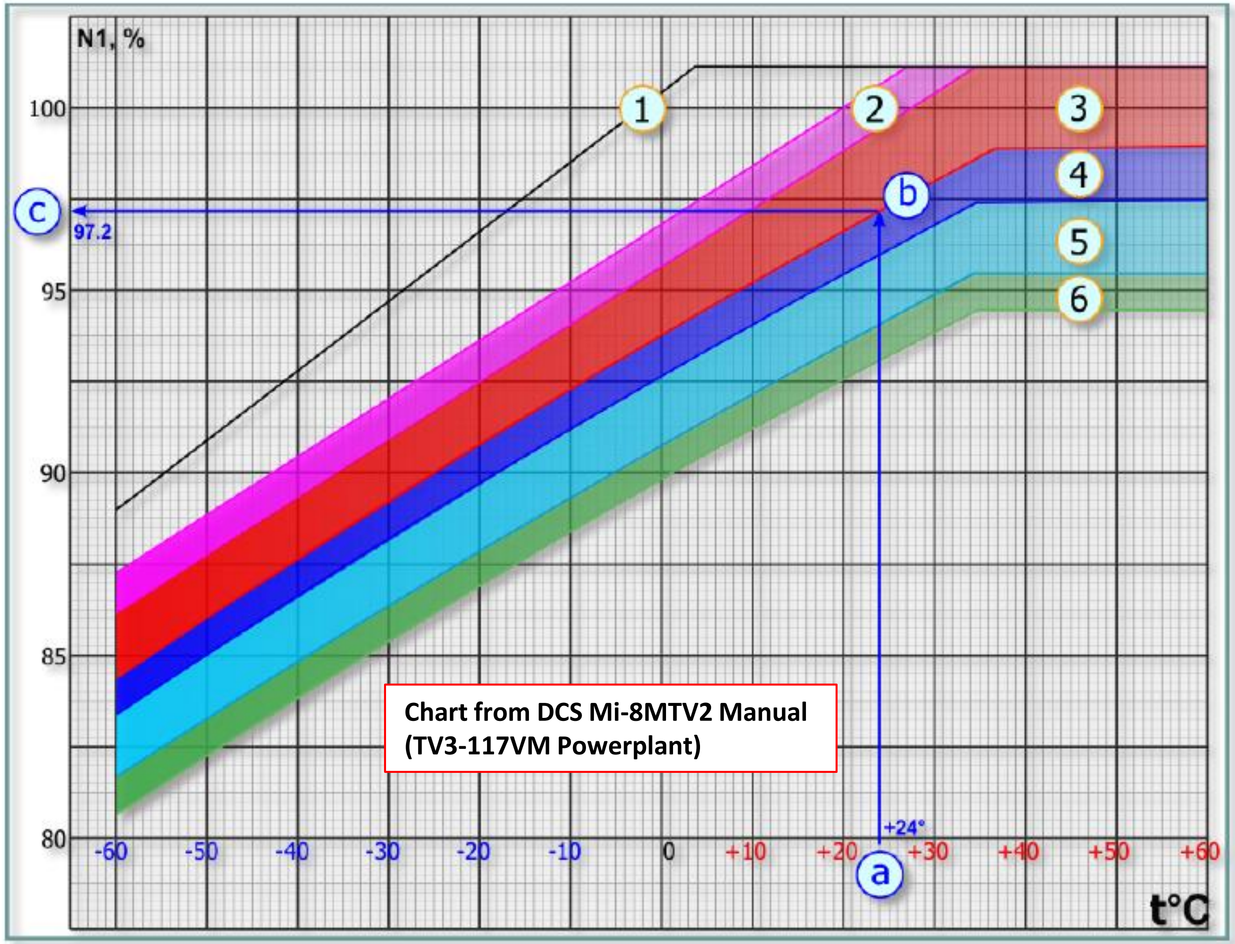
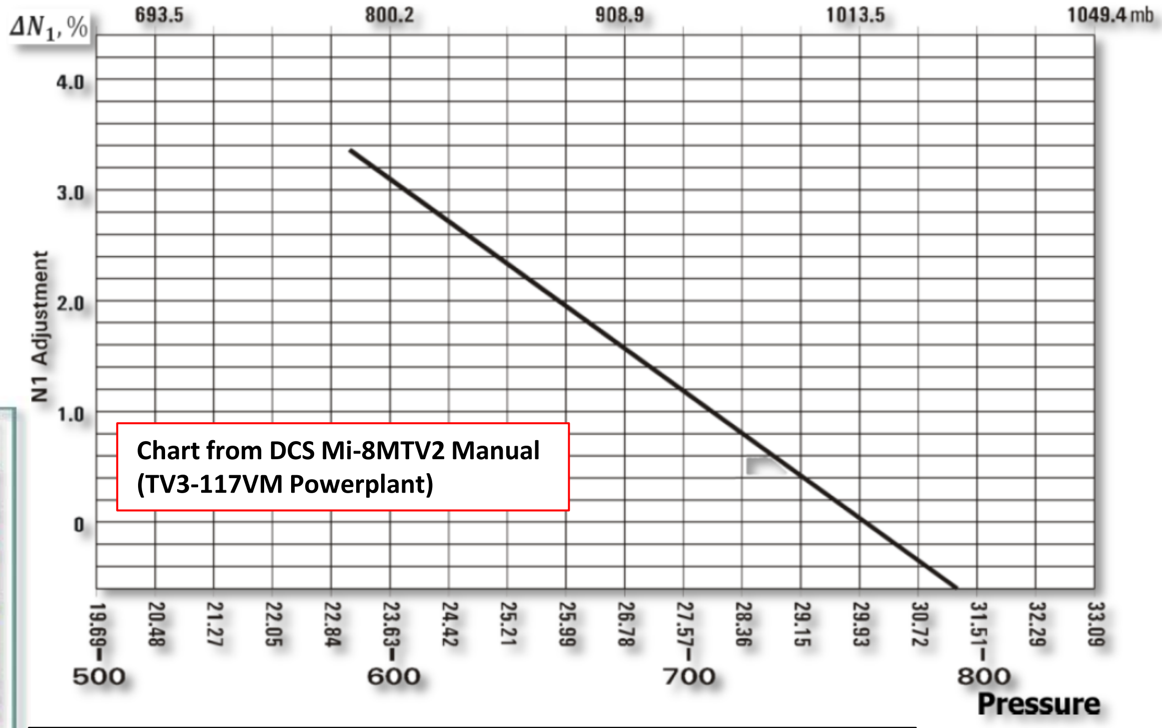


CHART B: N1 (%) Adjusted for Barometric Pressure



1. **Maximum allowed N1 at standard atmospheric pressure**
2. **MAX RATED Power Area**
3. **TAKEOFF Power Area**
4. **MAX LIMITED CRUISE Power Area**
5. **LIMITED CRUISE Power Area**
6. **CRUISE Power Area**

Note: *Apply the N1 (%) established in CHART A to CHART B (N1 Adjusted for Barometric Pressure) to find the N1 for the power setting required.*

Example: To obtain minimum N1 for 24 deg C (a), proceed vertically to the MIN Take Off power setting diagonals (b). Continue from the intersecting point to the left to obtain the Minimum N1 (97.2%, c). Maximum N1 is 99.4%.

As per CHART B, for a barometric pressure of 660 mm Hg (or 25.99 in Hg), an adjustment of 2 % N1 is required.

POWERPLANT – ENGINE OPERATION LIMITS

Main Transmission Maximum Operating Limits

Oil Pressure (kg/cm^2)		Oil Temperature (dec C)	
IDLE Mode	0.5	MAX	90
Other Power Setting Mode	3.5 ± 0.5	Recommended	50 – 85
		Min Initial Oil Temperature	-15
		Min Oil Temperature Continuous Operation	+30

Main Rotor RPM (NR) Limits

Absolute Limits	NR (% RPM)	Maximum Time Allowed
Max Rated & Takeoff Power	103 % Max	20 sec
Max Rated & Takeoff Power	88 % Min	30 sec
All Settings Above Limited Cruise	101 % Max	20 sec
All Settings Below Limited Cruise	103 % Max	20 sec
Normal Operating Limits	**NR (% RPM)**	**Maximum Time Allowed**
Idle	45 to 65 – two engines 40 to 55 – one engine	20 minutes
Cruise	93 – 97 % Max	Not Limited
Limited Cruise	97 % Max	60 minutes
Takeoff	94 % Max	6 to 15 minutes
Max Rated Power	94 % Max	6 to 60 minutes
Autoration (No Power)	90 – 98 % Max Avoid transient overspeeds of 115 % Avoid transient underspeeds of 85 %	N/A

Intermediate Gearbox Operating Limit

Oil Temperature (dec C)	
All Power Settings	MAX 110

Tail Rotor Gearbox Operating Limit

Oil Temperature (dec C)	
All Power Settings	MAX 110

Rotor Brake Application Limit

NR (% RPM)
Application of rotor brake is prohibited above 20 % NR RPM

POWERPLANT – ENGINE PROTECTION SYSTEMS
N1 (GAS GENERATOR/COMPRESSOR) GOVERNING LOOP

During steady-state operation, the N1 regulator, droop compensator, engine governor and temperature limiter automatically control the fuel flow into the combustion chamber of the engine. Each element affects the fuel flow only during specific conditions:

- The N1 RPM regulator controls the fuel flow at IDLE power
- The Droop Compensator adjusts the fuel flow at operational power conditions from FLIGHT IDLE up to LIMITED TAKEOFF. This includes flat pitch descents.
- The Engine Governor system controls maximum fuel flow at LIMITED TAKEOFF and TAKEOFF power.
- The Gas Temperature (PTIT) Limiter system also controls maximum fuel flow at LIMITED TAKEOFF and TAKEOFF power.

The **Engine Governor N1 Loop** prevents compressor overspeed by reducing the fuel flow to the combustion chamber when the preset maximum RPM is reached.

The system monitors and corrects the maximum N1 limit by using inputs from:

- N1 RPM transducer mounted on the engine accessory drive
- Pressure readings from a pressure transducer mounted in the cargo cabin
- Temperature readings from the engine inlet temperature probe

The Temperature Limiter actuator controls the amount of fuel reduction.

POWERPLANT – ENGINE PROTECTION SYSTEMS
N2 (FREE POWER TURBINE) GOVERNING LOOP

The Engine Governor N2 Loop automatically activates and shuts down the engine in the event of power turbine overspeed (118 +/- 2 % N2 RPM). The N2 loop uses the input from a pair of N2 transducers mounted in the aft support housing to determine actual N2 speed. The emergency fuel shutoff valve cuts off the fuel flow into the combustion chamber and the engine shuts down if the maximum N2 speed is reached. A power boost circuit is included in the governor system to allow maximum power for emergency takeoff with one engine.

In a **climb at maximum continuous power with a constant collective pitch angle**, the main rotor RPM is automatically maintained at 95±2% up to a limited altitude. Further climb will result in the main rotor RPM drooping as engine power output is reduced due to compressor RPM limits imposed by the engine governor system. Maintain main rotor RPM above 92% by gradually reducing collective pitch as main rotor RPM begins to droop. The maximum continuous power limitations begin to affect main rotor RPM at 1000 - 1500 m.

In a **climb at cruise power with a constant collective pitch angle**, the main rotor RPM is automatically maintained constant up to an altitude of 2000 - 2500 m.

In a **climb at takeoff power with constant collective pitch angle**, the main rotor RPM is not maintained automatically. Maintain main rotor RPM in the 92-94% range by gradually reducing collective pitch as altitude increases.

In **transitional maneuvering**, the main rotor RPM is automatically maintained at 95± 2% only within a limited rate of collective application:
- When increasing collective, no less than 5 seconds from 1 - 3° collective pitch up to the pitch angle establishing takeoff power.
- When reducing collective, no more than 1°/sec from any starting collective pitch angle

Collective input rates above these limits can lead to main rotor RPM drooping below the minimum allowable limit (88% NR) when increasing collective or overspeed the main rotor above the maximum allowable limit (103% NR) when reducing collective.

Note: If main rotor RPM runs outside 95±2%, adjust collective to return RPM to the normal range.

POWERPLANT – ENGINE PROTECTION SYSTEMS

PTIT (POWER TURBINE INLET TEMPERATURE) LIMITER

When the Power Turbine Inlet Gas Temperature (PTIT) reaches 985 ± 5°C, the temperature limiter begins to send signals to the temp limiter actuator. The RT LEFT (or RIGHT) ON caution light on the pilot's left side console begins to flash.

As the PTIT continues to increase, the signal pulse duration and the flashing speed of the caution light also increases. This results in increased fuel spillage from the throttle control chamber through the temp limiter actuator, decreasing the amount of fuel fed to the combustion chamber.

The gas temperature limits at all power settings are between 980 and 990°C. The fuel control includes a slide valve that blocks the actuator if the temperature limiter fails.

If the temperature limiter sends a constant false signal or a very high temperature signal to the actuator, the slide valve disengages the actuator when the N1 RPM decreases to 85±1% (overtemperature protection system).

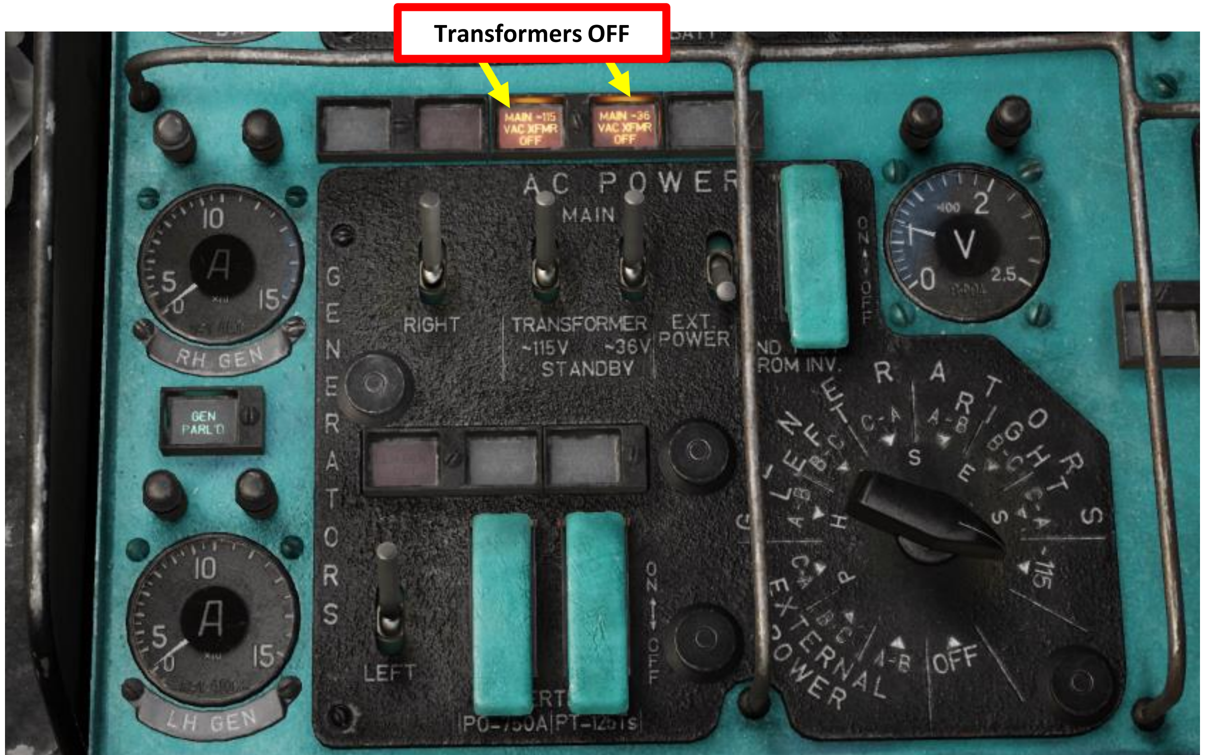
POWERPLANT – ENGINE PROTECTION SYSTEMS

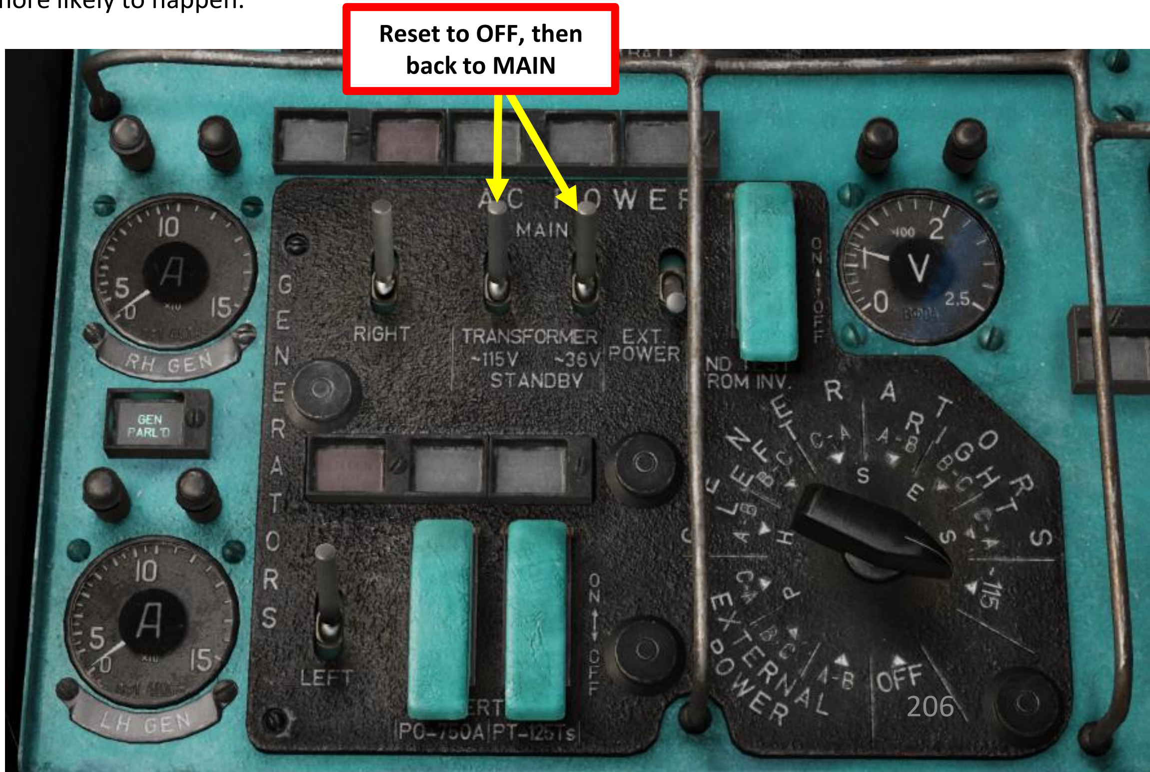
GENERATOR FAILURE

As you start flying the Mi-24 in aggressive manoeuvers, you may find yourself hearing the dreaded "GENERATOR FAILURE" aural warning and then lose electrical power (and the autopilot in the process). This is due to an electrical protection feature that automatically disconnects generators if Main Rotor RPM drops below safety limits or exceeds maximum limits.

If you happen to run into a GENERATOR FAILURE of your own doing, how do you fix this?

- In case of a Main Rotor underspeed (rotor droop), lower collective to unload the rotor. The RPM will then increase again. Generators will re-engage automatically again by themselves.
- When generators are re-engaged after an electrical power loss, the **MAIN 115 VAC XFMR OFF** and **MAIN 36 VAC XFMR OFF** lights will still remain illuminated. You will need to **manually set both Transformer switches to OFF, then back to MAIN**. The MAIN 115 VAC XFMR OFF and MAIN 36 VAC XFMR OFF lights should then extinguish. Also, the autopilot channels will need to be restarted manually.
- In general, fly smoothly and avoid sudden RPM drops/rotor drooping in the first place.
- Monitor power usage carefully on the relevant gauges (i.e. EPR Gauge, NR Gauge, N1 Gauge, and PTIT Gauge) whenever flying at high altitudes in the mountains or with heavy cargo, when rotor overload and RPM drop is more likely to happen.





POWERPLANT – ENGINE PROTECTION SYSTEMS

SYNCHRONIZER

Since the Mi-24 uses two engines, engine power synchronizers are required to balance joint engine operation; this is performed by engine fuel controls linked by power synchronizers.

The power synchronizers measure and compare the compressor delivery pressure of both engines. The engine with the lower delivery pressure (the driven engine) receives an increase in fuel flow which increases the N1 RPM. This action also causes an increase in the N1 RPM of the engine with the higher compressor delivery pressure (the driving engine). The droop compensator of the driving engine then reduces the fuel flow and thus, the RPM of the driving engine. The power synchronizers and droop compensators of both engines counterbalance each other until the compressor delivery pressure of both engines is equal.

The power synchronizer only affects the fuel flow of the driven engine, while the rotor droop compensator affects the driving engine.

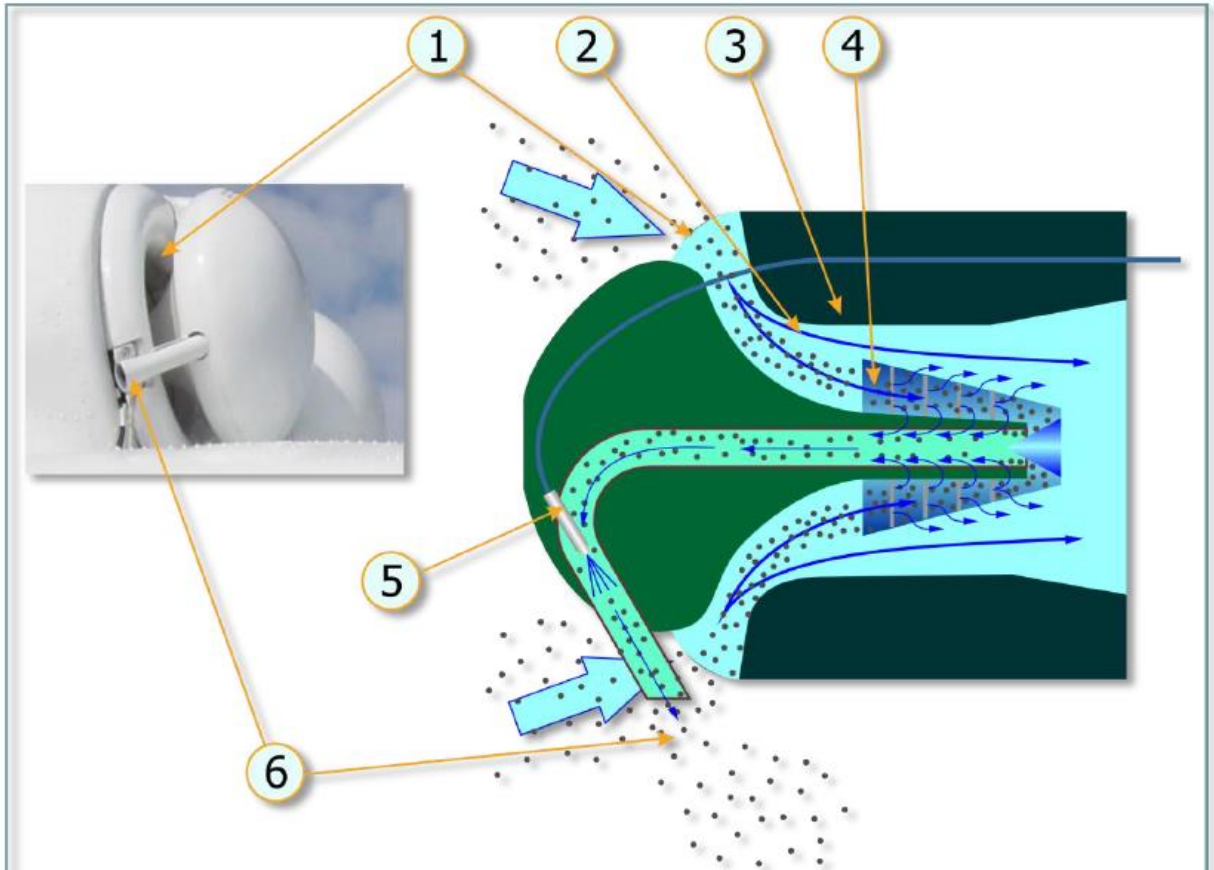
If the main rotor RPM surges above 107%, the synchronizer cutoff valve in the engine fuel control disconnects the power synchronizer of the driven engine. The driven engine drops to flight idle, while the driving engine continues to operate at maximum power.

To adjust and maintain the correct Main Rotor RPM if the power synchronizer disengages, the pilot must manually adjust the collective pitch, twist grip throttle control, or ECLs (Engine Condition Levers).

POWERPLANT – PZU
PSS (PARTICLE SEPARATOR SYSTEM) / DPD (DUST PROTECTION DEVICE)

The "PZU" air inlet Particle Separator System (PSS), or Dust Protection Device (DPD), protects the engine inlet during taxi, takeoff, and landing at unprepared airstrips and in sandy/dusty environments. In addition, the system provides electrical and bleed air anti-ice heating.

The system mounts on the front of the engine, in place of the nose cone assembly. Each engine has an independent particle separator system. The system begins to operate when bleed air is supplied to the ejector by opening the flow control valve. When the system is running, suction pulls contaminated air into the **inlet duct passages (1)**. Centrifugal forces throw the dust particles toward the **aft dome surface (2)** where they are driven by the air flow through the **separator baffles (4).** The main portion of the air, with the dust removed, passes through the duct to the **engine air inlet (3)**. The contaminated air (dust concentrate) is pulled into the **dust ejector duct (5)** and **discharged overboard (6)**.



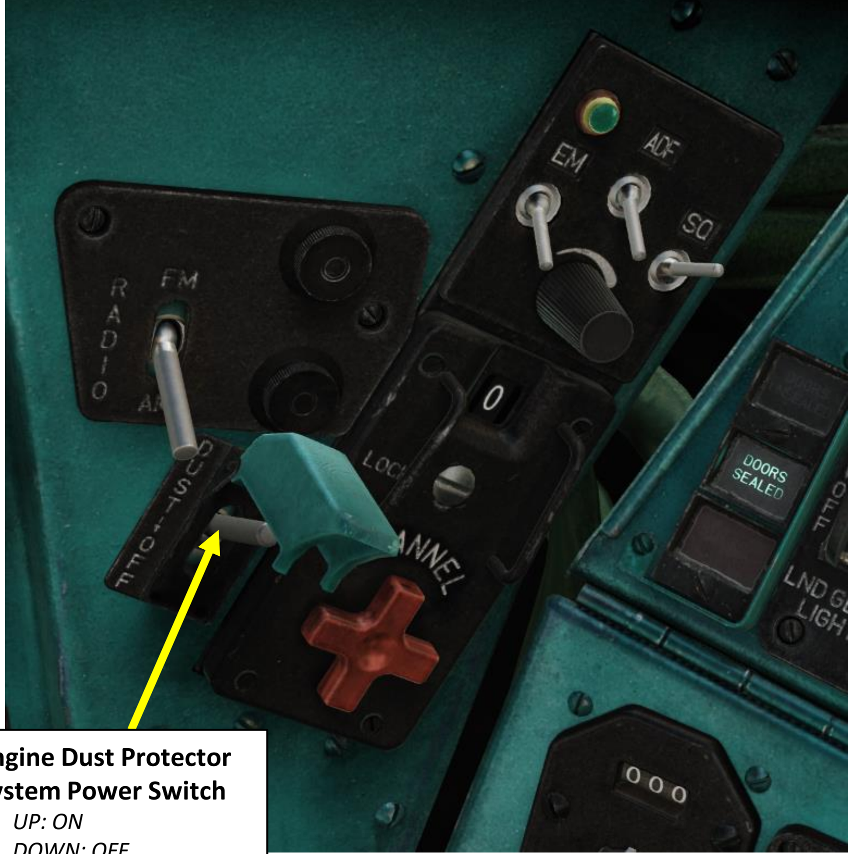
Air Inlet Particle Separator System Functional Diagram

POWERPLANT – PZU
PSS (PARTICLE SEPARATOR SYSTEM) / DPD (DUST PROTECTION DEVICE)

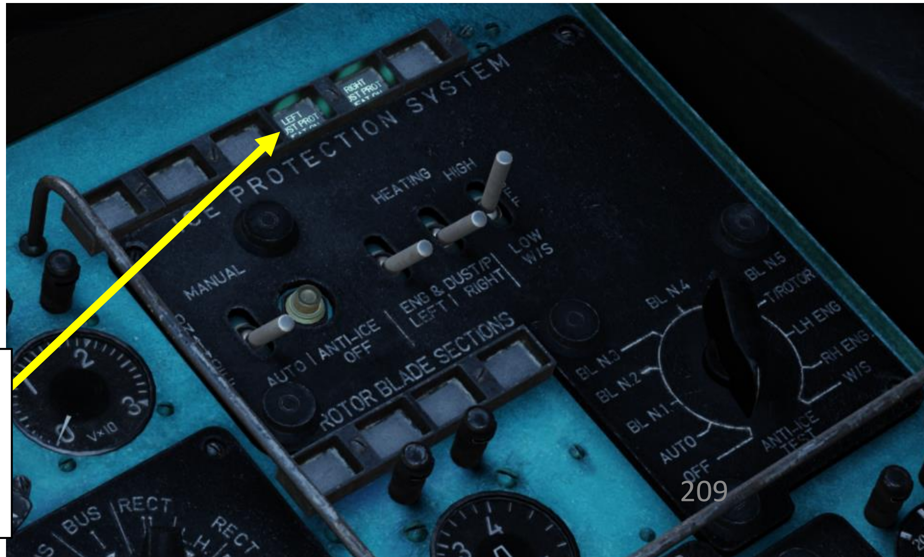
The dust protection system can be armed by setting the **Engine Dust Protector System Power Switch** ON (UP). Keep in mind that the PSS consumes engine bleed air, which **reduces available engine power** by about 100 Horsepower (or about 4.5 % power). In other words, the dust protector system should be used sparingly in order to keep as much power available during flight.

Left Engine Dust Protection (PZU) System ON Annunciator

Right Engine Dust Protection (PZU) System ON Annunciator



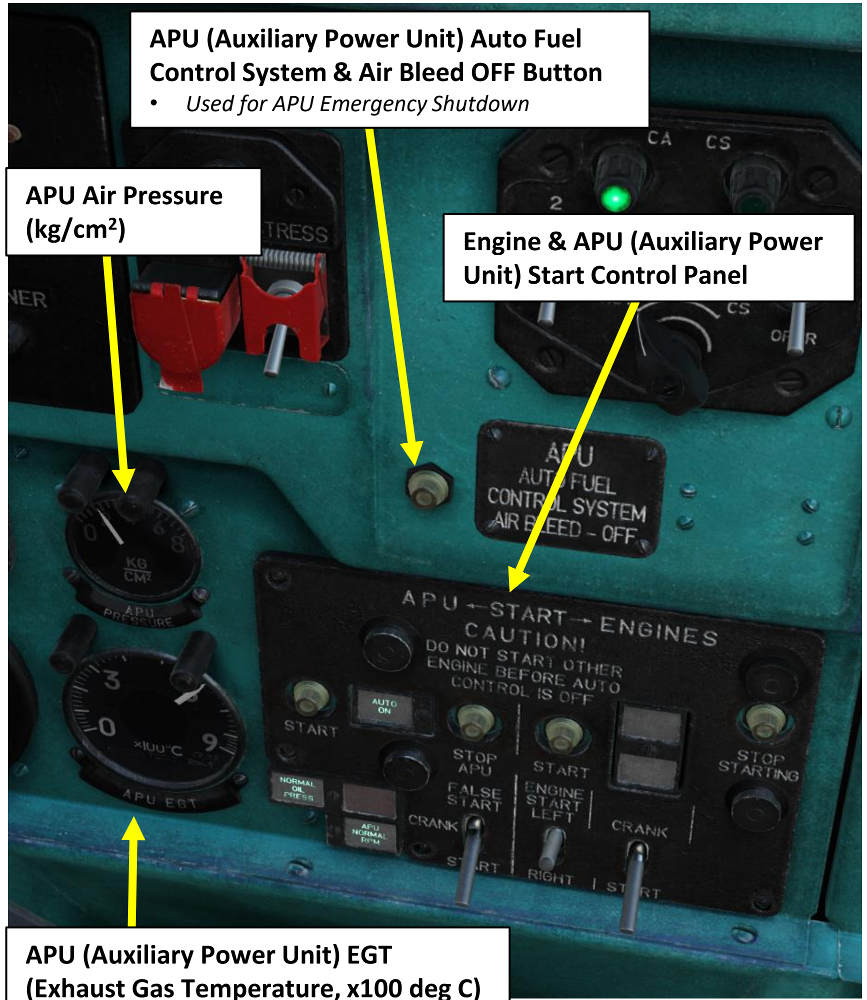
Engine Dust Protector System Power Switch
- *UP: ON*
- *DOWN: OFF*



Annunciators
- **Left Dust Protector (Particle Separator) ON**
- **Right Dust Protector (Particle Separator) ON**

AI-9V APU (AUXILIARY POWER UNIT)

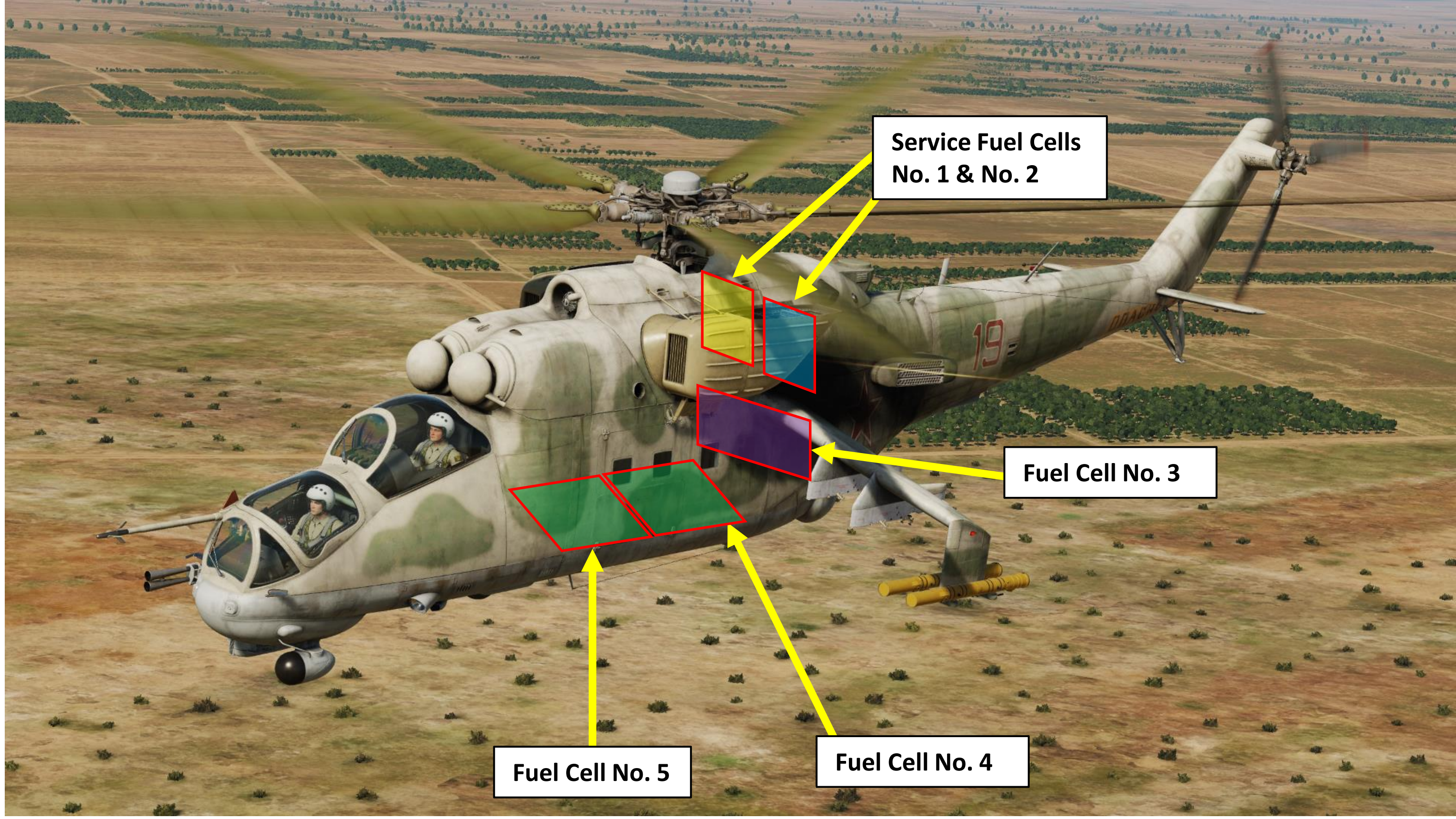
The Engine Start system requires pressurized bleed air to spool up the starter. The AI-9V Auxiliary Power Unit (APU) is basically a smaller engine that provides this air pressure for the engine starter. It also provides electrical power if required for ground operations where the engine generators are OFF.



FUEL SYSTEM

The engine fuel system supplies and controls the fuel flow to the combustion chamber, controls the inlet and compressor variable guide vanes and air discharge valves, and shuts down the engine in the event of power turbine overspeed.

The fuel components mounted on the engine include the fuel control, fuel nozzle/manifold assembly, fuel boost pump, fuel/drain valve, filters, and an emergency fuel shutoff valve. The aircraft fuel system supplies fuel to the input of the fuel boost pump. The fuel boost pump increases the fuel pressure to the required level and feeds it to the main fuel filter.



Fuel Tank Capacity	
Service Fuel Cell 1	320 liters / 248 kg
Service Fuel Cell 2	320 liters / 248 kg
Fuel Cell 3	485 liters / 376 kg
Fuel Cell 4 (aft floor)	445 liters / 345 kg
Fuel Cell 5 (forward floor)	485 liters / 376 kg
TOTAL	2055 liters / 1593 kg

FUEL SYSTEM

During normal operation, the Fuel Quantity Content Selector is best set to TOTAL.

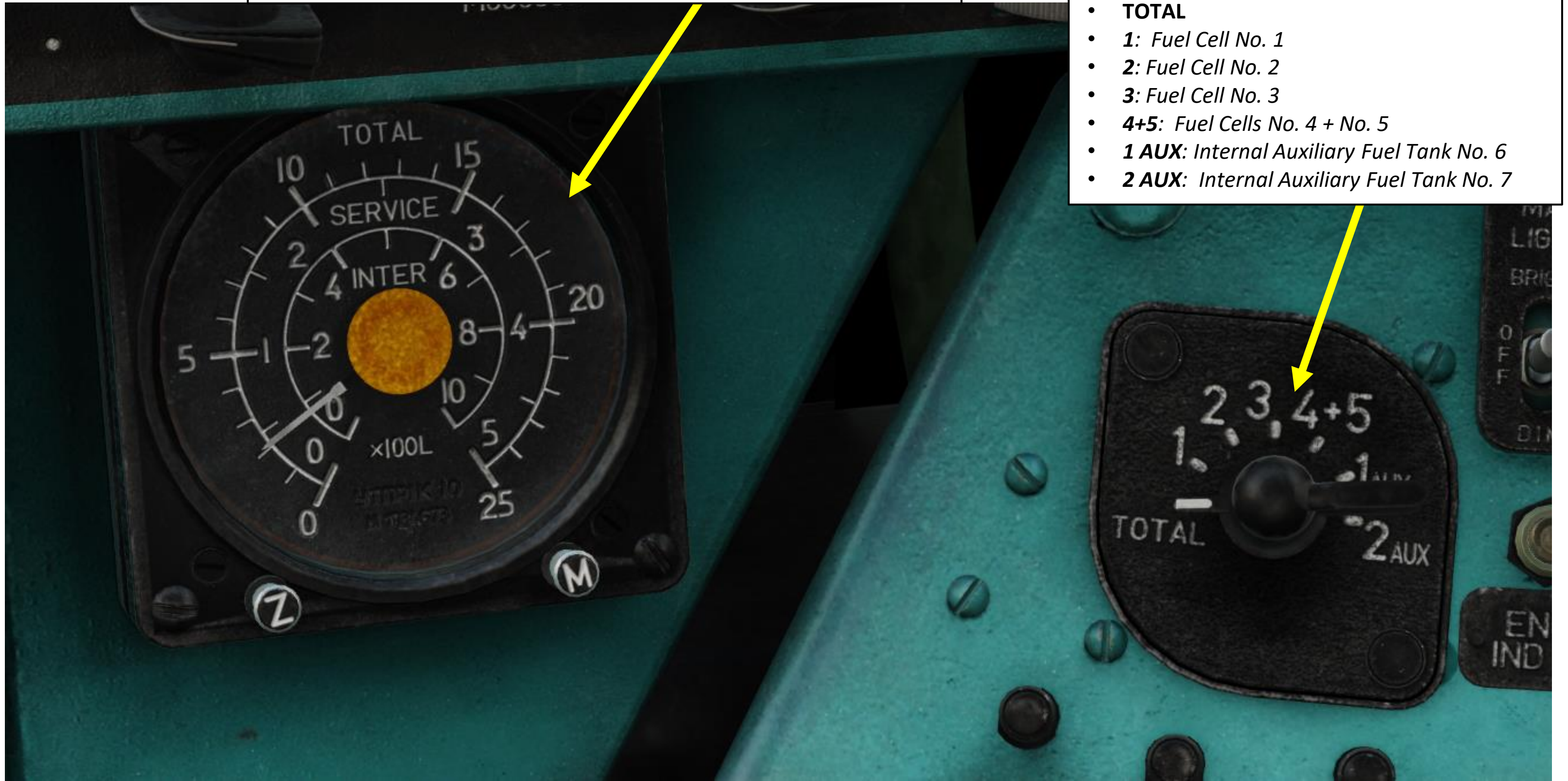
Fuel Tank Capacity	
Service Fuel Cell 1	320 liters / 248 kg
Service Fuel Cell 2	320 liters / 248 kg
Fuel Cell 3	485 liters / 376 kg
Fuel Cell 4 (aft floor)	445 liters / 345 kg
Fuel Cell 5 (forward floor)	485 liters / 376 kg
TOTAL	2055 liters / 1593 kg

Fuel Quantity Indicator (x100 L)

- ***External Outer Scale***: *Displays combined quantity of fuel in cells No. 1, 2, 3, 4 and 5 when selector is set to the TOTAL position.*
- ***External Inside Scale***: *Displays quantity of fuel in each cell individually when the selector is set to the 1, 2 or 3 position.*
- ***Inner Scale***:
    - *Selector to 4+5 position: Displays the combined fuel quantity in cells No. 4 and 5.*
    - *Selector to AUX 1: Displays fuel quantity in internal auxiliary tank No. 6*
    - *Selector to AUX 2: Displays fuel quantity in internal auxiliary tank No. 7*

Fuel Quantity Content Selector

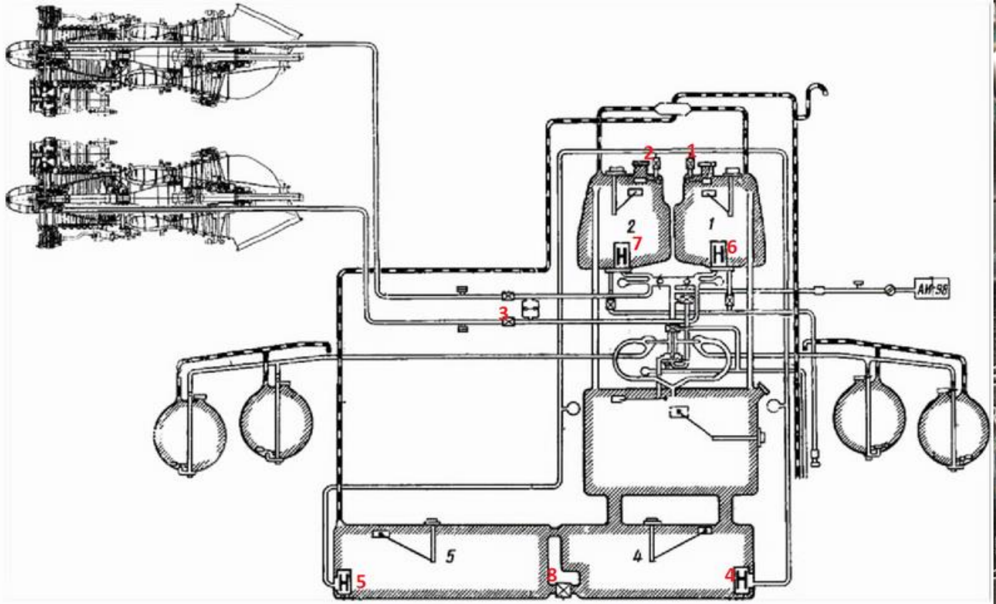
- **TOTAL**
- ***1***: *Fuel Cell No. 1*
- ***2***: *Fuel Cell No. 2*
- ***3***: *Fuel Cell No. 3*
- ***4+5***: *Fuel Cells No. 4 + No. 5*
- ***1 AUX***: *Internal Auxiliary Fuel Tank No. 6*
- ***2 AUX***: *Internal Auxiliary Fuel Tank No. 7*

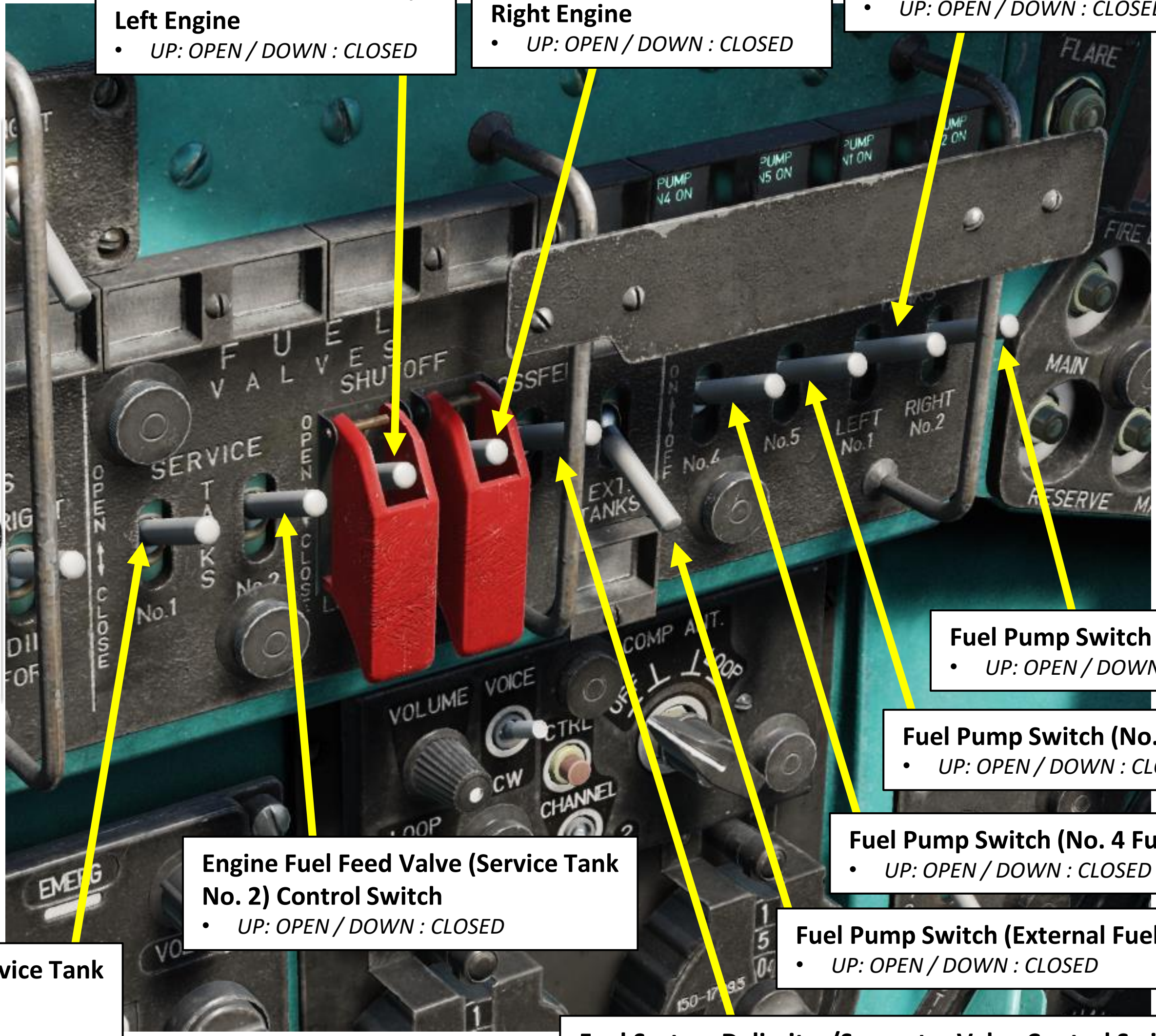


Fuel Cell No. 1 – 120 Liters Remaining Annunciator	Fuel Cell No. 2 – 120 Liters Remaining Annunciator

FUEL SYSTEM

Here is an overview of the Fuel Pump and Shutoff Valve switches.



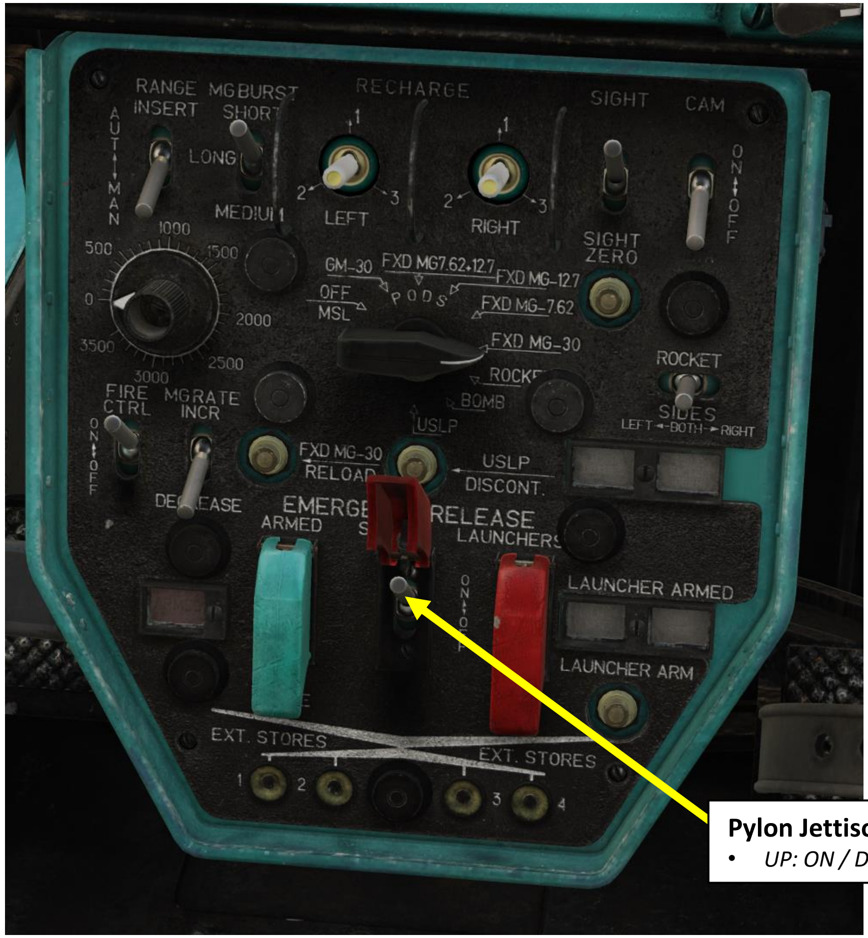


FUEL SYSTEM

The Mi-24 can have up to four **PTB-450 External Fuel Tanks** (**450 Liters** each, approx. 350 kg) installed under Pylons 1, 2, 3 and 4. Take note that the Fuel Quantity Indicator does not display the fuel quantity within the external tanks.

To consume fuel from external tanks, set **Fuel Pump Switch for the External Fuel Tanks** – OPEN (UP).

To jettison external fuel tanks, set **Pylon Jettison Switch** – UP (JETTISON).



Pylon Jettison Switch
- *UP: ON / DOWN: OFF*

PTB-450 External Tanks (450 L each)

Fuel Pump Switch (External Fuel Tanks)
- *UP: OPEN / DOWN : CLOSED*

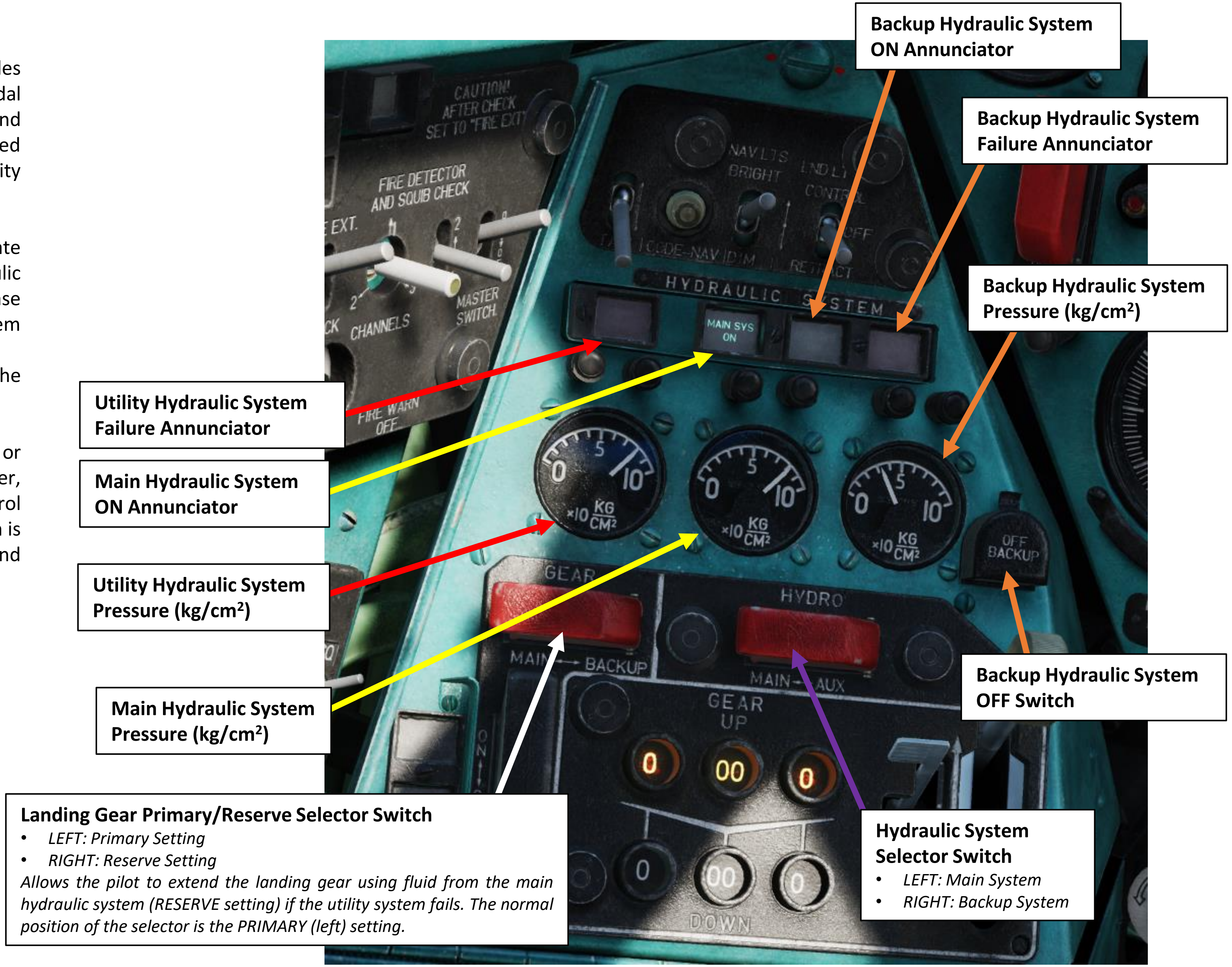
HYDRAULIC SYSTEM

The **Main hydraulic system** is used by default and provides hydraulic power to the cyclic, collective and anti-torque pedal controls. It also powers the collective lever clutch release, and the autopilot's switching valves. Also, the main system is used to retract or extend the landing gear in case of a utility hydraulic system failure.

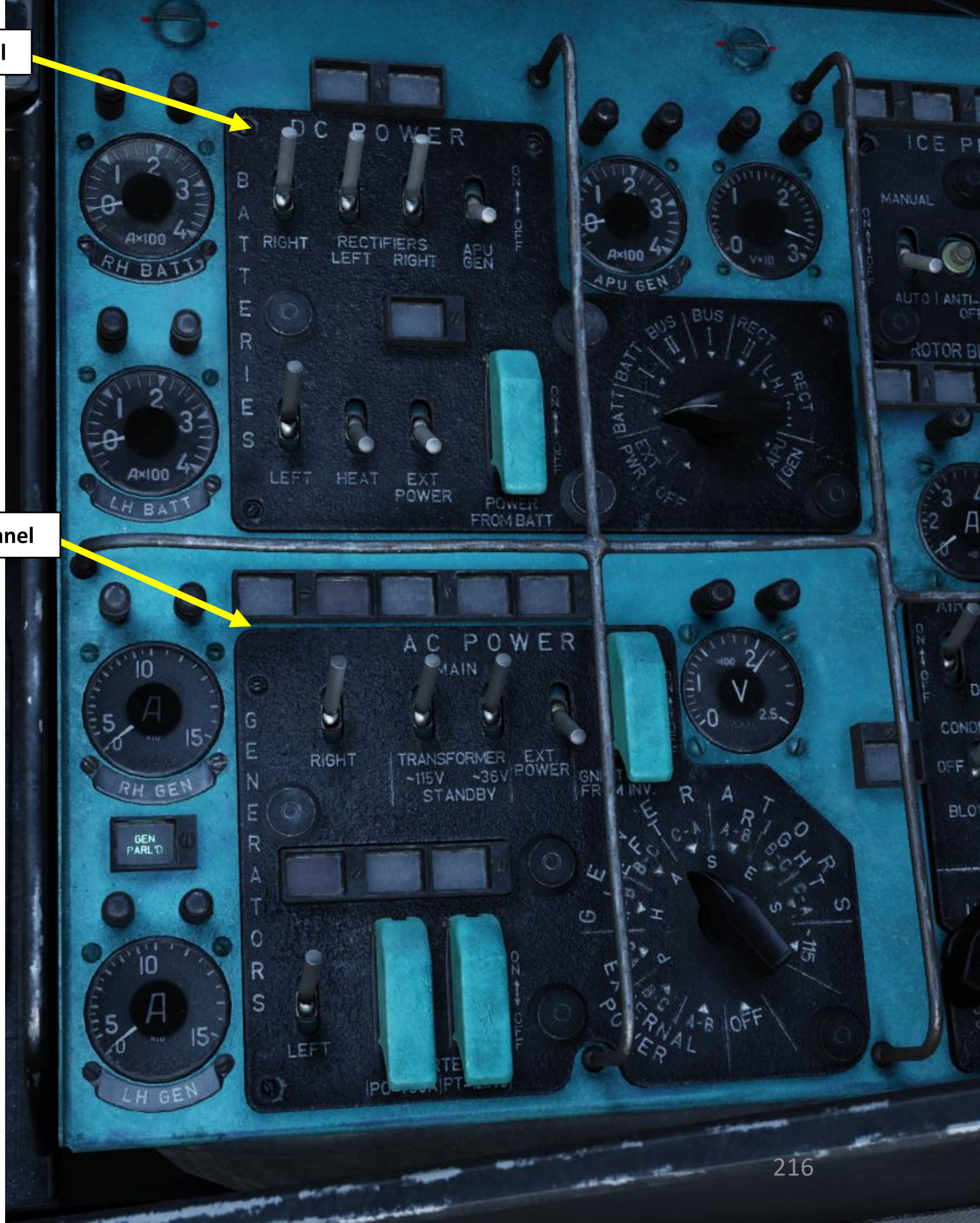
The **Backup (Standby) hydraulic system** is used to duplicate components and lines for all functions of the main hydraulic system functions (except the collective clutch release). In case of a main hydraulic system failure, the hydraulic backup system is atomatically powered and engaged.

- Take note that the backup hydraulic system can't extend the landing gear.

The **Utility hydraulic system**'s primary function is to retract or extend the landing gear, power the hydraulic pedal damper, engage and release of the Co-Pilot/Gunner's cyclic, and control of the missile guidance instrument hatches. The utility system is independent from the main and backup hydraulic systems and has its own separate hydraulic block and accumulator.



ELECTRICAL SYSTEM

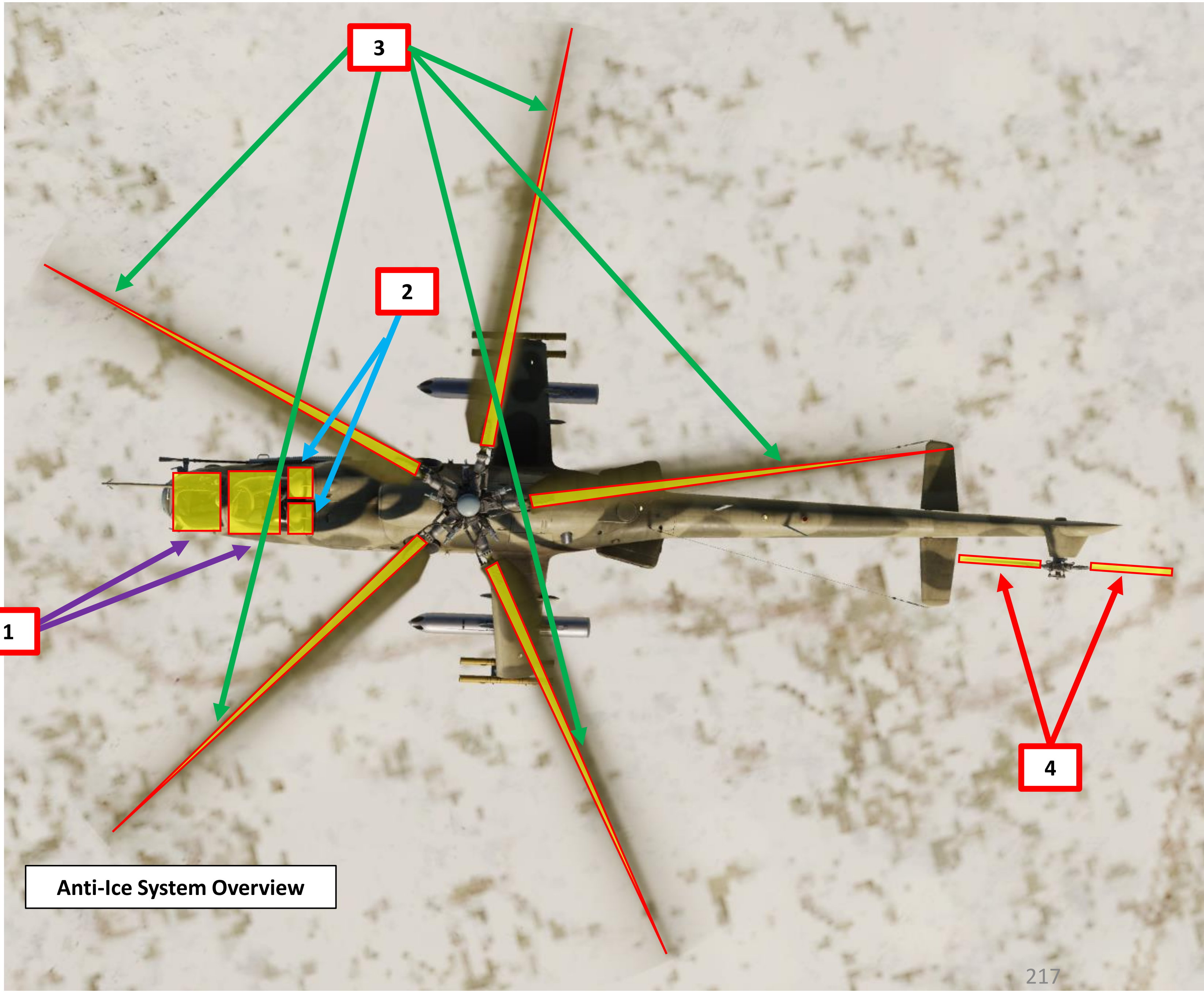


ANTI-ICE SYSTEM OVERVIEW

Icing conditions have a critical impact on four main areas of a helicopter:

- Front windshields of the cockpit (loss of visibility)
- Engine Inlet (loss of power)
- Main Rotor & Tail Rotor Blades (loss of lift)
- Pitot Tubes (loss of air pressure sensors)

Flying in icing conditions requires both a robust **ice detection system** and a reliable **anti-ice system**.



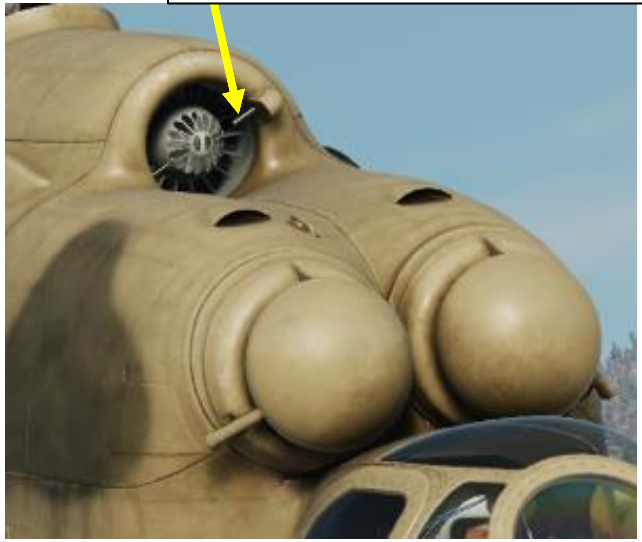
Anti-Ice System Overview

1. **Heated Cockpit Windshields**
2. **Heated parts of air intakes (including Particle Separator System and engine inlets)**
3. **Heated parts of Main Rotor Blades**
4. **Heated Parts of Tail Rotor Blades**

ANTI-ICE SYSTEM
ICE DETECTION

For detection of icing, warning about helicopter structures icing and automatic energizing of anti-icing system, the Mi-24 is equipped with a radio-isotopic ice detector (RIO-3). The detecting unit of the ice detector is installed in the fan's air intake duct. Operation of the ice detection system is based on the variation in conductivity of electric circuit section, which is energized by radio-isotope beta-ray emission.

Radio-isotopic Ice Detector



ANTI-ICE SYSTEM
PARTICLE SEPARATOR SYSTEM INTEGRATION

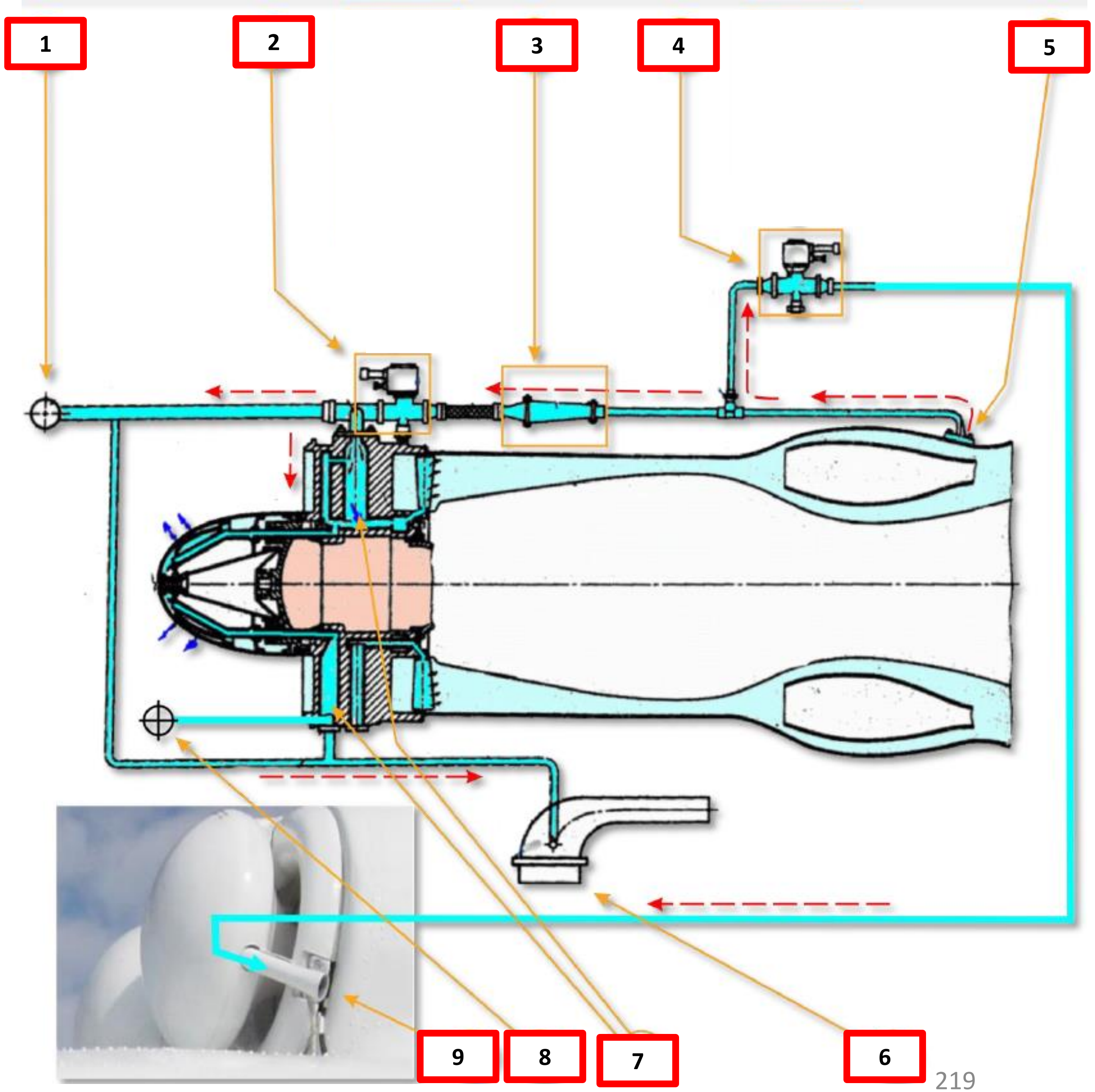
The air inlet of the PSS (Particle Separator System) anti-icing system combines two types of anti-icing:

- Hot Bleed Air (from combustor cooling loop)
- Electrical Heating

Note: Engine inlets are heated by bleed air only.

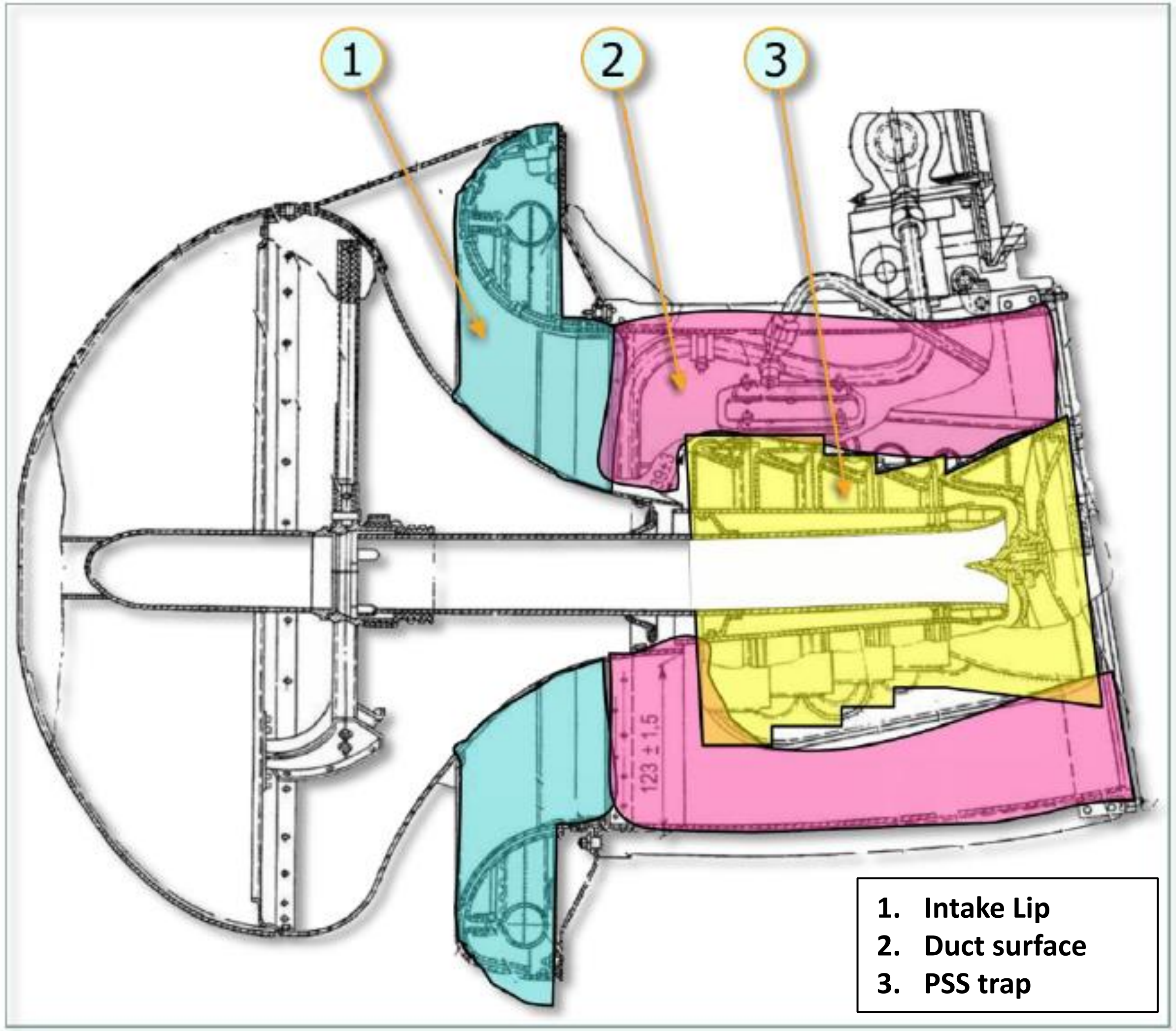
1. Anti-Ice System of air intake (intake lip)
2. Electric shutter, opens hot air flow for anti-ice system needs
3. Temperature regulator
4. Electric shutter, opens hot air flow to PSS ejector for vacuum creation
5. Fitting for bleed air from engine combustor cooling loop
6. Heating of governor pump thermal compensator air receiver (for correct operation of governor's system)
7. Heated parts of inlet guide vane (vertical and horizontal supports)
8. Bleed air for PSS trap heating
9. PSS ejector

Diagram of Hot Air Bleed for PSS and Engines' Inlets anti-ice system and for PSS Needs

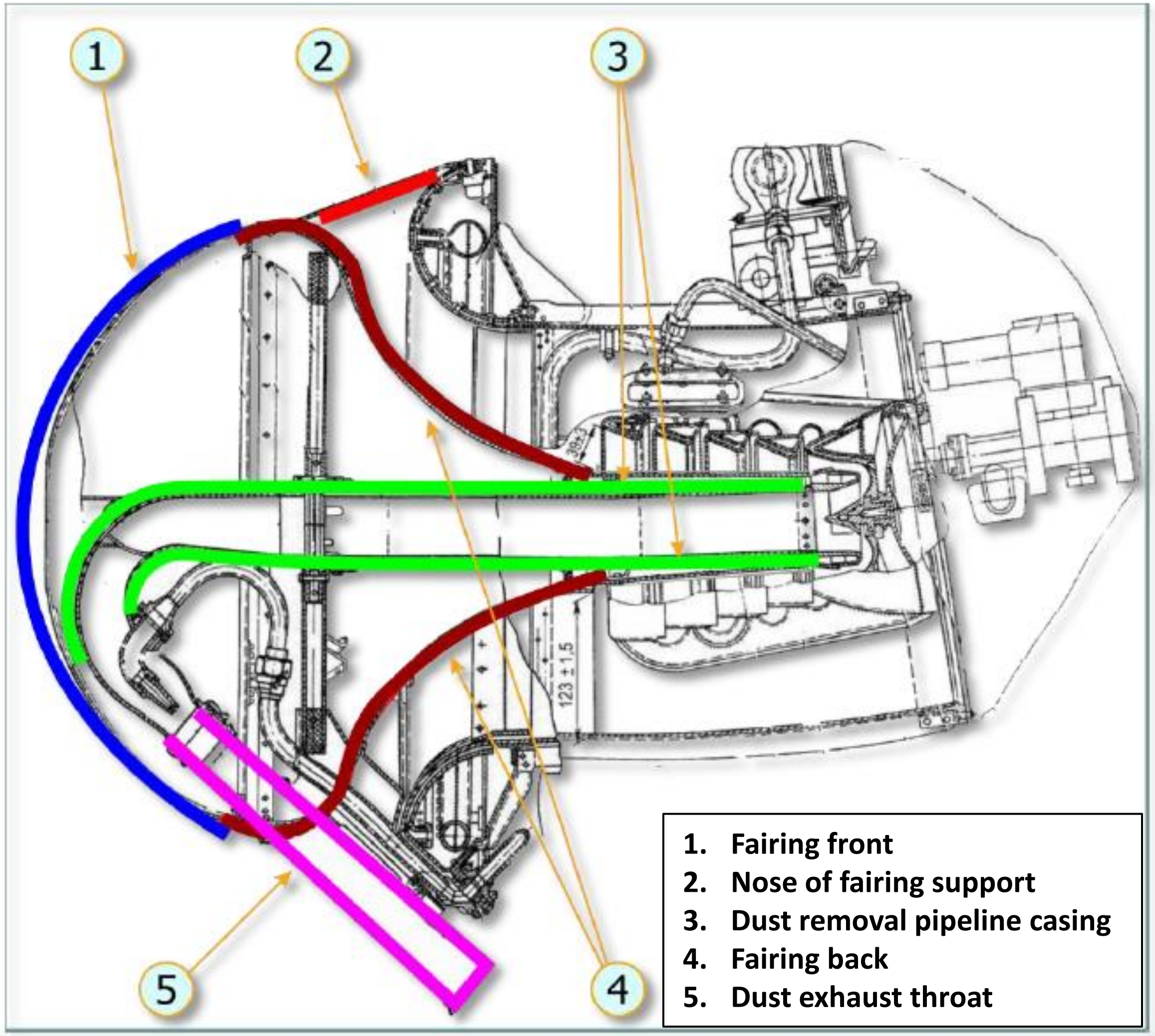


ANTI-ICE SYSTEM
BLEED AIR & ELECTRICAL HEATING COMPONENTS

Particle Separator System parts heated by hot bleed air



Particle Separator System parts heated by electrical heating elements



ANTI-ICE SYSTEM
ROTOR ANTI-ICE

Blades of the main rotor and tail rotor are heated by electrical heating elements powered by AC voltage.

- The Main Rotor heating element comprises four sections The Tail Rotor heating element comprises two sections

Sections are energized in cycles. In one cycle:

- The cyclic timer activates heating of every section of the main rotor blades (for 13 sec each, in turn) and tail rotor blades (for 25 sec each, in turn).
- The cycle is repeated until pilot turns off the anti-ice system or, under AUTO control mode, the ice formation sensor does not signal ice accretion anymore.

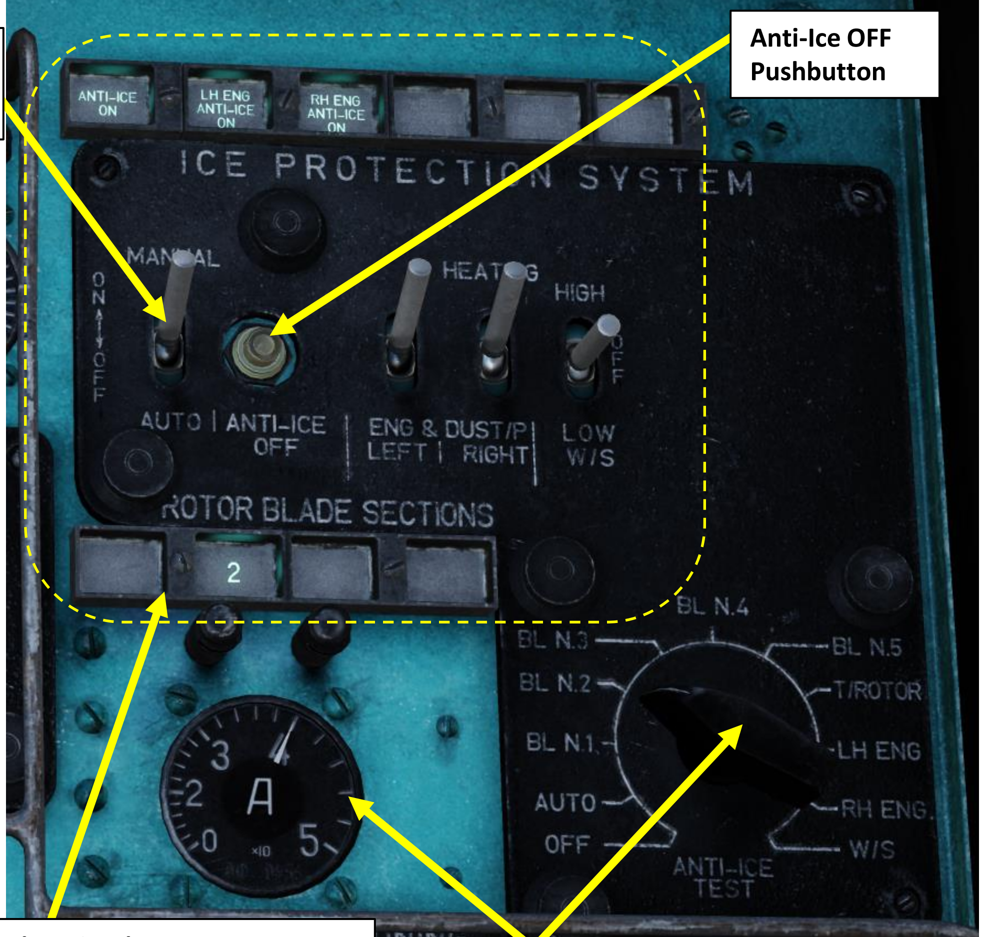
The Anti-Ice System can operate in either MANUAL or AUTOMATIC Mode, as per the **Anti-Ice System Mode Switch position**. When in AUTO mode, you turn off the anti-ice system by pressing the **Anti-Ice OFF Pushbutton**.

- Note: To turn on the anti-ice system it is actually required to flip this switch to the MANUAL position (ON) once to "turn on" the system, before putting it back to AUTO (OFF).

Anti-Ice System Mode Switch

- *UP: Manual*
- *DOWN: Auto*

Anti-Ice OFF Pushbutton



Anti-Ice Section Test Annunciators

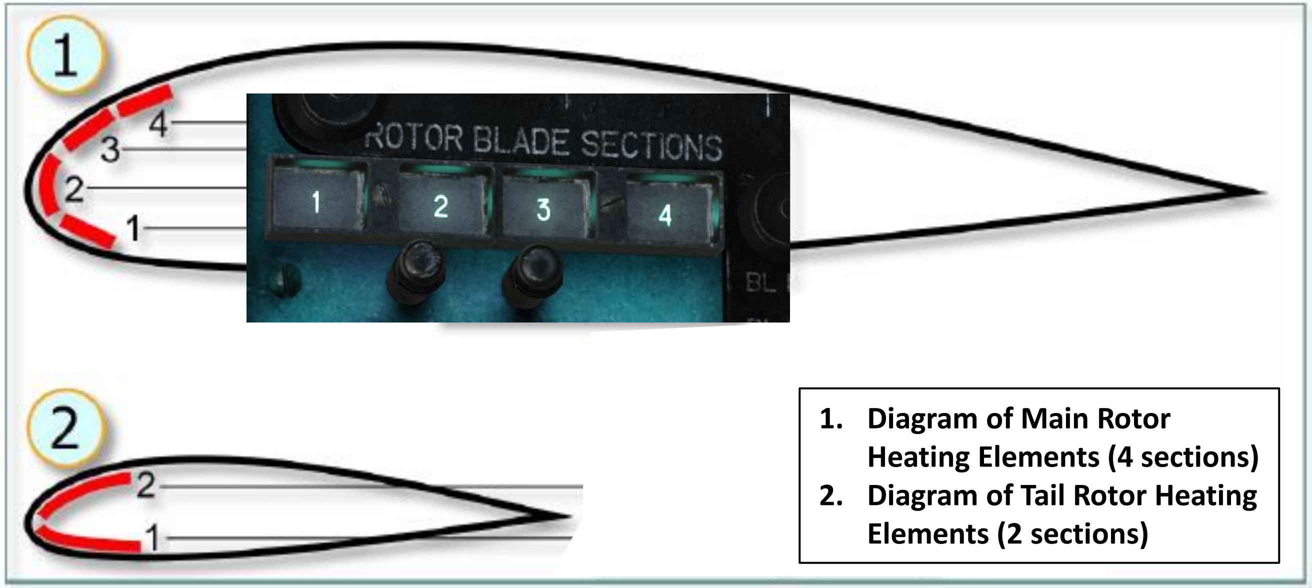
Indicates the section of the main rotor blade Anti-Icing system being tested.

- *Section 1*
- *Section 2*
- *Section 3*
- *Section 4*

Anti-Ice System Consumers Current Selector

Allows you to monitor main rotor blade heating element currents (sections I-2-3-4-5) and tail rotor blade heating elements currents.

Main & Tail Rotor Blades Anti-Ice System.
Diagram of Heating Elements Location Relative to Blade Profile

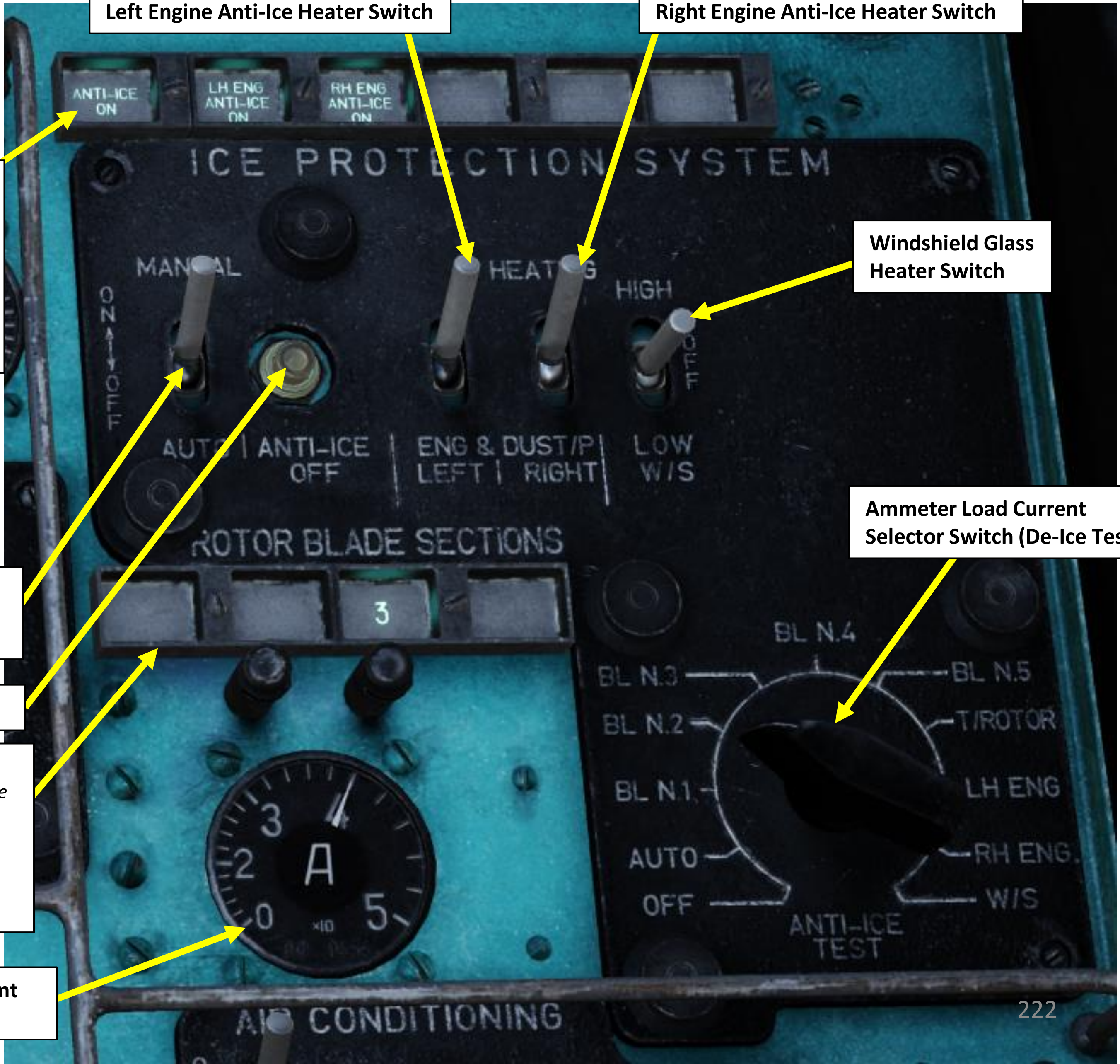


1. **Diagram of Main Rotor Heating Elements (4 sections)**
2. **Diagram of Tail Rotor Heating Elements (2 sections)**

ANTI-ICE SYSTEM
ROTOR ANTI-ICE

Keep in mind that the anti-ice system consumes engine bleed air, which **reduces available engine power** by a significant margin. In other words, the anti-ice system should be used sparingly in order to keep as much power available during flight.

Annunciators
- **Anti-Ice ON**
- **Left Engine Anti-Ice ON**
- **Right Engine Anti-Ice ON**
- **Left Dust Protector (Particle Separator) ON**
- **Right Dust Protector (Particle Separator) ON**
- **Ice Detector Heater ON**



Left Engine Anti-Ice Heater Switch

Right Engine Anti-Ice Heater Switch

Windshield Glass Heater Switch

Ammeter Load Current Selector Switch (De-Ice Test)

Anti-Ice System Mode Switch
- *UP: Manual*
- *DOWN: Auto*

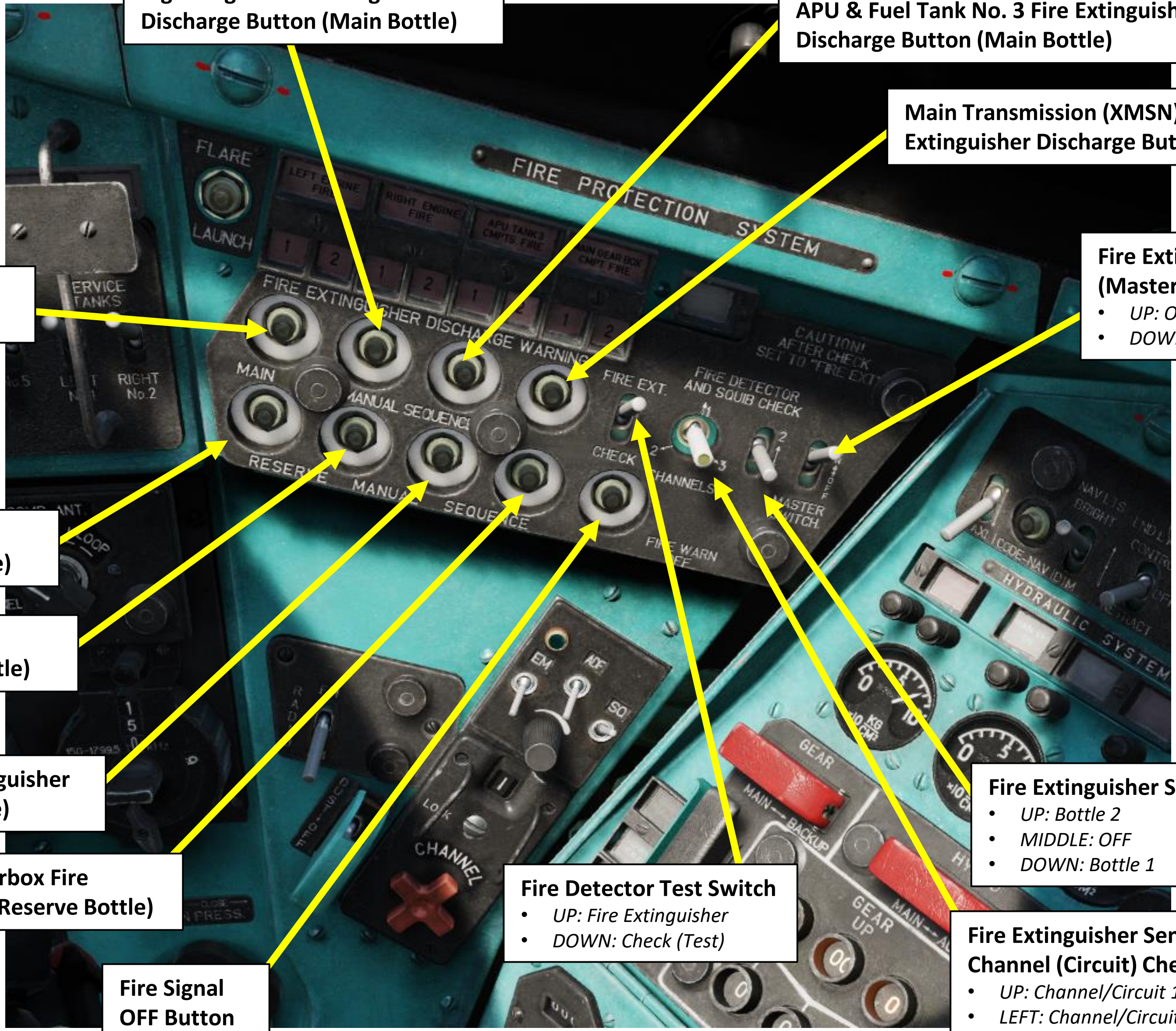
Anti-Ice OFF Pushbutton

Anti-Ice Section Test Annunciators
Indicates the section of the main rotor blade Anti-Icing system being tested.
- *Section 1*
- *Section 2*
- *Section 3*
- *Section 4*

Ammeter Load Current (x100 Amperes)

FIRE PROTECTION SYSTEM
GENERAL DESCRIPTION

As you fly in hostile territory, you may end up with an on-board fire. However, a fire detection, indication and extinguishing system can help you stay in the air even if a fire catches aboard the ship.

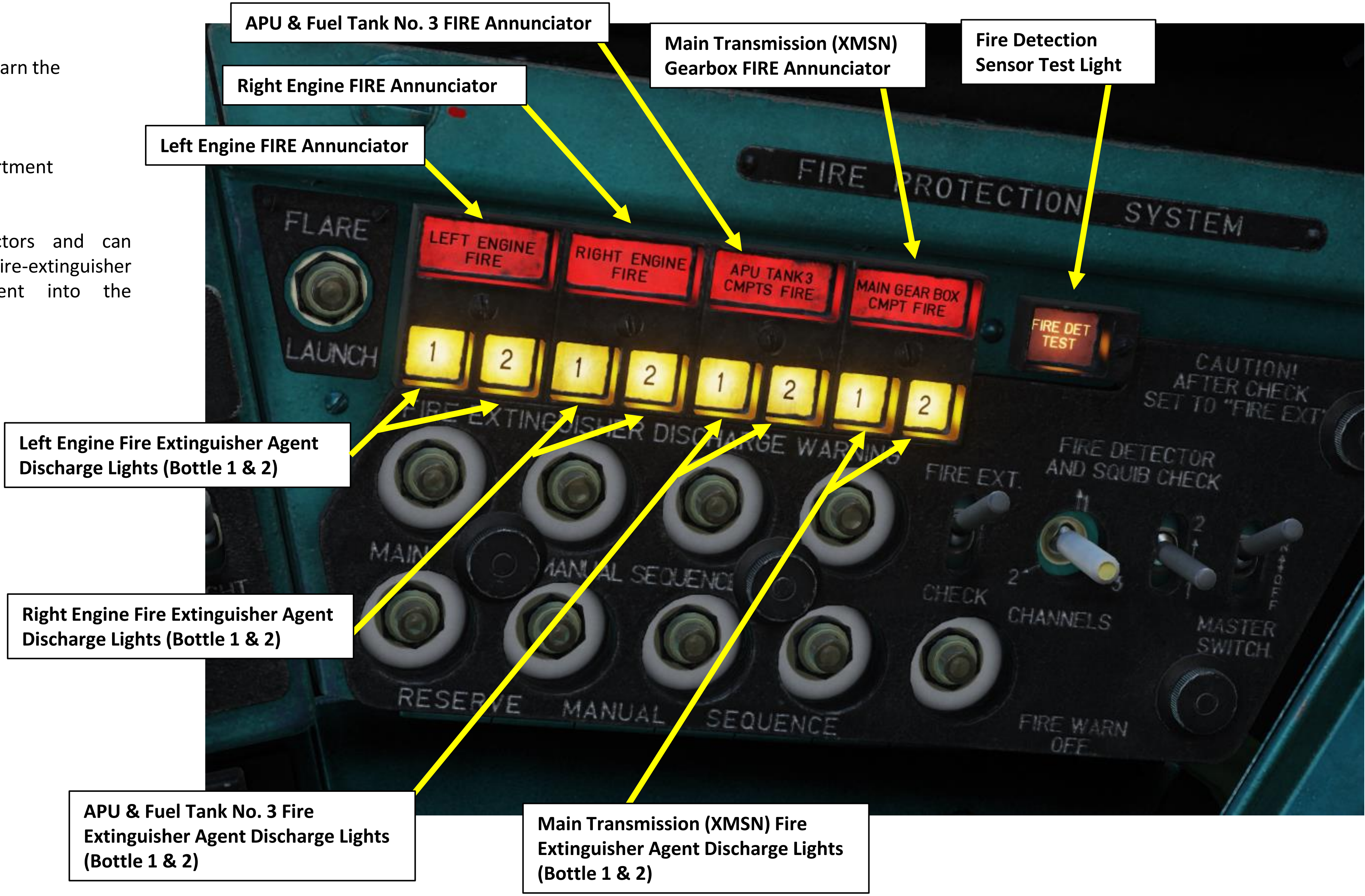


FIRE PROTECTION SYSTEM
GENERAL DESCRIPTION

The fire detection system is designed to warn the pilot of a fire in either:

- The engine compartment
- The transmission compartment
- The APU (Auxiliary Power Unit) compartment
- Fuel cell No. 3

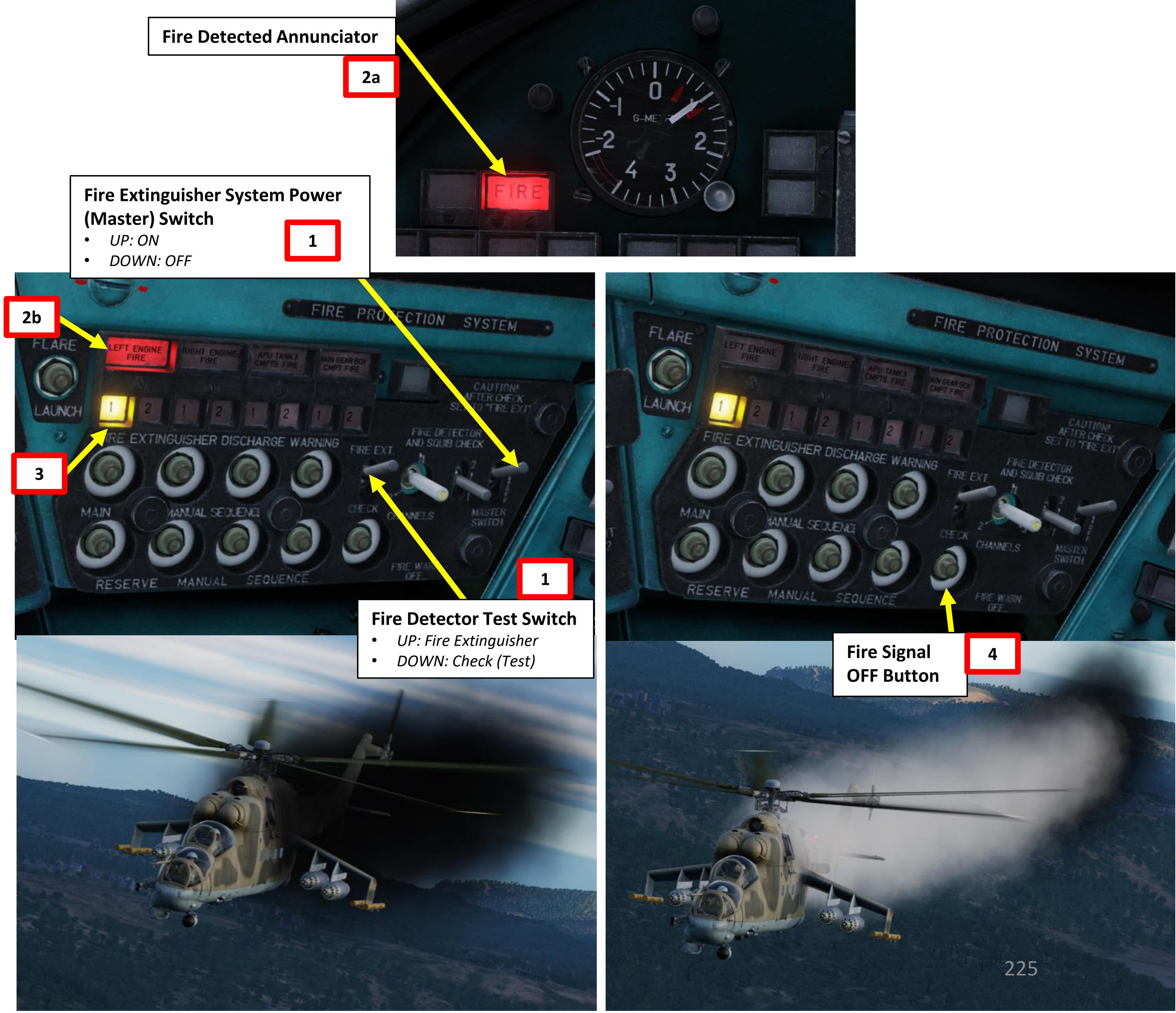
The system includes 36 heat detectors and can automatically detonate the squibs in the fire-extinguisher heads to release extinguishing agent into the compartment in which the fire is burning.



FIRE PROTECTION SYSTEM OPERATION

In this example, a fire breaks out in the Left Engine Compartment.

1. To arm the Fire Extinguisher System, set the Fire Extinguisher System Power (Master) Switch ON (UP) and set the Fire Detector Test Switch to FIRE EXT (UP).
2. When the fire is detected:
   a) The “FIRE” annunciator illuminates
   b) The lamp associated location of the fire illuminates (“LEFT ENGINE FIRE”)
   c) An aural voice warning is audible.
3. The first available squib of the MAIN bottle will automatically detonate when a heat increase is detected, releasing extinguishing agent.
4. When fire is extinguished, shut down the affected engine and press the FIRE SIGNAL OFF button to manually reset fire protection system.



AERODYNAMICS

The Mi-24 is a peculiar helicopter when it comes to aerodynamics. Its asymmetrical design is pretty uncommon among helicopters. The reason for this asymmetry is that the shape of the Hind has aerodynamic behaviours that are desirable in combat speeds (180 km/h to 270km/h), meaning that the Mi-24 flies exactly where you point it. This is very useful for weapon employment and dive attacks, which require very little correction.

The two “wings” that carry weapon pylons are also peculiar; at high speeds, these wings generate a significant amount of lift, which can either be used to go faster or to reduce the engine power required to maintain the current attitude.

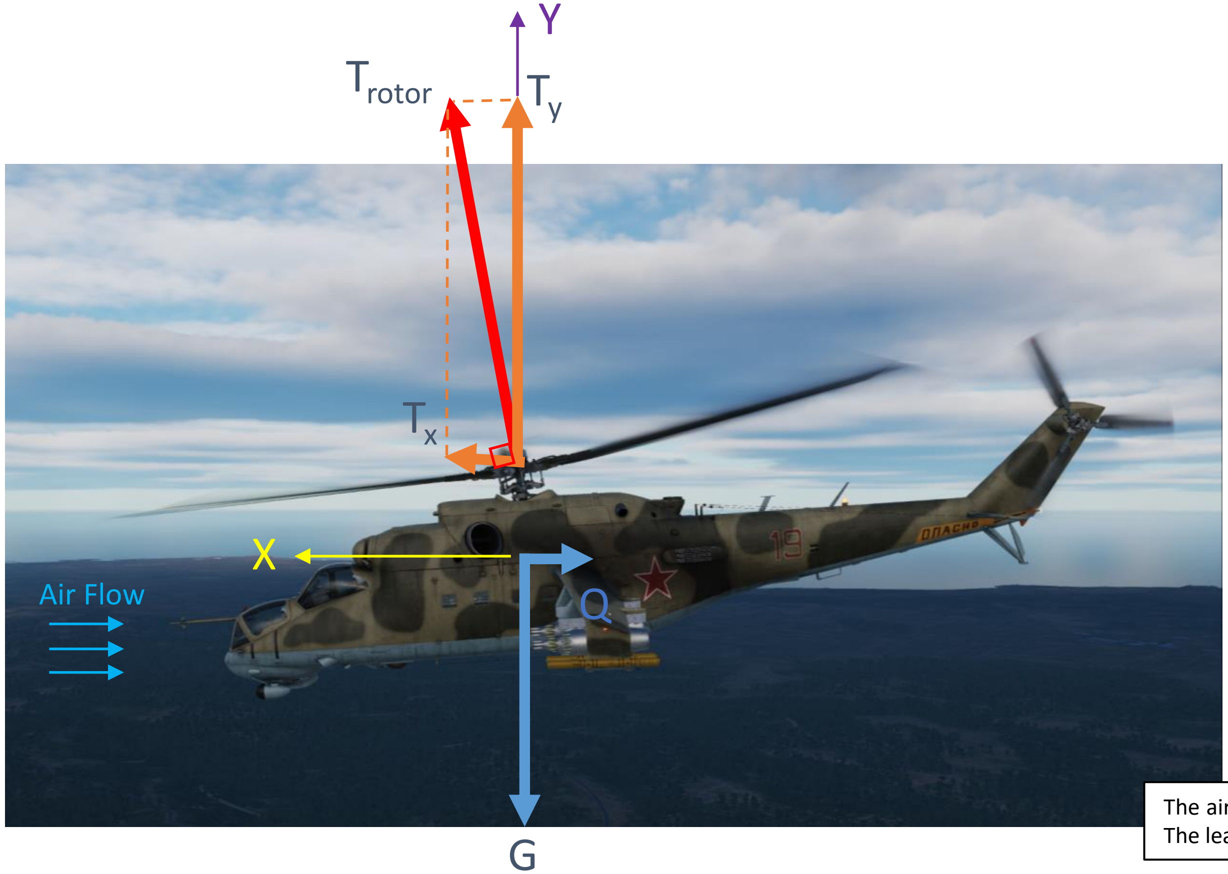
FORCES: TORQUE, TRANSLATIONAL & VERTICAL LIFT

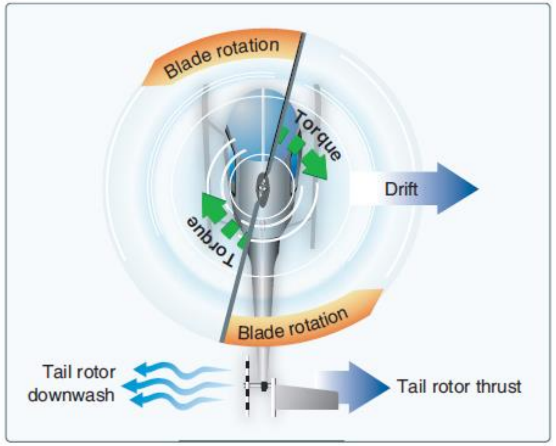
IN A NUTSHELL…

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.

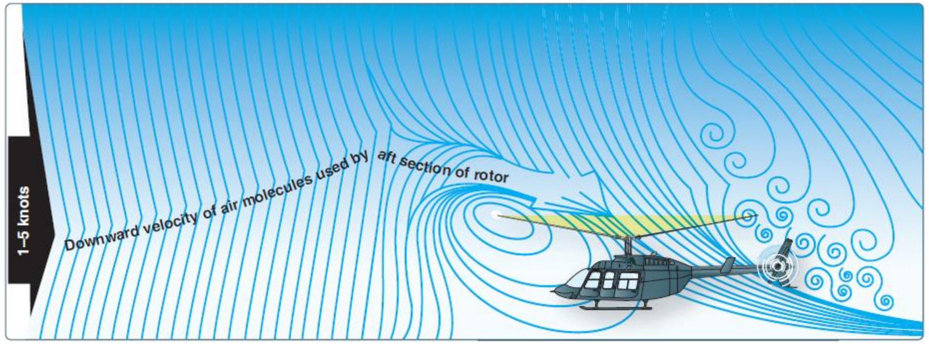
You might also wonder why you need to apply right pedal when you are hovering. This is simply to counter the **torque** created by the main rotor blades' rotation in the yaw axis. In a prop airplane, the torque will force you to use pedal on takeoff to stay straight. The same principle applies for a helicopter, but in a different axis.

Translating tendency is a left lateral movement of the helicopter that is a combination of tail rotor thrust and main rotor torque; translating tendency is countered with right cyclic.

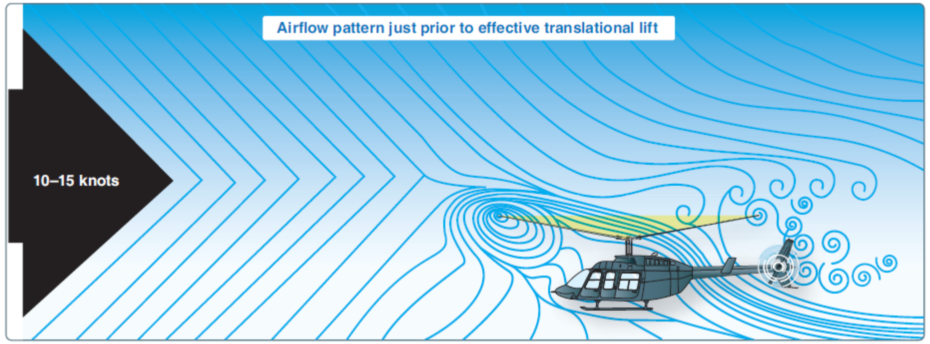




A tail rotor is designed to produce thrust in a direction opposite torque. The thrust produced by the tail rotor is sufficient to move the helicopter laterally.



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.



The airflow pattern for 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.

GYROSCOPIC PRECESSION

IN A NUTSHELL…

The spinning main rotor of a helicopter acts like a gyroscope. What we call "**gyroscopic precession**" is the resultant action or deflection of a spinning object when a force is applied to this object. This action occurs 90 degrees in the direction of rotation from the point where the force is applied, like on a rotating blade.

Now, what does this mean and why should you care about such mumbo jumbo? This means that if you want to push your nose down, you push your cyclic forward. What happens in reality is that pilot control input is mechanically offset 90 degrees "later", as shown on the pictures below.

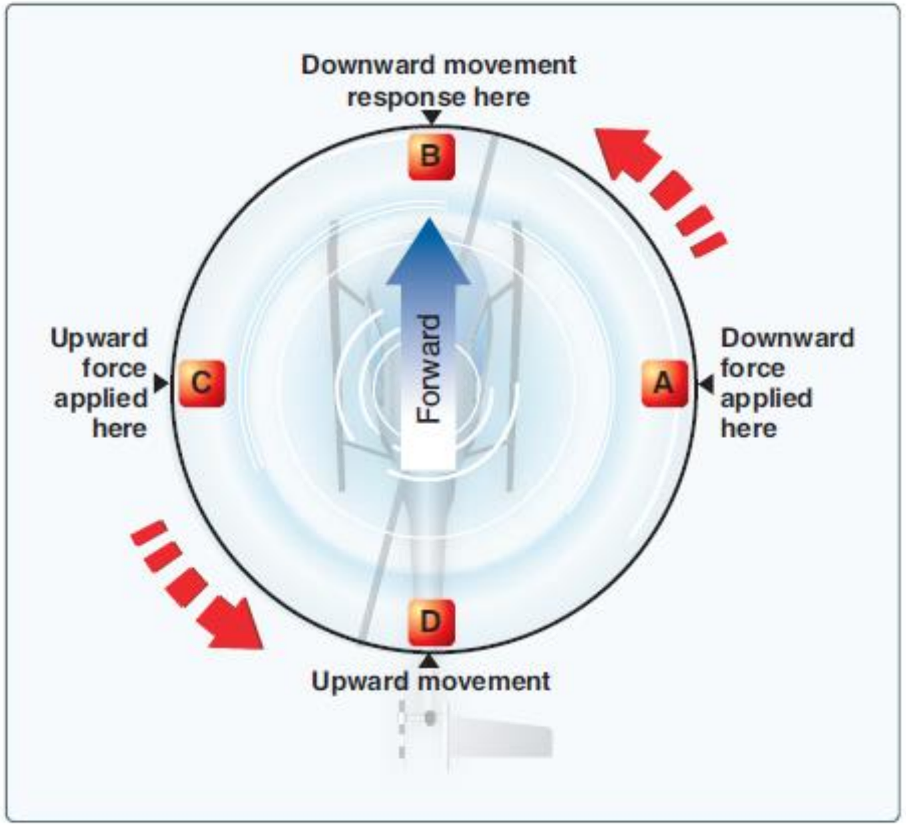


Figure 2-28. *Gyroscopic precession.*

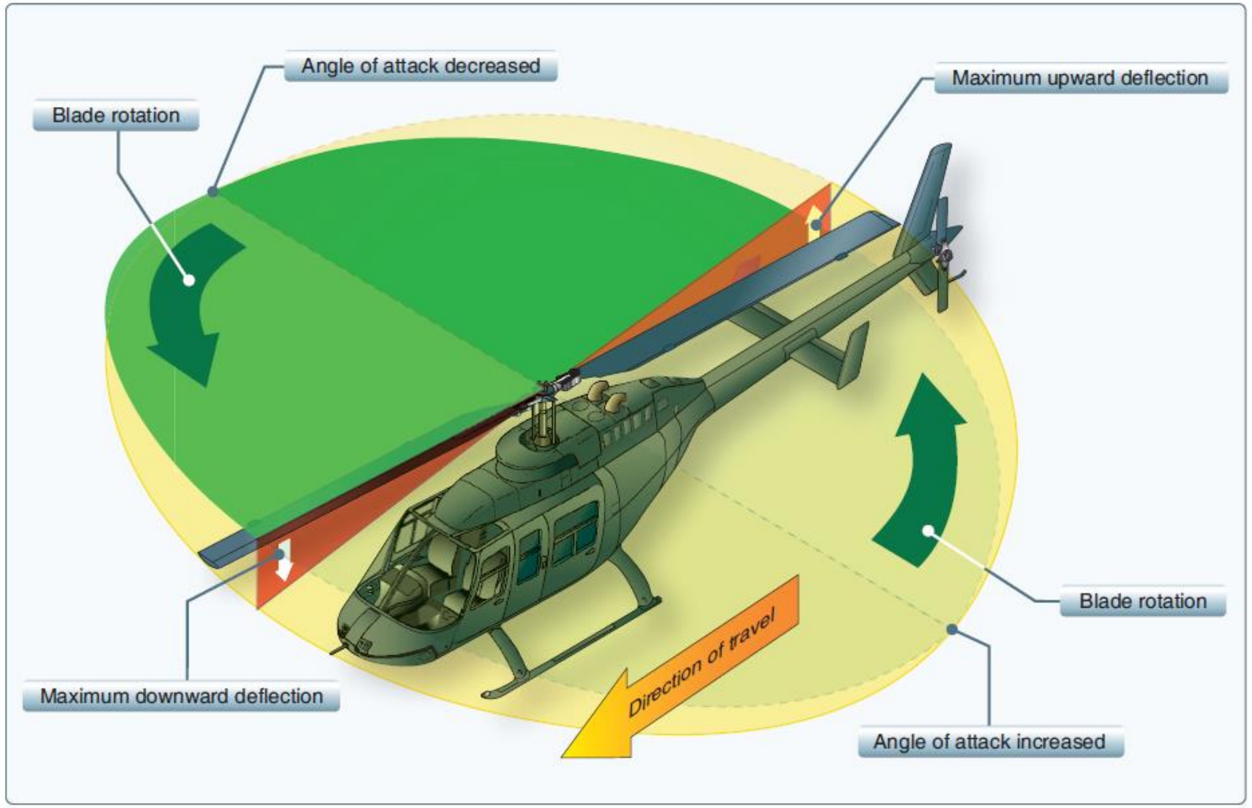


Figure 2-29. *As each blade passes the 90° position on the left in a counterclockwise main rotor blade rotation, the maximum increase in angle of incidence occurs. As each blade passes the 90° position to the right, the maximum decrease in angle of incidence occurs. Maximum deflection takes place 90° later—maximum upward deflection at the rear and maximum downward deflection at the front—and the tip-path plane tips forward.*

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.

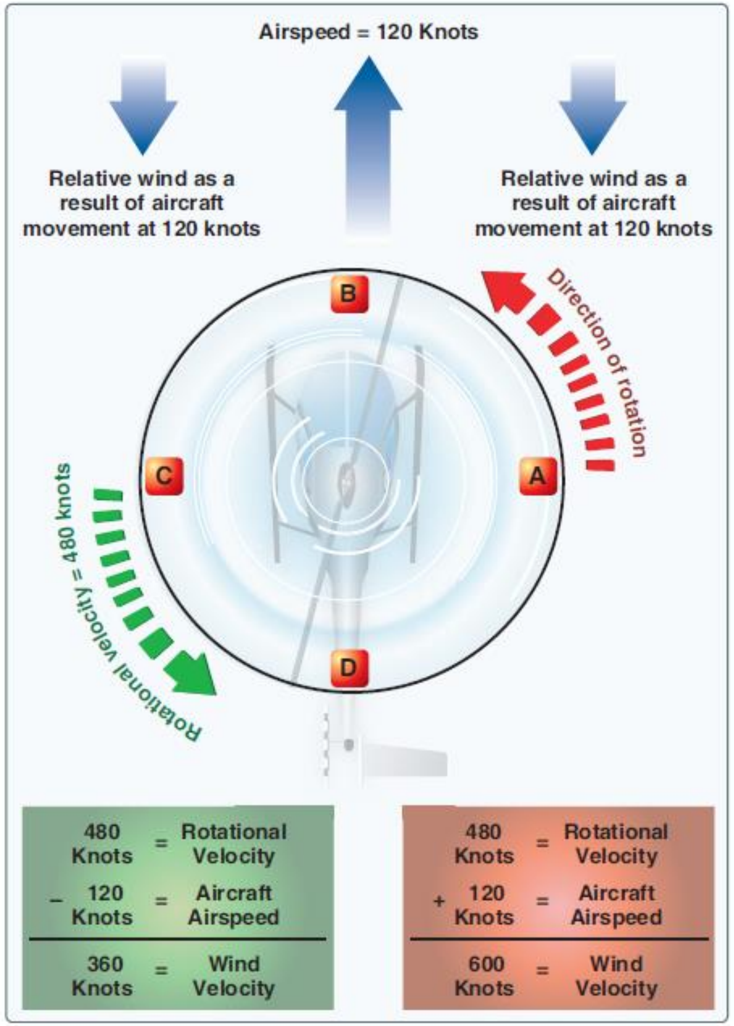


Figure 2-33. *Airflow in forward flight.*

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.

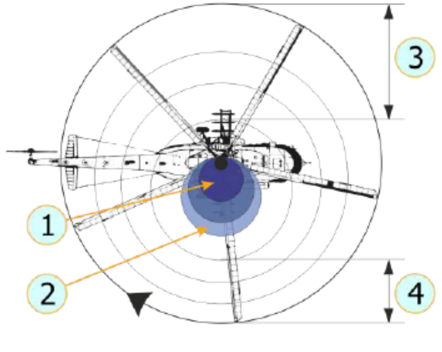


Fig. 9.11. Normal cruise lift pattern:

1 – reverse airflow area; 2 – no lift area; 3 – lift produced in this area requires low blade angle of attack; 4 – lift produced in this area requires greater blade angle of attack (lift must equal that of zone 3).

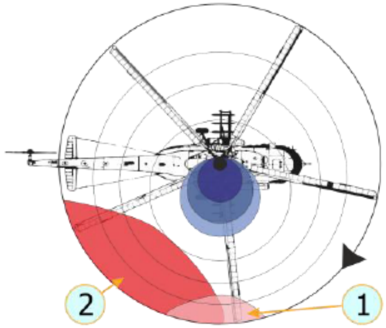


Fig. 9.12. Lift pattern at critical airspeed:

1 – area of blade tip stall, causes vibration and buffeting; 2 – if blade angle of attack continues to remain high, stall area increases. The helicopter pitches up and rolls right (stalling).

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.

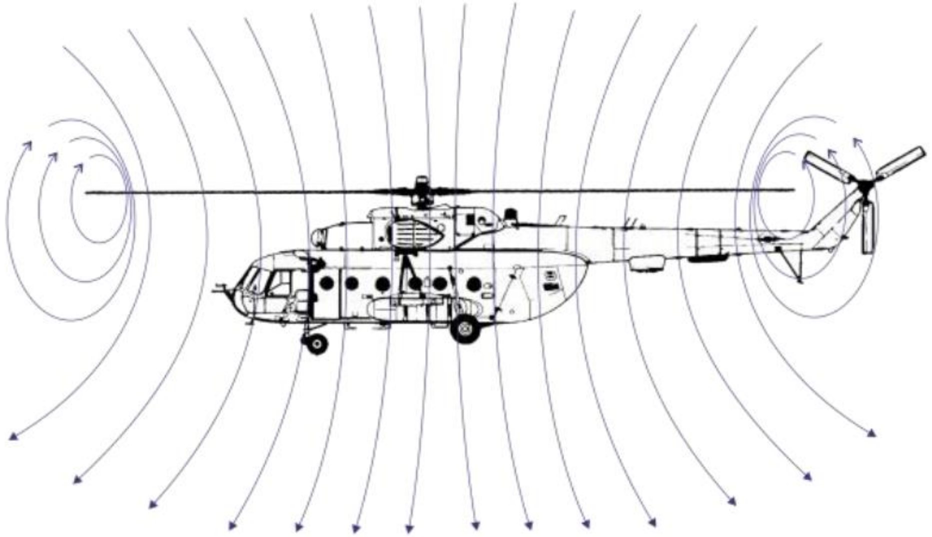
Maximum ground effect is achieved when hovering over smooth hard surfaces. When hovering over surfaces as tall grass, trees, bushes, rough terrain, and water, maximum ground effect is reduced. Rotor efficiency is increased by ground effect to a height of about one rotor diameter (measured from the ground 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).



**Airflow when Out of Ground Effect (OGE)
(Mi-8)**

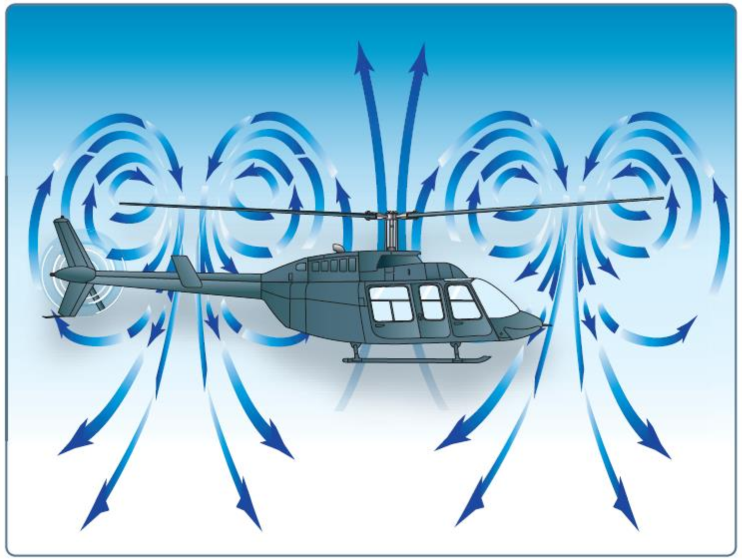
**Airflow when In Ground Effect (IGE)
(Mi-8)**

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.



Vortex Ring State

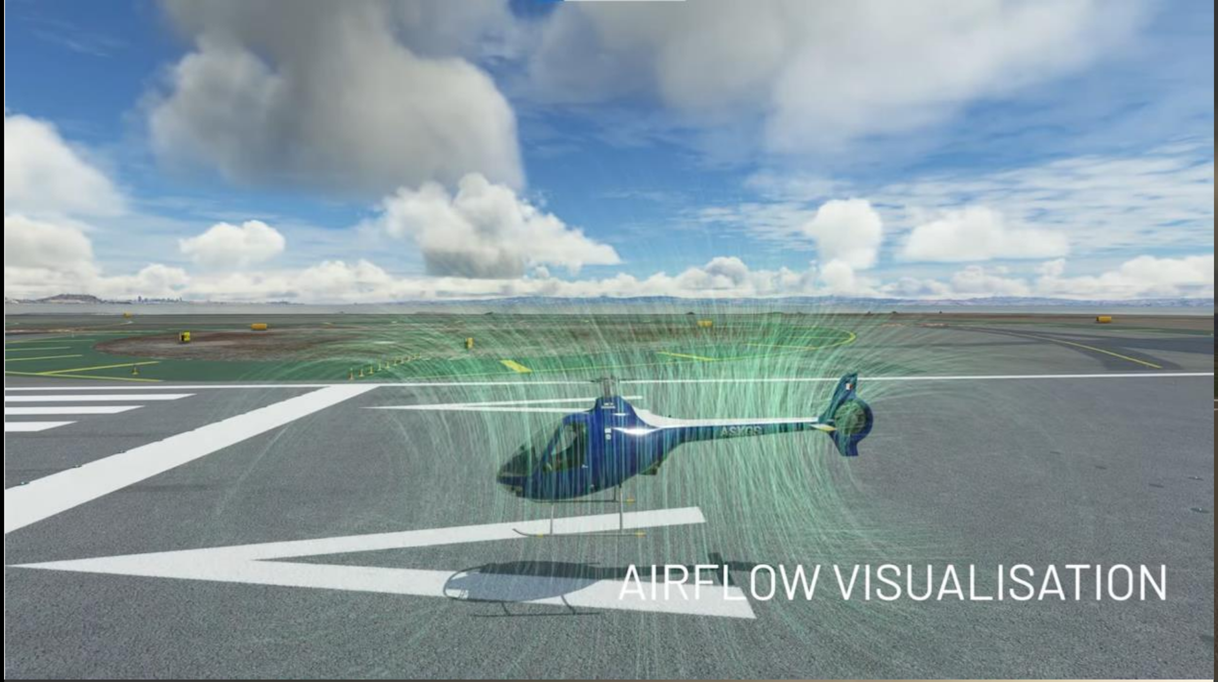
WHY SHOULD YOU CARE?

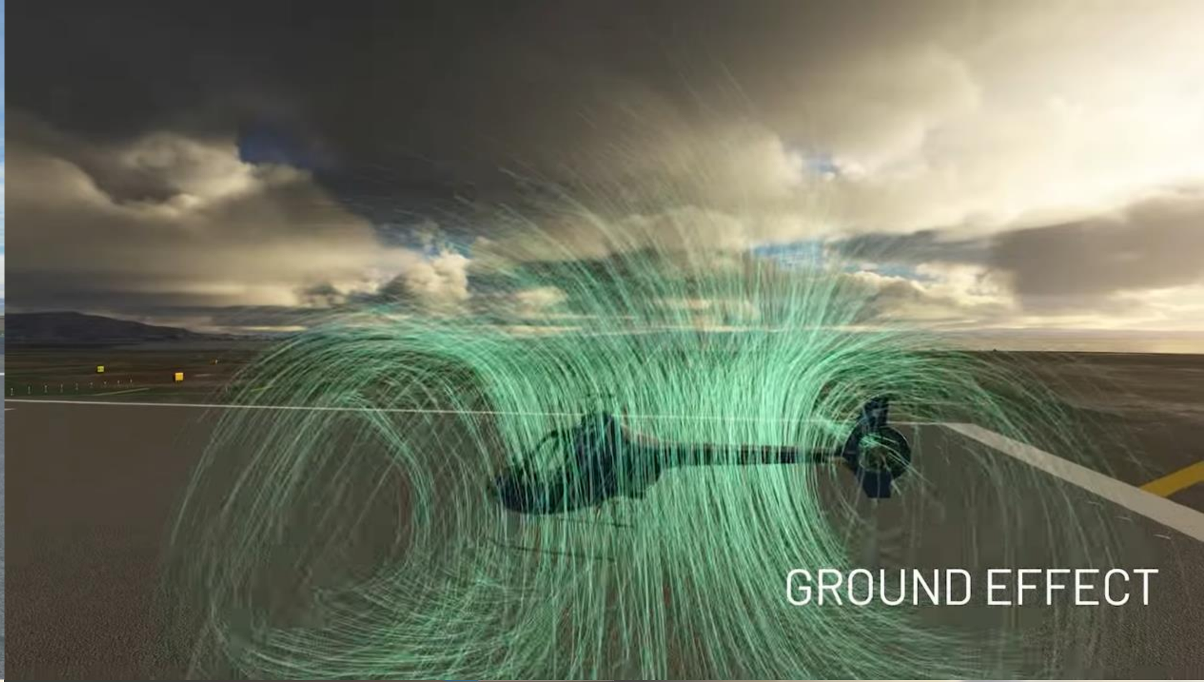
One of the biggest issues new pilots have is that they do not understand what VRS is, what it does, why it happens and how to counter it. In simple terms, if your airspeed is around 40 km/h (which is the speed at which VRS usually occurs), you will experience a sudden loss of lift that will cause you to drop like a rock. VRS also occurs in situations where you have a descent rate of 4 m/s or greater. 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.**

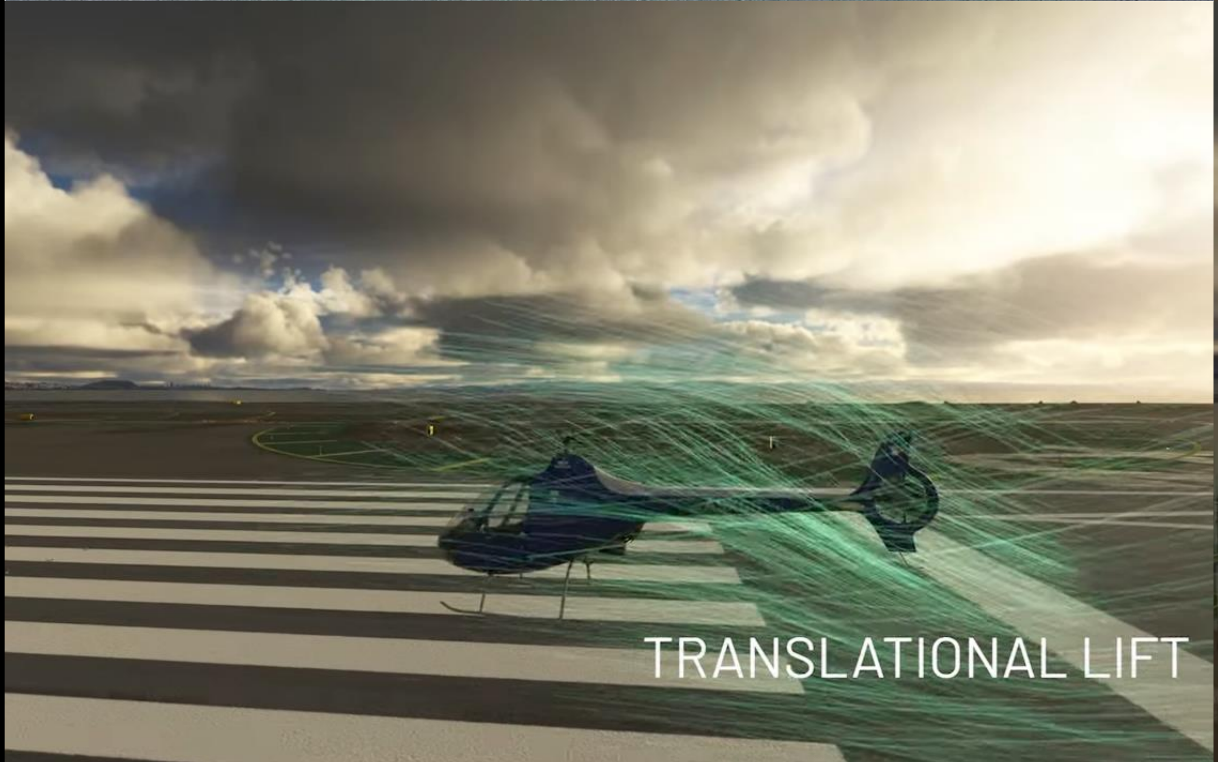
Oh, now I’ve got your attention? Good. One of the biggest problems Peter Pilots experience is to land their chopper. Even in real life, there are many pilots who do what we call a “hard landing” because they did not anticipate correctly the sudden loss of lift caused by VRS. A hard landing is when you impact the ground at a vertical speed that is too great, which causes structural damage to the landing gear, 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.

VRS: VERIFY DESCENT RATE & SPEED


AIRFLOW VISUALISATION


GROUND EFFECT

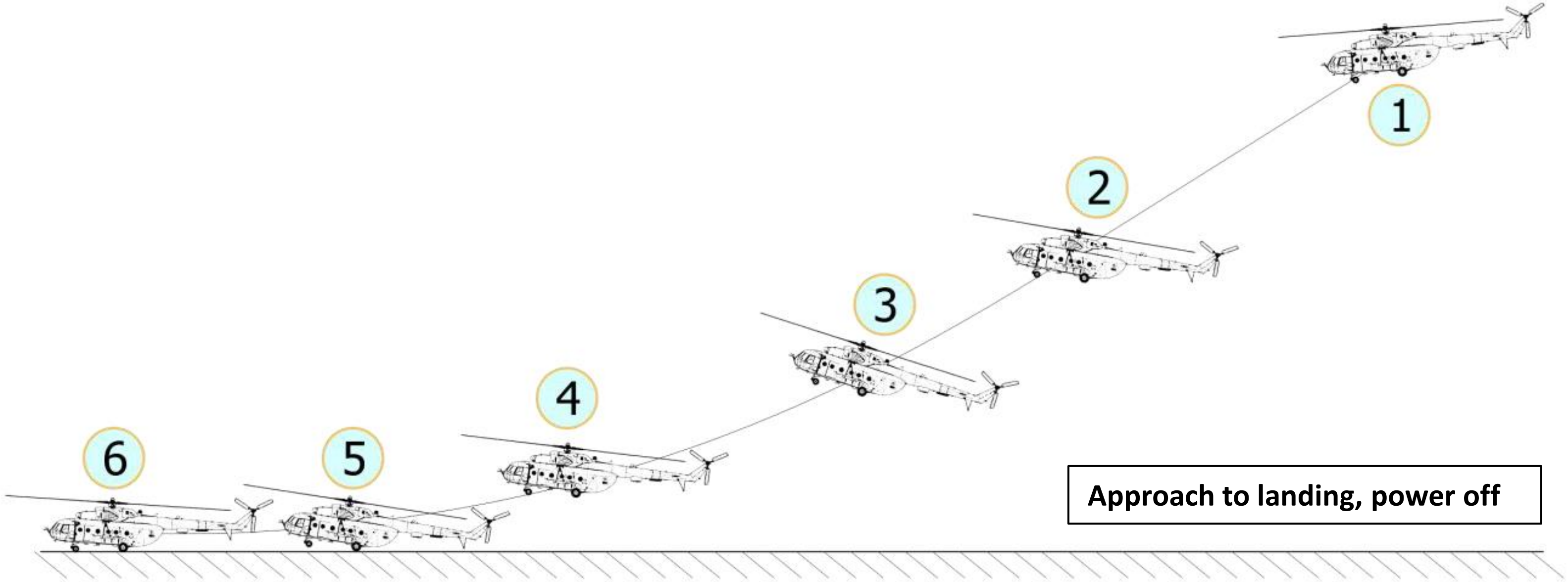

TRANSLATIONAL LIFT


RING VORTEX

PART 10 – AUTOROTATION

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, tail rotor failure or a sudden loss of tail rotor effectiveness.



1. *While descending, establish 120 km/h indicated airspeed with the cyclic and lower collective to maintain safe rotor RPM with collective (Main Rotor speed NR between 90-98 % RPM). Find a suitable place to land.*
    - *Extend Landing Gear*
    - *Jettison Pylon Ordnance as soon as possible*
    - *Turns are possible with 30 deg bank maximum above 80 km/h or 20 deg bank maximum below 80 km/h*
2. *At 40-50 m altitude, increase pitch to 20 degrees above horizon*
3. *At 10-15 m altitude, raise collective to reduce rate of descent. Airspeed should be between 60 and 80 km/h. This requires precise control and timing.*
4. *At 4-6 m altitude, set landing pitch attitude.*
5. *Landing*
6. *Short landing run to complete stop.*

Allowable Autorotation NR Range (% RPM): 90 – 98 %
Avoid NR transient overspeeds of 115 %
Avoid NR transient underspeeds of 85 %

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. 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. 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 1000 m or more.
2) Jettison weapons installed on pylons.
3) Extend Landing Gear.
4) Simulate engine loss of power by reducing throttle to IDLE (or using the Engine Stop Lever(s)).
5) Push TRIM RESET switch
6) Apply left anti-torque pedal to center the helicopter, lower collective and pull up cyclic to compensate for sudden RPM loss: make sure the power turbine reaches 90-98% RPM.
7) Adjust cyclic for a constant descent at 120 km/h
8) Maintain 90-98 % RPM and 120 km/h airspeed.
9) *RECOVERY MODE: TOUCHDOWN* (no power, continue descent and land)
    a) Once condition at step 8) is respected , continue descent and do not touch throttle.
    b) At 100 m AGL, apply aft cyclic to level out and decelerate to 70 km/h for a vertical landing or 100 km/h for a running landing. Descent rate should be around 5-8 m/s.
    c) At 10-15 m AGL, start flaring and raise collective with decision to cushion the landing: not too fast, not too slow. Keep in mind that you have wheels, not skids. This will be very helpful on landing. Tap your brake lever to slow down once you are on the ground.

Here is a video demonstration of a touchdown autorotation recovery by Commander Steinsch.
LINK: https://youtu.be/kLJ9ZNykvQw

Power-On Glide Airspeed Table
(Not Yet Available)

Main Rotor Autorotation Glide Airspeed Table
(Not Yet Available)

ROLE OF THE MI-24

The Mi-24 can act as both a troop transport or an attack helicopter, which is what it is primarily known for. This is a relatively unique design since at the time of its conception, the design engineers at the Mil Bureau wanted to create a helicopter suited to attack ground targets and support troops on the ground… but the soviet doctrine of the time forced the engineers to work with troop transport capability requirement as well. The solution resulting from this culminated in something that “could” carry troops in the cramped bay behind the Pilot-Commander… but in practice it was rarely used due to the performance penalty resulting from the extra weight.

In the Soviet-Afghan war, the Hind was mostly flown in pairs to either provide fire support, attack/suppress enemy positions, or escort more vulnerable helicopters like the Mi-8.

AIRSPEED & MANOEUVERING LIMITS

Airspeed Operating Limits

- V_{NE} (Do Not Exceed Speed), Gross weight 24700 lbs (11200 kg) or less – 335 km/h
- V_{NE} (Do Not Exceed Speed), Gross weight above 24700 lbs (11200 kg)– 315 km/h
- V_{TE} (Max Turbulence Penetration Speed): 200 km/h
- V_{Y} (Best Rate of Climb Speed): 130 – 140 km/h
- V_{YSE} (Best Single Engine Rate of Climb Speed): 130 km/h
- V_{LE} (Max Speed with Landing Gear Extended): 160 km/h
- Single Engine Approach Speed: 100 – 120 km/h
- Roll On Touchdown Speed: 35 – 50 km/h
- Maximum Touchdown Speed: 80 km/h
- Maximum Braking Speed: 50 km/h

Prohibited Manoeuvers

- Do not taxi rearward
- Do not perform hovering turns exceeding 18 deg per second (or 360 deg within 20 sec)
- Do not perform aerodynamic braking (pitching up the helicopter) during roll-on landings once aircraft nose gear is on the groud and collective is reduced
- Do not engage AFCS ALTITUDE HOLD mode while the Co-Pilot’s flight controls are engaged.
- Do not change main rotor speed using the N2 Trim switch or throttle while executing a dive, a zoom climb, a chandelle, performing a climbing or diving turn, or performing accelerated turns or spirals
- Do not use Force Trim button on recovery from a dive; this can potentially cause abnormal vertical Gs

Bank Angle Limits

- Maximum Bank Angle Allowable: 45 deg
- At gross weights above 25350 lbs (11500 kg), do not exceed a bank angle of 30 deg

Manoeuvering Limits

- When flying at 295 km/h or faster, do not allow slip indicator bubble to shift to the left more than 2 bubble diameters. This can send the helicopter into an unrecoverable attitude.
- When performing a vertical manoeuver, avoid sudden or large application of the cyclic longitudinally. This can lead the main rotor blades to clip the tail boom.

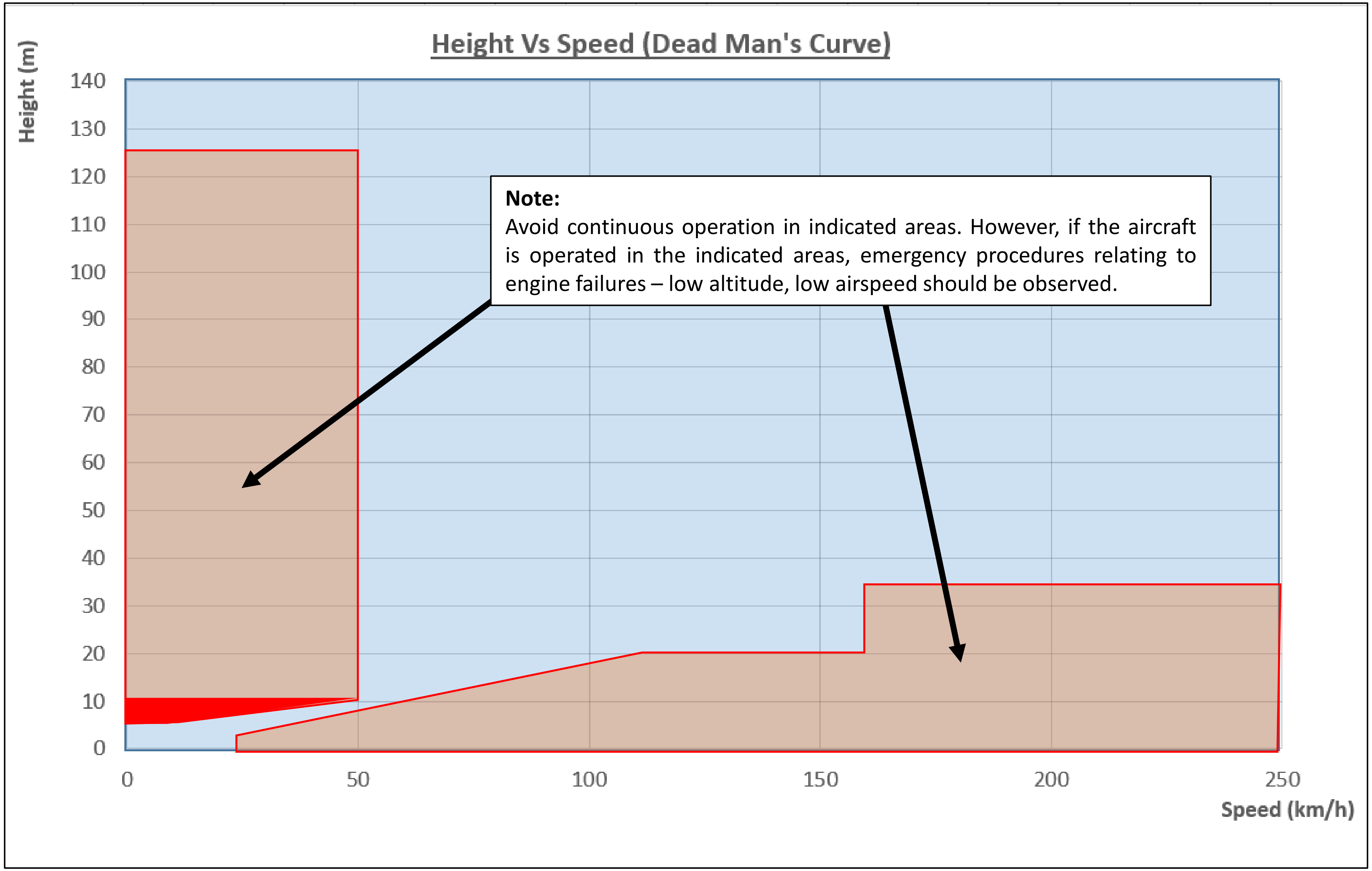
Landing Limits

- Do not exceed maximum touchdown sink rate of 1.5 m/s on level terrain.
- Do not exceed maximum forward touchdown speed of 80 km/h.

Failing to respect manoeuvering limits may trigger the **LIMIT MANEUVER** annunciator.

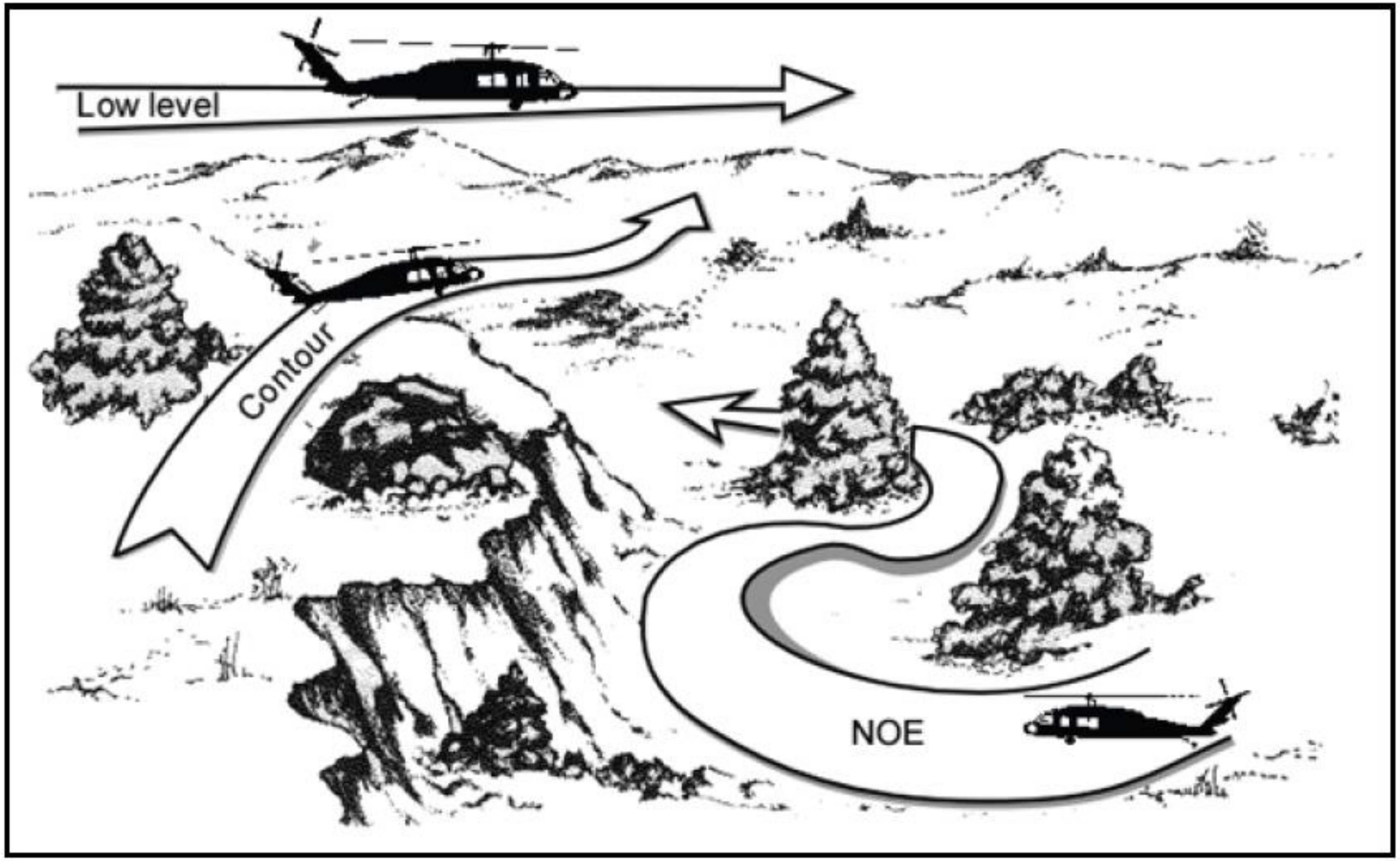
FLIGHT ENVELOPE: HEIGHT VS SPEED & "DEAD MAN'S CURVE"

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.

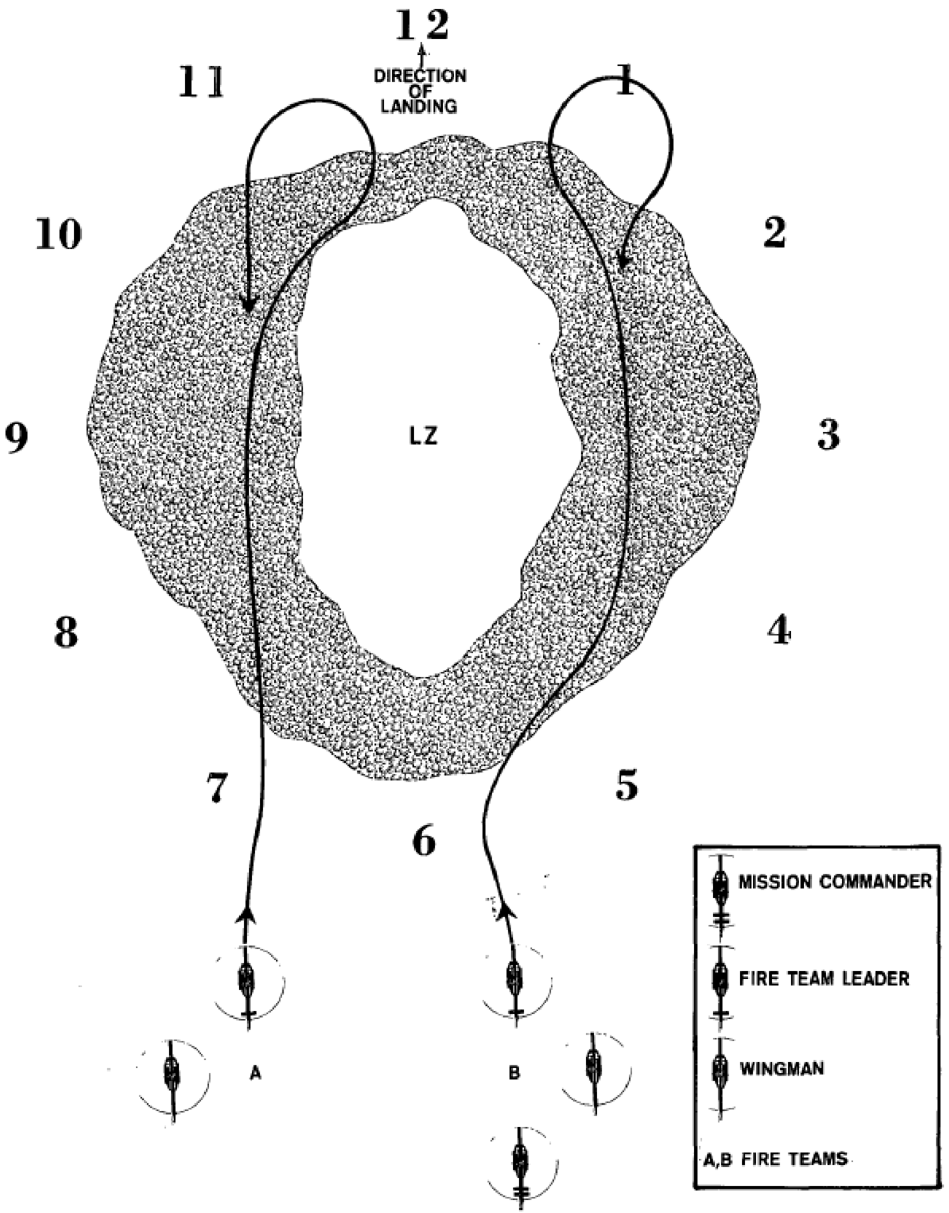


FLIGHT MODES

Mission planning is a crucial part of flying helicopters. Strike operations will often require you to reach the target as safely as possible. The Mi-24 can neither fly fast nor high (in the “fighter jet” sense), therefore his safest routes will often be as close to the ground as possible in order to avoid detection and use terrain to mask his approach. “NOE” is what pilots call “Nap-of-the-Earth”, a very low altitude flight mode done in a high-threat environment. NOE flying minimizes detection and vulnerability to enemy radar.



TROOP DEPLOYMENT



FIRE TEAM A IS RESPONSIBLE FOR LZ COVERAGE FROM 7 TO 1 O'CLOCK.
FIRE TEAM B IS RESPONSIBLE FOR LZ COVERAGE FROM 6 TO 2 O'CLOCK.

aavn 784

Figure 26. Double orbit of the landing zone.

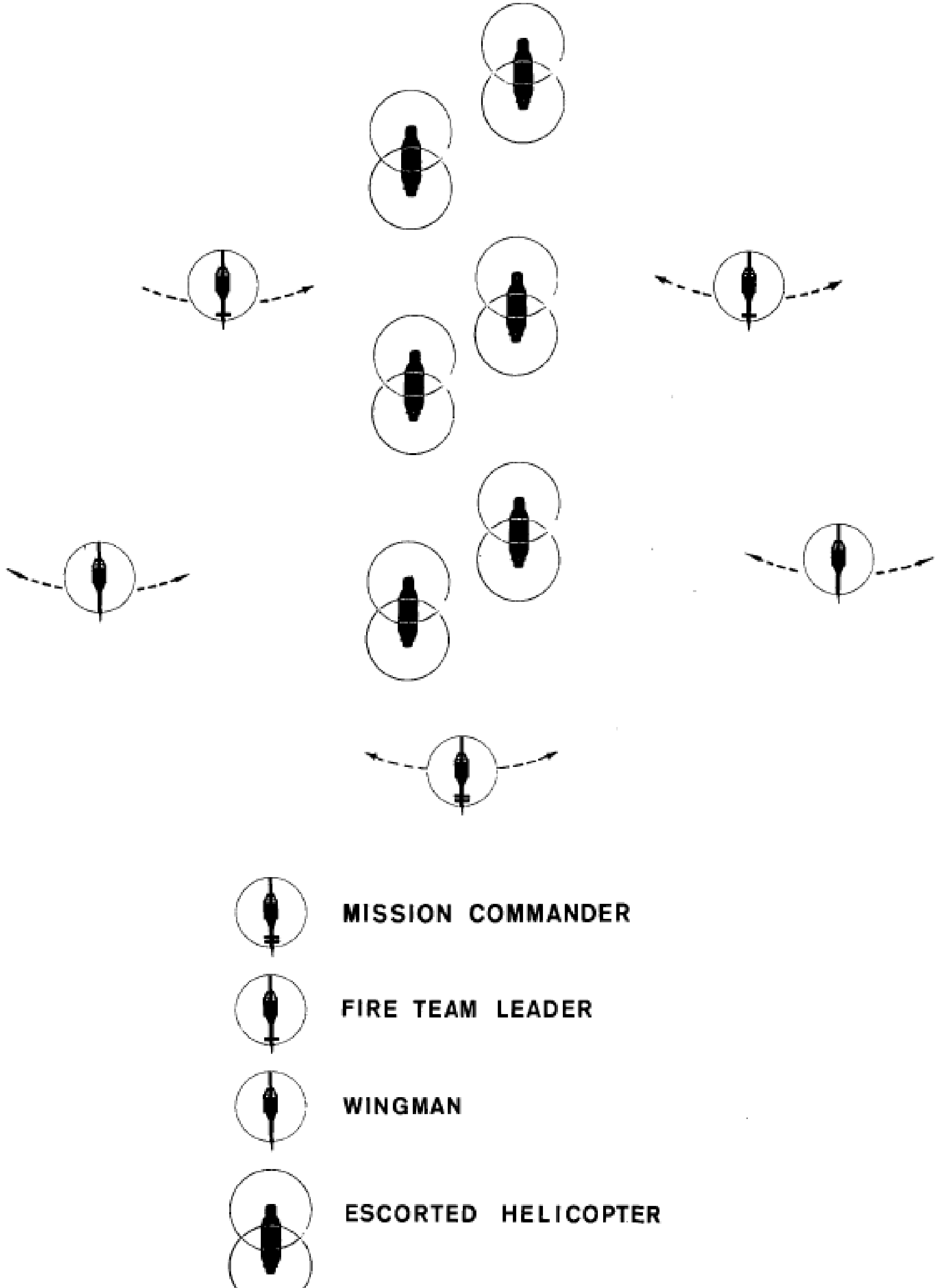


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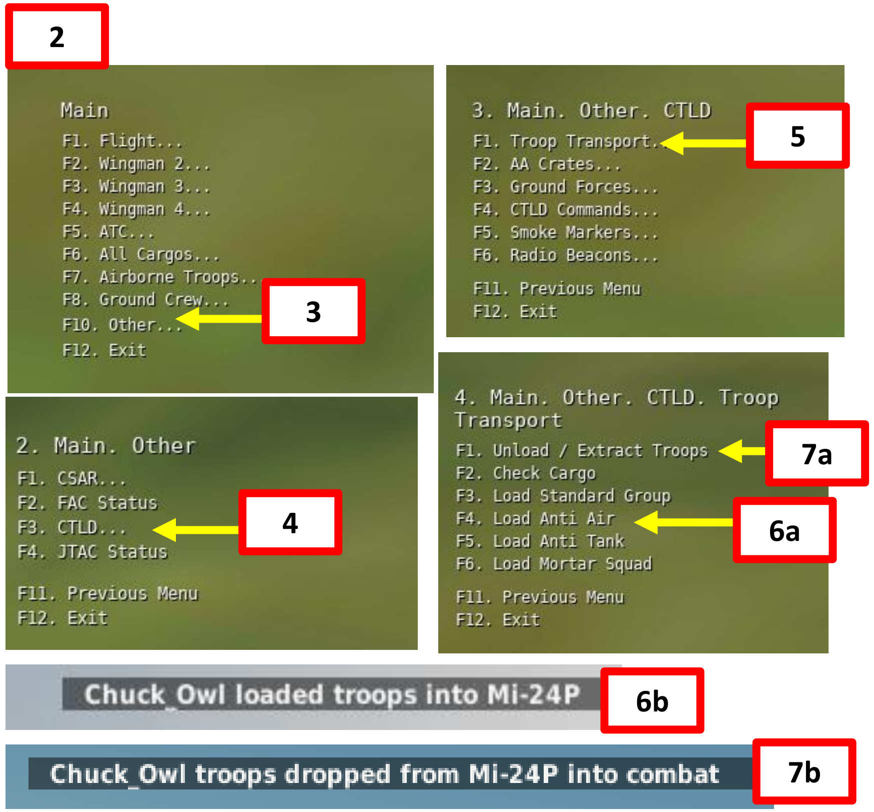
Figure 25. Escort formation at tree-top level or nap-of-the-earth.

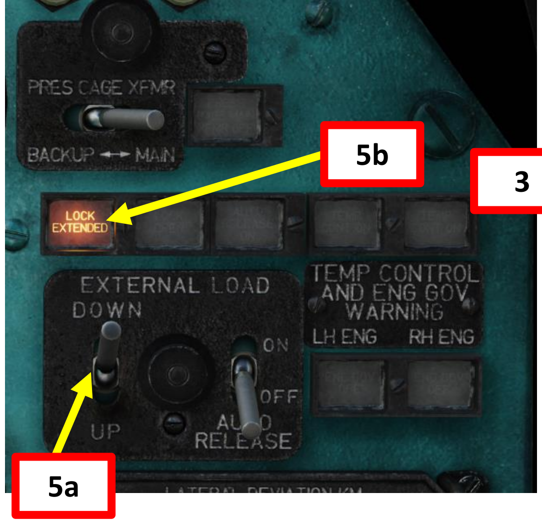
HOW TO LOAD AND DROP TROOPS (CTLD SCRIPT)

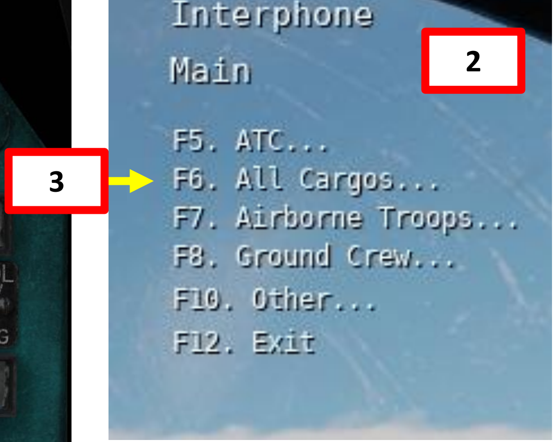
1. Land next to ground troops
2. Press "\" to open the main menu
3. Press "F10" to select Other
4. Press "F3" to select CTLD
5. Press "F1" to select Troop Transport
6. Select troops you want to load by pressing either "F3", "F4", "F5" or "F6".
7. To Unload / Extract Troops, repeats steps 2) through 5), then press "F1"

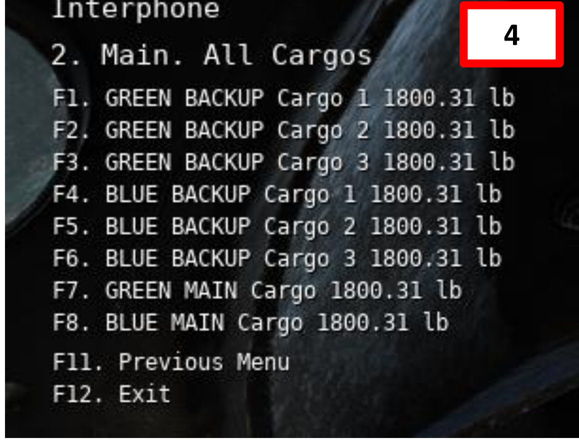


SLING LOADS

1. Land next to cargo crates
2. Press “\” to open the main menu
3. Press “F6” to select ALL CARGOS
4. Press the key specified to choose the cargo you will pick. Its location will be identified by a red smoke.
5. Set External Cargo Load Manual Release Switch – UP (Extends Cargo Hook DOWN). Confirm that LOCK EXTENDED light illuminates.

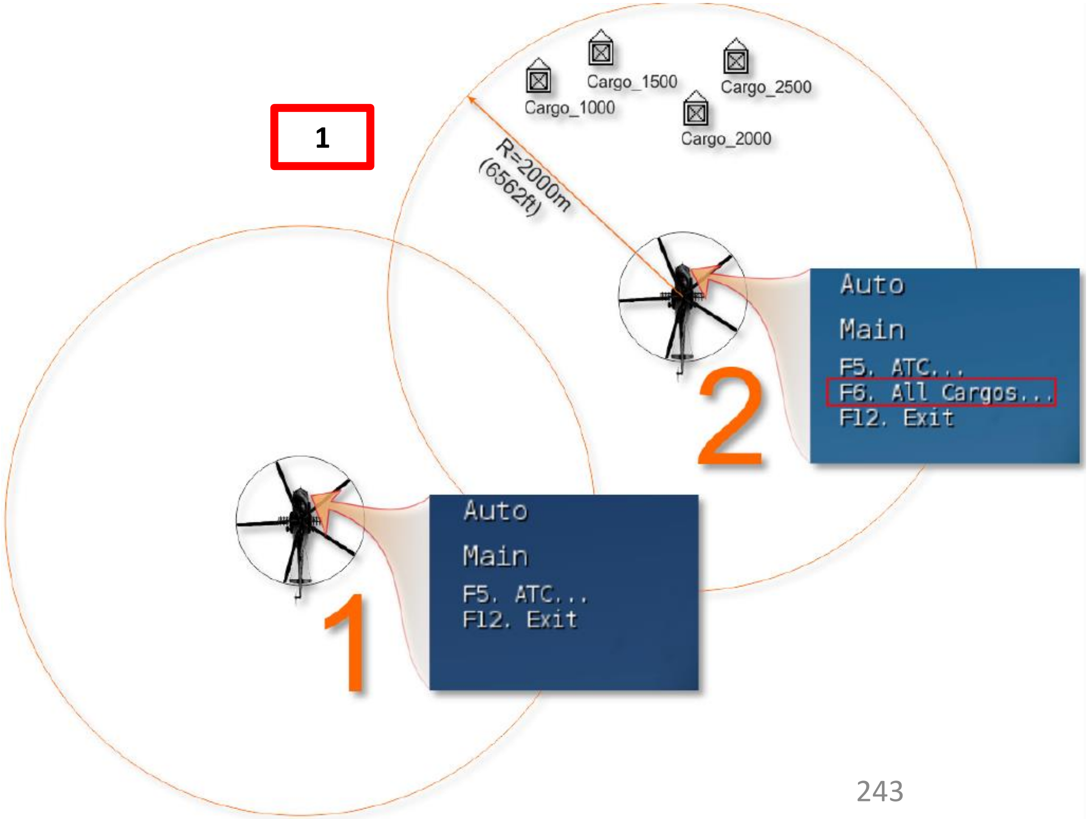






Cargo selection menu appearance depends on distance to cargo

Note: Cable Length can be set via the Mission Editor.



SLING LOADS

6. Hover about 10 ft (approx. 3 meters) above the target. The Co-Pilot will give you corrections (i.e. "Forward, Left.") Consult the **Doppler Hover & Low Speed Control Indicator** for help.
7. Press **External Cargo Hook** key binding (RCtrl+RShift+L) to request a ground crew to attach cargo to the hoist cable.

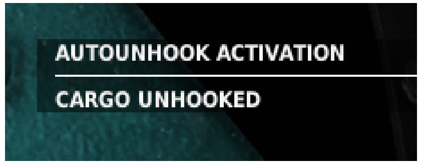
Hover and Low Speed Control Indicator

SLING LOADS

8. When the Co-Pilot tells you “Take Tension”, raise collective to gain altitude and create tension on the hoist cable. You will then be able to fly away with the sling load.
9. When you fly, be mindful of the pendulum effect the cargo will have. Do not make hard turns or the hoist cable will snap.

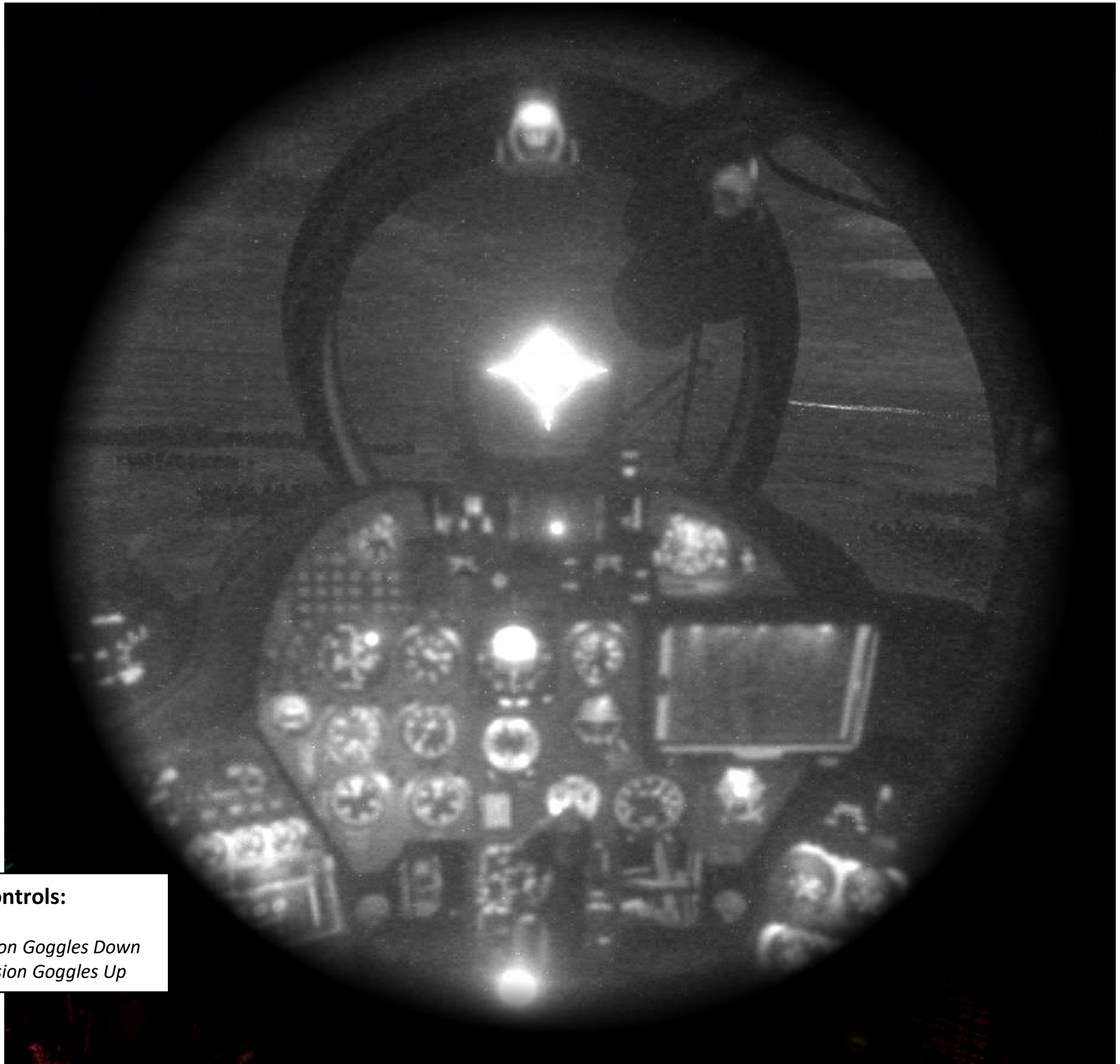
SLING LOADS

10. If you want to use the Automatic Unhook system, set the External Cargo Auto Release Switch UP (Automatic Release ON).
11. To drop cargo, maintain a hover above drop zone.
12. On the collective, flip the DROP CARGO safety switch, then unhook the cargo by pressing the **External Cargo Tactical Unhook** key (RCtrl+RShift+RAlt+L) binding to detach cargo. If the Automatic Unhook system is armed, the cargo hook will unhook as soon as no more tension is felt in the hoist cable.



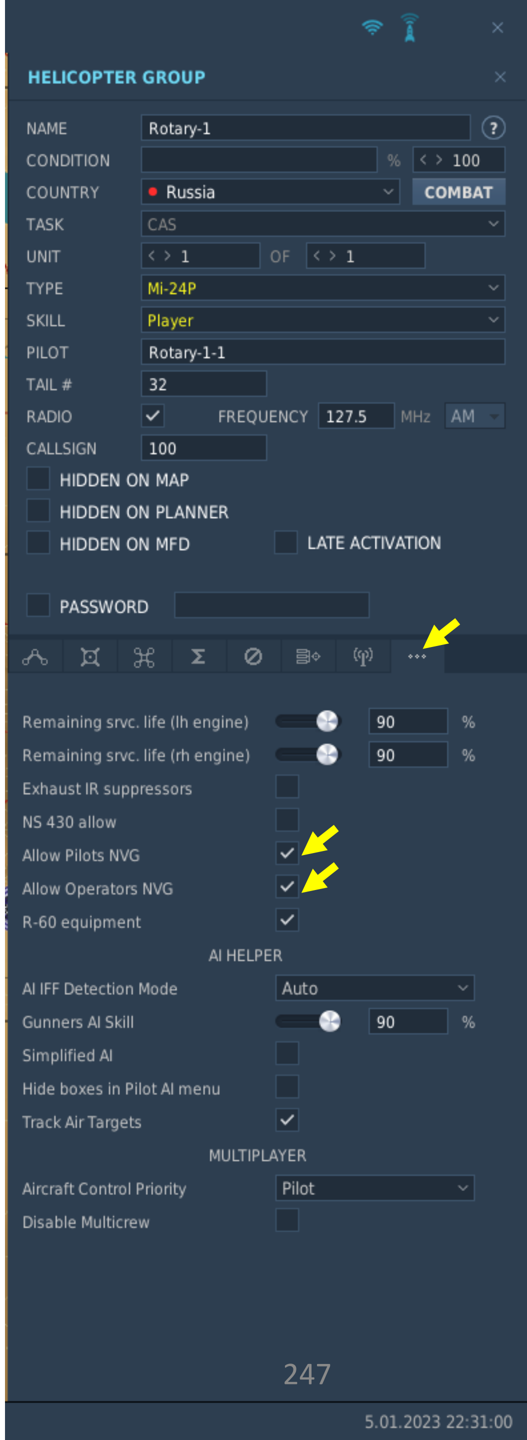
NIGHT OPERATIONS

If operating at night, you can equip night vision goggles (NVGs). However, this option needs to be enabled via the mission editor.



Night Vision Goggles (NVG) Controls:

- *RSHIFT+H: On/Off*
- *RSHIFT+RALT+H: Gain Night Vision Goggles Down*
- *RSHIFT+RCTRL+H: Gain Night Vision Goggles Up*

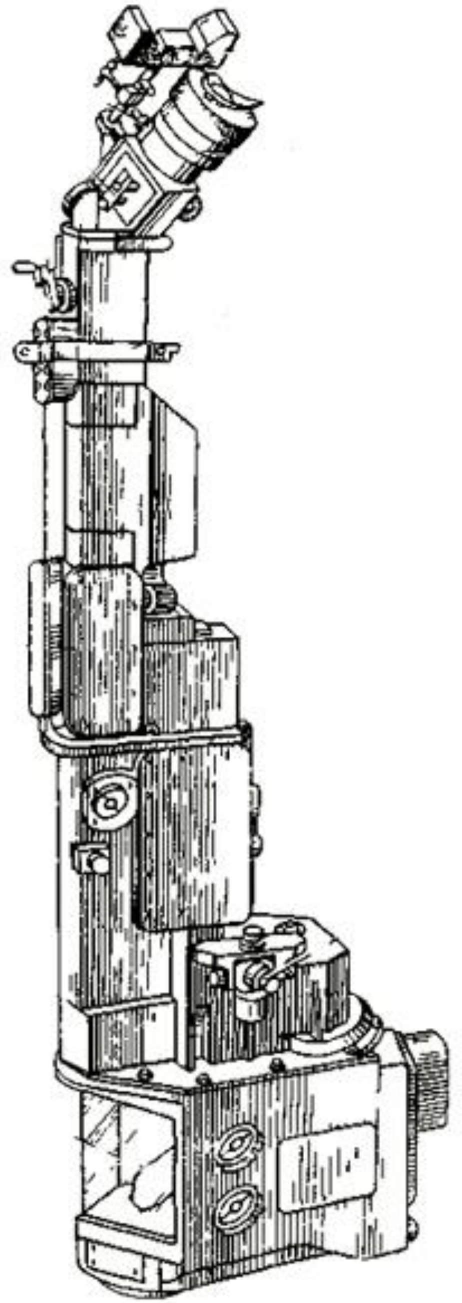


SECTION SUMMARY

1 – SENSOR OVERVIEW

Sensors in the Mi-24 do not have any fancy modern targeting pods; your only means to acquire targets is visually by looking outside the cockpit… or by using an on-board observation device that is basically a "periscope" that uses a system of mirrors to see outside through the underside of the helicopter nose. The periscope is used for two primary functions:

- Guidance of Air-to-Ground Missiles like the Shturm and the Ataka
- General Observation through the periscope



2 – RADUGA-SH OVERVIEW

The Raduga-Sh Complex (Радуга, russian for ”Rainbow”) is a Surveillance, Aiming & Guidance System designed to operate air-to-ground missiles. Russians do not refer to the Raduga as a a single system, but rather as a « complex », which is an ensemble of different systems operating together. Ultimately, the Raduga guides a SACLOS (Semi-Automatic Command to Line-of-Sight) radio-guided anti-tank missile. The missile and the aiming sight systems are closely integrated and interdependent, therefore it is hard to mention the periscope without mentioning the missile system as well.

The main system components of the Raduga-Sh are:

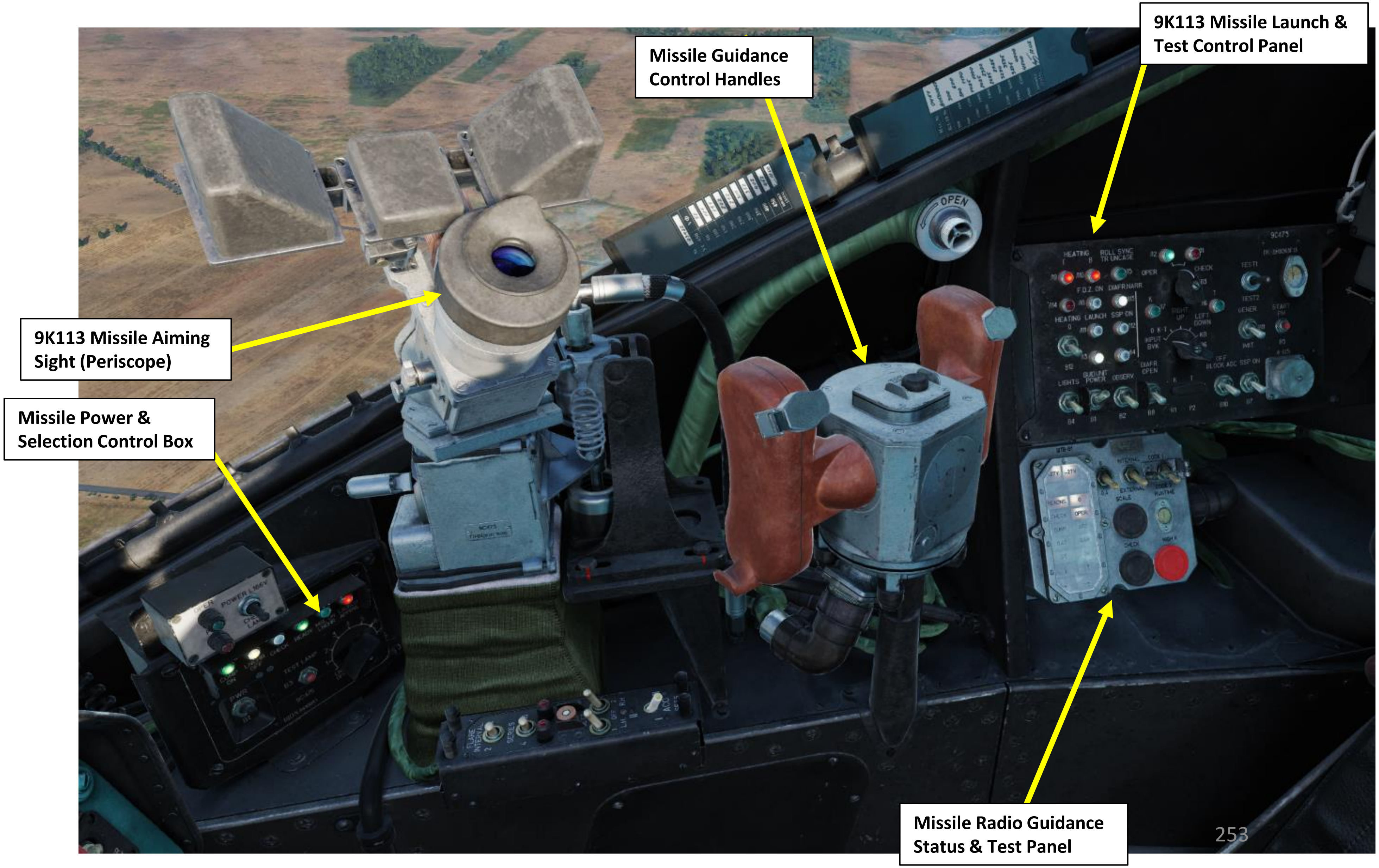
- The 9K113 Missile Guidance Unit
    - Missile Guidance Control Handles
    - Aiming Sight
    - Missile Selector Control Box
    - Missile Launch & Test Control Panel
    - Missile Guidance Radio Control Antenna
    - Missile Radio Guidance Status & Test Panel
- The Periscope
- The 9M114 Shturm (*AT-6 Spiral*) Missile, or a 9M120 Ataka (*AT-9 Spiral-2*) missile

2 – RADUGA-SH OVERVIEW

The principle behind a radio-guided SACLOS (Semi-Automatic Command to Line-of-Sight) missile is that a signal is sent from the operator's sights toward the target. The Missile Radio Guidance Control Unit Antenna transmits a radio signal to the missile. The missile has receivers for the signal on the rear of its fuselage. Some form of encoding is used in the signal to steer the missile towards the center of the periscope line-of-sight based on where the operator is looking; changing frequencies or dot patterns are commonly used. This system has the advantage that the link between the launcher and missile cannot easily be broken or jammed, but has the disadvantage that the guidance signal may be detected by the target.

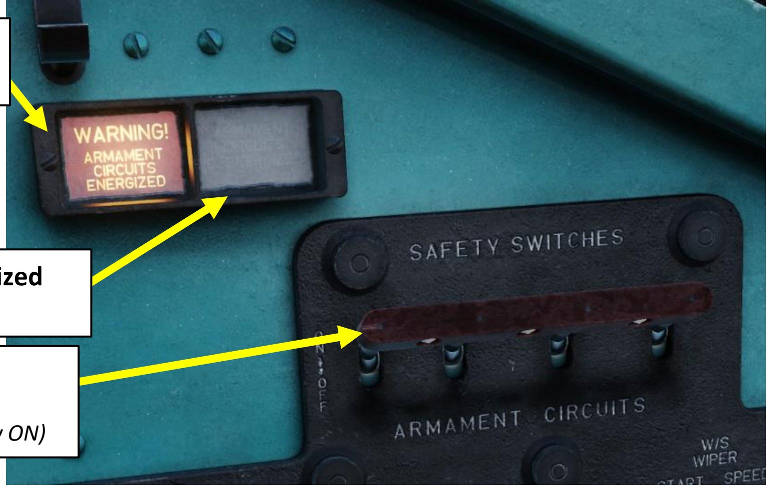
2 – RADUGA-SH OVERVIEW

Most of the controls for the missile guidance systems and the periscope are in the front cockpit of the CPG (Co-Pilot/Gunner).



2 – RADUGA-SH OVERVIEW

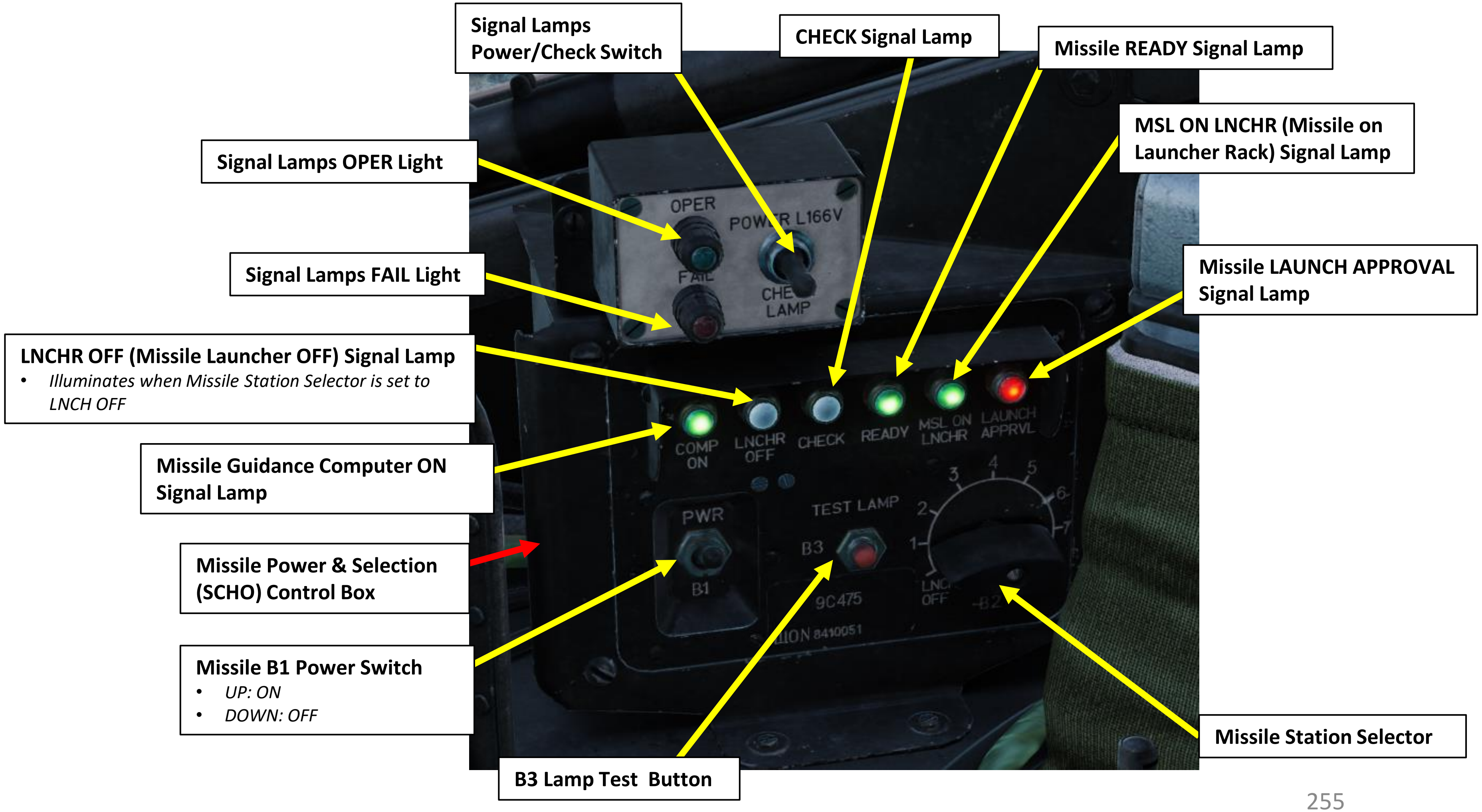
There are two frontal armament control panels in the front cockpit of the CPG (Co-Pilot/Gunner). The Armament Circuit Breakers are also on the left side of this cockpit and are essential to power-up the various sub-systems of the missiles, aiming sight and guidance unit.



3 – RADUGA-SH COMPONENTS

3.1 – Missile Power & Selection (SCHO) Control Box

The Missile Power & Selection (SCHO) control box is mainly used to select what missile to fire and to monitor the status of each missile.



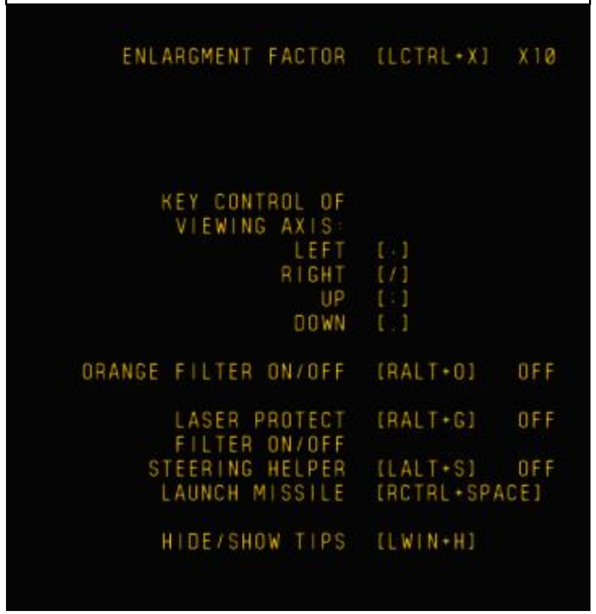
3 – RADUGA-SH COMPONENTS

3.2 – 9K113 Missile Aiming Sight (Periscope)

The missile aiming sight is an upside-down periscope. Most controls for the periscope being difficult to access while looking through the scope, there are a few bindings to memorize.

- To **look** through the sight, use the binding set for “9K113 Aiming Profile ON/OFF”, which is set to “**LALT + A**” by default.
- You can toggle **Orange Filter** using “**RALT + O**”.
- You can toggle **Laser (Green) Filter** using “**RALT + G**”.
- You can toggle **Aiming Sight Magnification Ratio (Zoom)** using “**LCTRL + X**”.
- When looking into the sight, you can **show/hide helping tips** using “**LWIN + H**”.

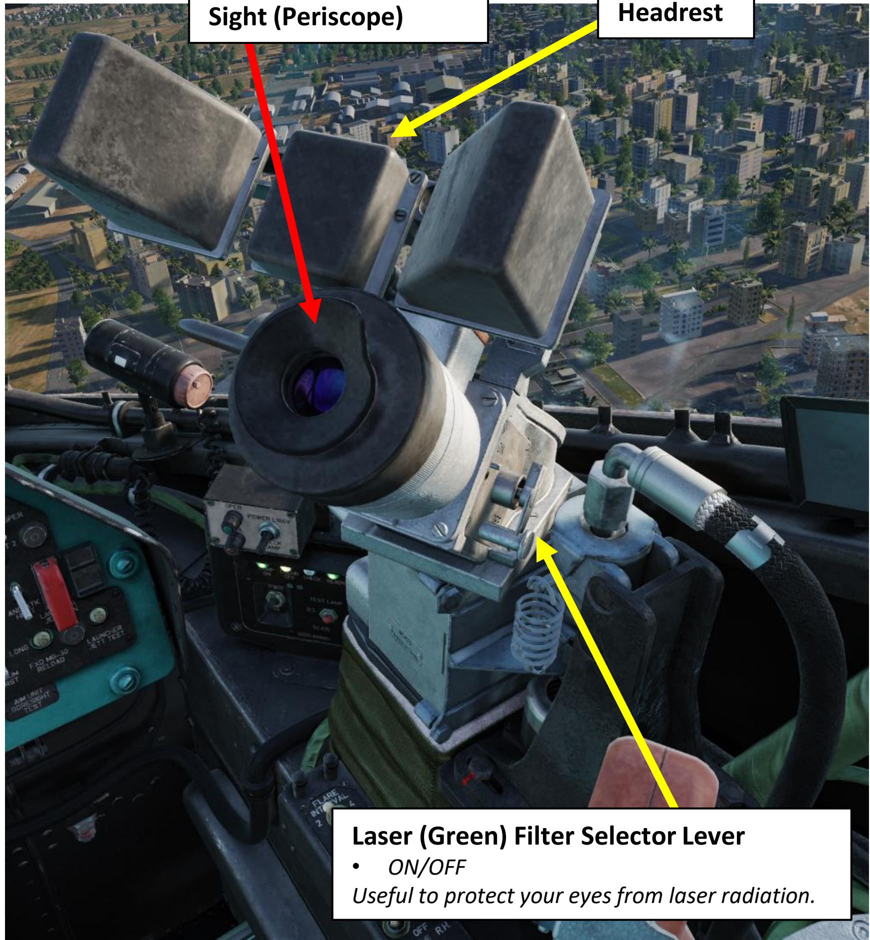
Aiming Sight Helping Tips (LWIN + H)



Orange Filter Selector Lever
- *ON/OFF*

Useful when operating in hazy conditions or poor contrast conditions due to weather

Aiming Sight Magnification Ratio (Zoom) Selector Lever
- *Inwards (As Shown): x3.3 Ratio*
- *Outwards: x10 Ratio*



9K113 Missile Aiming Sight (Periscope)

Headrest

Laser (Green) Filter Selector Lever
- *ON/OFF*

Useful to protect your eyes from laser radiation.

3 – RADUGA-SH COMPONENTS

3.2 – 9K113 Missile Aiming Sight (Periscope)

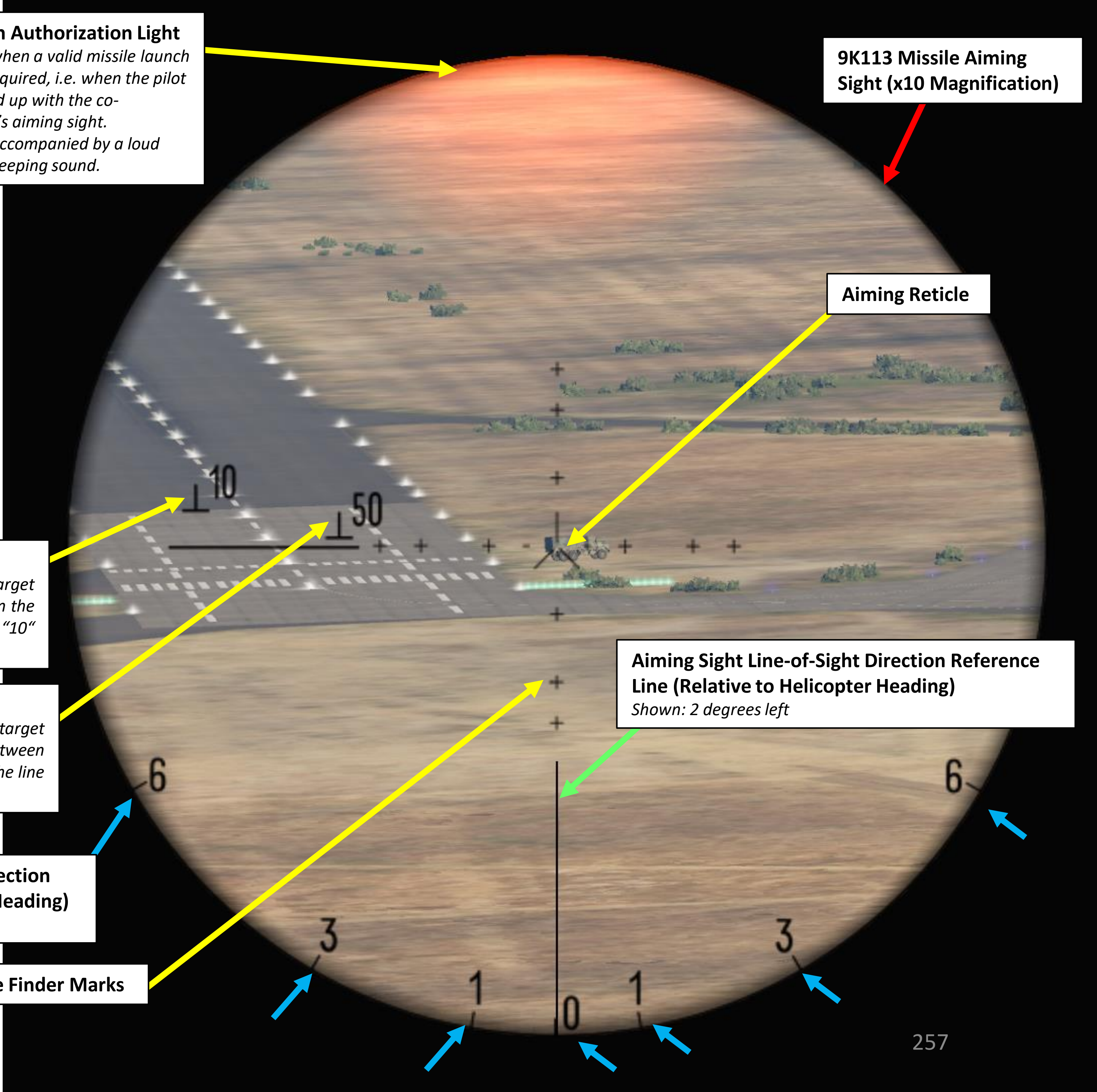
Here is an overview of the aiming sight's symbology.

The **Aiming Reticle** points where the periscope is looking.

The **"10" and "50" reference marks** are used to evaluate the range to a target.

The position of the **Aiming Sight Line-of-Sight Direction Reference Line** on the **Aiming Sight Direction Scale** shows the angle relative to the helicopter heading in tens of degrees.

The **Missile Launch Authorization Light** illuminates when a valid missile launch solution is acquired, accompanied by a loud beeping sound. See the Weapons section for more information.



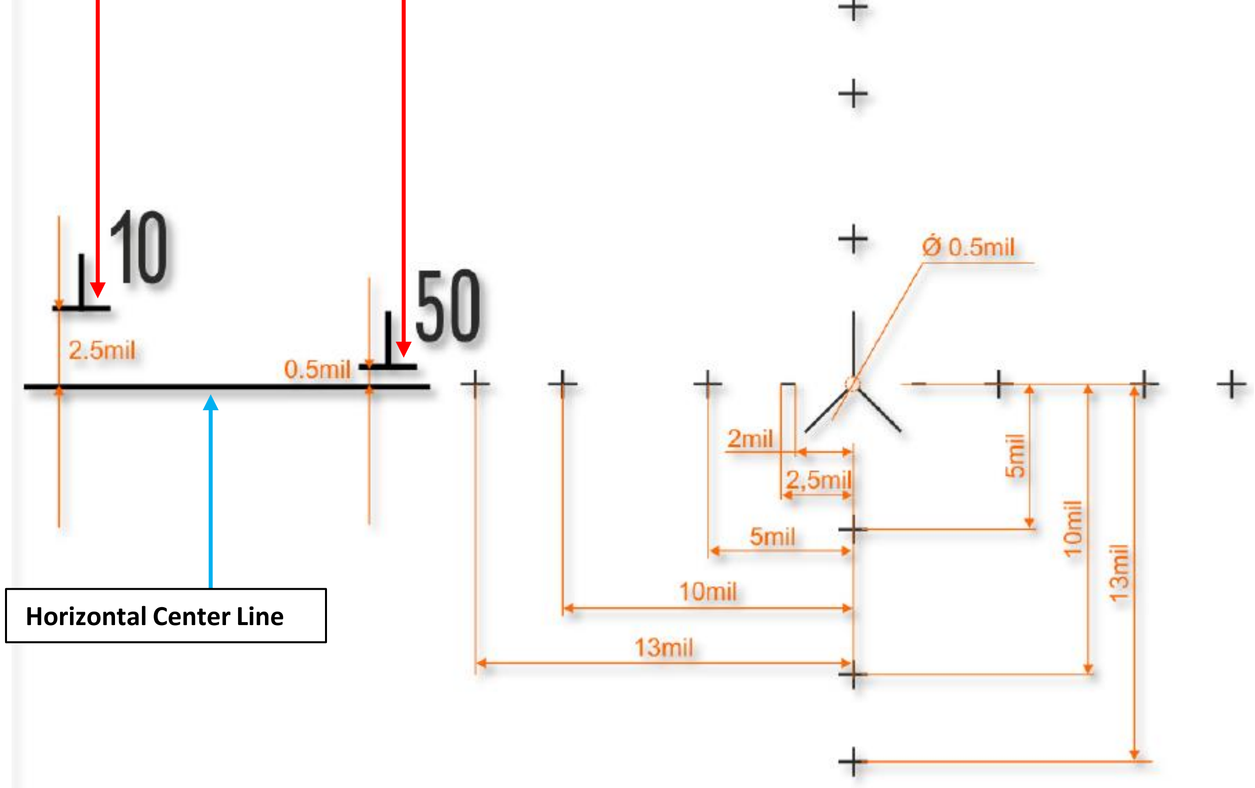
3 – RADUGA-SH COMPONENTS

3.2 – 9K113 Missile Aiming Sight (Periscope)

Here is an overview of the various ranging indications of the periscope. Use the **"10" and "50" reference marks** are to evaluate the range to a target. As an example, if a target of 2.5 meters of height fits between the "10" reference mark and the horizontal center line, it means it has a slant range of 1000 meters.

"10" Reference Mark
Indicates a range of 1000 m when the target (with a height of 2.5 m) is located between the horizontal line and the bottom of the line "10" marks, touching both lines.

"50" Reference Mark
Indicates a range of 5000 m when the target (with a height of 2.5 m) is located between the horizontal line and the bottom of the line "50" marks, touching both lines.



Horizontal Center Line

3 – RADUGA-SH COMPONENTS

3.2 – 9K113 Missile Aiming Sight (Periscope)

You can toggle **Aiming Sight Magnification Ratio (Zoom)** using “**LCTRL + X**”.

There are two zoom level ratios: x10 and x3.3.

Aiming Sight Magnification Ratio (Zoom) Selector Lever
- *Inwards (As Shown): x3.3 Ratio*
- *Outwards: x10 Ratio*

Zoom Level: x10 Ratio

Zoom Level: x3.3 Ratio

3 – RADUGA-SH COMPONENTS

3.2 – 9K113 Missile Aiming Sight (Periscope)

In cases of low visibility or low contrast, the sight may be difficult to use effectively. You can use the Reticle Sight Backlight (B4) switch to illuminate the sight symbology. Keep in mind that this does not provide any kind of infrared visibility; the periscope is merely a system of mirrors that is not suited to be used in bad weather or low lighting conditions.

Periscope Reticle (with backlight)

Reticle Sight Backlight (B4) Switch
- *UP: ON*
- *DOWN: OFF*

3 – RADUGA-SH COMPONENTS

3.3 – Periscope Doors

The periscope has two sets of doors: inner doors and outer doors.

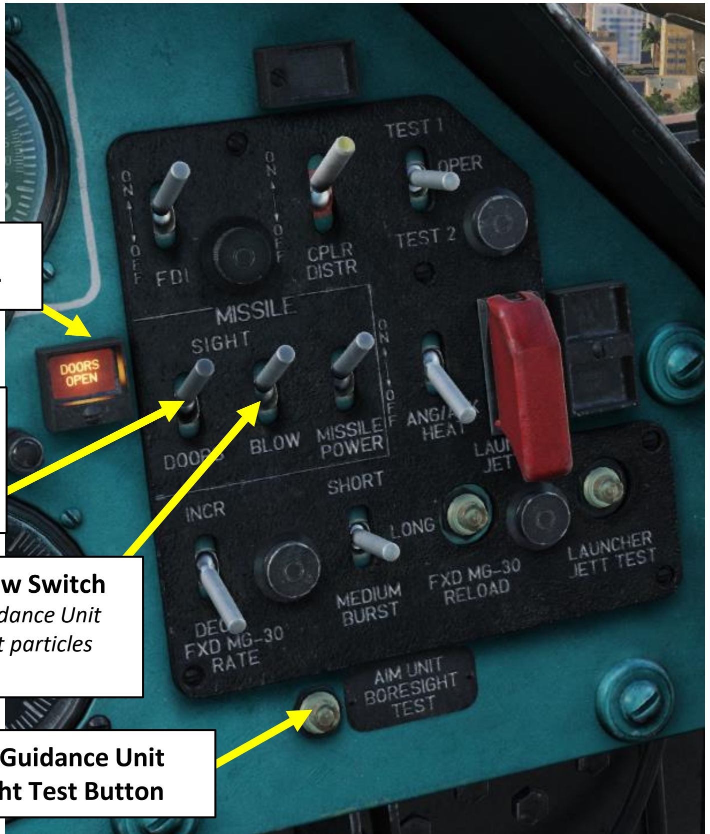
- The **outer doors** are controlled with the **OBSERVE (B2) Switch**, which must be set to the UP/ON position to open the doors, unlock the aiming sight gimbal system and see through the aiming sight. Closing the outer doors (OBSERVE in DOWN/OFF position) cages the aiming sight gimbal system, which can easily be damaged when the helicopter is performing hard manoeuvers.
- The **inner doors** are controlled with the **Periscope Inner Doors Control Switch** (UP position opens the doors, DOWN position closes the doors). The inner doors can be kept shut since they are transparent and allow you to see through the aiming sight even when closed. These doors are designed to protect the periscope against dust, dirt or bug splatter.

Periscope Outer Doors Closed

Periscope Outer Doors Open Inner Doors Closed

Periscope Outer Doors Open Inner Doors In Transition

Periscope Outer Doors Open Inner Doors Open



Missile Guidance Unit DOORS OPEN Annunciator

Periscope Inner Doors Control Switch
- *UP: ON*
- *DOWN: OFF*

Missile Guidance Unit Blow Switch
- *UP: Air is blown on the Guidance Unit glass to remove dust or dirt particles*
- *DOWN: OFF*

Missile Guidance Unit Boresight Test Button

OBSERVE (B2) Switch
- *UP: ON, opens periscope protective doors and unlocks aiming sight gimbal system*
- *DOWN: OFF, closes periscope protective (outer) doors and cages aiming sight gimbal system*

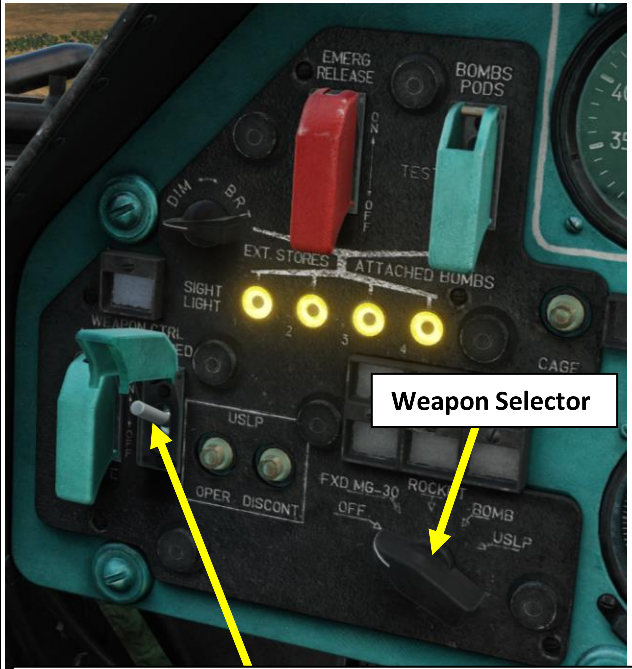
3 – RADUGA-SH COMPONENTS

3.3 – Periscope Doors

In order to properly operate the doors, you have four main pre-requisites:

- The periscope door controls require the **Pilot/CPG Weapon Selection Control Handover Switch** to be set to UP (Co-Pilot/Gunner). Having the Weapon Control Handover to DOWN (Pilot-Commander) will automatically close the protective doors.
- The **Guidance Unit Power (B1) Switch** needs to be set to ON (UP).
- The **Missile Power Switch** needs to be set to ON (UP) to power up 9K113 system.
- The **Weapon Selector** has to be set to OFF/MSL since other weapons can damage periscope optics from gun smoke, powder residue and vibrations.

Guidance Unit Power (B1) Switch
- *UP: ON, provides power to 9K113 missile aiming sight*
- *DOWN: OFF*



Weapon Selector

Missile Power Switch
- *UP: ON*
- *DOWN: OFF*

Pilot/CPG Weapon Selection Control Handover Switch
- *UP: Co-Pilot/Gunner has Weapon Selection Control*
- *DOWN: Pilot-Commander has Weapon Selection Control*

3 – RADUGA-SH COMPONENTS

3.4 – Missile Guidance Controls

The Missile Guidance Controls are split between a set of **Rotary Handles** (which control the **vertical axis** of the periscope), and a **Rotary Head** (which controls the **lateral axis** of the periscope).

There are two Missile Fire Buttons with safety covers on the Rotary Handles; they are used to fire the anti-tank missile.

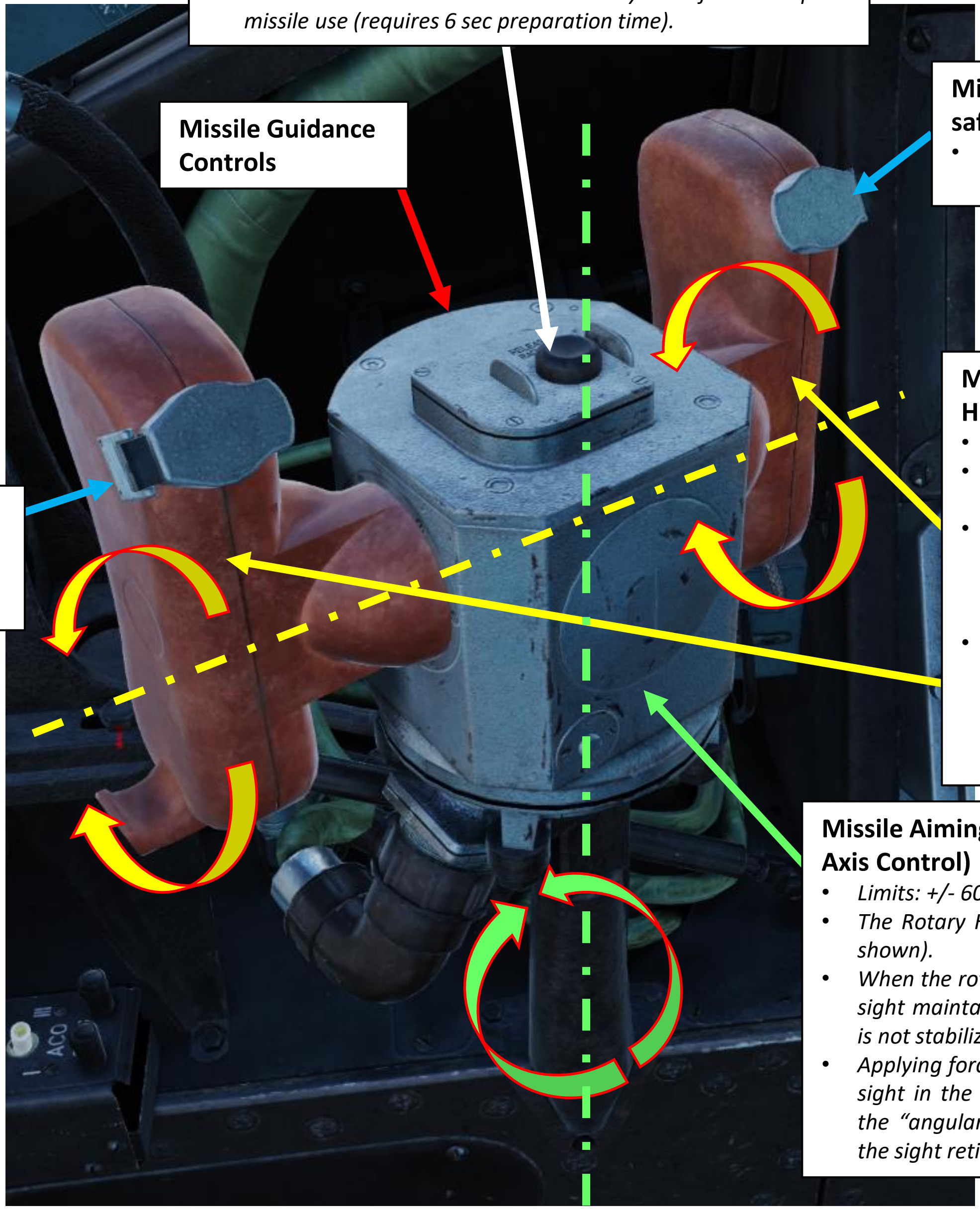
The Radiation Reset button is used to reset the missile system for subsequent launches and to stop radiation emission of the radio guidance system.

- **Periscope Lateral Axis Limits: +/- 60 deg**
- **Periscope Vertical Axis Limits: + 20 deg / -15 deg**

One important aspect to take into account with the Rotary Handles and Rotary Head is that they are sprung-back to a center position. The periscope's aiming sight is NOT stabilized, meaning that it will keep moving and require constant adjustment to stay "fixed" on a target. The position of the Rotary Handles and Rotary Head induce a speed compensation, therefore you can "fix" the sight on a target by applying adequate force on the controls.

These controls can be simulated using a mouse, which can increase or decrease the speed compensation based on how long you move the mouse left/right/up/down.

A more "instinctive" method of simulating these controls is with your own joystick axes, since most of them are designed to be spung back and can easily be maintained to an intermediate position with a small amount of force.

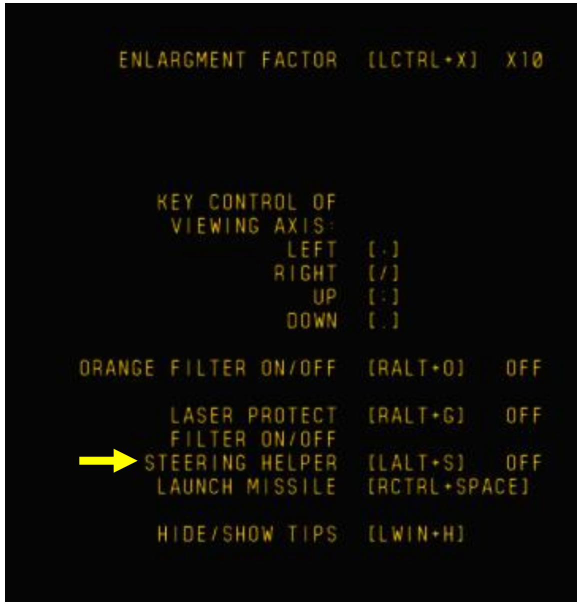


3 – RADUGA-SH COMPONENTS

3.4 – Missile Guidance Controls

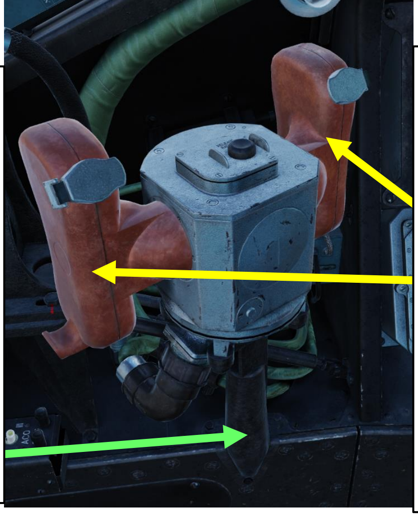
The speed compensation of the Rotary Head and Rotary Handles is observed by watching the state of the background in the sight. If the background is more-or-less static, the speed compensation is adequate. If the background keeps moving, you need to adjust your speed compensation setting (or ask the pilot to fly a more stable heading).

A red “steering helper” arrow can be displayed to display the amount of force applied by the Missile Guidance Controls. The further the arrow is from the center of the aiming reticle, the more force is applied. When the arrow is centered, no force is applied. You can toggle the steering helper arrow using “LALT + S”.



Missile Aiming Sight Line-of-Sight Rotary Head (Lateral Axis Control)

- *Limits: +/- 60 deg*
- *The Rotary Head is spring-loaded to the centered position (as shown).*
- *When the rotary head is centered (no force applied), the aiming sight maintains its current line-of-sight lateral angle. The sight is not stabilized.*
- *Applying force on the rotary head moves the periscope's aiming sight in the lateral axis; the amount of force applied controls the "angular velocity" at which the electrical actuators move the sight reticle.*

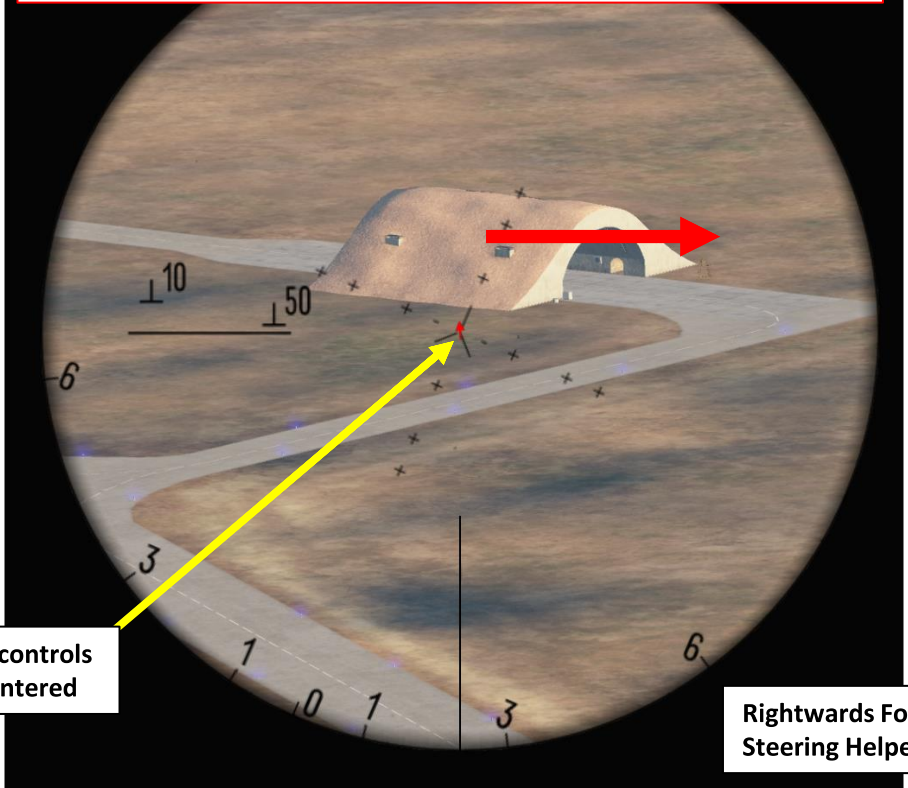


Missile Aiming Sight Line-of-Sight Rotary Handles (Vertical Axis Control)

- *Limits: + 20 deg / -15 deg*
- *The Rotary Handles are spring-loaded to the centered position (as shown).*
- *When the handles are centered (no force applied), the aiming sight maintains its current line-of-sight vertical angle. The sight is not stabilized.*
- *Applying force on the handles moves the periscope's aiming sight in the vertical axis; the amount of force applied controls the "angular velocity" at which the electrical actuators move the sight reticle.*

Target is located 25 deg to our right

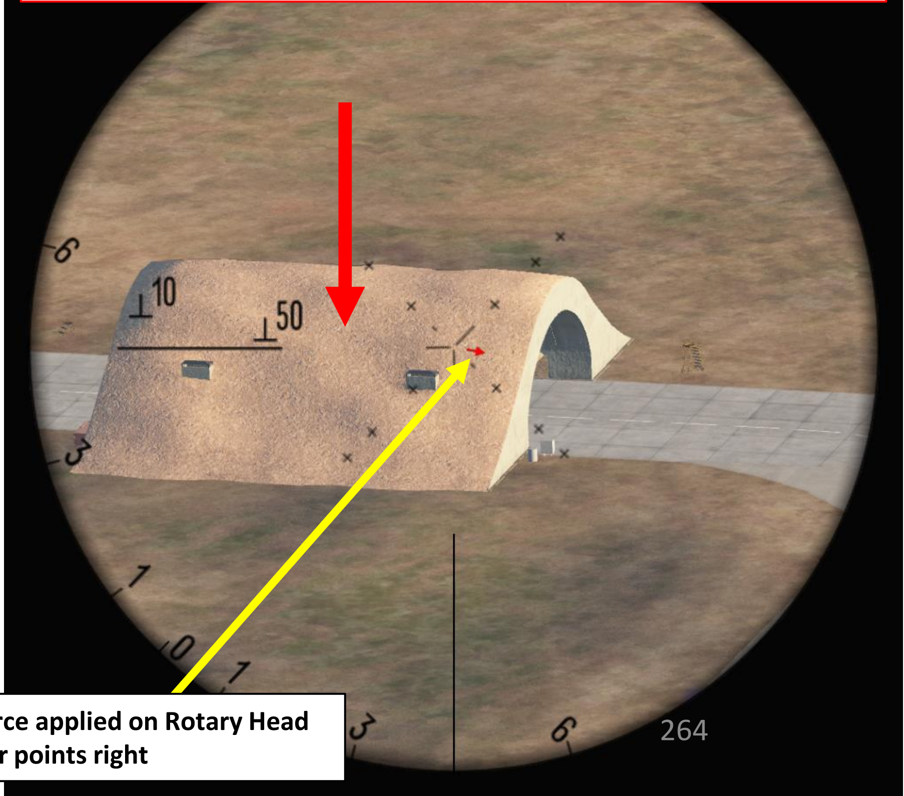
- *Bunker is not centered on the sight and will exit the sight rightwards since no force is applied to compensate for the helicopter's speed.*



No force applied on controls
Steering Helper is centered

Target is located 45 deg to our right

- *Bunker remains centered on the sight since rightwards force is applied to compensate for the helicopter's speed.*

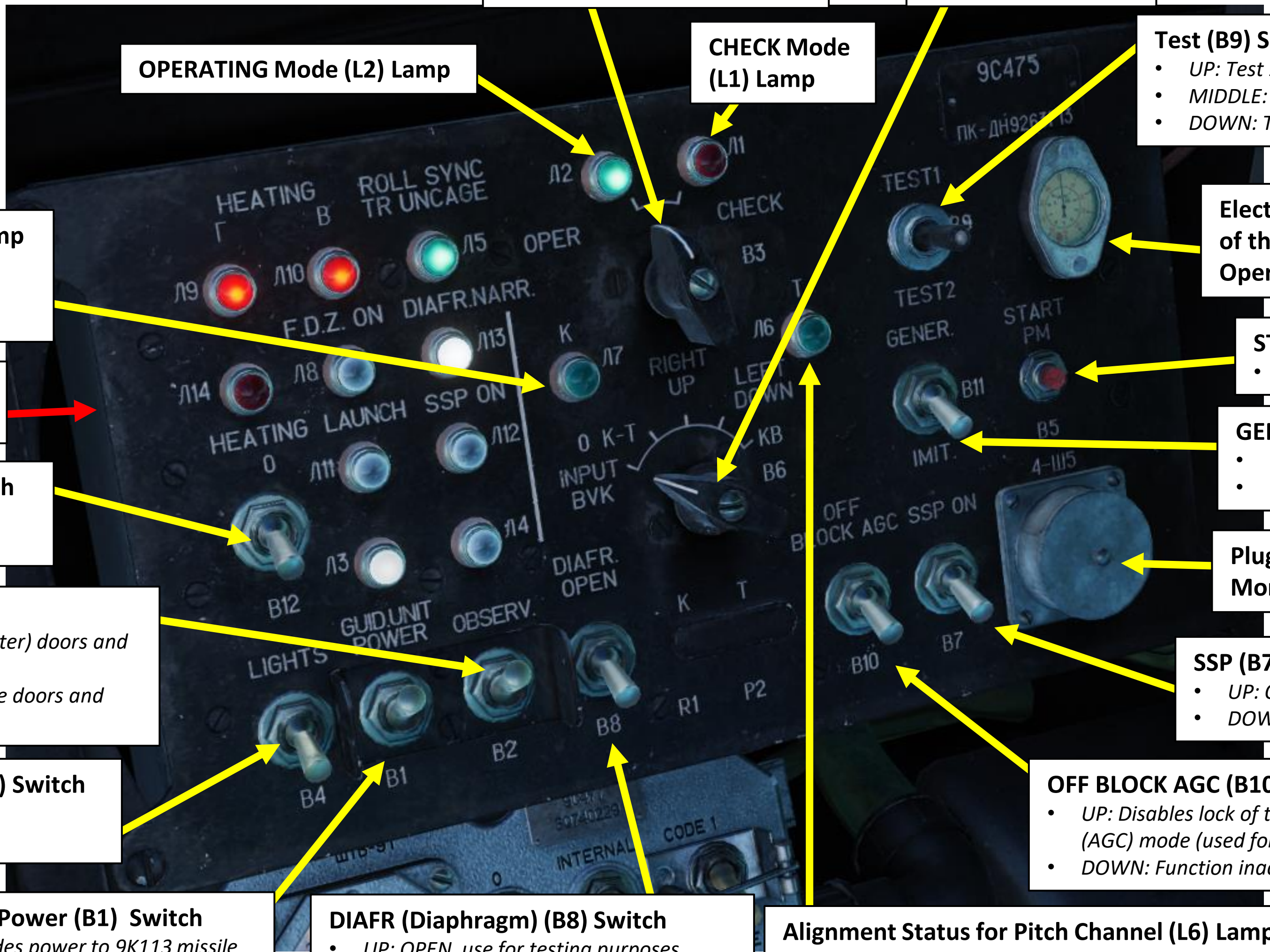


Rightwards Force applied on Rotary Head
Steering Helper points right

3 – RADUGA-SH COMPONENTS

3.5 – 9K113 Missile Launch & Test Control Panel

The Missile Launch & Test Control Panel is mainly used to power up the missile and aiming sight systems. Many test functions are also available, but we will not go through them at this time.



Aiming Sight Mode Selector
- *LEFT: Operation Mode*
- *RIGHT: Check Mode, used for testing*

BVK (B6) Selector

OPERATING Mode (L2) Lamp

CHECK Mode (L1) Lamp

Test (B9) Switch
- *UP: Test 1*
- *MIDDLE: OFF*
- *DOWN: Test 2*

Alignment Status for Course Channel (L7) Lamp
- *Illuminates to signal alignment of axis of the transmitting antenna with the line-of-sight in the course (K for Kurs) channel.*

Electro-Mechanical Counter of the Stabilizer Gyromotor Operating Time

9K113 Missile Launch & Test Control Panel

START PM (B5) Button
- *Starts BVK software*

GENER/IMIT (B11) Switch
- *UP: GENER*
- *DOWN: IMIT*

Aiming Sight Heating (B12) Switch
- *UP: Heating ON*
- *DOWN: Heating OFF*

Plug Connector for External Monitoring Equipment

OBSERVE (B2) Switch
- *UP: ON, opens periscope protective (outer) doors and unlocks aiming sight gimbal system*
- *DOWN: OFF, closes periscope protective doors and cages aiming sight gimbal system*

SSP (B7) Switch
- *UP: ON*
- *DOWN: OFF*

Reticle Sight Backlight (B4) Switch
- *UP: ON*
- *DOWN: OFF*

OFF BLOCK AGC (B10) Switch
- *UP: Disables lock of the automatic gain control (AGC) mode (used for CHECK mode tests)*
- *DOWN: Function inactive.*

Guidance Unit Power (B1) Switch
- *UP: ON, provides power to 9K113 missile aiming sight*
- *DOWN: OFF*

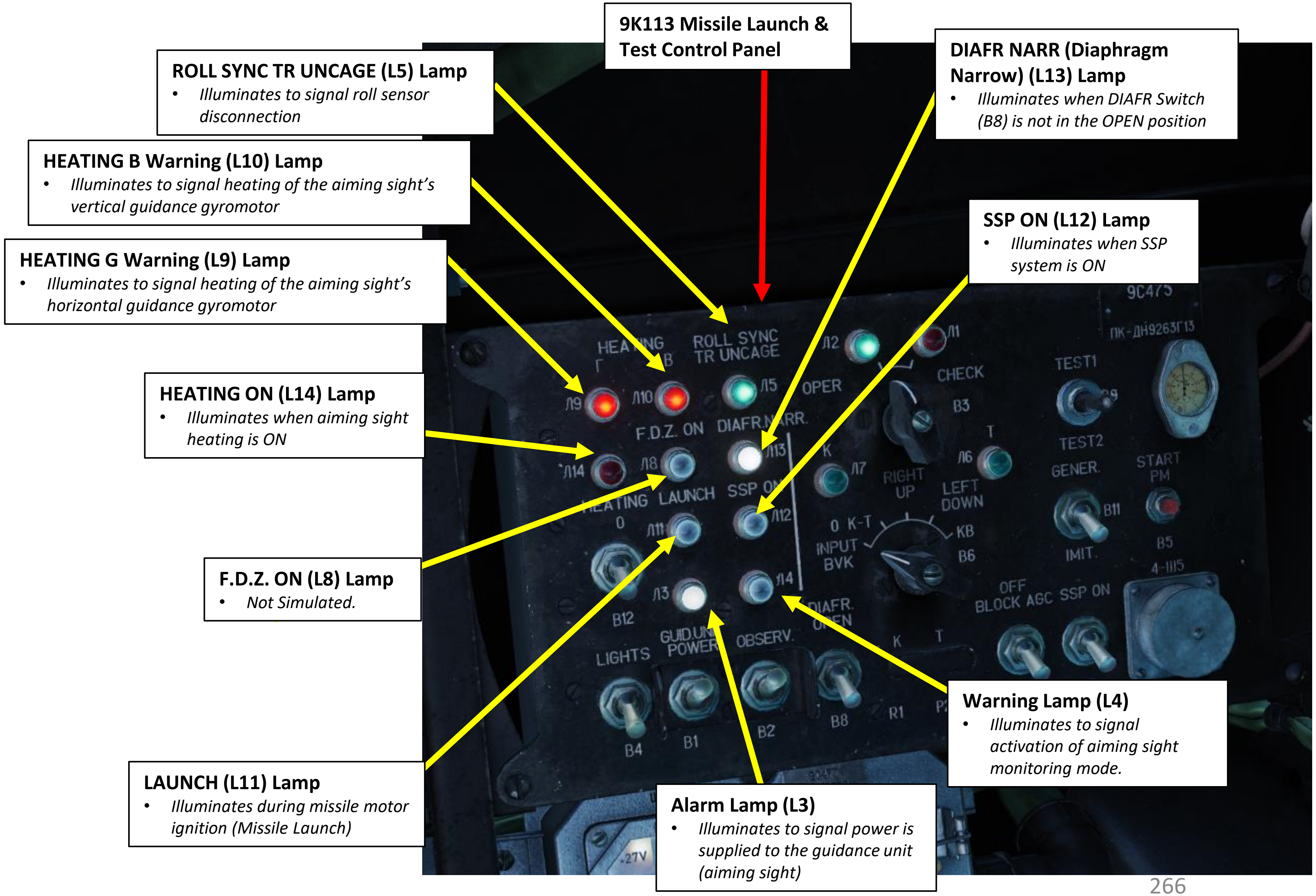
DIAFR (Diaphragm) (B8) Switch
- *UP: OPEN, use for testing purposes*
- *DOWN: Narrow Setting, reduces radio signal interference*

Alignment Status for Pitch Channel (L6) Lamp
- *Illuminates to signal alignment of axis of the transmitting antenna with the line-of-sight in the pitch (T) channel.*

3 – RADUGA-SH COMPONENTS

3.5 – 9K113 Missile Launch & Test Control Panel

Signal lamps indicate the status of various systems related to the missiles and aiming sight.



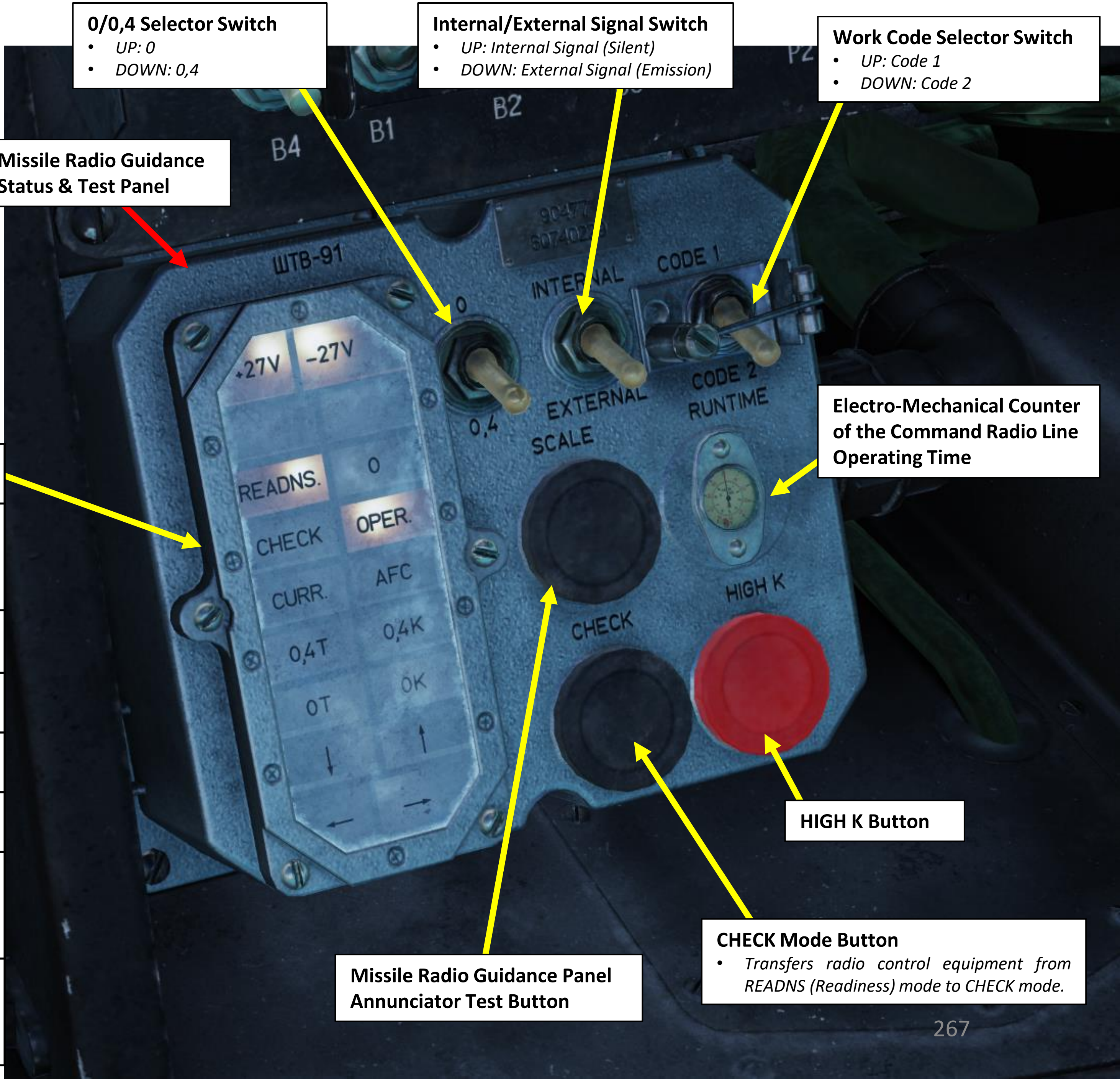
3 – RADUGA-SH COMPONENTS

3.6 – Missile Radio Guidance Status & Test Panel

The Missile Radio Guidance Status & Test panel is not something you will generally use… the only information in there that might interest you are:

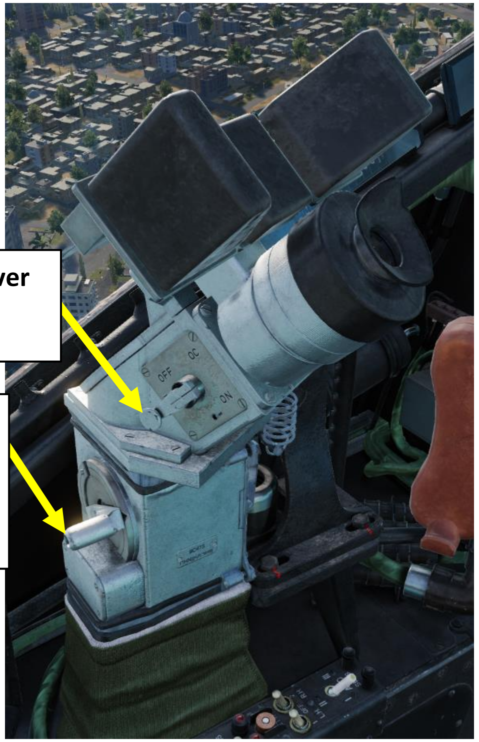
- The **down/up/left/right gimbal limit arrow** annunciators
- The **OPER** annunciator, which confirms that the OPERATION mode is selected.
- The **READNS** (Readiness) annunciator, which indicates that the aiming sight power-up sequence is finished and the stabilizer gyro motors of the periscope are ready to be used.

+27V Annunciator	**-27V Annunciator**
READNS Annunciator *Indicates aiming sight readiness when stabilizer gyro motors are spinning.*	**0 Annunciator**
CHECK Annunciator *Check Mode Selected*	**OPER Annunciator** *Operation Mode Selected*
CURR Annunciator	**AFC Annunciator**
0,4 T Annunciator	**0,4 K Annunciator**
0 T Annunciator	**0 K Annunciator**
DOWN Annunciator *Aiming sight line-of-sight has reached the maximum downward gimbal limit.*	**UP Annunciator** *Aiming sight line-of-sight has reached the maximum upward gimbal limit.*
LEFT Annunciator *Aiming sight line-of-sight has reached the maximum leftward gimbal limit.*	**RIGHT Annunciator** *Aiming sight line-of-sight has reached the maximum rightward gimbal limit.*



4 – RECOMMENDED SENSORS CONTROL SETUP

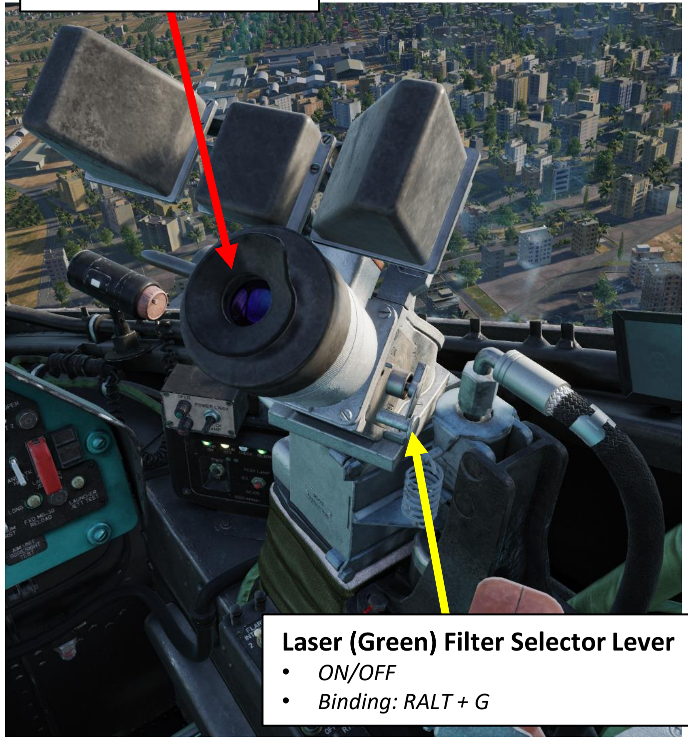
Real Aircraft Controls



Orange Filter Selector Lever
- *ON/OFF*
- *Binding: RALT + O*

Aiming Sight Magnification Ratio (Zoom) Selector Lever
- *Inwards (As Shown): x3.3 Ratio*
- *Outwards: x10 Ratio*
- *Binding: LCTRL + X*

9K113 Missile Aiming Sight (Periscope)
- *Binding: LALT + A*



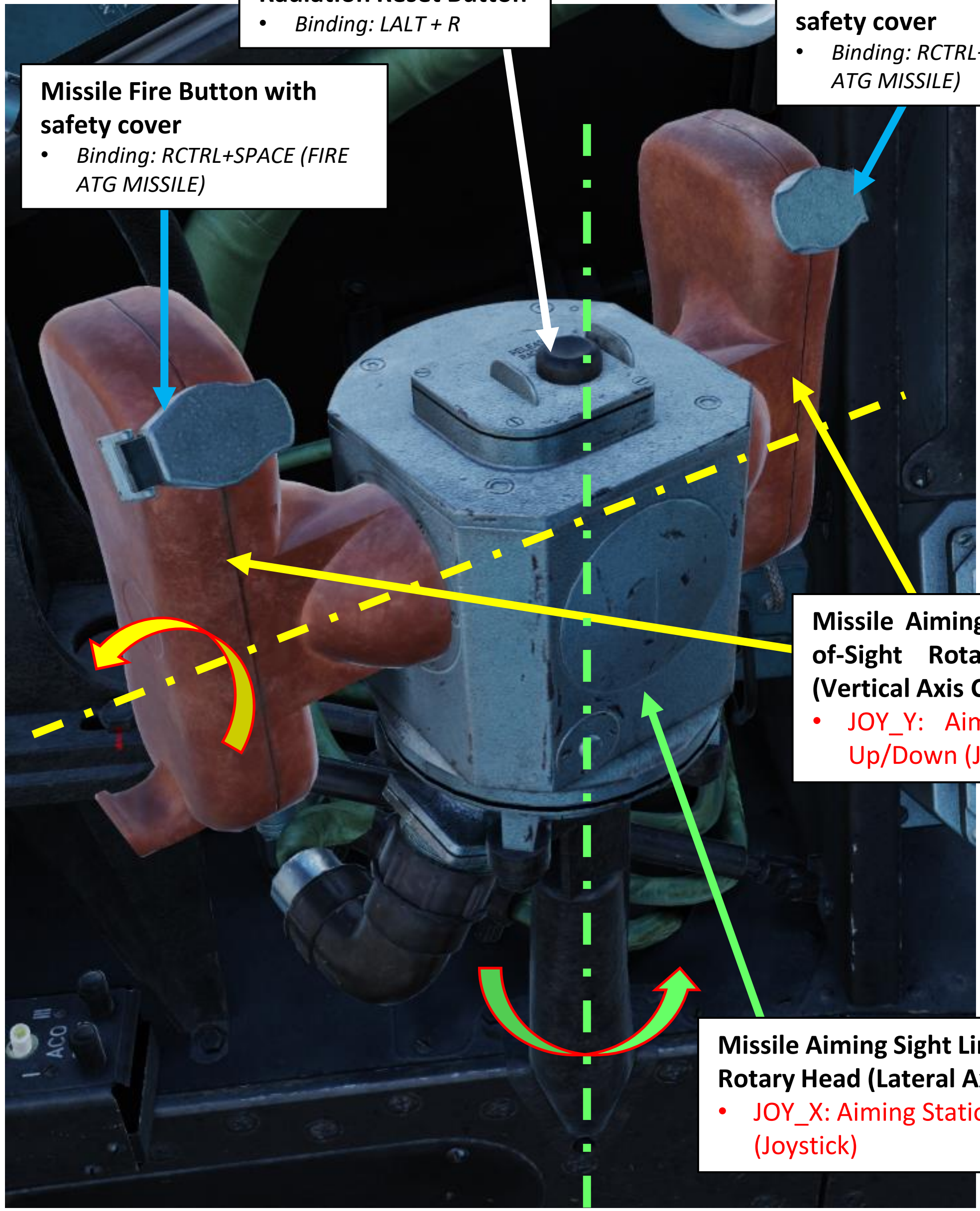
Laser (Green) Filter Selector Lever
- *ON/OFF*
- *Binding: RALT + G*

OBSERVE (B2) Switch
- *Binding: "O"*

Radiation Reset Button
- *Binding: LALT + R*

Missile Fire Button with safety cover
- *Binding: RCTRL+SPACE (FIRE ATG MISSILE)*

Missile Fire Button with safety cover
- *Binding: RCTRL+SPACE (FIRE ATG MISSILE)*



Missile Aiming Sight Line-of-Sight Rotary Handles (Vertical Axis Control)
- JOY_Y: Aiming Station Up/Down (Joystick)

Missile Aiming Sight Line-of-Sight Rotary Head (Lateral Axis Control)
- JOY_X: Aiming Station Left/Right (Joystick)

4 – RECOMMENDED SENSORS CONTROL SETUP

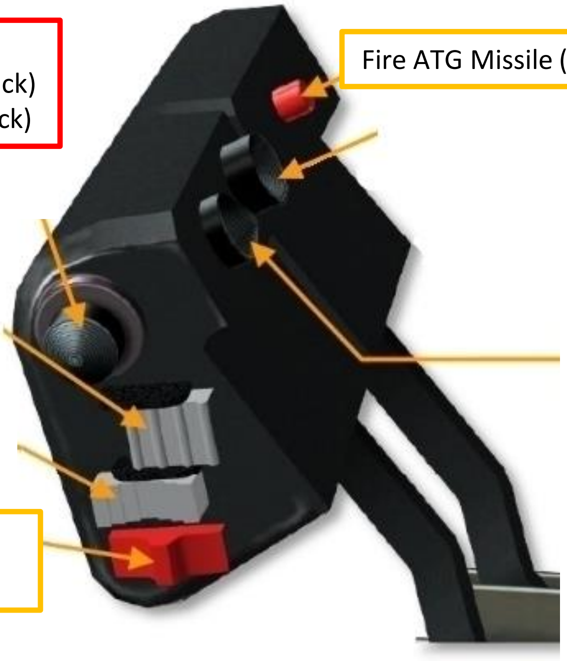
My Controls

Co-Pilot/Gunner Controls

Bindings Summary
- LALT+A: 9K113 Aiming Profile ON/OFF
- RALT+O: Orange Filter ON/OFF
- RALT+G: Laser Protection Filter ON/OFF
- LCTRL+X: Enlargement Factor (Aiming Sight Magnification Ratio (Zoom)
- LALT + R: Radiation Reset
- O: Toggle Observe (B2) Switch ON/OFF

↑
→ 9K113 Aiming Profile ON/OFF
↓
← OBSERVE (B2) ON/OFF

Mi-24P Aiming Station – Axis Commands
- JOY_X: Aiming Station Left/Right (Joystick)
- JOY_Y: Aiming Station Up/Down (Joystick)



Fire ATG Missile (RCTRL+SPACE)

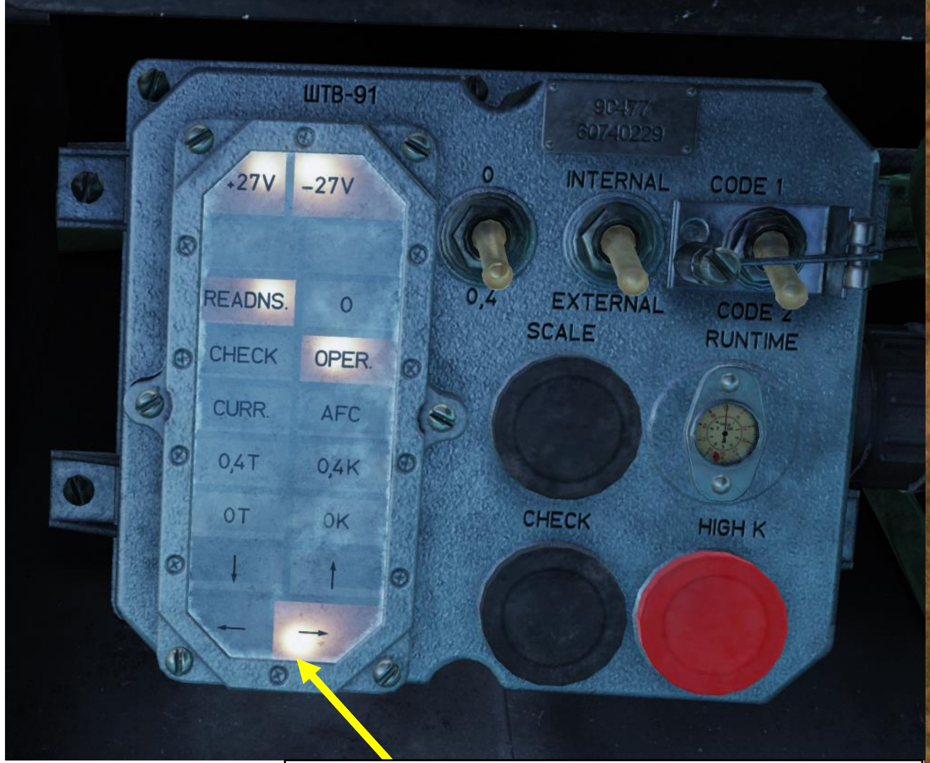
← Radiation Reset (LALT+R)
→ Enlargement x3/x10 (LCTRL+X)

5 – PERISCOPE LIMITATIONS

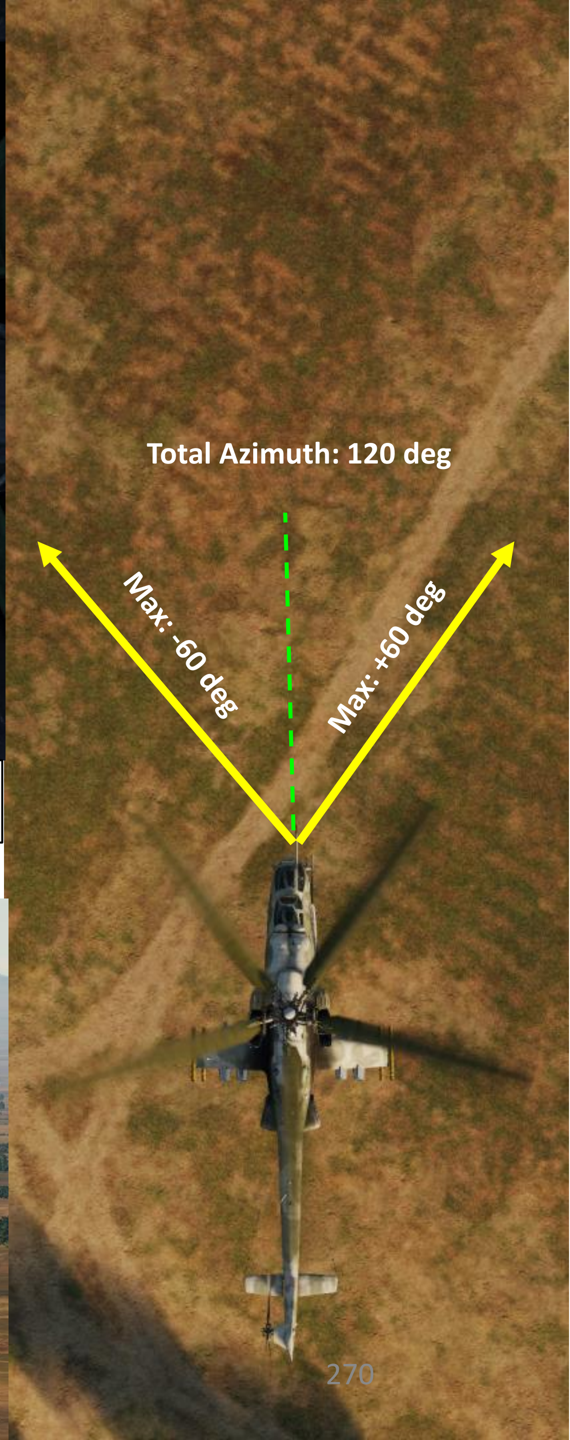
The periscope has a restricted field-of-view.

- **Periscope Lateral Axis Limits: +/- 60 deg**
- **Periscope Vertical Axis Limits: + 20 deg / -15 deg**

If the periscope has reached a limit in the vertical or lateral axis, the relevant gimbal limit annunciator will illuminate.



Gimbal Limit Annunciators
- *Shown: periscope has reached the rightmost gimbal limit.*



5 – PERISCOPE LIMITATIONS

The periscope's gyromotors are sensitive to hard turns (**anything more than 25 degrees of bank angle**) and can easily be damaged/decalibrated if the pilot performs aggressive manoeuvers while the periscope doors are open and the gimbals are unlocked.

It is recommended that the pilot maintains a stable attitude while the periscope is being operated.

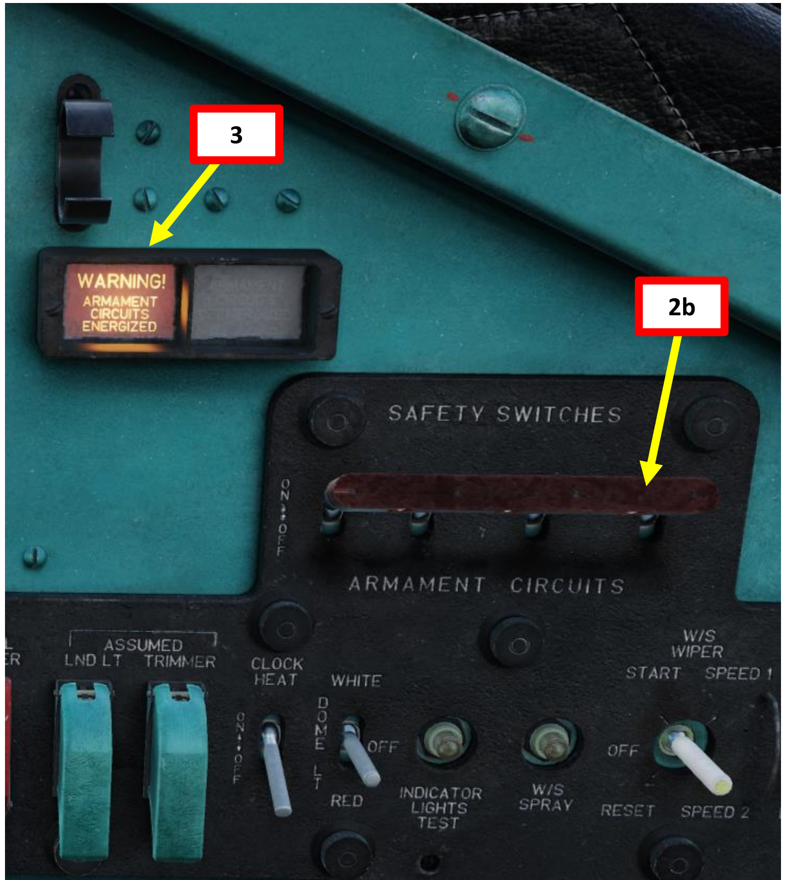
1. During normal flight operations, keep the OBSERVE (B2) switch to OFF (DOWN). This will keep the protective doors closed and the gimbal system caged and boresighted.
2. When Pilot-Commander maintains a stable attitude pointed roughly towards the target, he can tell the Co-Pilot/Gunner to "Open Periscope Doors".
3. Co-Pilot/Gunner then opens protective doors and unlocks aiming sight gimbals by setting the OBSERVE (B2) switch to ON (UP).
4. Once OBSERVE switch is ON, the doors open and a delay of 10 seconds is required before the periscope can be moved by the guidance unit handles.
5. Once missile is fired and target is destroyed, the Co-Pilot/Gunner can then set the OBSERVE (B2) switch to OFF (DOWN) to close the protective doors, boresight the periscope, cage the gimbals. Then, the Co-Pilot/Gunner calls "Periscope Doors Closed" to the Pilot-Commander to let him know that he can start evasive manoeuvers without risking damaging the periscope gimbals.

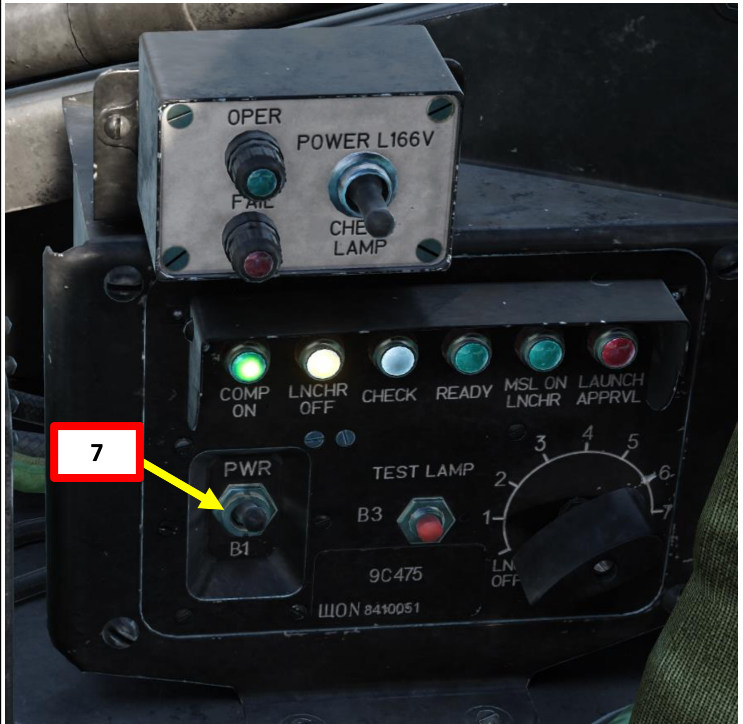
OBSERVE (B2) Switch
- *UP: ON, opens periscope protective (outer) doors and unlocks aiming sight gimbal system*
- *DOWN: OFF, closes periscope protective doors and cages aiming sight gimbal system*

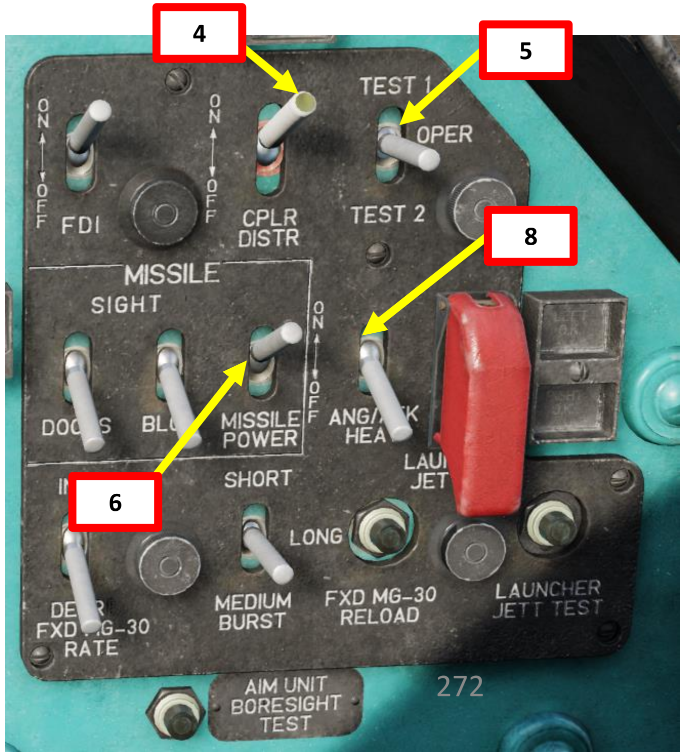
6 – PERISCOPE OPERATION (CPG)

NOTE: This tutorial will show you how to use the periscope to observe a target area. It will not show how to fire missiles… missile employment procedures will be explained in section 13 – Weapons & Armament.

1. Make sure engines are running, generator power is available and gyros are powered. The pilot-commander should give you that information.
2. Set Armament Circuit Breakers – ON (UP)
3. Confirm Armament Circuit Breakers are energized.
4. Set USR-24M (CPLR DISTR) Switch – ON (UP)
5. Set USR-24M Mode Switch - OPER
6. Set Missile Power Switch – ON (UP)
7. Set Missile B1 Power Switch – ON (UP)
8. Set DUAS (Air Data Probe) Heating Switch – As Required.
    - ON/UP if temperature is below 5 deg C
    - DOWN/OFF if temperature is above 5 deg C.

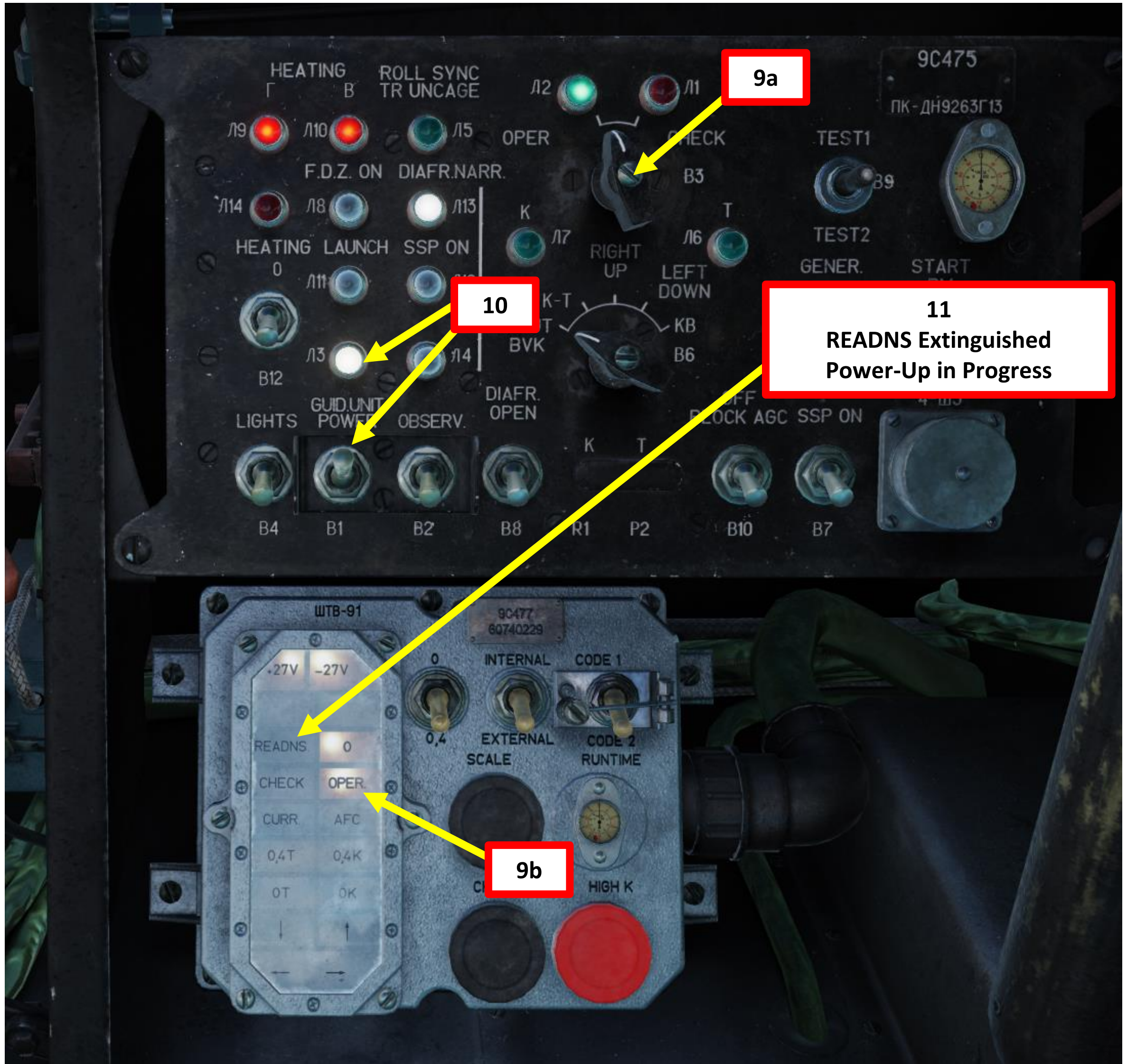


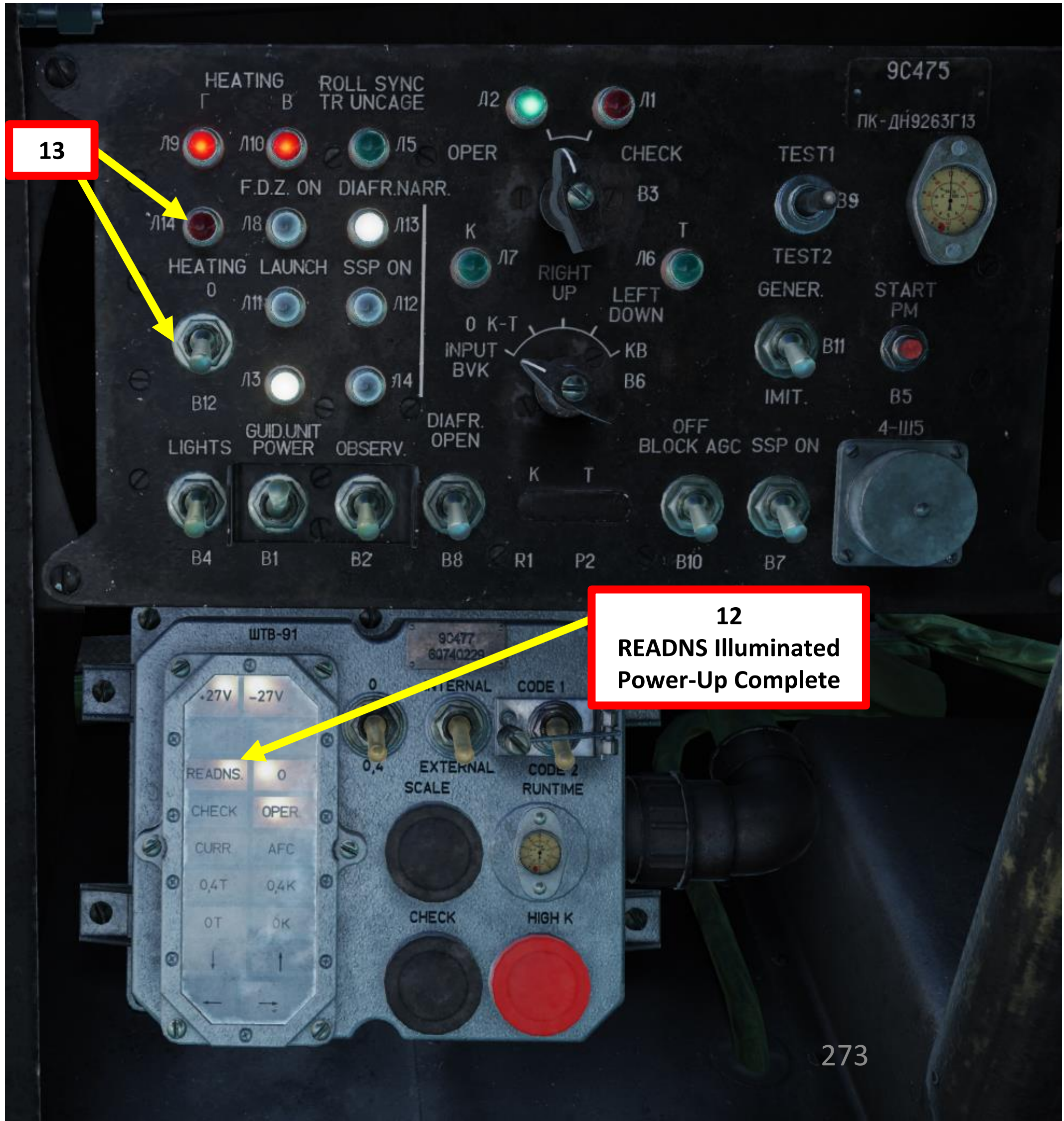




6 – PERISCOPE OPERATION (CPG)

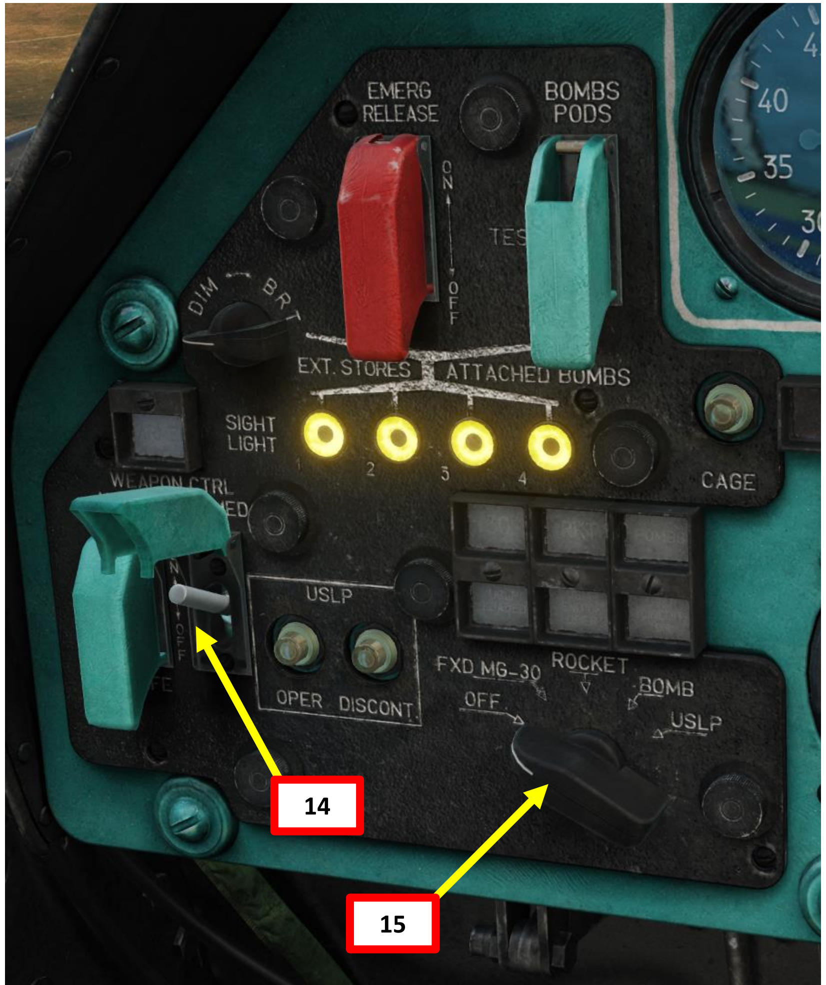
9. Set Aiming Sight Mode – OPER.
10. Set Guidance Unit Power (B1) Switch – ON (UP). Confirm that « L3 » lamp illuminates.
11. Power-up sequence of the Guidance Unit takes approximately 3 minutes.
12. When READNS (Readiness) annunciator illuminates, power-up sequence is complete. You may now start using the periscope.
13. If operating in freezing temperatures, set Aiming Sight Heating (B12) Switch – ON (UP). Otherwise, leave to OFF.

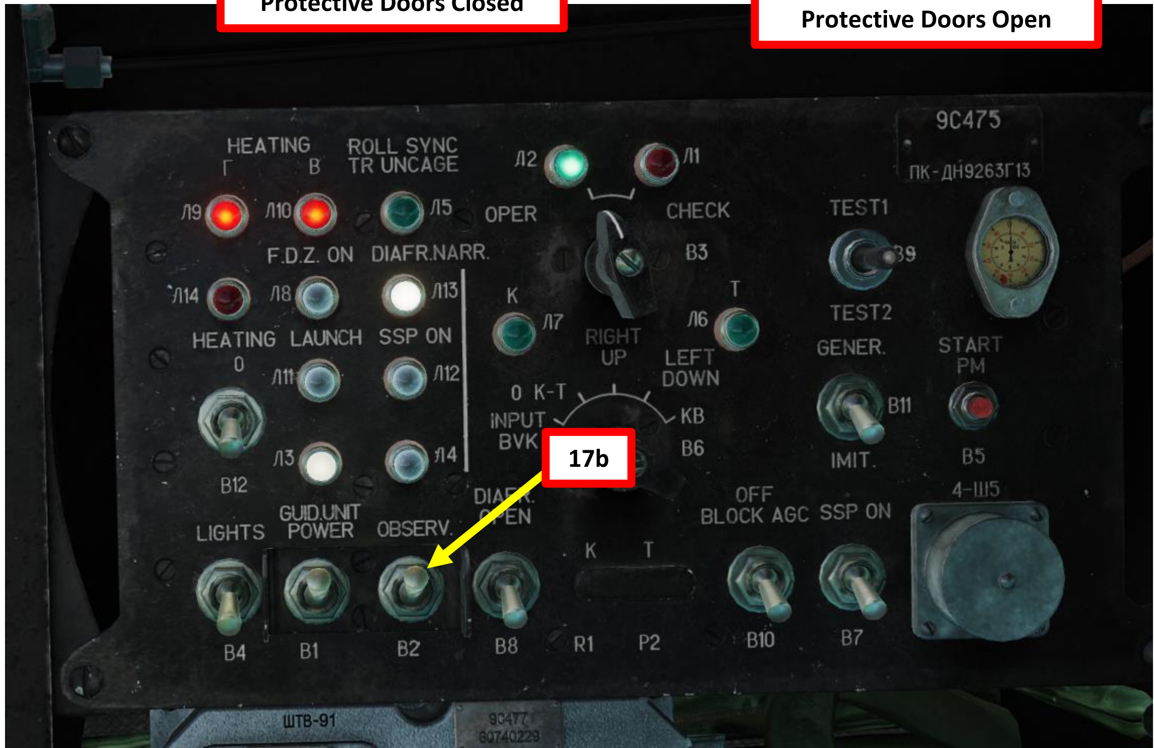




6 – PERISCOPE OPERATION (CPG)

14. Set Pilot/CPG Weapon Selection Control Handover Switch – UP (Co-Pilot/Gunner has Weapon Selection Control).
15. Set Weapon Selector – OFF/MSL.
16. Check in with the Pilot-Commander to make sure the helicopter attitude remains stable. Pilot-Commander can call out “Open Periscope Doors” when ready.
17. Set OBSERVE (B2) Switch – ON (UP).
18. The periscope protective doors open and the aiming sight remains caged in boresight (centered) position for a delay of 10 seconds. After 10 seconds, the periscope is uncaged and the sight can be moved by the guidance unit handles.



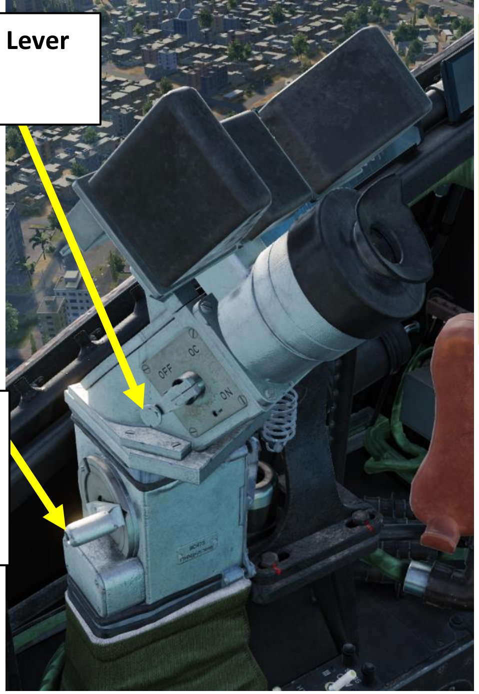


6 – PERISCOPE OPERATION (CPG)

19. Lean on the Aiming Sight by using « LALT+A » (9K113 Aiming Profile ON/OFF).
20. Hide/Show sight tooltips using « LWIN+H ».
21. Hide/Show simulated Steering Helper (red arrow) using « LALT+S ». As a personal preference, I leave it off since it doesn't exist in the real helicopter.
22. Select desired magnification ratio (zoom) by using « LCTRL+X ».
23. Apply Orange Filter (RALT+O) or Laser Protection Green Filter (RALT+G) if desired. I typically don't use them if operating in good weather conditions.

Orange Filter Selector Lever
- *ON/OFF*
- *Binding: RALT + O*

Aiming Sight Magnification Ratio (Zoom) Selector Lever
- *Inwards (As Shown): x3.3 Ratio*
- *Outwards: x10 Ratio*
- *Binding: LCTRL + X*



9K113 Missile Aiming Sight (Periscope)
- *Binding: LALT + A*

Laser (Green) Filter Selector Lever
- *ON/OFF*
- *Binding: RALT + G*

Bindings Summary
- LALT+A: 9K113 Aiming Profile ON/OFF
- RALT+O: Orange Filter ON/OFF
- RALT+G: Laser Protection Filter ON/OFF
- LCTRL+X: Enlargement Factor (Aiming Sight Magnification Ratio (Zoom)
- LALT + R: Radiation Reset
- O: Toggle Observe (B2) Switch ON/OFF

ENLARGMENT FACTOR [LCTRL+X]X3

KEY CONTROL OF
VIEWING AXIS:
LEFT [,]
RIGHT [/]
UP [;]
DOWN [.]

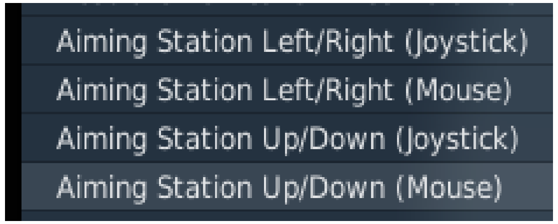
ORANGE FILTER ON/OFF [RALT+O] OFF

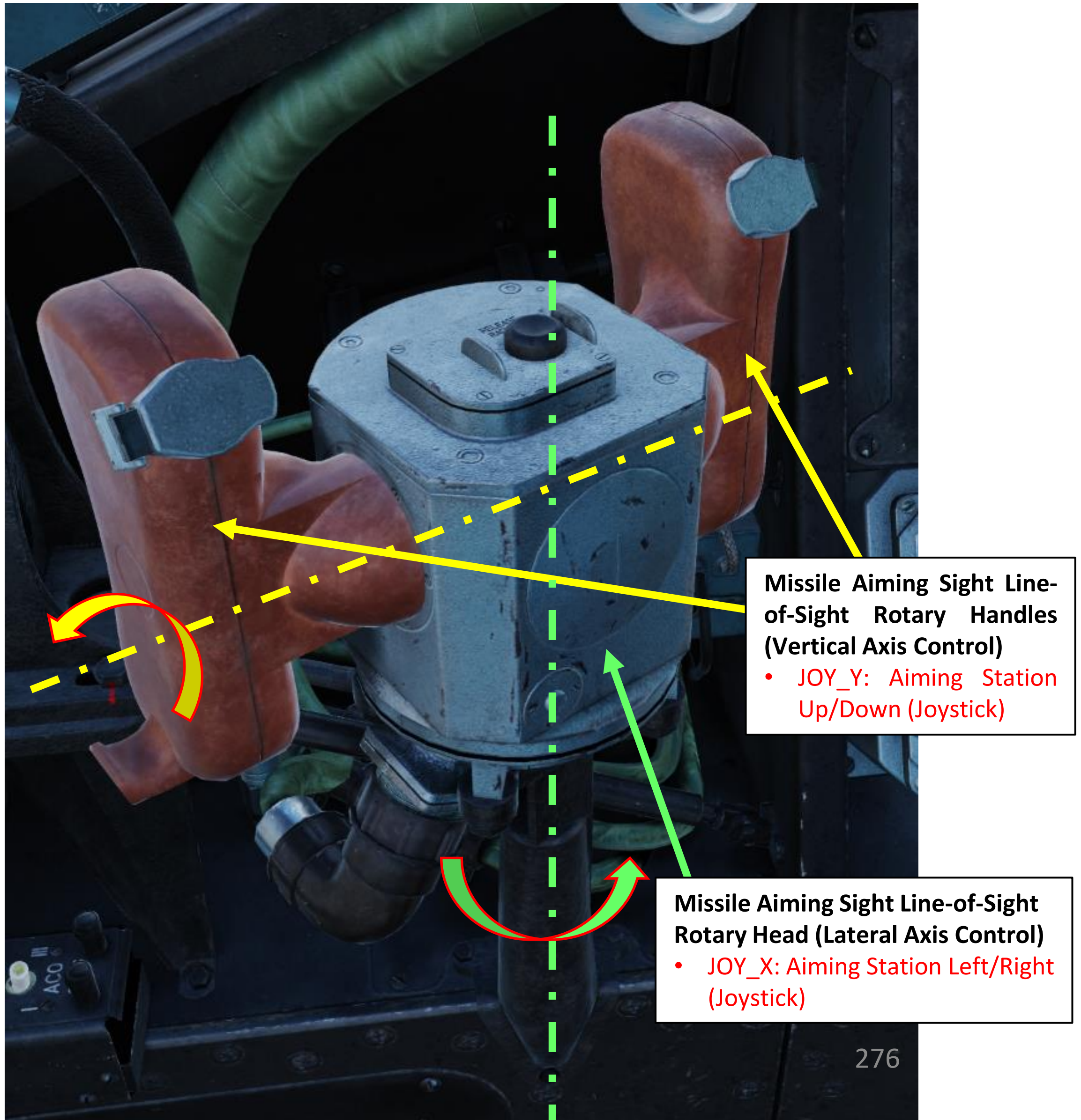
LASER PROTECT [RALT+G] OFF
FILTER ON/OFF
STEERING HELPER [LALT+S] OFF
LAUNCH MISSILE [RCTRL+SPACE]

HIDE/SHOW TIPS [LWIN+H]

6 – PERISCOPE OPERATION (CPG)

24. To move the periscope's aiming sight laterally, use the Aiming Station Rotary Head (Aiming Station Left/Right axis). To move the periscope's aiming sight vertically, use the Aiming Station Rotary Handles (Aiming Station Up/Down axis). Position of rotary head and handles induce angular speed (not angular position). You can use either a joystick binding or the mouse. Personally, I prefer the joystick over the mouse since most joysticks spring back to the center position when released, which is closer to how the controls work in the real helicopter.
25. Exit the Aiming Sight by using « LALT+A » (9K113 Aiming Profile ON/OFF).





6 – PERISCOPE OPERATION (CPG)

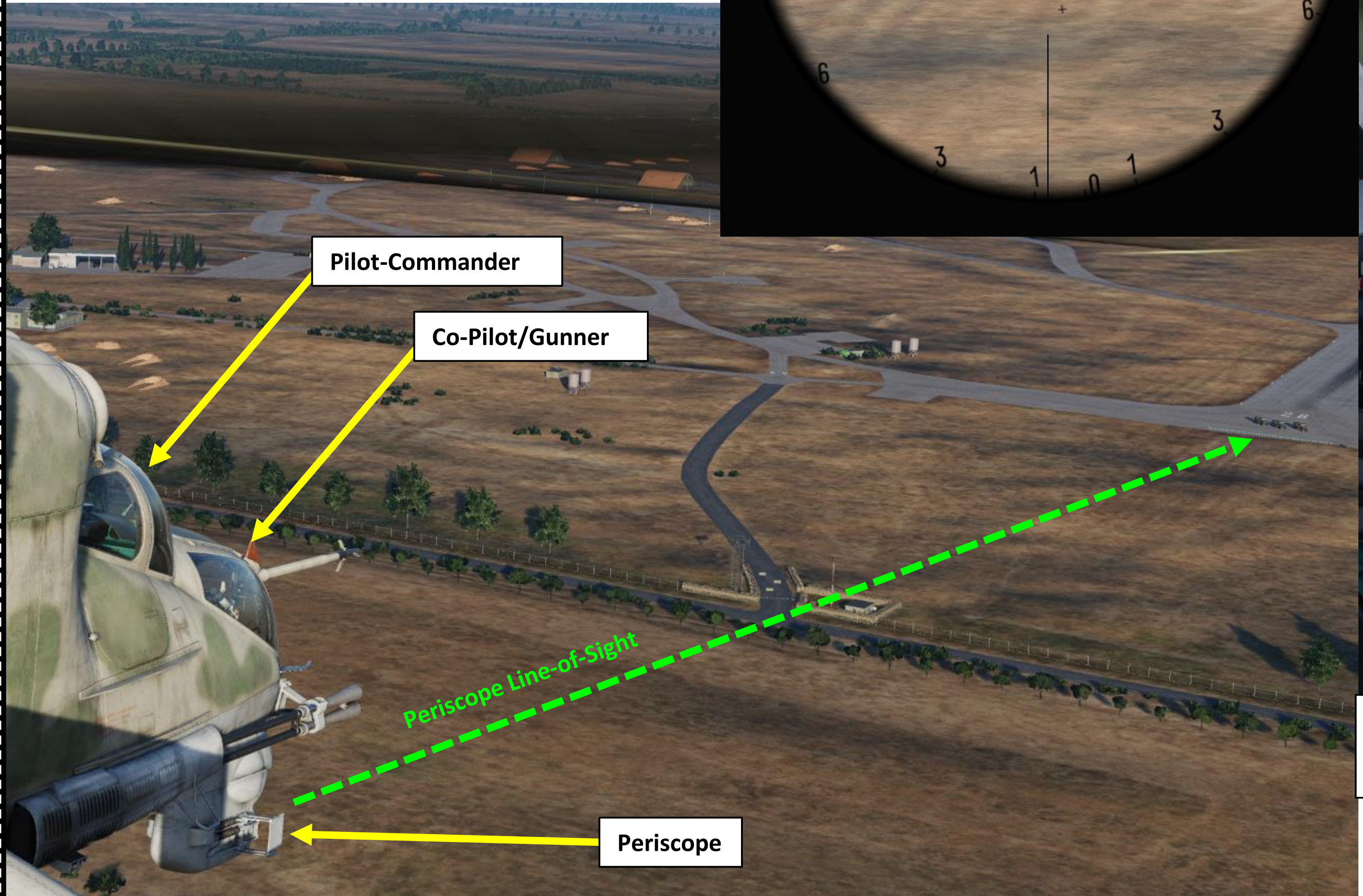
26. The Pilot-Commander can see the periscope's line-of-sight on his own ASP-17VP optical sight if the Sight Mode Selector switch is set to AUTO (UP).
27. Set the OBSERVE (B2) switch to OFF (DOWN) to close the protective doors, boresight the periscope, cage the gimbals. Then, the Co-Pilot/Gunner calls "Periscope Doors Closed" to the Pilot-Commander to let him know that he can start evasive manoeuvers without risking damaging the periscope gimbals.

Co-Pilot/Gunner Aiming Sight

Pilot-Commander Cockpit

Sight Mode Selector
- *UP: Automatic, displays the Floating Reticle*
- *DOWN: Manual*

26a



SECTION SUMMARY

1.1 – ARMAMENT INTRODUCTION

The Mi-24 may seem like a complicated weapon platform at first, but its operation is relatively simple. Here are a few things to remember:

- The main duty of the Pilot-Commander (PC) is to fly the helicopter towards the target. The Master Arm control (**Weapon Fire Control Main Power Switch**) is located in this cockpit, which makes the pilot ultimately responsible to deliver unguided weapons (rockets, bombs, gun pods, cannons). The pilot can launch missiles but the target designation with the periscope is ultimately the Co-Pilot's job.
- The main duty of the Co-Pilot/Gunner (CPG) is to power up the weapon circuits (the Pilot-Commander cannot employ any weapons without them being powered), manage countermeasure programs and operate guided weapons like the Shturm and Ataka missiles.
- In case the Pilot-Commander is incapacitated, it is possible for the Co-Pilot/Gunner to fly the helicopter and to employ unguided weapons using the **Weapon Selection Control Handover Switch**. However, the Master Arm (Fire Control Main Power) in the Pilot-Commander's cockpit must be ON.
- The key to operate the Mi-24 successfully is efficient communication between both crew members.

Weapon Fire Control Main Power Switch
(In Pilot-Commander Aft Cockpit)
- *UP: ON*
- *DOWN: OFF*

Pilot/CPG Weapon Selection Control Handover Switch
(In Co-Pilot/Gunner Front Cockpit)
- *UP: Co-Pilot/Gunner has Weapon Selection Control*
- *DOWN: Pilot-Commander has Weapon Selection Control*

1.2 – ARMAMENT OVERVIEW

CANNON, EXTERNAL GUNPOD & ROCKETS		
NAME	DESCRIPTION	GOOD AGAINST
GSh-2-30K 30 mm Dual Barrel Cannon	Gryazev-Shipunov 30 mm dual barrel autocannon (250 rounds)	Soft Ground Targets
UB-32 Rocket Pod	32 x S-5KO 57 mm Unguided Rockets	Soft Ground Targets
B-8V2OA Rocket Pod	20 x S-8KOM 80 mm Unguided Rockets	Soft Ground Targets
BL-13L1 Rocket Pod	5 x S-13OF 122mm Unguided Rockets	Soft Ground Targets
S-24B	Single rocket (240 mm) for hard targets. Warheads: A= Fragmentation / B= Anti-Bunker	Hard Ground Targets
GUV 8700 Gun Pod Variant 9A800	30 mm AP-30 Grenade Launcher	Infantry
GUV 8700 Gun Pod Variant 9A624/9A622	1 x 12.7 mm + 2 x 7.62 mm four-barrel Gatling machineguns	Infantry

BOMBS (UNGUIDED)		
NAME	DESCRIPTION	GOOD AGAINST
FAB-100/250/500	100, 250 and 500 kg general purpose bombs	Single Ground Targets
KMGU-2 (USLP)	96 x AO-25RT Cluster Munitions	Clusters of targets

1.2 – ARMAMENT OVERVIEW

AIR-TO-GROUND MISSILE

NAME	RANGE MAX/EFFECTIVE	DESCRIPTION	GOOD AGAINST
9M114 Shturm (AT-6 Spiral)	5 / 5 km	SACLOS (Semi-Automatic Command to Line-of-Sight) radio-guided anti-tank missile, can be used on both air and ground targets. The missile is guided by the copilot-gunner looking through the periscope.	Ground Targets
9M120 Ataka (AT-9 Spiral-2)	6 / 6 km	SACLOS (Semi-Automatic Command to Line-of-Sight) radio-guided anti-tank missile, can be used on both air and ground targets. The missile is guided by the copilot-gunner looking through the periscope. There are three main missiles that are compatible with the launch system: • **9M120**: first missile variant, a two-stage a HEAT (high explosive anti-tank) weapon that features a tandem warhead for dealing with add-on armor. • **9M120F**: second missile variant, features a thermobaric warhead for use against buildings, infantry positions and bunkers. • **9M220**: third missile variant, features a proximity fused expanding rod warhead, providing the missile with air-to-air capability against low-flying and slow-flying aircraft.	Ground Targets (9M120, 9M120F) Helicopters (9M220)

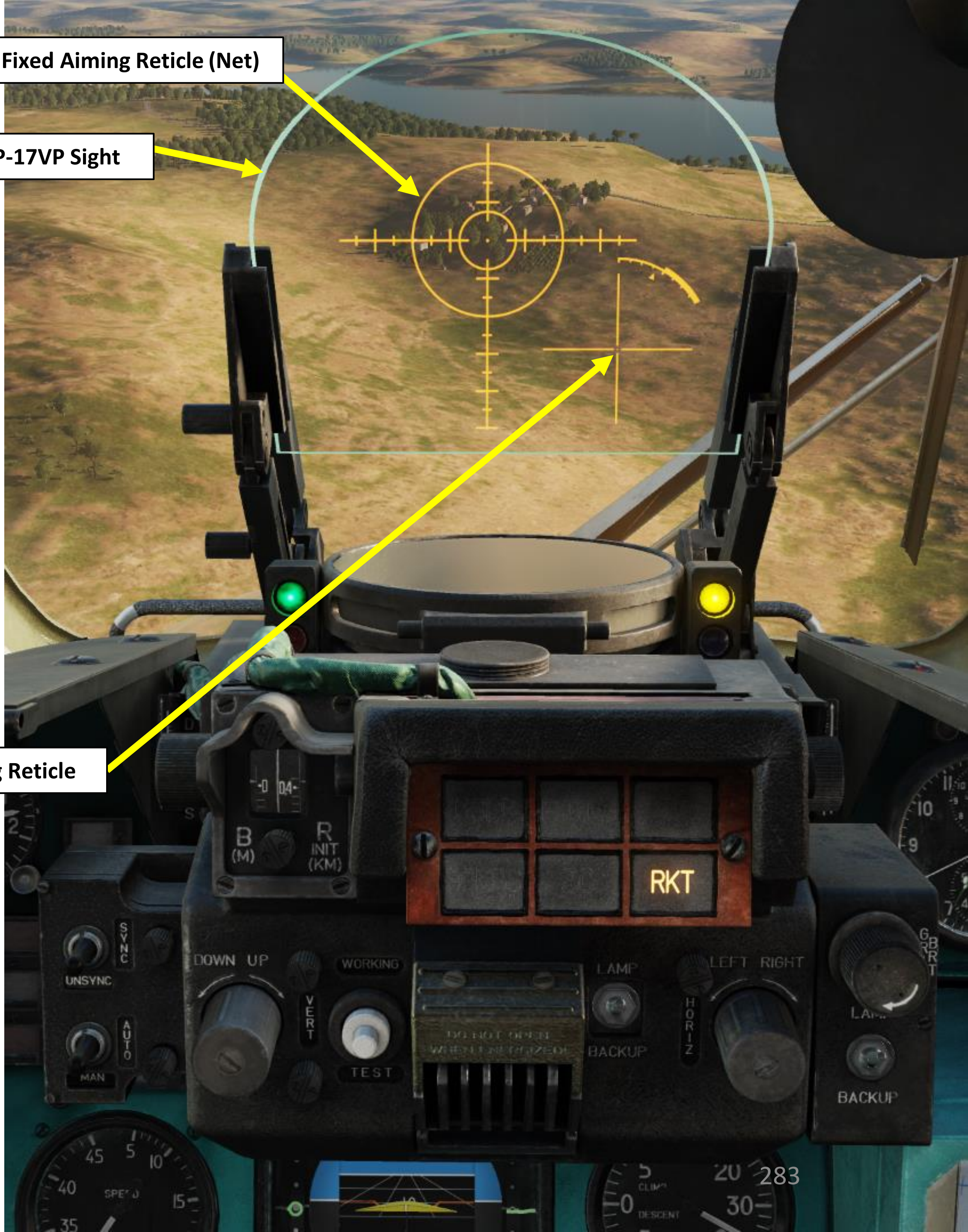
AIR-TO-AIR MISSILES

NAME	RANGE MAX/EFFECTIVE	DESCRIPTION	GOOD AGAINST
R-60M Aphid	8 / 4 km	Infrared Seeker, 1982, All Aspect	Aircraft & Helicopters

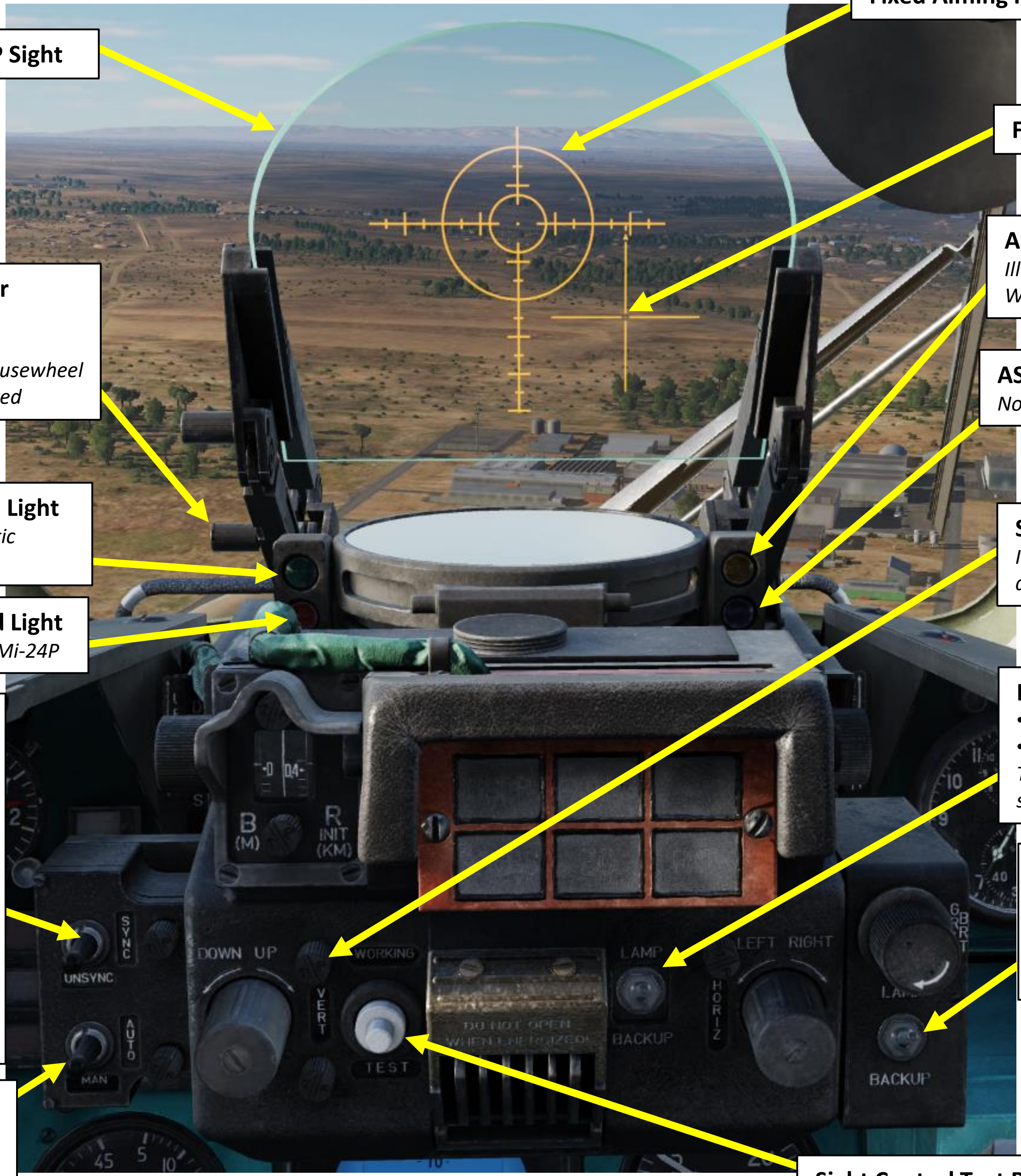
1.3 – ASP-17VP OPTICAL SIGHT (PC)

The Pilot-Commander's (PC) ASP-17VP Optical Sight is used to help him aim his weapons on target. The sight has two main components:

- The **Fixed Aiming Reticle**, which is static
- The **Floating Aiming Reticle** is dynamic and is a bit more useful since it can provide automatic ranging information based on the helicopter's attitude and altitude.
    - This reticle is used with GUV-8700 Gun Pods with 12.7 mm and 7.62 mm Machineguns, S-5 Rockets, S-8 Rockets and the GSh-2-30K Fixed Main 30 mm twin-barrel cannon.
    - This reticle can also display where the periscope of the CPG (Co-Pilot Gunner) is looking when employing air-to-ground missiles.



1.3 – ASP-17VP OPTICAL SIGHT (PC)



ASP-17VP Sight

Fixed Aiming Reticle (Net)

Floating Aiming Reticle

Sight Reflector Glass Control Lever
- *UP: Sight Unlocked*
- *DOWN: Sight Locked*

When lever is unlocked (UP), scroll mousewheel to adjust reflector glass position as desired

ASP-17VP Sight Yellow Light
Illuminates when in Optimal Weapons Range

ASP-17VP Sight Purple Light
Not operational in the Mi-24P

ASP-17VP Sight Green Light
Illuminates when Automatic Ranging is ON

ASP-17VP Sight Red Light
Not operational in the Mi-24P

Sight Test WORKING (OPERATIONAL) Lamp
Illuminates when sight test has been performed and sight is operating as expected.

Sight Synchronization Mode Selector
- *UP: SYNCHRONIZED. This mode provides the pilot with automatic speed correction. This is used for moving targets. Hold the aiming reticle on a moving target for 2–3 seconds, and the fire control computer will automatically adjust for target velocity.*
- *DOWN: UNSYNCHRONIZED. In AUTO Ranging mode, wind and sideslip calculations are performed by the fire control computer (suitable for stationary targets)*

Floating Reticle Lamp Selector
- *UP: Primary Lamp Selected*
- *DOWN: Backup Lamp Selected*

Toggles between the primary and standby lamp for the floating reticle.

Fixed Reticle Lamp Selector
- *UP: Primary Lamp Selected*
- *DOWN: Backup Lamp Selected*

Toggles between the primary and standby lamp for the fixed reticle.

Sight Mode Selector
- *UP: Automatic, displays the Floating Reticle*
- *DOWN: Manual*

Sight Control Test Button

1.3 – ASP-17VP OPTICAL SIGHT (PC)

Armament Selection Lights
- ***USLP** (КМГ): KMGU-2 (КМГУ-2) Cluster Munitions Dispenser*
- ***FXD MG** (ГУВ): GUV-8700 (ГУВ-8700) Gun Pod or AP-30 Automatic Grenade Launcher pod*
- ***Blank**: Not Used*
- ***BOMBS** (БОМБЫ): Fragmentation and Cluster Bombs*
- ***30**: Fixed 30 mm twin-barrel cannon (GSh-2-30K)*
- ***RKT** (НРС): Unguided rocket pods or S-24B Rockets*

Target Base (Size) & Range Scale
- *Left Scale: target size in meters*
- *Right Scale: range in kilometers*

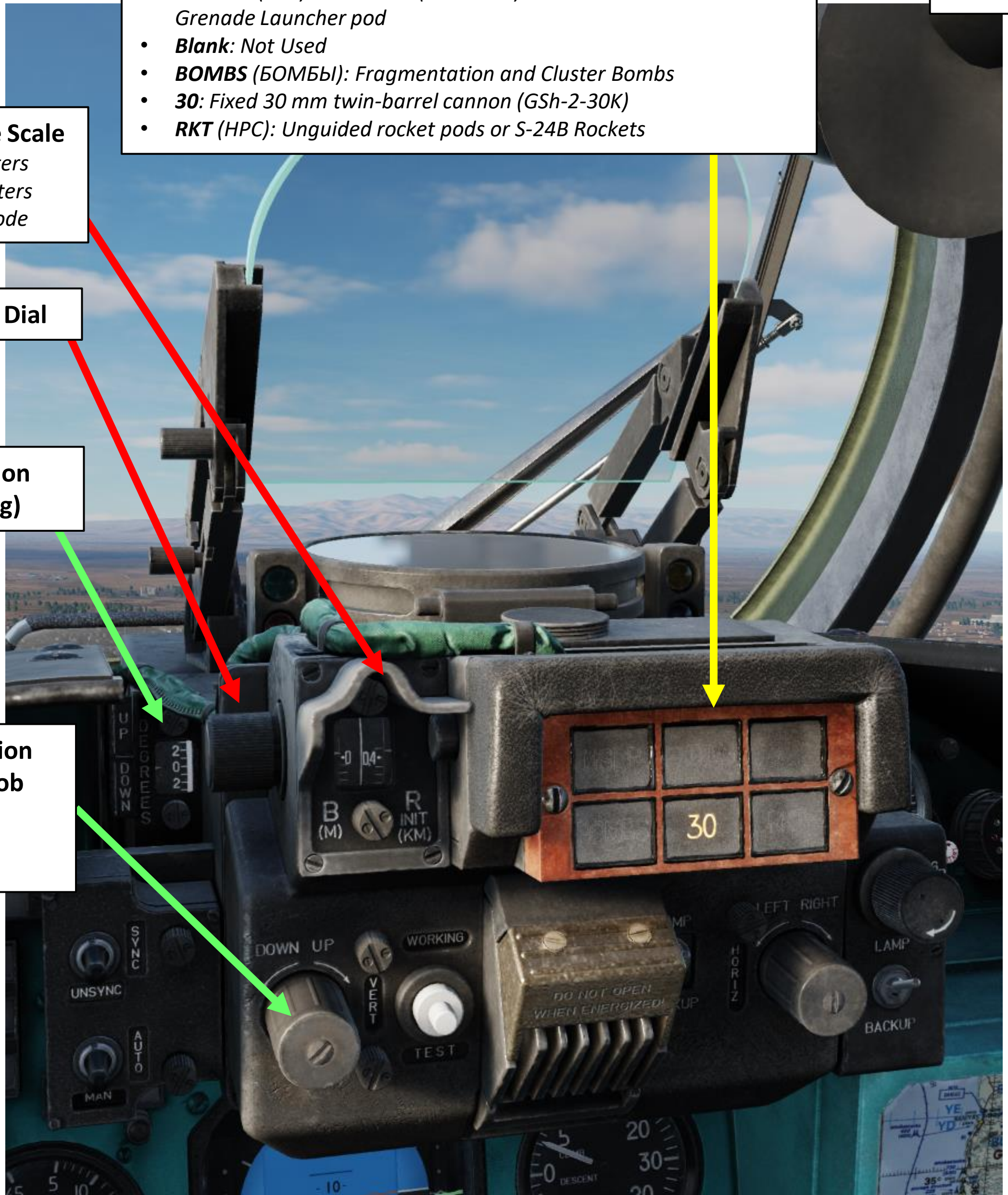
Applicable to AUTO Ranging Mode

Target Base (Size) Setting Dial

Sight Floating Reticle Elevation Angle Correction Setting (deg)

Sight Floating Reticle Elevation Angle Correction Setting Knob

Used for Manual Mode.
- *Turn Left = DOWN*
- *Turn Right = UP*



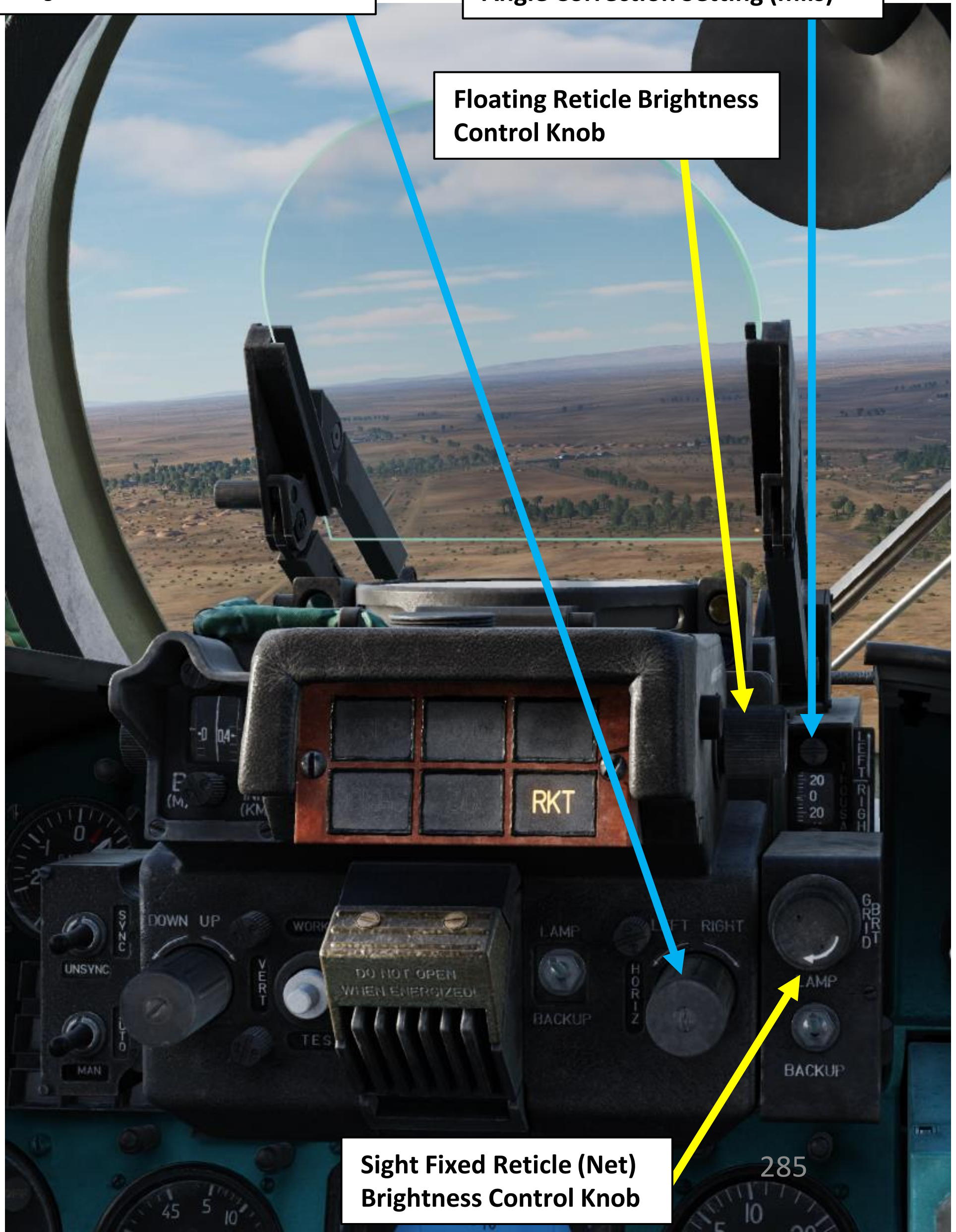
Sight Floating Reticle Azimuth Angle Correction Setting Knob

Used for Manual Mode
- *Turn Left = LEFT*
- *Turn Right = RIGHT*

Sight Floating Reticle Azimuth Angle Correction Setting (mils)

Floating Reticle Brightness Control Knob

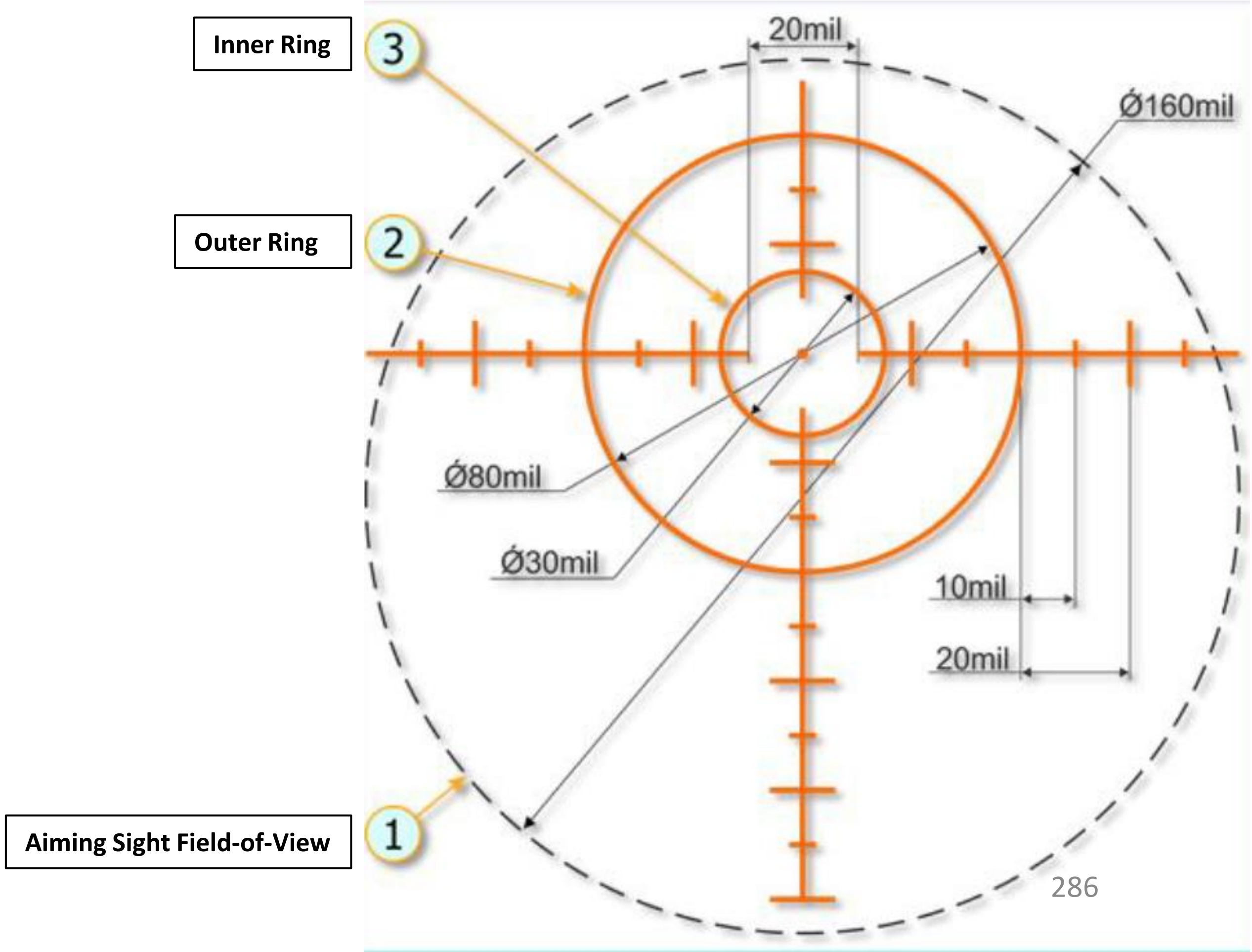
Sight Fixed Reticle (Net) Brightness Control Knob



1.3 – ASP-17VP OPTICAL SIGHT (PC)

Fixed Reticle

The fixed reticle is 8 degrees wide and mainly used for manual ranging. The reticle is best used to estimate a target range when the “floating reticle” isn’t available.



1.3 – ASP-17VP OPTICAL SIGHT (PC)

Target Ranging – Fixed Reticle

Now… how do we know when the target is in range to fire? Typically, you choose a firing range/distance first (as an example, 2000 meters), then place the fixed sight on the target and approach until it fits reference marks in "mils" (milliradians, which is an angle) for the desired firing distance.

As an example, let's take a T-72 tank, which has a length of 7 meters.

There is a rule in trigonometry that states that "in a right triangle, the tangent (tan) of an angle is the length of the opposite side divided by the length of the adjacent side". For very small angles, simplifications can be made. I'll spare you the math, but the bottom line is:

$$\frac{\theta}{2} = \arctan\left(\frac{L/2}{D}\right)$$

$$\text{For small angles, } \arctan\left(\frac{L/2}{D}\right) \ \textit{can be approximated to} \ \frac{L/2}{D}$$

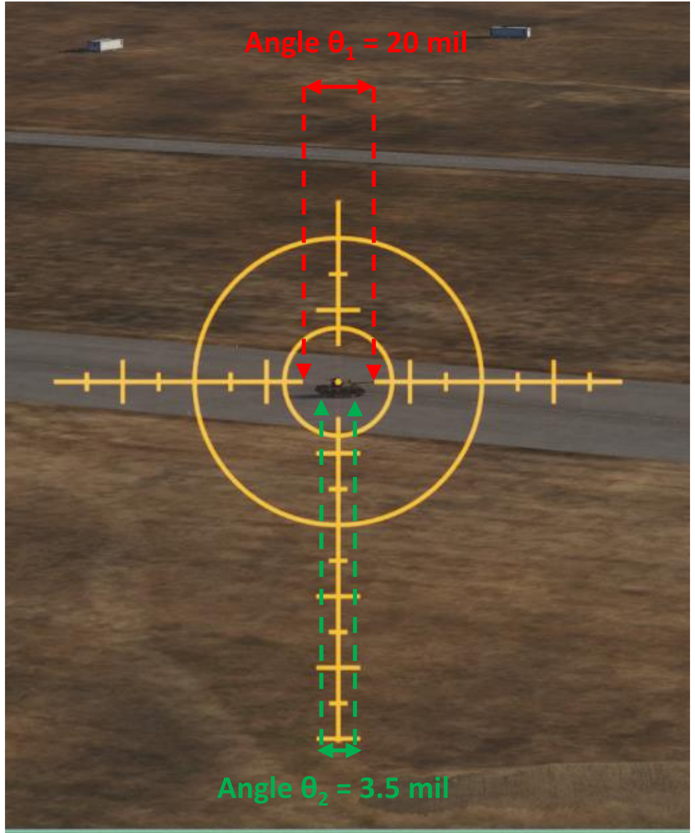
$$\text{Therefore: } \theta = \frac{L}{D}$$

For a target with a length L_1 = 7 m at a distance D_1 of 350 m:

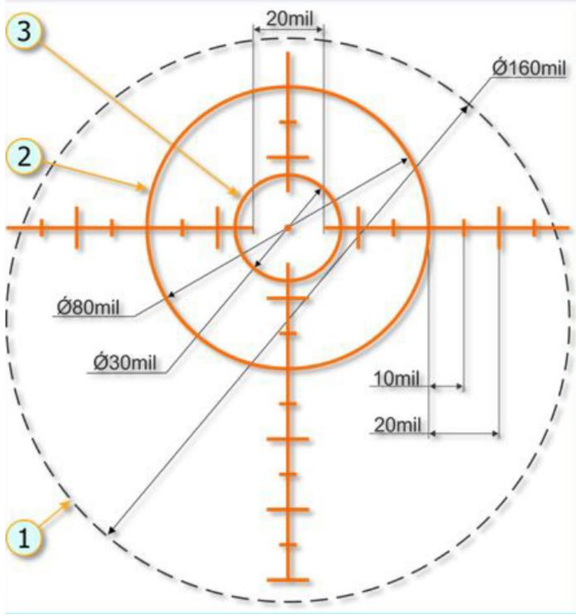
$$\theta_1 = \frac{L_1}{D_1} = \frac{7\ m}{350\ m} = 0.020\ rad = 20\ mil\ (milliradians)$$

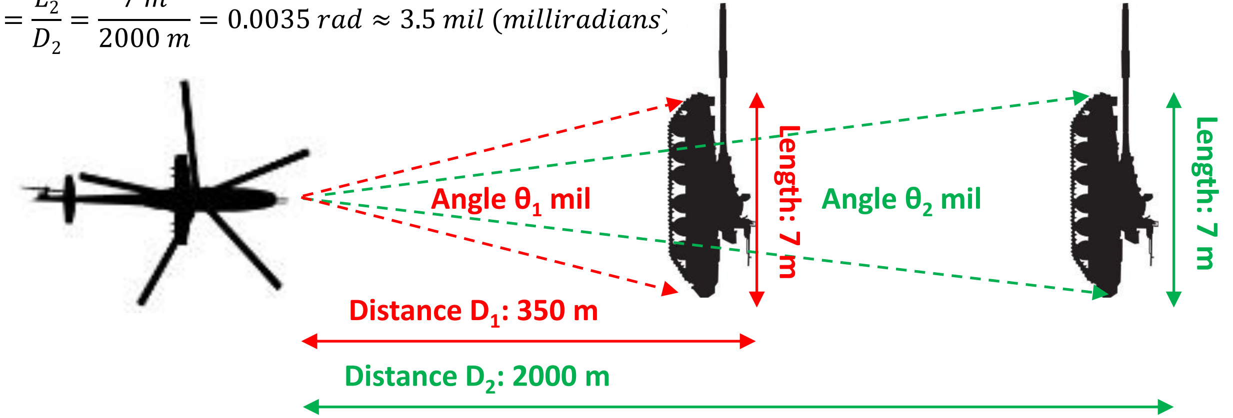
For a target with a length L_2 = 7 m at a distance D_2 of 2000 m:

$$\theta_2 = \frac{L_2}{D_2} = \frac{7\ m}{2000\ m} = 0.0035\ rad \approx 3.5\ mil\ (milliradians)$$



You are at a 350 m range when target fits between the 20 mil lines, which is often way too close to a target. Good firing ranges around 2000 m are better suited, which means the target should fit within 3.5 mils, which is about a fifth of the 20 mil reference marks.





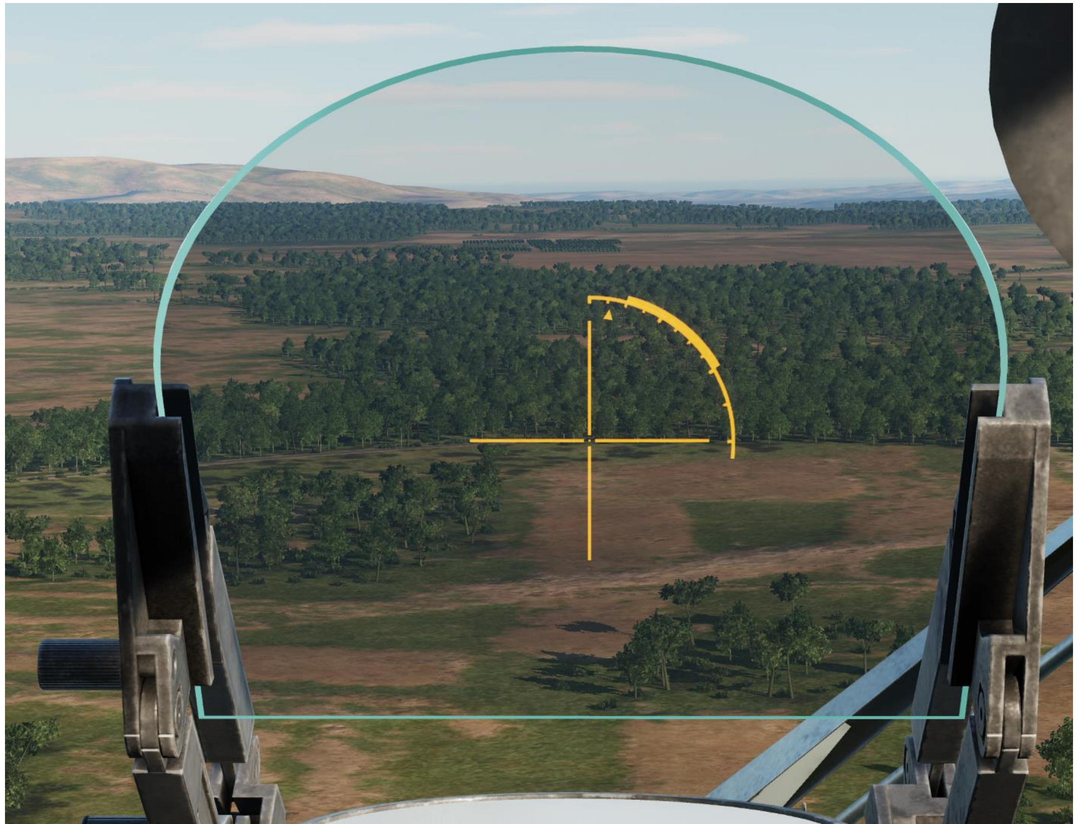
1.3 – ASP-17VP OPTICAL SIGHT (PC)

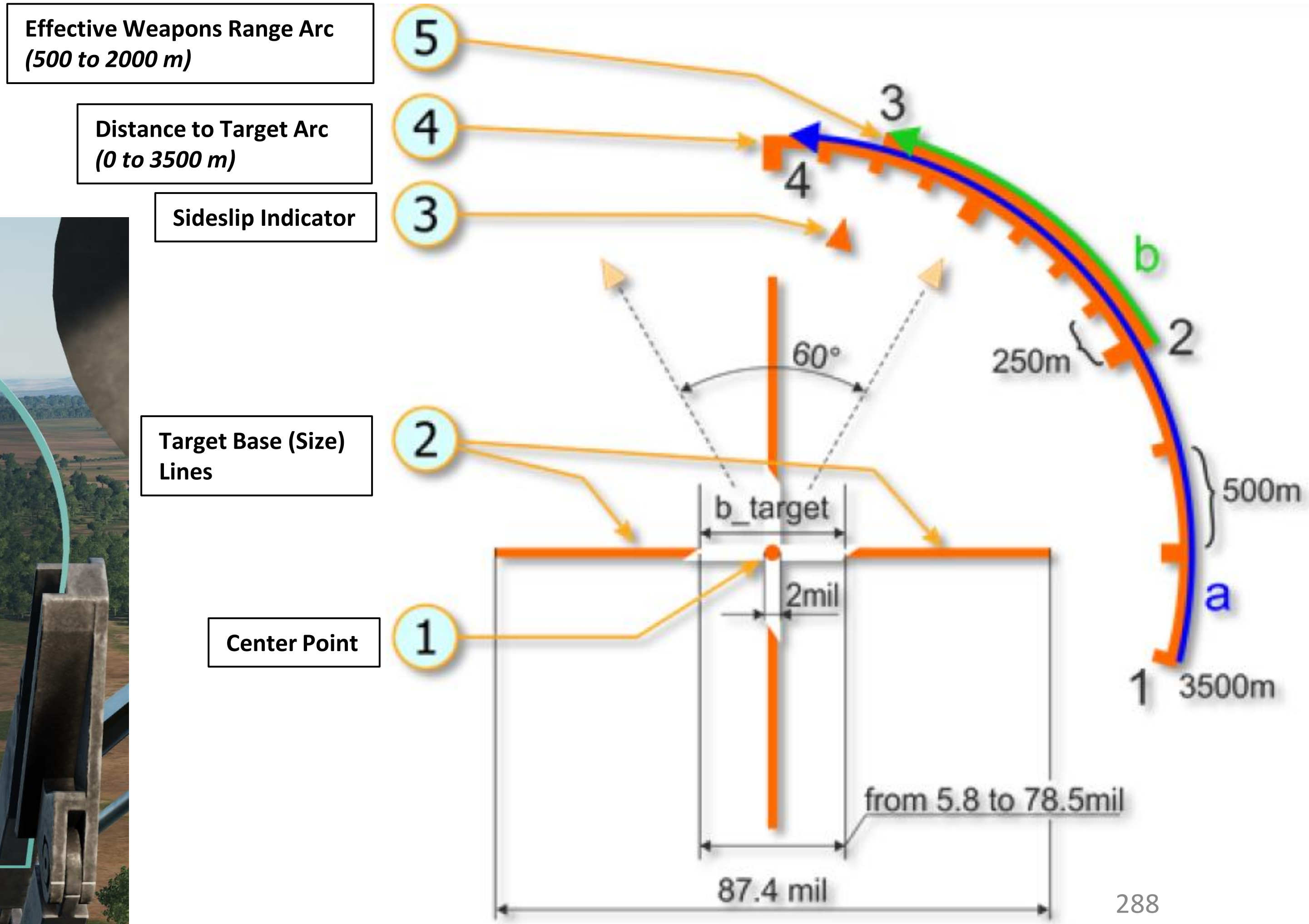
Floating Reticle

When in automatic mode, the floating reticle gives a dynamic range solution indication when employing any of the following weapons:

- GUV-8700 Gun Pods with 12.7 mm and 7.62 mm Machineguns
- S-5 Rockets
- S-8 Rockets
- GSh-2-30K Fixed Main 30 mm twin-barrel cannon

Distance to target is displayed as an arc spanning from point 1 to point 4, shrinking as distance decreases. Effective weapons range is shown as an arc from point 2 to point 3.

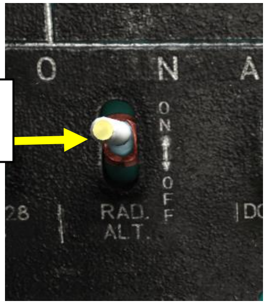


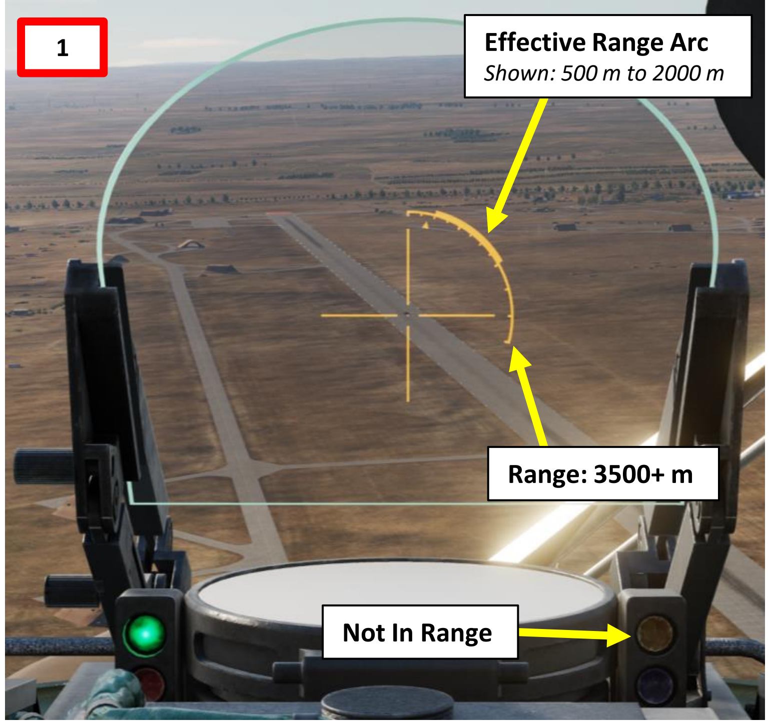


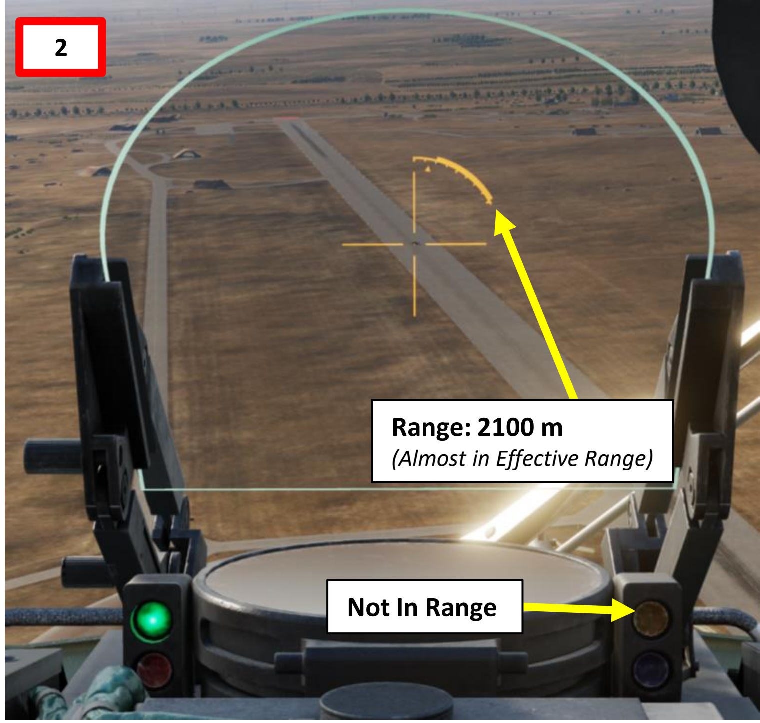
1.3 – ASP-17VP OPTICAL SIGHT (PC)

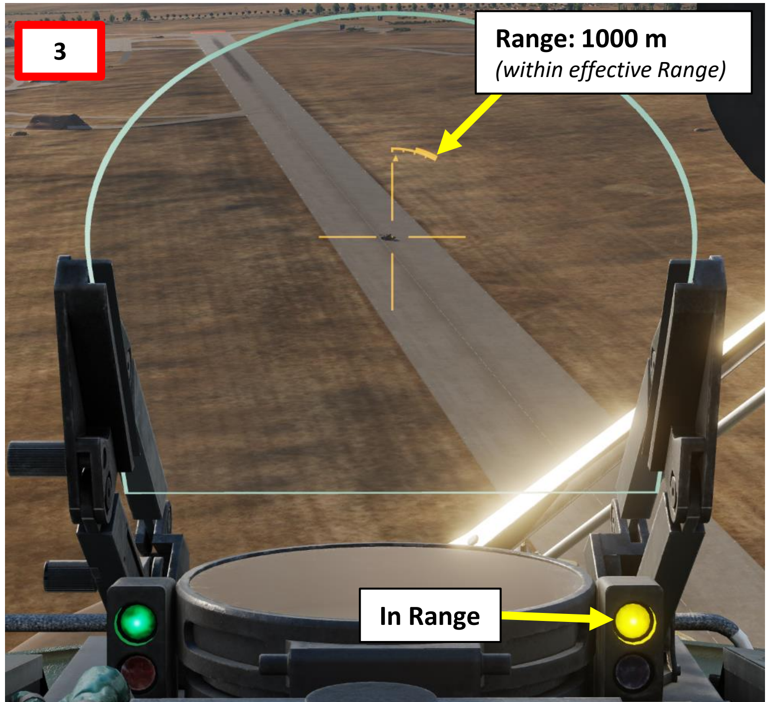
Target Ranging – Floating Reticle

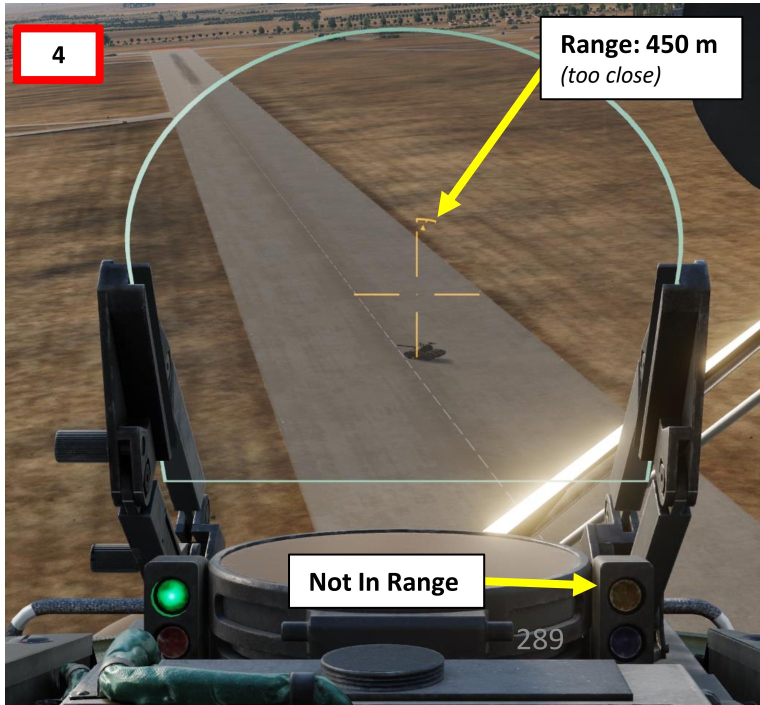
Here is an example of how the range indication evolves as you approach a target. The helicopter uses aircraft pitch attitude and radar altimeter information to determine the range, so make sure you have your RAD ALT switch set to ON (UP).











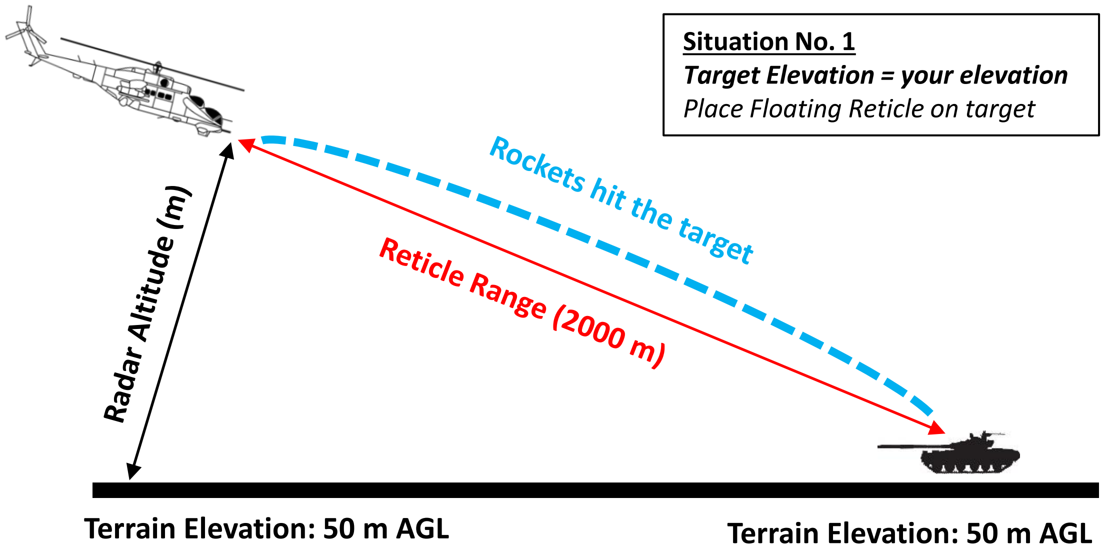
1.3 – ASP-17VP OPTICAL SIGHT (PC)

Floating Reticle

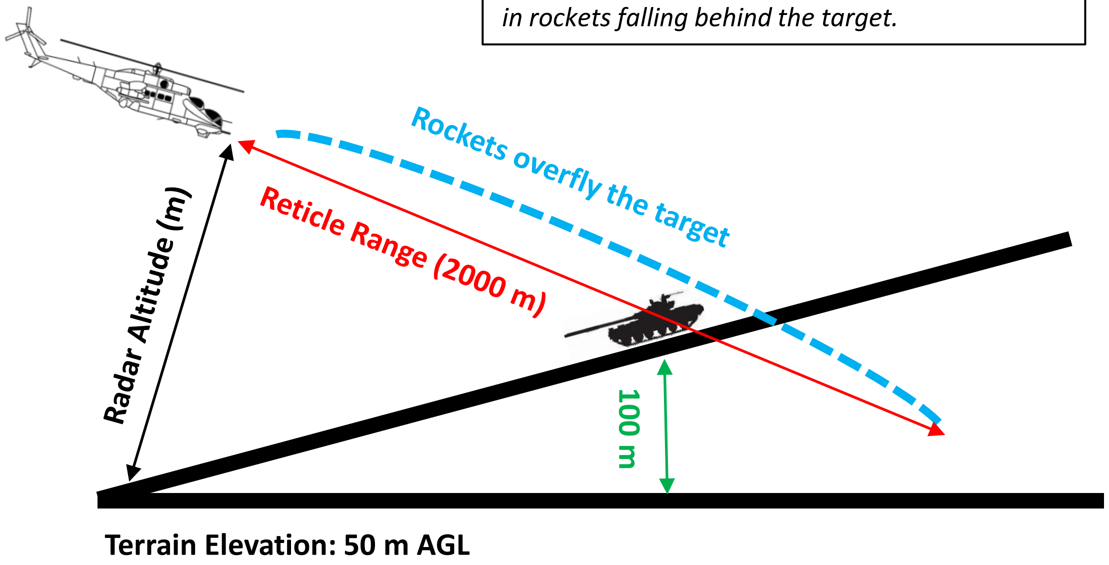
The Mi-24 is not equipped with a laser range finder; the range is computed using a combination of the helicopter pitch attitude and radar altitude. This means that the computed range is accurate for targets located at the same elevation as you (situation No. 1), but a difference in elevation between you and the target may require you to adjust your aim to take into account this elevation differential:

- If little to no terrain elevation difference, place the floating reticle on the target. See Situation No. 1.
- If target elevation is greater than your own elevation, aim a little short of the target. See Situation No. 2 for a bad aiming solution and Situation No. 3 for a good aiming solution.
- If target elevation is lesser than your own elevation, aim a little behind the target.

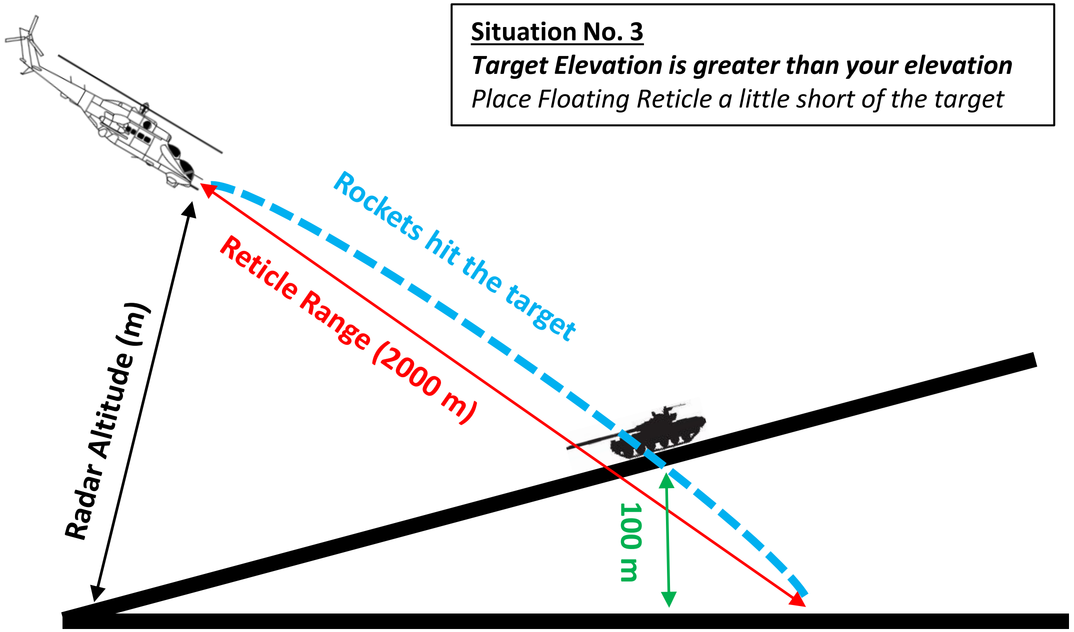
Situation No. 1
Target Elevation = your elevation
Place Floating Reticle on target



Situation No. 2
Target Elevation is greater than your elevation
Placing Floating Reticle on the target may result in rockets falling behind the target.



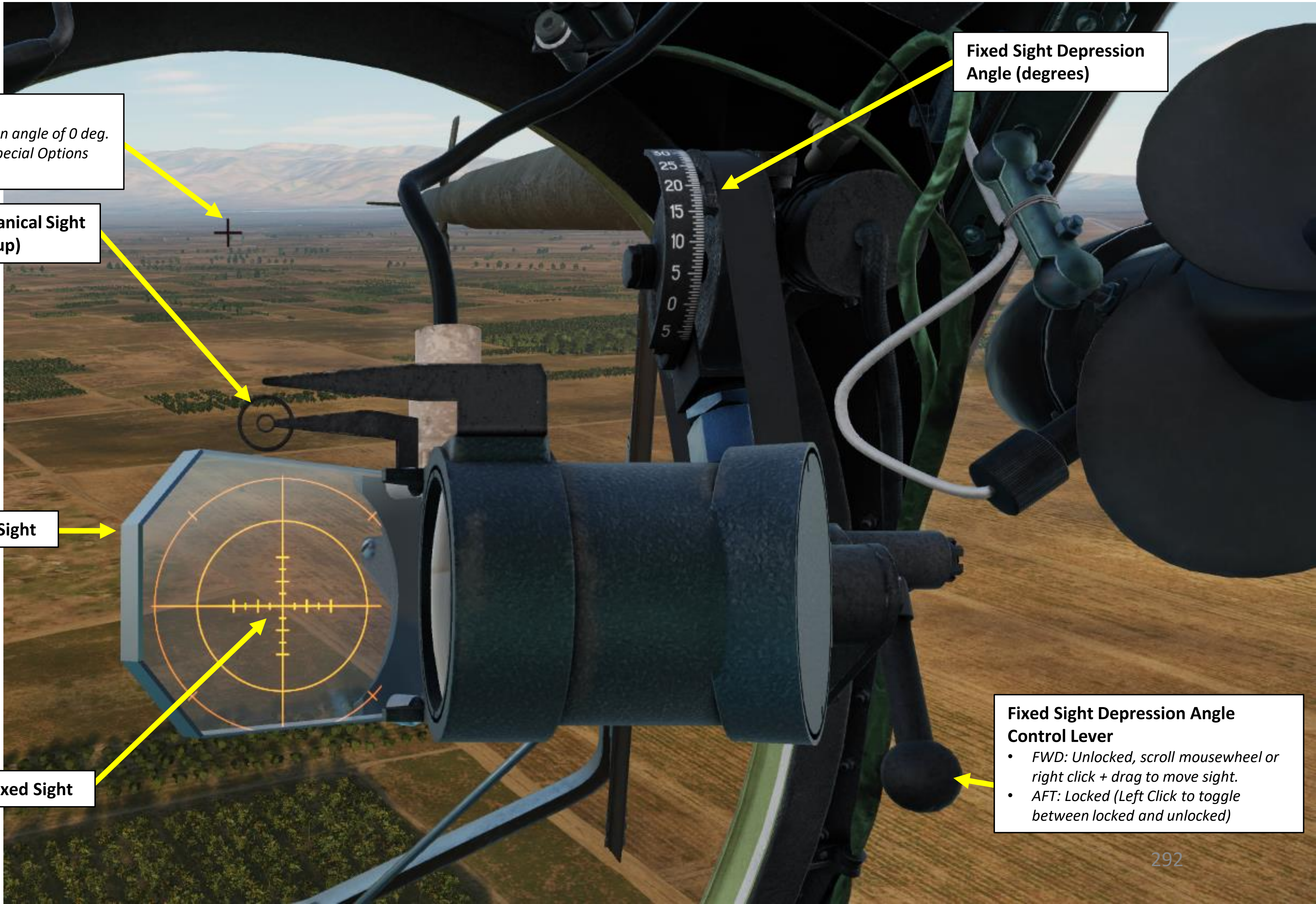
Situation No. 3
Target Elevation is greater than your elevation
Place Floating Reticle a little short of the target



1.4 – PKI REFLECTOR SIGHT (CPG)

In situations where the Pilot-Commander is incapacitated, the Co-Pilot/Gunner (CPG) also has a fixed (static) reflector sight (PKI), which he can use to deliver unguided weapons like rockets and the cannon.

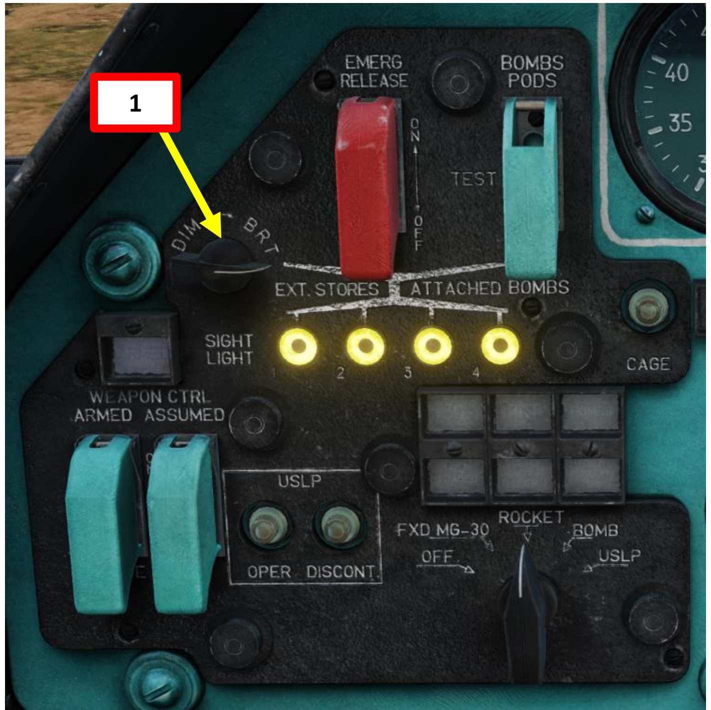
1.4 – PKI REFLECTOR SIGHT (CPG)

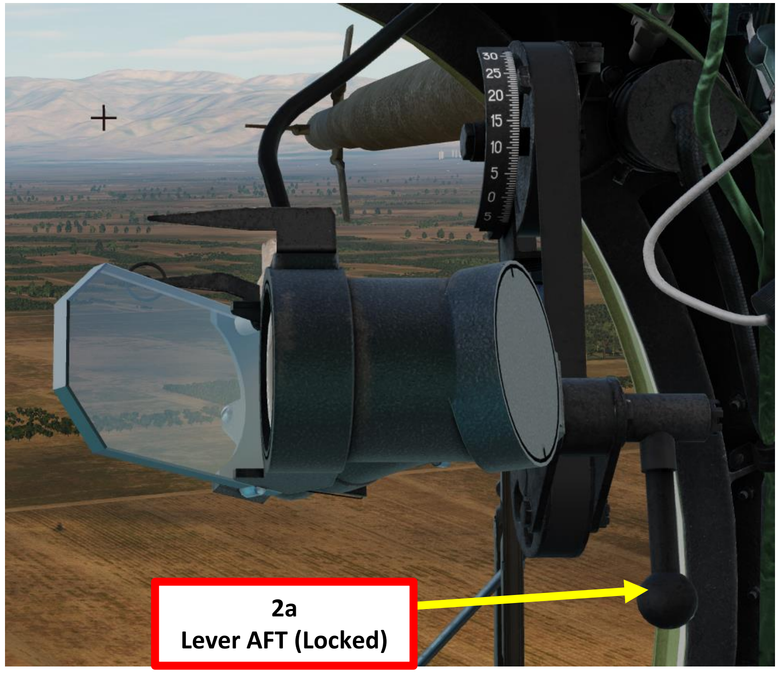


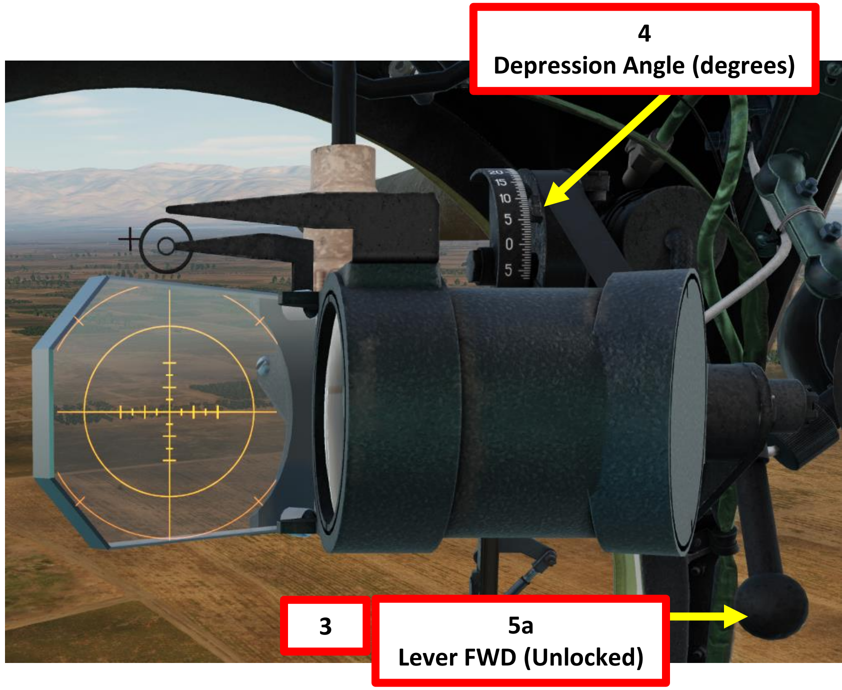
1.4 – PKI REFLECTOR SIGHT (CPG)

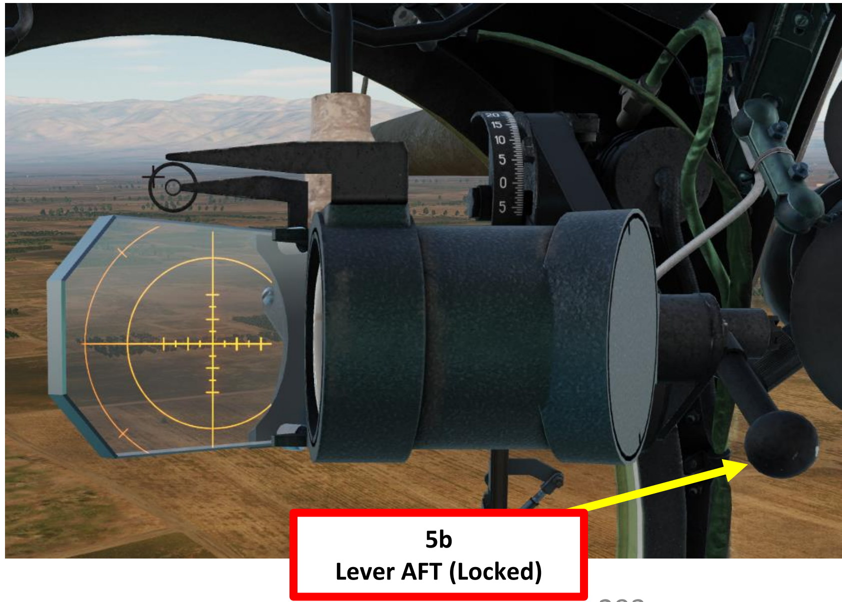
To adjust the PKI sight depression:

1. Turn PKI Reflector Sight Brightness Control Knob to the right to BRT (Bright)
2. Left click on the Fixed Sight Depression Angle Control Lever to unlock it. When unlocked, the lever should be at the FWD position.
3. Right click (and hold right mouse button) on the Fixed Sight Depression Angle Control Lever, then move mouse to adjust the PKI sight position (alternatively, you can scroll mousewheel on the lever).
4. Use the Fixed Sight Depression Angle (degrees) scale to see what depression setting the sight is set to.
5. When PKI sight is in the desired position/depression angle, left click on the Fixed Sight Depression Angle Control Lever to lock it again.



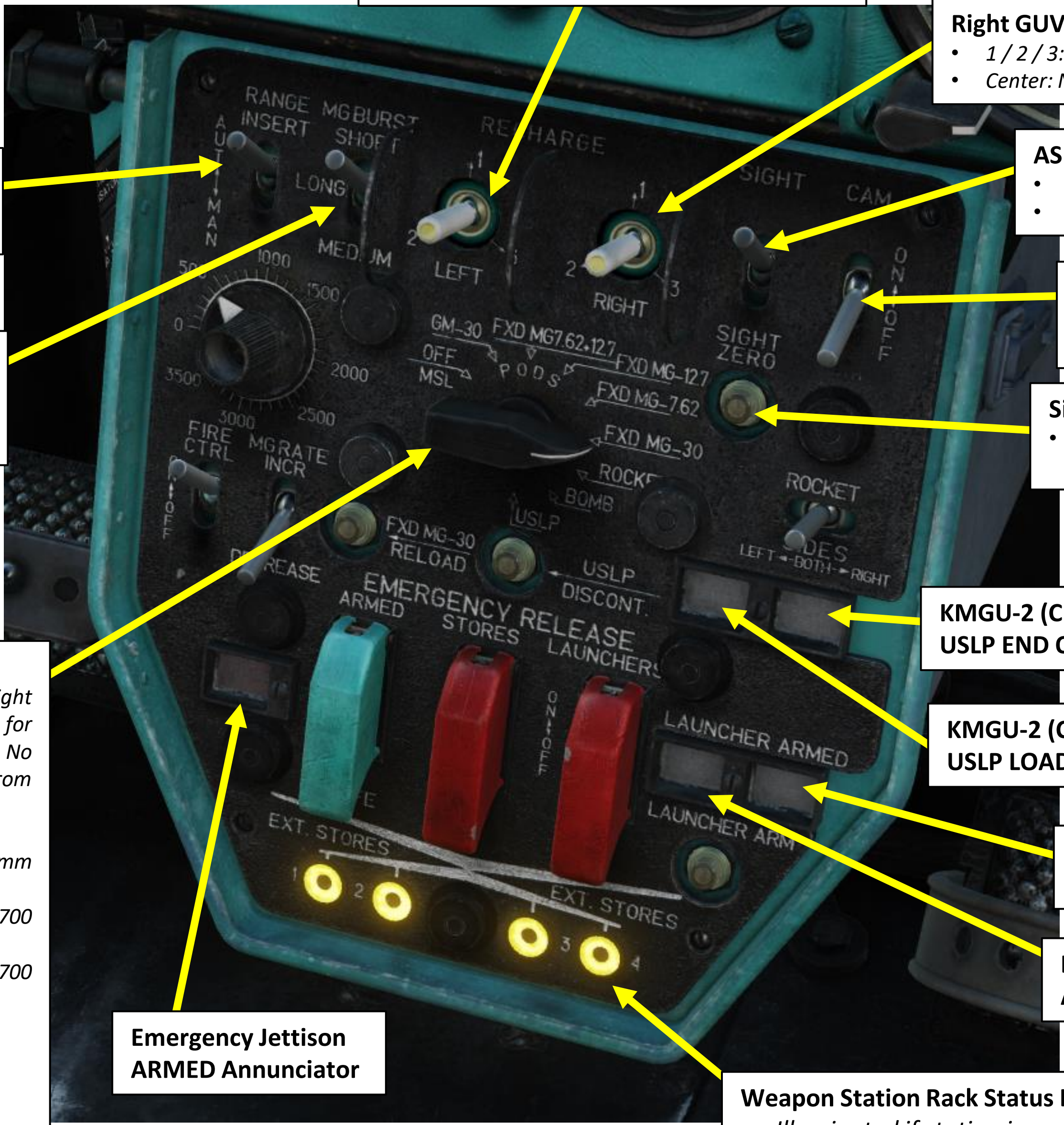






1.5 – WEAPON INTERFACE (PC)

Here is an overview of the weapon interface for the Pilot-Commander (PC).



Left GUV-8700 Gun Pod Reload Switch
- *1 / 2 / 3: Selects Reloading Charge 1, 2 or 3*
- *Center: No Reloading Charge Selected*

Right GUV-8700 Gun Pod Reload Switch
- *1 / 2 / 3: Selects Reloading Charge 1, 2 or 3*
- *Center: No Reloading Charge Selected*

Sight Ranging Mode Selector
- *UP: Automatic Ranging*
- *DOWN: Manual Ranging*

ASP-17VP Sight Power Switch
- *UP: ON*
- *DOWN: OFF*

Camera Power Switch
- *UP: ON*
- *DOWN: OFF*

Burst Length Selector Switch
- *UP: Short Burst*
- *MIDDLE: Long Burst*
- *DOWN: Medium Burst*

Sight ZERO (Reset Crosshair) Button
- *When held, floating reticle is caged to fixed reticle.*

Weapon Selector
- ***OFF/MSL**: Slaves the floating reticle of the Pilot-Commander sight to the Co-Pilot/Gunner's "ПН" (PN) periscope sight. Used for observation and ATGM (Air-to-Ground Missile) guidance. No weapons are active in this mode; ATGM launch is controlled from either the forward or aft cockpit.*
- ***GM-30 Pod**: Selects AP-30 automatic grenade launcher*
- ***FXD MG 7.62 + 12.7 Pod**: Selects both the 12.7 mm and 7.62 mm guns on the ГУВ-8700 (GUV-8700) gun pod*
- ***FXD MG 12.7 Pod**: Selects the 12.7 mm gun on the ГУВ-8700 (GUV-8700) gun pod*
- ***FXD MG 7.62 Pod**: Selects the 7.62 mm gun on the ГУВ-8700 (GUV-8700) gun pod*
- ***FXD MG 30**: Selects GSh-2-30K fixed 30 mm twin barrel cannon*
- ***ROCKETS**: Selects rockets*
- ***BOMBS**: Selects bombs*
- ***USLP**: Selects КМГУ-2 (KMGU-2) cluster munitions dispenser*

KMGU-2 (Cluster Munitions Dispenser, USLP) USLP END OF OPERATION (Empty) Annunciator

KMGU-2 (Cluster Munitions Dispenser, USLP) USLP LOADED (Available) Annunciator

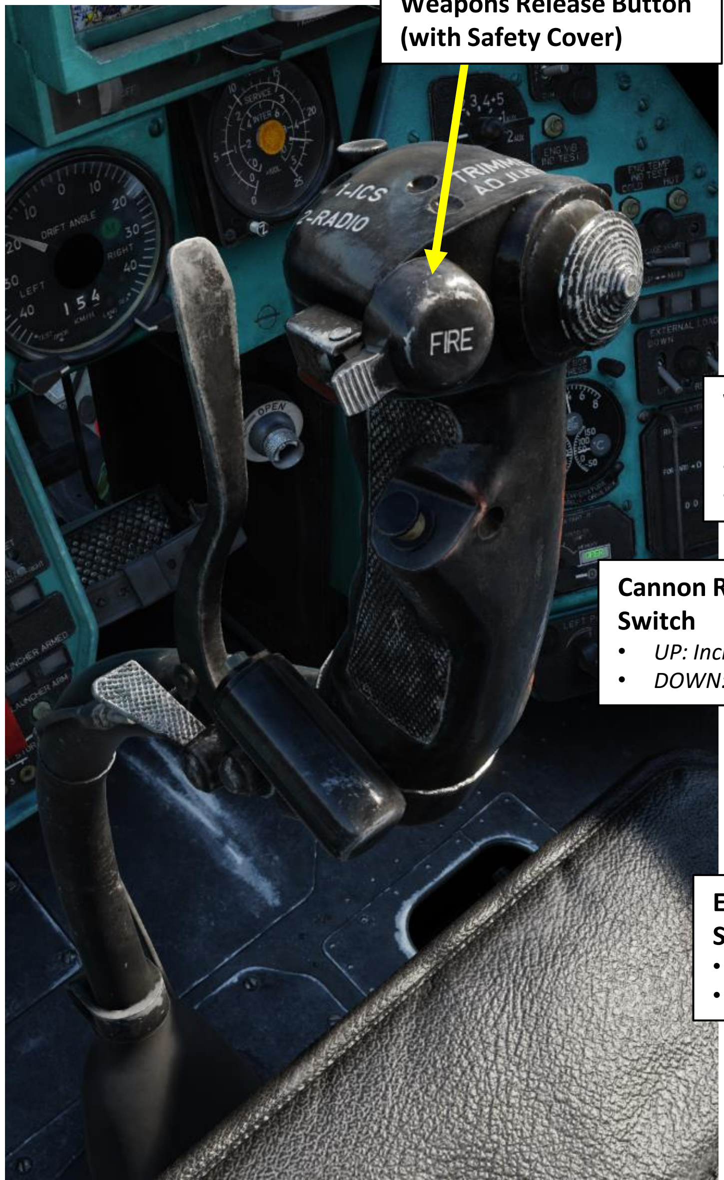
Right Side Rocket Launcher ARMED Annunciator

Left Side Rocket Launcher ARMED Annunciator

Emergency Jettison ARMED Annunciator

Weapon Station Rack Status Lights
- *Illuminated if station is powered and if the AUX STORES LIGHT switch is set to ON (UP).*

1.5 – WEAPON INTERFACE (PC)



Weapons Release Button (with Safety Cover)

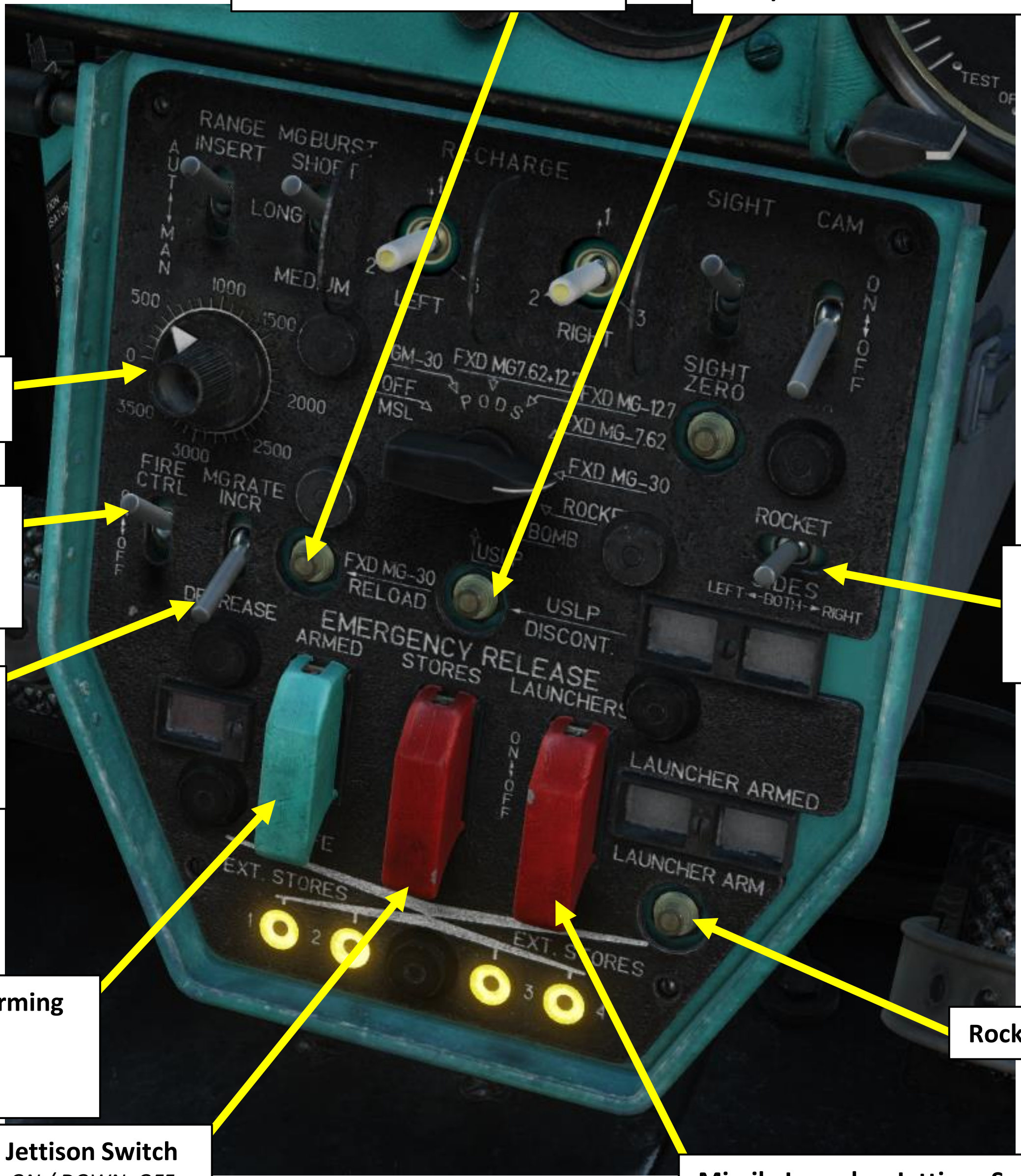
Manual Sight Range Setting Knob (meters)

Weapon Fire Control Main Power Switch
- *UP: ON*
- *DOWN: OFF*

Cannon Rate of Fire Selector Switch
- *UP: Increased (High) Rate of Fire*
- *DOWN: Decreased (Low) Rate of Fire*

Emergency Jettison Bomb Arming Switch
- *UP: ARMED*
- *DOWN: SAFE*

Pylon Jettison Switch
- *UP: ON / DOWN: OFF*



FXD MG-30 (30 mm Cannon) Reload Button

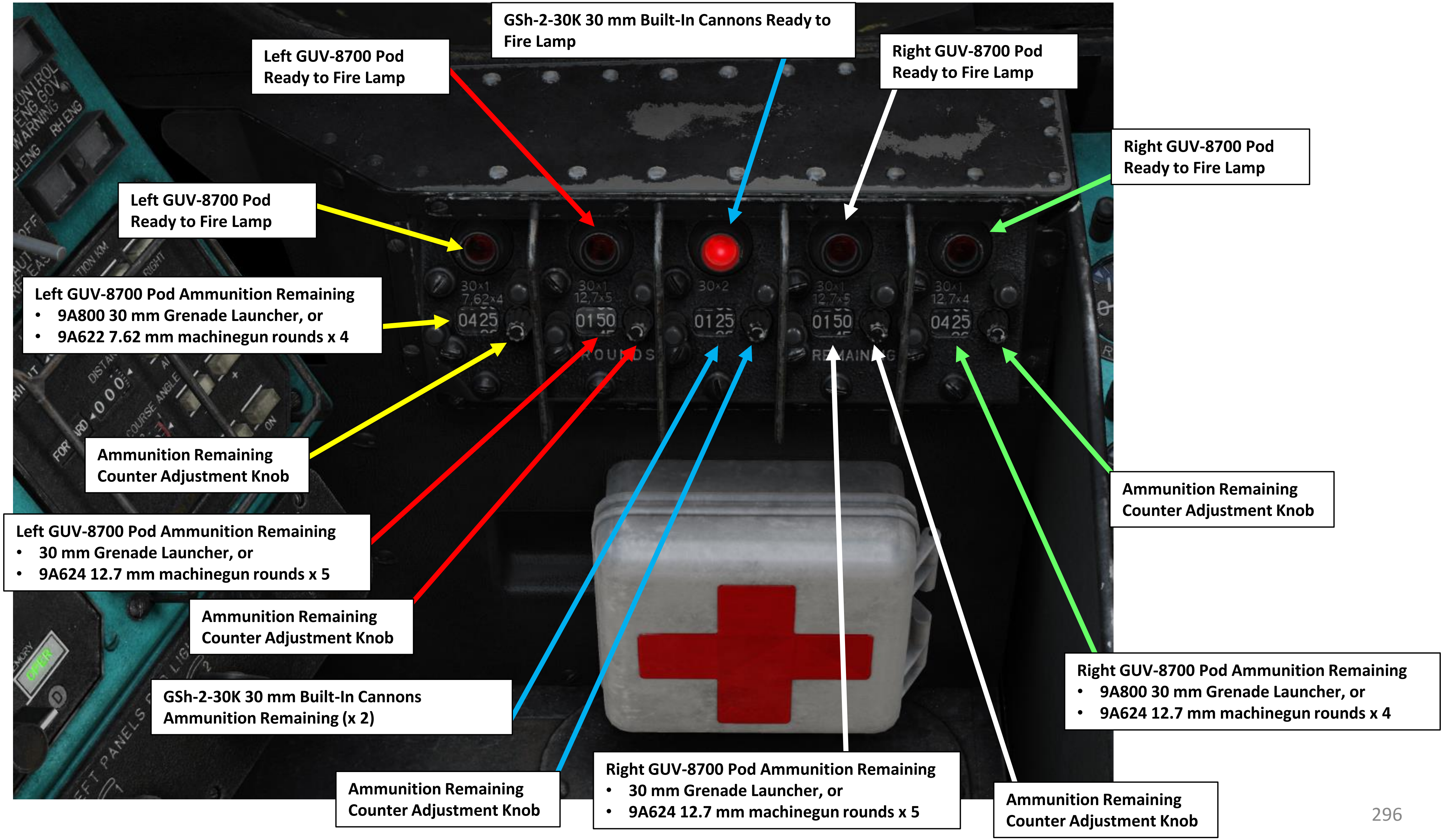
KMGU-2 Cluster Munitions Dispenser STOP/DISCONTINUE Button

Rocket Pod Selector
- *LEFT: Left Stations*
- *MIDDLE: All Stations*
- *RIGHT: Right Stations*

Rocket Pod Arming Button

Missile Launcher Jettison Switch
- *UP: ON / DOWN: OFF*

1.5 – WEAPON INTERFACE (PC)



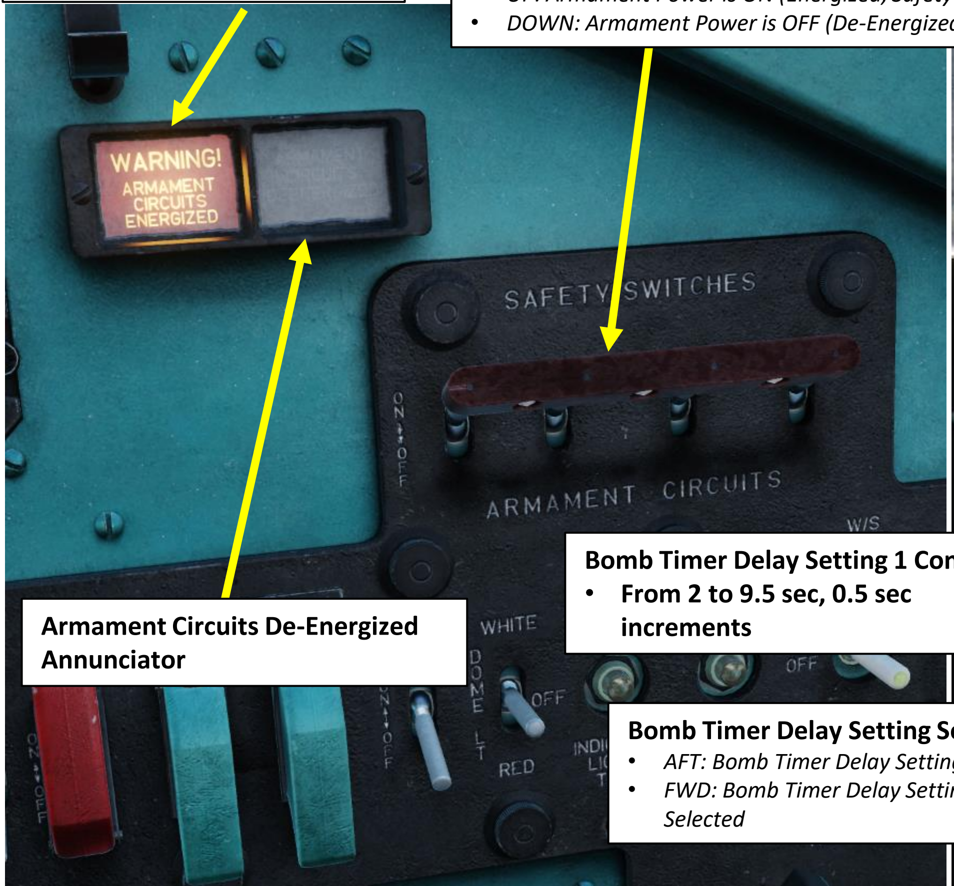
1.6 – WEAPON INTERFACE (CPG)

Here is an overview of the weapon interface for the Co-Pilot/Gunner (CPG).

Weapons Release Button (with Safety Cover)

Warning - Armament Circuits Energized Annunciator

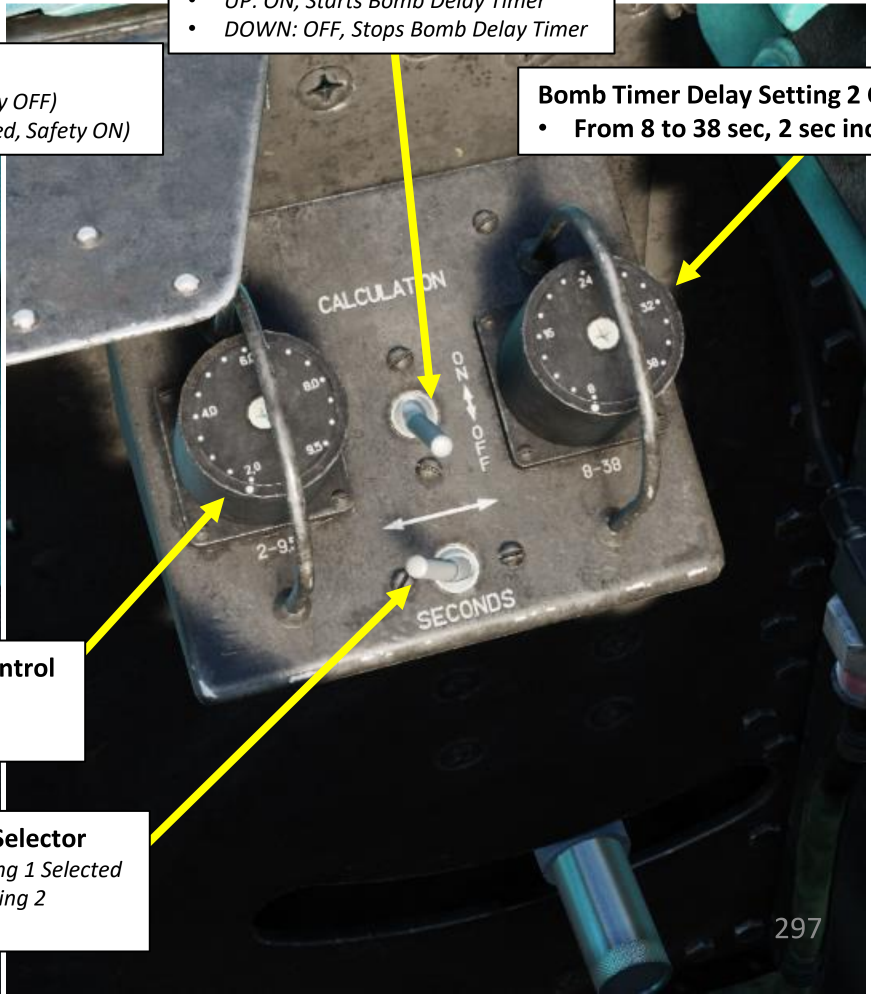
Armament Circuit Breakers
- *UP: Armament Power is ON (Energized, Safety OFF)*
- *DOWN: Armament Power is OFF (De-Energized, Safety ON)*



Armament Circuits De-Energized Annunciator

Bomb Timer Start/Stop Switch
- *UP: ON, Starts Bomb Delay Timer*
- *DOWN: OFF, Stops Bomb Delay Timer*

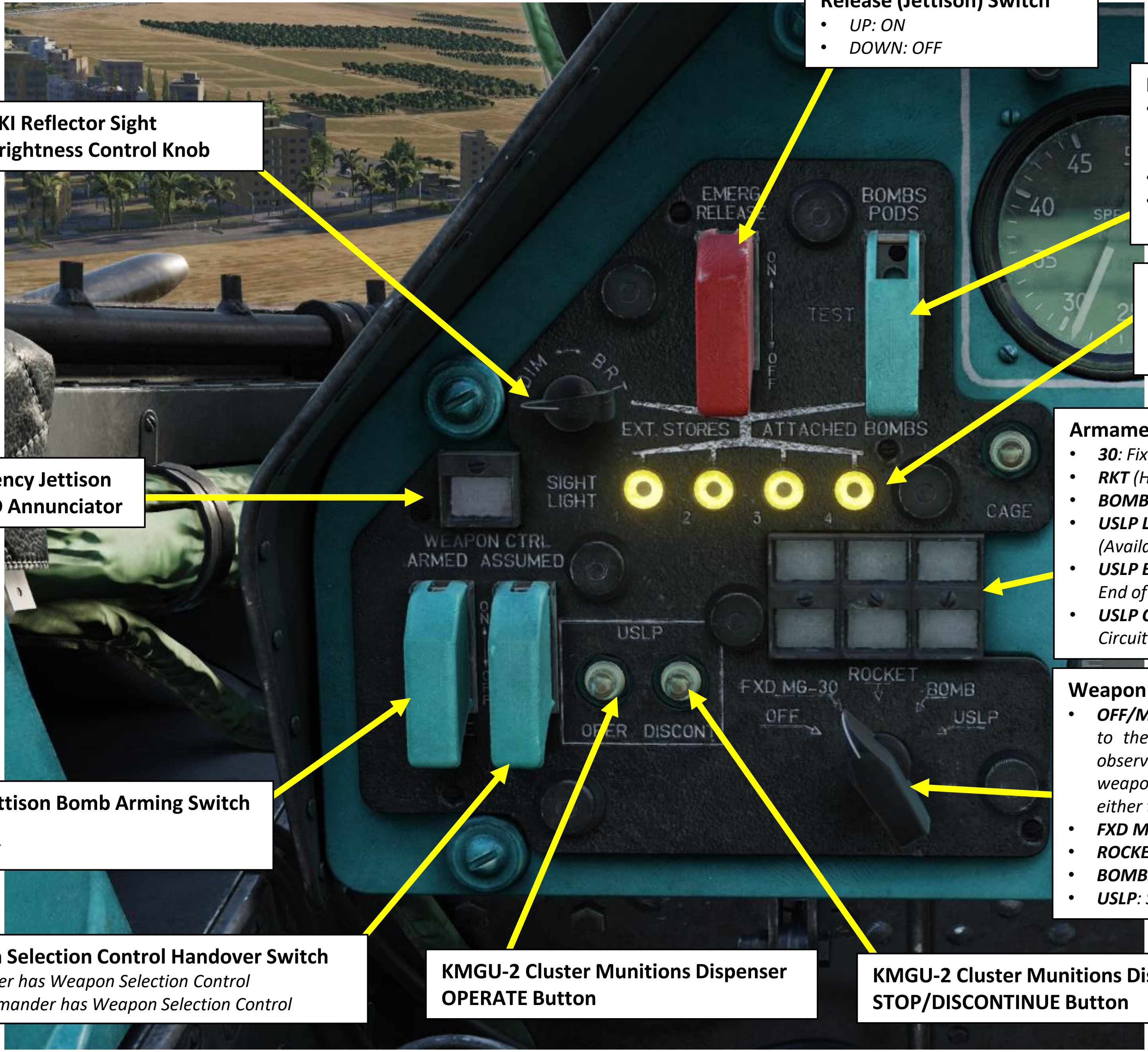
Bomb Timer Delay Setting 2 Control
- **From 8 to 38 sec, 2 sec increments**



Bomb Timer Delay Setting 1 Control
- **From 2 to 9.5 sec, 0.5 sec increments**

Bomb Timer Delay Setting Selector
- *AFT: Bomb Timer Delay Setting 1 Selected*
- *FWD: Bomb Timer Delay Setting 2 Selected*

1.6 – WEAPON INTERFACE (CPG)



External Stores Emergency Release (Jettison) Switch
- *UP: ON*
- *DOWN: OFF*

Bomb Mode Selector Switch
- *UP: Bombs and other Pods are equipped. Using the Weapon Release button will not drop "pods" as if they were bombs.*
- *MIDDLE: Test*
- *DOWN: Bombs. Using the Weapon Release button will drop "pods" as if they were bombs.*

PKI Reflector Sight Brightness Control Knob

Weapon Station Rack Status Lights
- *Illuminated if station is powered and if the AUX STORES LIGHT switch is set to ON (UP) in the pilot cockpit.*

Armament Selection Lights
- ***30**: Fixed 30 mm twin-barrel cannon (GSh-2-30K)*
- ***RKT** (НРС): Unguided rocket pods or S-24B Rockets*
- ***BOMBS** (БОМБЫ): Fragmentation and Cluster Bombs*
- ***USLP LOADED**: KMGU-2 (КМГУ-2) Cluster Munitions Dispenser Loaded (Available)*
- ***USLP END OF OPER**: KMGU-2 (КМГУ-2) Cluster Munitions Dispenser End of Operation (Empty)*
- ***USLP CIRCUIT ON**: KMGU-2 (КМГУ-2) Cluster Munitions Dispenser Circuit is Powered ON*

Emergency Jettison ARMED Annunciator

Weapon Selector
- ***OFF/MSL**: Slaves the floating reticle of the Pilot-Commander sight to the Co-Pilot/Gunner's "ПН" (PN) periscope sight. Used for observation and ATGM (Air-to-Ground Missile) guidance. No weapons are active in this mode; ATGM launch is controlled from either the forward or aft cockpit.*
- ***FXD MG 30**: Selects GSh-2-30K fixed 30 mm twin barrel cannon*
- ***ROCKETS**: Selects rockets*
- ***BOMBS**: Selects bombs*
- ***USLP**: Selects КМГУ-2 (KMGU-2) cluster munitions dispenser*

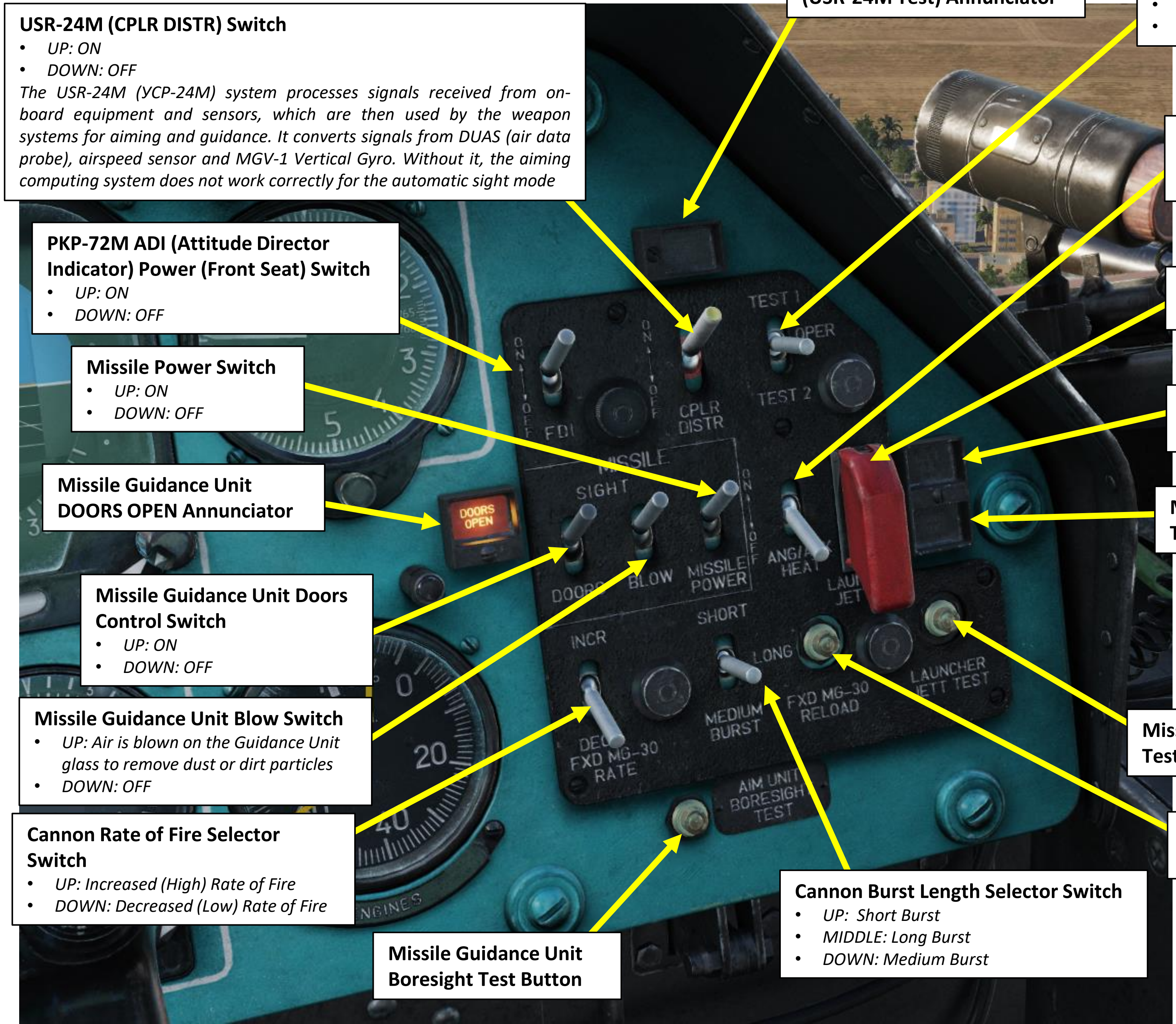
Emergency Jettison Bomb Arming Switch
- *UP: ARMED*
- *DOWN: SAFE*

Pilot/CPG Weapon Selection Control Handover Switch
- *UP: Co-Pilot/Gunner has Weapon Selection Control*
- *DOWN: Pilot-Commander has Weapon Selection Control*

KMGU-2 Cluster Munitions Dispenser OPERATE Button

KMGU-2 Cluster Munitions Dispenser STOP/DISCONTINUE Button

1.6 – WEAPON INTERFACE (CPG)



CPL/DISTR TEST PERFORM (USR-24M Test) Annunciator

USR-24M Mode Switch
- *UP: Test 1*
- *MIDDLE: Operation Mode*
- *DOWN: Test 2*

USR-24M (CPLR DISTR) Switch
- *UP: ON*
- *DOWN: OFF*

The USR-24M (УСР-24М) system processes signals received from on-board equipment and sensors, which are then used by the weapon systems for aiming and guidance. It converts signals from DUAS (air data probe), airspeed sensor and MGV-1 Vertical Gyro. Without it, the aiming computing system does not work correctly for the automatic sight mode

DUAS (Air Data Probe) Heating Switch
- *UP: Heating ON*
- *DOWN: Heating OFF*

PKP-72M ADI (Attitude Director Indicator) Power (Front Seat) Switch
- *UP: ON*
- *DOWN: OFF*

Missile Launcher Jettison Switch
- *UP: ON / DOWN: OFF*

Missile Power Switch
- *UP: ON*
- *DOWN: OFF*

Missile Launcher Jettison Test LEFT OK Annunciator

Missile Guidance Unit DOORS OPEN Annunciator

Missile Launcher Jettison Test RIGHT OK Annunciator

Missile Guidance Unit Doors Control Switch
- *UP: ON*
- *DOWN: OFF*

Missile Guidance Unit Blow Switch
- *UP: Air is blown on the Guidance Unit glass to remove dust or dirt particles*
- *DOWN: OFF*

Missile Launcher Jettison Test Button

Cannon Rate of Fire Selector Switch
- *UP: Increased (High) Rate of Fire*
- *DOWN: Decreased (Low) Rate of Fire*

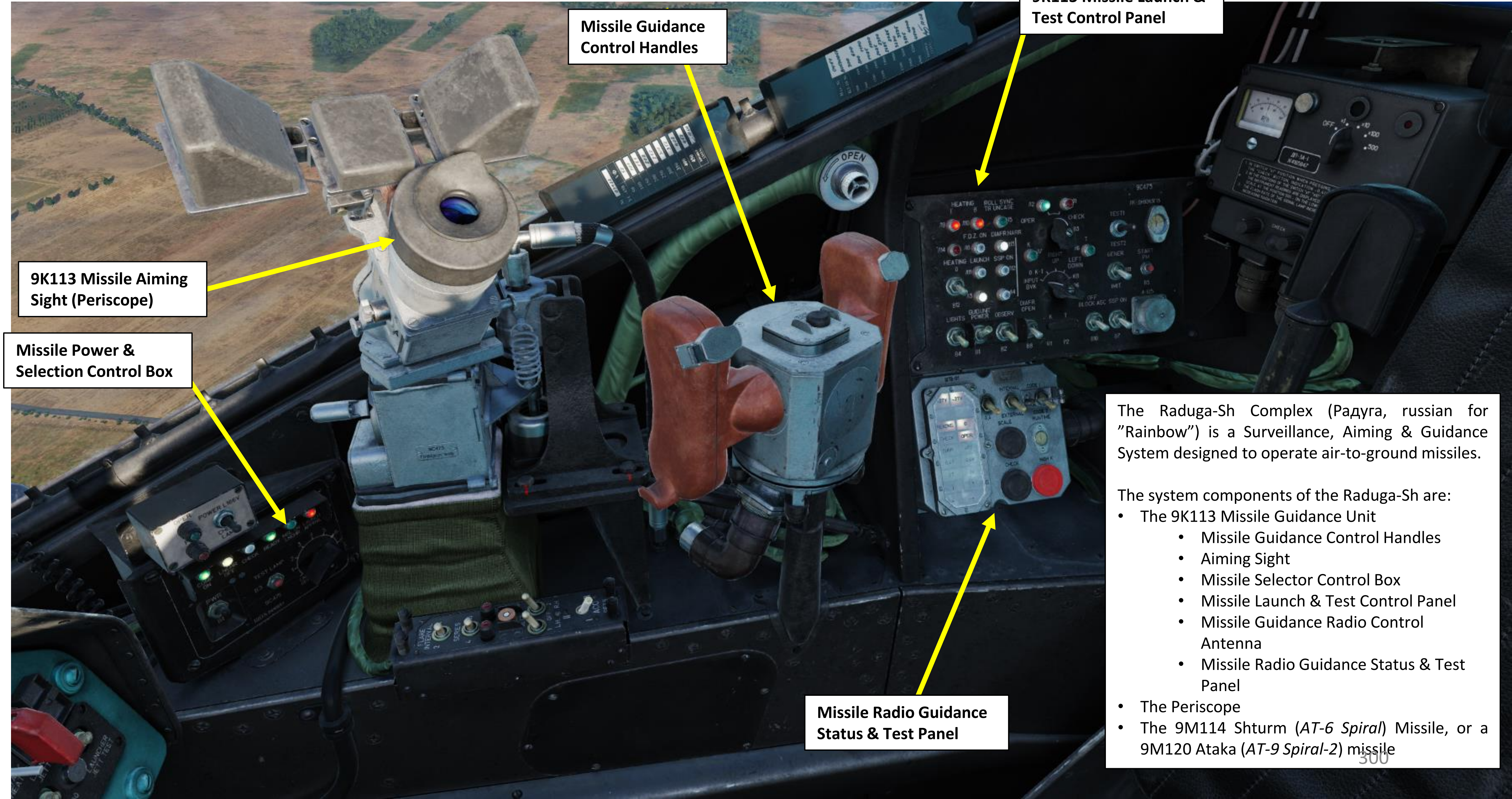
FXD MG-30 (30 mm Cannon) Reload Button

Cannon Burst Length Selector Switch
- *UP: Short Burst*
- *MIDDLE: Long Burst*
- *DOWN: Medium Burst*

Missile Guidance Unit Boresight Test Button

1.6 – WEAPON INTERFACE (CPG)

For more information about the Raduga-Sh System, consult sections 12 (Sensors) and 13 (Weapons) in missile tutorial 2.6.



The Raduga-Sh Complex (Радуга, russian for "Rainbow") is a Surveillance, Aiming & Guidance System designed to operate air-to-ground missiles.

The system components of the Raduga-Sh are:

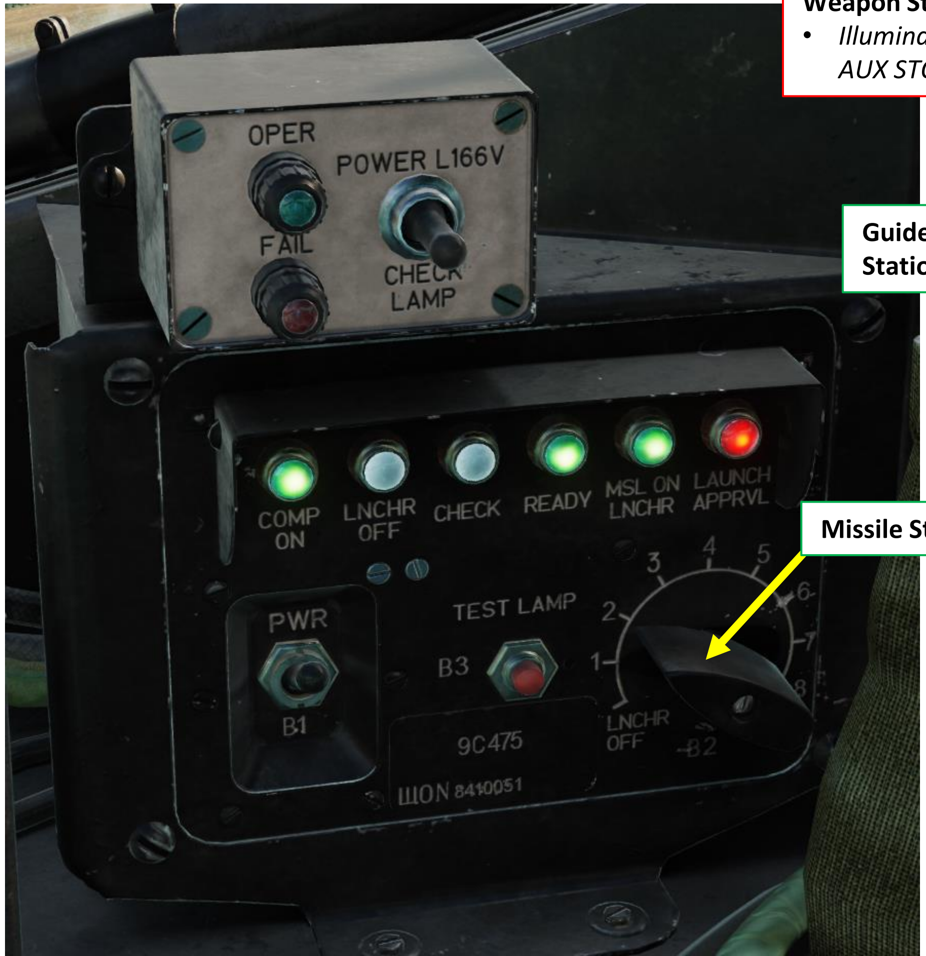
- The 9K113 Missile Guidance Unit
  - Missile Guidance Control Handles
  - Aiming Sight
  - Missile Selector Control Box
  - Missile Launch & Test Control Panel
  - Missile Guidance Radio Control Antenna
  - Missile Radio Guidance Status & Test Panel
- The Periscope
- The 9M114 Shturm (*AT-6 Spiral*) Missile, or a 9M120 Ataka (*AT-9 Spiral-2*) missile

1.7 – WEAPON PYLON & MISSILE STATION NUMBERING

Take note that Weapon Station (Pylon) numbering is different from the Missile Station numbering. Why?

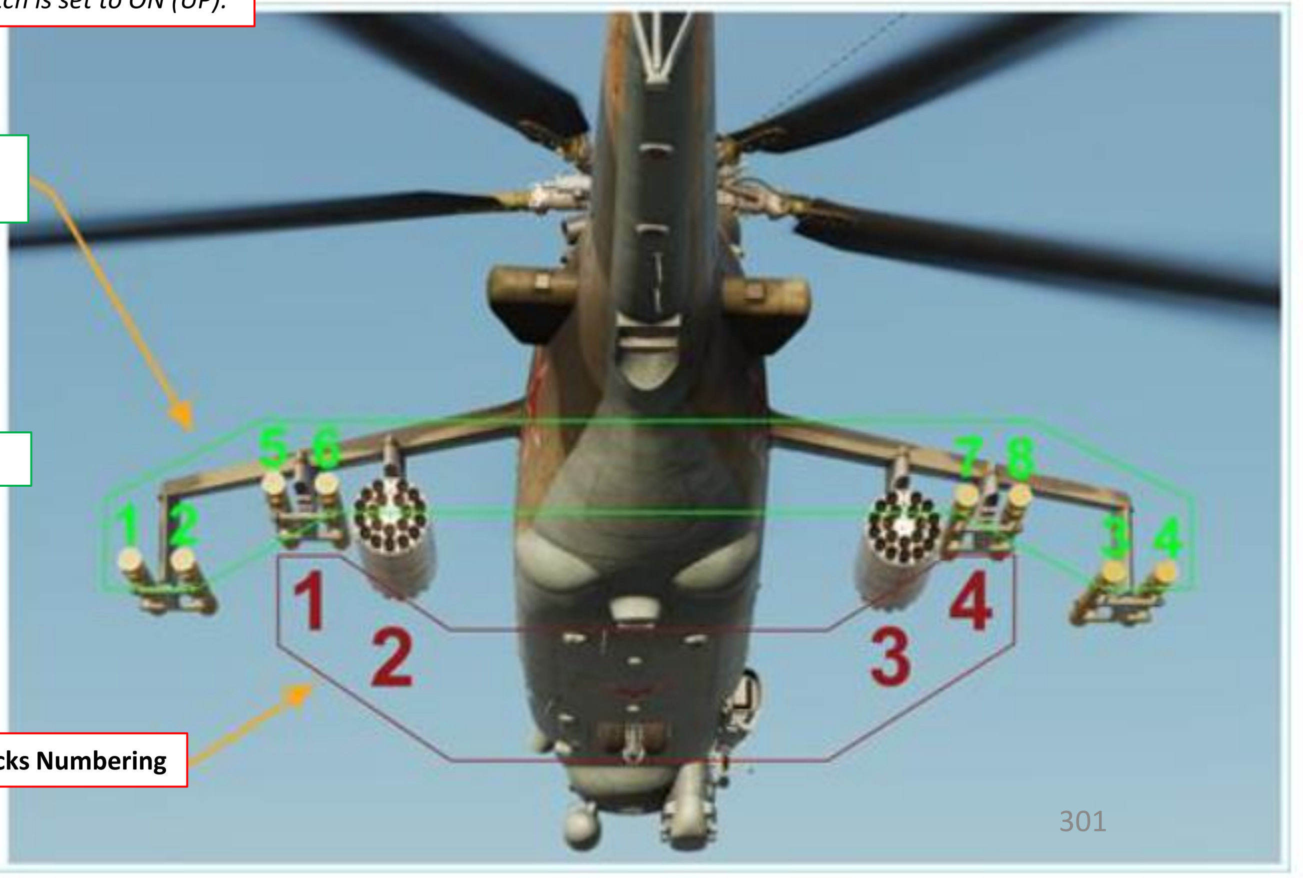
- Missile stations are numbered from 1 to 8. The numbering order from left to right is 1-2-5-6-7-8-3-4. The order may seem weird at first, but keep in mind that a Mi-24 crew will typically prefer to fire the missiles on the outer stations first since they have the most impact on the helicopter stability compared to inner stations.
- Weapon pylons/racks are numbered from 1 to 4. The numbering order from left to right is 1-2-3-4.
- Missiles are not allowed on the innermost stations. Only missiles are allowed on the outermost stations. Missile stations 5-6-7-8 (weapon racks 1 and 4) allow the use of any type of ordnance.

Weapon Station Rack Status Lights
- *Illuminated if station is powered and if the AUX STORES LIGHT switch is set to ON (UP).*



Guided Missiles Stations Numbering

Missile Station Selector

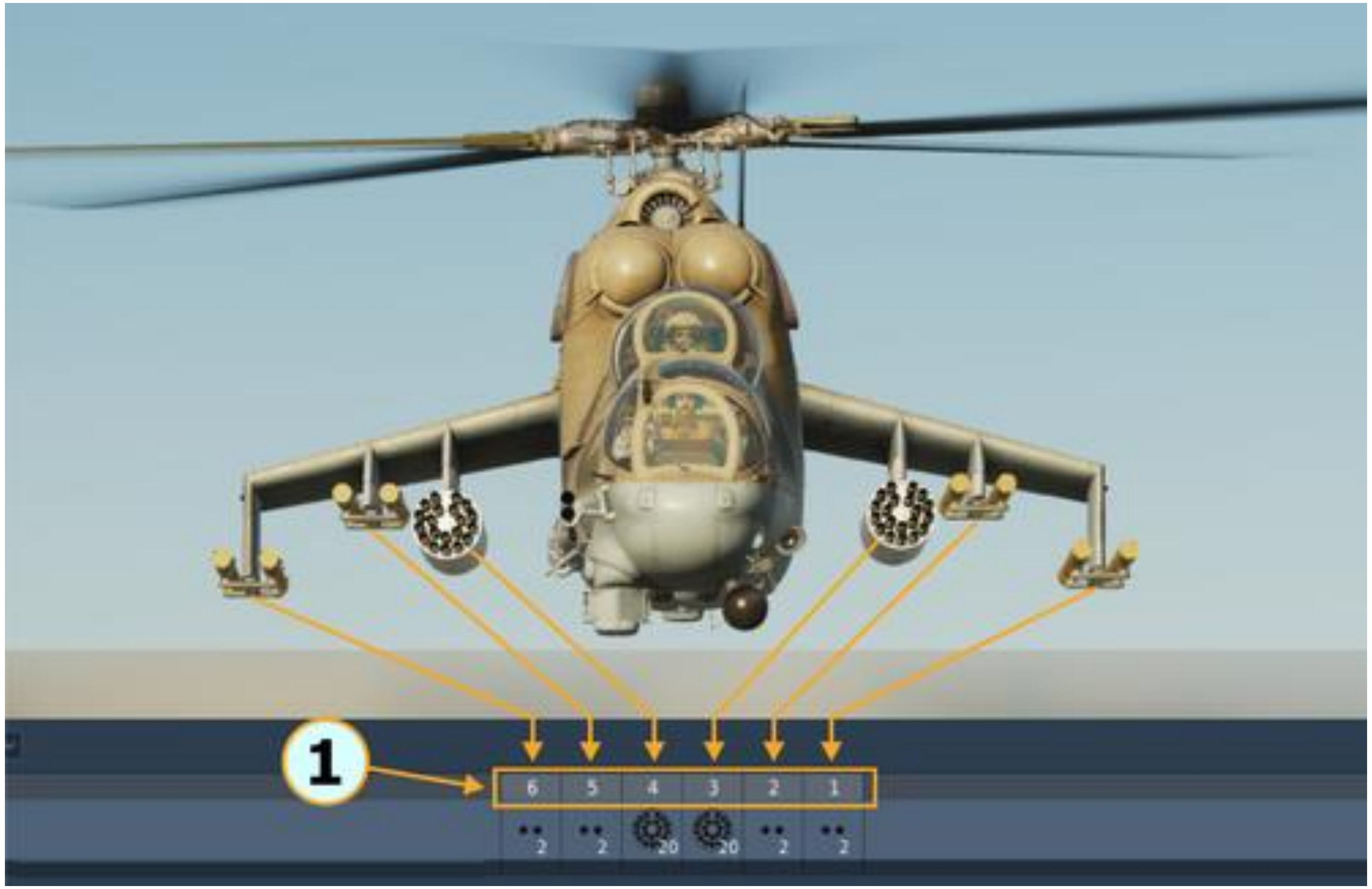


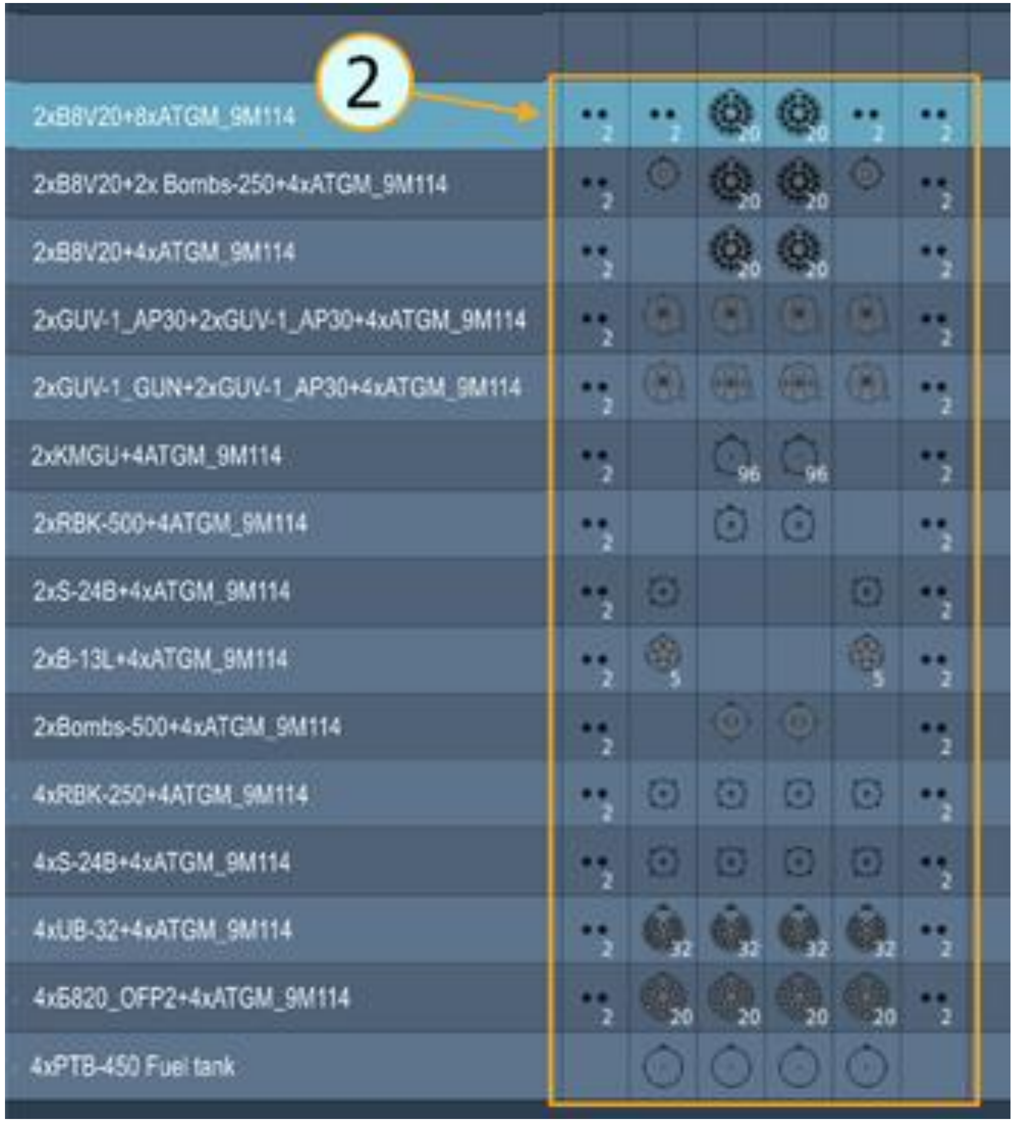
Weapon Racks Numbering

1.8 – WEAPON LOADOUT COMPATIBILITY

The Mi-24 weapon pylons only support certain specific loadouts. I highly recommend you use the preset loadouts available.

Failing to use one of the “allowable” configurations may result in incompatible mixed ordnance types and the inability to fire/deliver munitions.





1.8 – WEAPON LOADOUT COMPATIBILITY

Here is a compatibility matrix for **symmetric loadouts**.

Symmetric loadout

Green – both weapons are usable;
Orange – only one weapon is usable (which one is marked in cell);
Blue – no bomb drop from racks 2,3. Bombs/Blocks switch has no effect In this case.

Rack 1 = Rack 4 Rack 2 = Rack 3	GUV	KMGU-2 (only Racks 2 and 3)	S-24B (APU-68UM3)	S-8 (B8V20)	S-13 (B-13L1 on Racks 1 and 4)	S-5 (UB-32)	Bombs (Racks 1-4)	R-60M (APU-60-I,II on racks 1 and 4)	2 x 9M114(120,220) at RP2-149TK (on racks 1 and 4)
GUV		Only GUV	Only GUV	Only GUV	Only GUV	Only GUV		Only GUV	Only GUV
KMGU-2 (only Racks 2 and 3)	Only GUV		Only KMGU	Only KMGU	Only KMGU	Only KMGU			
S-24B (APU-68UM3)	Only GUV	Only KMGU		Only S-24B	Only S-24B	Only S-24B			
S-8 (B8V20)	Only GUV	Only KMGU	Only S-24B			Only S-8			
S-13 (B-13L1 on Racks 2 and 3)	Only GUV	Only KMGU	Only S-24B			Only S-13			
S-5 (UB-32)	Only GUV	Only KMGU	Only S-24B	Only S-8	Only S-13			Only R-60	Only 9M114(110,220)
Bombs (Racks 1-4)									
R-60M (APU-60-I,II on racks 1 and 4)	Only GUV					Only R-60			
2 x 9M114(120,220) at RP2-149TK (on racks 1 and 4)	Only GUV					Only 9M114(110,220)			

1.8 – WEAPON LOADOUT COMPATIBILITY

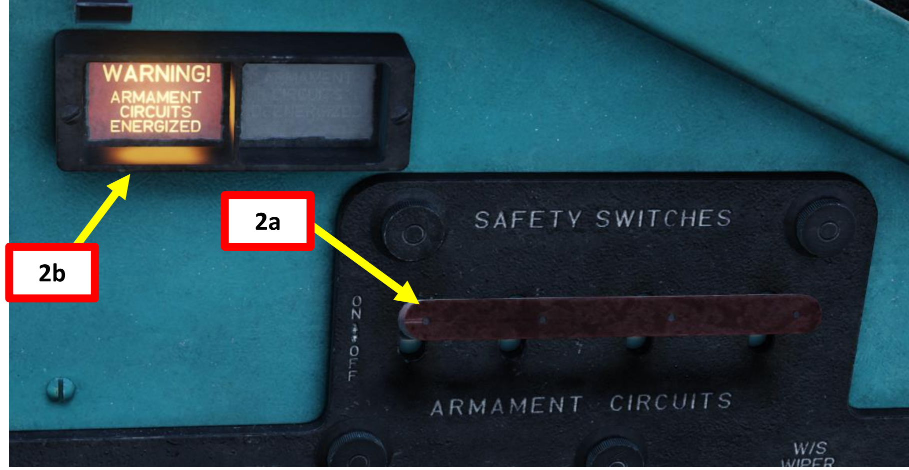
Here is a compatibility matrix for **asymmetric loadouts**.

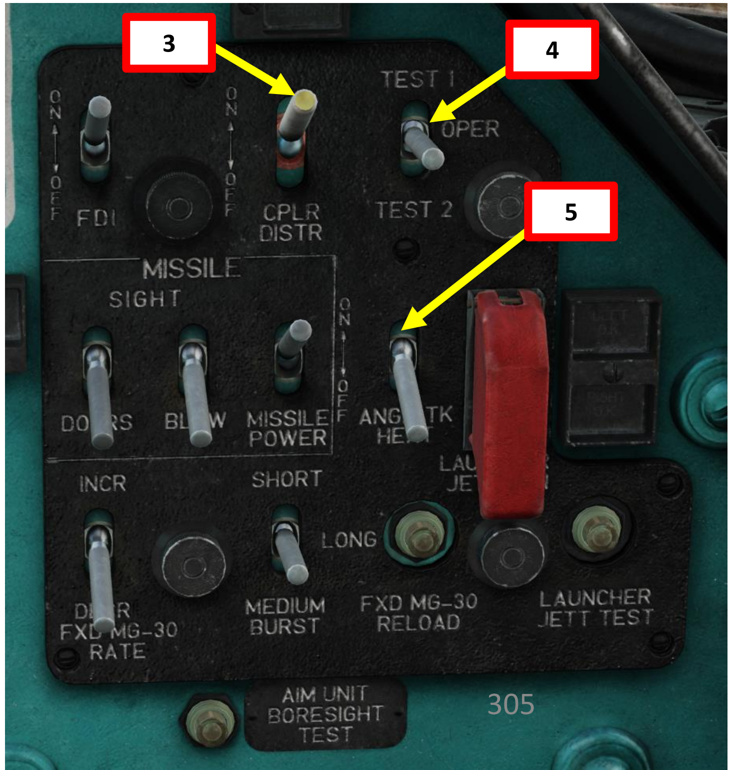
Asymmetric loadout	Green – both weapons are usable; Orange – only one weapon is usable (which one is marked in cell); Blue – no bomb drop from racks 2,3. Bombs/Blocks switch has no effect In this case.								
Rack 1 ≠ Rack 4 Rack 2 ≠ Rack 3	GUV	KMGU-2 (only Racks 2 and 3)	S-24B (APU-68UM3)	S-8 (B8V20)	S-13 (B-13L1 on Racks 1 and 4)	S-5 (UB-32)	Bombs (Racks 1-4)	R-60M (APU-60-I,II on racks 1 and 4)	2 x 9M114(120,220) at RP2-149TK (on racks 1 and 4)
GUV		Only GUV	Only GUV	Only GUV	Only GUV	Only GUV		Only GUV	Only GUV
KMGU-2 (only Racks 2 and 3)	Only GUV		Only KMGU	Only KMGU	Only KMGU	Only KMGU			
S-24B (APU-68UM3)	Only GUV	Only KMGU		Only S-24B	Only S-24B	Only S-24B			
S-8 (B8V20)	Only GUV	Only KMGU	Only S-24B			Only S-8	Only R-60	Only R-60	Only 9M114(110,220)
S-13 (B-13L1 on Racks 2 and 3)	Only GUV	Only KMGU	Only S-24B			Only S-13		Only R-60	Only 9M114(110,220)
S-5 (UB-32)	Only GUV	Only KMGU	Only S-24B	Only S-8	Only S-13			Only R-60	Only 9M114(110,220)
Bombs (Racks 1-4)									
R-60M (APU-60-I,II on racks 1 and 4)	Only GUV			Only R-60	Only R-60	Only R-60			
2 x 9M114(120,220) at RP2-149TK (on racks 1 and 4)	Only GUV			Only 9M114(110,220)	Only 9M114(110,220)	Only 9M114(110,220)			

2.1 – GSH-2-30K (30 mm) CANNON

- *Steps preceded by [PC] are performed by the Pilot-Commander.*
- *Steps preceded by [CPG] are performed by the Co-Pilot Gunner (or the Petrovich AI if no player is manning the operator station).*

1. [PC] If not flying in Multicrew, request Petrovich AI to power up weapons (LCTRL+W).
2. [CPG] Set Armament Circuit Breakers – ON (UP).
3. [CPG] Set USR-24 (CPLR DISTR) Switch – ON (UP).
4. [CPG] Set USR-24 Mode Switch – OPERATION MODE (MIDDLE).
5. [CPG] Set DUAS (Air Data Probe) Heating Switch – As Required.
    - ON/UP if temperature is below 5 deg C
    - DOWN/OFF if temperature is above 5 deg C.
6. [CPG] Set Pilot/CPG Weapon Selection Control Handover Switch – DOWN (Pilot-Commander has Weapon Selection Control).

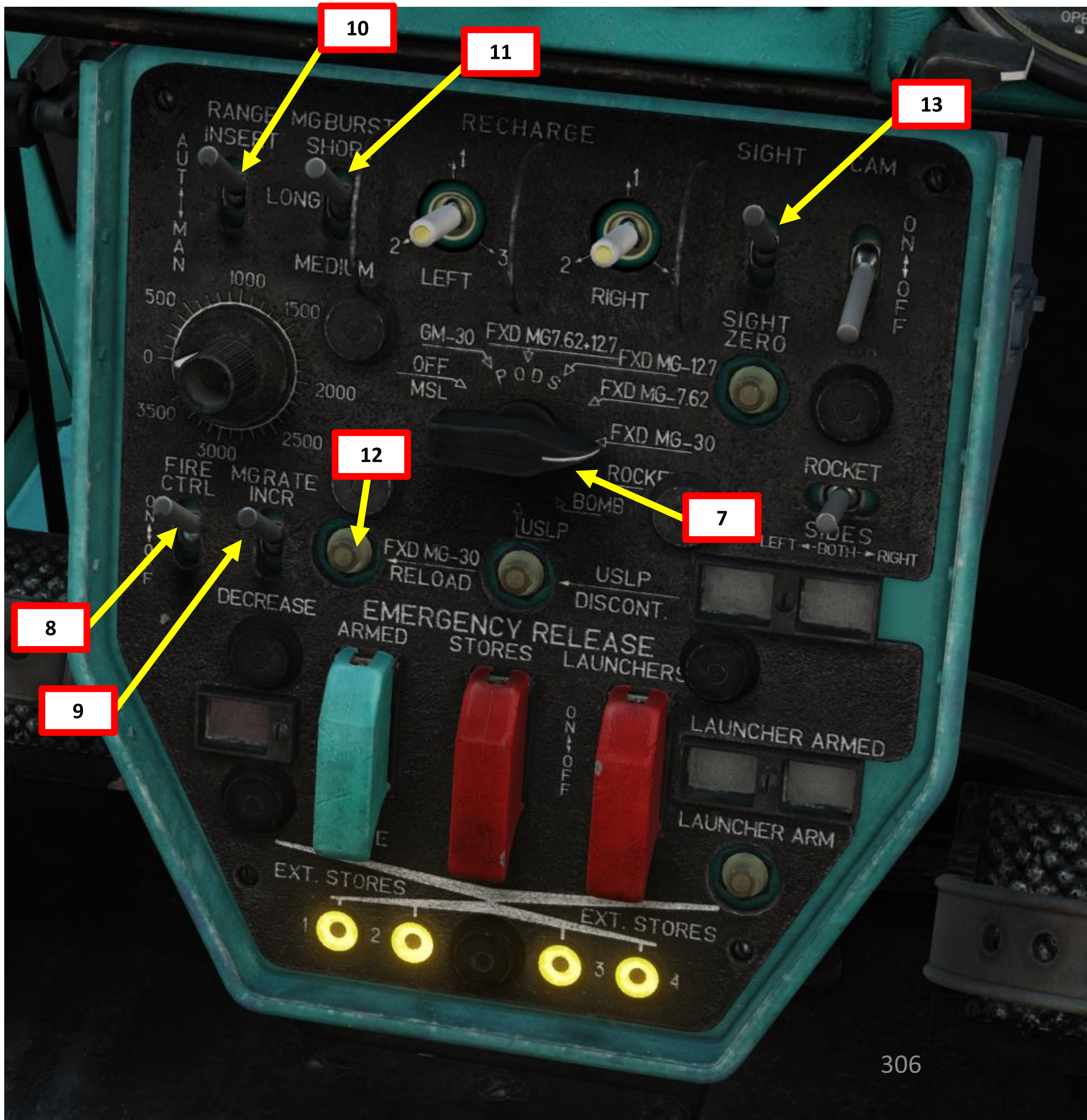




Gryazev-Shipunov GSh-2-30K
30 mm Twin Barrel Autocannon

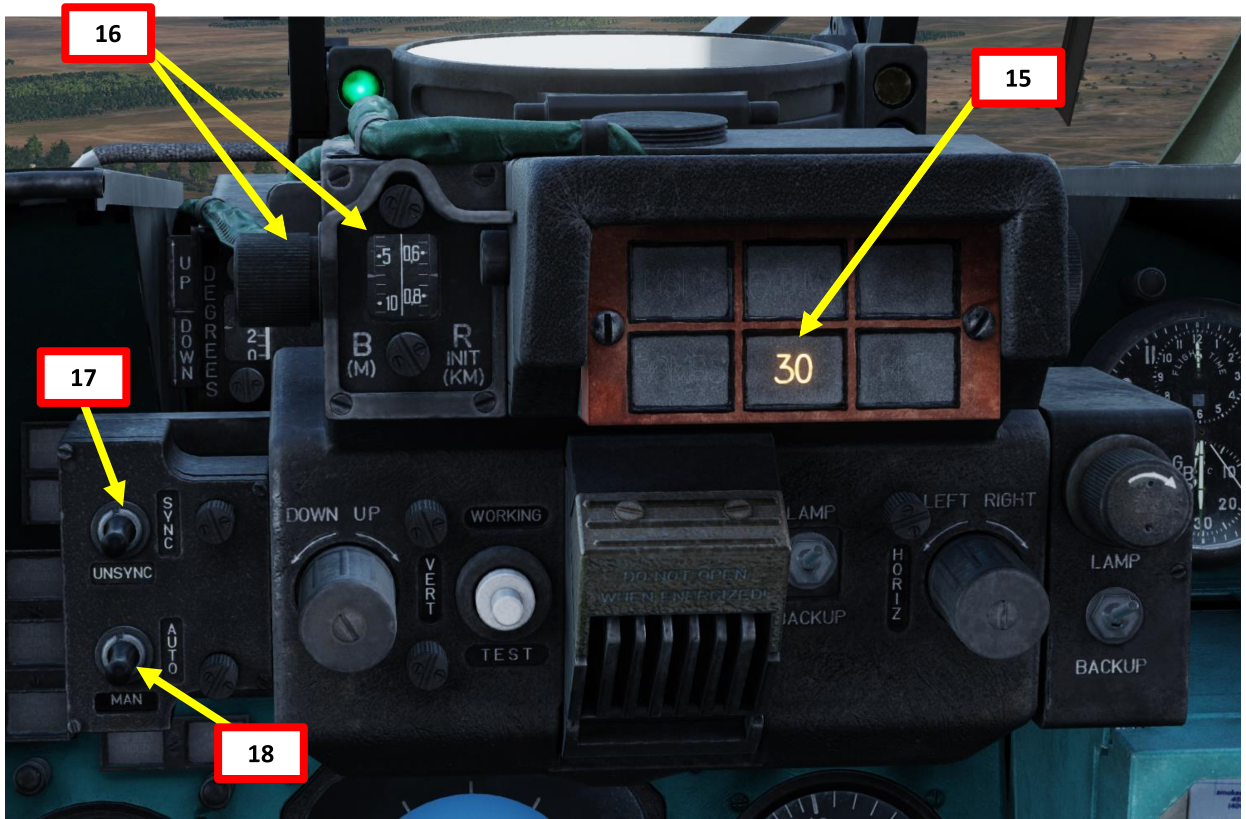
2.1 – GSH-2-30K (30 mm) CANNON

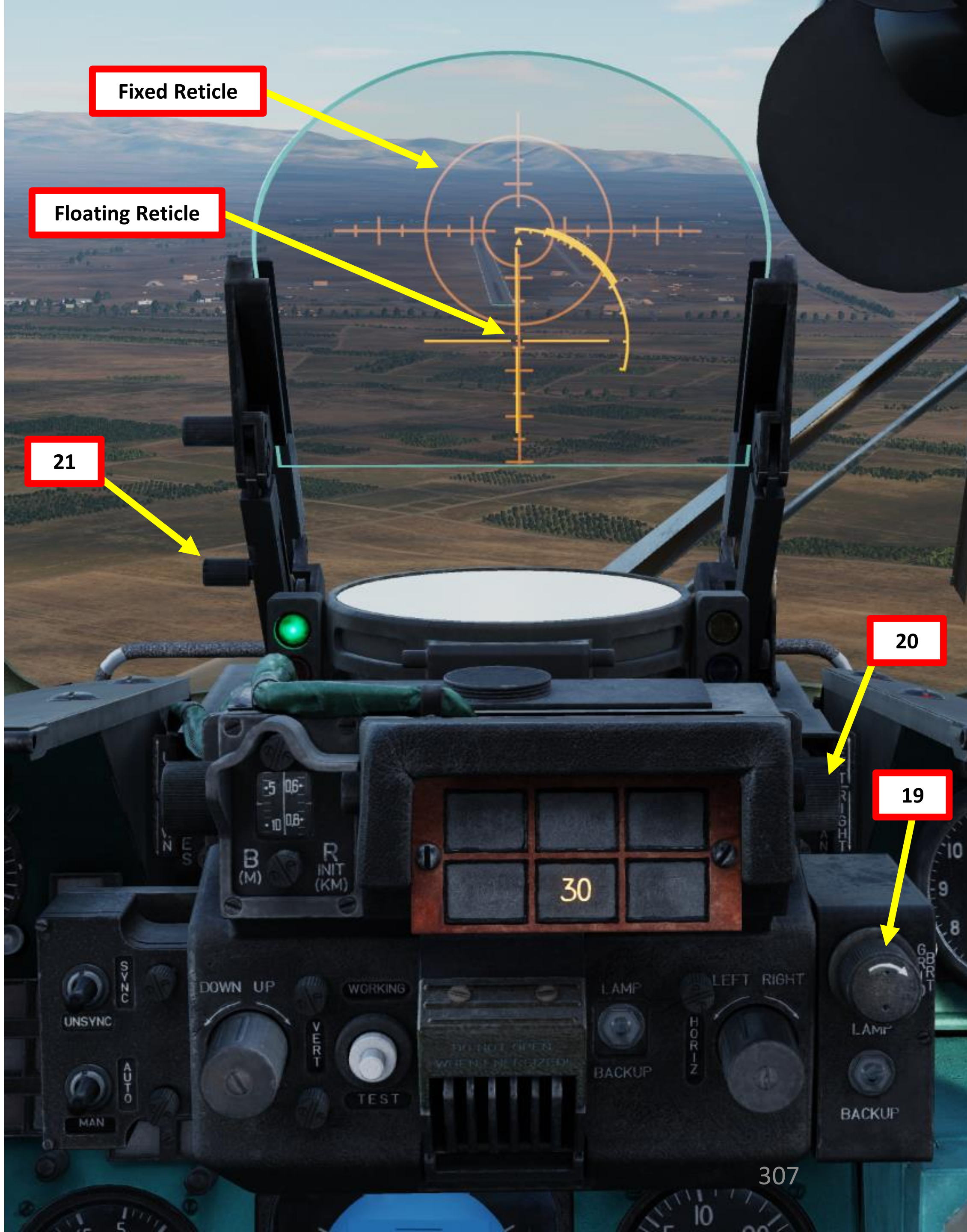
7. *[PC]* Set Weapon Selector – FXD MG-30.
8. *[PC]* Set Fire Control Switch – ON (UP).
9. *[PC]* Set Cannon Rate of Fire Selector Switch – As Desired.
    - Increased/UP setting is recommended
10. *[PC]* Set Sight Ranging Mode Selector – AUTOMATIC (UP).
    - Note: since we will use automatic ranging instead of manual ranging, setting the manual range distance setting is not required.
11. *[PC]* Set Burst Length Selector Switch – As Desired.
    - Short Burst/UP setting is recommended.
12. *[PC]* If cannon is jammed or suffered a malfunction, press and hold FXD MG-30 Reload Button for 2-3 seconds. Otherwise, pressing this button is not required.
13. *[PC]* Set ASP-17VP Sight Power Switch – ON (UP).
14. *[PC]* Set Auxiliary Stores Light Switch – ON (UP).



2.1 – GSH-2-30K (30 mm) CANNON

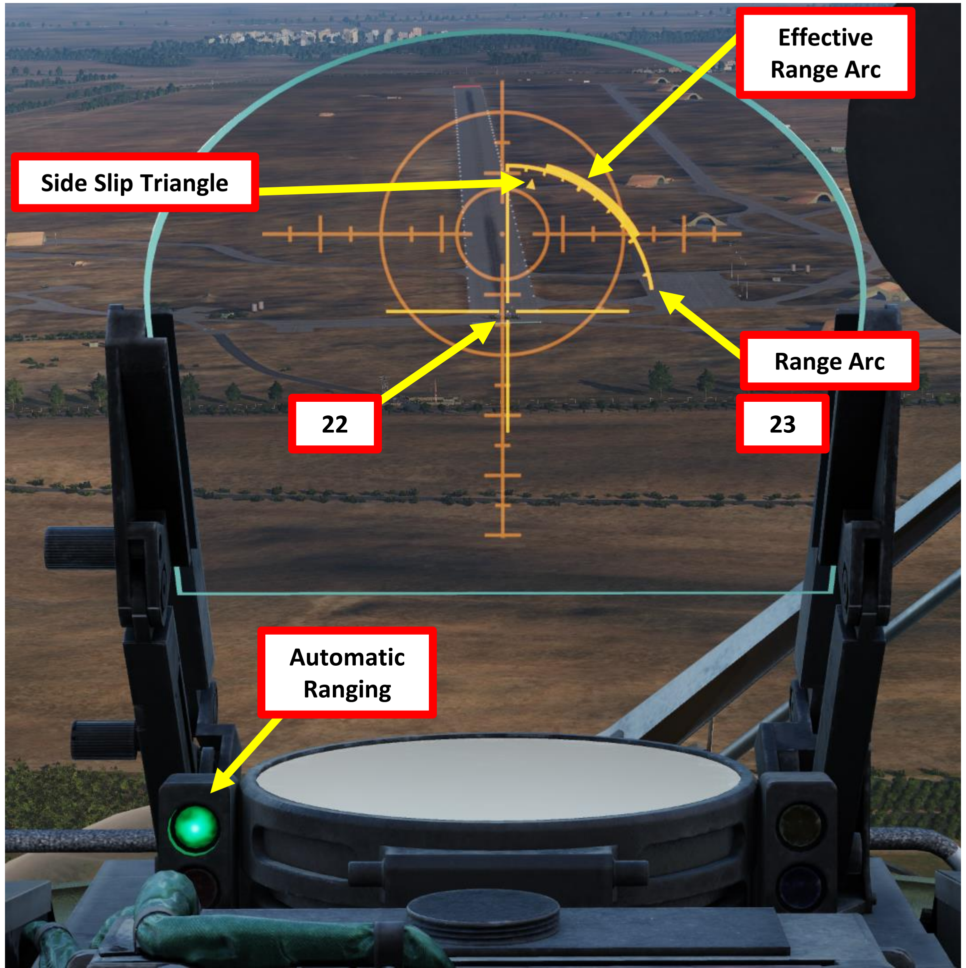
15. *[PC]* Confirm selection of 30 mm Cannon by checking the Armament Selection Lights, which should display « 30 ».
16. *[PC]* Set target size in meters using the Target Base (Size) Setting Dial.
17. *[PC]* Set Sight Synchronization Mode Selector – SYNC (UP).
18. *[PC]* Set Sight Mode Selector – AUTOMATIC (UP).
19. *[PC]* Adjust Sight Fixed Reticle (Net) Brightness Control Knob to make the Fixed Reticle dim enough to see the Floating Reticle properly.
20. *[PC]* Adjust Sight Floating Reticle Brightness Control Knob as required.
21. *[PC]* Adjust Sight Reflector Glass as desired using the Sight Reflector Glass Control Lever.
    - *Lever UP: Sight Unlocked / Lever DOWN: Sight Locked*
    - *When lever is unlocked (UP), scroll mousewheel to adjust reflector glass position as desired*

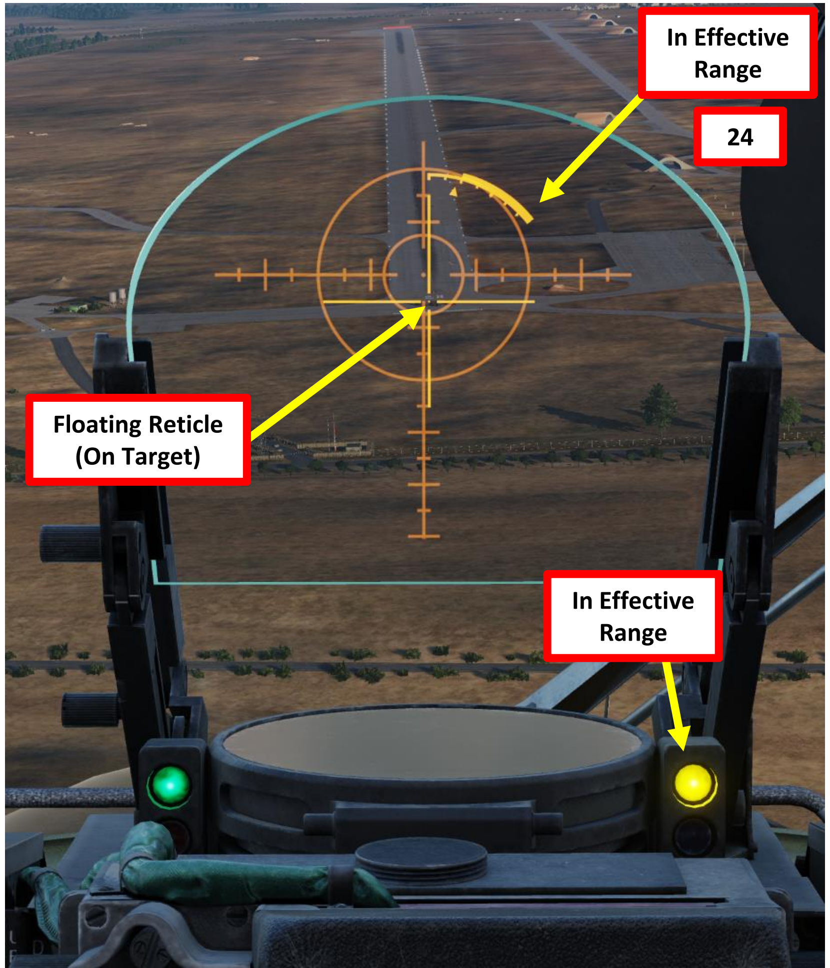


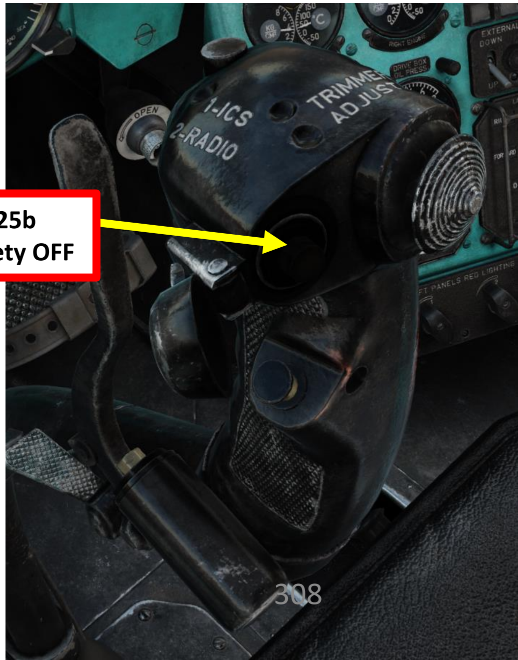


2.1 – GSH-2-30K (30 mm) CANNON

22. *[PC]* Fly the helicopter to align the Floating Reticle on the target.
    - Take into account relative target elevation when placing the Floating Reticle.
23. *[PC]* As you approach the target, the range arc shrinks as distance decreases. A green light indicates that automatic ranging is selected.
24. *[PC]* When you are in range, the range arc reaches the Effective Range arc (which is thicker) and a yellow light illuminates to indicate that you are within effective firing range.
25. *[PC]* Flip the weapon safety on the cyclic, then press and hold the « Weapon Release » (RALT + SPACE) button to fire the cannon.

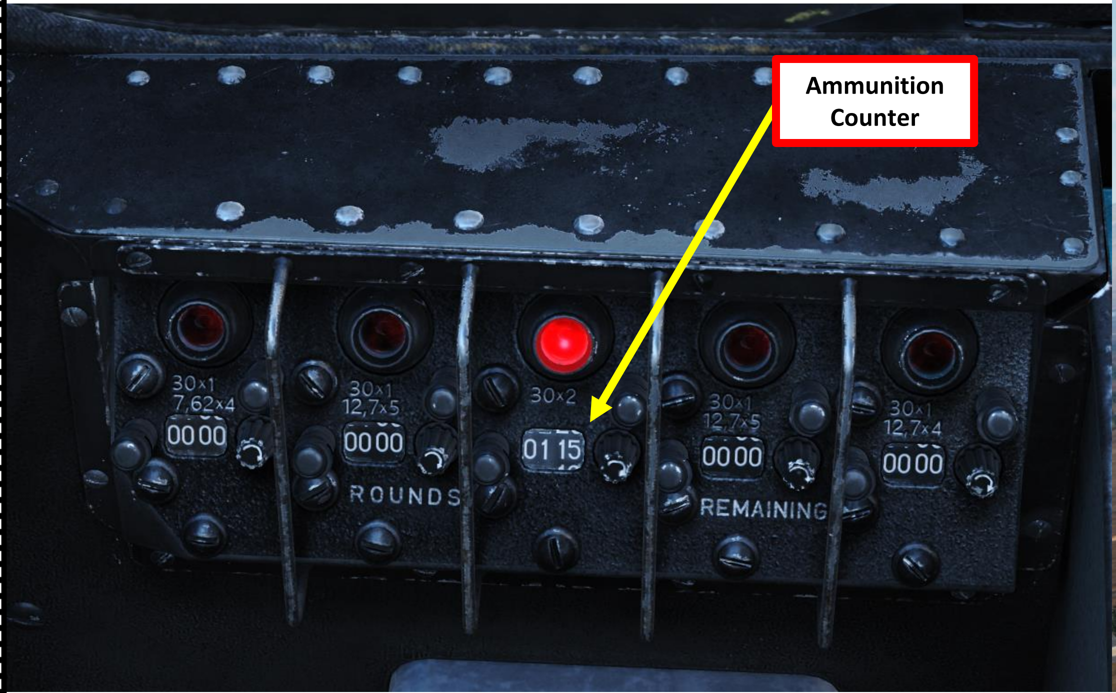






2.1 – GSH-2-30K (30 mm) CANNON

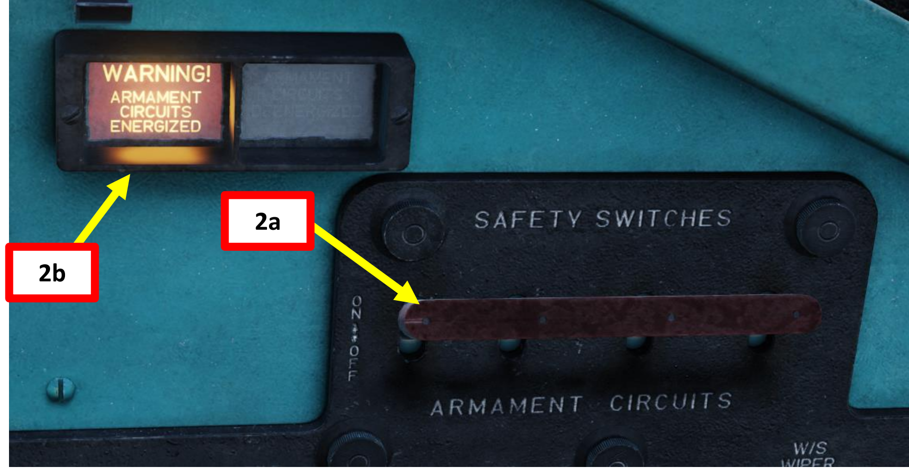
26. *[PC]* As the cannon fires, the helicopter pitches down and shifts slightly to the right due to cannon recoil.
27. *[PC]* Avoid flying directly over the target. Break off from the target once the attack is complete, preferably to the left since visibility is better and the rotor torque makes left turns easier.
28. *[PC]* Ammunition count is visible in the Pilot-Commander's cockpit.

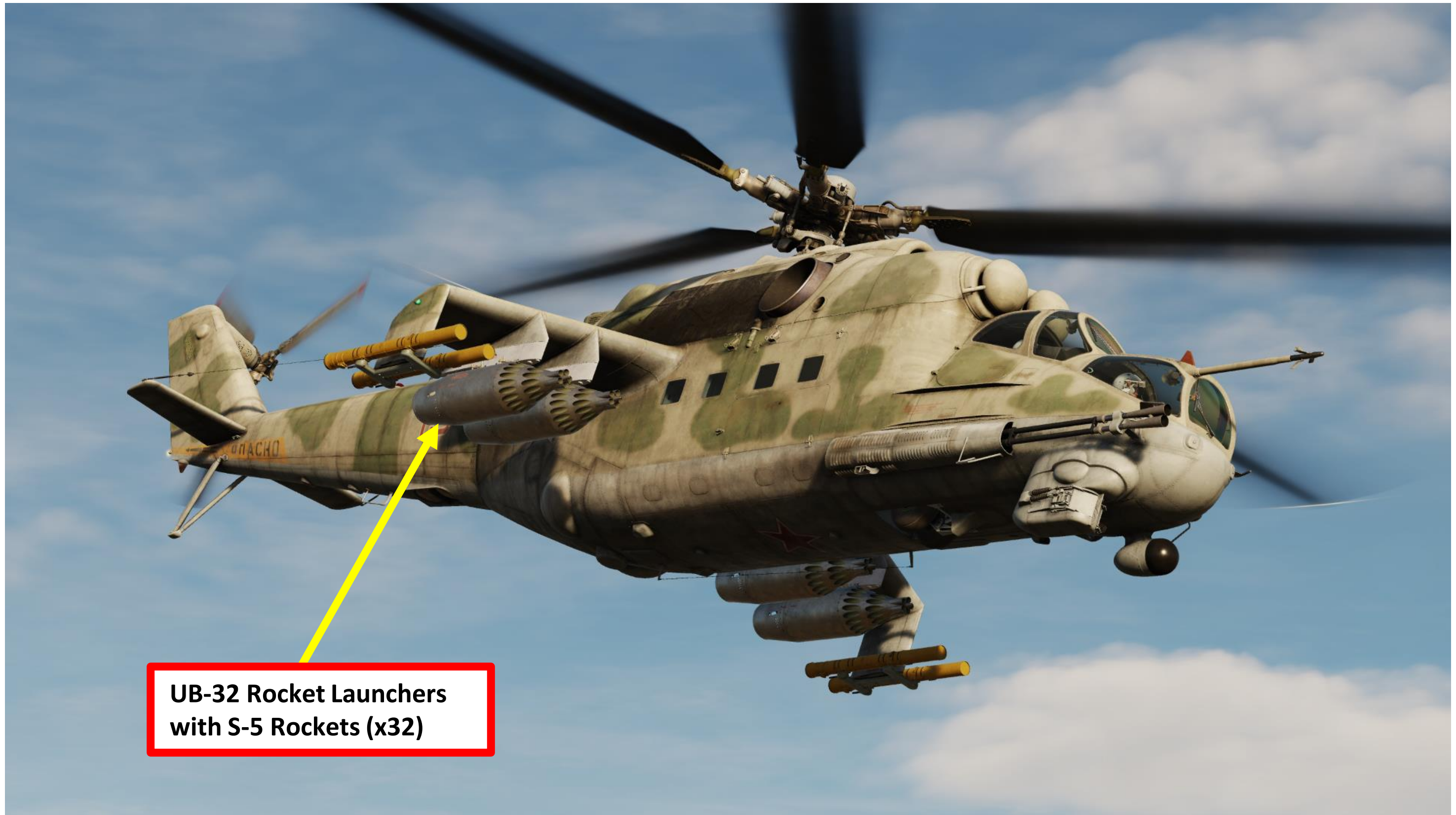


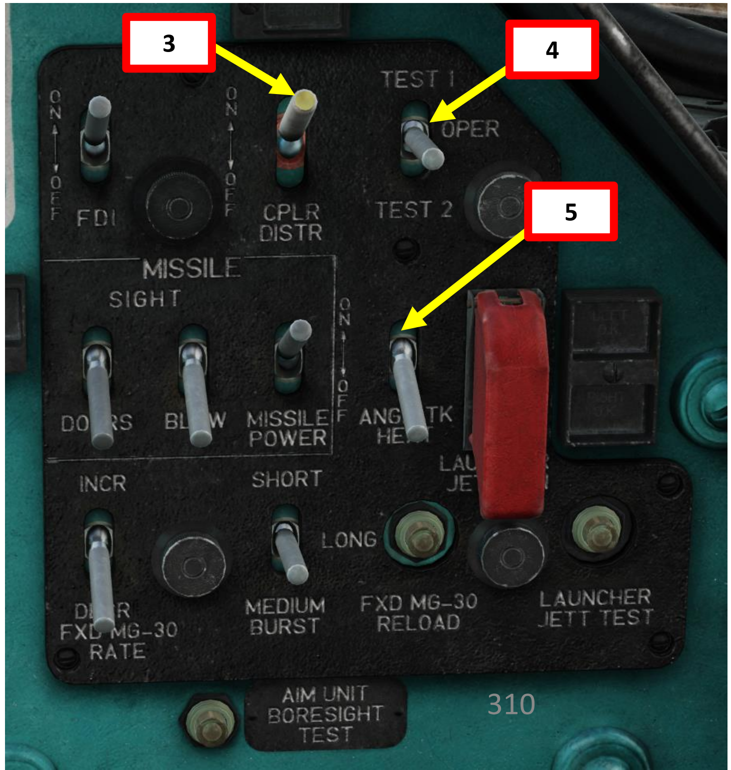
2.2.1 – S-5 (57 mm) ROCKETS

- *Steps preceded by [PC] are performed by the Pilot-Commander.*
- *Steps preceded by [CPG] are performed by the Co-Pilot Gunner (or the Petrovich AI if no player is manning the operator station).*

1. *[PC]* If not flying in Multicrew, request Petrovich AI to power up weapons (LCTRL+W).
2. *[CPG]* Set Armament Circuit Breakers – ON (UP).
3. *[CPG]* Set USR-24 (CPLR DISTR) Switch – ON (UP).
4. *[CPG]* Set USR-24 Mode Switch – OPERATION MODE (MIDDLE).
5. *[CPG] Set DUAS (Air Data Probe) Heating Switch* – As Required.
   - ON/UP if temperature is below 5 deg C
   - DOWN/OFF if temperature is above 5 deg C.
6. *[CPG]* Set Pilot/CPG Weapon Selection Control Handover Switch – DOWN (Pilot-Commander has Weapon Selection Control).

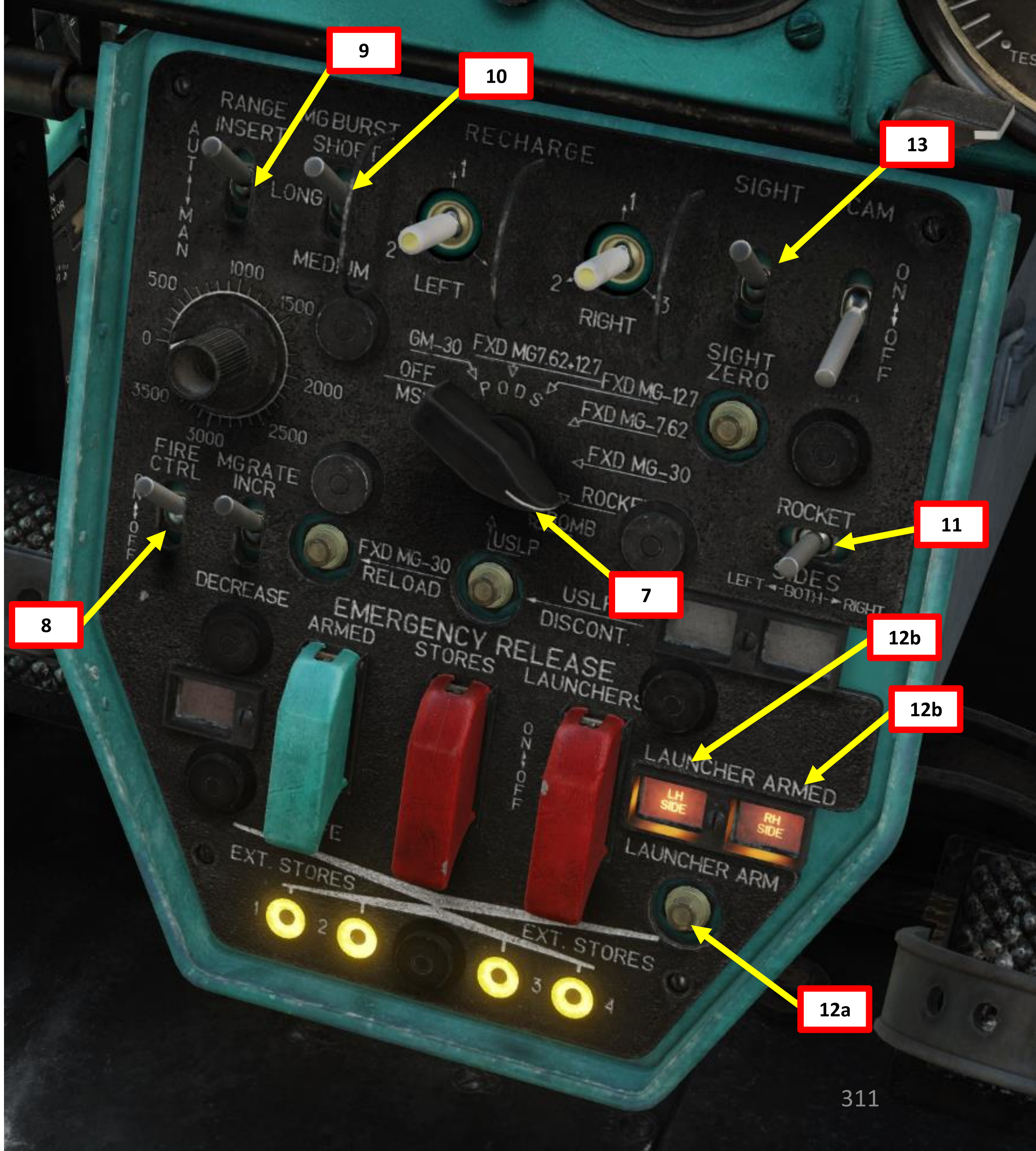






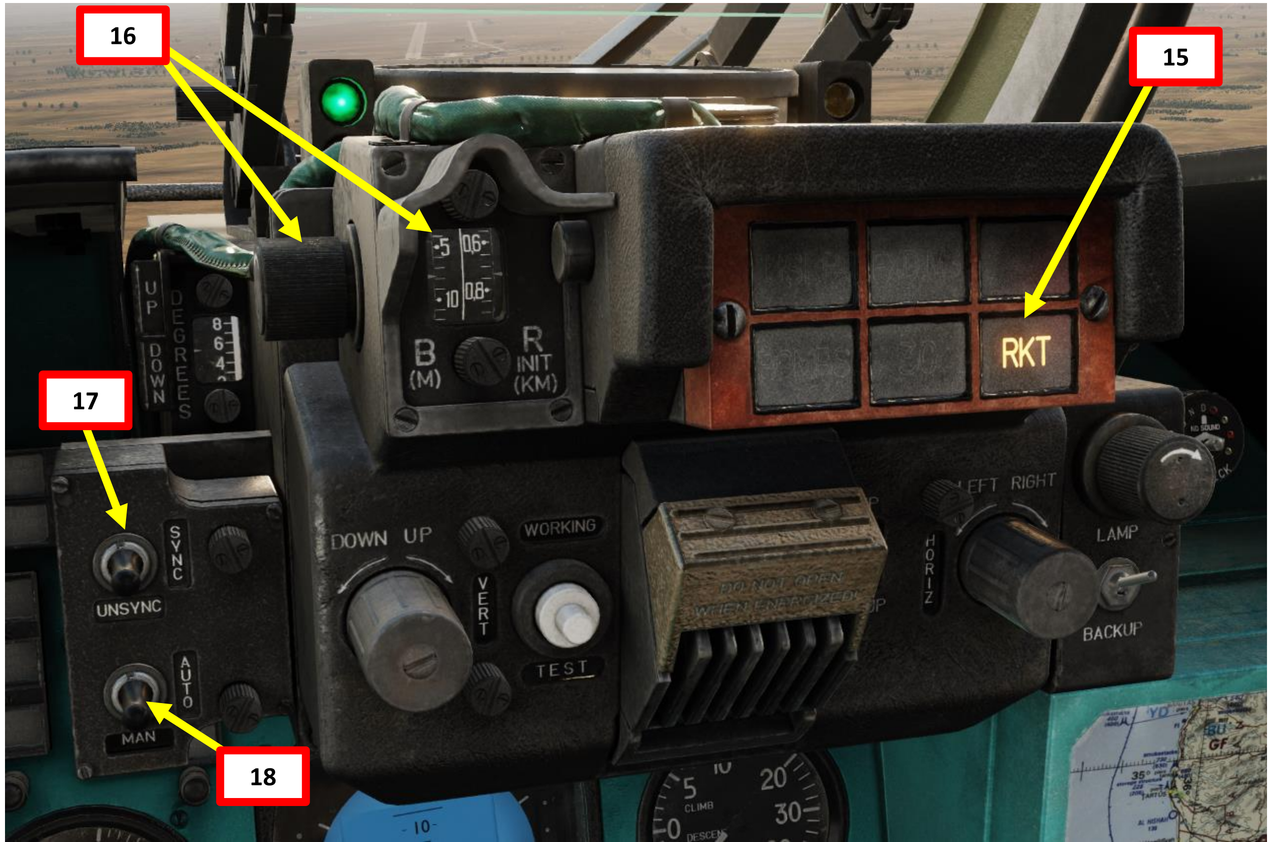
2.2.1 – S-5 (57 mm) ROCKETS

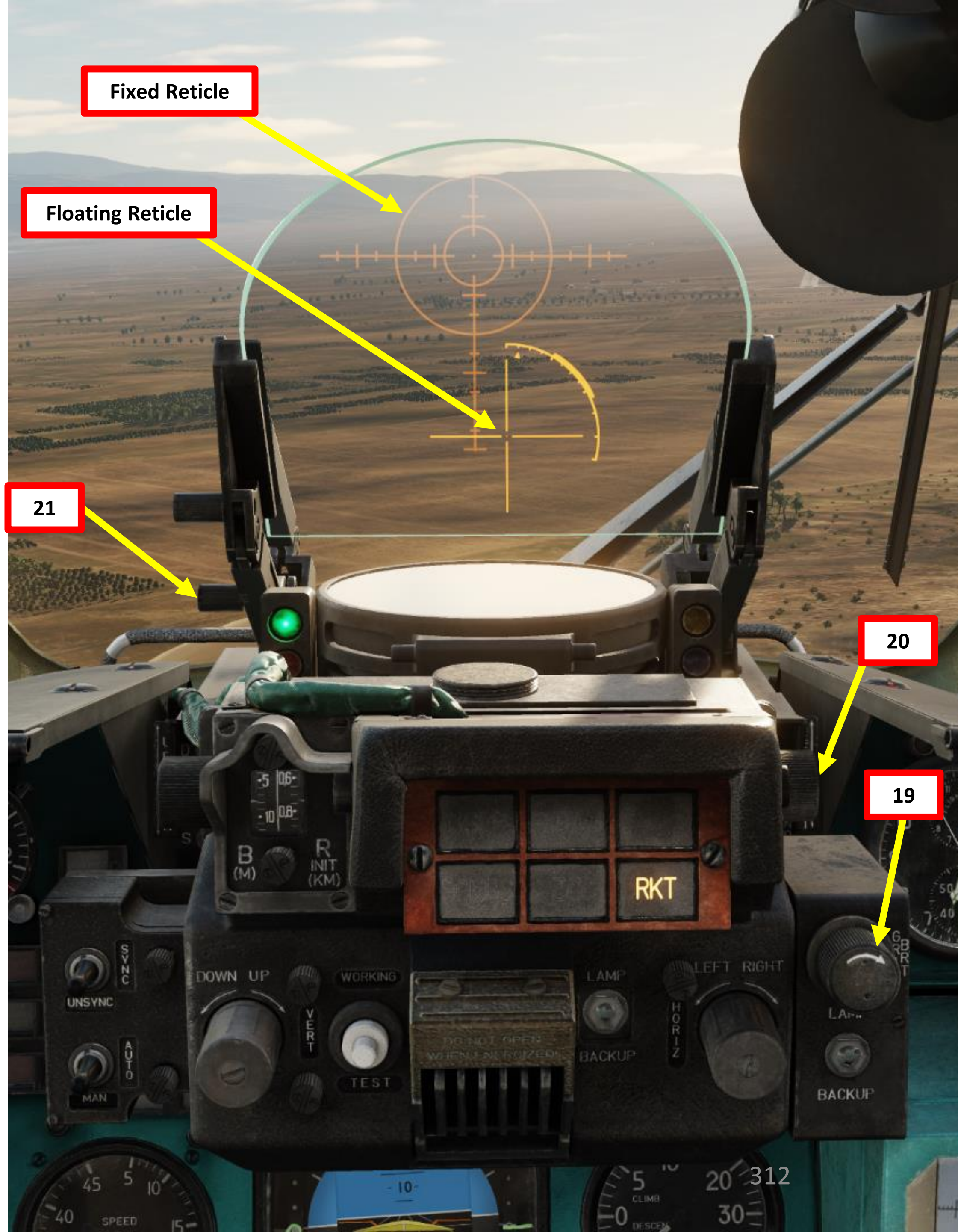
7. *[PC]* Set Weapon Selector – ROCKETS.
8. *[PC]* Set Fire Control Switch – ON (UP).
9. *[PC]* Set Sight Ranging Mode Selector – AUTOMATIC (UP).
    - Note: since we will use automatic ranging instead of manual ranging, setting the manual range distance setting is not required.
10. *[PC]* Set Burst Length Selector Switch – As Desired.
    - Short Burst/UP setting is recommended.
11. *[PC]* Set Rocket Pod Selector Switch – As Desired.
    - BOTH/Middle is recommended.
12. *[PC]* Press and hold LAUNCHER ARM (Rocket Pod Arming) Button for 2-3 seconds. Confirm that LAUNCHER ARMED lights of selected rocket pods illuminate.
13. *[PC]* Set ASP-17VP Sight Power Switch – ON (UP).
14. *[PC]* Set Auxiliary Stores Light Switch – ON (UP).



2.2.1 – S-5 (57 mm) ROCKETS

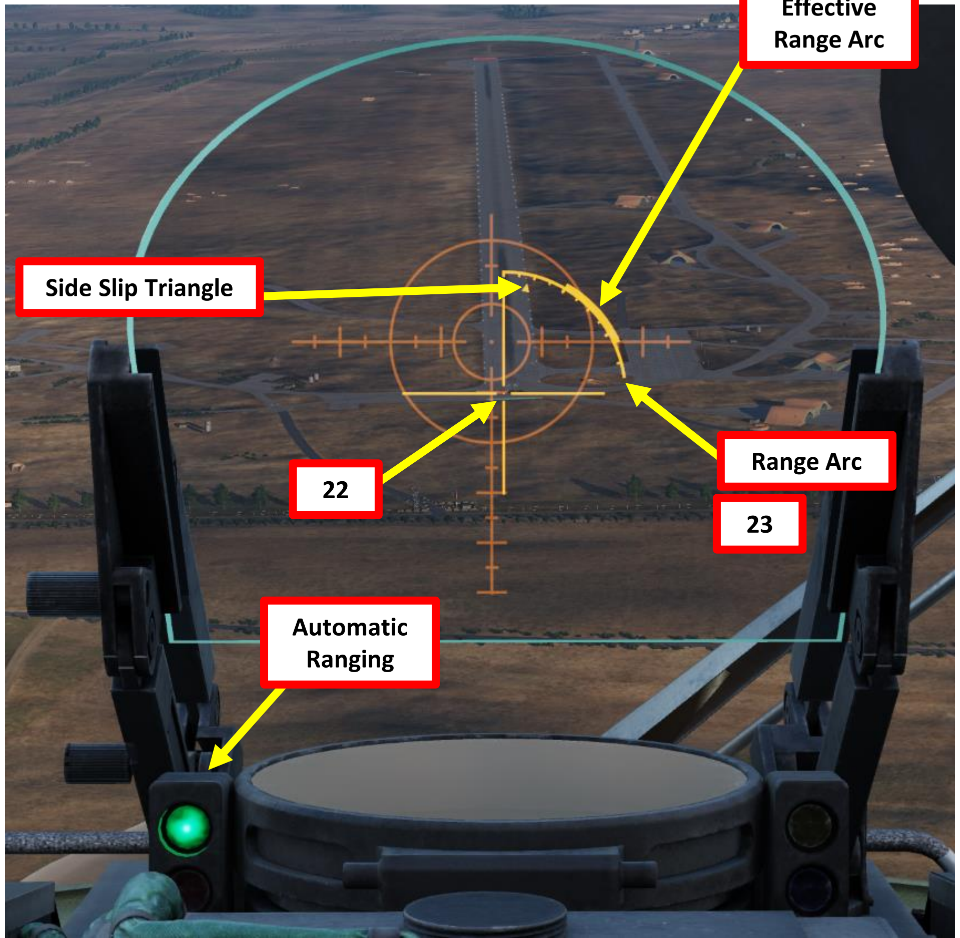
15. *[PC]* Confirm selection of Rockets by checking the Armament Selection Lights, which should display « RKT ».
16. *[PC]* Set target size in meters using the Target Base (Size) Setting Dial.
17. *[PC]* Set Sight Synchronization Mode Selector – SYNC (UP).
18. *[PC]* Set Sight Mode Selector – AUTOMATIC (UP).
19. *[PC]* Adjust Sight Fixed Reticle (Net) Brightness Control Knob to make the Fixed Reticle dim enough to see the Floating Reticle properly.
20. *[PC]* Adjust Sight Floating Reticle Brightness Control Knob as required.
21. *[PC]* Adjust Sight Reflector Glass as desired using the Sight Reflector Glass Control Lever.
    - *Lever UP: Sight Unlocked / Lever DOWN: Sight Locked*
    - *When lever is unlocked (UP), scroll mousewheel to adjust reflector glass position as desired*

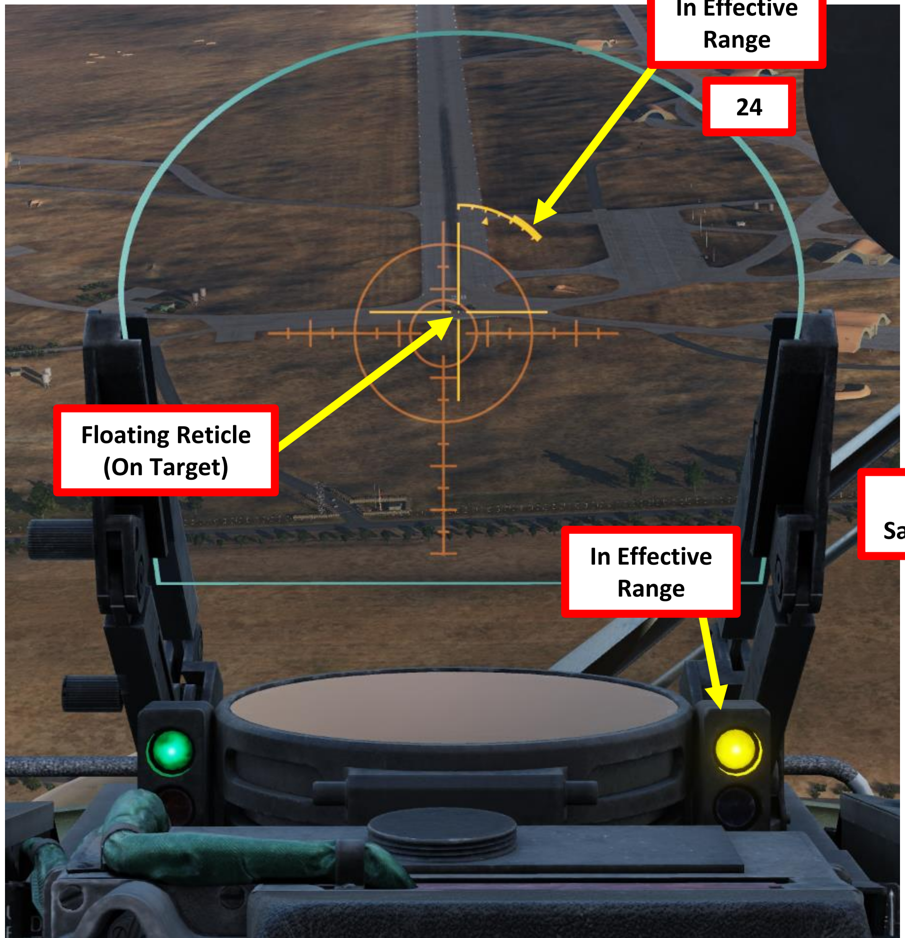


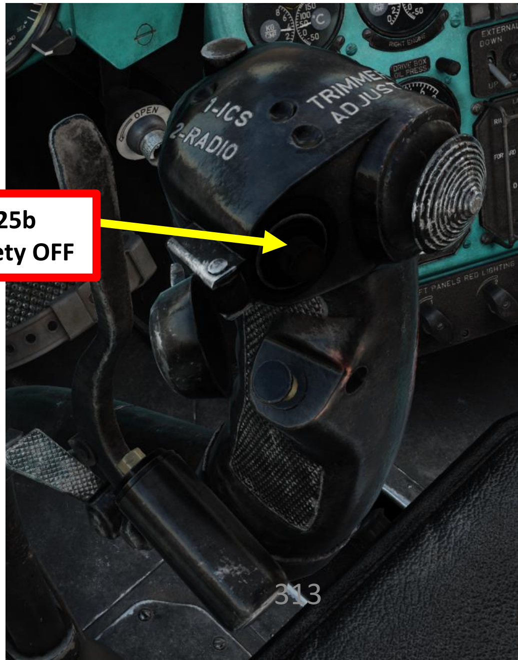


2.2.1 – S-5 (57 mm) ROCKETS

22. *[PC]* Fly the helicopter to align the Floating Reticle on the target.
    - Take into account relative target elevation when placing the Floating Reticle.
23. *[PC]* As you approach the target, the range arc shrinks as distance decreases. A green light indicates that automatic ranging is selected.
24. *[PC]* When you are in range, the range arc reaches the Effective Range arc (which is thicker) and a yellow light illuminates to indicate that you are within effective firing range.
25. *[PC]* Flip the weapon safety on the cyclic, then press and hold the « Weapon Release » (RALT + SPACE) button to fire rockets.
    - Note: When firing rockets at low airspeeds, the smoke can be ingested by the engine intakes and can cause an engine surge. To mitigate this dynamic effect, it is recommended to fire unguided rockets when flying at airspeeds above 110 km/h.







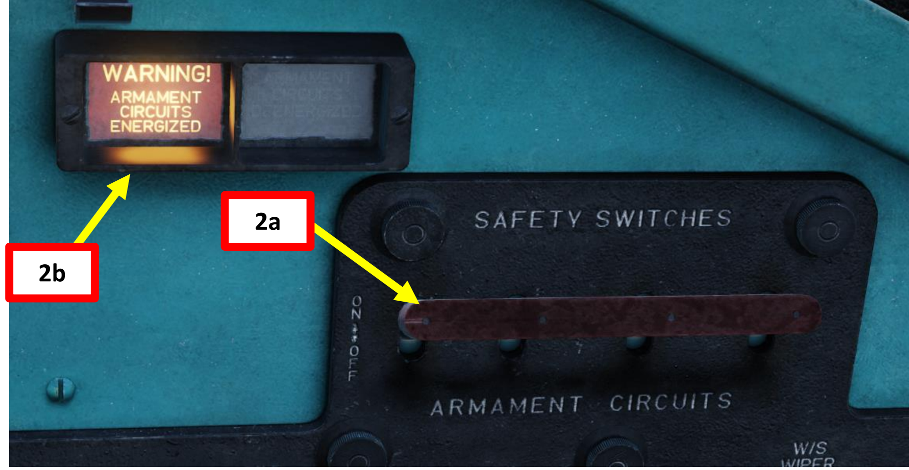
2.2.1 – S-5 (57 mm) ROCKETS

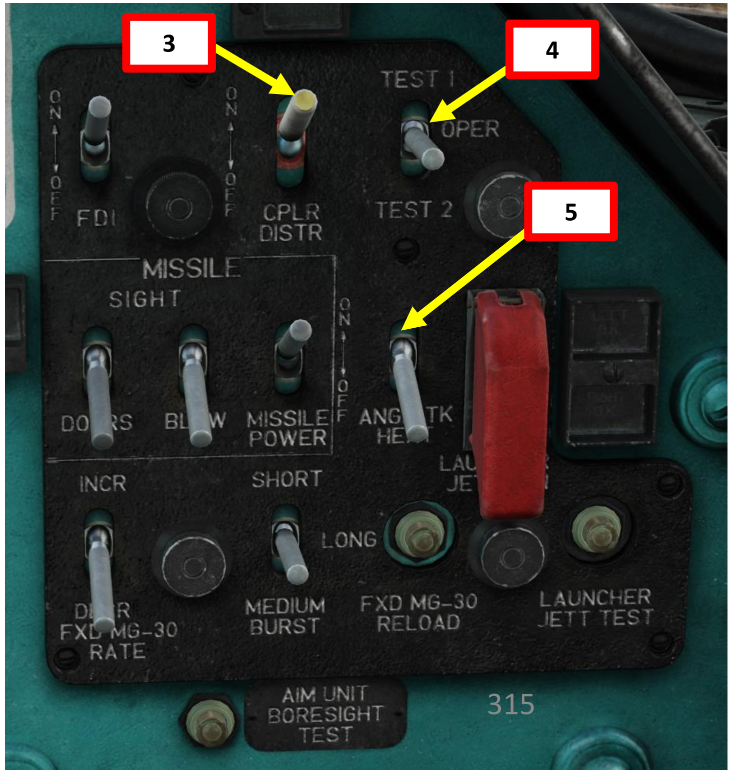
26. *[PC]* As the rockets fire, you may be temporarily blinded by the rocket motor smoke.
27. *[PC]* Avoid flying directly over the target. Break off from the target once the attack is complete, preferably to the left since visibility is better and the rotor torque makes left turns easier.

2.2.2 – S-8 (80 mm) ROCKETS

- *Steps preceded by [PC] are performed by the Pilot-Commander.*
- *Steps preceded by [CPG] are performed by the Co-Pilot Gunner (or the Petrovich AI if no player is manning the operator station).*

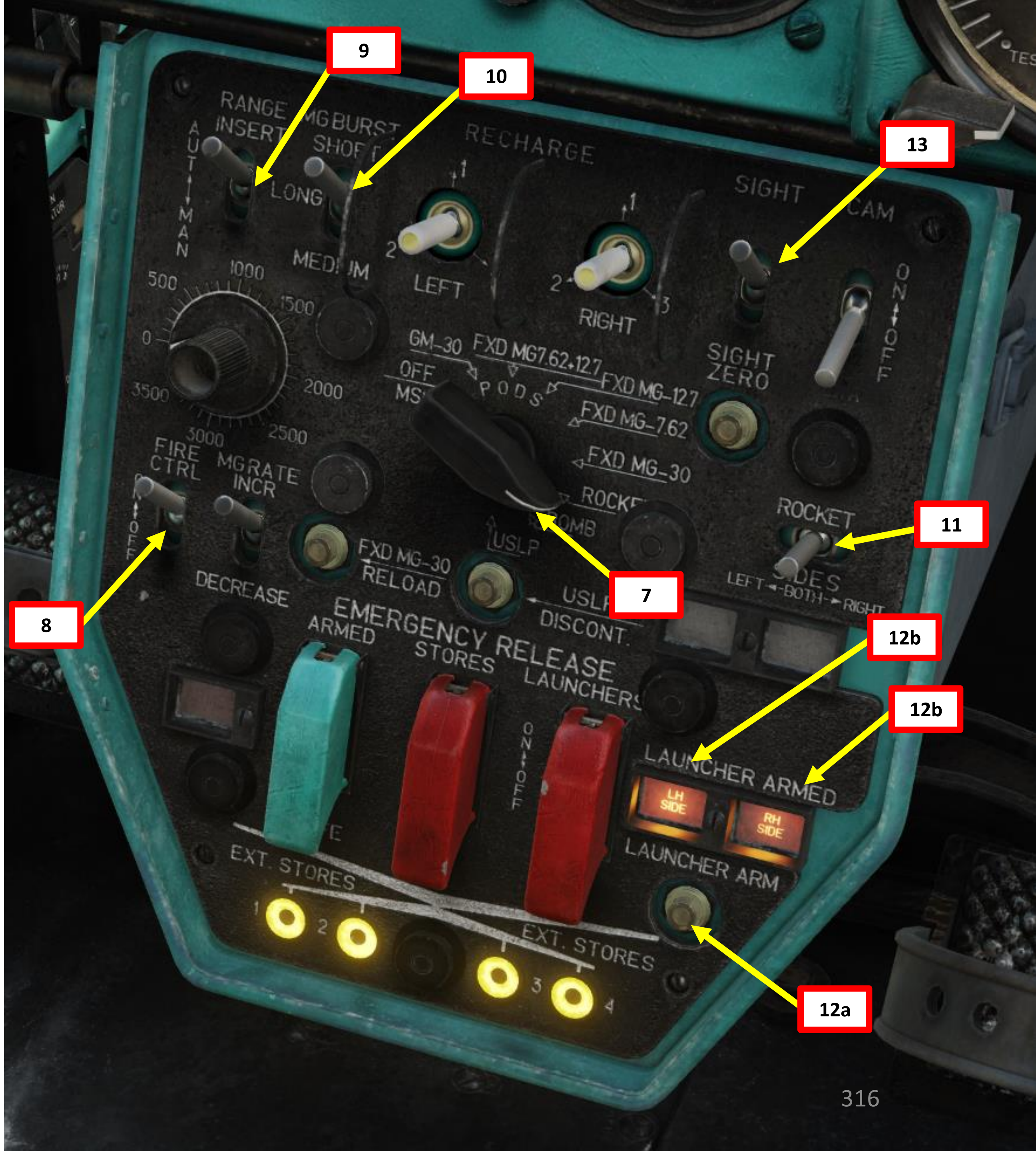
1. *[PC]* If not flying in Multicrew, request Petrovich AI to power up weapons (LCTRL+W).
2. *[CPG]* Set Armament Circuit Breakers – ON (UP).
3. *[CPG]* Set USR-24 (CPLR DISTR) Switch – ON (UP).
4. *[CPG]* Set USR-24 Mode Switch – OPERATION MODE (MIDDLE).
5. *[CPG] Set DUAS (Air Data Probe) Heating Switch* – As Required.
   - ON/UP if temperature is below 5 deg C
   - DOWN/OFF if temperature is above 5 deg C.
6. *[CPG]* Set Pilot/CPG Weapon Selection Control Handover Switch – DOWN (Pilot-Commander has Weapon Selection Control).





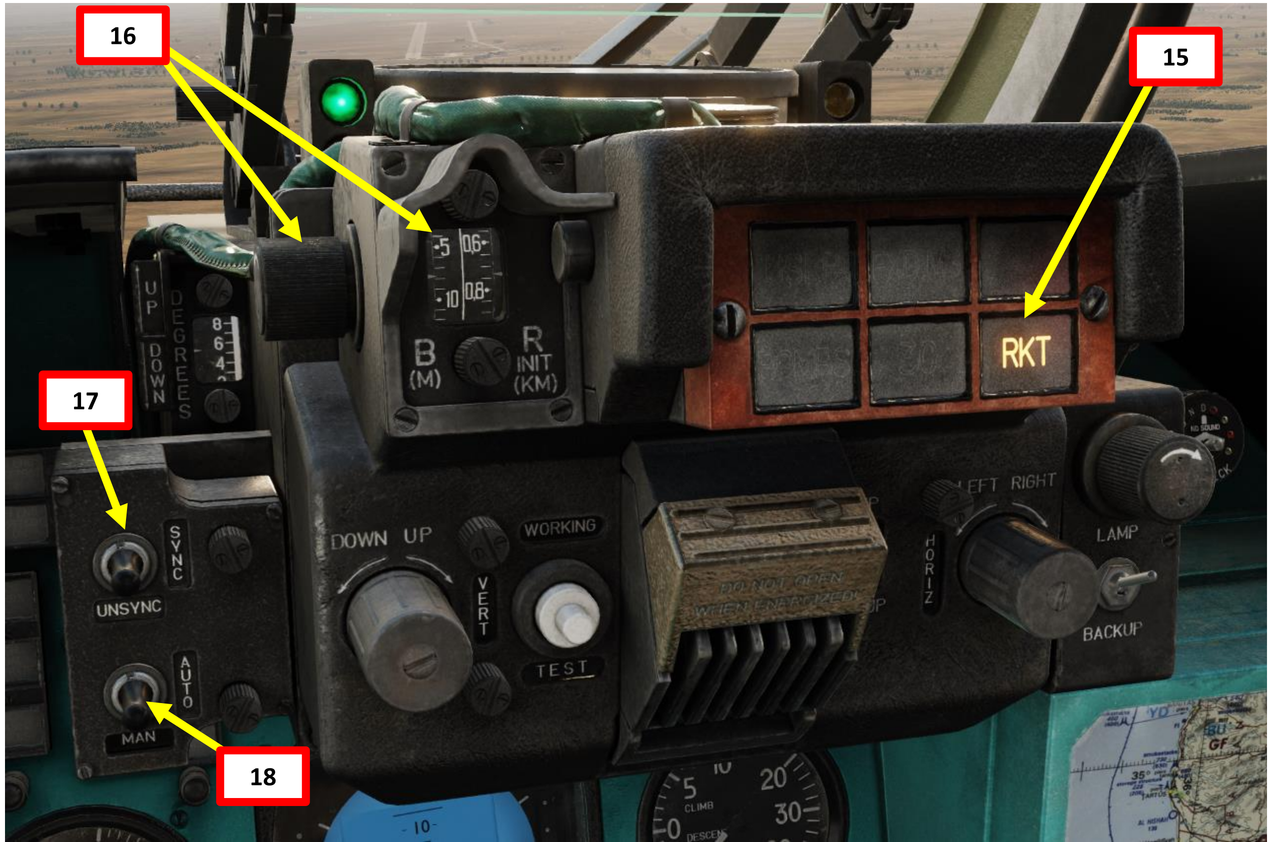
2.2.2 – S-8 (80 mm) ROCKETS

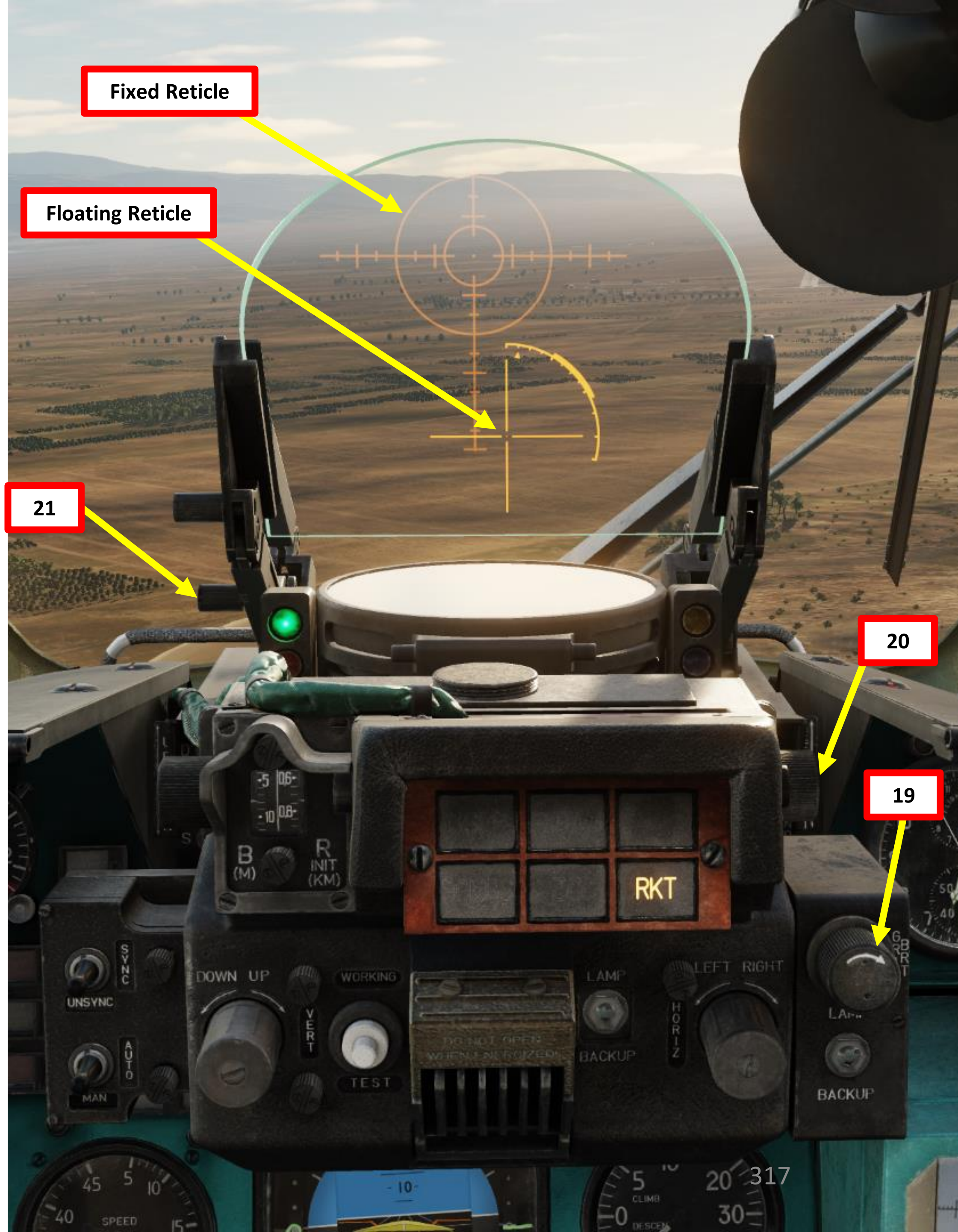
7. *[PC]* Set Weapon Selector – ROCKETS.
8. *[PC]* Set Fire Control Switch – ON (UP).
9. *[PC]* Set Sight Ranging Mode Selector – AUTOMATIC (UP).
   - Note: since we will use automatic ranging instead of manual ranging, setting the manual range distance setting is not required.
10. *[PC]* Set Burst Length Selector Switch – As Desired.
    - Short Burst/UP setting is recommended.
11. *[PC]* Set Rocket Pod Selector Switch – As Desired.
    - BOTH/Middle is recommended.
12. *[PC]* Press and hold LAUNCHER ARM (Rocket Pod Arming) Button for 2-3 seconds. Confirm that LAUNCHER ARMED lights of selected rocket pods illuminate.
13. *[PC]* Set ASP-17VP Sight Power Switch – ON (UP).
14. *[PC]* Set Auxiliary Stores Light Switch – ON (UP).



2.2.2 – S-8 (80 mm) ROCKETS

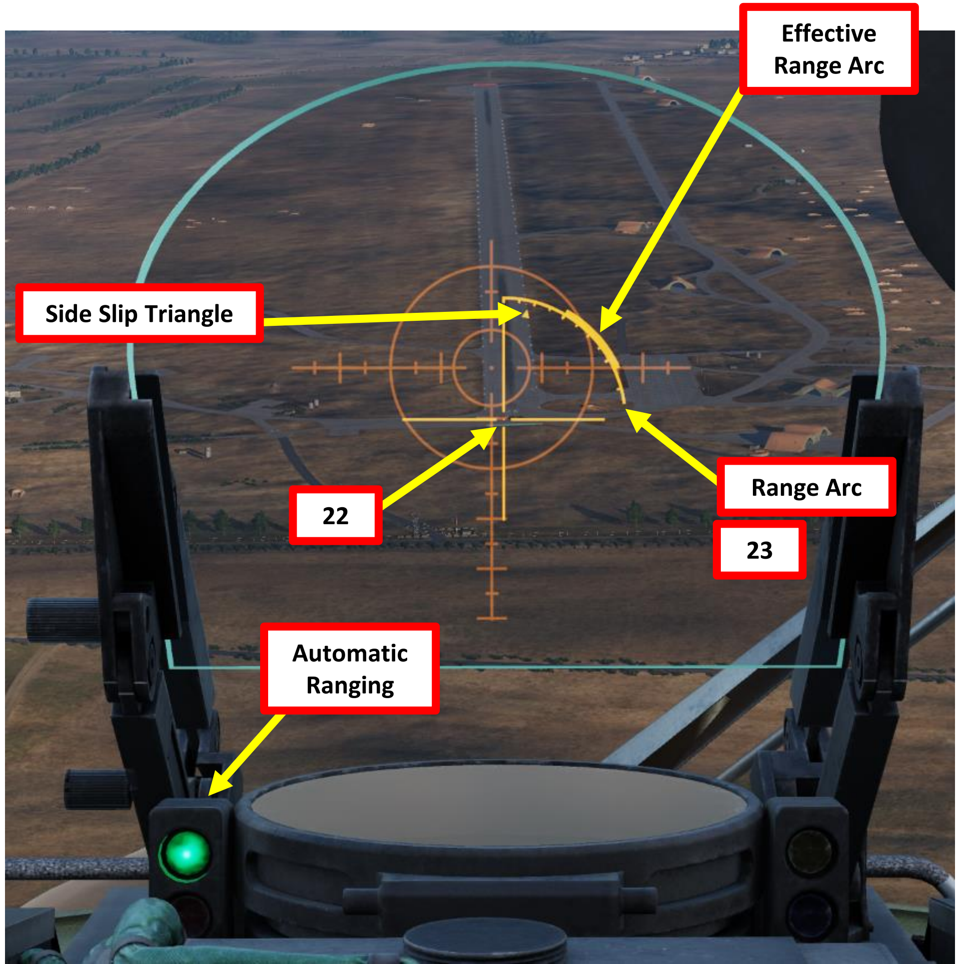
15. *[PC]* Confirm selection of Rockets by checking the Armament Selection Lights, which should display « RKT ».
16. *[PC]* Set target size in meters using the Target Base (Size) Setting Dial.
17. *[PC]* Set Sight Synchronization Mode Selector – SYNC (UP).
18. *[PC]* Set Sight Mode Selector – AUTOMATIC (UP).
19. *[PC]* Adjust Sight Fixed Reticle (Net) Brightness Control Knob to make the Fixed Reticle dim enough to see the Floating Reticle properly.
20. *[PC]* Adjust Sight Floating Reticle Brightness Control Knob as required.
21. *[PC]* Adjust Sight Reflector Glass as desired using the Sight Reflector Glass Control Lever.
    - *Lever UP: Sight Unlocked / Lever DOWN: Sight Locked*
    - *When lever is unlocked (UP), scroll mousewheel to adjust reflector glass position as desired*

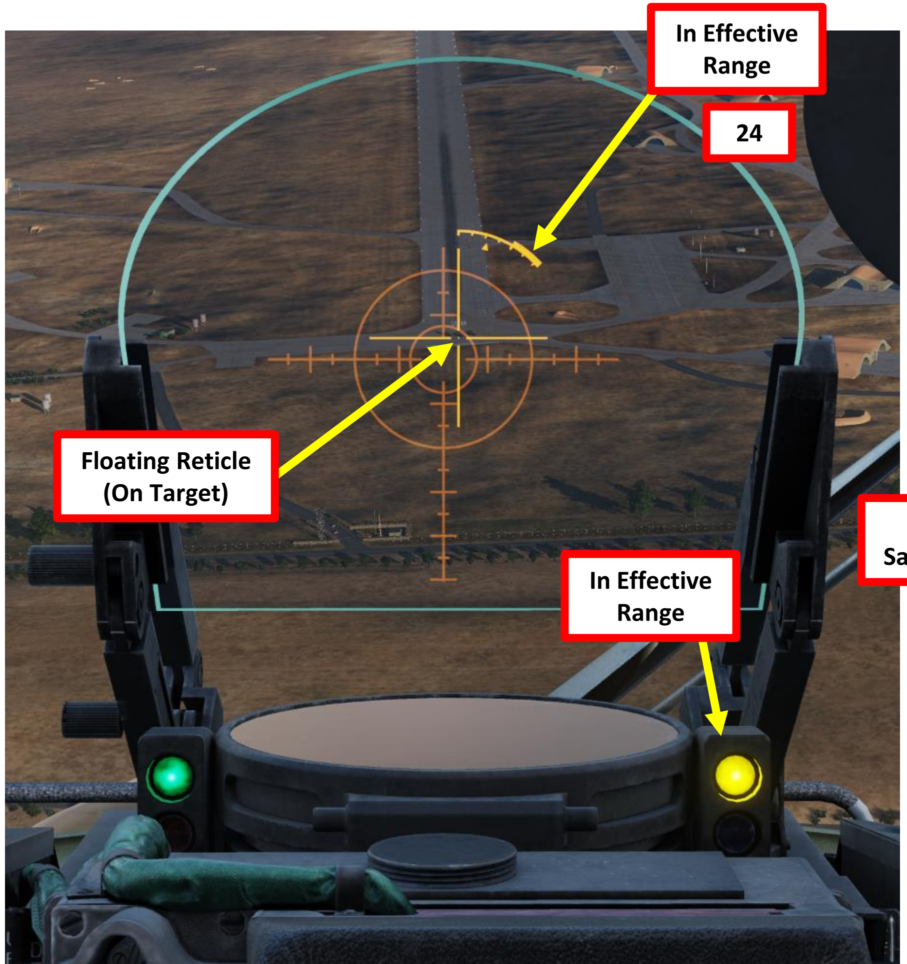


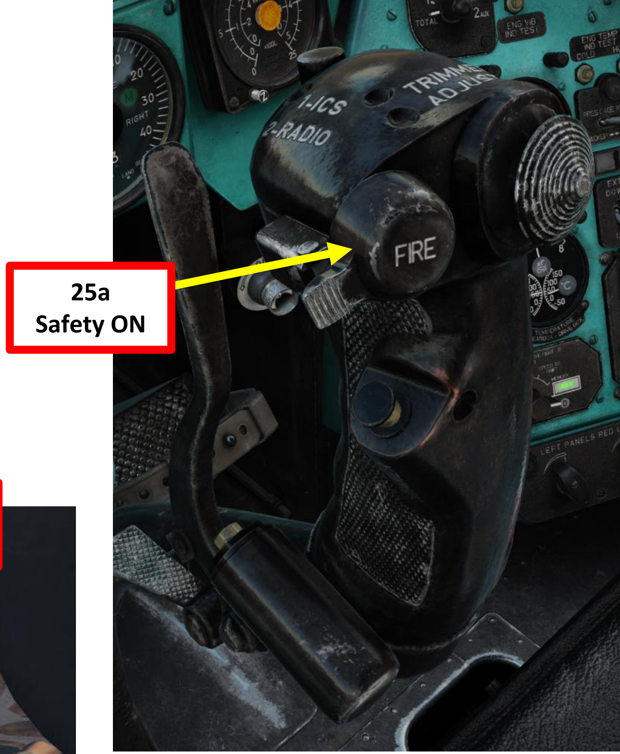


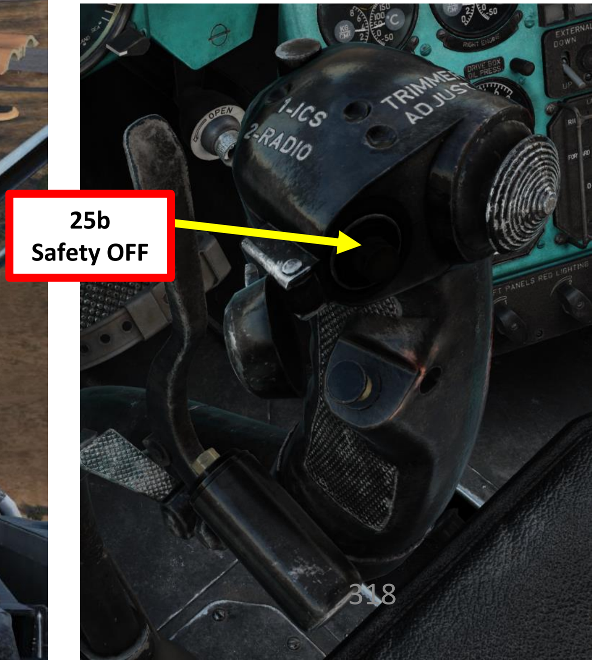
2.2.2 – S-8 (80 mm) ROCKETS

22. *[PC]* Fly the helicopter to align the Floating Reticle on the target.
    - Take into account relative target elevation when placing the Floating Reticle.
23. *[PC]* As you approach the target, the range arc shrinks as distance decreases. A green light indicates that automatic ranging is selected.
24. *[PC]* When you are in range, the range arc reaches the Effective Range arc (which is thicker) and a yellow light illuminates to indicate that you are within effective firing range.
25. *[PC]* Flip the weapon safety on the cyclic, then press and hold the « Weapon Release » (RALT + SPACE) button to fire rockets.
    - Note: When firing rockets at low airspeeds, the smoke can be ingested by the engine intakes and can cause an engine surge. To mitigate this dynamic effect, it is recommended to fire unguided rockets when flying at airspeeds above 110 km/h.









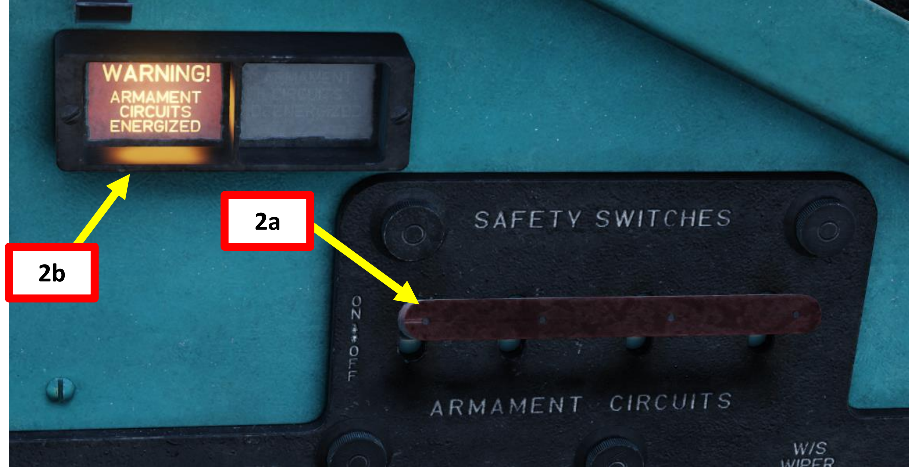
2.2.2 – S-8 (80 mm) ROCKETS

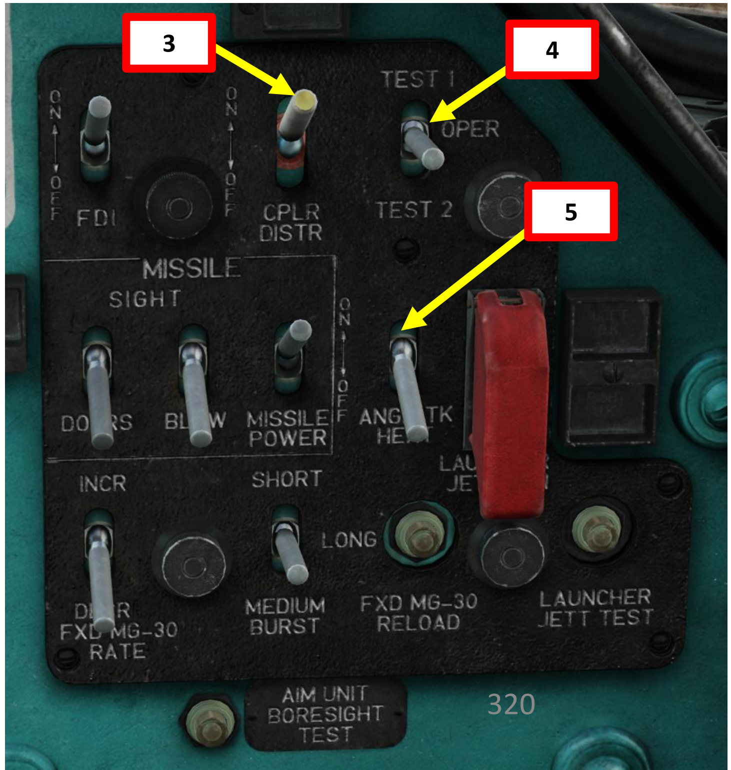
26. *[PC]* As the rockets fire, you may be temporarily blinded by the rocket motor smoke.
27. *[PC]* Avoid flying directly over the target. Break off from the target once the attack is complete, preferably to the left since visibility is better and the rotor torque makes left turns easier.

2.2.3 – S-13 (122 mm) ROCKETS

- *Steps preceded by [PC] are performed by the Pilot-Commander.*
- *Steps preceded by [CPG] are performed by the Co-Pilot Gunner (or the Petrovich AI if no player is manning the operator station).*

1. *[PC]* If not flying in Multicrew, request Petrovich AI to power up weapons (LCTRL+W).
2. *[CPG]* Set Armament Circuit Breakers – ON (UP).
3. *[CPG]* Set USR-24 (CPLR DISTR) Switch – ON (UP).
4. *[CPG]* Set USR-24 Mode Switch – OPERATION MODE (MIDDLE).
5. *[CPG] Set DUAS (Air Data Probe) Heating Switch* – As Required.
   - ON/UP if temperature is below 5 deg C
   - DOWN/OFF if temperature is above 5 deg C.
6. *[CPG]* Set Pilot/CPG Weapon Selection Control Handover Switch – DOWN (Pilot-Commander has Weapon Selection Control).

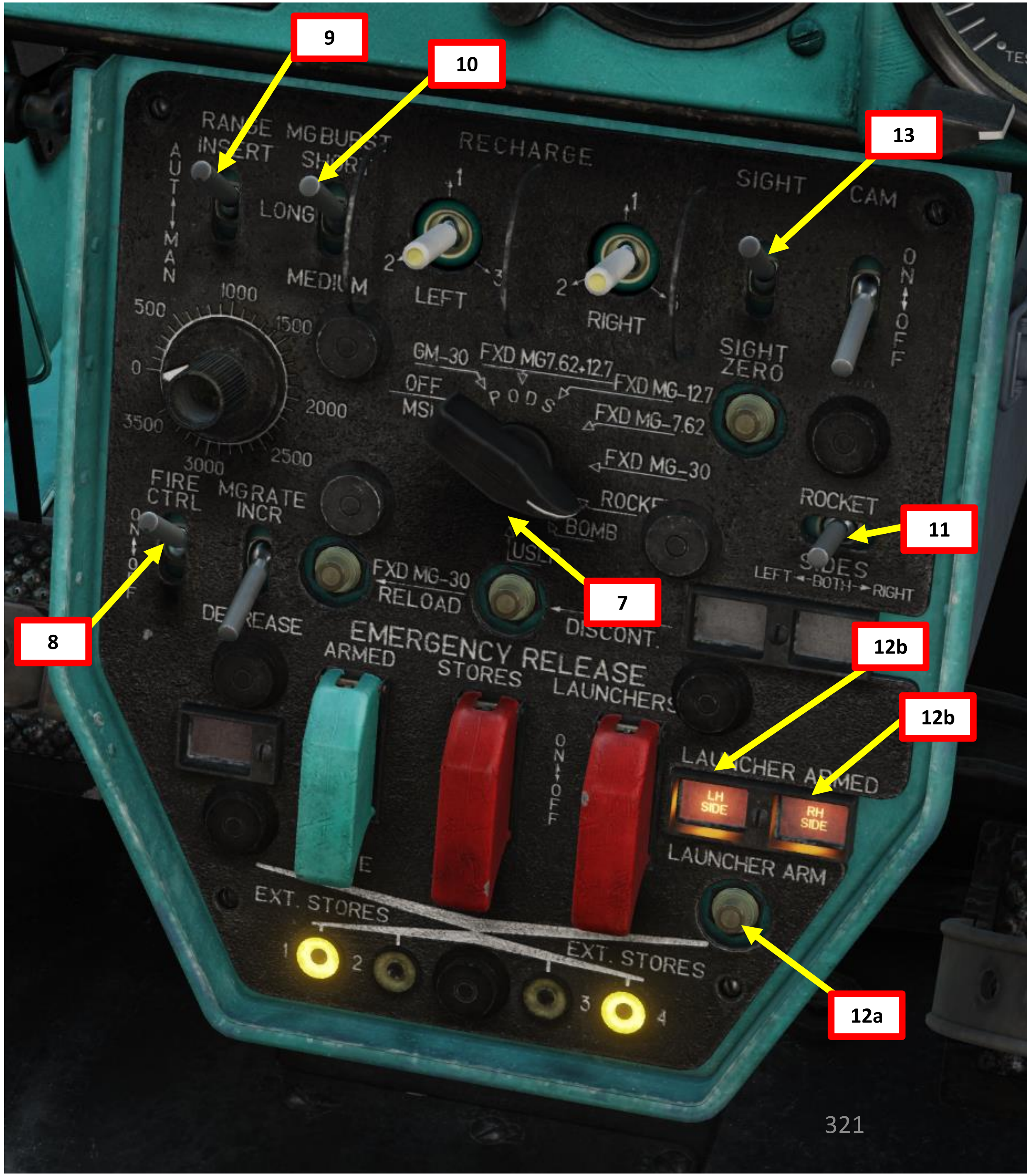





B-13L Rocket Launchers with S-13 Rockets (x5)

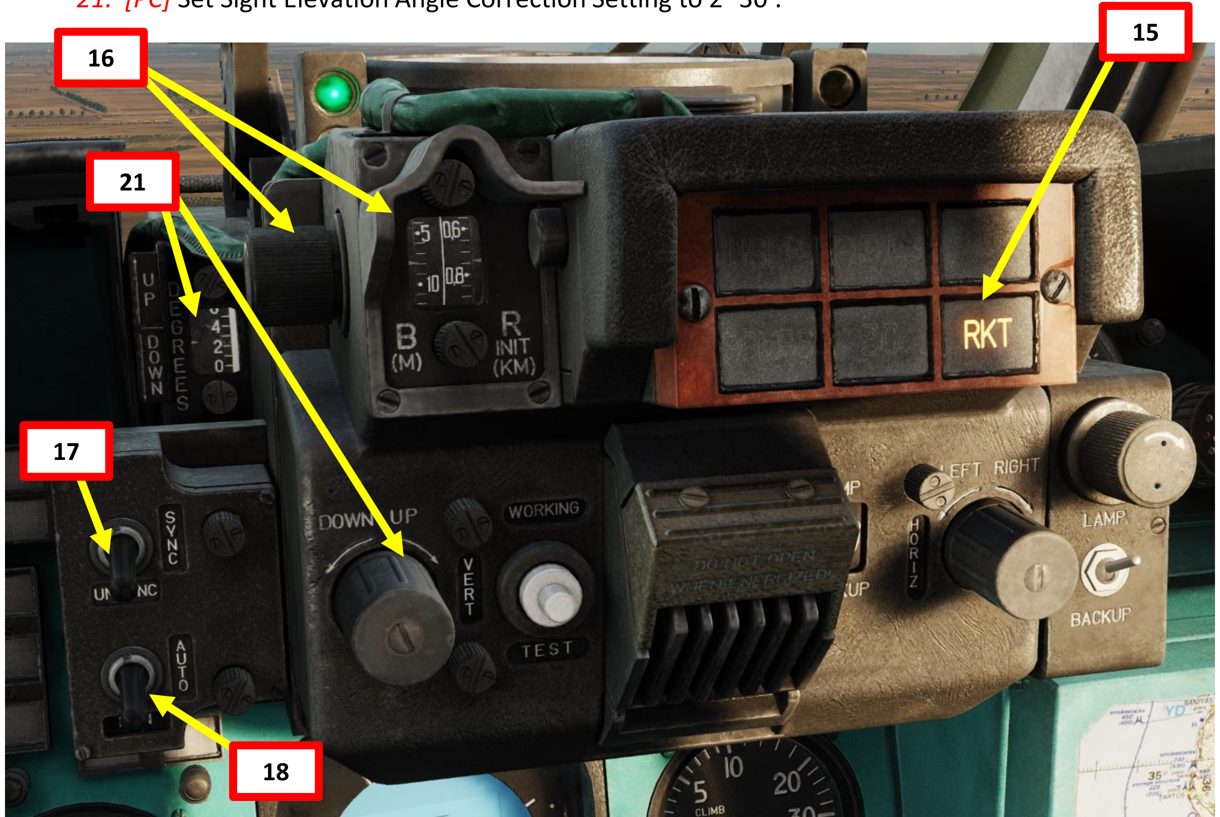
2.2.3 – S-13 (122 mm) ROCKETS

7. *[PC]* Set Weapon Selector – ROCKETS.
8. *[PC]* Set Fire Control Switch – ON (UP).
9. *[PC]* Set Sight Ranging Mode Selector – AUTOMATIC (UP).
   - Note: since we will use automatic ranging instead of manual ranging, setting the manual range distance setting is not required.
10. *[PC]* Set Burst Length Selector Switch – As Desired.
    - Short Burst/UP setting is recommended.
11. *[PC]* Set Rocket Pod Selector Switch – As Desired.
    - BOTH/Middle is recommended.
12. *[PC]* Press and hold LAUNCHER ARM (Rocket Pod Arming) Button for 2-3 seconds. Confirm that LAUNCHER ARMED lights of selected rocket pods illuminate.
13. *[PC]* Set ASP-17VP Sight Power Switch – ON (UP).
14. *[PC]* Set Auxiliary Stores Light Switch – ON (UP).



2.2.3 – S-13 (122 mm) ROCKETS

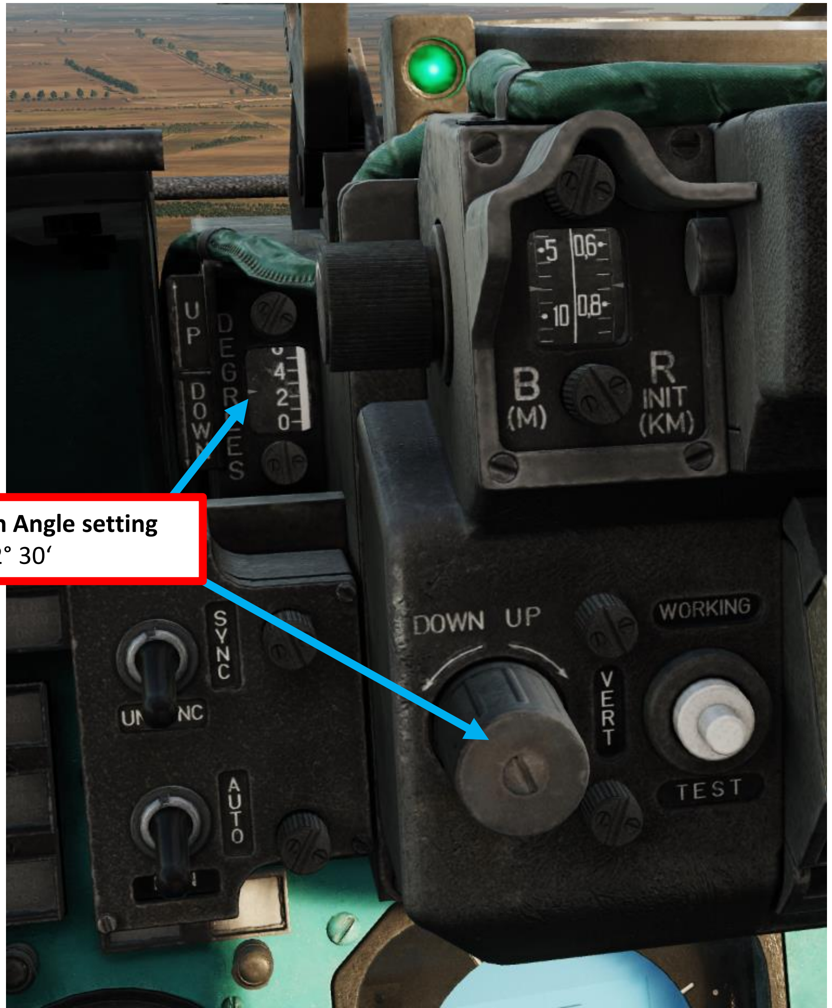
15. *[PC]* Confirm selection of Rockets by checking the Armament Selection Lights, which should display « RKT ».
16. *[PC]* Set target size in meters using the Target Base (Size) Setting Dial.
17. *[PC]* Set Sight Synchronization Mode Selector – ASYNC (DOWN).
18. *[PC]* Set Sight Mode Selector – MANUAL (DOWN). This will cage the floating reticle on the fixed reticle.
19. *[PC]* Consult the Attack Profile tables to determine required reticle depression angle for attack speed and target distance. The complete tables are available in section 2.2.5.
20. *[PC]* We will select the following dive attack profile:
    - 10 deg dive
    - Dive Entry Airspeed: 150 km/h
    - Airspeed at Launch: 180 km/h
    - Distance to target: 2000 m
    - Depression angle: 2° 30‘
21. *[PC]* Set Sight Elevation Angle Correction Setting to 2° 30‘.

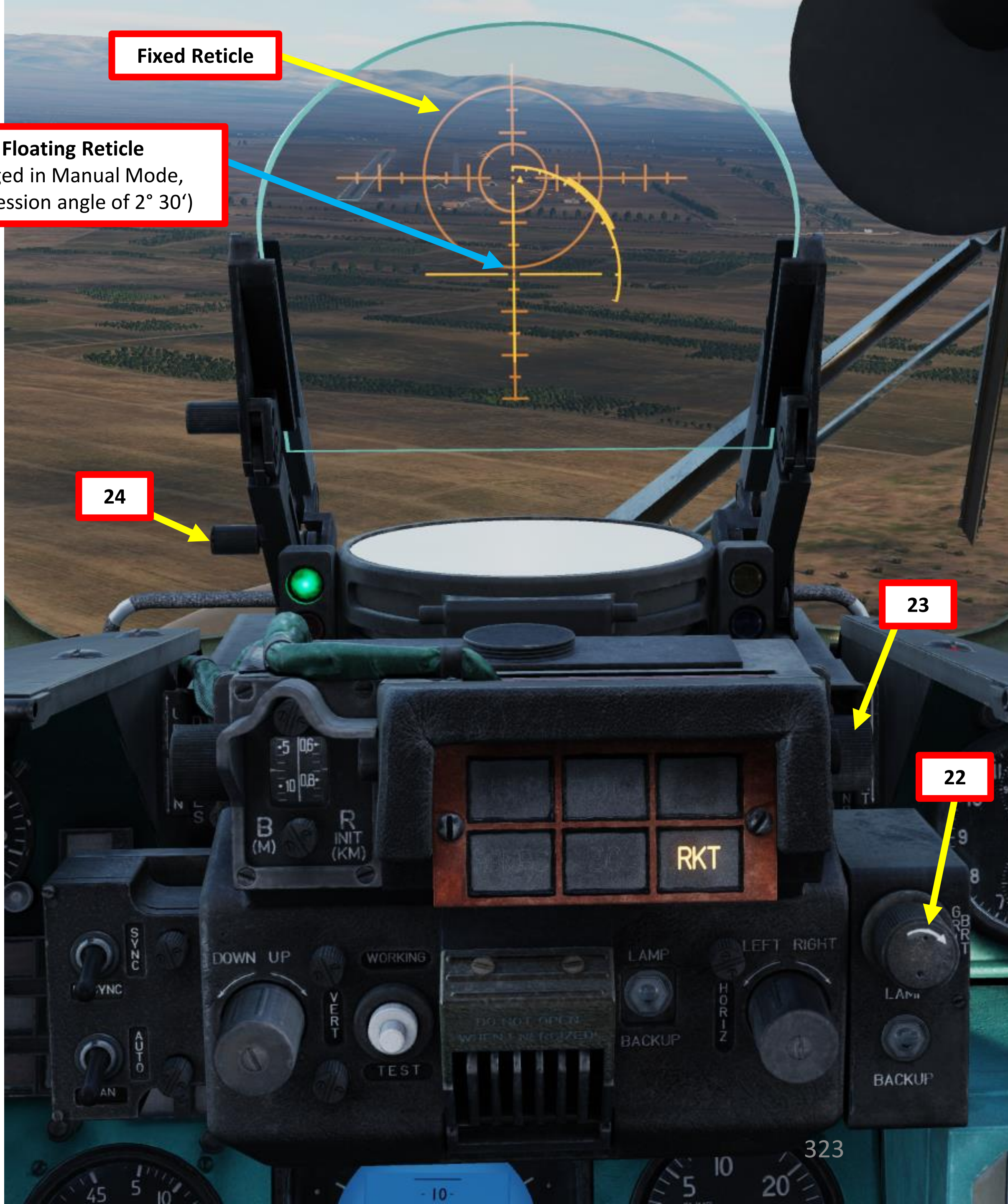


Rocket Dive Attack Profile – Sight Depression Angle Table				
Dive Pitch Angle (deg)	**Dive Entry Airspeed (km/h)**	**Airspeed at Launch (km/h)**	**Distance to Target (m)**	**S-13D Rockets**
10	150	180	1000 1500 2000 2500 3000 3500	- 2° 05‘ 2° 30‘ 3° 00‘ 3° 30‘ 4° 05‘
20	150	200-210	1000 1500 2000 2500 3000 3500	- 1° 10‘ 1° 35‘ 2° 00‘ 2° 30‘ 3° 00‘
30	100	180-200	1000 1500 2000 2500 3000 3500	- 1° 10‘ 1° 30‘ 1° 55‘ 2° 30‘ 3° 00‘

2.2.3 – S-13 (122 mm) ROCKETS

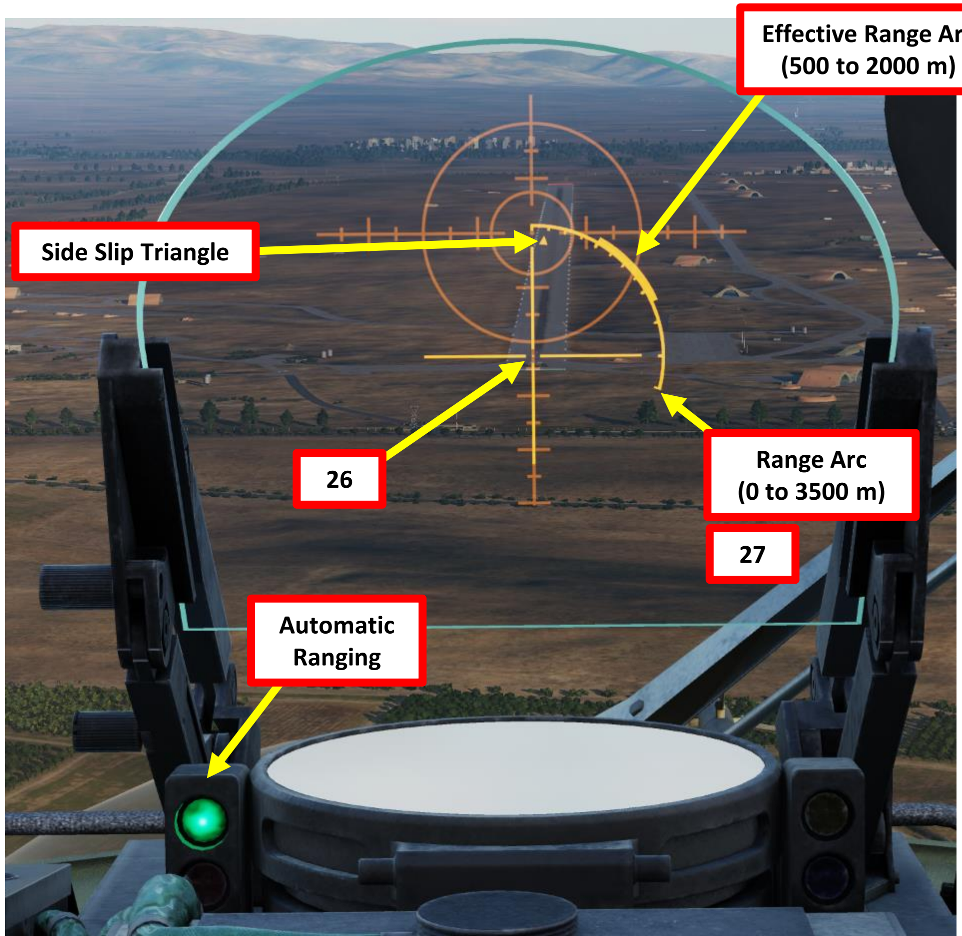
22. *[PC]* Adjust Sight Fixed Reticle (Net) Brightness Control Knob to make the Fixed Reticle dim enough to see the Floating Reticle properly.
23. *[PC]* Adjust Sight Floating Reticle Brightness Control Knob as required.
24. *[PC]* Adjust Sight Reflector Glass as desired using the Sight Reflector Glass Control Lever.
    - *Lever UP: Sight Unlocked / Lever DOWN: Sight Locked*
    - *When lever is unlocked (UP), scroll mousewheel to adjust reflector glass position as desired*

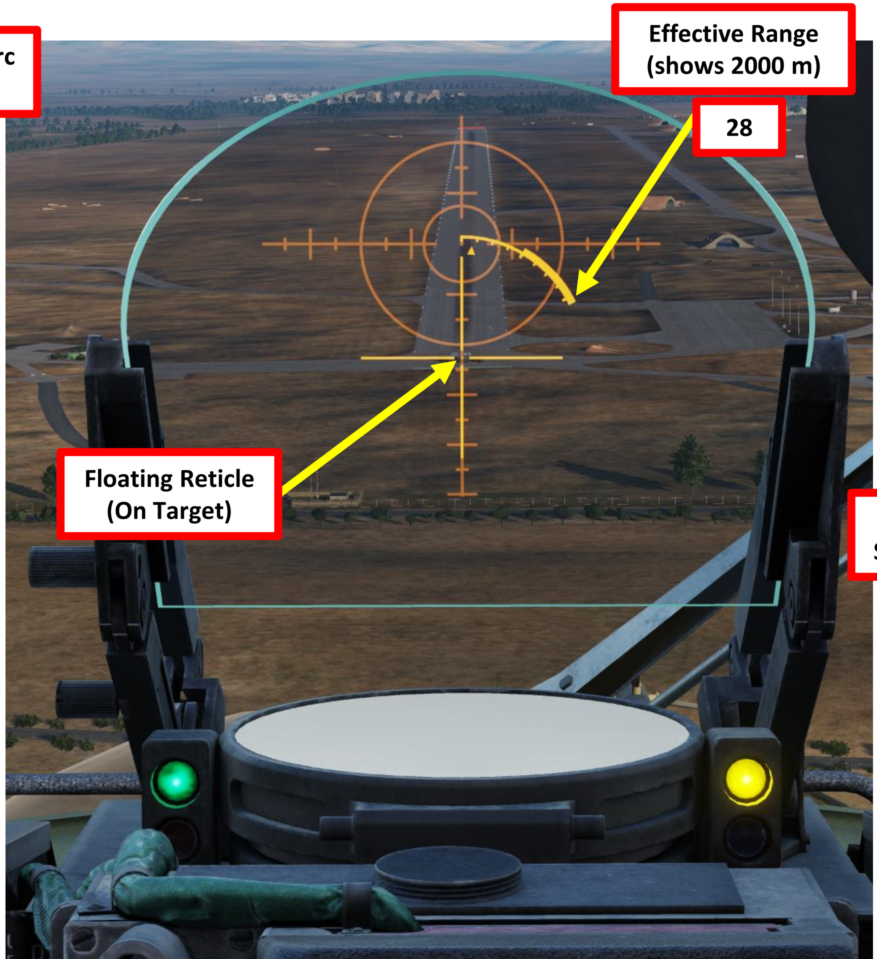


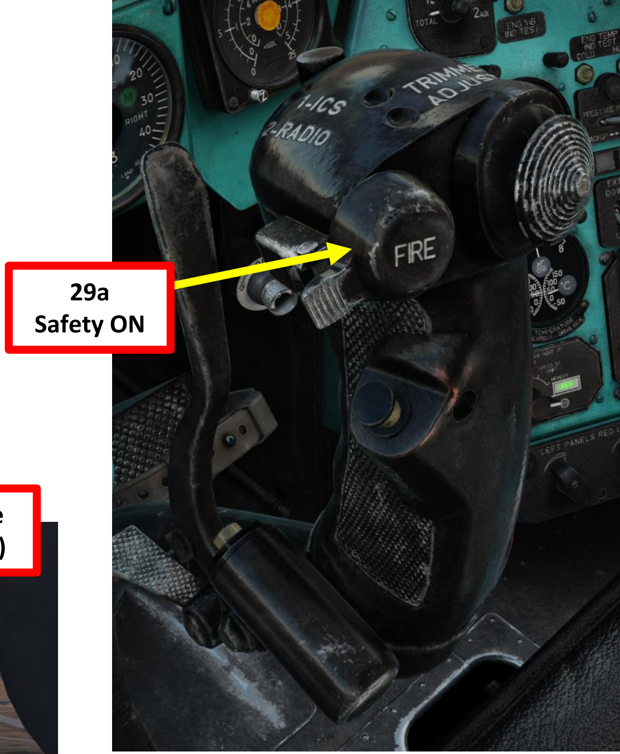


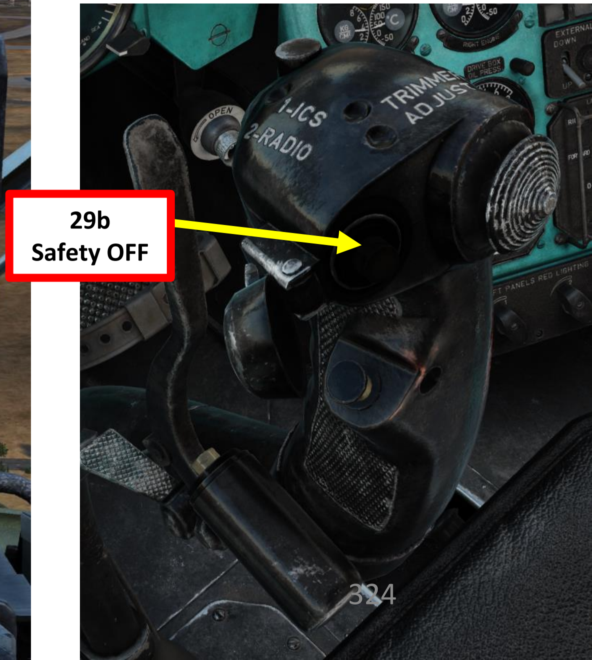
2.2.3 – S-13 (122 mm) ROCKETS

25. *[PC]* Unlike S-5 and S-8 rockets, the Floating Reticle is fixed since we selected Manual Sight mode. We use Automatic Ranging, therefore the sight is caged on the Fixed Reticle but it will still display a range approximation based on radar altitude and helicopter pitch attitude.
26. *[PC]* Fly the attack profile; enter a 10 de dive at 150 km/h, then fly the helicopter to align the caged Floating Reticle on the target (which should be aligned on the fixed reticle with the angle depression setting).
27. *[PC]* As you approach the target, the range arc shrinks as distance decreases. A green light indicates that automatic ranging is selected.
28. *[PC]* Use the range arc to estimate your 2000 m firing range, which should coincide with the lower part of the Effective Range arc (which is thicker). You should be flying at 180 km/h when ready to fire rockets.
29. *[PC]* Flip the weapon safety on the cyclic, then press and hold the « Weapon Release » (RALT + SPACE) button to fire rockets.
    - Note: When firing rockets at low airspeeds, the smoke can be ingested by the engine intakes and can cause an engine surge. To mitigate this dynamic effect, it is recommended to fire unguided rockets when flying at airspeeds above 110 km/h.









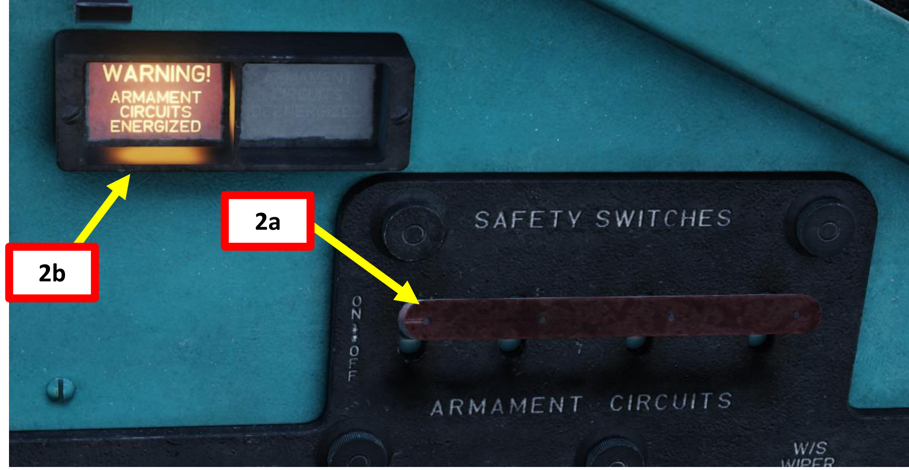
2.2.3 – S-13 (122 mm) ROCKETS

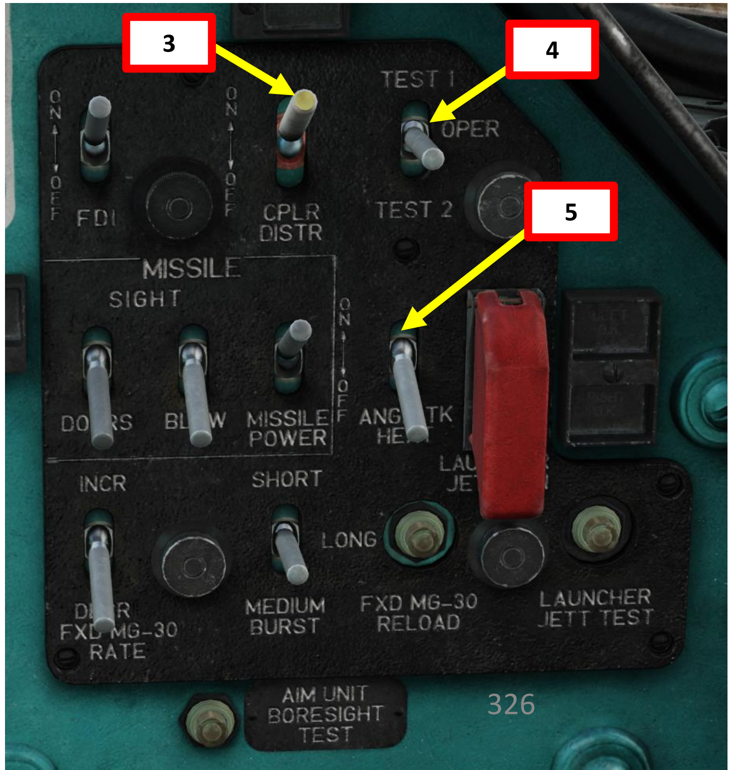
30. *[PC]* As the rockets fire, you may be temporarily blinded by the rocket motor smoke.
31. *[PC]* Avoid flying directly over the target. Break off from the target once the attack is complete, preferably to the left since visibility is better and the rotor torque makes left turns easier.

2.2.4 – S-24B (240 mm) ROCKETS

- *Steps preceded by [PC] are performed by the Pilot-Commander.*
- *Steps preceded by [CPG] are performed by the Co-Pilot Gunner (or the Petrovich AI if no player is manning the operator station).*

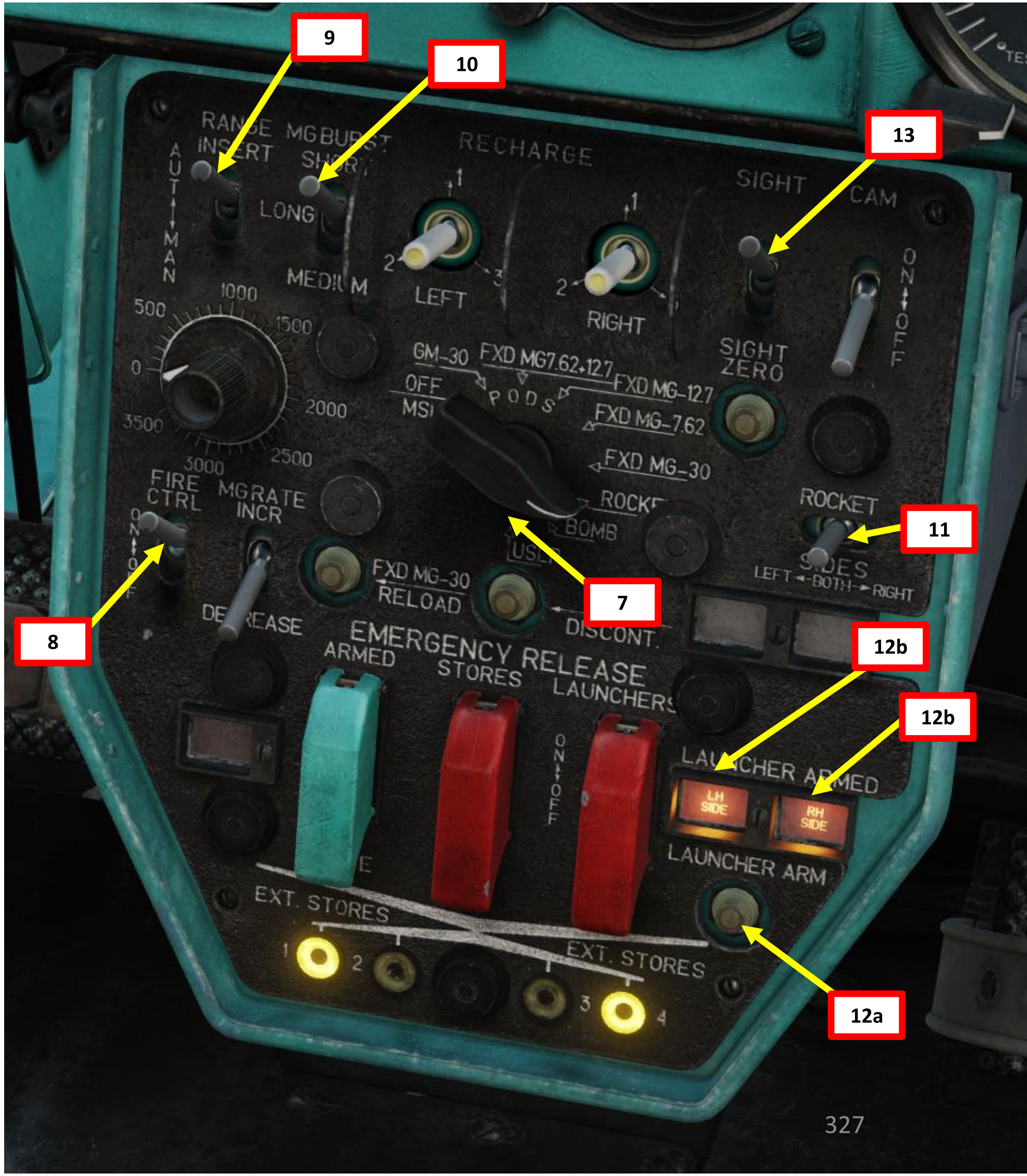
1. *[PC]* If not flying in Multicrew, request Petrovich AI to power up weapons (LCTRL+W).
2. *[CPG]* Set Armament Circuit Breakers – ON (UP).
3. *[CPG]* Set USR-24 (CPLR DISTR) Switch – ON (UP).
4. *[CPG]* Set USR-24 Mode Switch – OPERATION MODE (MIDDLE).
5. *[CPG] Set DUAS (Air Data Probe) Heating Switch* – As Required.
   - ON/UP if temperature is below 5 deg C
   - DOWN/OFF if temperature is above 5 deg C.
6. *[CPG]* Set Pilot/CPG Weapon Selection Control Handover Switch – DOWN (Pilot-Commander has Weapon Selection Control).





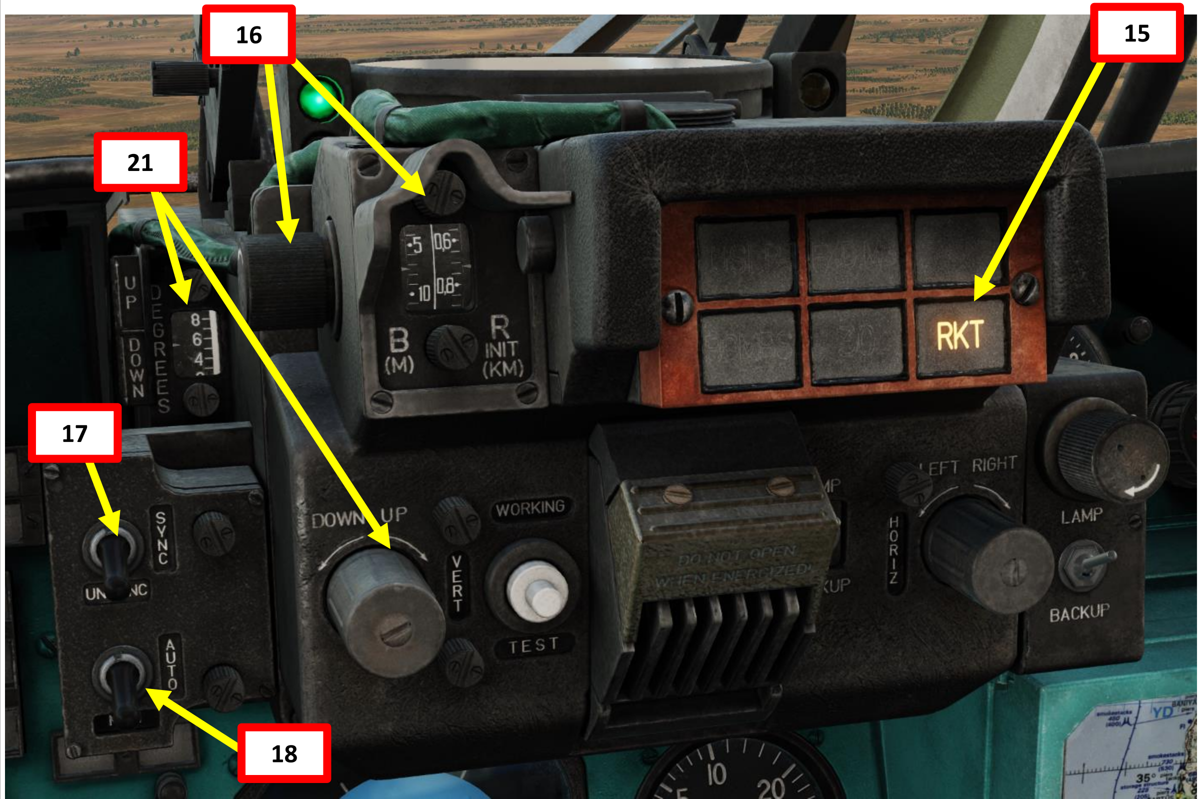
2.2.4 – S-24B (240 mm) ROCKETS

7. *[PC]* Set Weapon Selector – ROCKETS.
8. *[PC]* Set Fire Control Switch – ON (UP).
9. *[PC]* Set Sight Ranging Mode Selector – AUTOMATIC (UP).
   - Note: since we will use automatic ranging instead of manual ranging, setting the manual range distance setting is not required.
10. *[PC]* Set Burst Length Selector Switch – As Desired.
    - Short Burst/UP setting is recommended.
11. *[PC]* Set Rocket Pod Selector Switch – As Desired.
    - BOTH/Middle is recommended.
12. *[PC]* Press and hold LAUNCHER ARM (Rocket Pod Arming) Button for 2-3 seconds. Confirm that LAUNCHER ARMED lights of selected rocket pods illuminate.
13. *[PC]* Set ASP-17VP Sight Power Switch – ON (UP).
14. *[PC]* Set Auxiliary Stores Light Switch – ON (UP).



2.2.4 – S-24B (240 mm) ROCKETS

15. *[PC]* Confirm selection of Rockets by checking the Armament Selection Lights, which should display « RKT ».
16. *[PC]* Set target size in meters using the Target Base (Size) Setting Dial.
17. *[PC]* Set Sight Synchronization Mode Selector – ASYNC (DOWN).
18. *[PC]* Set Sight Mode Selector – MANUAL (DOWN). This will cage the floating reticle on the fixed reticle.
19. *[PC]* Consult the Attack Profile tables to determine required reticle depression angle for attack speed and target distance. The complete tables are available in section 2.2.5.
20. *[PC]* We will select the following dive attack profile:
    - 10 deg dive
    - Dive Entry Airspeed: 150 km/h
    - Airspeed at Launch: 180 km/h
    - Distance to target: 2000 m
    - Depression angle: 5° 45‘
21. *[PC]* Set Sight Elevation Angle Correction Setting to 5° 45‘.

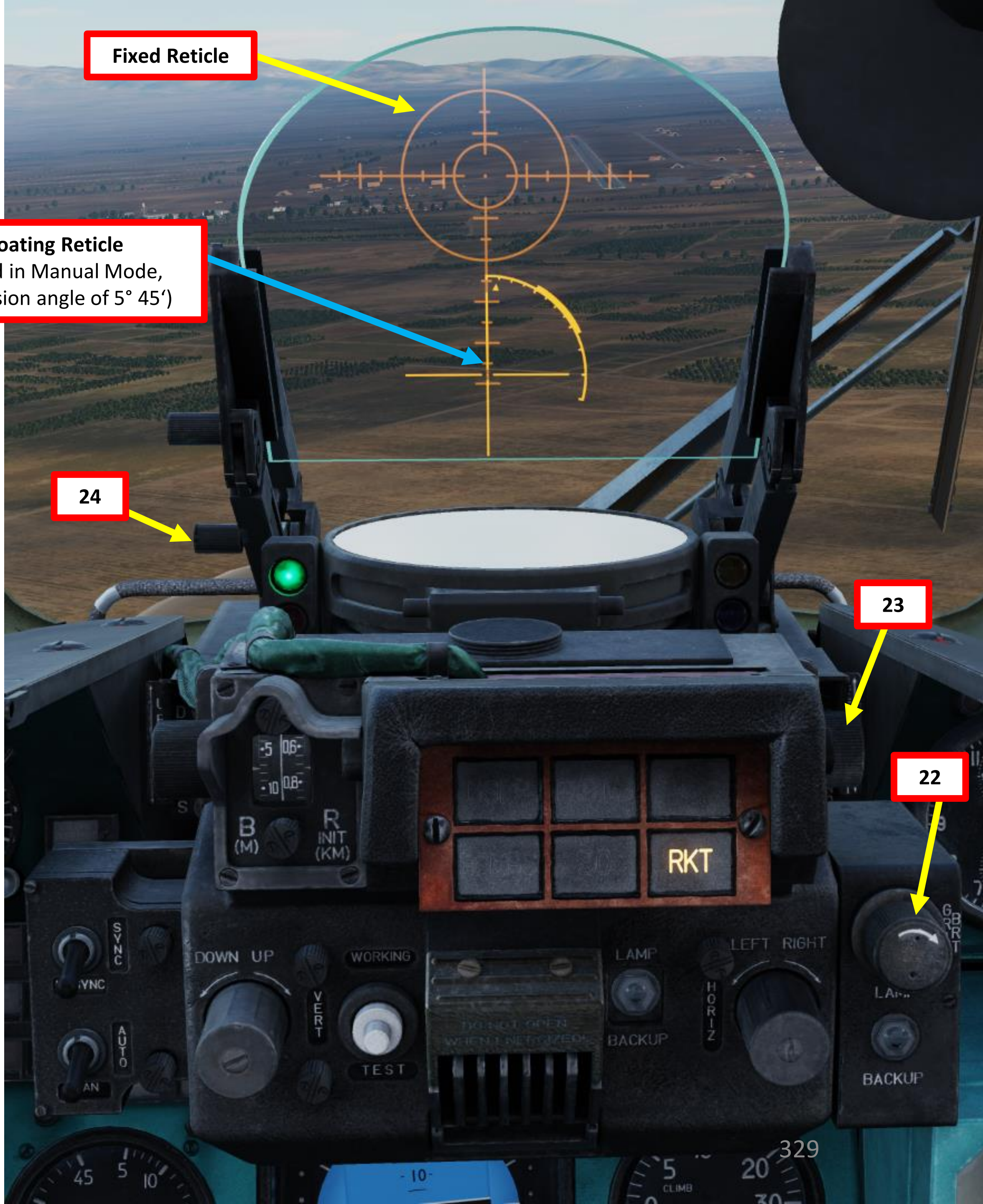


Rocket Dive Attack Profile – Sight Depression Angle Table

Dive Pitch Angle (deg)	Dive Entry Airspeed (km/h)	Airspeed at Launch (km/h)	Distance to Target (m)	S-24B Rockets
10	150	180	1000	-
			1500	5° 15‘
			2000	5° 45‘
			2500	6° 30‘
			3000	7° 20‘
			3500	8° 15‘
20	150	200-210	1000	-
			1500	4° 45‘
			2000	5° 15‘
			2500	5° 55‘
			3000	6° 45‘
			3500	7° 20‘
30	100	180-200	1000	-
			1500	2° 00‘
			2000	2° 30‘
			2500	3° 00‘
			3000	3° 45‘
			3500	4° 45‘

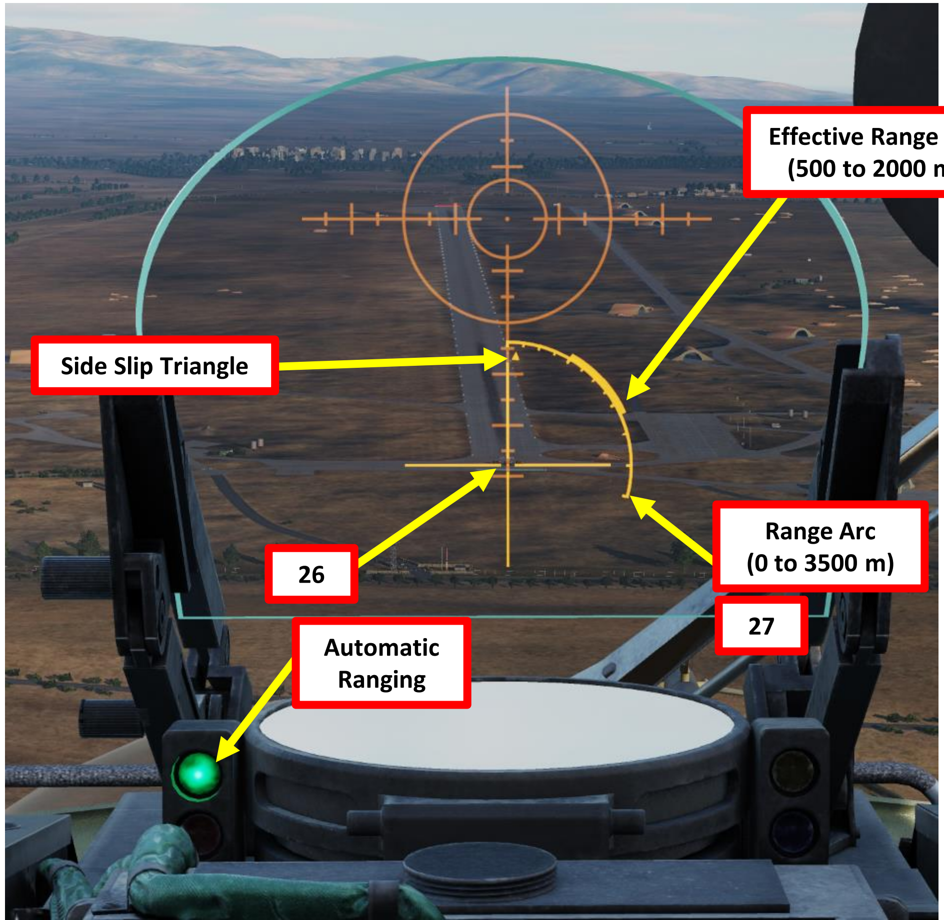
2.2.4 – S-24B (240 mm) ROCKETS

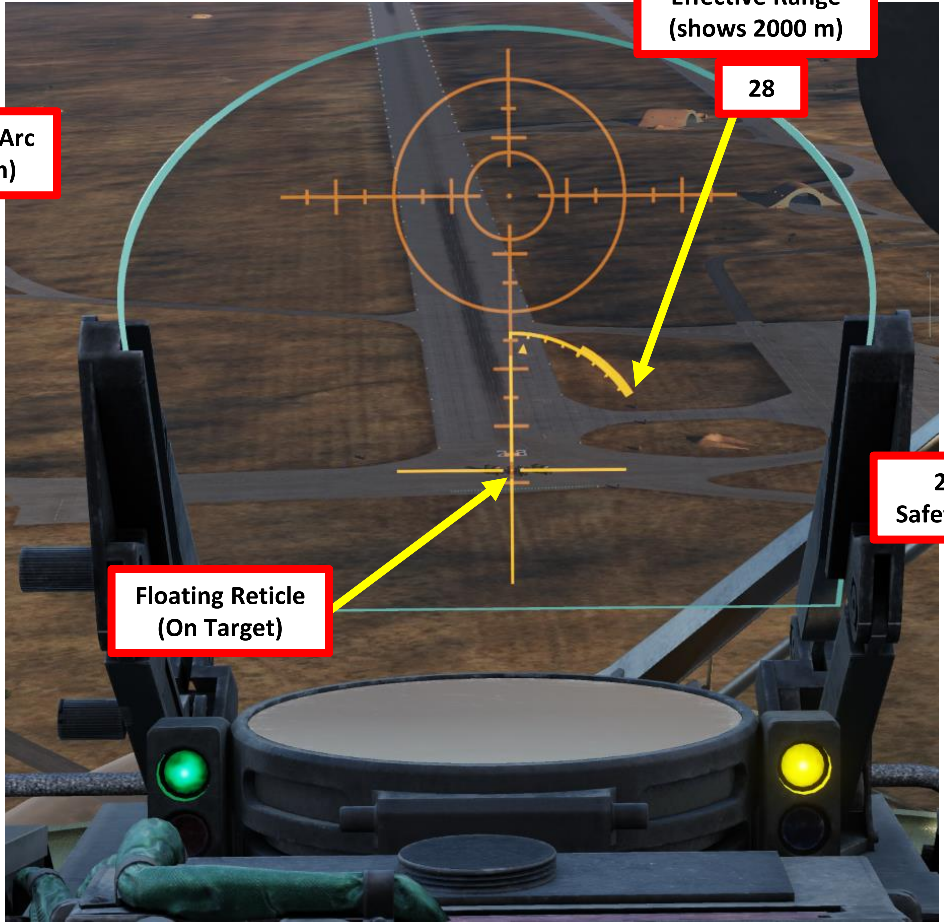
22. *[PC]* Adjust Sight Fixed Reticle (Net) Brightness Control Knob to make the Fixed Reticle dim enough to see the Floating Reticle properly.
23. *[PC]* Adjust Sight Floating Reticle Brightness Control Knob as required.
24. *[PC]* Adjust Sight Reflector Glass as desired using the Sight Reflector Glass Control Lever.
    - *Lever UP: Sight Unlocked / Lever DOWN: Sight Locked*
    - *When lever is unlocked (UP), scroll mousewheel to adjust reflector glass position as desired*

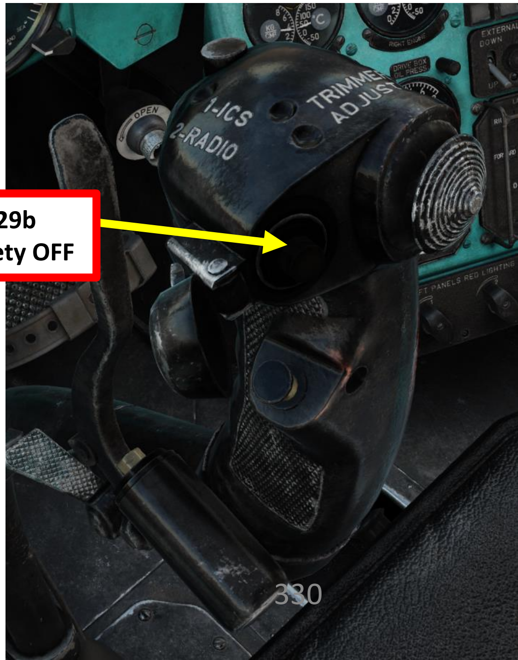


2.2.4 – S-24B (240 mm) ROCKETS

25. *[PC]* Unlike S-5 and S-8 rockets, the Floating Reticle is fixed since we selected Manual Sight mode. We use Automatic Ranging, therefore the sight is caged on the Fixed Reticle but it will still display a range approximation based on radar altitude and helicopter pitch attitude.
26. *[PC]* Fly the attack profile; enter a 10 de dive at 150 km/h, then fly the helicopter to align the caged Floating Reticle on the target (which should be aligned on the fixed reticle with the angle depression setting).
27. *[PC]* As you approach the target, the range arc shrinks as distance decreases. A green light indicates that automatic ranging is selected.
28. *[PC]* Use the range arc to estimate your 2000 m firing range, which should coincide with the lower part of the Effective Range arc (which is thicker). You should be flying at 180 km/h when ready to fire rockets.
29. *[PC]* Flip the weapon safety on the cyclic, then press and hold the « Weapon Release » (RALT + SPACE) button to fire rockets.
    - Note: When firing rockets at low airspeeds, the smoke can be ingested by the engine intakes and can cause an engine surge. To mitigate this dynamic effect, it is recommended to fire unguided rockets when flying at airspeeds above 110 km/h.







2.2.4 – S-24B (240 mm) ROCKETS

30. *[PC]* As the rockets fire, you may be temporarily blinded by the rocket motor smoke.
31. *[PC]* Avoid flying directly over the target. Break off from the target once the attack is complete, preferably to the left since visibility is better and the rotor torque makes left turns easier.

2.2.5 – Rocket Attack Profile Depression Angle Tables

Rocket Horizontal Flight Attack Profile – Sight Depression Angle Table								
Airspeed (km/h)	Distance to Target (m)	Rocket Types						
		S-8M, S-8OF, S-8KO	S-8B	S-8D	S-8KOM	S-8TS	S-13D	S-24B
100	1000	-	-	-	-	-	-	-
	1500	3° 00′	3° 35′	3° 00′	1° 56′	2° 50′	3° 20′	6° 30′
	2000	3° 25′	4° 50′	3° 45′	2° 39′	4° 20′	3° 50′	7° 30′
	2500	4° 00′	6° 20′	4° 40′	3° 37′	-	4° 20′	8° 00′
	3000	4° 50′	8° 00′	5° 50′	5° 01′	-	5° 00′	9° 00′
	3500	5° 45′	9° 40′	7° 05′	6° 28′	-	5° 40′	-
150	1000	-	-	-	-	-	-	-
	1500	2° 25′	2° 45′	2° 25′	1° 24′	2° 04′	-	5° 55′
	2000	2° 45′	4° 00′	3° 00′	2° 05′	3° 40′	-	6° 45′
	2500	3° 15′	5° 25′	3° 55′	3° 01′	-	-	7° 25′
	3000	4° 00′	7° 00′	5° 00′	4° 16′	-	-	8° 25′
	3500	5° 30′	8° 40′	6° 50′	5° 43′	-	-	-
200	1000	-	-	-	-	-	-	-
	1500	1° 20′	1° 35′	1° 20′	0° 51′	1° 20′	1° 50′	5° 15′
	2000	1° 45′	2° 50′	2° 00′	1° 31′	3° 00′	2° 20′	6° 00′
	2500	2° 20′	4° 10′	3° 00′	2° 25′	-	2° 50′	6° 45′
	3000	3° 00′	5° 35′	4° 00′	3° 30′	-	3° 20′	7° 45′
	3500	3° 50′	7° 15′	5° 10′	4° 57′	-	4° 00′	-
250	1000	-	-	-	-	-	-	-
	1500	-0° 25′	-0° 25′	-0° 25′	-0° 11′	0° 00′	-	3° 15′
	2000	-0° 10′	-0° 50′	0° 10′	-0° 26′	1° 35′	-	4° 00′
	2500	0° 25′	2° 05′	1° 00′	1° 18′	-	-	4° 45′
	3000	1° 00′	3° 25′	2° 00′	2° 20′	-	-	5° 40′
	3500	1° 50′	5° 05′	3° 10′	3° 42′	-	-	-
300	1500	-2° 35′	-2° 45′	-2° 35′	-1° 13′	-1° 20′	-0° 35′	-
	2000	-2° 20′	-1° 30′	-2° 00′	-0° 39′	0° 15′	-0° 12′	-
	2500	-1° 45′	-0° 15′	-1° 00′	0° 09′	-	0° 15′	-
	3000	-1° 10′	1° 00′	-0° 10′	1° 10′	-	0° 40′	-
	3500	-0° 25′	2° 35′	1° 00′	2° 27′	-	1° 20′	-

2.2.5 – Rocket Attack Profile Depression Angle Tables

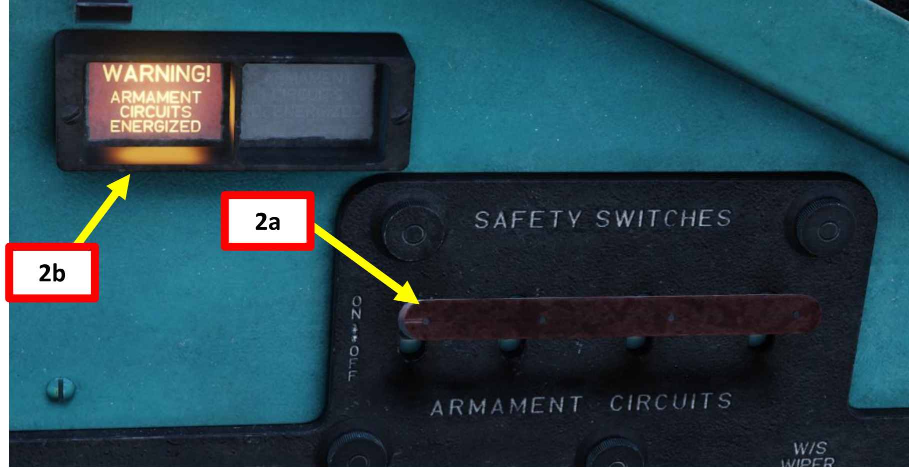
Rocket Dive Attack Profile – Sight Depression Angle Table

Dive Pitch Angle (deg)	Dive Entry Airspeed (km/h)	Airspeed at Launch (km/h)	Distance to Target (m)	Rocket Types						
				S-8M, S-8OF, S-8KO	S-8B	S-8D	S-8KOM	S-8TS	S-13D	S-24B
10	150	180	1000	-	-	-	-	-	-	-
			1500	-	-	-	0° 51′	1° 15′	2° 05′	5° 15′
			2000	-	-	-	1° 25′	2° 30′	2° 30′	5° 45′
			2500	-	-	-	2° 08′	-	3° 00′	6° 30′
			3000	-	-	-	3° 05′	-	3° 30′	7° 20′
			3500	-	-	-	4° 15′	-	4° 05′	8° 15′
20	150	200-210	1000	-	-	-	-	-	-	-
			1500	1° 00′	1° 30′	1° 00′	0° 30′	0° 50′	1° 10′	4° 45′
			2000	1° 35′	2° 45′	1° 45′	1° 03′	2° 15′	1° 35′	5° 15′
			2500	2° 30′	4° 10′	2° 50′	1° 40′	-	2° 00′	5° 55′
			3000	3° 15′	5° 45′	3° 45′	2° 26′	-	2° 30′	6° 45′
			3500	4° 10′	7° 15′	4° 50′	3° 26′	-	3° 00′	7° 20′
30	100	180-200	1000	-	-	-	-	-	-	-
			1500	0° 25′	0° 40′	0° 25′	0° 08′	0° 20′	1° 10′	2° 00′
			2000	0° 40′	1° 25′	0° 50′	0° 35′	1° 20′	1° 30′	2° 30′
			2500	0° 55′	2° 10′	1° 10′	1° 09′	-	1° 55′	3° 00′
			3000	1° 15′	3° 15′	1° 45′	1° 53′	-	2° 30′	3° 45′
			3500	1° 45′	4° 30′	2° 30′	2° 42′	-	3° 00′	4° 45′

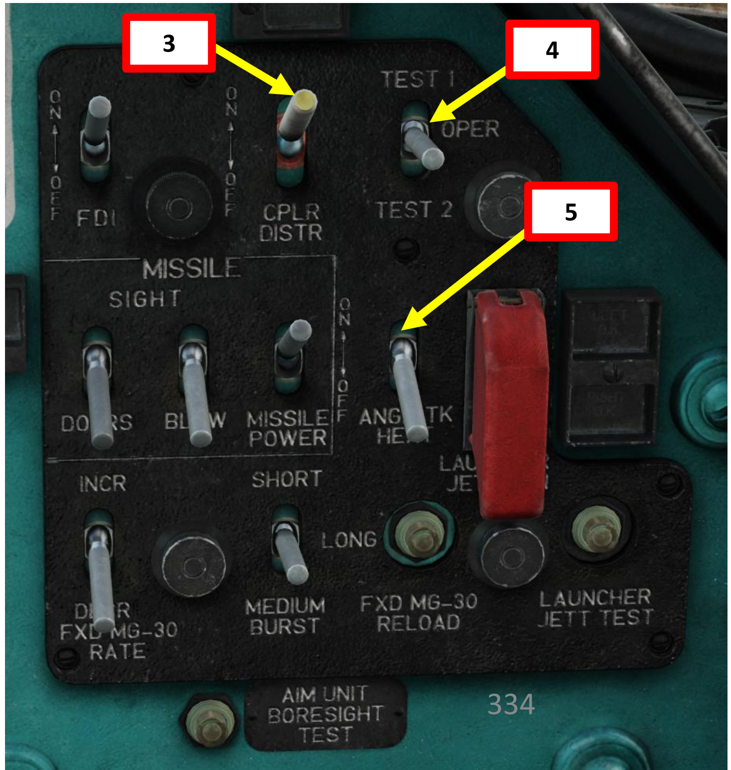
2.3 – GUV-8700 POD
2.3.1 – Machinegun Pod (Variant 9A624/9A622)

- *Steps preceded by [PC] are performed by the Pilot-Commander.*
- *Steps preceded by [CPG] are performed by the Co-Pilot Gunner (or the Petrovich AI if no player is manning the operator station).*

1. *[PC]* If not flying in Multicrew, request Petrovich AI to power up weapons (LCTRL+W).
2. *[CPG]* Set Armament Circuit Breakers – ON (UP).
3. *[CPG]* Set USR-24 (CPLR DISTR) Switch – ON (UP).
4. *[CPG]* Set USR-24 Mode Switch – OPERATION MODE (MIDDLE).
5. *[CPG]* Set DUAS (Air Data Probe) Heating Switch – As Required.
   - ON/UP if temperature is below 5 deg C
   - DOWN/OFF if temperature is above 5 deg C.
6. *[CPG]* Set Pilot/CPG Weapon Selection Control Handover Switch – DOWN (Pilot-Commander has Weapon Selection Control).

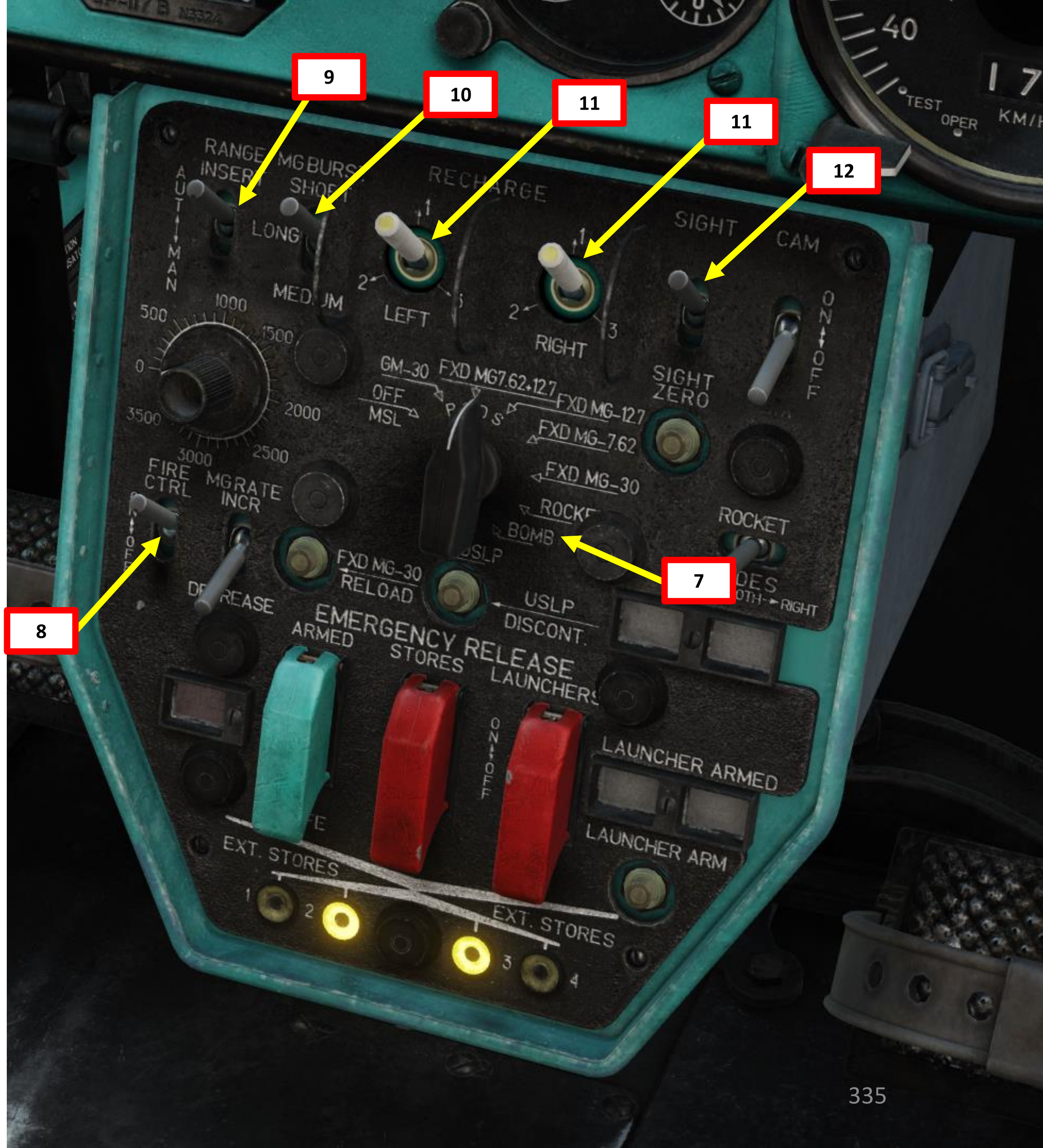


GUV 8700 Pod
Variant 9A624/9A622
(1 x 12.7 mm + 2 x 7.62 mm four-barrel Gatling machineguns)



2.3 – GUV-8700 POD
2.3.1 – Machinegun Pod (Variant 9A624/9A622)

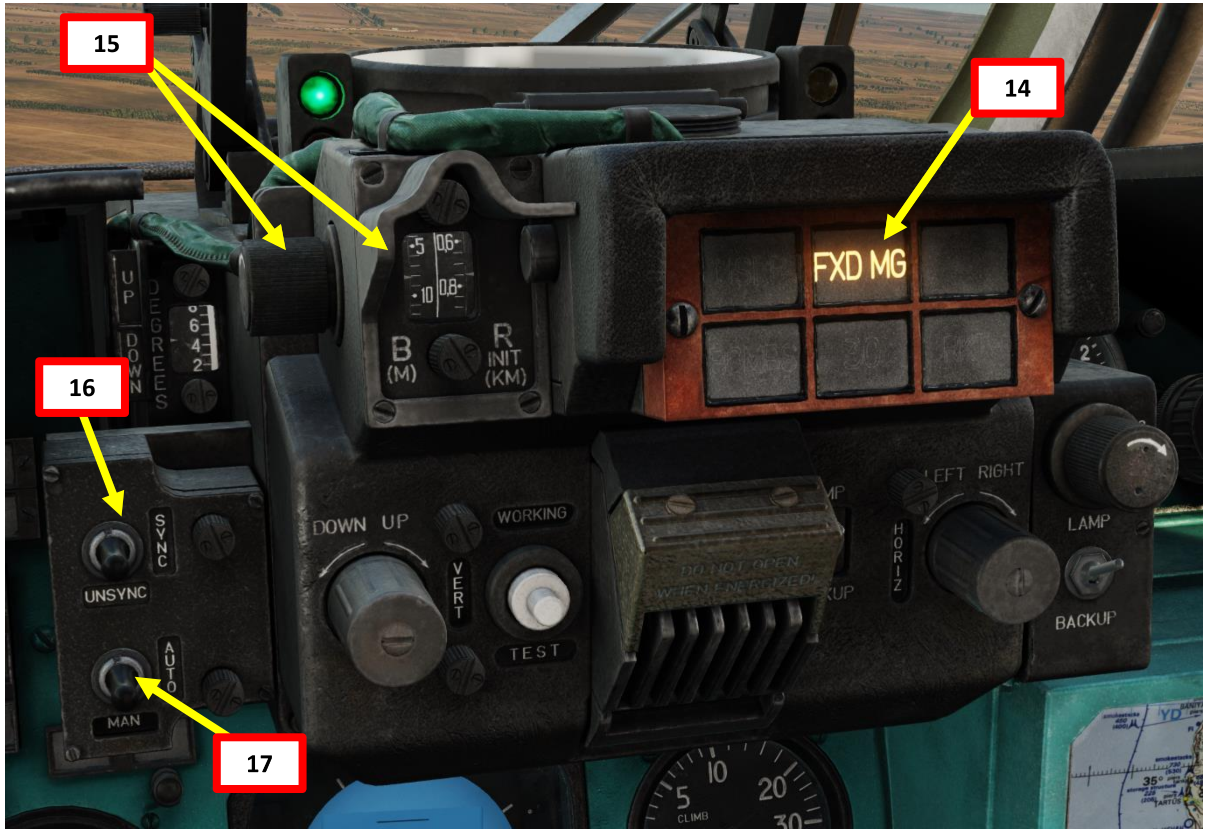
7. *[PC]* Set Weapon Selector to desired FXD PODS position:
    - FXD MG 7.62 x 12.7: fires both 7.62 mm and 12.7 mm machineguns
    - FXD MG 12.7: fires 12.7 mm machineguns only
    - FXD MG 7.62: fires 7.62 mm machineguns only
8. *[PC]* Set Fire Control Switch – ON (UP).
9. *[PC]* Set Sight Ranging Mode Selector – AUTOMATIC (UP).
    - Note: since we will use automatic ranging instead of manual ranging, setting the manual range distance setting is not required.
10. *[PC]* Set Burst Length Selector Switch – As Desired.
    - Short Burst/UP setting is recommended.
11. *[PC]* If machineguns are jammed or suffered a malfunction, set the appropriate GUV-8700 Gun Pod Reload Switch to either 1, 2 or 3. Otherwise, this step is not required.
12. *[PC]* Set ASP-17VP Sight Power Switch – ON (UP).
13. *[PC]* Set Auxiliary Stores Light Switch – ON (UP).

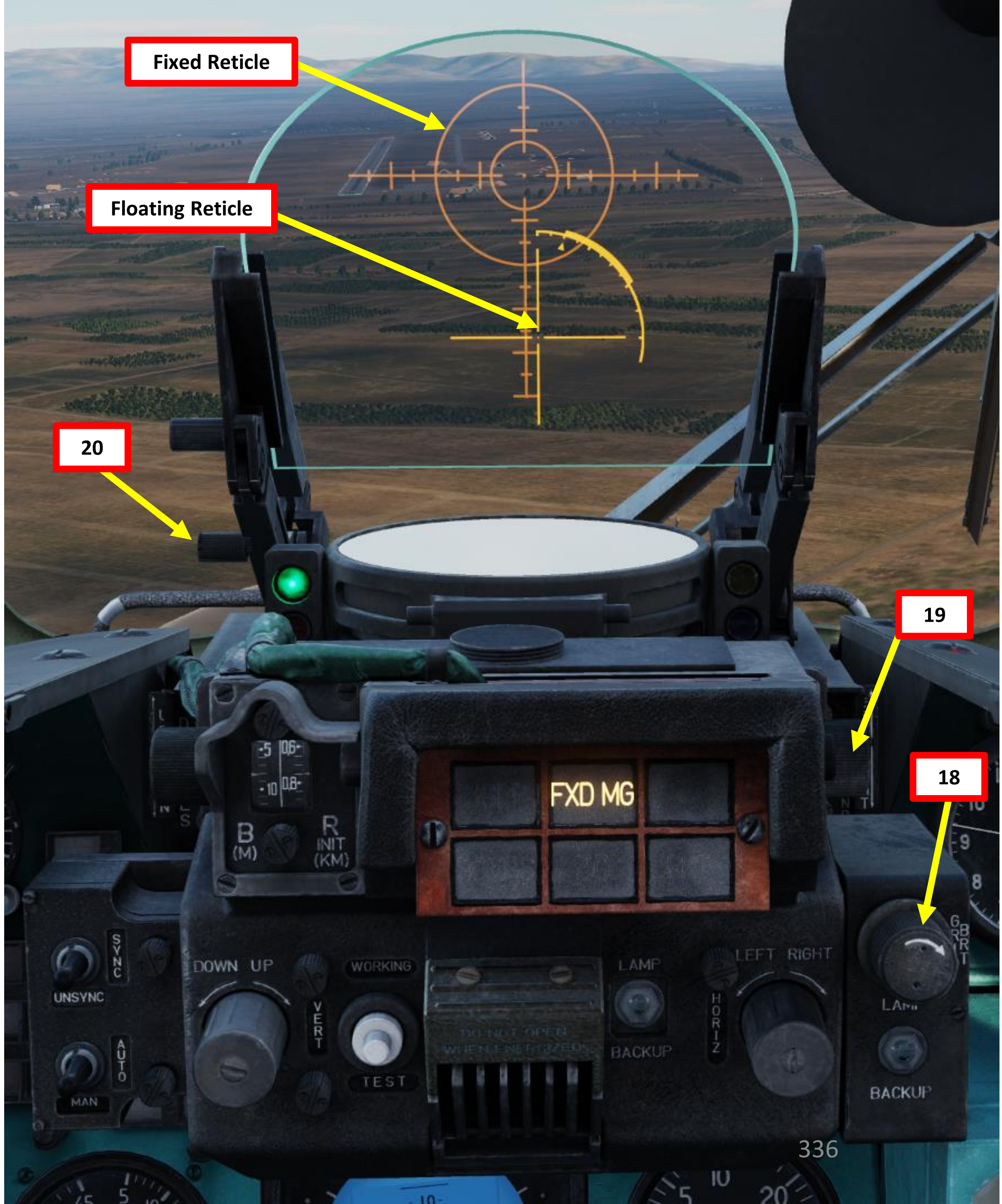


2.3 – GUV-8700 POD

2.3.1 – Machinegun Pod (Variant 9A624/9A622)

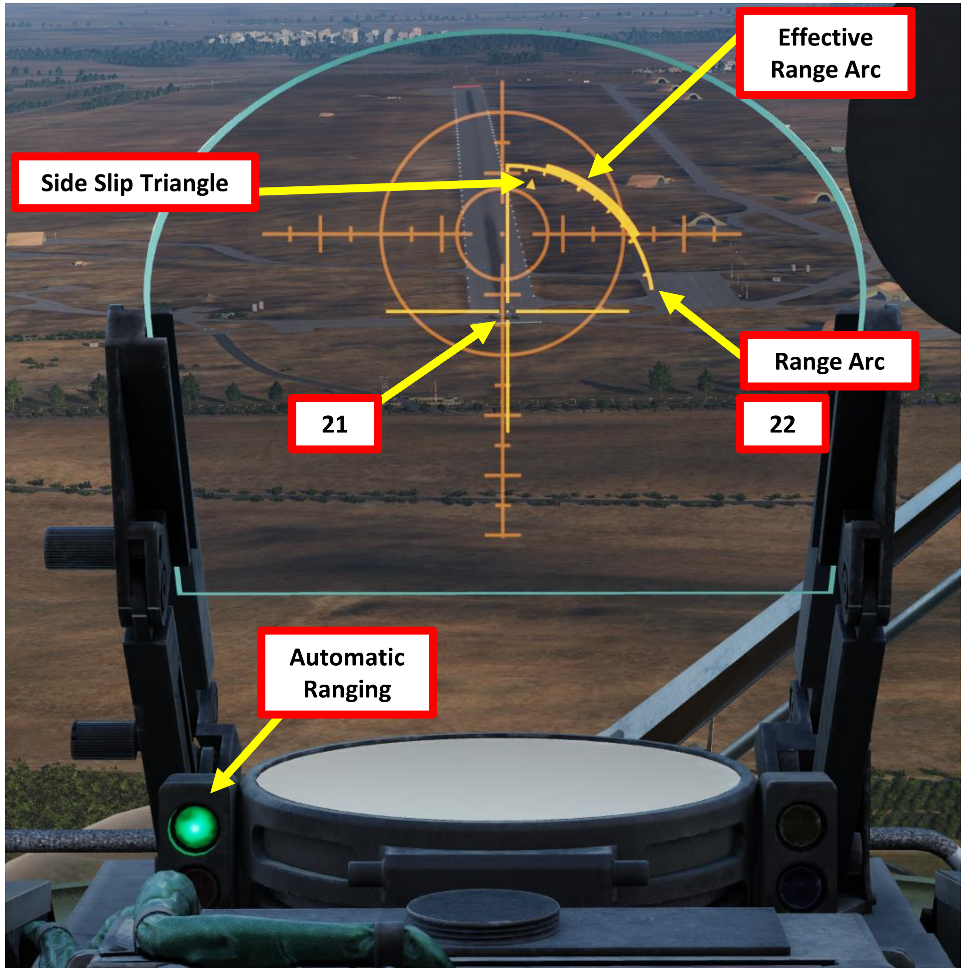
14. *[PC]* Confirm selection of Machinegun Pods by checking the Armament Selection Lights, which should display « FXD MG ».
15. *[PC]* Set target size in meters using the Target Base (Size) Setting Dial.
16. *[PC]* Set Sight Synchronization Mode Selector – SYNC (UP).
17. *[PC]* Set Sight Mode Selector – AUTOMATIC (UP).
18. *[PC]* Adjust Sight Fixed Reticle (Net) Brightness Control Knob to make the Fixed Reticle dim enough to see the Floating Reticle properly.
19. *[PC]* Adjust Sight Floating Reticle Brightness Control Knob as required.
20. *[PC]* Adjust Sight Reflector Glass as desired using the Sight Reflector Glass Control Lever.
    - *Lever UP: Sight Unlocked / Lever DOWN: Sight Locked*
    - *When lever is unlocked (UP), scroll mousewheel to adjust reflector glass position as desired*

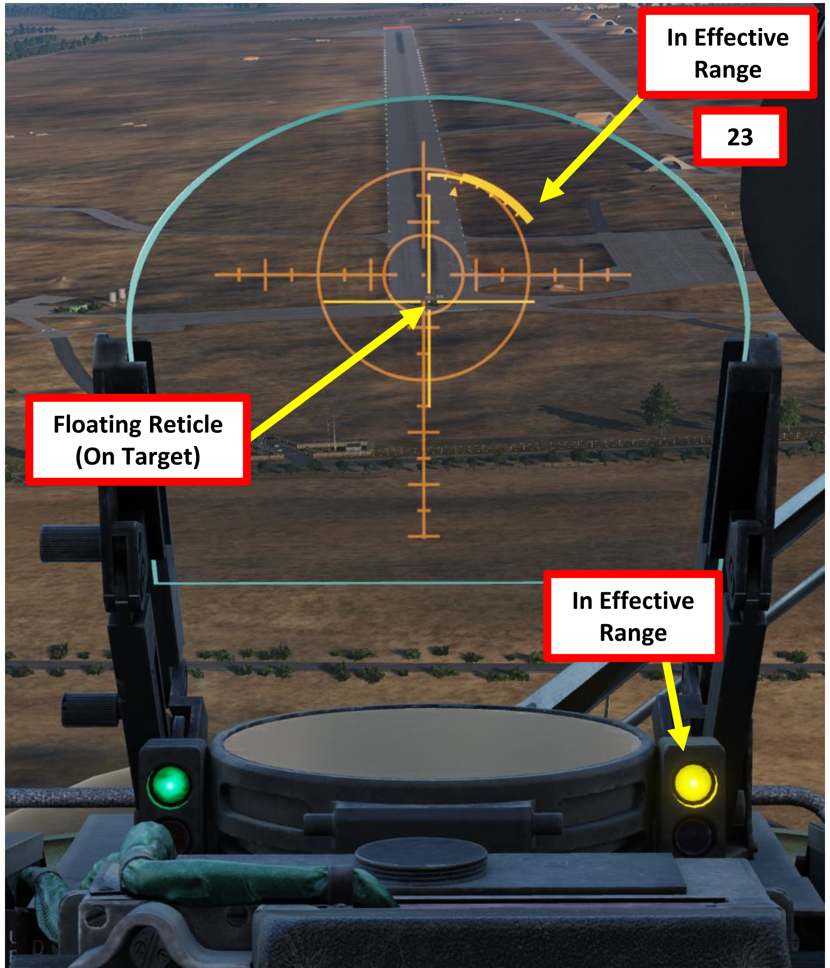


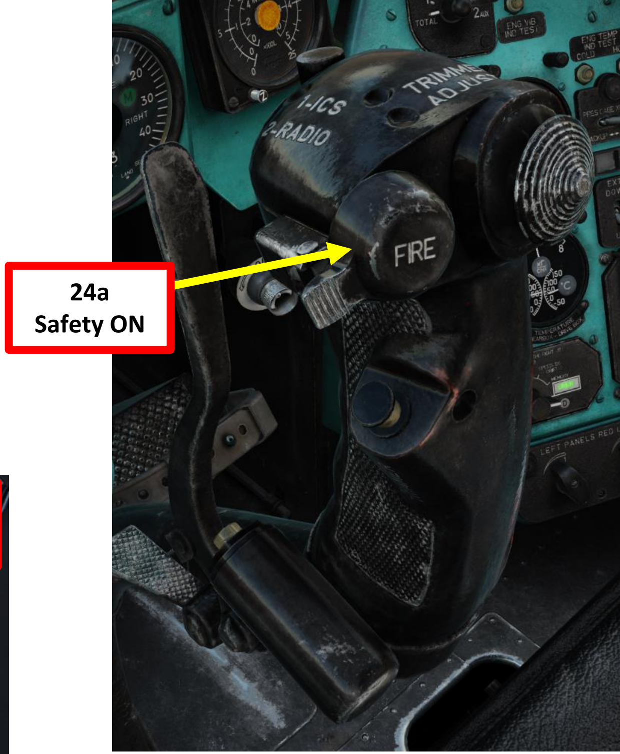


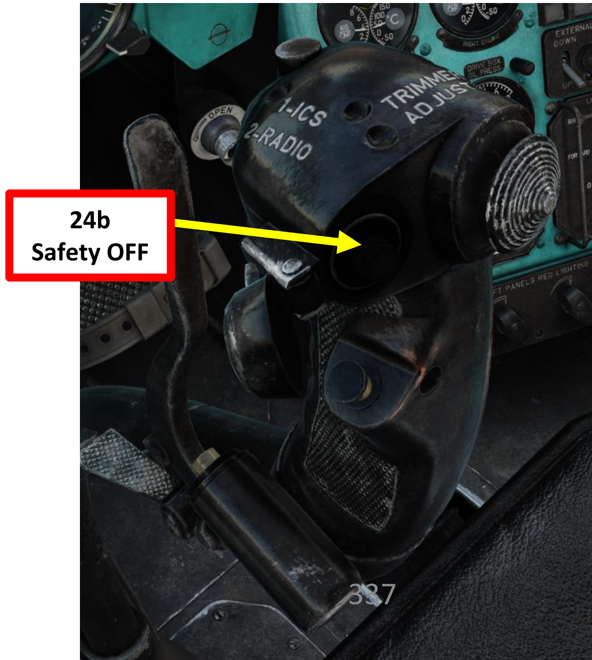
2.3 – GUV-8700 POD
2.3.1 – Machinegun Pod (Variant 9A624/9A622)

21. *[PC]* Fly the helicopter to align the Floating Reticle on the target. Aim slightly in front of the target for better accuracy.
    - Take into account relative target elevation when placing the Floating Reticle.
22. *[PC]* As you approach the target, the range arc shrinks as distance decreases. A green light indicates that automatic ranging is selected.
23. *[PC]* When you are in range, the range arc reaches the Effective Range arc (which is thicker) and a yellow light illuminates to indicate that you are within effective firing range.
24. *[PC]* Flip the weapon safety on the cyclic, then press and hold the « Weapon Release » (RALT + SPACE) button to fire machineguns.





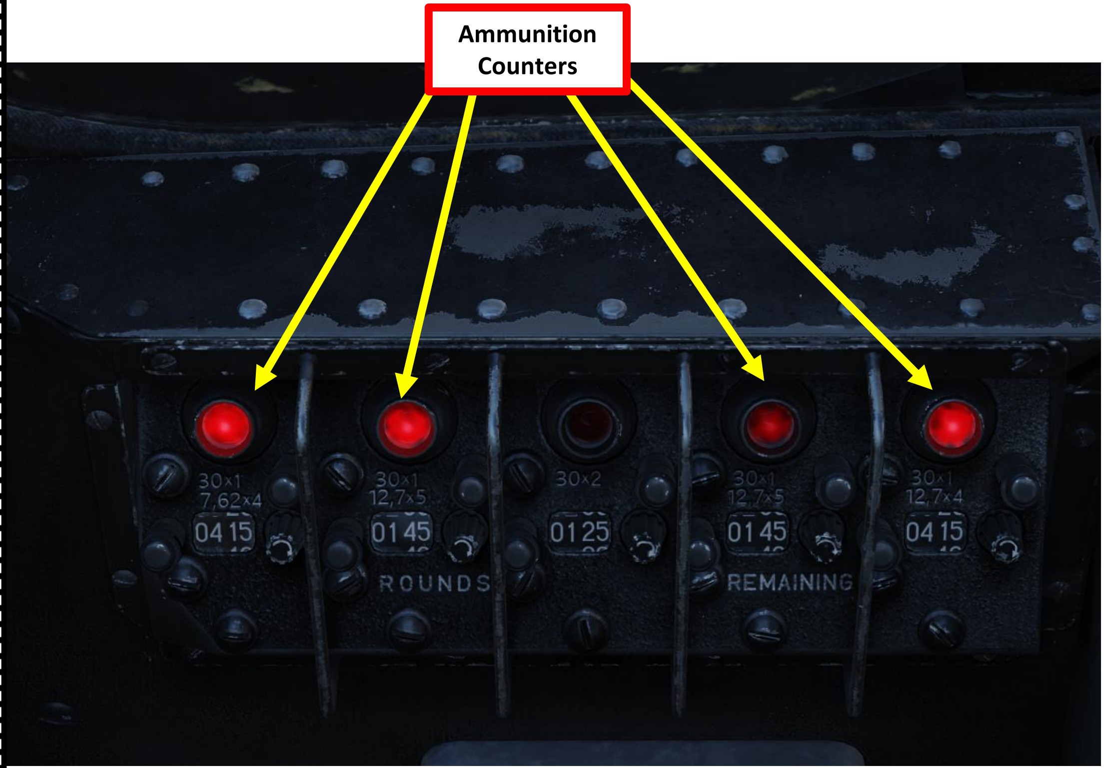




2.3 – GUV-8700 POD

2.3.1 – Machinegun Pod (Variant 9A624/9A622)

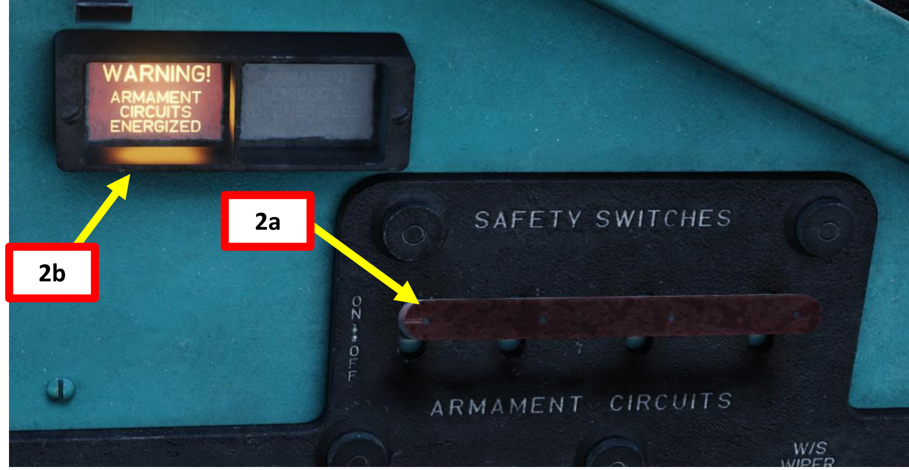
25. *[PC]* Fire machineguns using short bursts and re-adjust your shots if your aiming is off.
26. *[PC]* Avoid flying directly over the target. Break off from the target once the attack is complete, preferably to the left since visibility is better and the rotor torque makes left turns easier.
27. *[PC]* Ammunition count is visible in the Pilot-Commander's cockpit.

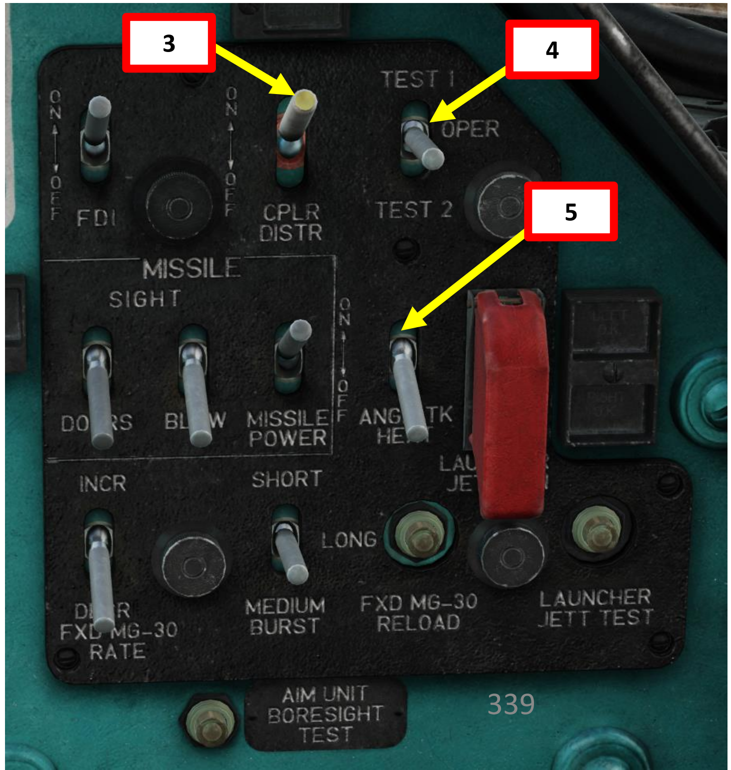


2.3 – GUV-8700 POD
2.3.2 – AP-30 (30 mm) Grenade Launcher (Variant 9A800)

- *Steps preceded by [PC] are performed by the Pilot-Commander.*
- *Steps preceded by [CPG] are performed by the Co-Pilot Gunner (or the Petrovich AI if no player is manning the operator station).*

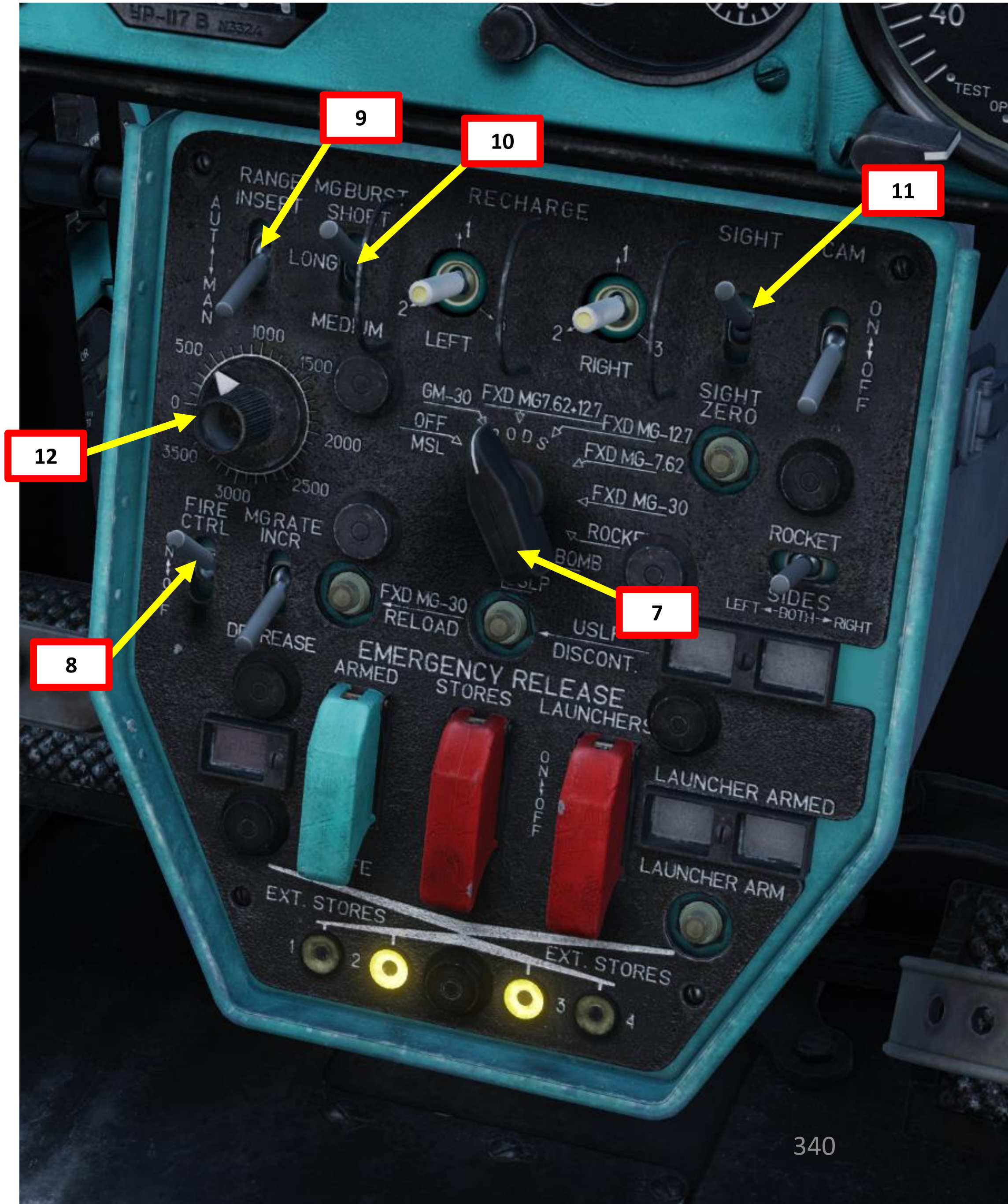
1. *[PC]* If not flying in Multicrew, request Petrovich AI to power up weapons (LCTRL+W).
2. *[CPG]* Set Armament Circuit Breakers – ON (UP).
3. *[CPG]* Set USR-24 (CPLR DISTR) Switch – ON (UP).
4. *[CPG]* Set USR-24 Mode Switch – OPERATION MODE (MIDDLE).
5. *[CPG] Set DUAS (Air Data Probe) Heating Switch* – As Required.
    - ON/UP if temperature is below 5 deg C
    - DOWN/OFF if temperature is above 5 deg C.
6. *[CPG]* Set Pilot/CPG Weapon Selection Control Handover Switch – DOWN (Pilot-Commander has Weapon Selection Control).





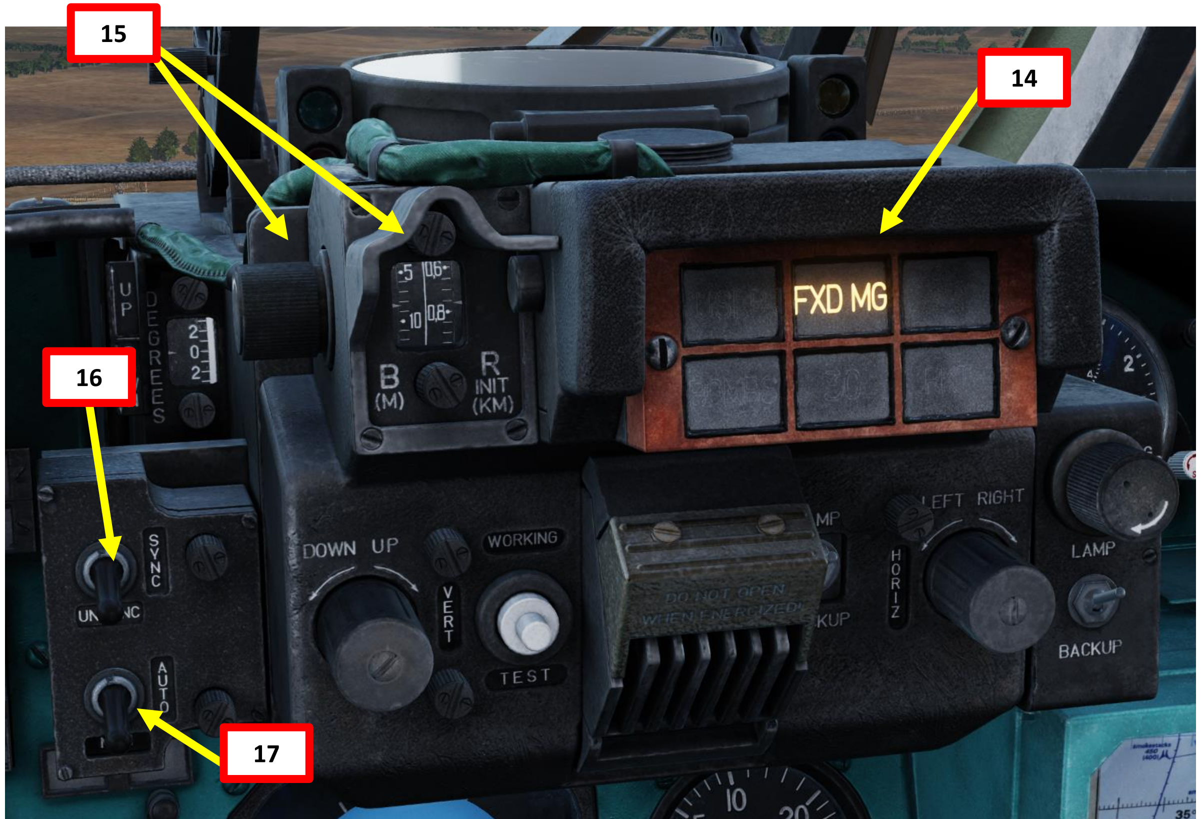
2.3 – GUV-8700 POD
2.3.2 – AP-30 (30 mm) Grenade Launcher (Variant 9A800)

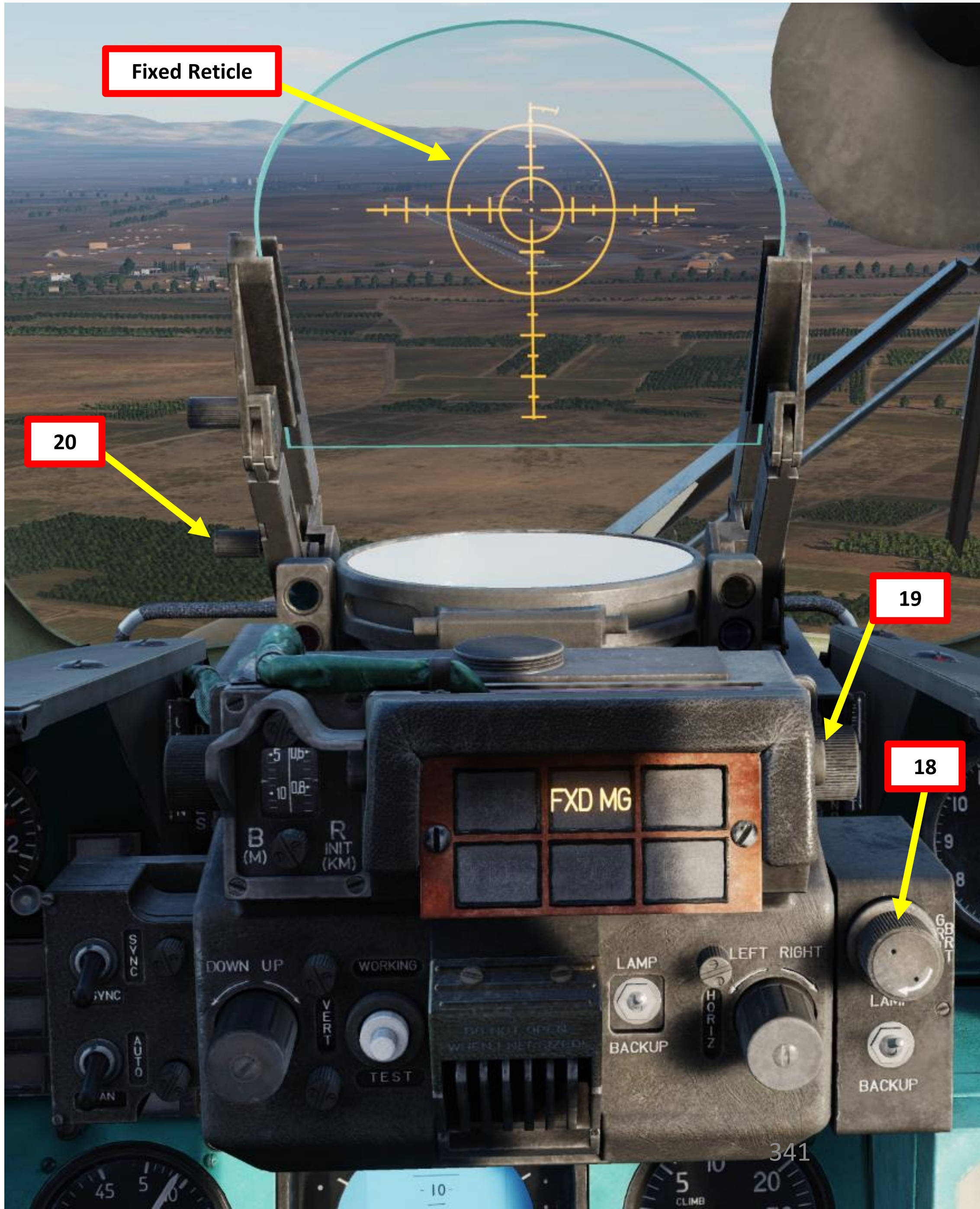
7. *[PC]* Set Weapon Selector to GM-30.
8. *[PC]* Set Fire Control Switch – ON (UP).
9. *[PC]* Set Sight Ranging Mode Selector – MANUAL (DOWN).
    - Note: no automatic computed ranging information is available for the grenade launchers.
10. *[PC]* Set Burst Length Selector Switch – As Desired.
11. *[PC]* Set ASP-17VP Sight Power Switch – ON (UP).
12. *[PC]* Set Sight Manual Ranging Setting to 500 meters
13. *[PC]* Set Auxiliary Stores Light Switch – ON (UP).



2.3 – GUV-8700 POD
2.3.2 – AP-30 (30 mm) Grenade Launcher (Variant 9A800)

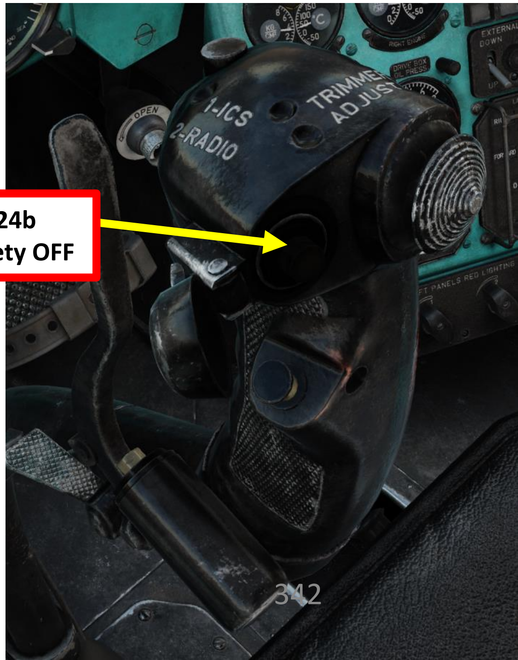
14. *[PC]* Confirm selection of Grenade Launcher Pods by checking the Armament Selection Lights, which should display « FXD MG ».
15. *[PC]* Set target size in meters using the Target Base (Size) Setting Dial.
16. *[PC]* Set Sight Synchronization Mode Selector – ASYNC (DOWN).
17. *[PC]* Set Sight Mode Selector – MANUAL (DOWN).
18. *[PC]* Adjust Sight Fixed Reticle (Net) Brightness Control Knob as required.
19. *[PC]* Adjust Sight Floating Reticle Brightness Control Knob as required.
20. *[PC]* Adjust Sight Reflector Glass as desired using the Sight Reflector Glass Control Lever.
    - *Lever UP: Sight Unlocked / Lever DOWN: Sight Locked*
    - *When lever is unlocked (UP), scroll mousewheel to adjust reflector glass position as desired*





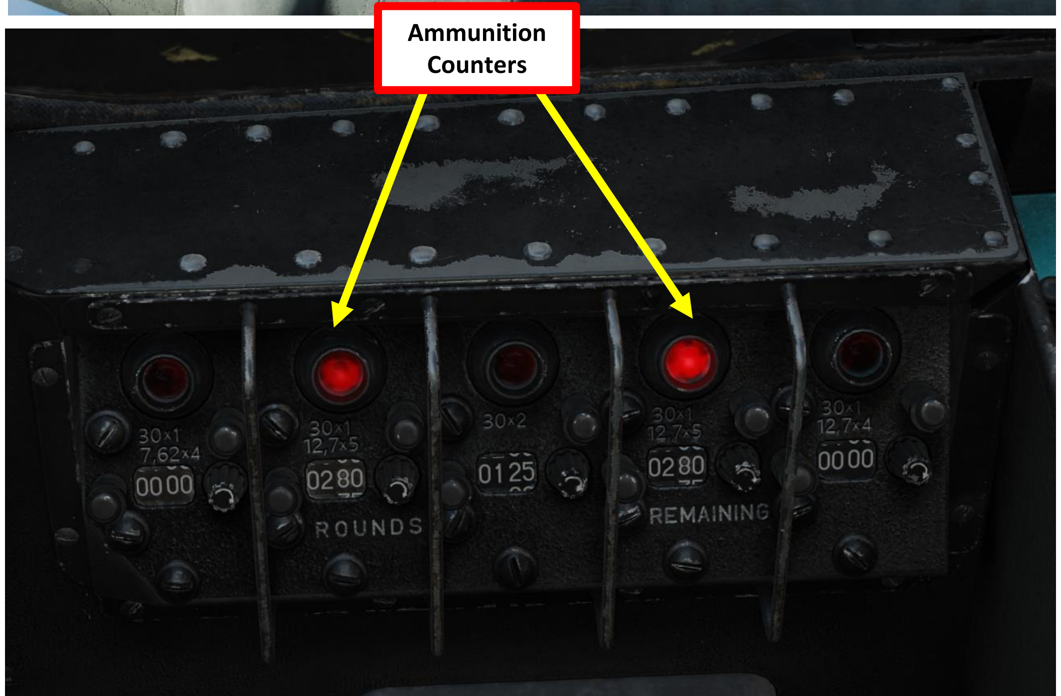
2.3 – GUV-8700 POD
2.3.2 – AP-30 (30 mm) Grenade Launcher (Variant 9A800)

21. *[PC]* Fly the helicopter to align the Fixed Reticle on the target. Aim slightly in front of the target for better accuracy.
22. *[PC]* As you approach the target, keep in mind that you do not have automatic ranging information. You need to estimate the range visually.
23. *[PC]* When you are about 500 m from the target, you should be within effective range. Keep in mind that the grenade launchers are not very precise and require constant adjustments.
24. *[PC]* Flip the weapon safety on the cyclic, then press and hold the « Weapon Release » (RALT + SPACE) button to launch grenades.



2.3 – GUV-8700 POD
2.3.2 – AP-30 (30 mm) Grenade Launcher (Variant 9A800)

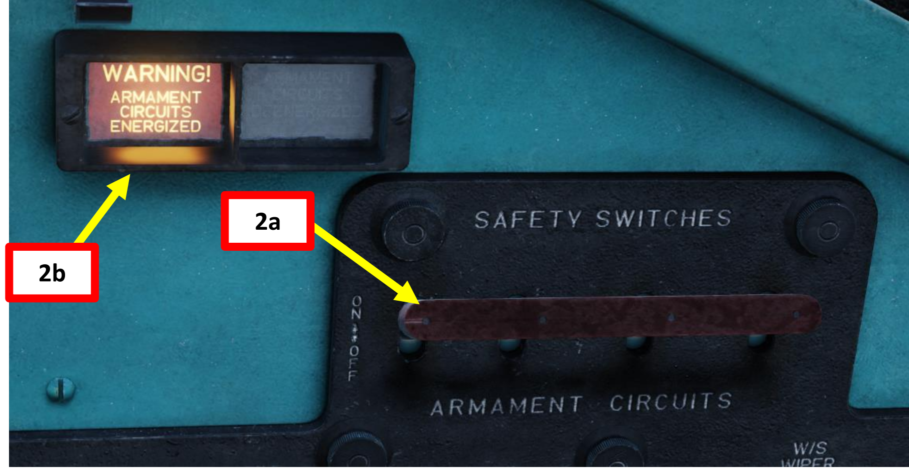
25. *[PC]* Fire grenades using short bursts and re-adjust your shots if your aiming is off.
26. *[PC]* Avoid flying directly over the target. Break off from the target once the attack is complete, preferably to the left since visibility is better and the rotor torque makes left turns easier.
27. *[PC]* Ammunition count is visible in the Pilot-Commander's cockpit.

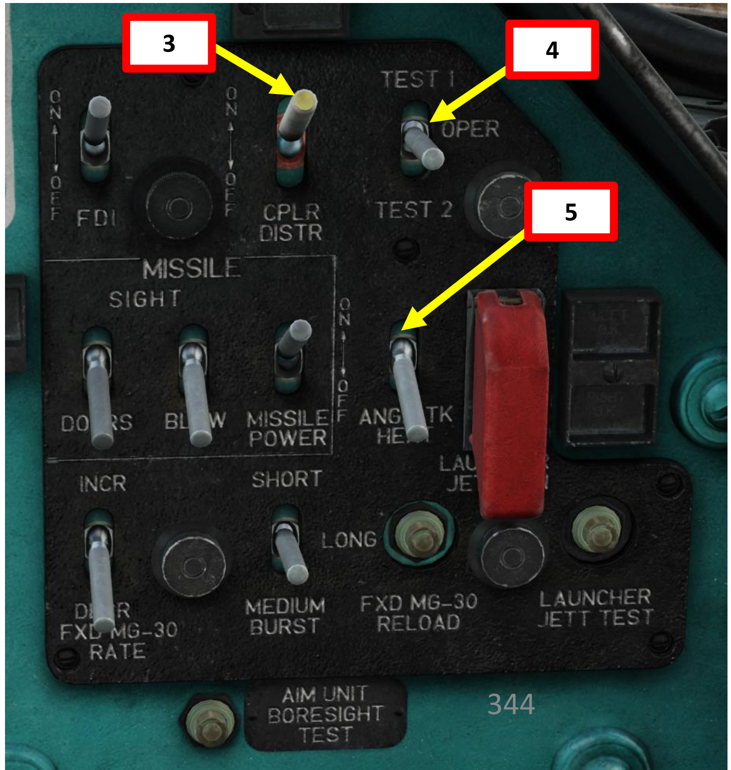


2.4 – KMGU-2 (USLP) CLUSTER MUNITIONS
2.4.1 – Level Attack

- *Steps preceded by [PC] are performed by the Pilot-Commander.*
- *Steps preceded by [CPG] are performed by the Co-Pilot Gunner (or the Petrovich AI if no player is manning the operator station).*

1. *[PC]* If not flying in Multicrew, request Petrovich AI to power up weapons (LCTRL+W).
2. *[CPG]* Set Armament Circuit Breakers – ON (UP).
3. *[CPG]* Set USR-24 (CPLR DISTR) Switch – ON (UP).
4. *[CPG]* Set USR-24 Mode Switch – OPERATION MODE (MIDDLE).
5. *[CPG] Set DUAS (Air Data Probe) Heating Switch* – As Required.
    - ON/UP if temperature is below 5 deg C
    - DOWN/OFF if temperature is above 5 deg C.
6. *[CPG]* Set Pilot/CPG Weapon Selection Control Handover Switch – DOWN (Pilot-Commander has Weapon Selection Control).



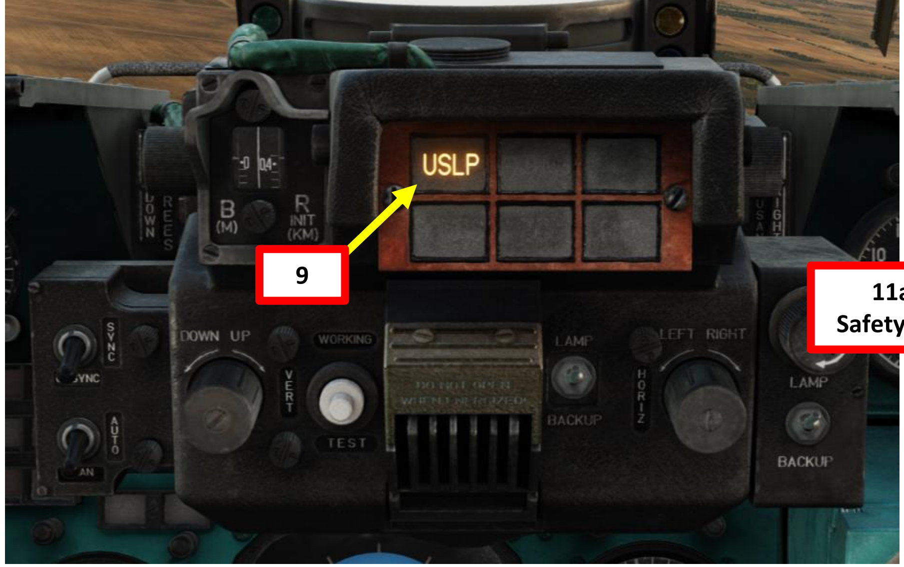


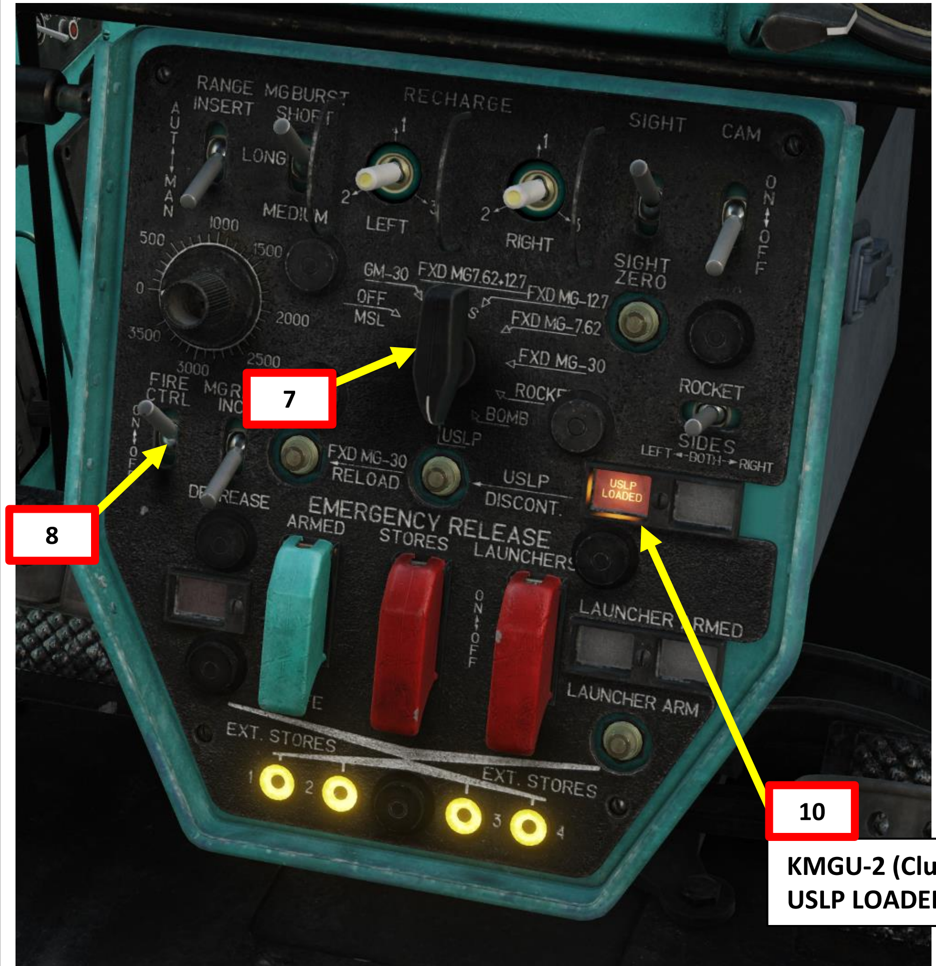
KMGU-2 (USLP) Cluster Munitions Dispensers (96 x AO-2.5RT Cluster Bombs)

2.4 – KMGU-2 (USLP) CLUSTER MUNITIONS

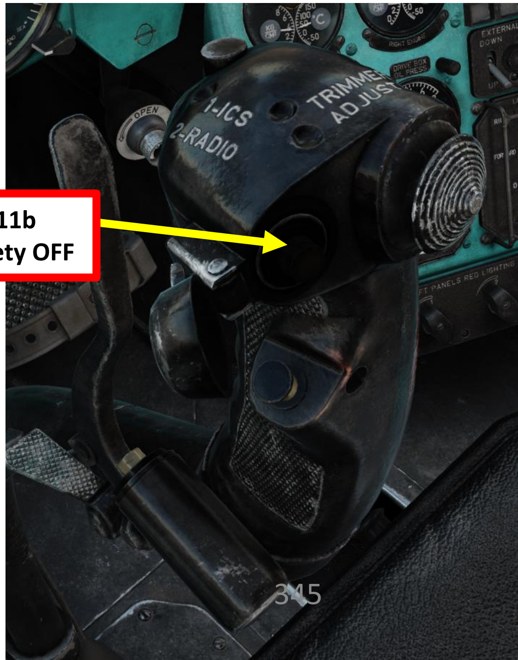
2.4.1 – Level Attack

7. *[PC]* Set Weapon Selector to USLP.
8. *[PC]* Set Fire Control Switch – ON (UP).
9. *[PC]* Confirm selection of KMGU-2 (USLP) dispensers by checking the Armament Selection Lights, which should display « USLP ».
10. *[PC]* Confirm USLP LOADED annunciator is illuminated.
11. *[PC]* Flip the weapon safety on the cyclic, then press and hold the « Weapon Release » (RALT + SPACE) button to start dispensing cluster munitions.





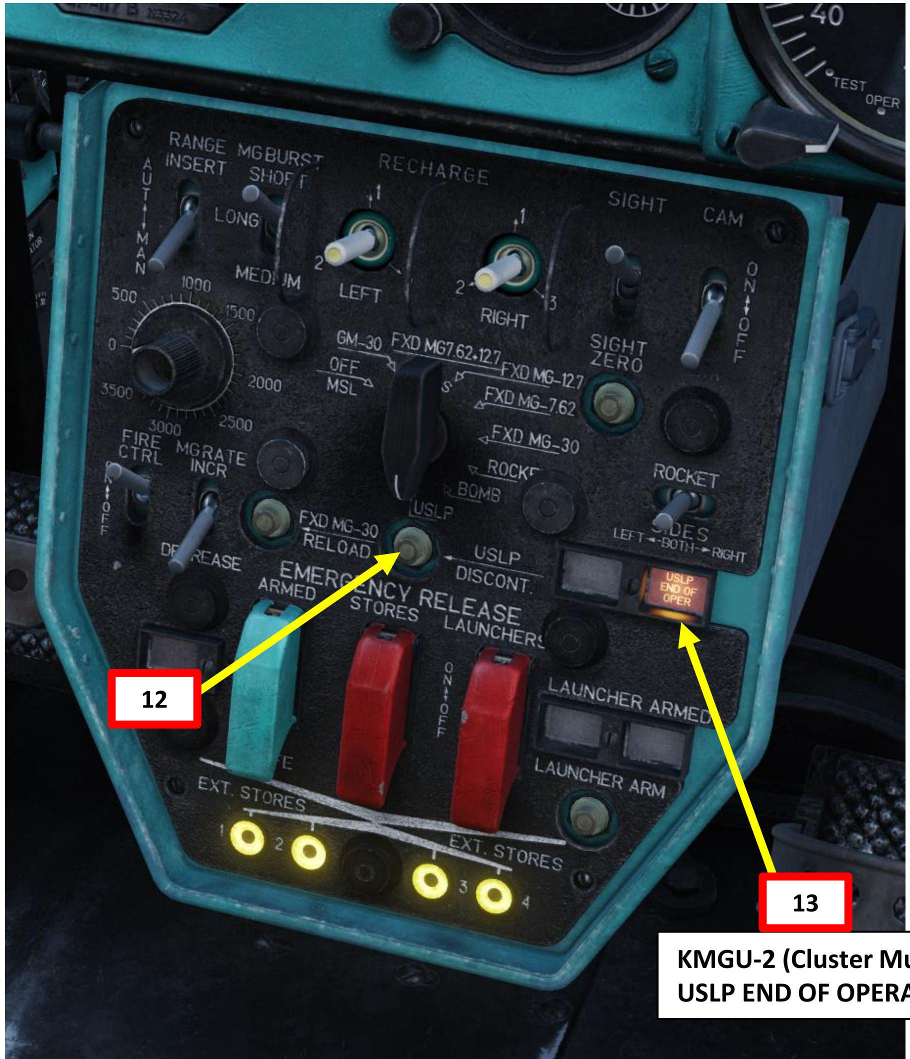
KMGU-2 (Cluster Munitions Dispenser, USLP)
USLP LOADED (Available) Annunciator



2.4 – KMGU-2 (USLP) CLUSTER MUNITIONS

2.4.1 – Level Attack

12. *[PC]* If you want to abort/stop dispensing munitions, press the USLP DISCONT button.
13. *[PC]* When USLP END OF OPERATION annunciator illuminates, the dispensing sequence is finished.



KMGU-2 (Cluster Munitions Dispenser, USLP)
USLP END OF OPERATION (Empty) Annunciator

2.4 – KMGU-2 (USLP) CLUSTER MUNITIONS

2.4.1 – Level Attack

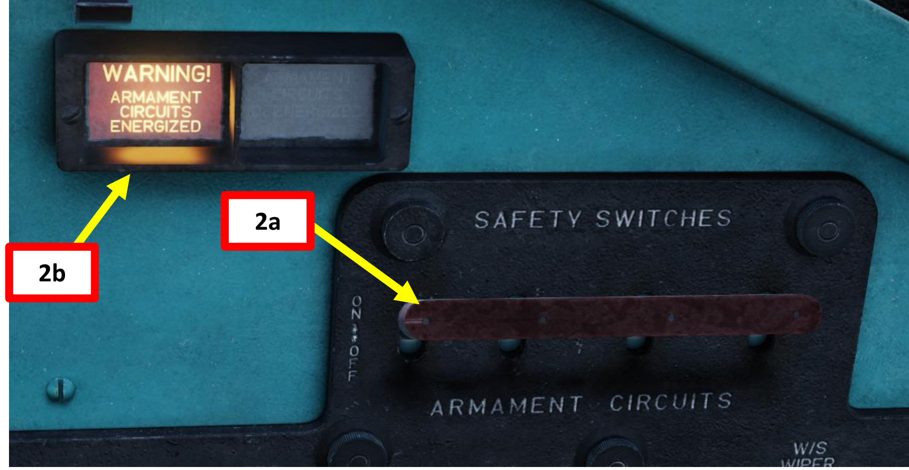
2.4 – KMGU-2 (USLP) CLUSTER MUNITIONS
2.4.2 – Cluster Munitions Attack Profile Table

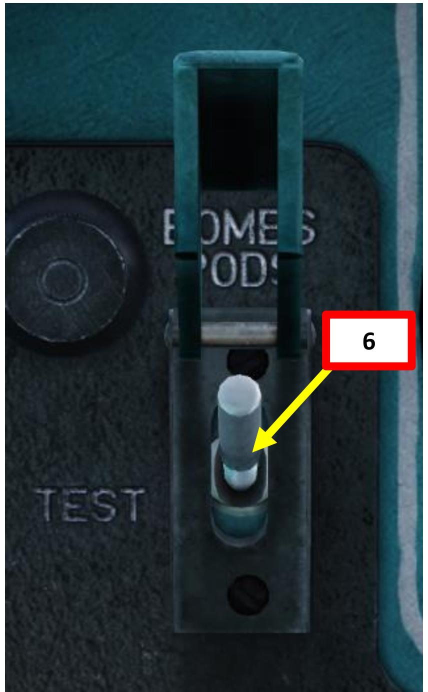
Level Bombing Attack Profile – Sight Depression Angle Table Use for KGMU-2 (USLP) Cluster Munitions **Indicated Airspeed 250 km/h** **Bomb Fall Time 25 s** **Helicopter Pitch Angle: -3 deg**							
Important Note: If using a Bomb Delay Time, sight depression angle should be set to **30°**.							
Bombing Altitude (m)	**Ground Speed (km/h)**						
	190	**210**	**230**	**250**	**270**	**290**	**310**
	Sighting Angle (deg, minutes) or Bomb Delay Time (sec)						
50	14° 45‘	13° 00‘	11° 45‘	10° 30‘	9° 30‘	8° 30‘	7° 45‘
100	22° 00‘	19° 45‘	17° 30‘	16° 00‘	14° 30‘	13° 15‘	12° 15‘
200	30° 00‘	23° 45‘	26° 00‘	23° 30‘	21° 15‘	19° 45‘	18° 30‘
400	4.5	3	1.6	0.8	0.1	28° 30‘	26° 45‘
600	9	6.8	5.2	4	2.6	1.6	0.4
800	13.5	10.8	8.7	7	5.5	4.2	2.8
1000	17.9	14.7	12.2	10	8.1	6.5	5.1
1200	22.5	18.8	15.8	14.3	11	19.2	17.6
1400	17	12.8	19.4	16.4	13.7	11.7	10
1600	36	30.8	26.5	22.8	19.6	16.8	14.6
2000	40.4	34.8	30.1	26.1	22.6	19.6	16.9

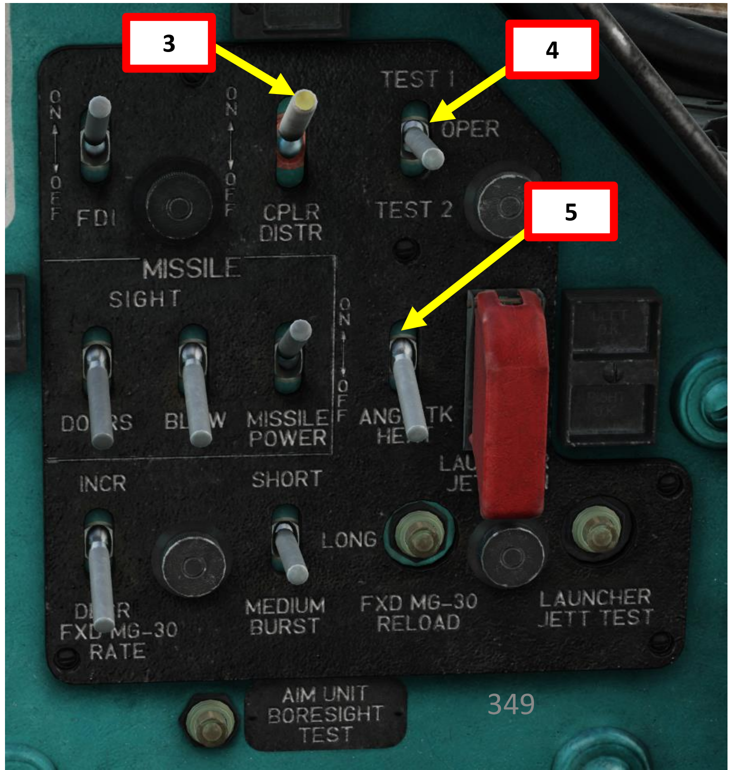
2.5 – FAB-250 BOMBS
2.5.1 – Dive Bombing

- *Steps preceded by [PC] are performed by the Pilot-Commander.*
- *Steps preceded by [CPG] are performed by the Co-Pilot Gunner (or the Petrovich AI if no player is manning the operator station).*

1. *[PC]* If not flying in Multicrew, request Petrovich AI to power up weapons (LCTRL+W).
2. *[CPG]* Set Armament Circuit Breakers – ON (UP).
3. *[CPG]* Set USR-24 (CPLR DISTR) Switch – ON (UP).
4. *[CPG]* Set USR-24 Mode Switch – OPERATION MODE (MIDDLE).
5. *[CPG] Set DUAS (Air Data Probe) Heating Switch* – As Required.
   - ON/UP if temperature is below 5 deg C
   - DOWN/OFF if temperature is above 5 deg C.
6. *[CPG]* Set Bomb Mode Selector – As required.
   - Set to UP (BOMBS & PODS) if other pods are also equipped (recommended).
   - Set to DOWN (BOMBS ONLY) if only bombs are equipped.
7. *[CPG]* Set Pilot/CPG Weapon Selection Control Handover Switch – DOWN (Pilot-Commander has Weapon Selection Control).

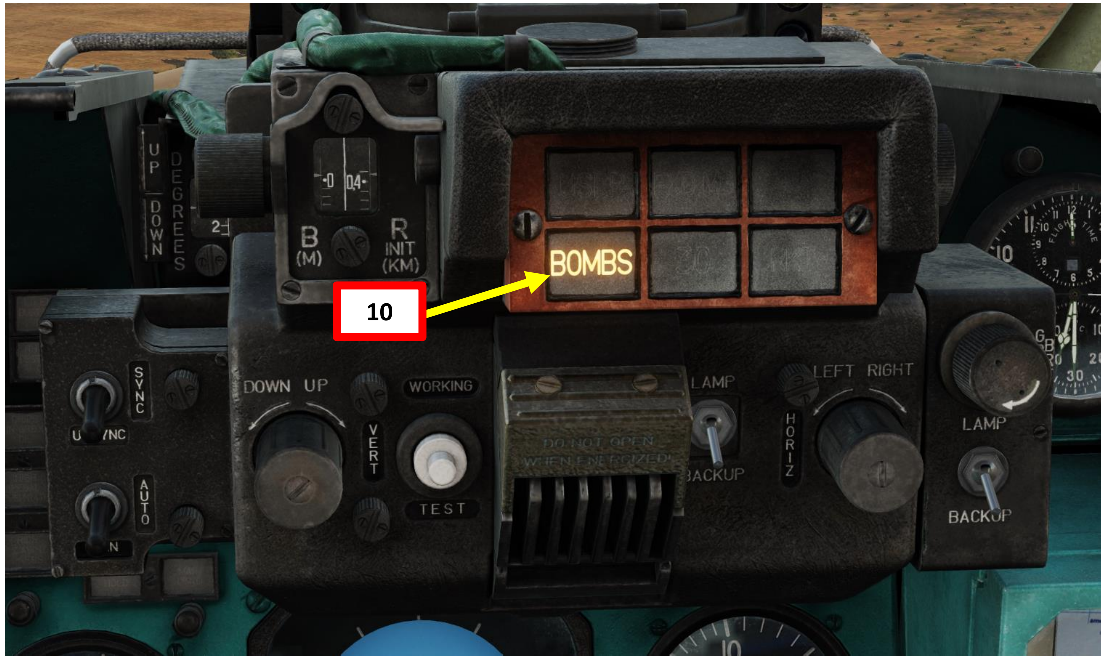


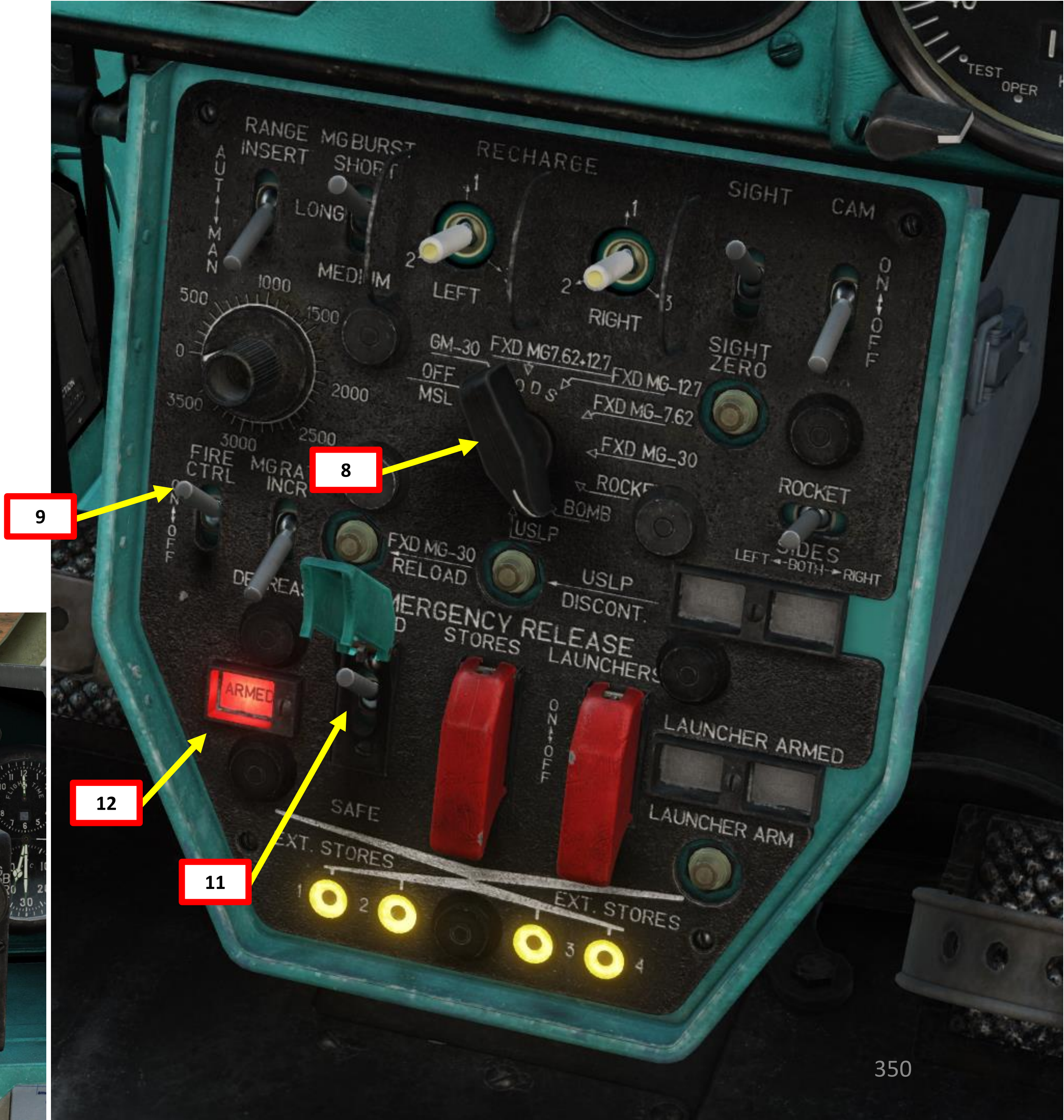




2.5 – FAB-250 BOMBS
2.5.1 – Dive Bombing

8. *[PC]* Set Weapon Selector to BOMB.
9. *[PC]* Set Fire Control Switch – ON (UP).
10. *[PC]* Confirm selection of bombs by checking the Armament Selection Lights, which should display « BOMBS ».
11. *[PC]* Set Emergency Jettison Bomb Arming Switch – UP (ARMED).
12. *[PC]* Confirm that ARMED light illuminates.





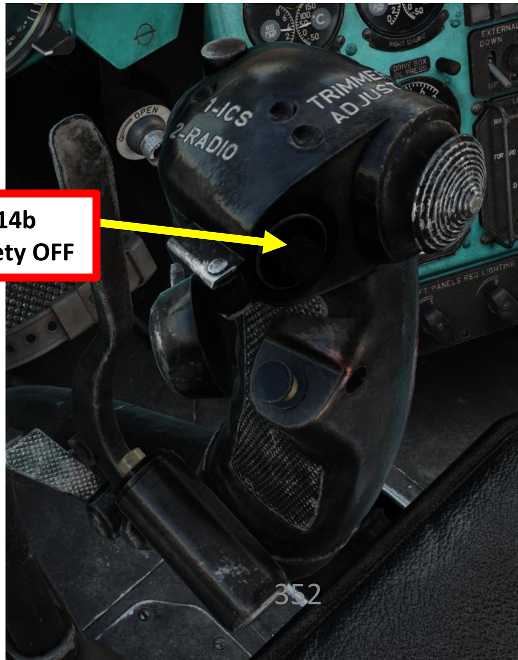
2.5 – FAB-250 BOMBS
2.5.1 – Dive Bombing

13. *[PC]* Perform attack profile on the target.

2.5 – FAB-250 BOMBS
2.5.1 – Dive Bombing

14. *[PC]* Flip the weapon safety on the cyclic, then press and hold the « Weapon Release » (RALT + SPACE) button to drop a bomb.

14a
Safety ON

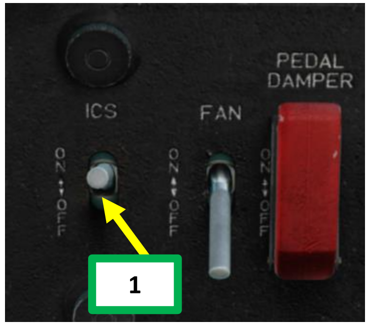


14b
Safety OFF

2.5 – FAB-250 BOMBS
2.5.2 – Level Bombing with Petrovich AI as Pilot-Commander

- *Steps preceded by [PC] are performed by the Pilot-Commander (press "1" to select seat).*
- *Steps preceded by [CPG] are performed by the Petrovich AI if no player is manning the operator station (press "2" to select seat).*

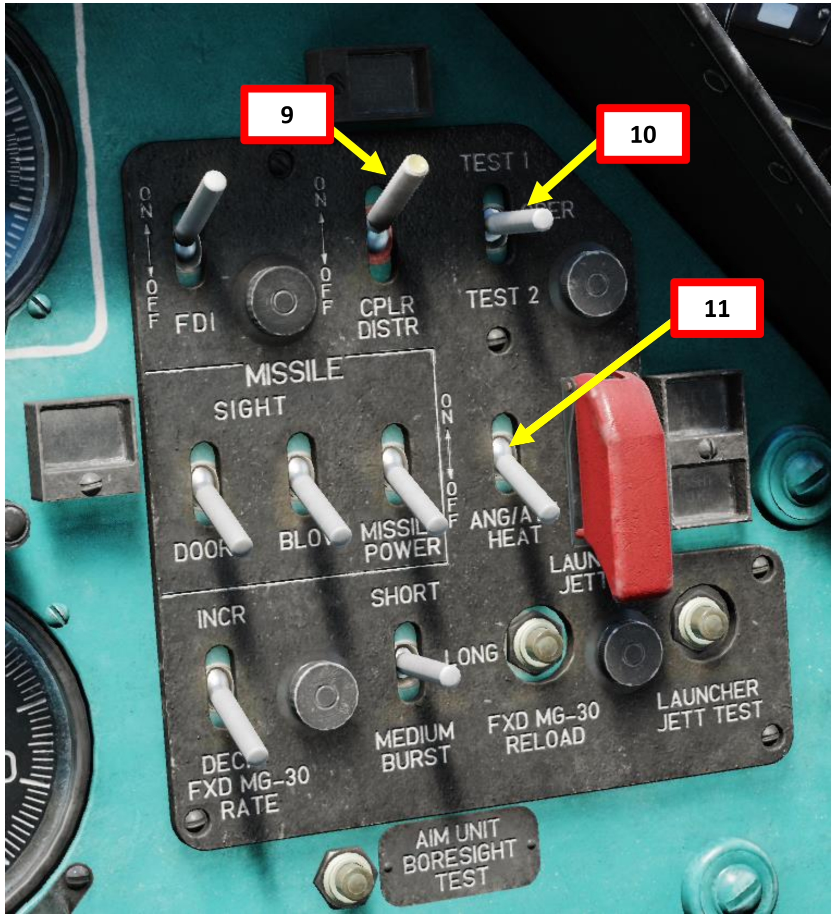
1. *[PC][CPG]* Verify that SPU-8 Intercom (ICS) Power Switches are ON (UP) and that ICS/Radio Selectors are set to UP (ICS) for both the Pilot-Commander and the Co-Pilot/Gunner cockpits.
2. *[PC]* Select Pilot-Commander seat by pressing « 1 ».
3. *[PC]* Set Fire Control Switch – ON (UP).
4. *[PC]* Set Auxiliary Stores Light Switch – ON (UP).

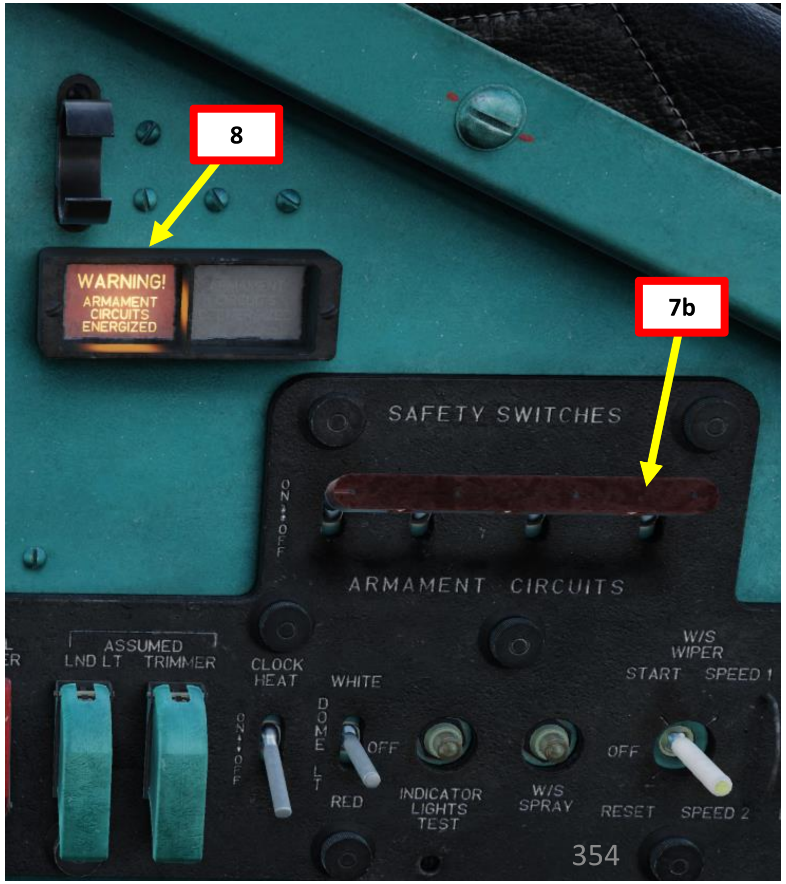


2.5 – FAB-250 BOMBS

2.5.2 – Level Bombing with Petrovich AI as Pilot-Commander

5. *[CPG]* Select Co-Pilot/Gunner seat by pressing « 2 ».
6. *[CPG]* Make sure engines are running, generator power is available and gyros are powered.
7. *[CPG]* Set Armament Circuit Breakers – ON (UP)
8. *[CPG]* Confirm Armament Circuit Breakers are energized.
9. *[CPG]* Set USR-24M (CPLR DISTR) Switch – ON (UP)
10. *[CPG]* Set USR-24M Mode Switch - OPER
11. *[CPG]* Set DUAS (Air Data Probe) Heating Switch – As Required.
    - ON/UP if temperature is below 5 deg C
    - DOWN/OFF if temperature is above 5 deg C.

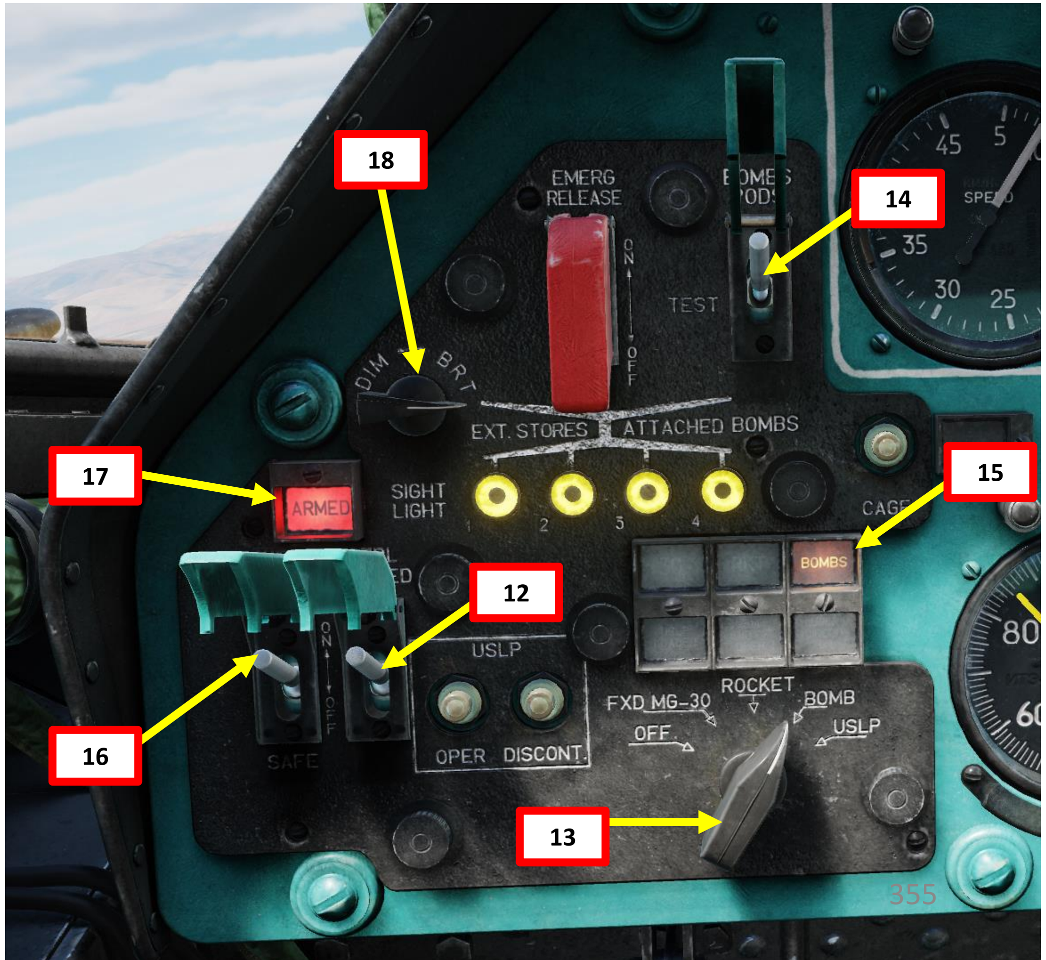




2.5 – FAB-250 BOMBS

2.5.2 – Level Bombing with Petrovich AI as Pilot-Commander

12. *[CPG]* Set Pilot/CPG Weapon Selection Control Handover Switch – UP (Co-Pilot/Gunner has Weapon Selection Control).
13. *[CPG]* Set Weapon Selector – BOMB.
14. *[CPG]* Set Bomb Mode Selector – As required.
    - Set to UP (BOMBS & PODS) if other pods are also equipped (recommended).
    - Set to DOWN (BOMBS ONLY) if only bombs are equipped.
15. *[CPG]* Confirm selection of bombs by checking the Armament Selection Lights, which should display « BOMBS ».
16. *[CPG]* Set Emergency Jettison Bomb Arming Switch – UP (ARMED).
17. *[CPG]* Confirm that ARMED light illuminates.



2.5 – FAB-250 BOMBS

2.5.2 – Level Bombing with Petrovich AI as Pilot-Commander

18. We want to perform a level bombing attack; aiming is performed with the PKI Reflector Sight. In this example, we will use the PKI Reflector Sight in the front cockpit to aim and tell the Pilot-Commander (controlled by Petrovich AI) where to steer the helicopter.
    - The Pilot-Commander flies the helicopter at a specific level altitude and airspeed, as specified in the **Level Bombing Attack Profile Table**. He steers the helicopter towards the target, guided by the Co-Pilot/Gunner vocal commands.
    - The Co-Pilot/Gunner aims with the PKI Reflector Sight of the front cockpit. Sight depression and bomb timer parameters are provided in the **Level Bombing Attack Profile Table.**
    - When the PKI Reflector Sight reticle is over the target, the Co-Pilot/Gunner starts the timer.
    - When the Bomb Release Light illuminates, the Co-Pilot/Gunner releases the bombs.
19. For this example, we will select the following level bombing profile:
    - **Bombing Altitude: 1000 m AGL (Above Ground Level)**
    - **Ground Speed: 250 km/h**
    - **Bomb Delay Timer: 7.5 sec (obtained from table)**
    - **PKI Sight Depression Angle: 30 deg**

Level Bombing Attack Profile – Sight Depression Angle Table
Use for Low-Drag Bombs
Indicated Airspeed: 250 km/h
Bomb Fall Time: 21 s
Helicopter Pitch Angle: -3 deg

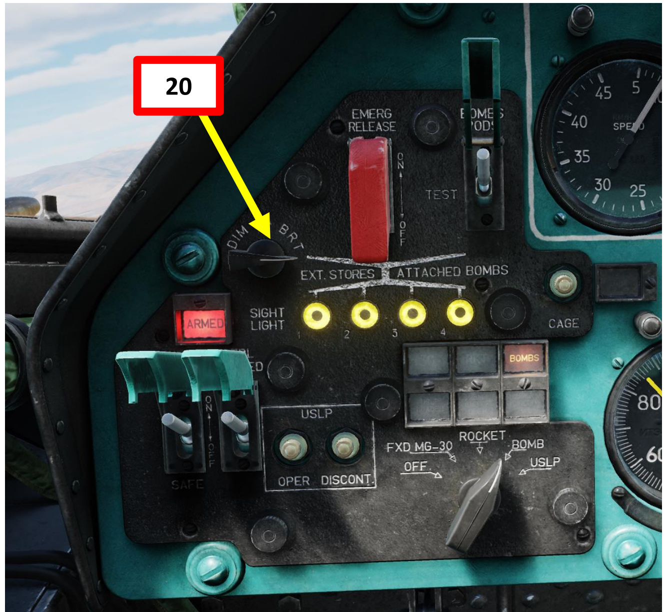
Important Note: If using a Bomb Delay Time, sight depression angle should be set to **30°**.

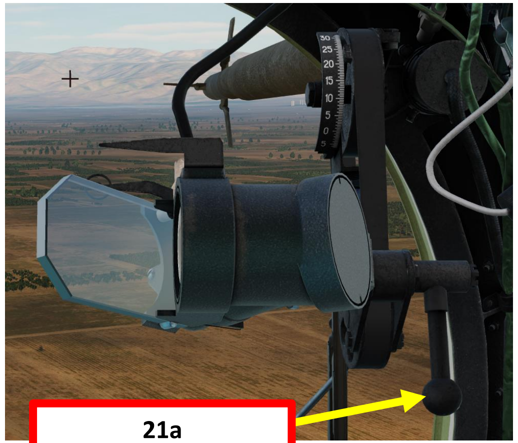
Bombing Altitude (m)	Ground Speed (km/h)						
	190	210	230	250	270	290	310
	Sighting Angle (deg, minutes) or Bomb Delay Time (sec)						
50	13° 45'	12° 15'	10° 45'	9° 45'	9° 00'	8° 00'	7° 30'
100	20° 00'	18° 00'	16° 30'	14° 45'	13° 30'	12° 50'	11° 30'
200	28° 00'	25° 15'	23° 30'	21° 30'	20° 00'	18° 15'	17° 00'
400	2.5	1.4	0.6	30° 00'	28° 00'	26° 00'	24° 30'
600	6.5	4.7	3.4	2.3	1.3	0.2	30° 00'
800	10.4	8.1	6.4	5.0	3.7	2.3	1.3
1000	14.1	11.5	9.3	7.5	6.0	4.6	3.4
1200	18.0	15.0	12.5	10.3	8.5	6.8	5.5
1400	21.7	18.3	15.5	13.0	10.9	9.0	7.5
1600	25.6	21.7	18.5	15.7	13.4	11.4	9.6
1800	29.4	25.2	21.6	18.4	15.8	13.6	11,6
2000	33.1	28.4	24.6	21.3	18.4	15.9	13.7

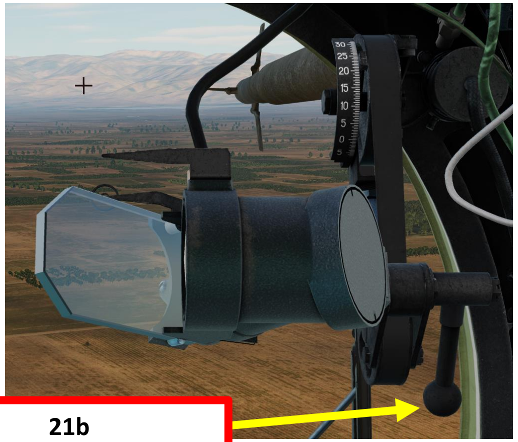
2.5 – FAB-250 BOMBS
2.5.2 – Level Bombing with Petrovich AI as Pilot-Commander

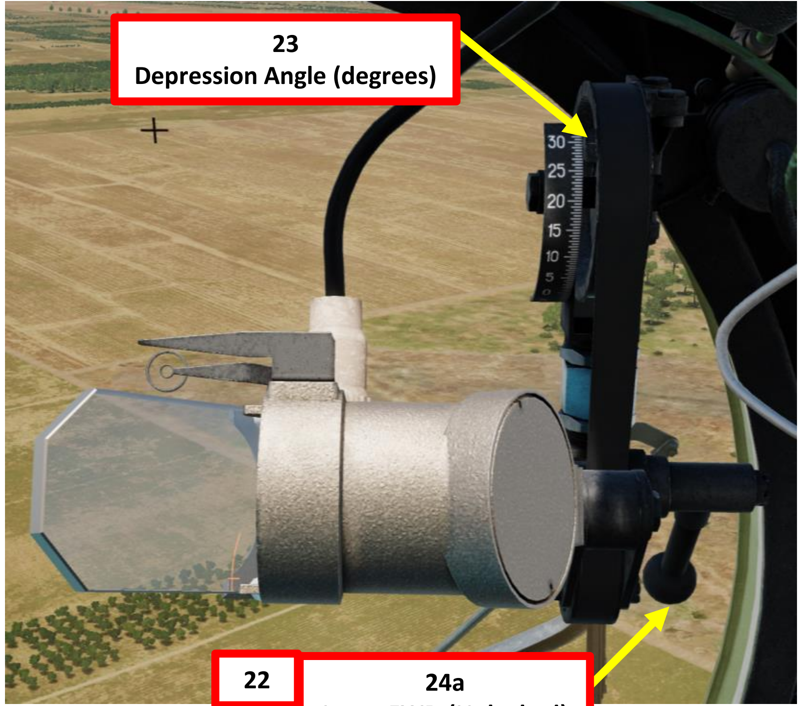
Level Bombing Profile:
- **Bombing Altitude: 1000 m AGL (Above Ground Level)**
- **Ground Speed: 250 km/h**
- **Bomb Delay Timer: 7.5 sec (obtained from table)**
- **PKI Sight Depression Angle: 30 deg**

20. *[CPG]* Turn PKI Reflector Sight Brightness Control Knob to the right to BRT (Bright)
21. *[CPG]* Left click on the Fixed Sight Depression Angle Control Lever to unlock it. When unlocked, the lever should be at the FWD position.
22. *[CPG]* Right click (and hold right mouse button) on the Fixed Sight Depression Angle Control Lever, then move mouse to adjust the **PKI sight position to 30 deg**, which is the required PKI Sight Depression Angle. Alternatively, you can scroll mousewheel on the lever.
23. *[CPG]* Use the Fixed Sight Depression Angle (degrees) scale to see what depression setting the sight is set to.
24. *[CPG]* When PKI sight is in the desired position/depression angle, left click on the Fixed Sight Depression Angle Control Lever to lock it again.
25. *[CPG]* Take note that for a 30 deg angle, you will need to move your head much further ahead since the sight glass is angled in order to view the reticle.





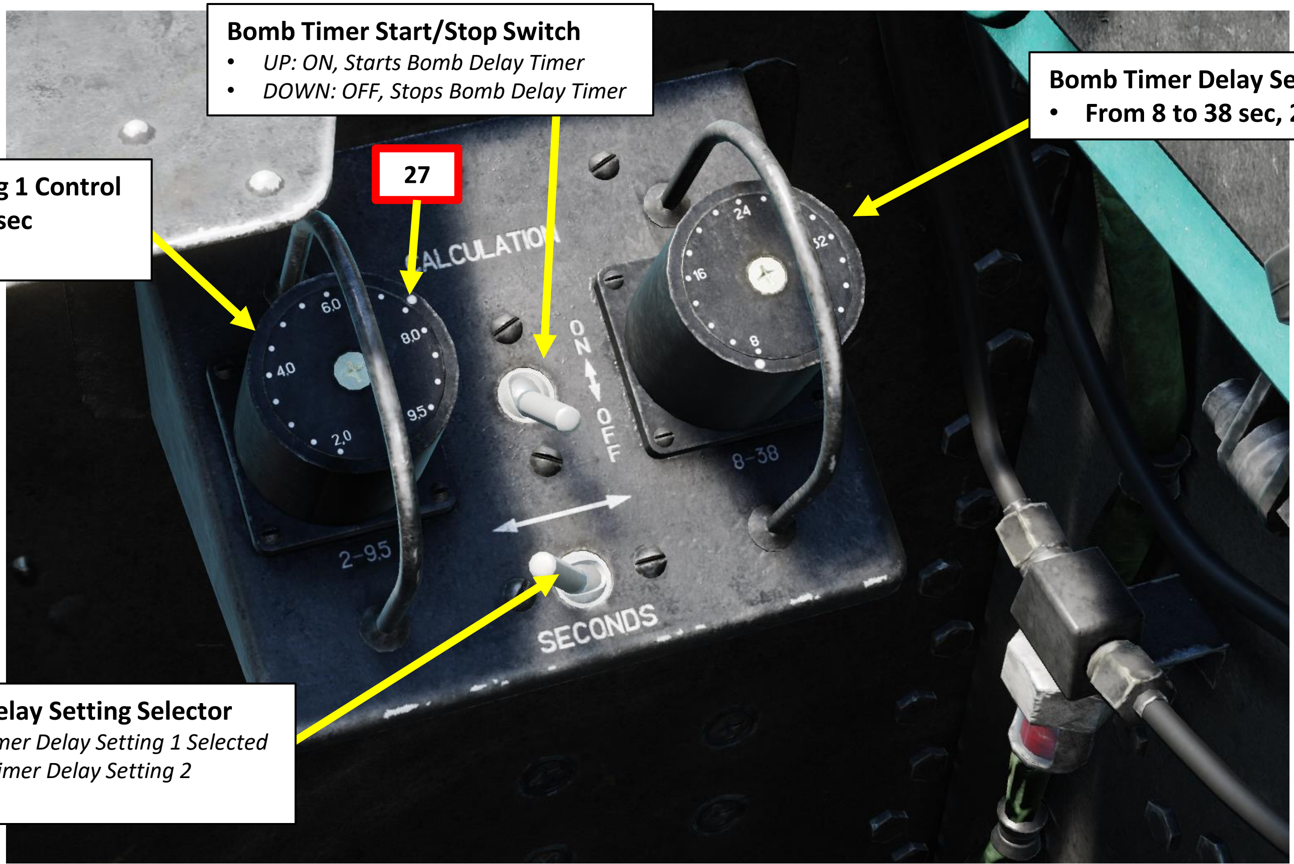




2.5 – FAB-250 BOMBS
2.5.2 – Level Bombing with Petrovich AI as Pilot-Commander

Level Bombing Profile:
- **Bombing Altitude: 1000 m AGL (Above Ground Level)**
- **Ground Speed: 250 km/h**
- **Bomb Delay Timer: 7.5 sec (obtained from table)**
- **PKI Sight Depression Angle: 30 deg**

26. *[CPG]* Since we will use a 7.5 sec delay, we will use Bomb Timer Delay Setting 1 (which goes from 2 to 9.5 sec). Set Bomb Timer Delay Setting Selector to 1 (AFT) to select Setting 1.
27. *[CPG]* Set the **Bomb Timer Delay Setting to 7.5 sec**, as required by the Level Bombing Profile Table.
    a) Left Click on Bomb Timer Delay Setting 1 to unlock the knob (pulled UP)
    b) Scroll mousewheel on the knob to set the timer to 7.5 sec
    c) Left click again to lock the knob (pushed DOWN).

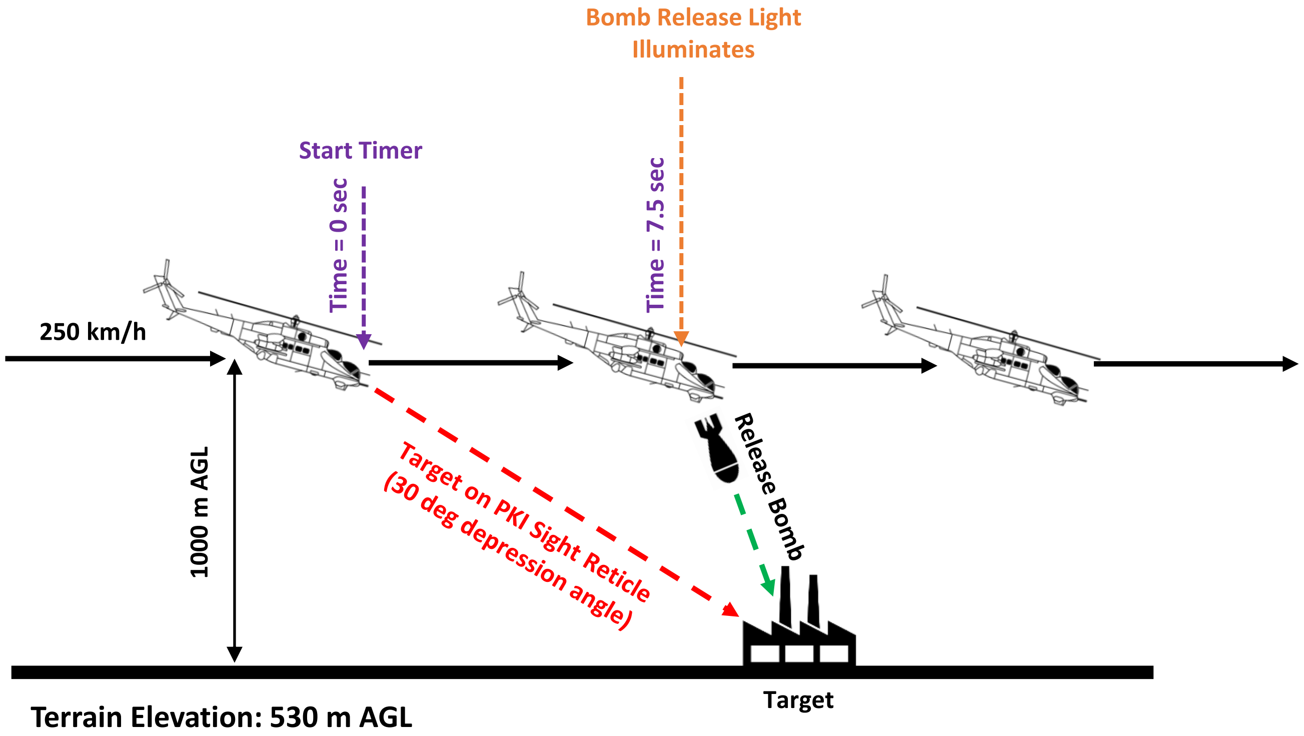


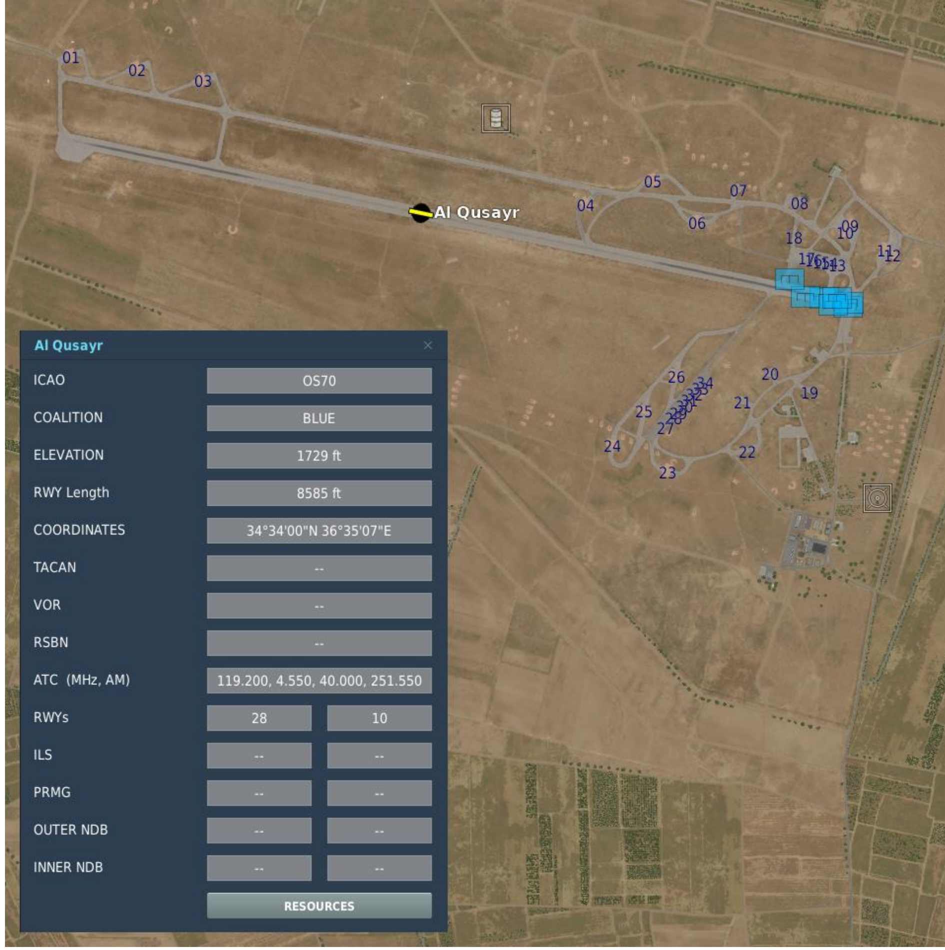
2.5 – FAB-250 BOMBS
2.5.2 – Level Bombing with Petrovich AI as Pilot-Commander

Level Bombing Profile:

- **Bombing Altitude: 1000 m AGL (Above Ground Level)**
- **Ground Speed: 250 km/h**
- **Bomb Delay Timer: 7.5 sec (obtained from table)**
- **PKI Sight Depression Angle: 30 deg**

28. [CPG] Verify from the F10 map the target's elevation. In our case, the terrain elevation is 530 m above ground level. Since we need to be 1000 m over the target when dropping our bombs, we should keep in mind that we will **release our bombs** when flying at a **barometric altitude of 1530 m** (assuming a standard barometric pressure setting).





2.5 – FAB-250 BOMBS
2.5.2 – Level Bombing with Petrovich AI as Pilot-Commander

29. *[CPG]* Release Controls using "C", then show the Petrovich Menu by using « LCTRL+V ». This command will display a horizontal situation indicator that can be used to give commands to Petrovich (acting as Pilot-Commander).
30. *[CPG]* If CBTM AI Mode is selected, select FLT (Flight) AI Mode with « A » Short. Otherwise, leave AI Mode to FLT.
31. *[CPG]* Set desired Airspeed **(250 km/h)** by using « W » SHORT (Increase) or « S » SHORT (Decrease).
32. *[CPG]* Set desired Entry Altitude **(1530 m barometric as determined previously)** by using « W » LONG (Increase) or « S » LONG (Decrease).
33. *[CPG]* Press « D » SHORT to display a Designation Reticle. Move reticle using head tracking over the target area, then press « D » SHORT a second time to designate. Petrovich will then steer helicopter towards the target.
    - Alternatively, you can set desired heading using « A » LONG (Heading Bug Left) or « D » LONG (Heading Bug Right).

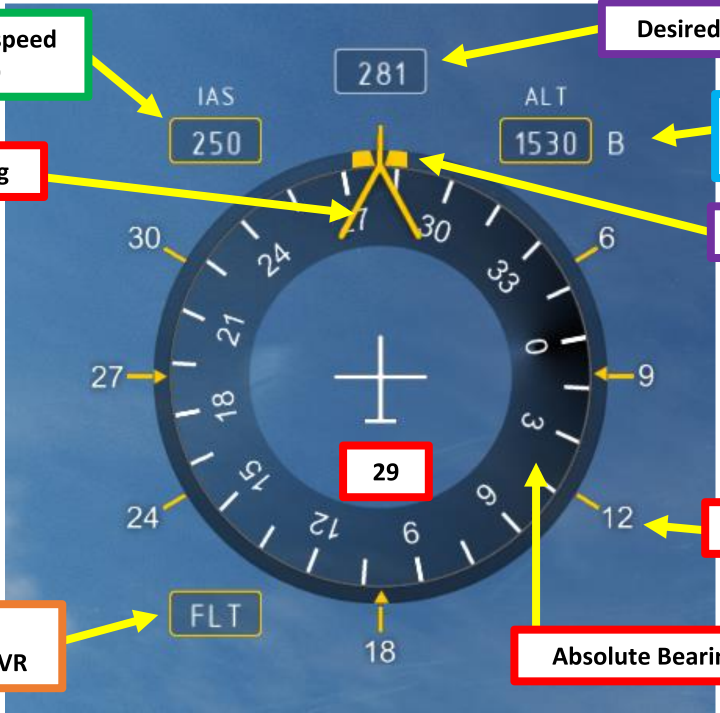
FLT Mode

- **UP (W) SHORT**: **Increases** desired **speed** in the IAS window. After a short delay, Petrovich will accelerate the helicopter to the new speed.
- **UP (W) LONG**: **Increases** the desired **altitude** in the ALT window. After button is released, Petrovich will increase the helicopter's altitude.

- **LEFT (A) SHORT**: Changes AI Menu mode to CMBT (Combat).
- **LEFT (A) LONG**: Moves desired **heading** bug **left**. After button is released, commands Petrovich to turn the helicopter to the new heading.

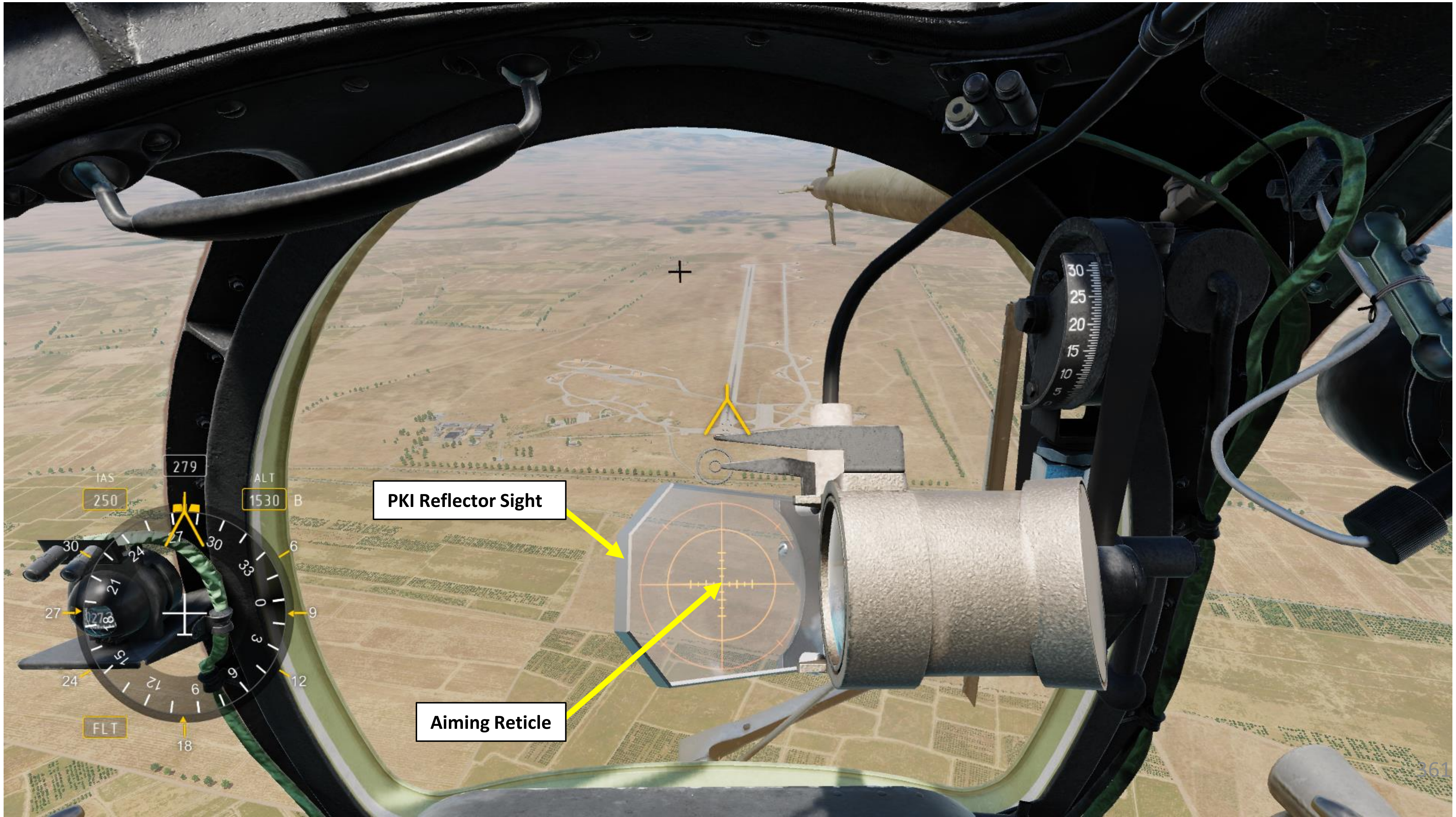
- **RIGHT (D) SHORT**: Activates **head-tracking steering**. A reticle will be displayed in the center of the screen. You can then look in the direction you wish Petrovich to fly, then press Right (D) Short again.
- **RIGHT (D) LONG**: Moves desired **heading** bug **right**. After button is released, commands Petrovich to turn the helicopter to the new heading.

- **DOWN (S) SHORT**: **Decreases** desired **speed** in the IAS window. After a short delay, Petrovich will accelerate the helicopter to the new speed. HVR (Hover) mode is activated if speed decreases below 50 km/h.
- **DOWN (S) LONG**: **Decreases** the desired **altitude** int he ALT window. After button is released, Petrovich will decrease the helicopter's altitude.



2.5 – FAB-250 BOMBS
2.5.2 – Level Bombing with Petrovich AI as Pilot-Commander

34. *[CPG]* Command the pilot to fly to the target. Use the PKI Reflector Sight's aiming reticle as a reference; it should be lined up on the target.
    - If fine adjustments are needed, set desired heading using « A » LONG (Steer Left) or « D » LONG (Steer Right).

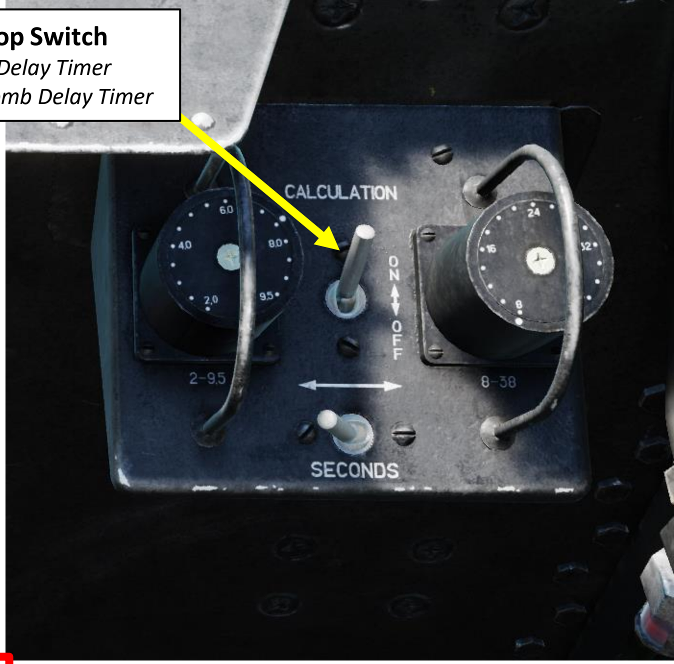


2.5 – FAB-250 BOMBS
2.5.2 – Level Bombing with Petrovich AI as Pilot-Commander

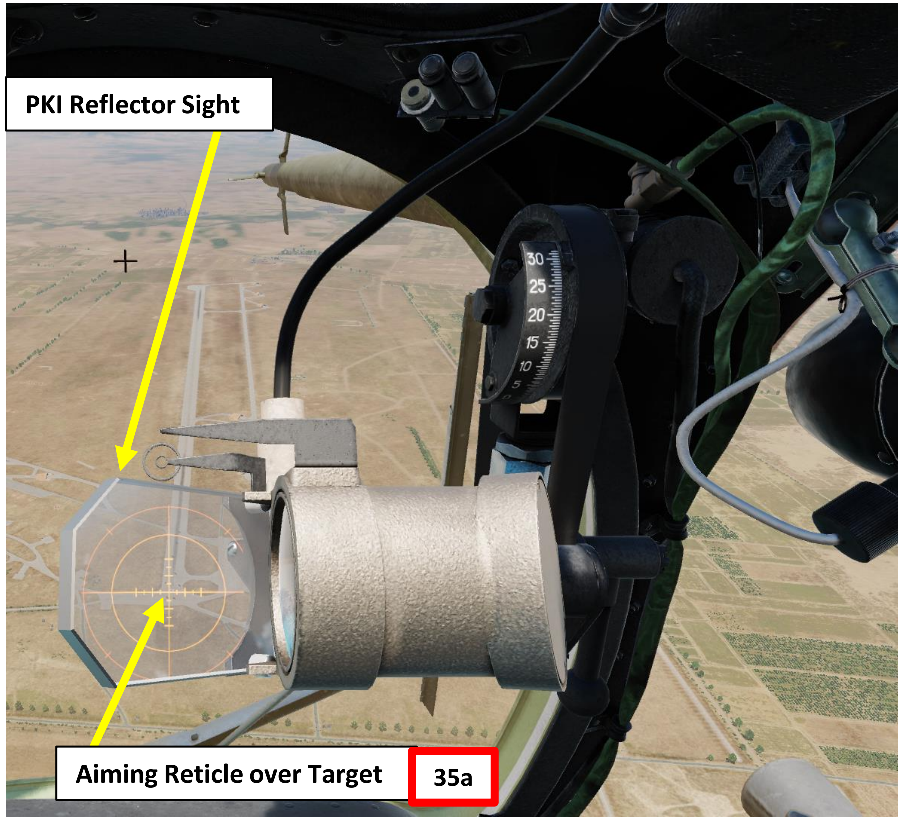
35. *[CPG]* When the PKI Reflector Sight's aiming reticle is on the target, flip the Bomb Timer Start/Stop Switch UP (ON). This will start the 7.5 sec timer we have set up previously.
36. *[CPG]* When the Bomb Release Light illuminates (after 7.5 sec), it is time for the Co-Pilot/Gunner to release bombs.
37. *[CPG]* Flip the weapon safety on the cyclic, then press and hold the « Weapon Release » (RALT + SPACE) button to release bombs.
38. *[CPG]* Flip the Bomb Timer Start/Stop Switch DOWN (OFF).

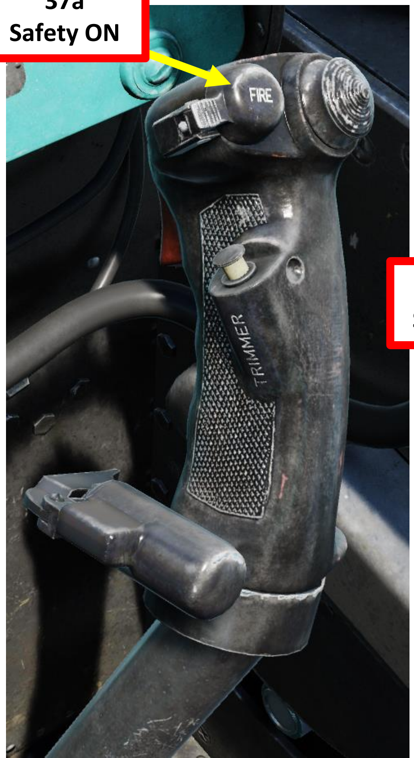
- **Note: a similar procedure can be used with KMGU-2 Cluster Munitions, but with a different Bombing Profile Table and bomb release timer delay.**

35b
Bomb Timer Start/Stop Switch
- *UP: ON, Starts Bomb Delay Timer*
- *DOWN: OFF, Stops Bomb Delay Timer*



Bomb Release Light
- *When illuminated, this is your cue to release bombs!*





2.5 – FAB-250 BOMBS

2.5.2 – Level Bombing with Petrovich AI as Pilot-Commander

2.5 – FAB-250 BOMBS
2.5.3 – Bomb Attack Profile Table

Level Bombing Attack Profile – Sight Depression Angle Table
Use for Low-Drag Bombs
Indicated Airspeed: 250 km/h
Bomb Fall Time: 21 s
Helicopter Pitch Angle: -3 deg

Important Note: If using a Bomb Delay Time, sight depression angle should be set to **30°**.

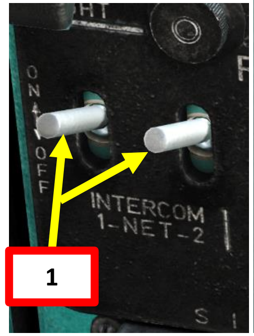
Bombing Altitude (m)	Ground Speed (km/h)						
	190	210	230	250	270	290	310
	Sighting Angle (deg, minutes) or Bomb Delay Time (sec)						
50	13° 45‘	12° 15‘	10° 45‘	9° 45‘	9° 00‘	8° 00‘	7° 30‘
100	20° 00‘	18° 00‘	16° 30‘	14° 45‘	13° 30‘	12° 50‘	11° 30‘
200	28° 00‘	25° 15‘	23° 30‘	21° 30‘	20° 00‘	18° 15‘	17° 00‘
400	2.5	1.4	0.6	30° 00‘	28° 00‘	26° 00‘	24° 30‘
600	6.5	4.7	3.4	2.3	1.3	0.2	30° 00‘
800	10.4	8.1	6.4	5.0	3.7	2.3	1.3
1000	14.1	11.5	9.3	7.5	6.0	4.6	3.4
1200	18.0	15.0	12.5	10.3	8.5	6.8	5.5
1400	21.7	18.3	15.5	13.0	10.9	9.0	7.5
1600	25.6	21.7	18.5	15.7	13.4	11.4	9.6
1800	29.4	25.2	21.6	18.4	15.8	13.6	11,6
2000	33.1	28.4	24.6	21.3	18.4	15.9	13.7

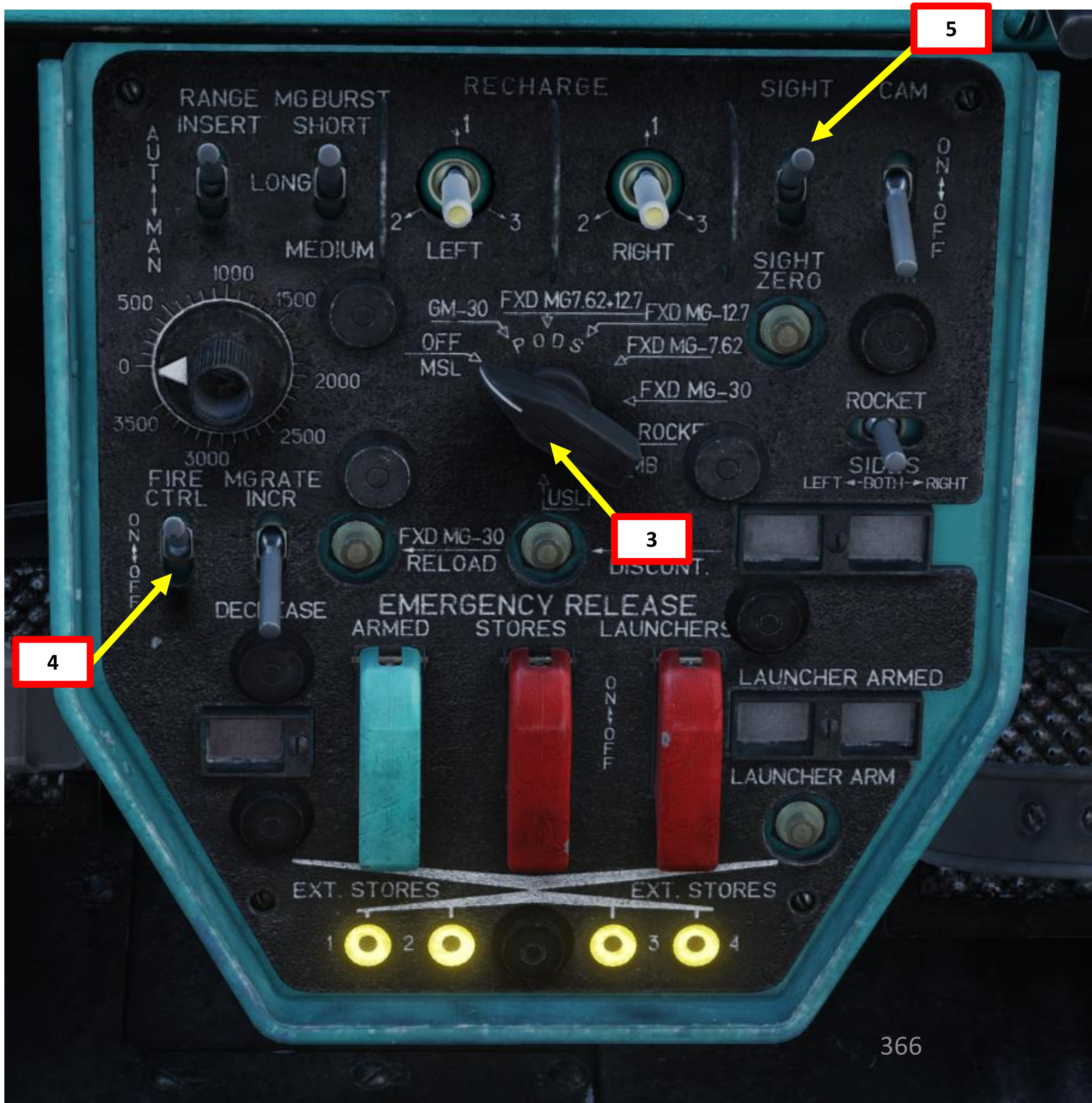
2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE

2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE
2.6.1 – Missile Operation with Petrovich AI as Co-Pilot/Gunner

- *Steps preceded by [PC] are performed by the Pilot-Commander.*
- *Steps preceded by [CPG] are performed by the Petrovich AI if no player is manning the operator station.*

1. *[PC][CPG]* Verify that SPU-8 Intercom (ICS) Power Switches are ON (UP) and that ICS/Radio Selectors are set to UP (ICS).
2. *[PC]* Request Petrovich AI to power up weapons and countermeasures (LCTRL+W). This process takes about 3 minutes
3. *[PC]* Set Weapon Selector to desired OFF/MSL position
4. *[PC]* Set Fire Control Switch – ON (UP).
5. *[PC]* Set ASP-17VP Sight Power Switch – ON (UP).
6. *[PC]* Set Auxiliary Stores Light Switch – ON (UP).

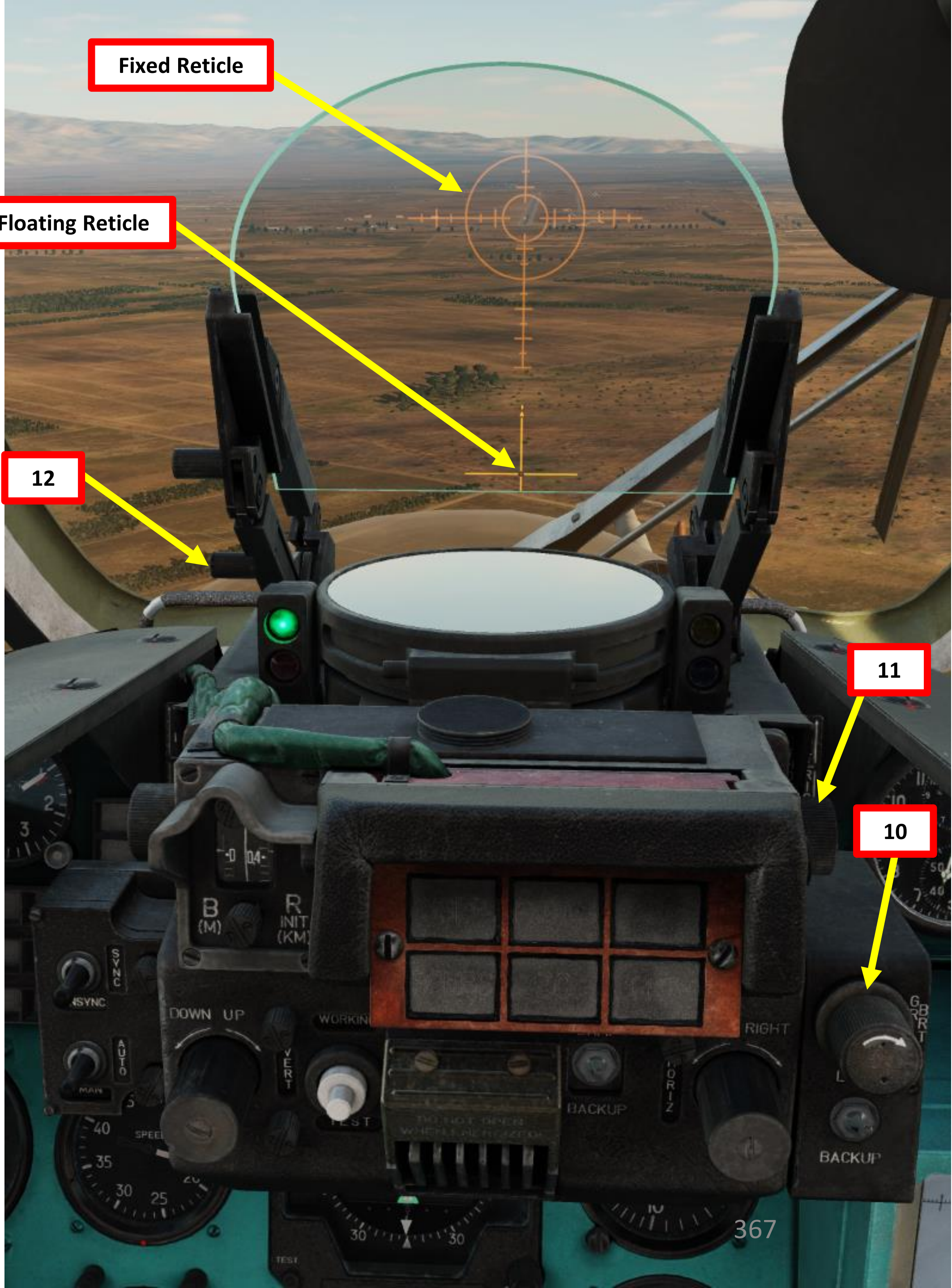




2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE

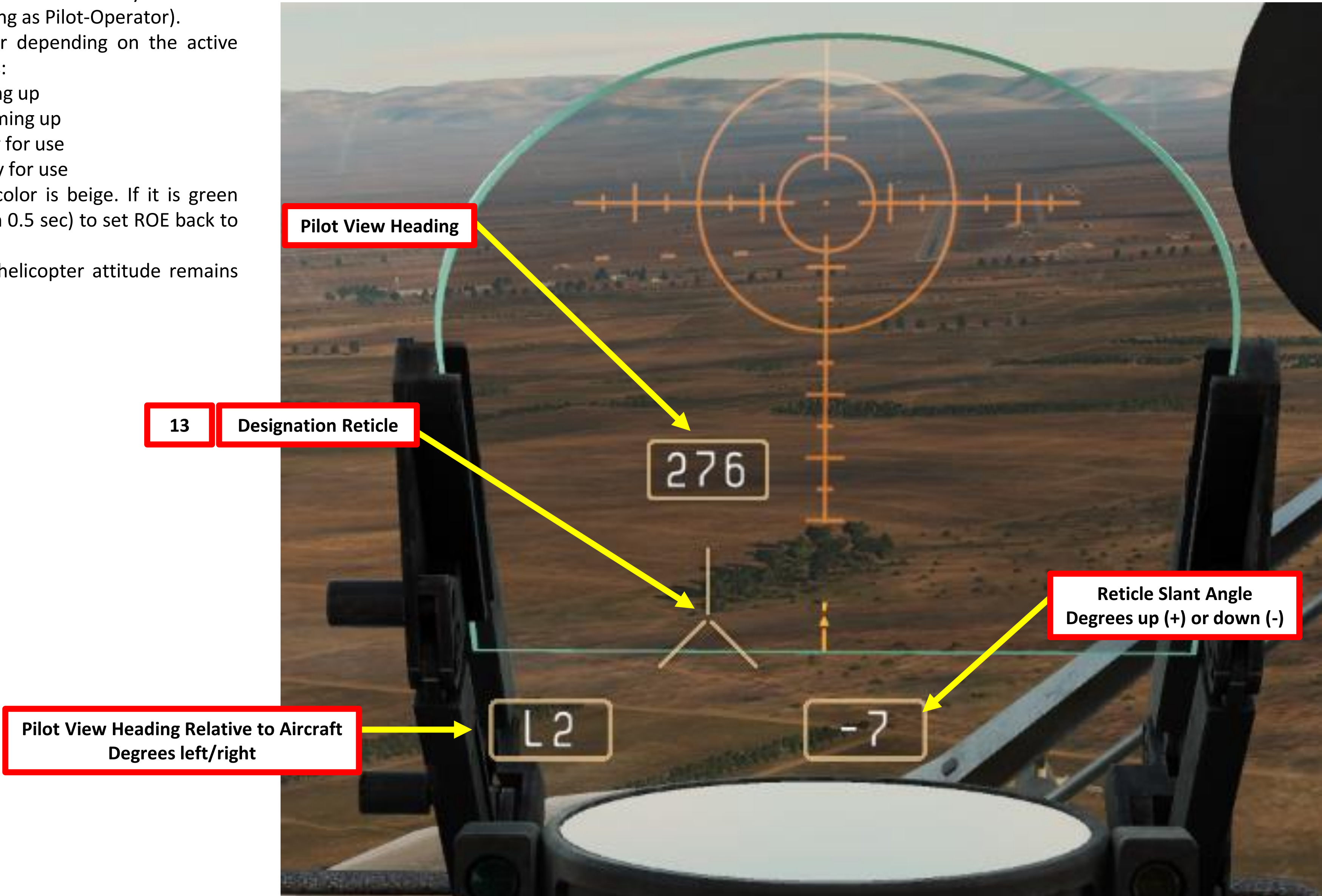
2.6.1 – Missile Operation with Petrovich AI as Co-Pilot/Gunner

7. *[PC]* Confirm selection of missiles by checking the Armament Selection Lights, which should not display anything (all lights OFF).
8. *[PC]* Set Sight Synchronization Mode Selector – SYNC (UP).
9. *[PC]* Set Sight Mode Selector – AUTOMATIC (UP).
10. *[PC]* Adjust Sight Fixed Reticle (Net) Brightness Control Knob to make the Fixed Reticle dim enough to see the Floating Reticle properly.
11. *[PC]* Adjust Sight Floating Reticle Brightness Control Knob as required.
12. *[PC]* Adjust Sight Reflector Glass as desired using the Sight Reflector Glass Control Lever.
    - Lever UP: Sight Unlocked / Lever DOWN: Sight Locked
    - When lever is unlocked (UP), scroll mousewheel to adjust reflector glass position as desired



2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE
2.6.1 – Missile Operation with Petrovich AI as Co-Pilot/Gunner

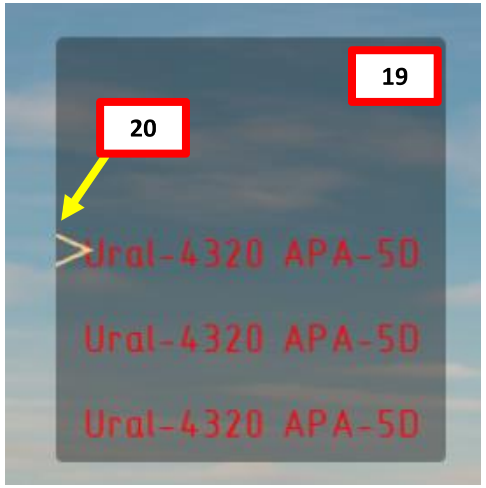
13. *[PC]* Show the Petrovich Menu by using « LCTRL+V ». This command will display a Designation Reticle that can be used to identify and track targets, and give commands to Petrovich (acting as Pilot-Operator).
14. *[PC]* The designation interface changes color depending on the active rules of engagement (ROE) and weapon status:
    - Red: Weapons Hold, Missile is warming up
    - Yellow: Weapons Free, Missile is warming up
    - Beige: Weapons Hold, Missile is ready for use
    - Green: Weapons Free, Missile is ready for use
15. *[PC]* Confirm that the Designation Reticle's color is beige. If it is green (weapons free), press « W » LONG (more than 0.5 sec) to set ROE back to weapons hold.
16. *[PC]* Fly towards the target and ensure the helicopter attitude remains stable.

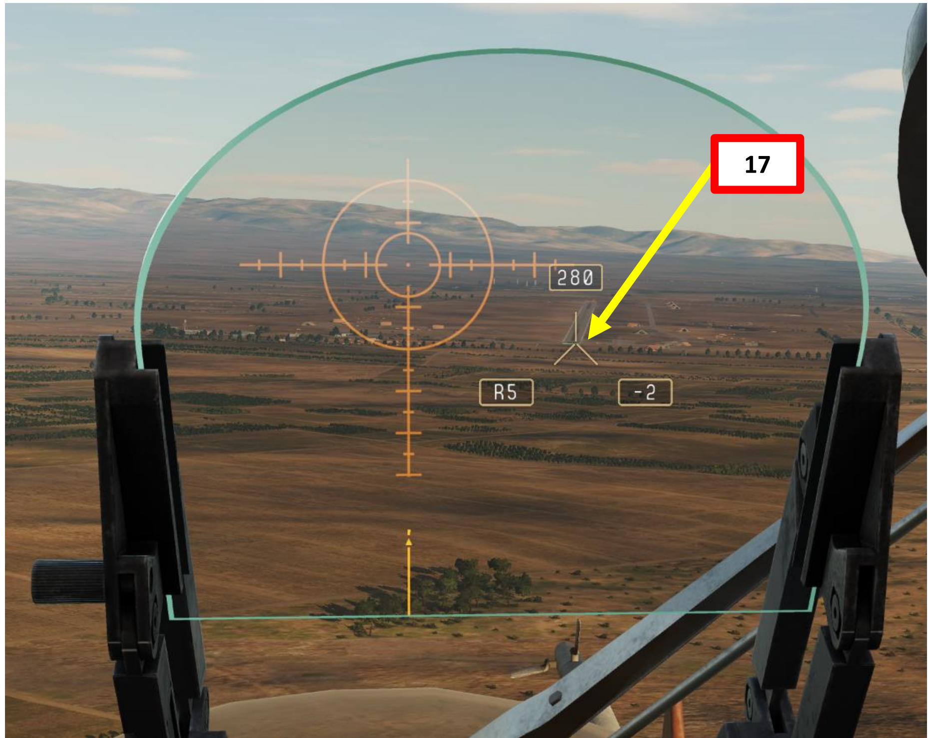


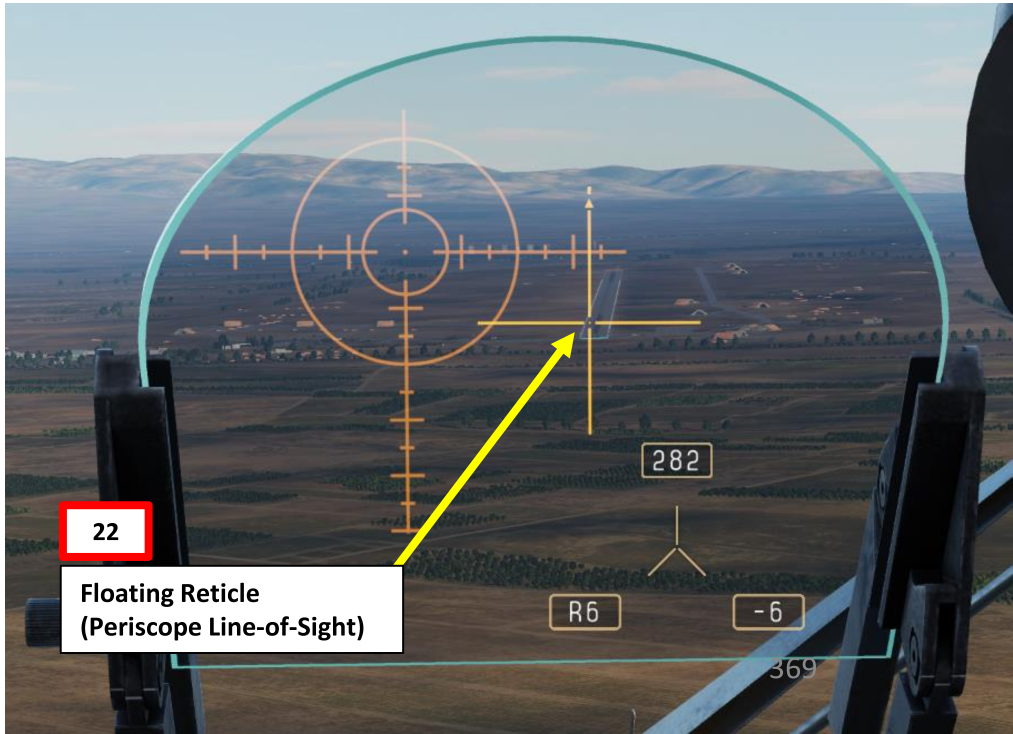
2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE

2.6.1 – Missile Operation with Petrovich AI as Co-Pilot/Gunner

17. *[PC]* Move your head (Designation Reticle) near the area you want the Co-Pilot/Gunner to search for targets, then press « W » SHORT (less than 0.5 sec).
18. *[CPG]* Petrovich will first call out « Observ ON. Can't move sight yet »; the periscope gimbals require about 10 seconds before the periscope is uncaged and the sight can be moved by the guidance unit handles of the Co-Pilot/Gunner.
19. *[CPG]* Petrovich will then start searching, scanning for targets in the designated area. When targets are found, a menu with a list of targets appears.
20. *[PC]* Cycle through the target list using « W » SHORT (UP) or « S » SHORT (DOWN) until desired target is selected by the **>** symbol.
21. *[PC]* Press « D » SHORT (RIGHT) to select target.
    - Note: Pressing "S" SHORT (DOWN) undesignates Petrovich's target.
22. *[CPG]* Petrovich will then select a missile station and control the periscope to set the aiming sight on the target. The periscope's line-of-sight is represented on the ASP-17VP optical sight by the Floating Reticle.

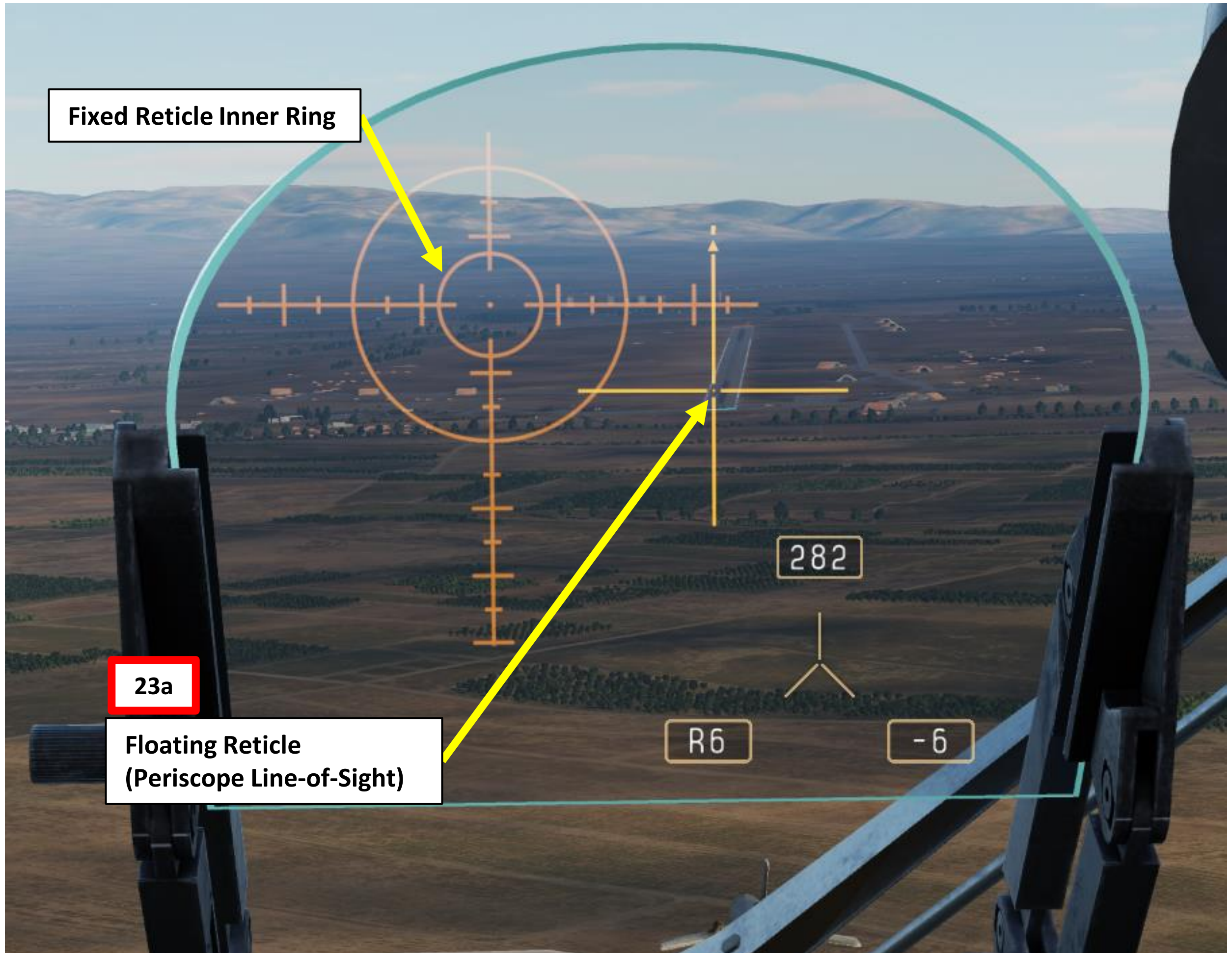






2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE
2.6.1 – Missile Operation with Petrovich AI as Co-Pilot/Gunner

23. *[PC]* Fly helicopter to line up the inner ring of the Fixed Reticle with the Floating Reticle (periscope line-of-sight).
24. *[CPG]* Petrovich will keep the aiming reticle on the target and estimate range to target. When a valid firing solution is available, a continuous high pitch beep is audible through the headphones of both crew members.
25. *[CPG]* When target is in range and a valid firing solution is available, Petrovich will call out « Target In Range ».

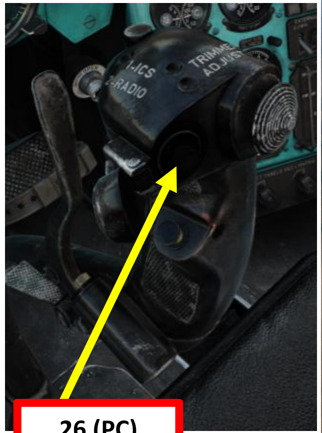


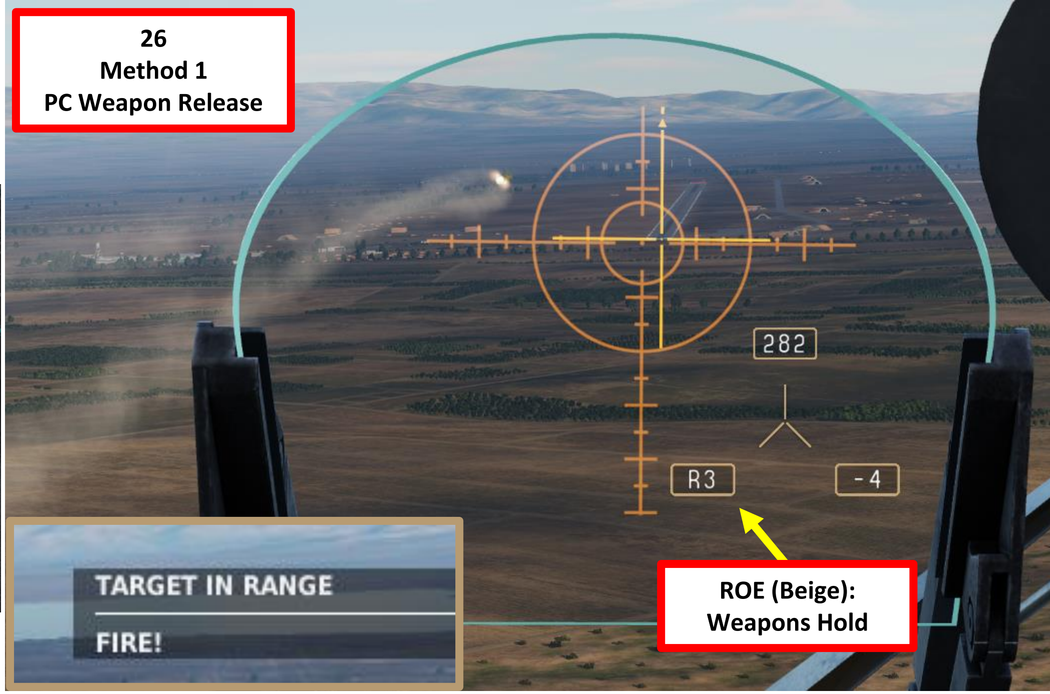
2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE
2.6.1 – Missile Operation with Petrovich AI as Co-Pilot/Gunner

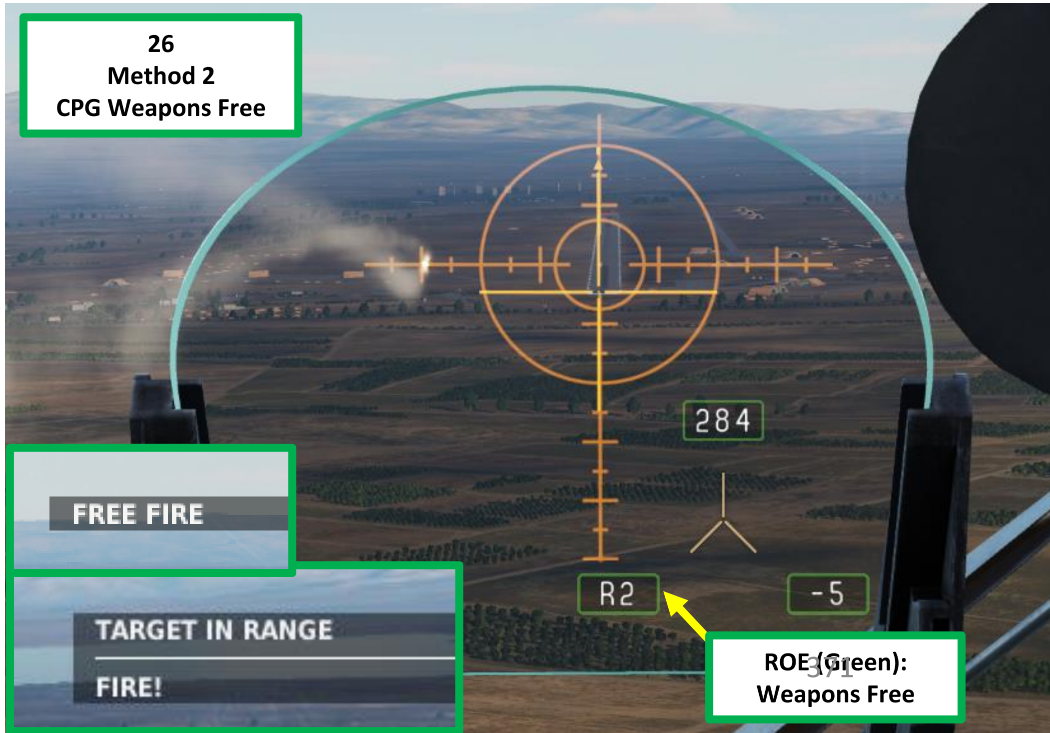
26. Fire Missile.
    - *[PC]* ***Method 1:*** Flip the weapon safety on the cyclic, then press and hold the « Weapon Release » (RALT + SPACE) button to launch missile.
    - *[CPG]* ***Method 2:*** Press « W » LONG (more than 0.5 sec) to set ROE to weapons free. The Designation Reticle will turn to green. Petrovich will then automatically press and hold the « Fire ATG Missile» buttons on the Rotary Handles (RCTRL+SPACE) to launch missile when target is in range and a valid firing solution is available.

27. [CPG] Using the Rotary Head (lateral axis) and Rotary Handle (vertical axis) guidance controls, Petrovich will keep the aiming reticle on the target as the missile is steered toward the periscope's line-of-sight by the guidance unit radio.

28. [PC] Maintain Fixed Reticle and Floating Reticles lined up while the missile heads towards the target, and deploy countermeasures during the attack run; this is a phase where the helicopter is most vulnerable since the pilot has to fly relatively straight to help the Co-Pilot/Gunner minimize the amount of correction required to keep a steady aim.







2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE
2.6.1 – Missile Operation with Petrovich AI as Co-Pilot/Gunner

29. *[CPG]* After missile impact, press "S" SHORT (DOWN) to undesignate Petrovich's target. Petrovich will exit the Aiming Sight and set the OBSERVE (B2) switch to OFF (DOWN) to close the protective doors, boresight the periscope, and cage the gimbals.
30. *[CPG]* Petrovich will call out "No Target Selected" to the Pilot-Commander to let him know that he can start evasive manoeuvers without risking damaging the periscope gimbals.
31. *[PC]* Avoid flying directly over the target. Break off from the target once the attack is complete, preferably to the left since visibility is better and the rotor torque makes left turns easier.
32. *[PC]* You can hide the Petrovich Menu (Designation Reticle) by using « LCTRL+V ».

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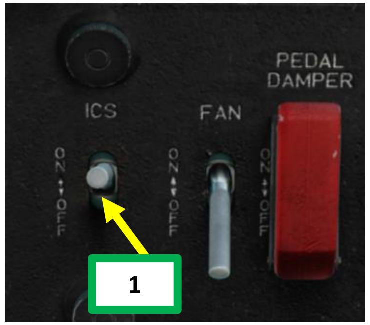
2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE
2.6.2 – Missile Operation with Petrovich AI as Pilot-Commander

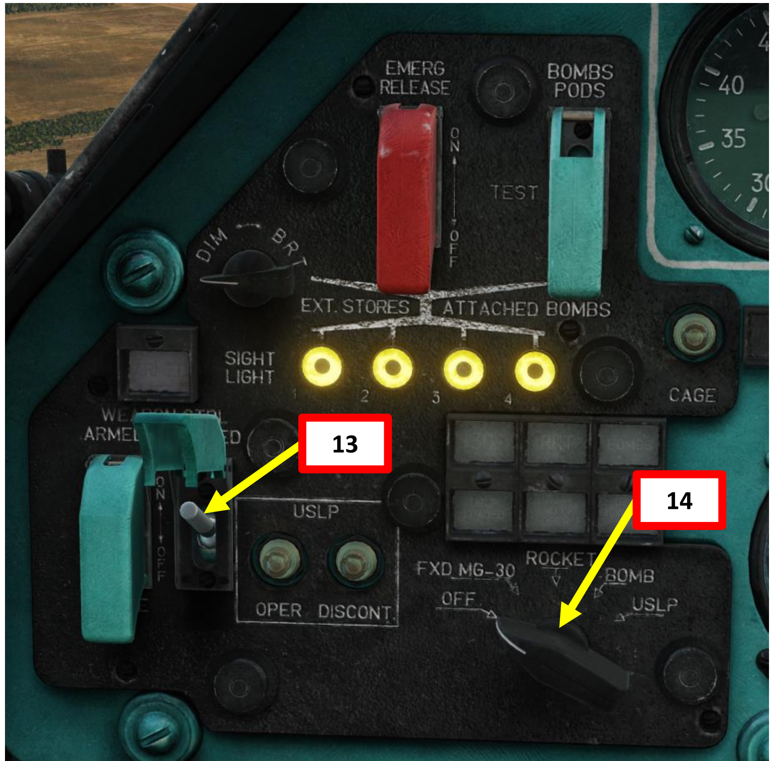
- *Steps preceded by [PC] are performed by the Pilot-Commander (press "1" to select seat).*
- *Steps preceded by [CPG] are performed by the Petrovich AI if no player is manning the operator station (press "2" to select seat).*

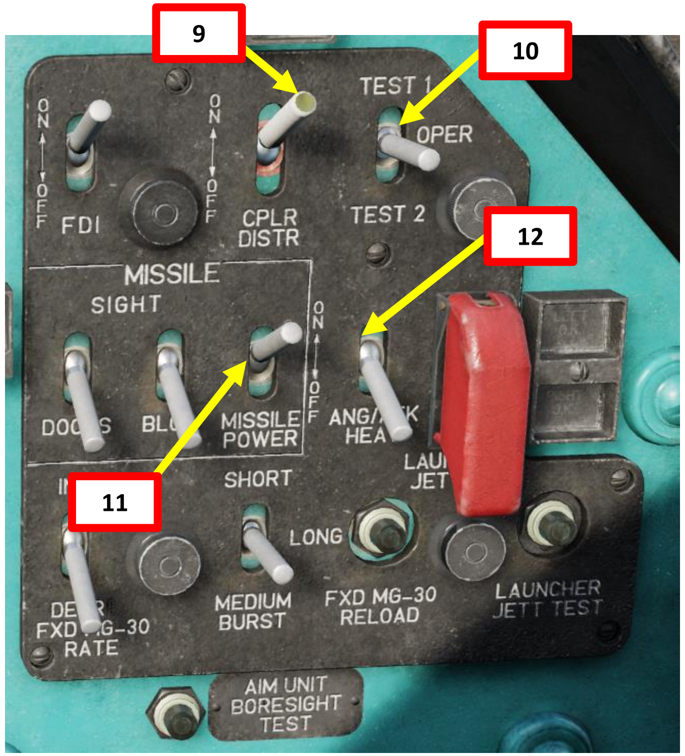
1. *[PC][CPG]* Verify that SPU-8 Intercom (ICS) Power Switches are ON (UP) and that ICS/Radio Selectors are set to UP (ICS) for both the Pilot-Commander and the Co-Pilot/Gunner cockpits.
2. *[PC]* Select Pilot-Commander seat by pressing « 1 ».
3. *[PC]* Set Fire Control Switch – ON (UP).
4. *[PC]* Set Auxiliary Stores Light Switch – ON (UP).

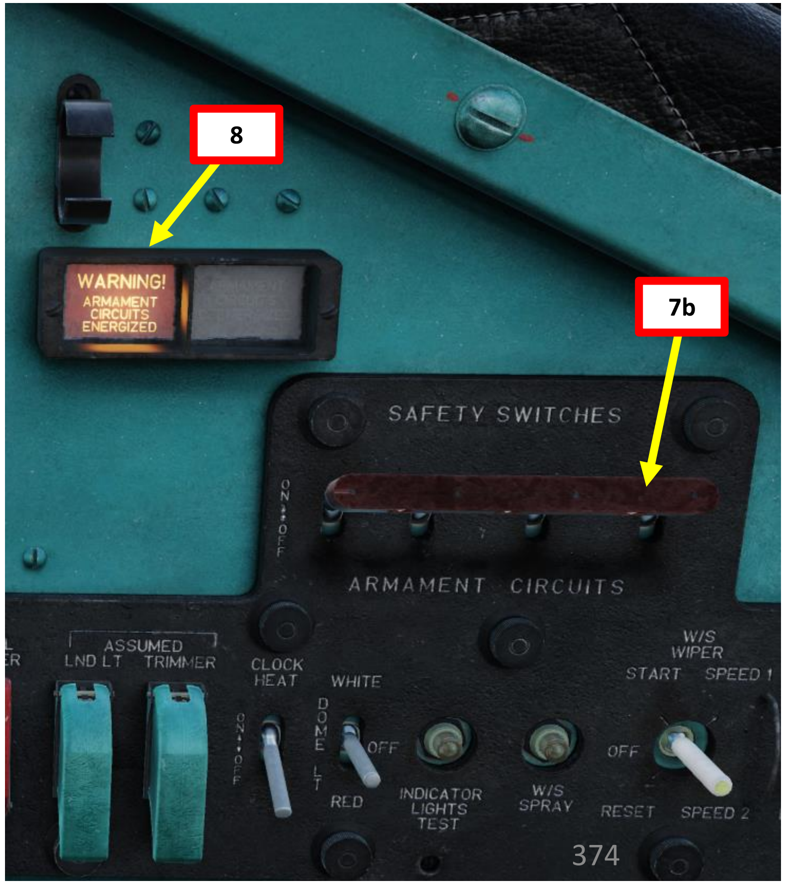


2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE
2.6.2 – Missile Operation with Petrovich AI as Pilot-Commander

5. *[CPG]* Select Co-Pilot/Gunner seat by pressing « 2 ». Petrovich as the Pilot-Commander AI will set up the remaining sight settings as required for weapon employment.
6. *[CPG]* Make sure engines are running, generator power is available and gyros are powered.
7. *[CPG]* Set Armament Circuit Breakers – ON (UP)
8. *[CPG]* Confirm Armament Circuit Breakers are energized.
9. *[CPG]* Set USR-24M (CPLR DISTR) Switch – ON (UP)
10. *[CPG]* Set USR-24M Mode Switch - OPER
11. *[CPG]* Set Missile Power Switch – ON (UP)
12. *[CPG]* Set DUAS (Air Data Probe) Heating Switch – As Required.
    - ON/UP if temperature is below 5 deg C
    - DOWN/OFF if temperature is above 5 deg C.
13. *[CPG]* Set Pilot/CPG Weapon Selection Control Handover Switch – UP (Co-Pilot/Gunner has Weapon Selection Control).
14. *[CPG]* Set Weapon Selector – OFF/MSL.



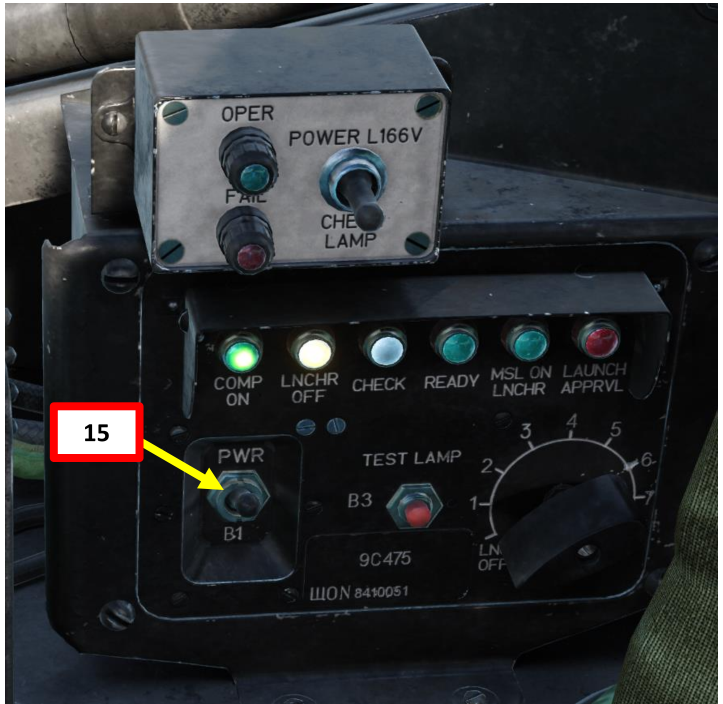


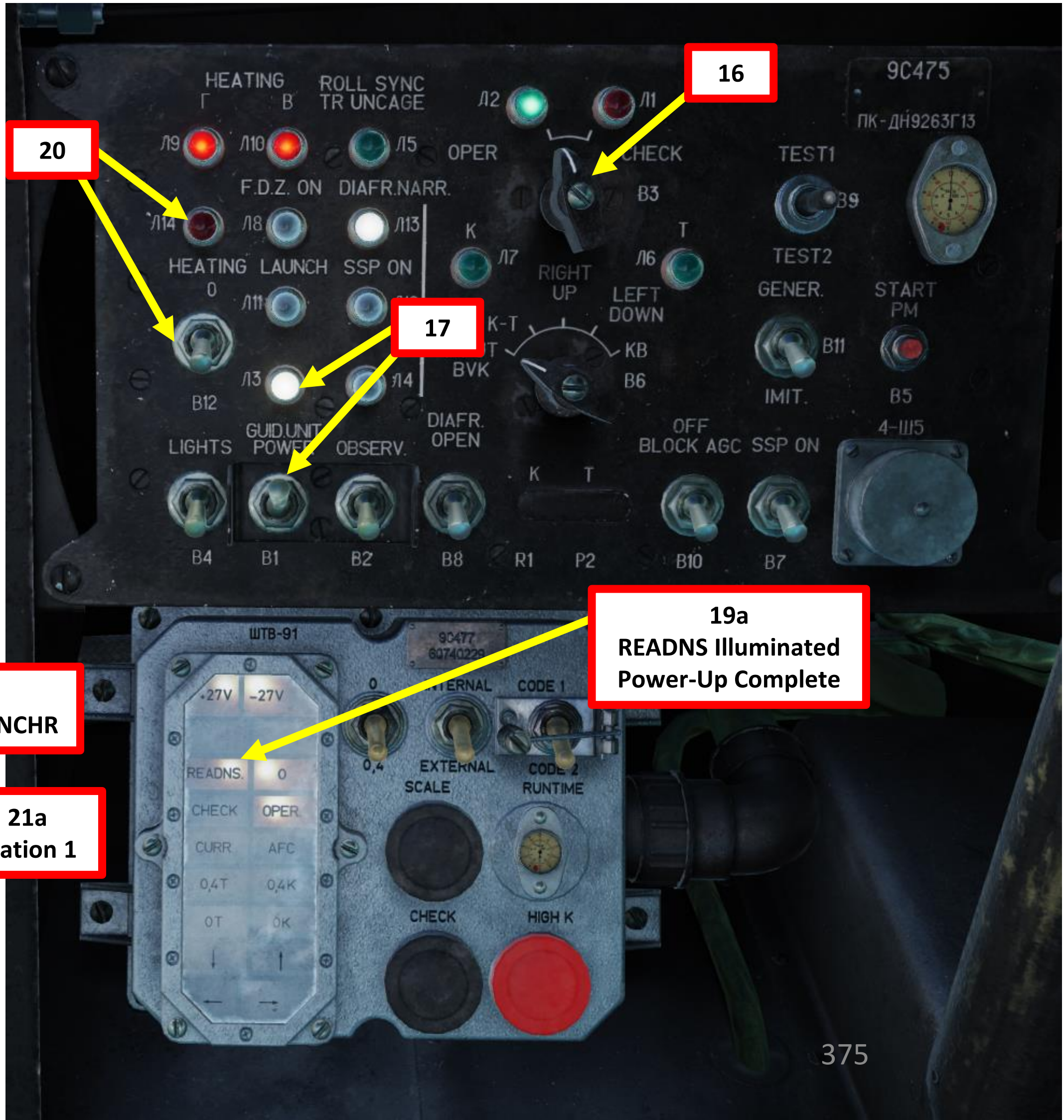


2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE

2.6.2 – Missile Operation with Petrovich AI as Pilot-Commander

15. *[CPG]* Set Missile B1 Power Switch – ON (UP)
16. *[CPG]* Set Aiming Sight Mode – OPER.
17. *[CPG]* Set Guidance Unit Power (B1) Switch – ON (UP). Confirm that « L3 » lamp illuminates.
18. *[CPG]* Power-up sequence of the Guidance Unit takes approximately 3 minutes.
19. *[CPG]* When READNS (Readiness) annunciator and the READY lamp both illuminate, power-up sequence is complete. You may now start using the periscope.
20. *[CPG]* If operating in freezing temperatures, set Aiming Sight Heating (B12) Switch – ON (UP). Otherwise, leave to OFF.
21. *[CPG]* Select desired missile station. When a valid station is selected, the LNCHR OFF lamp extinguishes and the MSL ON LNCHR illuminates.





2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE

2.6.2 – Missile Operation with Petrovich AI as Pilot-Commander

22. *[CPG]* Release Controls using "C", then show the Petrovich Menu by using « LCTRL+V ». This command will display a horizontal situation indicator that can be used to give commands to Petrovich (acting as Pilot-Commander).
23. *[CPG]* If CBTM AI Mode is selected, select FLT (Flight) AI Mode with « A » Short. Otherwise, leave AI Mode to FLT.
24. *[CPG]* Set desired Airspeed by using « W » SHORT (Increase) or « S » SHORT (Decrease).
25. *[CPG]* Set desired Entry Altitude by using « W » LONG (Increase) or « S » LONG (Decrease).
26. *[CPG]* Press « D » SHORT to display a Designation Reticle. Move reticle using head tracking over the target area, then press « D » SHORT a second time to designate. Petrovich will then steer helicopter towards the target.
    - Alternatively, you can set desired heading using « A » LONG (Heading Bug Left) or « D » LONG (Heading Bug Right).

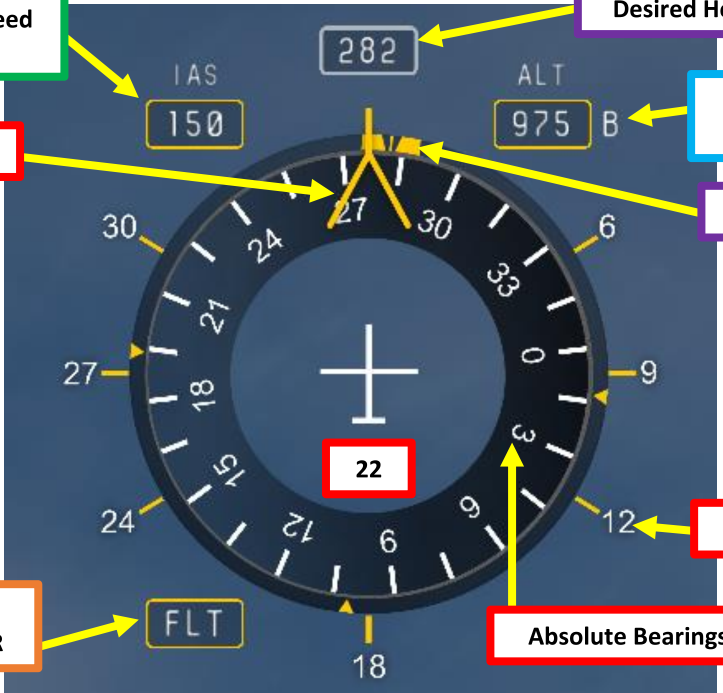
FLT Mode

- **UP (W) SHORT**: **Increases** desired **speed** in the IAS window. After a short delay, Petrovich will accelerate the helicopter to the new speed.
- **UP (W) LONG**: **Increases** the desired **altitude** in the ALT window. After button is released, Petrovich will increase the helicopter's altitude.

- **LEFT (A) SHORT**: Changes AI Menu mode to CMBT (Combat).
- **LEFT (A) LONG**: Moves desired **heading** bug **left**. After button is released, commands Petrovich to turn the helicopter to the new heading.

- **RIGHT (D) SHORT**: Activates **head-tracking steering**. A reticle will be displayed in the center of the screen. You can then look in the direction you wish Petrovich to fly, then press Right (D) Short again.
- **RIGHT (D) LONG**: Moves desired **heading** bug **right**. After button is released, commands Petrovich to turn the helicopter to the new heading.

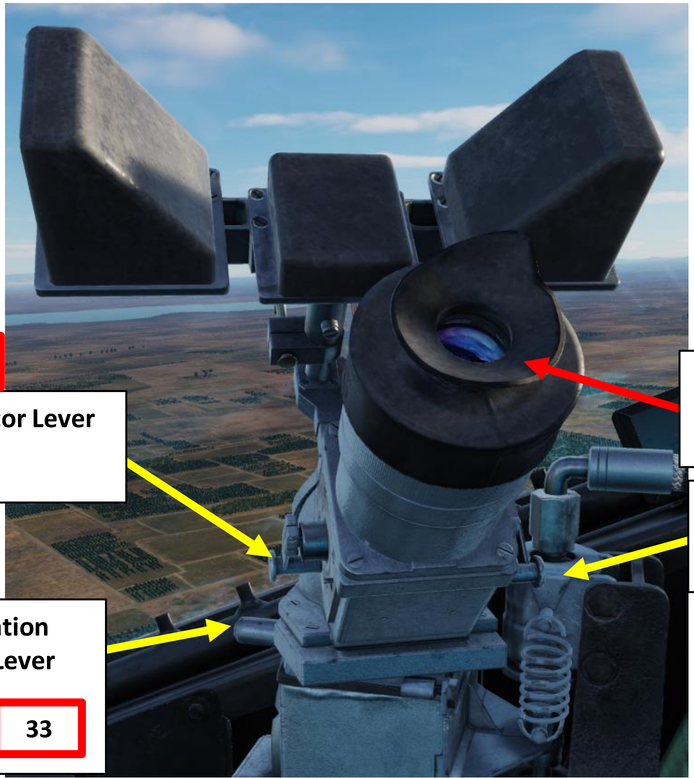
- **DOWN (S) SHORT**: **Decreases** desired **speed** in the IAS window. After a short delay, Petrovich will accelerate the helicopter to the new speed. HVR (Hover) mode is activated if speed decreases below 50 km/h.
- **DOWN (S) LONG**: **Decreases** the desired **altitude** int he ALT window. After button is released, Petrovich will decrease the helicopter's altitude.



26b
Target Designated, Course Set

2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE
2.6.2 – Missile Operation with Petrovich AI as Pilot-Commander

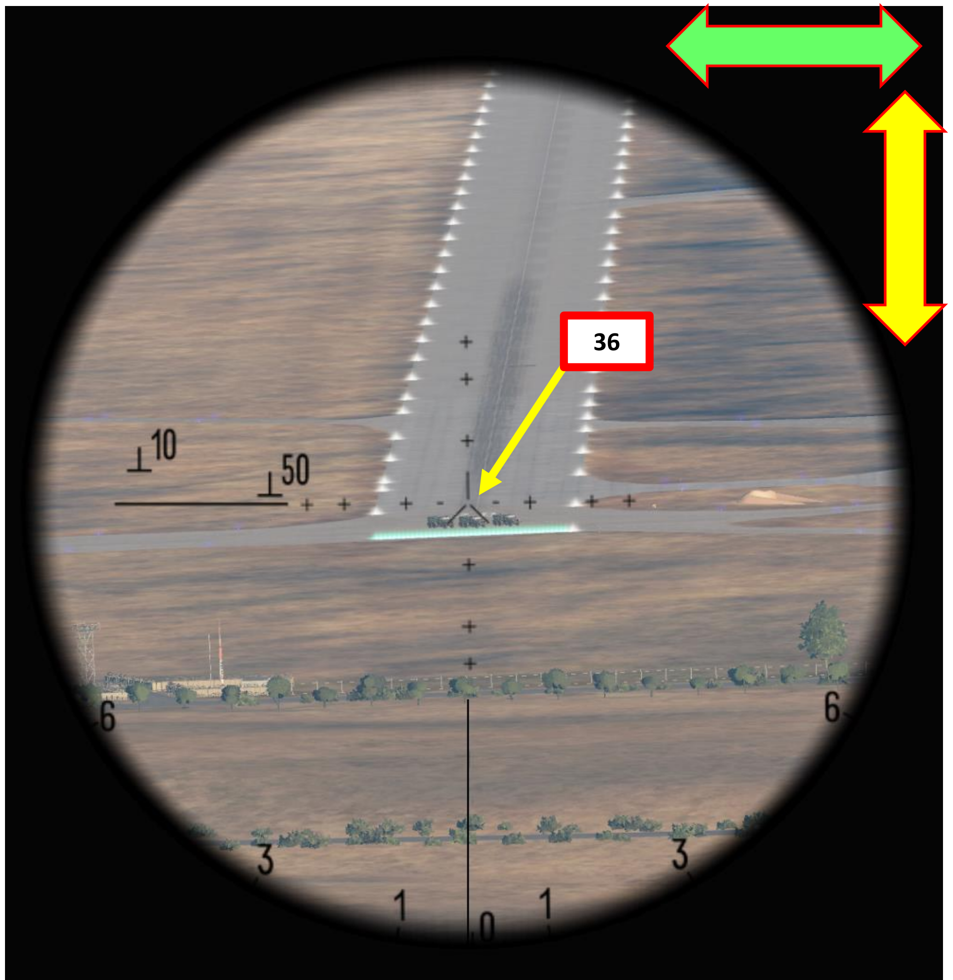
27. *[CPG]* Once Petrovich AI is flying the helicopter towards the target, we can now designate the target properly using the periscope.
28. *[CPG]* Set OBSERVE (B2) Switch – ON (UP).
29. *[CPG]* The periscope protective doors open and the aiming sight remains caged in boresight (centered) position for a delay of 10 seconds. After 10 seconds, the periscope is uncaged and the sight can be moved by the guidance unit handles.
30. *[CPG]* Lean on the Aiming Sight by using « LALT+A » (9K113 Aiming Profile ON/OFF).
31. *[CPG]* Hide/Show sight tooltips using « LWIN+H ».
32. *[CPG]* Hide/Show simulated Steering Helper (red arrow) using « LALT+S ». As a personal preference, I leave it off since it doesn't exist in the real helicopter.
33. *[CPG]* Select desired magnification ratio (zoom) by using « LCTRL+X ».
34. *[CPG]* Apply Orange Filter (RALT+O) or Laser Protection Green Filter (RALT+G) if desired. I typically don't use them if operating in good weather conditions.

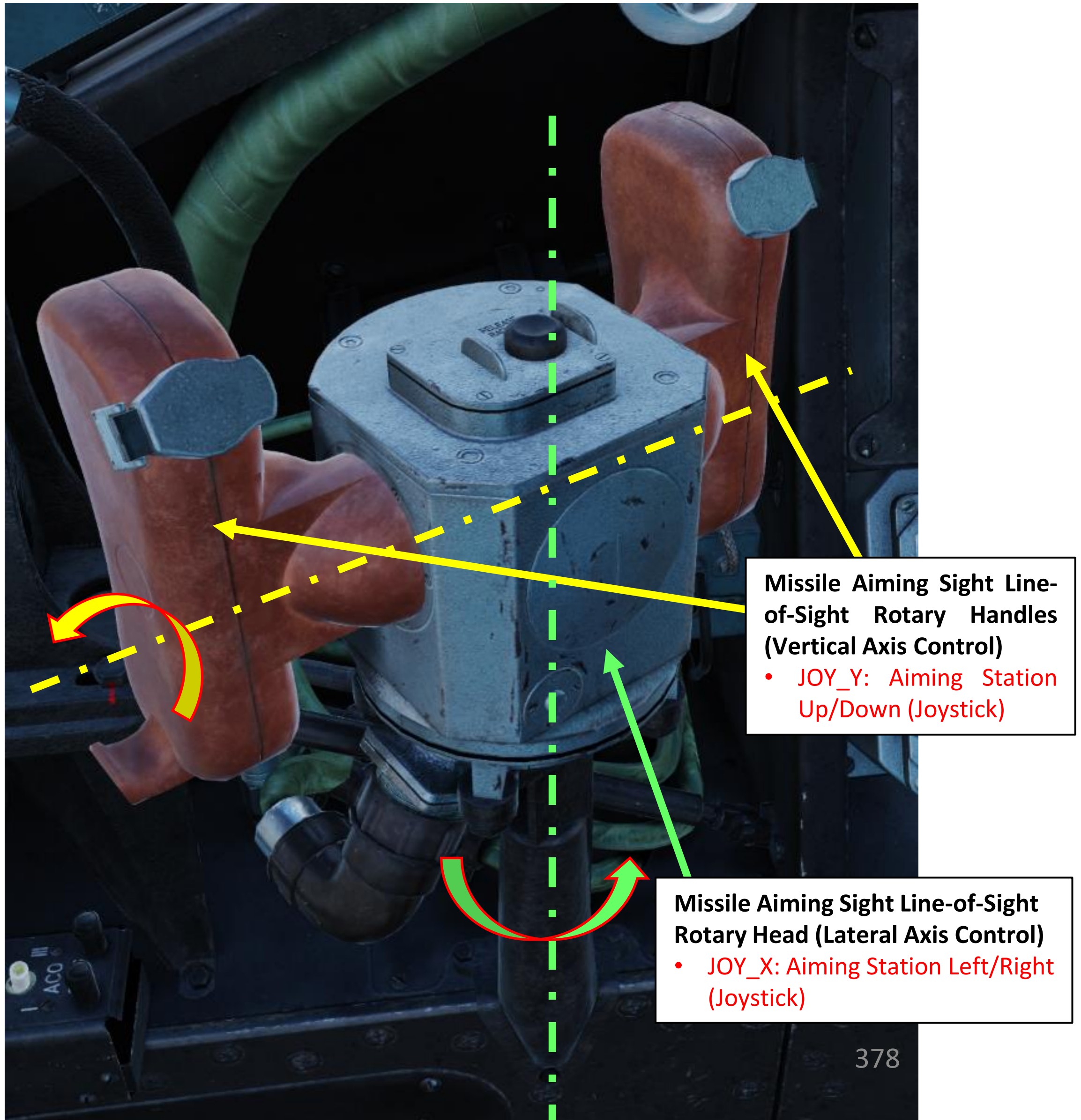


2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE

2.6.2 – Missile Operation with Petrovich AI as Pilot-Commander

35. *[CPG]* To move the periscope's aiming sight laterally, use the Aiming Station Rotary Head (Aiming Station Left/Right axis). To move the periscope's aiming sight vertically, use the Aiming Station Rotary Handles (Aiming Station Up/Down axis). Position of rotary head and handles induce angular speed (not angular position). You can use either a joystick binding or the mouse. Personally, I prefer the joystick over the mouse since most joysticks spring back to the center position when released, which is closer to how the controls work in the real helicopter.
36. *[CPG]* Keep the aiming reticle on the target.





2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE

2.6.2 – Missile Operation with Petrovich AI as Pilot-Commander

37. *[CPG]* Select CBTM (Combat Manoeuvers) AI Mode with « A » Short.
38. *[CPG]* Press “W” SHORT to command Petrovich to turn the helicopter to the current targeting periscope bearing. While the helicopter is flying horizontally, keep in mind that the missile may not be within valid launch parameters yet since the Pilot-Commander still needs to line up the inner ring of the Fixed Reticle with the Floating Reticle (periscope line-of-sight).
39. *[CPG]* Press “W” LONG to command Petrovich to begin the missile attack run. Petrovich will manoeuver the helicopter to achieve launch approval from the missile guidance system and hold these parameters until maximum airspeed is reached, at which point it will return to horizontal flight. It is recommended to set up your attack runs from realistic starting points. Attack runs ordered from excessive altitudes will result in Petrovich aborting the attack due to airspeed limitations, i.e. before the missile can reach its target.

- **UP (W) SHORT**: Commands Petrovich to **turn** the helicopter to the **current targeting periscope bearing**. This is useful for beginning attack runs.
- **UP (W) LONG**: Commands Petrovich to begin **missile attack run**. Petrovich will manoeuver the helicopter to achieve launch approval from the missile guidance system and hold these parameters until maximum airspeed is reached, at which point it will return to horizontal flight.

CBTM Mode

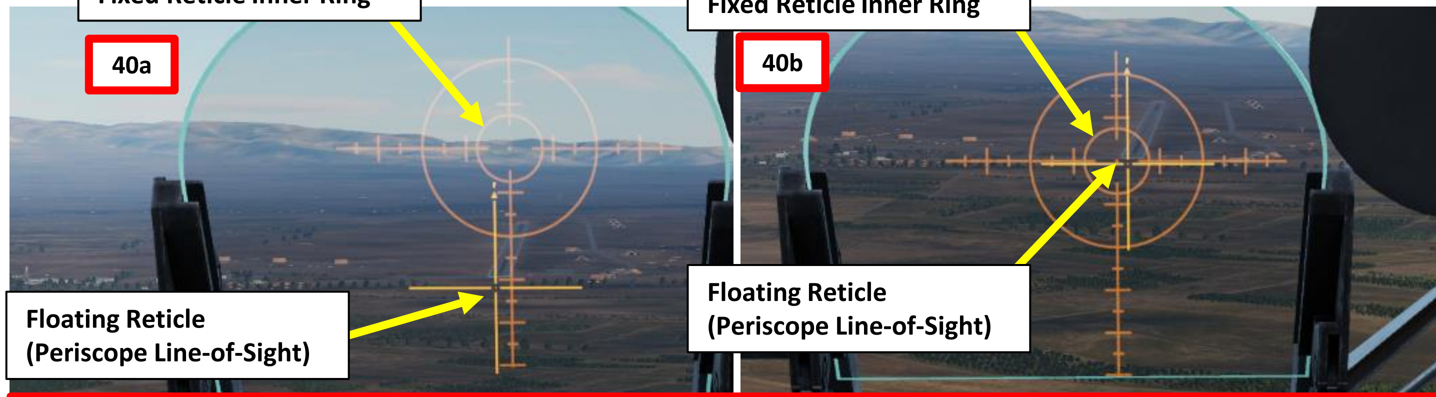
- **LEFT (A) SHORT**: Changes AI Menu mode to FLT (Flight) or HVR (Hover) depending on airspeed.
- **LEFT (A) LONG**: No Function.

- **RIGHT (D) SHORT**: No Function.
- **RIGHT (D) LONG**: No Function.

- **DOWN (S) SHORT**: No Function
- **DOWN (S) LONG**: Commands Petrovich to perform a 180 deg combat evasion turn. Intended to be used following an attack run. Turn off the targeting gyros (OBSERVE B2 switch DOWN) switch for a faster turn.

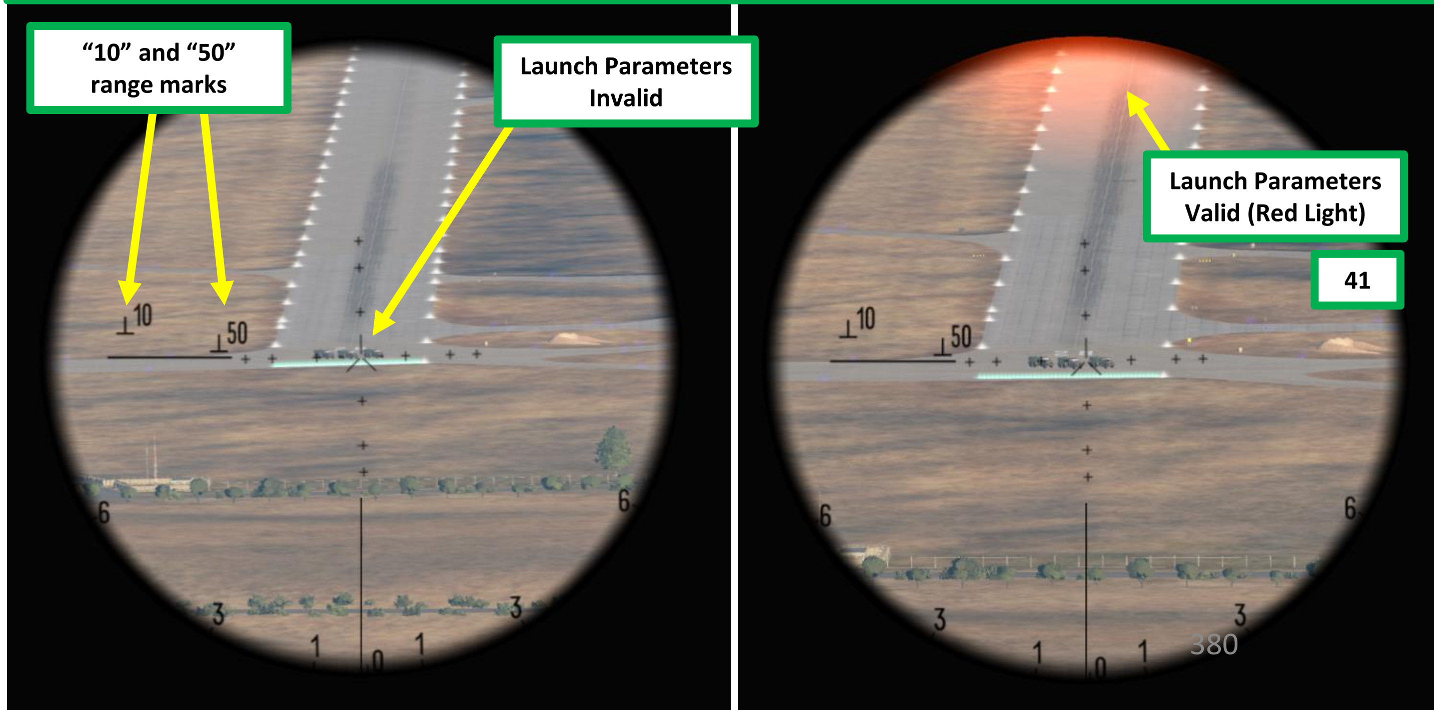
2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE
2.6.2 – Missile Operation with Petrovich AI as Pilot-Commander

40. *[PC]* When Petrovich begins his attack run, he will fly the helicopter to line up the inner ring of the Fixed Reticle with the Floating Reticle (periscope line-of-sight).
41. *[CPG]* Keep the aiming reticle on the target and estimate range to target using the « 10 » (1000 m) and « 50 » (5000 m) reference marks (a target height of 2.5 m should fit within the marks to indicate the range). When a valid firing solution is available, a red light illuminates at the top of the aiming sight, a continuous high pitch beep is audible through the headphones of both crew members, and the « LAUNCH APPRVL » (Launch Approval) lamp also illuminates.
42. *[CPG]* When a valid firing solution is obtained and target is less than 5 km away, you are now ready to fire the missile.



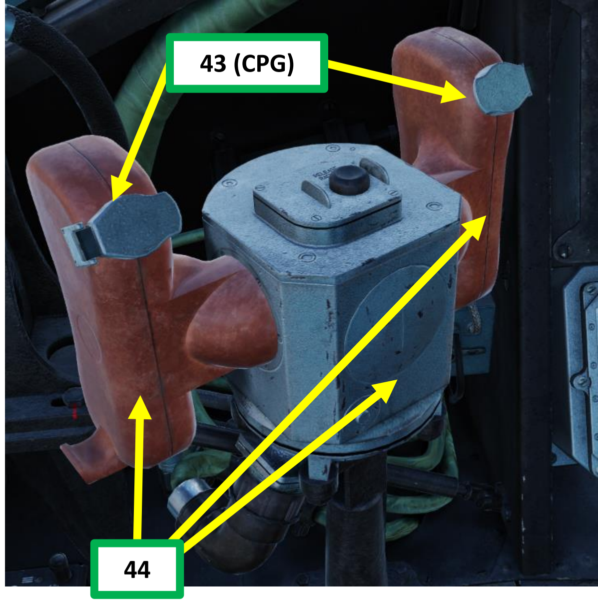
Petrovich (Pilot-Commander) View

Co-Pilot/Gunner View



2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE
2.6.2 – Missile Operation with Petrovich AI as Pilot-Commander

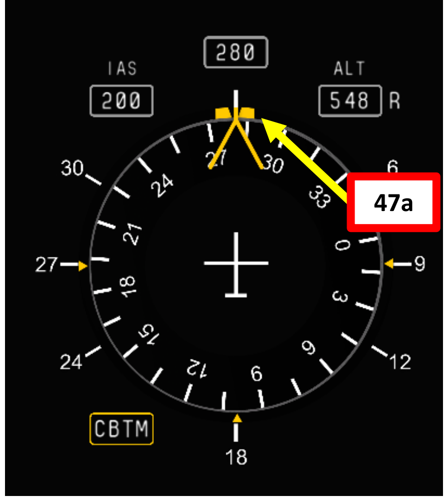
43. *[CPG]* Press and hold the « Fire ATG Missile» buttons on the Rotary Handles (RCTRL+SPACE) to launch missile.
44. *[CPG]* Using the Rotary Head (lateral axis) and Rotary Handle (vertical axis) guidance controls, keep the aiming reticle on the target as the missile is steered toward the periscope's line-of-sight by the guidance unit radio until impact.
45. *[PC]* Petrovich will maintain Fixed Reticle and Floating Reticles lined up while the missile heads towards the target.

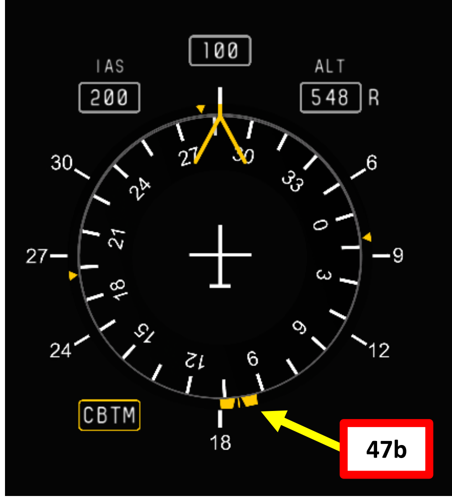


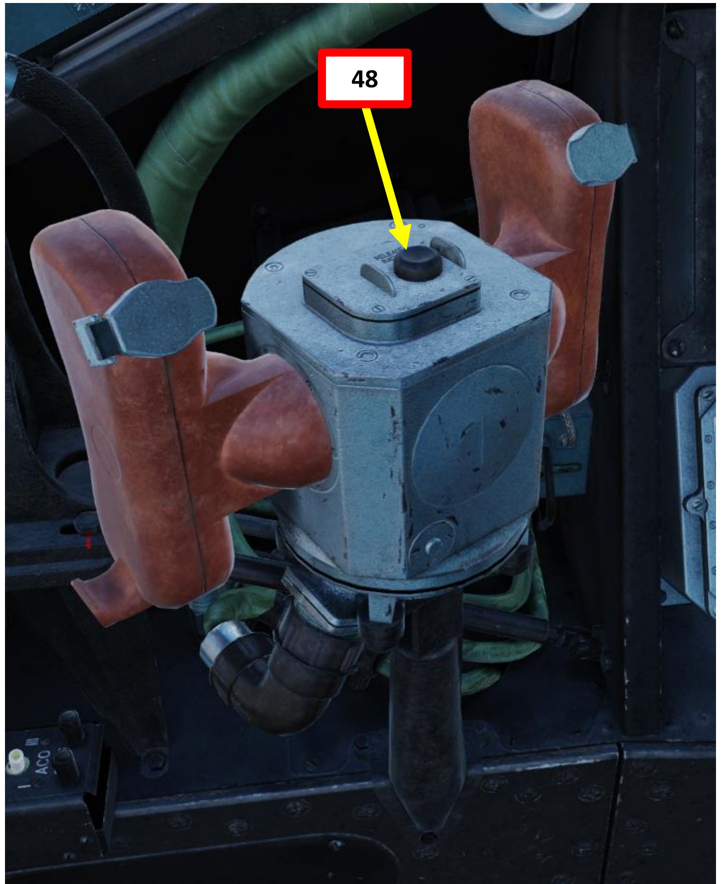
2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE

2.6.2 – Missile Operation with Petrovich AI as Pilot-Commander

46. *[CPG]* After missile impact, exit the Aiming Sight by using « LALT+A » (9K113 Aiming Profile ON/OFF) and set the OBSERVE (B2) switch to OFF (DOWN) to close the protective doors, boresight the periscope, and cage the gimbals.
47. *[CPG]* Press "S" LONG to command Petrovich to perform a 180 deg combat evasion turn.
48. *[CPG]* Press Radiation Reset button on the guidance unit (LALT+R). This will reset the guidance command radio for the next missile.
49. *[CPG]* Select next missile station for subsequent attacks.



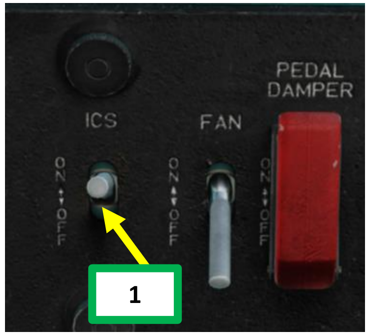


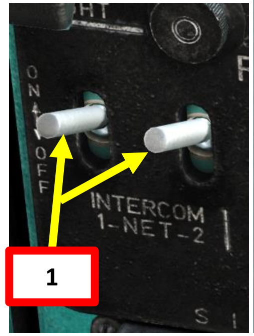


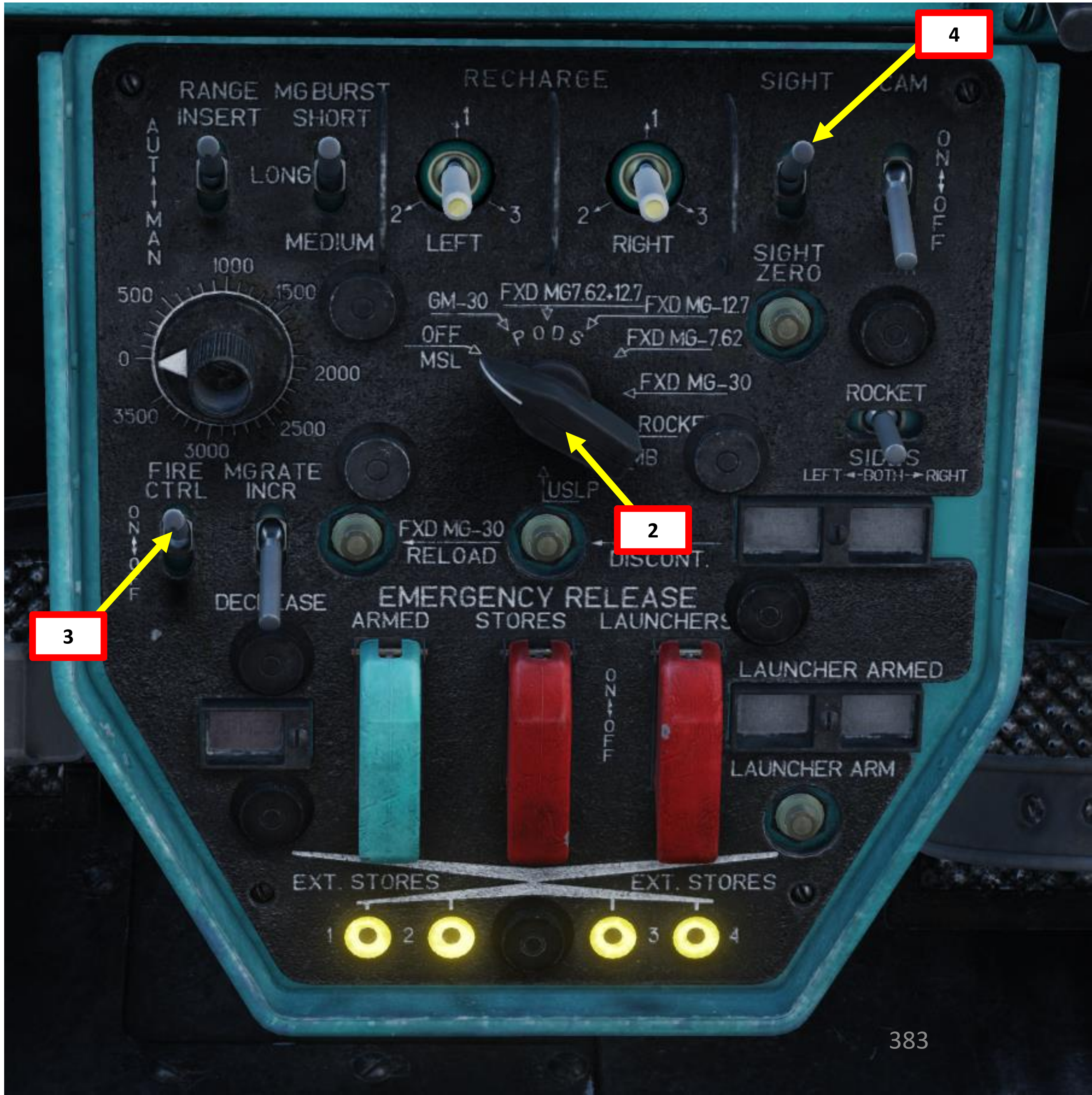
2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE
2.6.3 – Missile Operation with Multicrew

- *Steps preceded by [PC] are performed by the Pilot-Commander.*
- *Steps preceded by [CPG] are performed by the Co-Pilot Gunner (or the Petrovich AI if no player is manning the operator station).*

1. *[PC][CPG]* Verify that SPU-8 Intercom (ICS) Power Switches are ON (UP) and that ICS/Radio Selectors are set to UP (ICS) for both the Pilot-Commander and the Co-Pilot/Gunner cockpits.
2. *[PC]* Set Weapon Selector to desired OFF/MSL position
3. *[PC]* Set Fire Control Switch – ON (UP).
4. *[PC]* Set ASP-17VP Sight Power Switch – ON (UP).
5. *[PC]* Set Auxiliary Stores Light Switch – ON (UP).

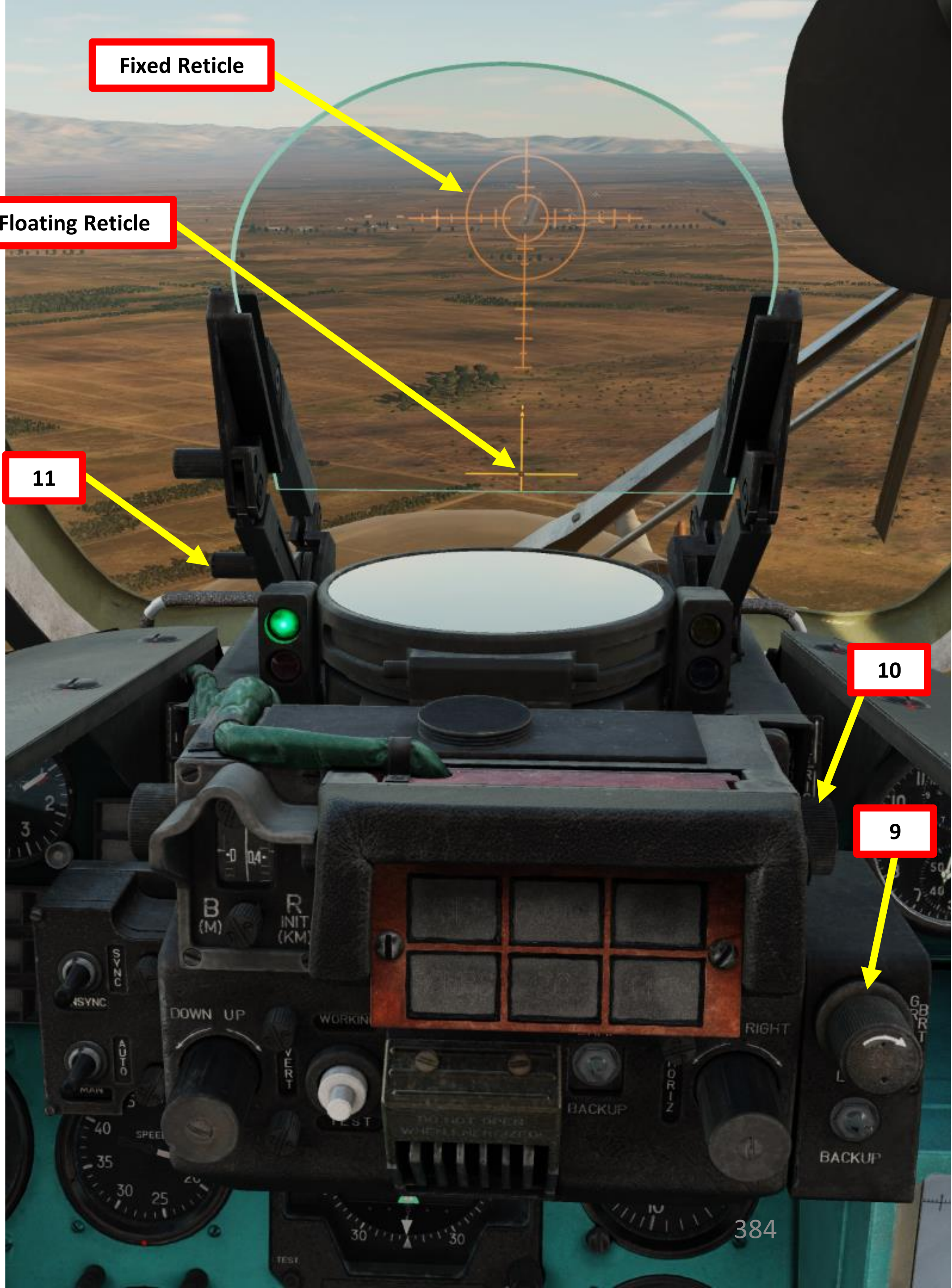






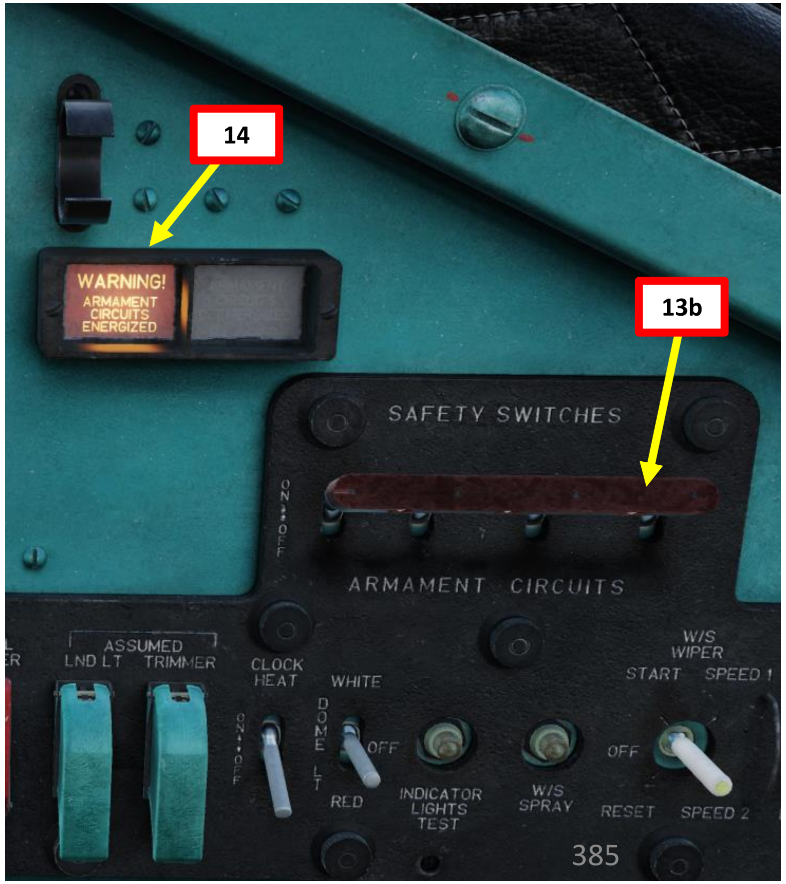
2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE
2.6.3 – Missile Operation with Multicrew

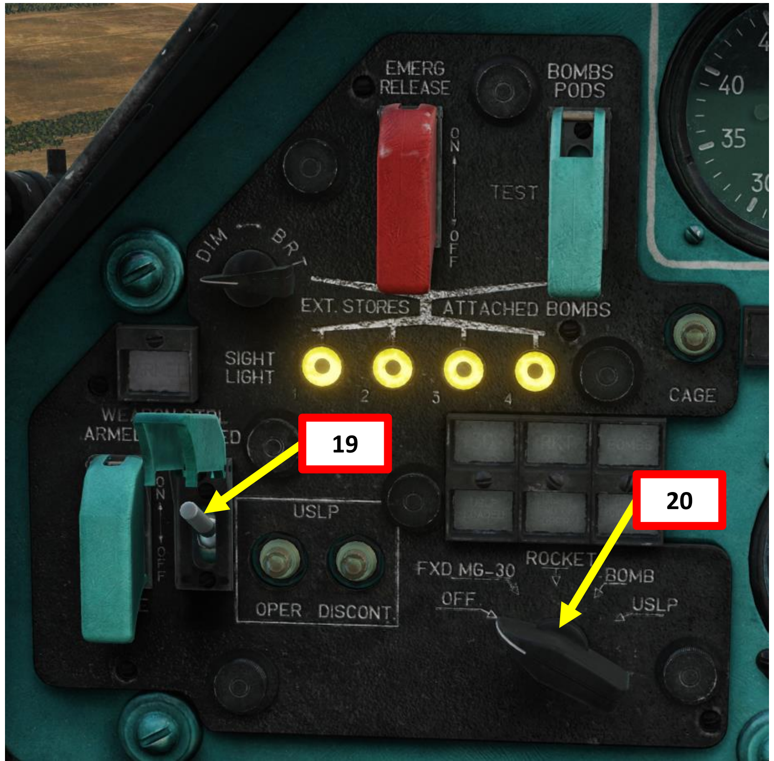
6. *[PC]* Confirm selection of missiles by checking the Armament Selection Lights, which should not display anything (all lights OFF). Coordinate with Co-Pilot since this step should be done once weapon systems are powered up.
7. *[PC]* Set Sight Synchronization Mode Selector – SYNC (UP).
8. *[PC]* Set Sight Mode Selector – AUTOMATIC (UP).
9. *[PC]* Adjust Sight Fixed Reticle (Net) Brightness Control Knob to make the Fixed Reticle dim enough to see the Floating Reticle properly.
10. *[PC]* Adjust Sight Floating Reticle Brightness Control Knob as required.
11. *[PC]* Adjust Sight Reflector Glass as desired using the Sight Reflector Glass Control Lever.
    - Lever UP: Sight Unlocked / Lever DOWN: Sight Locked
    - When lever is unlocked (UP), scroll mousewheel to adjust reflector glass position as desired

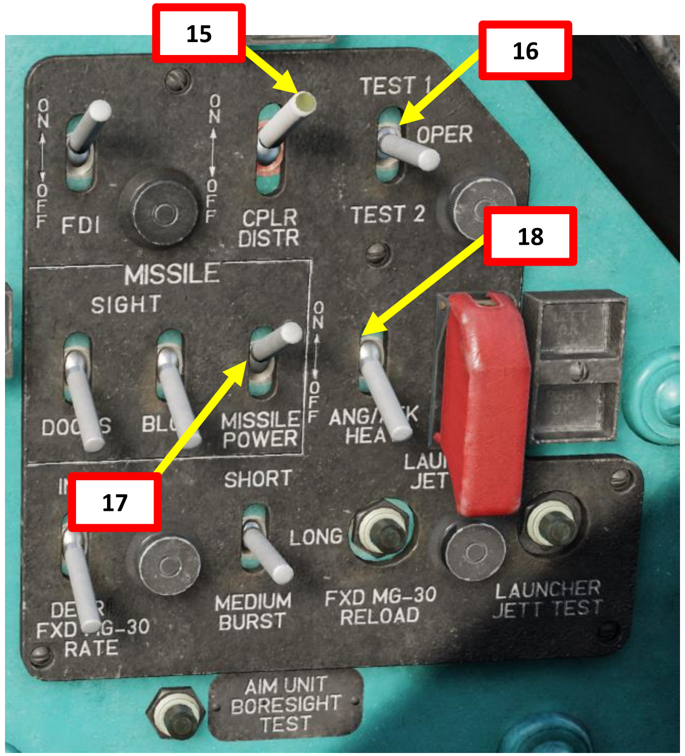


2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE
2.6.3 – Missile Operation with Multicrew

12. *[CPG]* Make sure engines are running, generator power is available and gyros are powered. The pilot-commander should give you that information.
13. *[CPG]* Set Armament Circuit Breakers – ON (UP)
14. *[CPG]* Confirm Armament Circuit Breakers are energized.
15. *[CPG]* Set USR-24M (CPLR DISTR) Switch – ON (UP)
16. *[CPG]* Set USR-24M Mode Switch - OPER
17. *[CPG]* Set Missile Power Switch – ON (UP)
18. *[CPG]* Set DUAS (Air Data Probe) Heating Switch – As Required.
    - ON/UP if temperature is below 5 deg C
    - DOWN/OFF if temperature is above 5 deg C.
19. *[CPG]* Set Pilot/CPG Weapon Selection Control Handover Switch – UP (Co-Pilot/Gunner has Weapon Selection Control).
20. *[CPG]* Set Weapon Selector – OFF/MSL.

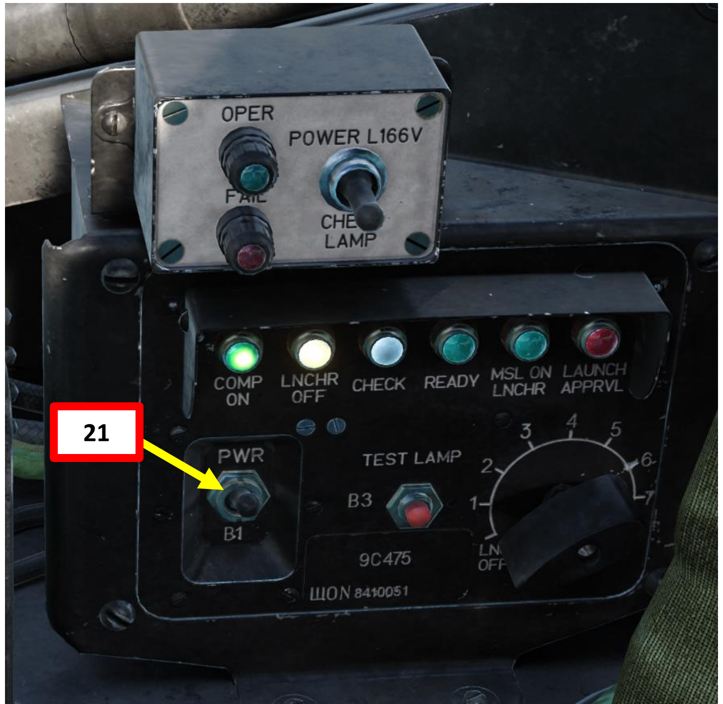


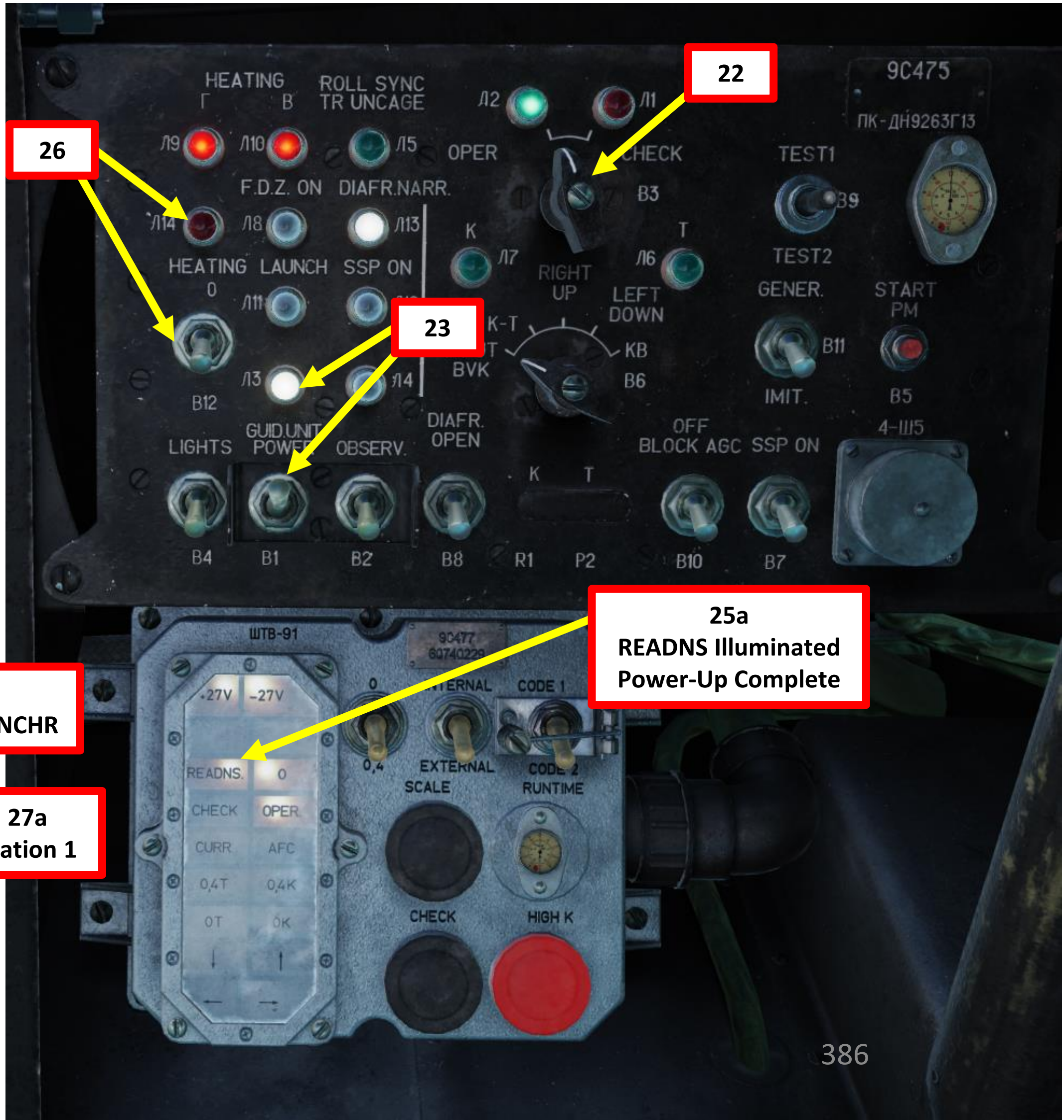




2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE
2.6.3 – Missile Operation with Multicrew

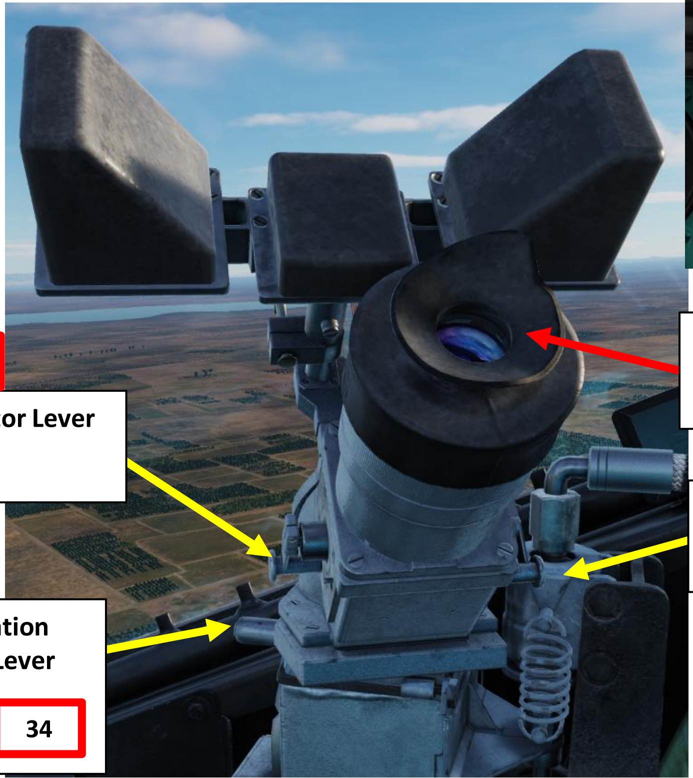
21. *[CPG]* Set Missile B1 Power Switch – ON (UP)
22. *[CPG]* Set Aiming Sight Mode – OPER.
23. *[CPG]* Set Guidance Unit Power (B1) Switch – ON (UP). Confirm that « L3 » lamp illuminates.
24. *[CPG]* Power-up sequence of the Guidance Unit takes approximately 3 minutes.
25. *[CPG]* When READNS (Readiness) annunciator and the READY lamp both illuminate, power-up sequence is complete. You may now start using the periscope.
26. *[CPG]* If operating in freezing temperatures, set Aiming Sight Heating (B12) Switch – ON (UP). Otherwise, leave to OFF.
27. *[CPG]* Select desired missile station. When a valid station is selected, the LNCHR OFF lamp extinguishes and the MSL ON LNCHR illuminates.





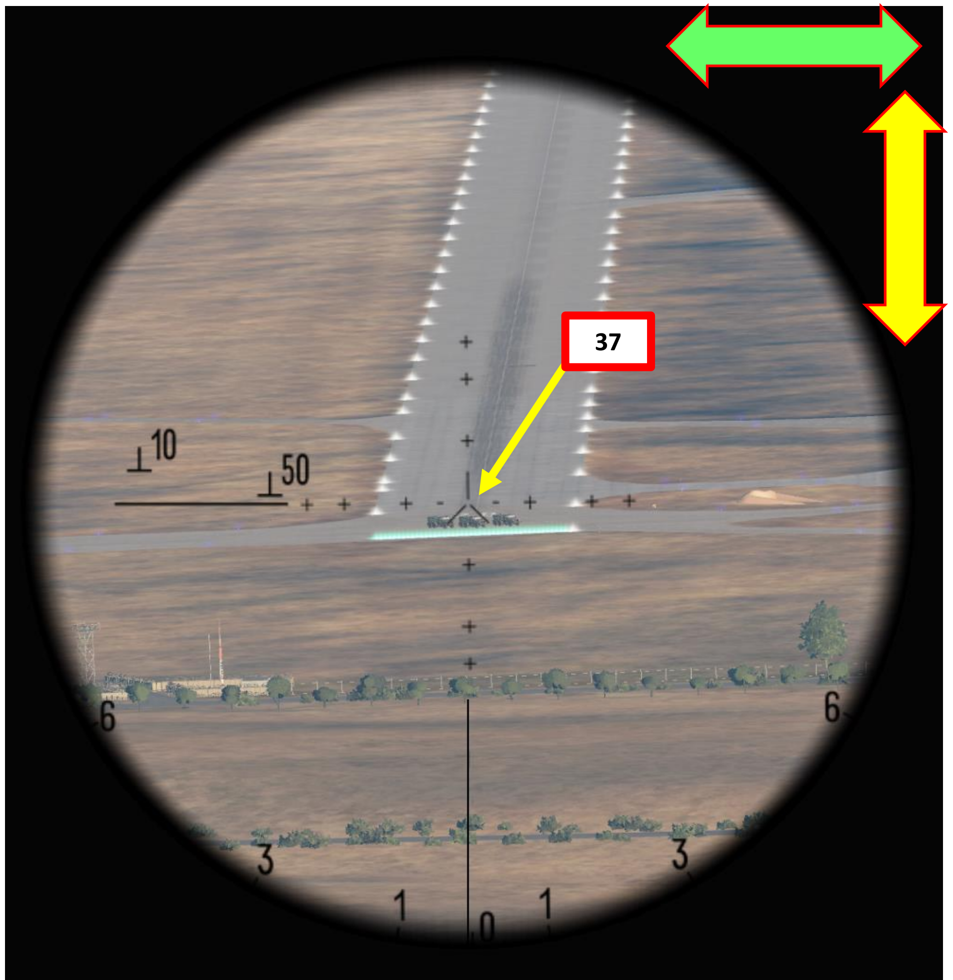
2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE
2.6.3 – Missile Operation with Multicrew

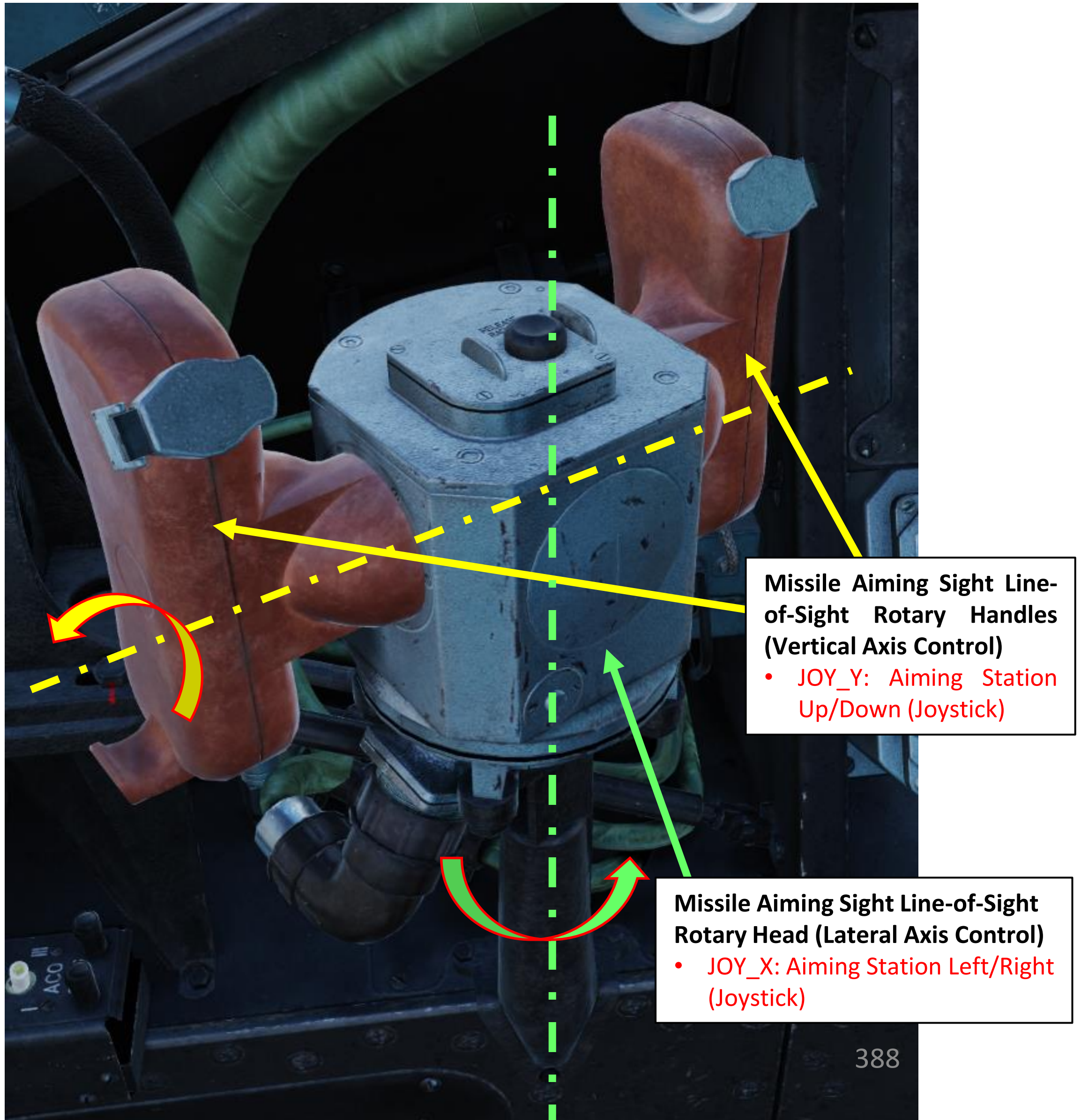
28. *[PC]* Fly towards the target and ensure the helicopter attitude remains stable. Call out "Open Periscope Doors" to the Co-Pilot/Gunner when ready.
29. *[CPG]* Set OBSERVE (B2) Switch – ON (UP).
30. *[CPG]* The periscope protective doors open and the aiming sight remains caged in boresight (centered) position for a delay of 10 seconds. After 10 seconds, the periscope is uncaged and the sight can be moved by the guidance unit handles.
31. *[CPG]* Lean on the Aiming Sight by using « LALT+A » (9K113 Aiming Profile ON/OFF).
32. *[CPG]* Hide/Show sight tooltips using « LWIN+H ».
33. *[CPG]* Hide/Show simulated Steering Helper (red arrow) using « LALT+S ». As a personal preference, I leave it off since it doesn't exist in the real helicopter.
34. *[CPG]* Select desired magnification ratio (zoom) by using « LCTRL+X ».
35. *[CPG]* Apply Orange Filter (RALT+O) or Laser Protection Green Filter (RALT+G) if desired. I typically don't use them if operating in good weather conditions.



2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE
2.6.3 – Missile Operation with Multicrew

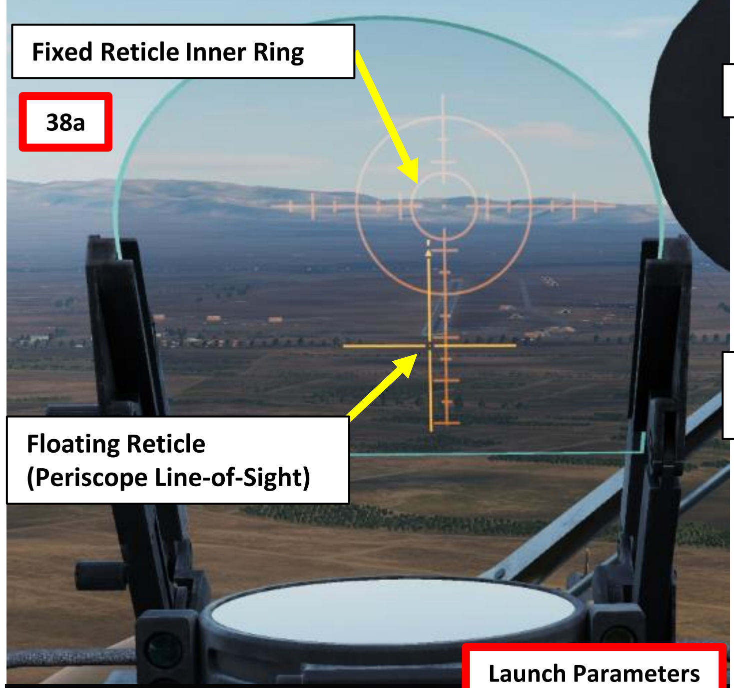
36. *[CPG]* To move the periscope's aiming sight laterally, use the Aiming Station Rotary Head (Aiming Station Left/Right axis). To move the periscope's aiming sight vertically, use the Aiming Station Rotary Handles (Aiming Station Up/Down axis). Position of rotary head and handles induce angular speed (not angular position). You can use either a joystick binding or the mouse. Personally, I prefer the joystick over the mouse since most joysticks spring back to the center position when released, which is closer to how the controls work in the real helicopter.
37. *[CPG]* Keep the aiming reticle on the target, then call out « Target Acquired » to the Pilot-Commander.

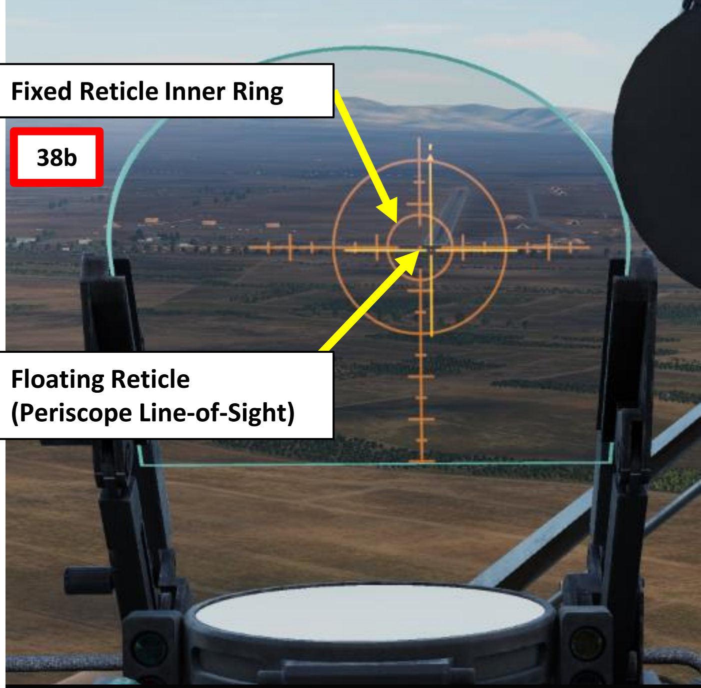


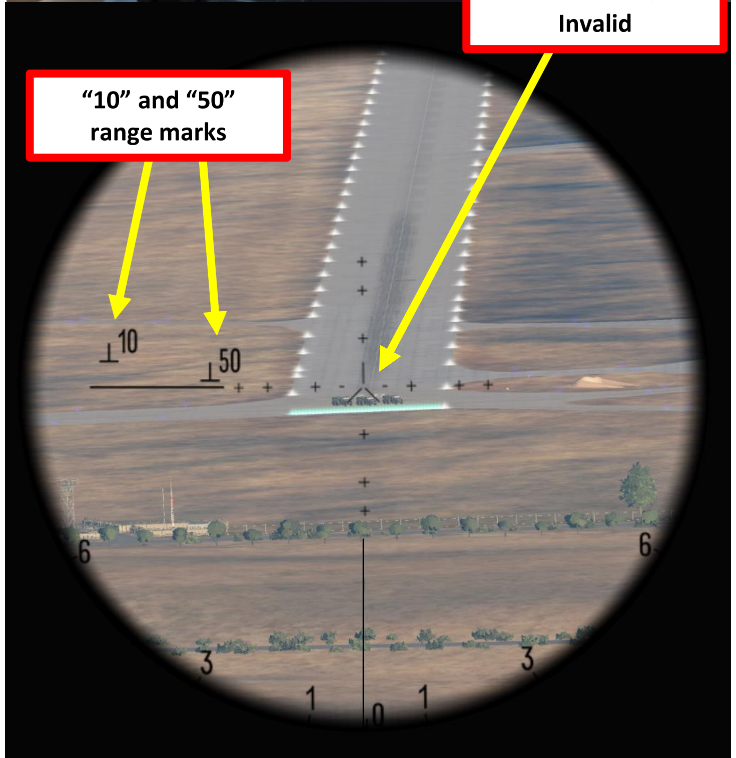


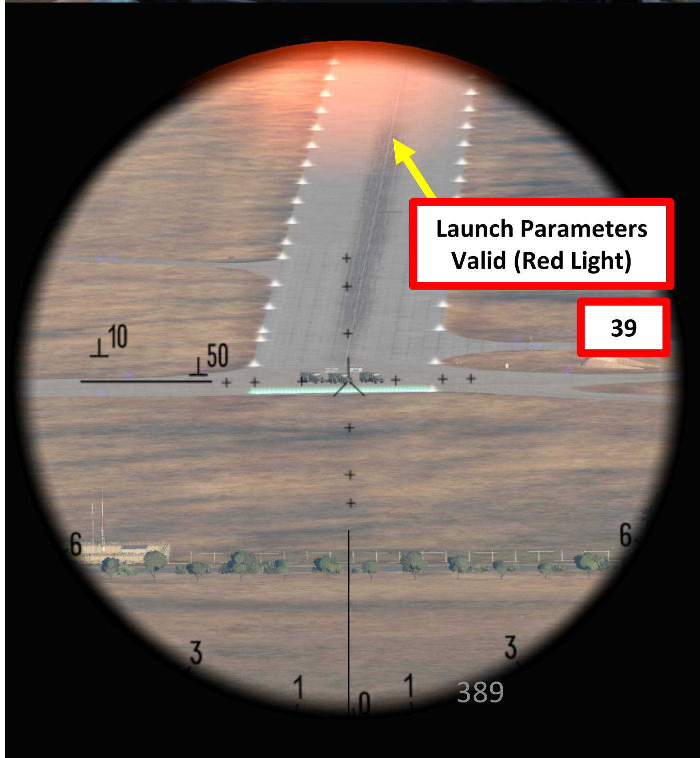
2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE
2.6.3 – Missile Operation with Multicrew

38. *[PC]* Fly helicopter to line up the inner ring of the Fixed Reticle with the Floating Reticle (periscope line-of-sight).
39. *[CPG]* Keep the aiming reticle on the target and estimate range to target using the « 10 » (1000 m) and « 50 » (5000 m) reference marks (a target height of 2.5 m should fit within the marks to indicate the range). When a valid firing solution is available, a red light illuminates at the top of the aiming sight, a continuous high pitch beep is audible through the headphones of both crew members, and the « LAUNCH APPRVL » (Launch Approval) lamp also illuminates.
40. *[CPG]* When a valid firing solution is obtained and target is less than 5 km away, call out « Target In Range » so the pilot knows missile launch is imminent.



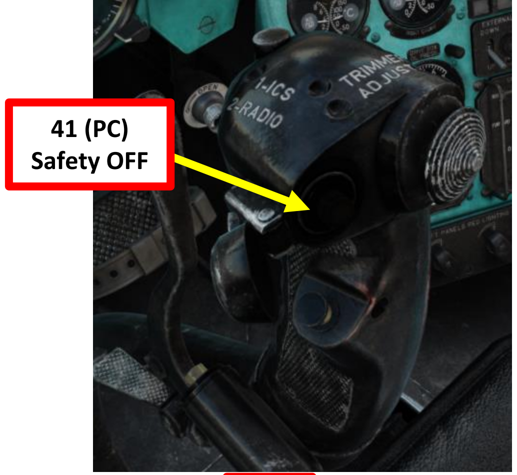


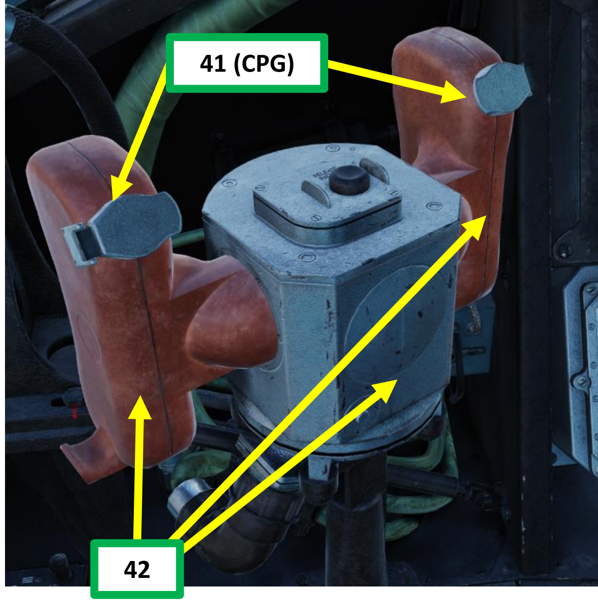


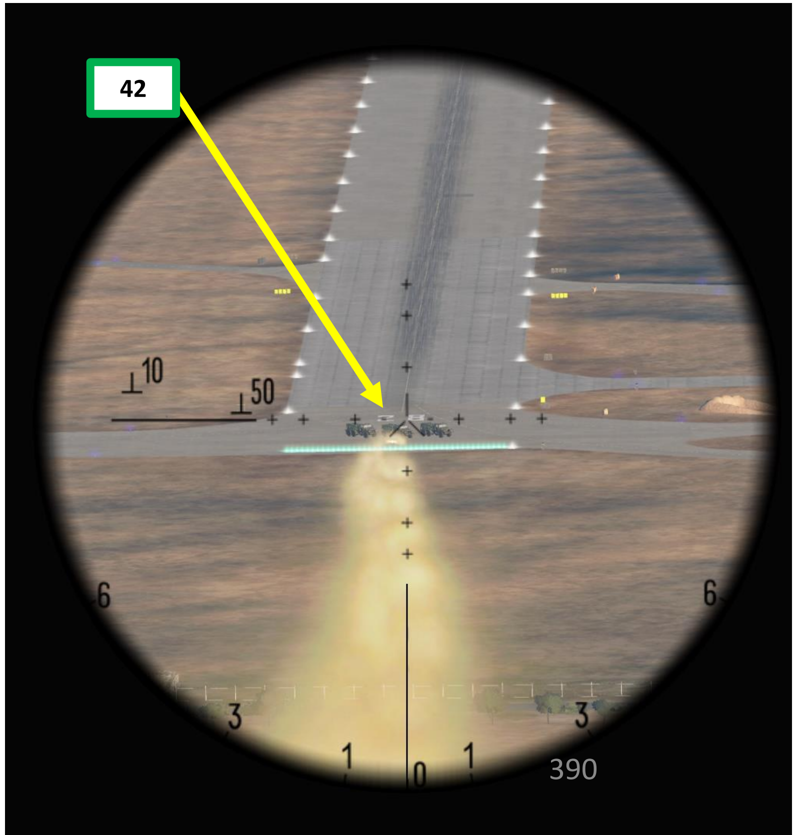


2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE
2.6.3 – Missile Operation with Multicrew

41. [PC][CPG] Fire Missile. This can be performed by either the Pilot-Commander or the Co-Pilot/Gunner.
    - [PC] Flip the weapon safety on the cyclic, then press and hold the « Weapon Release » (RALT + SPACE) button to launch missile.
    - [CPG] Press and hold the « Fire ATG Missile» buttons on the Rotary Handles (RCTRL+SPACE) to launch missile.
42. [CPG] Using the Rotary Head (lateral axis) and Rotary Handle (vertical axis) guidance controls, keep the aiming reticle on the target as the missile is steered toward the periscope's line-of-sight by the guidance unit radio until impact.
43. [PC] Maintain Fixed Reticle and Floating Reticles lined up while the missile heads towards the target, and deploy countermeasures during the attack run; this is a phase where the helicopter is most vulnerable since the pilot has to fly relatively straight to help the Co-Pilot/Gunner minimize the amount of correction required to keep a steady aim.

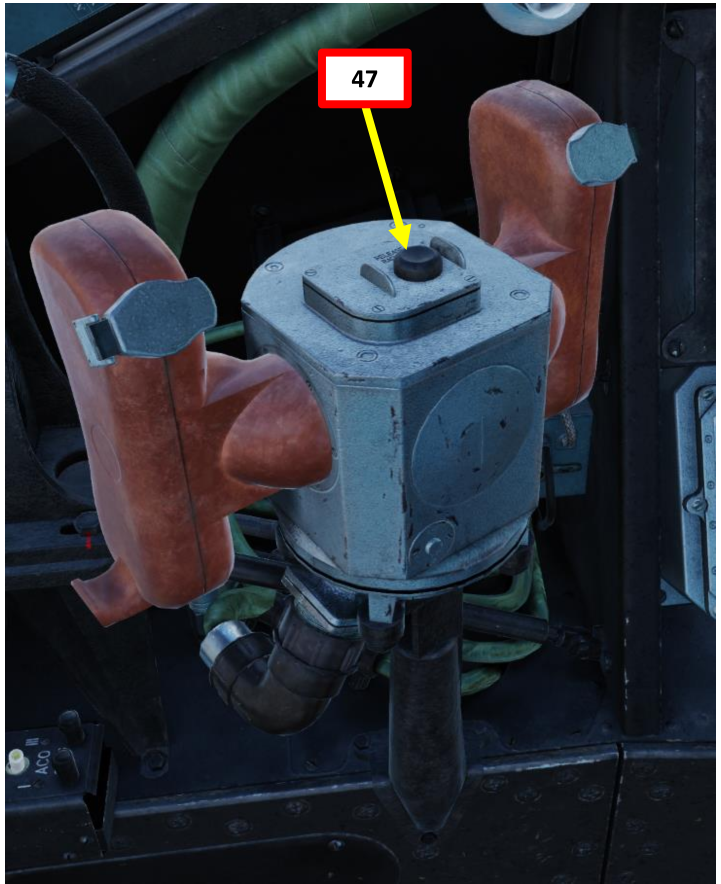






2.6 – 9M114 SHTURM (AT-6 SPIRAL) MISSILE
2.6.3 – Missile Operation with Multicrew

44. [CPG] After missile impact, exit the Aiming Sight by using « LALT+A » (9K113 Aiming Profile ON/OFF) and set the OBSERVE (B2) switch to OFF (DOWN) to close the protective doors, boresight the periscope, and cage the gimbals.
45. [CPG] Call out “Periscope Doors Closed” to the Pilot-Commander to let him know that he can start evasive manoeuvers without risking damaging the periscope gimbals.
46. [PC] Avoid flying directly over the target. Break off from the target once the attack is complete, preferably to the left since visibility is better and the rotor torque makes left turns easier.
47. [CPG] Press Radiation Reset button on the guidance unit (LALT+R). This will reset the guidance command radio for the next missile.
48. [CPG] Select next missile station for subsequent attacks.



2.7 – 9M120 ATAKA (AT-9 SPIRAL-2) MISSILE

2.7 – 9M120 ATAKA (AT-9 SPIRAL-2) MISSILE

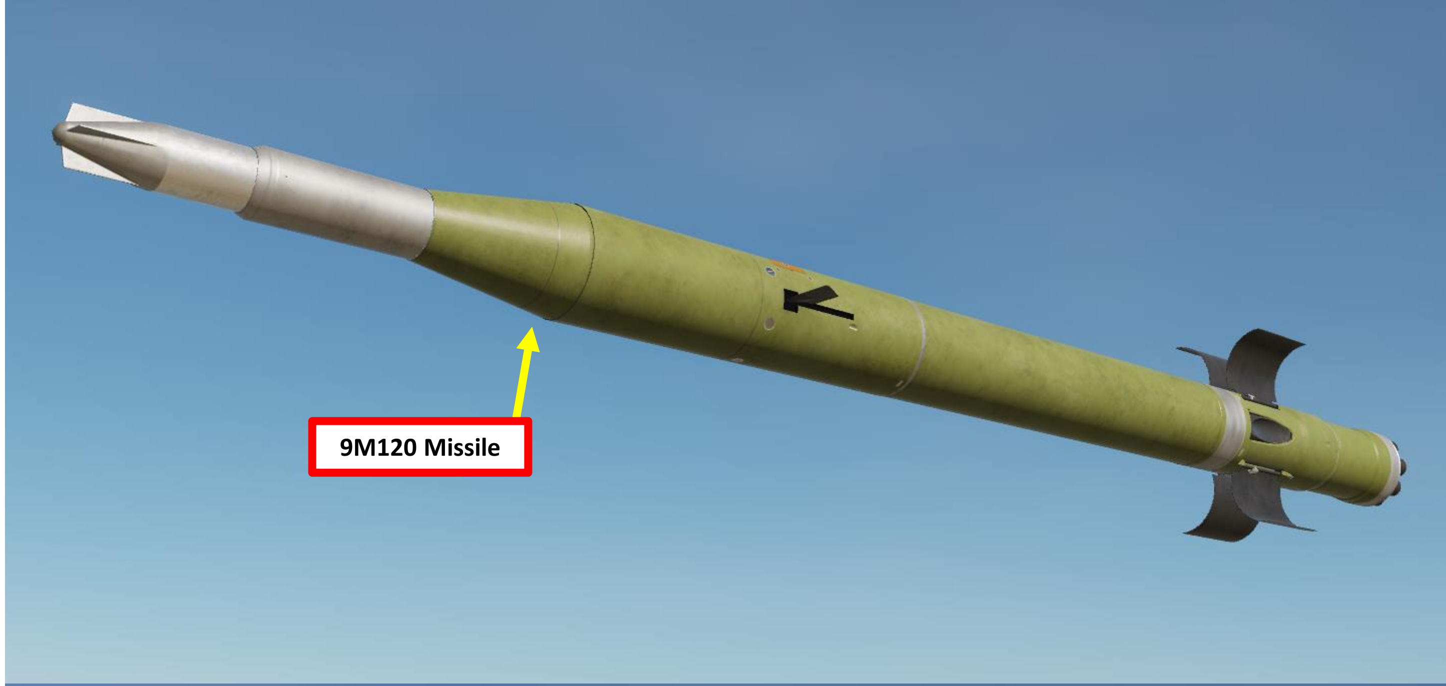
2.7.1 – Missile Types

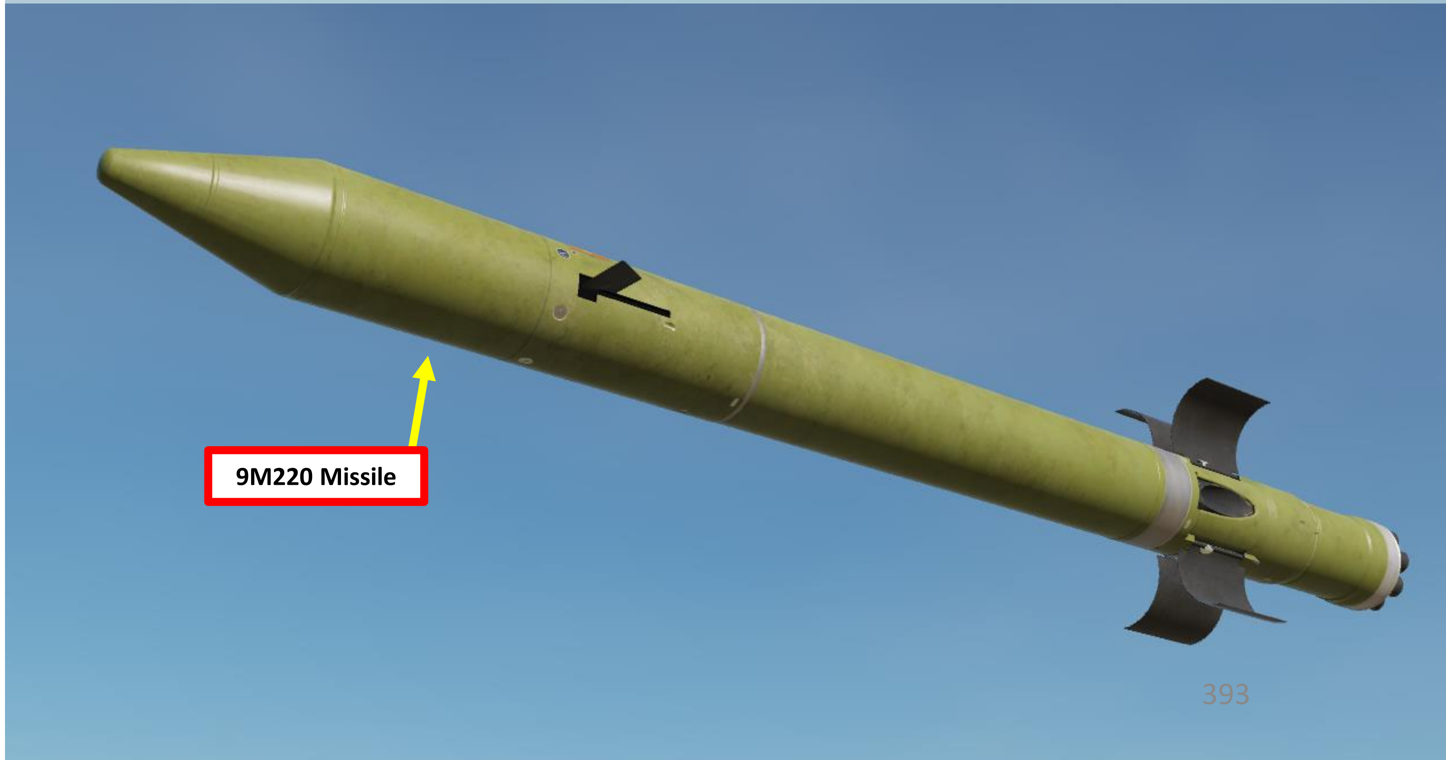
The 9M120 Ataka missile (designated "AT-9 Spiral-2 by the Russians) is stored in a glass reinforced plastic tube, which also acts as its launcher. The missile is reported to be considerably faster than the 9M114 Shturm, with longer range than the original version. It still uses radio command guidance, but the system has been improved when compared to the earlier 9M114 Shturm.

There are three main missiles that are compatible with the launch system:

- **9M120**: first missile variant, a two-stage a HEAT (high explosive anti-tank) weapon that features a tandem warhead for dealing with add-on armor.
- **9M120F**: second missile variant, features a thermobaric warhead for use against buildings, infantry positions and bunkers.
- **9M220**: third missile variant, features a proximity fused expanding rod warhead, providing the missile with air-to-air capability against low-flying and slow-flying aircraft.

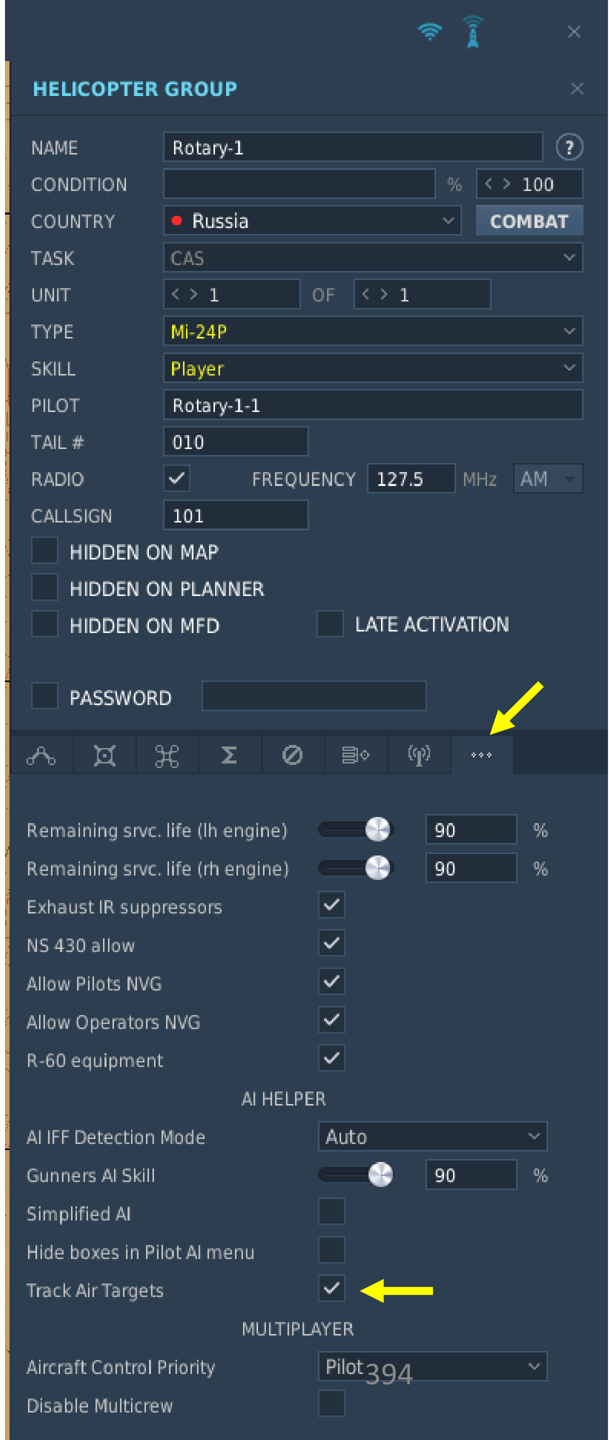
The employment method of these missiles is pretty much identical to the 9M114 Shturm missile, therefore this section will only explore air-to-air use of the Ataka.





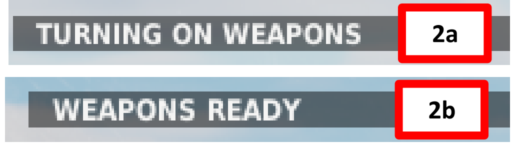
2.7 – 9M120 ATAKA (AT-9 SPIRAL-2) MISSILE
2.7.2 – Air-to-Air Operation (9M220O) with Petrovich AI as Co-Pilot/Gunner

Note: In order for Petrovich to target air targets, the “Track Air Targets” option needs to be ticked (ON) via the Mission Editor.



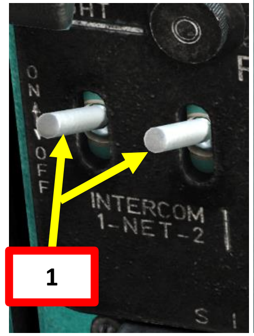
2.7 – 9M120 ATAKA (AT-9 SPIRAL-2) MISSILE

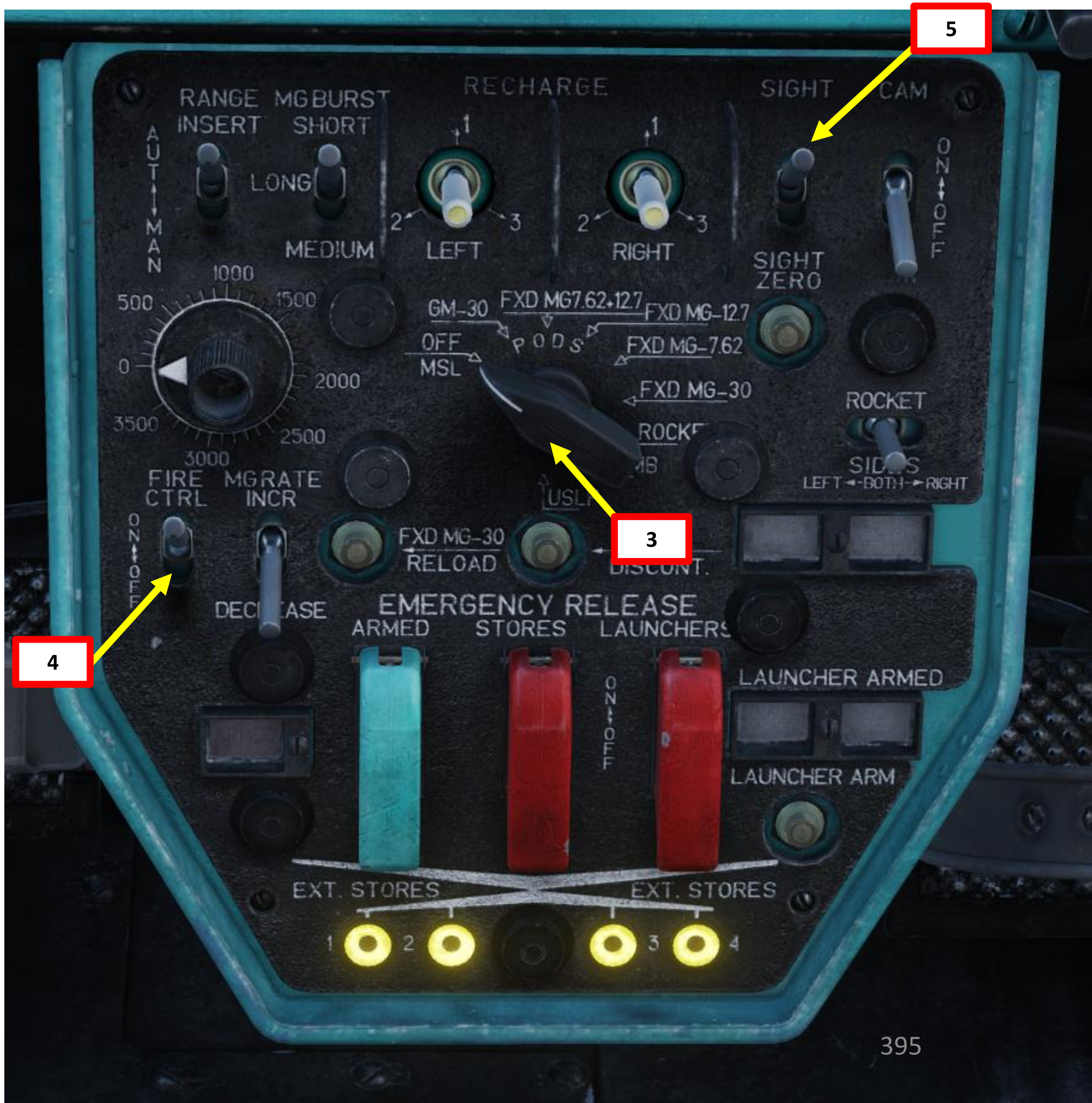
2.7.2 – Air-to-Air Operation (9M220O) with Petrovich AI as Co-Pilot/Gunner



- *Steps preceded by [PC] are performed by the Pilot-Commander.*
- *Steps preceded by [CPG] are performed by the Petrovich AI if no player is manning the operator station.*

1. *[PC][CPG]* Verify that SPU-8 Intercom (ICS) Power Switches are ON (UP) and that ICS/Radio Selectors are set to UP (ICS).
2. *[PC]* Request Petrovich AI to power up weapons and countermeasures (LCTRL+W). This process takes about 3 minutes
3. *[PC]* Set Weapon Selector to desired OFF/MSL position
4. *[PC]* Set Fire Control Switch – ON (UP).
5. *[PC]* Set ASP-17VP Sight Power Switch – ON (UP).
6. *[PC]* Set Auxiliary Stores Light Switch – ON (UP).

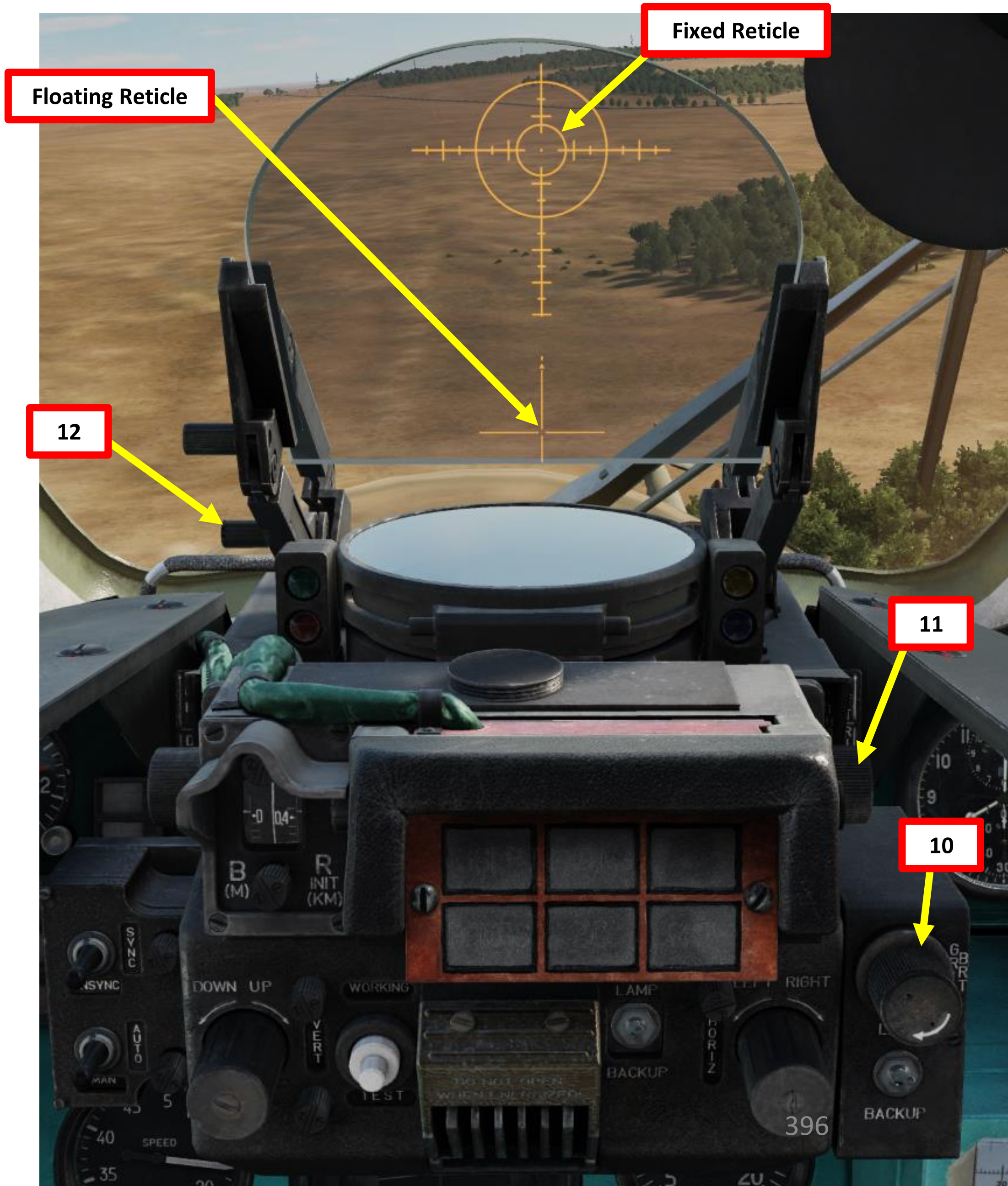




2.7 – 9M120 ATAKA (AT-9 SPIRAL-2) MISSILE

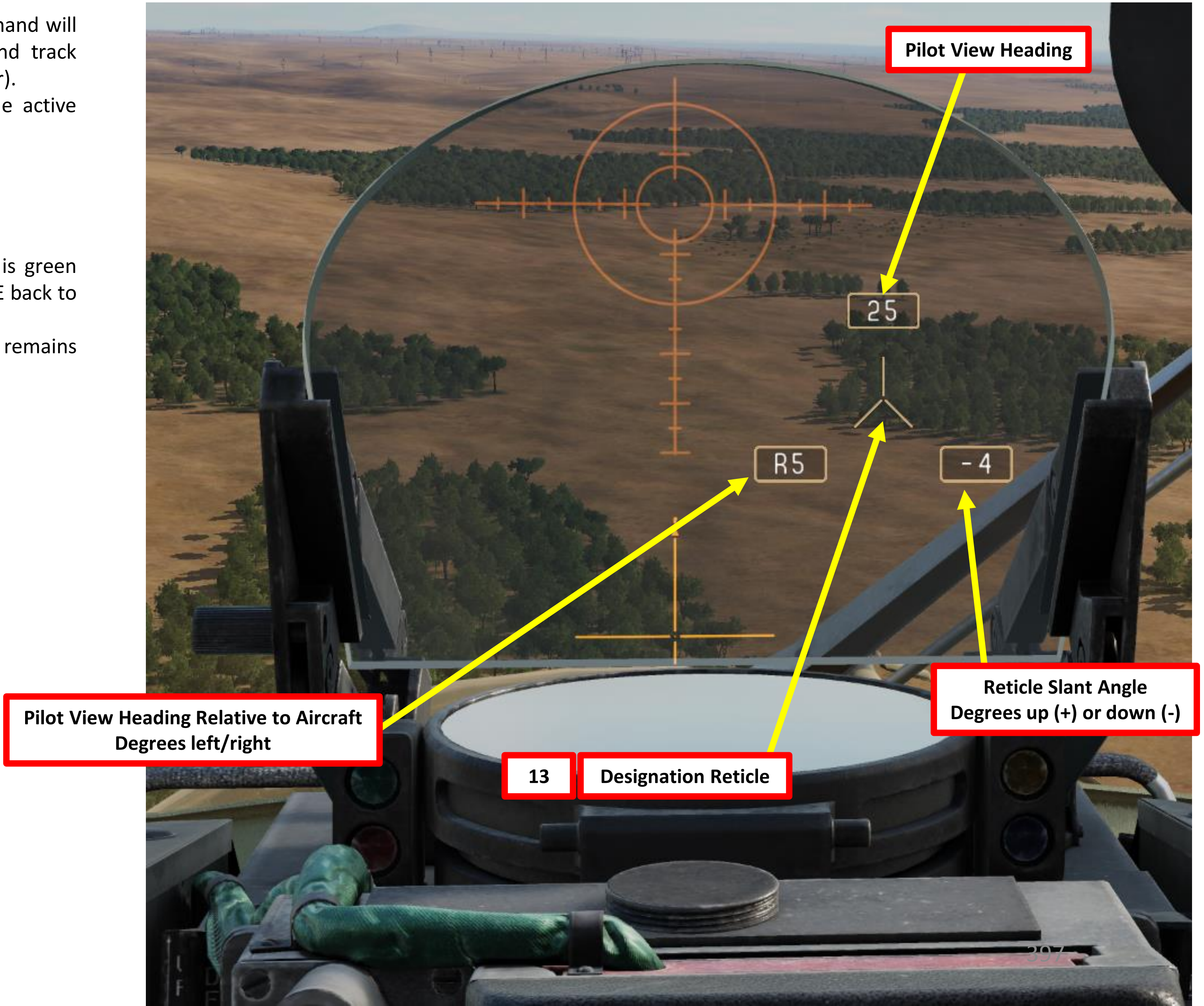
2.7.2 – Air-to-Air Operation (9M220O) with Petrovich AI as Co-Pilot/Gunner

7. *[PC]* Confirm selection of missiles by checking the Armament Selection Lights, which should not display anything (all lights OFF).
8. *[PC]* Set Sight Synchronization Mode Selector – SYNC (UP).
9. *[PC]* Set Sight Mode Selector – AUTOMATIC (UP).
10. *[PC]* Adjust Sight Fixed Reticle (Net) Brightness Control Knob to make the Fixed Reticle dim enough to see the Floating Reticle properly.
11. *[PC]* Adjust Sight Floating Reticle Brightness Control Knob as required.
12. *[PC]* Adjust Sight Reflector Glass as desired using the Sight Reflector Glass Control Lever.
    - Lever UP: Sight Unlocked / Lever DOWN: Sight Locked
    - When lever is unlocked (UP), scroll mousewheel to adjust reflector glass position as desired



2.7 – 9M120 ATAKA (AT-9 SPIRAL-2) MISSILE
2.7.2 – Air-to-Air Operation (9M220O) with Petrovich AI as Co-Pilot/Gunner

13. *[PC]* Show the Petrovich Menu by using « LCTRL+V ». This command will display a Designation Reticle that can be used to identify and track targets, and give commands to Petrovich (acting as Pilot-Operator).
14. *[PC]* The designation interface changes color depending on the active rules of engagement (ROE) and weapon status:
    - Red: Weapons Hold, Missile is warming up
    - Yellow: Weapons Free, Missile is warming up
    - Beige: Weapons Hold, Missile is ready for use
    - Green: Weapons Free, Missile is ready for use
15. *[PC]* Confirm that the Designation Reticle's color is beige. If it is green (weapons free), press « W » LONG (more than 0.5 sec) to set ROE back to weapons hold.
16. *[PC]* Fly towards the target and ensure the helicopter attitude remains stable.



2.7 – 9M120 ATAKA (AT-9 SPIRAL-2) MISSILE

2.7.2 – Air-to-Air Operation (9M220O) with Petrovich AI as Co-Pilot/Gunner

17. *[PC]* Move your head (Designation Reticle) near the area you want the Co-Pilot/Gunner to search for targets, then press « W » SHORT (less than 0.5 sec).
18. *[CPG]* Petrovich will first call out « Can't move sight yet »; the periscope gimbals require about 10 seconds before the periscope is uncaged and the sight can be moved by the guidance unit handles of the Co-Pilot/Gunner.
19. *[CPG]* Petrovich will then start scanning for targets in the designated area. When targets are found, a menu with a list of targets appears.
20. *[PC]* Cycle through the target list using « W » SHORT (UP) or « S » SHORT (DOWN) until desired target is selected by the **>** symbol.
21. *[PC]* Press « D » SHORT (RIGHT) to select target. In our case, we select a helicopter.
    - Note: Pressing "S" SHORT (DOWN) undesignates Petrovich's target.
22. *[CPG]* Petrovich will then select a missile station and control the periscope to set the aiming sight on the target. The periscope's line-of-sight is represented on the ASP-17VP optical sight by the Floating Reticle.

2.7 – 9M120 ATAKA (AT-9 SPIRAL-2) MISSILE

2.7.2 – Air-to-Air Operation (9M220O) with Petrovich AI as Co-Pilot/Gunner

23. *[PC]* Fly helicopter to line up the inner ring of the Fixed Reticle with the Floating Reticle (periscope line-of-sight).
24. *[CPG]* Petrovich will keep the aiming reticle on the target and estimate range to target. When a valid firing solution is available, a continuous high pitch beep is audible through the headphones of both crew members.
25. *[CPG]* When target is in range and a valid firing solution is available, Petrovich will call out « Target In Range ».

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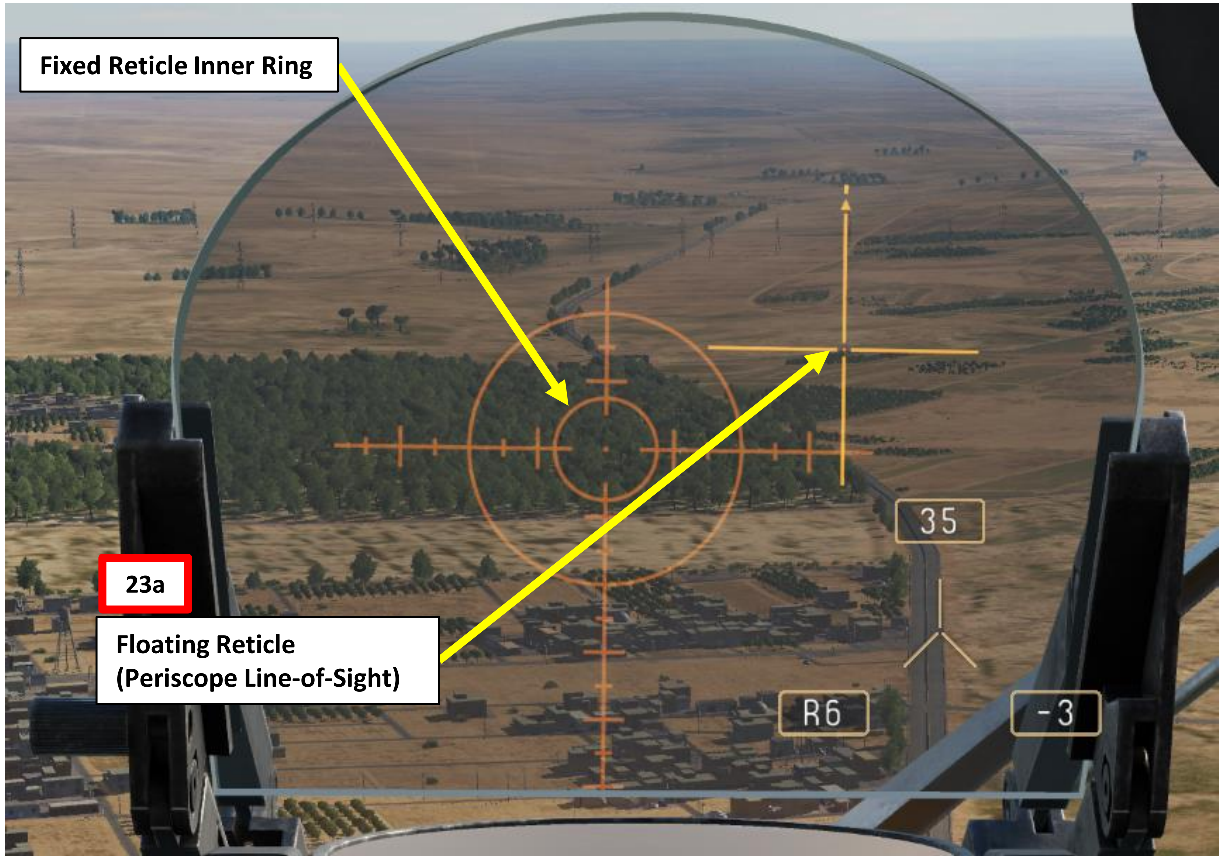
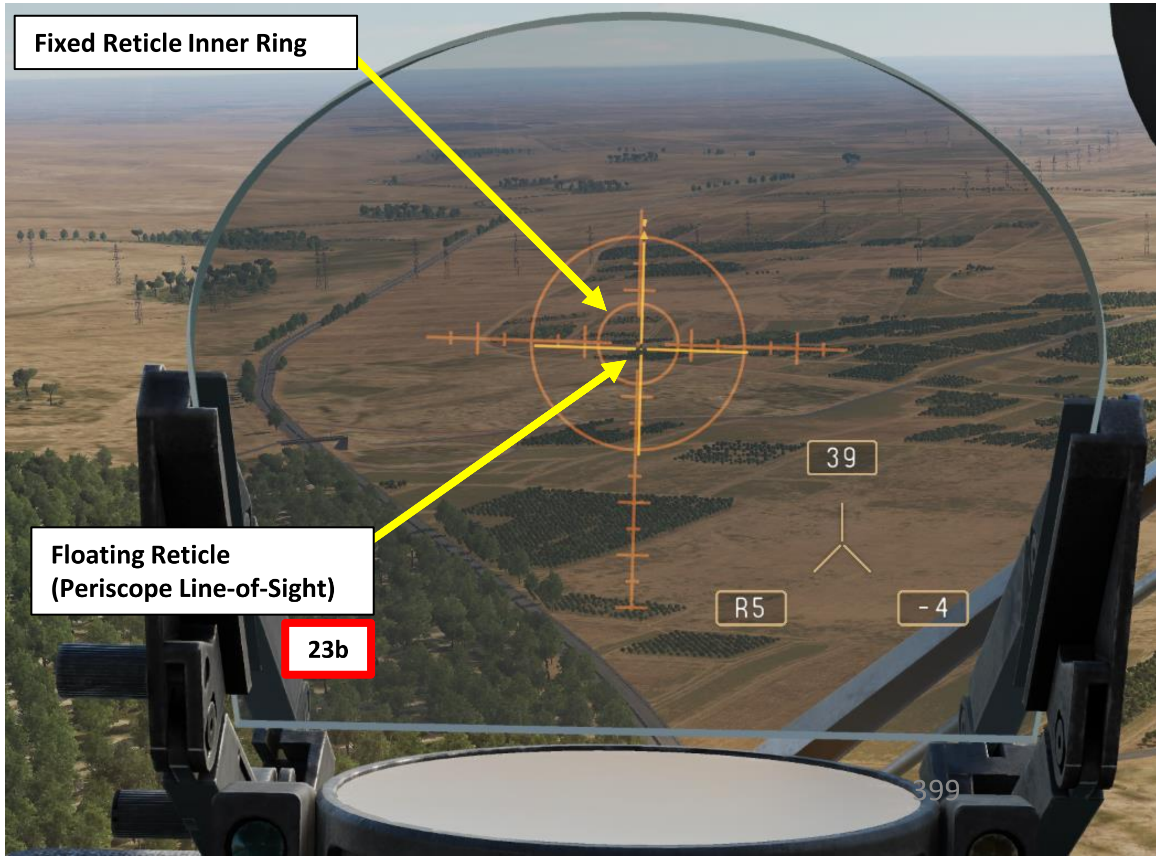
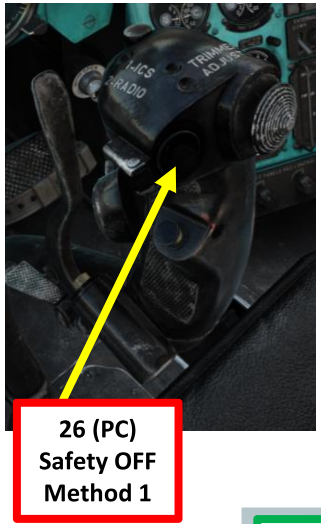
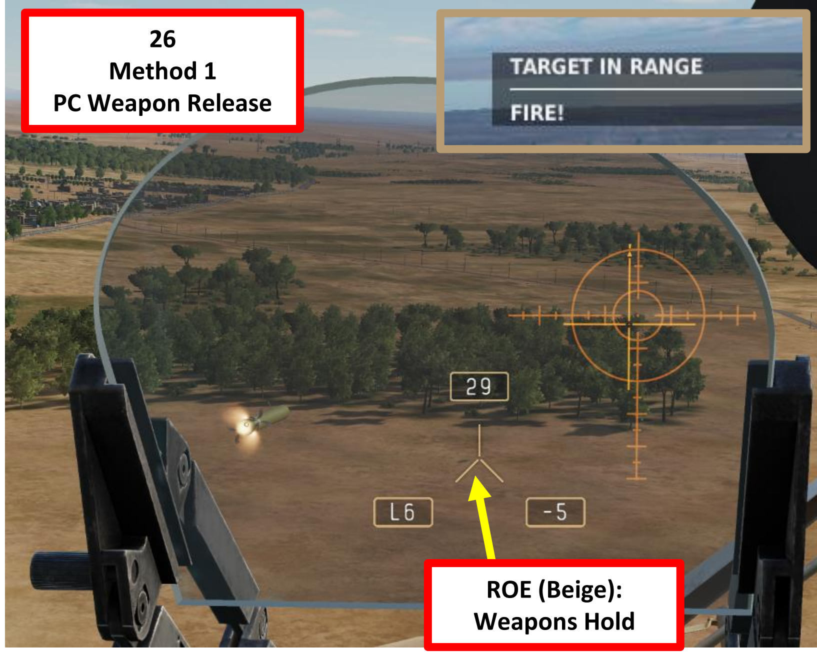


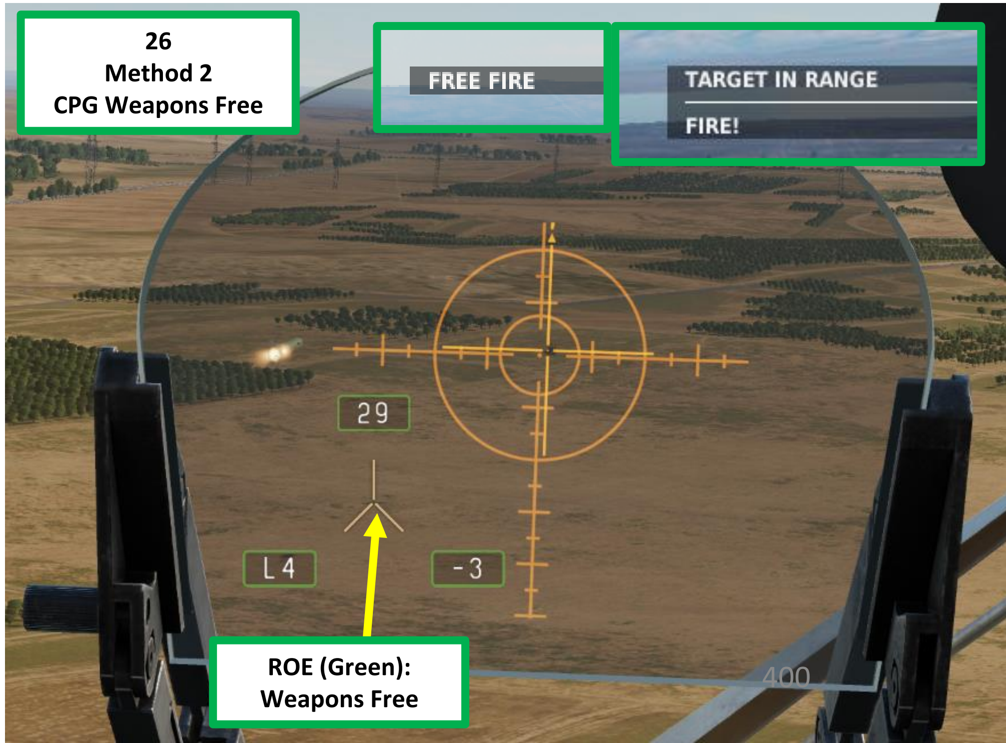


2.7 – 9M120 ATAKA (AT-9 SPIRAL-2) MISSILE
2.7.2 – Air-to-Air Operation (9M220O) with Petrovich AI as Co-Pilot/Gunner

26. Fire Missile.
    - [PC] ***Method 1:*** Flip the weapon safety on the cyclic, then press and hold the « Weapon Release » (RALT + SPACE) button to launch missile.
    - [CPG] ***Method 2:*** Press « W » LONG (more than 0.5 sec) to set ROE to weapons free. The Designation Reticle will turn to green. Petrovich will then automatically press and hold the « Fire ATG Missile» buttons on the Rotary Handles (RCTRL+SPACE) to launch missile when target is in range and a valid firing solution is available.
27. *[CPG]* Using the Rotary Head (lateral axis) and Rotary Handle (vertical axis) guidance controls, Petrovich will keep the aiming reticle on the target as the missile is steered toward the periscope's line-of-sight by the guidance unit radio.
28. *[PC]* Maintain Fixed Reticle and Floating Reticles lined up while the missile heads towards the target; the pilot has to fly relatively straight to help the Co-Pilot/Gunner minimize the amount of correction required to keep a steady aim. The proximity fused expanding rod warhead will detonate when it flies close enough to the enemy helicopter.







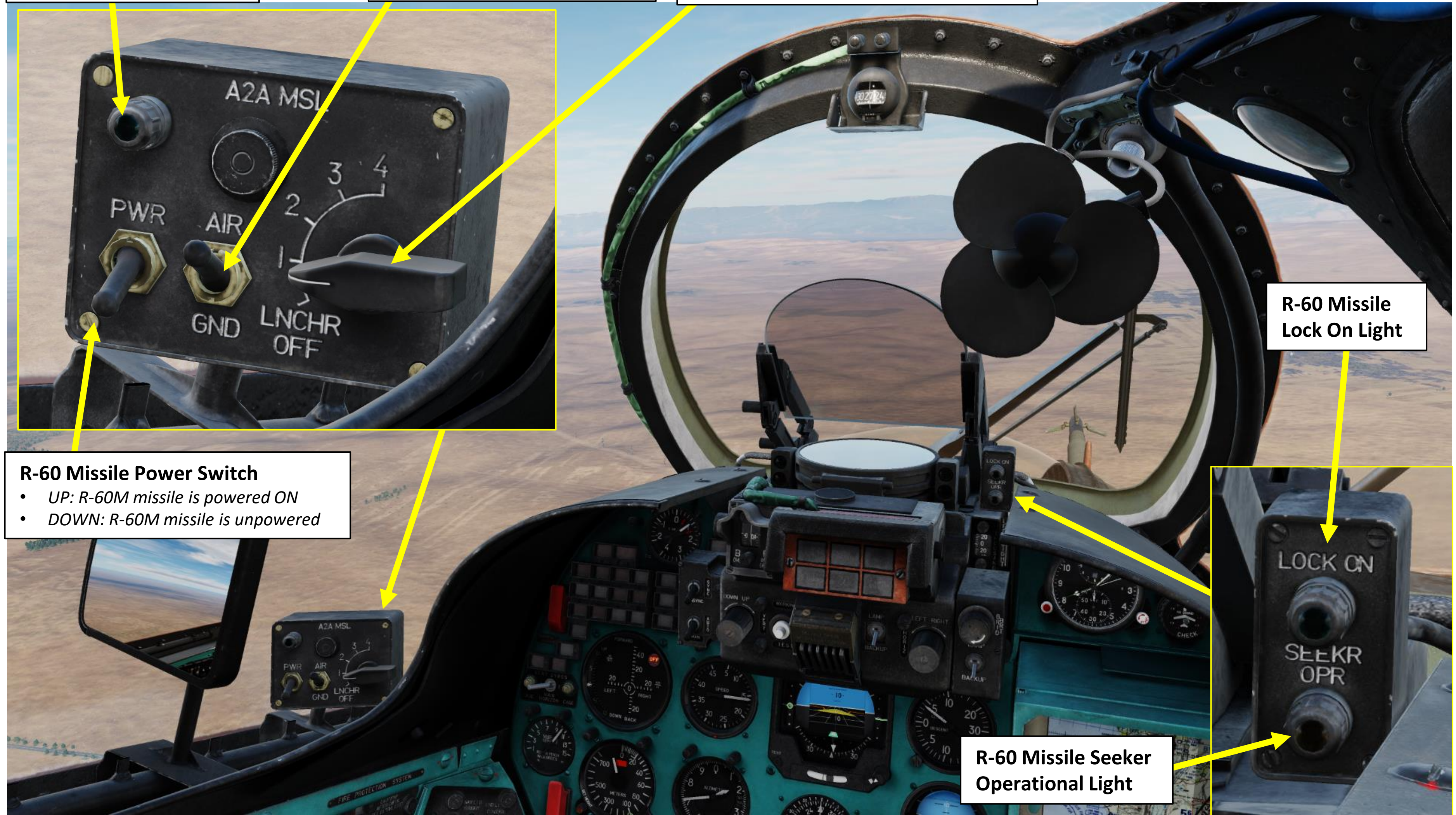
2.7 – 9M120 ATAKA (AT-9 SPIRAL-2) MISSILE
2.7.2 – Air-to-Air Operation (9M220O) with Petrovich AI as Co-Pilot/Gunner

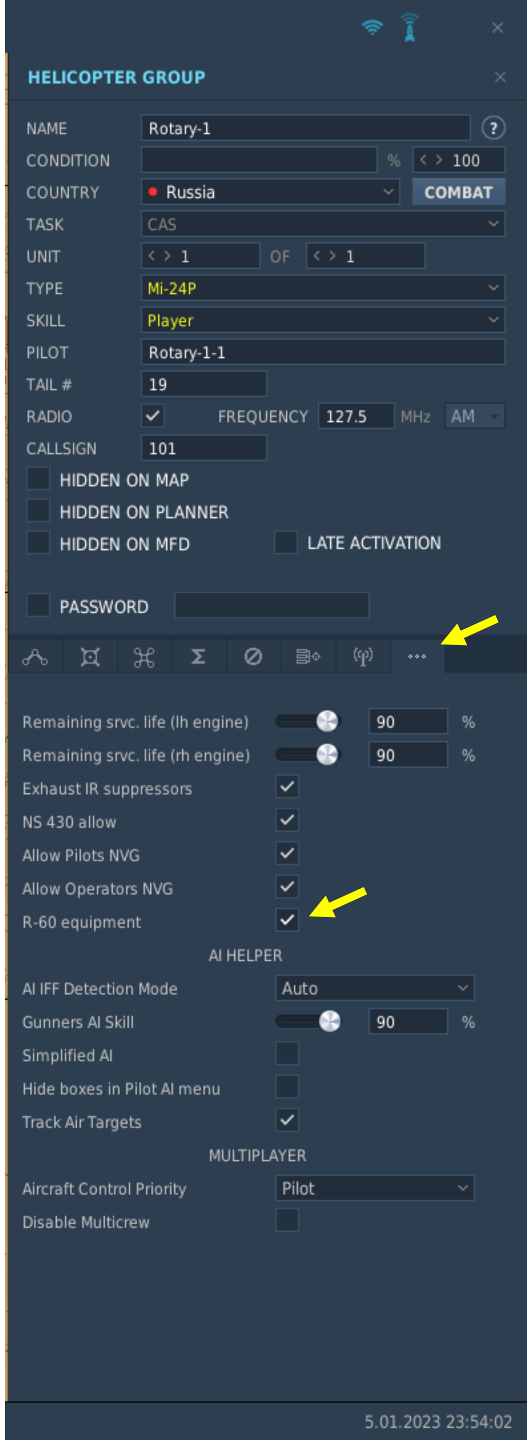
29. *[CPG]* After missile detonation, press "S" SHORT (DOWN) to undesignate Petrovich's target. Petrovich will exit the Aiming Sight and set the OBSERVE (B2) switch to OFF (DOWN) to close the protective doors, boresight the periscope, and cage the gimbals.
30. *[CPG]* Petrovich will call out "No Target Selected" to the Pilot-Commander to let him know that he can start evasive manoeuvers without risking damaging the periscope gimbals.
31. *[PC]* You can hide the Petrovich Menu (Designation Reticle) by using « LCTRL+V ».

30

2.8 – R-60M APHID (IR MISSILE)
2.8.1 – Air-to-Air Employment

In order to use the R-60M missile, the « R-60 Equipment » option in the Mission Editor needs to be enabled (ticked, ON).

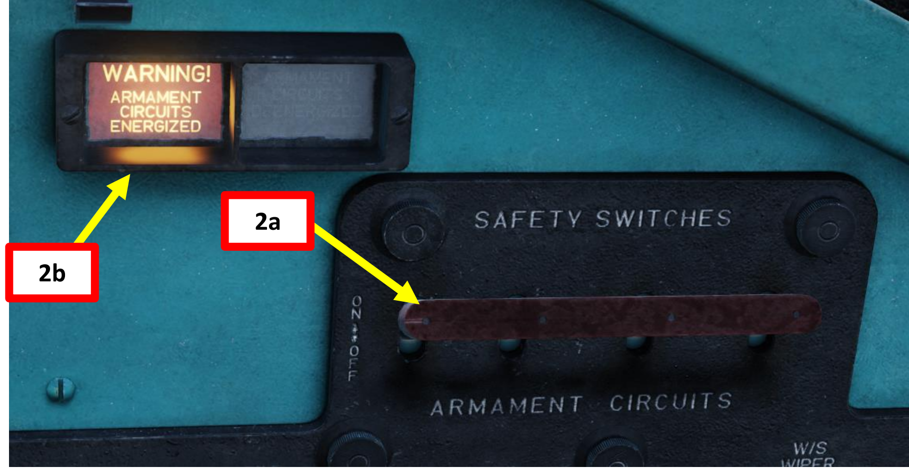


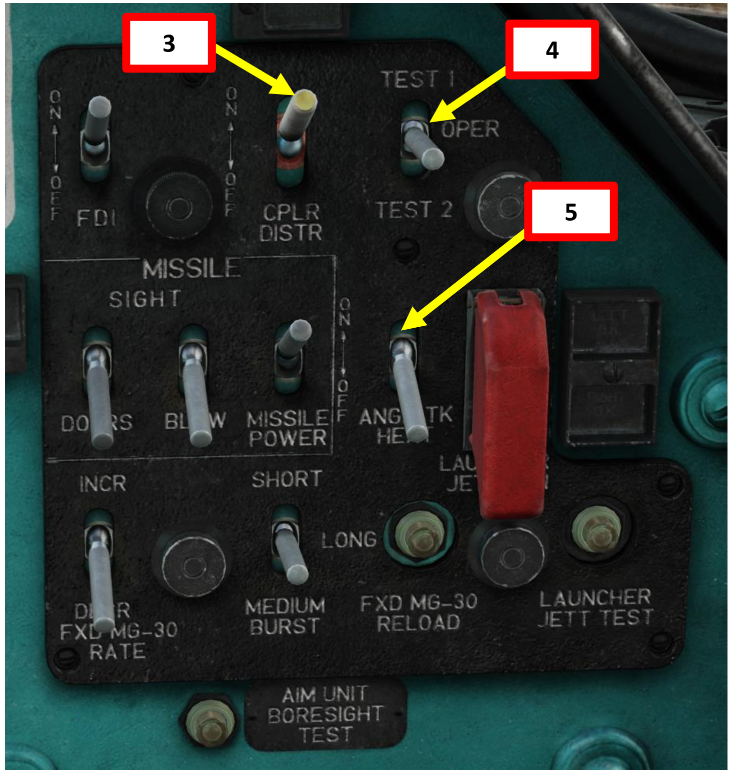


2.8 – R-60M APHID (IR MISSILE)
2.8.1 – Air-to-Air Employment

- *Steps preceded by [PC] are performed by the Pilot-Commander.*
- *Steps preceded by [CPG] are performed by the Co-Pilot Gunner (or the Petrovich AI if no player is manning the operator station).*

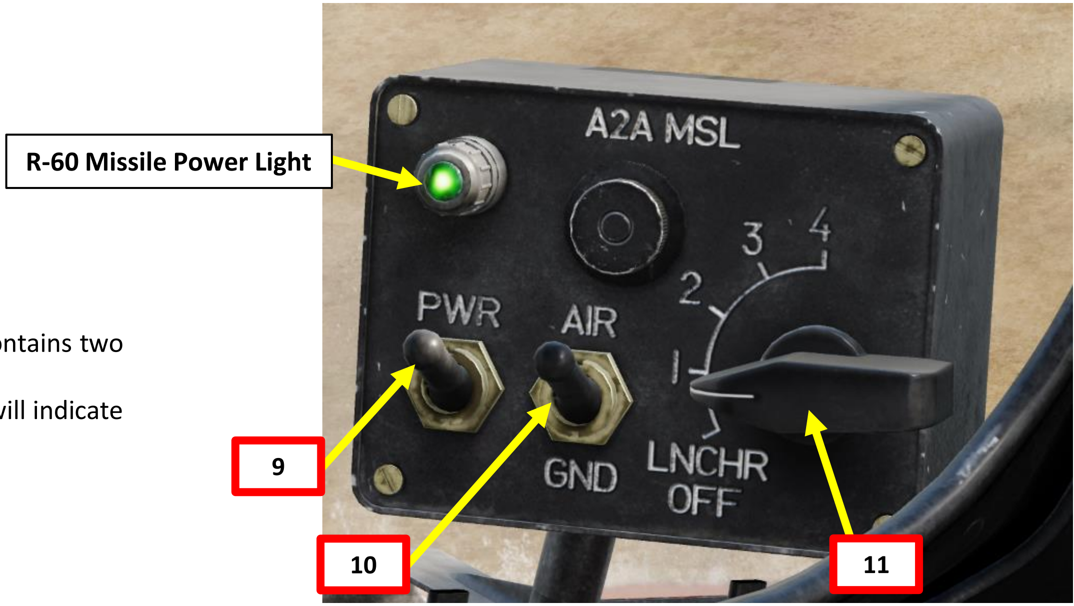
1. [PC] If not flying in Multicrew, request Petrovich AI to power up weapons (LCTRL+W).
2. [CPG] Set Armament Circuit Breakers – ON (UP).
3. [CPG] Set USR-24 (CPLR DISTR) Switch – ON (UP).
4. [CPG] Set USR-24 Mode Switch – OPERATION MODE (MIDDLE).
5. [CPG] Set DUAS (Air Data Probe) Heating Switch – As Required.
    - ON/UP if temperature is below 5 deg C
    - DOWN/OFF if temperature is above 5 deg C.
6. [CPG] Set Pilot/CPG Weapon Selection Control Handover Switch – DOWN (Pilot-Commander has Weapon Selection Control).

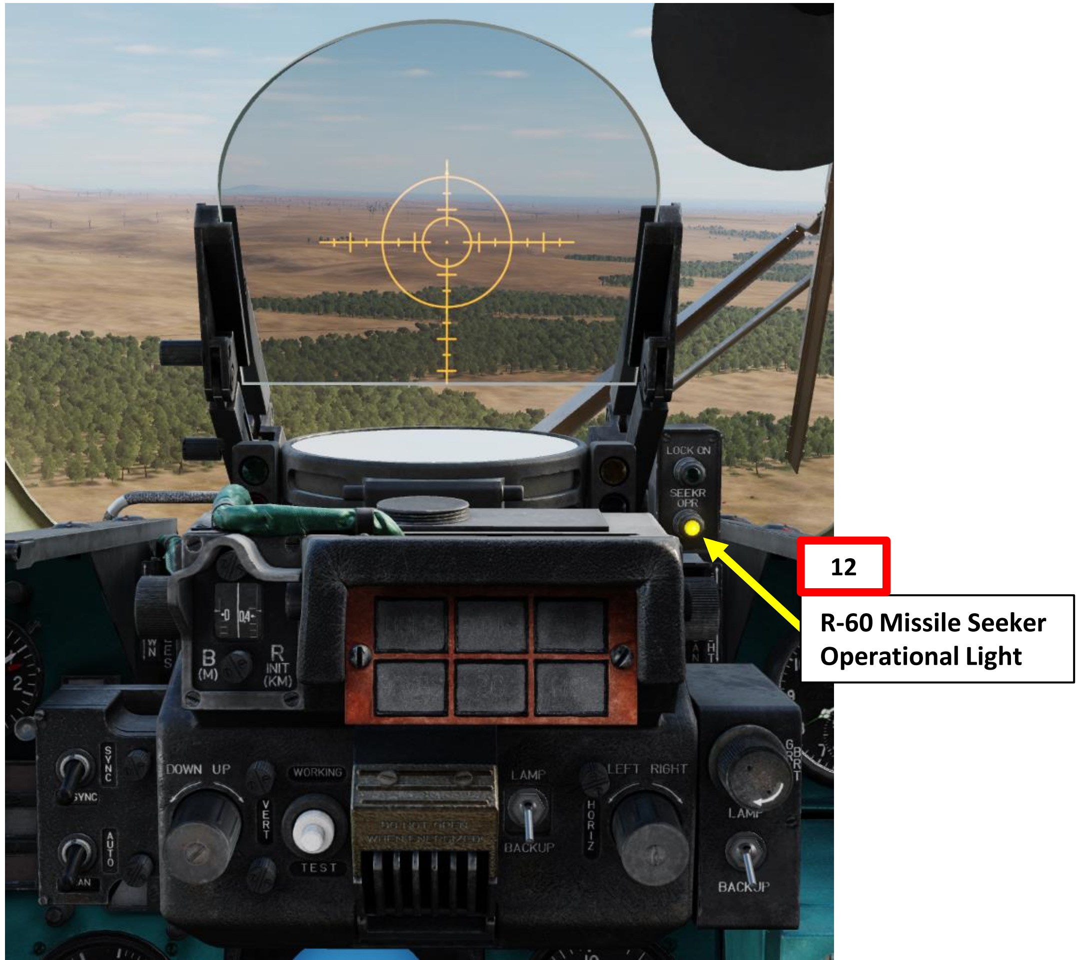


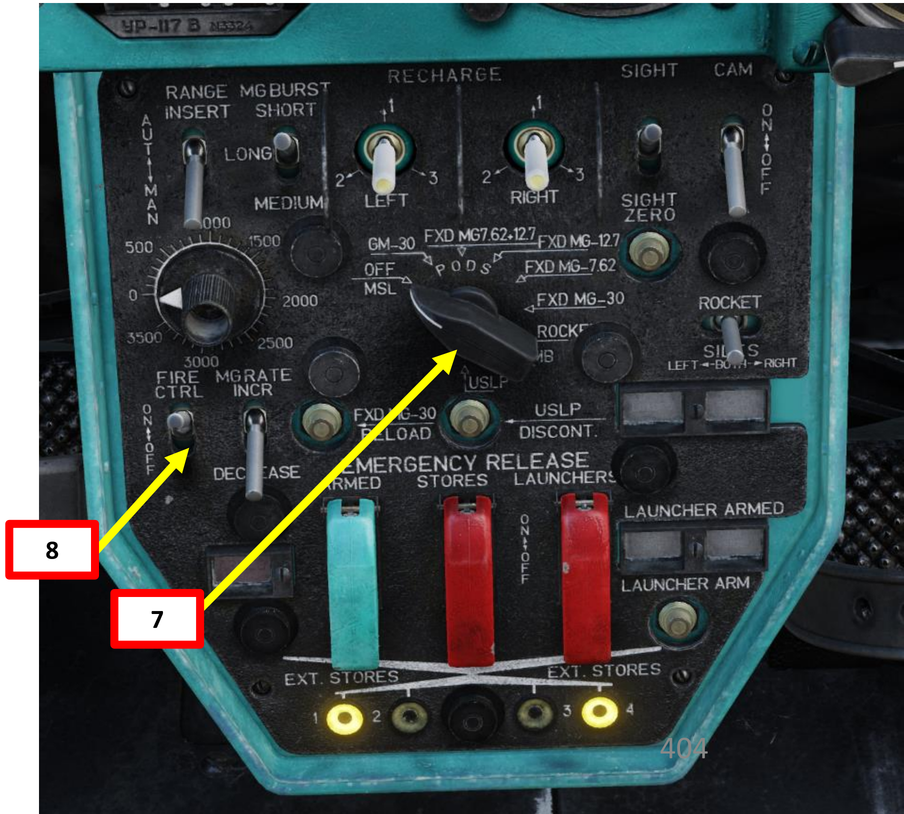


2.8 – R-60M APHID (IR MISSILE)
2.8.1 – Air-to-Air Employment

7. *[PC]* Set Weapon Selector to desired OFF/MSL position
8. *[PC]* Set Fire Control Switch – ON (UP).
9. *[PC]* Set R-60 Missile Power Switch – ON (UP).
10. *[PC]* Set R-60 Missile Fuze Activation Mode Switch – AIR (UP).
11. *[PC]* Set R-60 Missile Launcher Rack Selector – As desired. We will select « 1 » for the left rack, which contains two missiles. « 2 » would be used for the right rack, which also contains two missiles.
12. *[PC]* Missile should take about a minute to warm up. Confirm Missile Operational Light illuminates. This will indicate the missile is ready to be used.

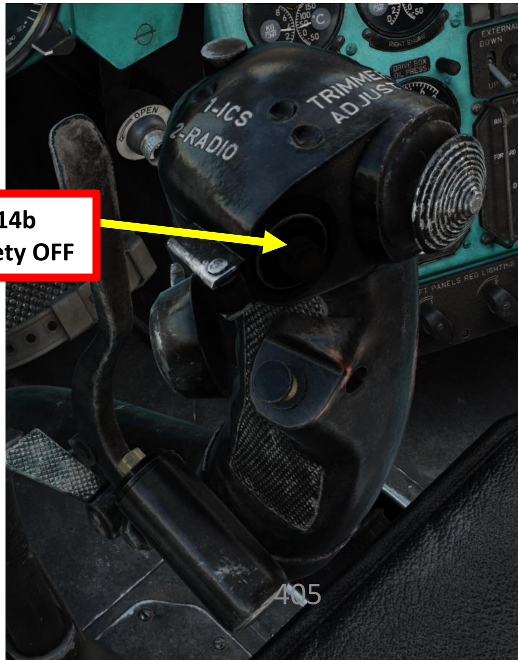






2.8 – R-60M APHID (IR MISSILE)
2.8.1 – Air-to-Air Employment

13. *[PC]* Line up the helicopter with a flying target. Once a heat signature is detected, the R-60 Missile Lock On Light will illuminate, accompanied with a high pitch lock tone.
14. *[PC]* Flip the weapon safety on the cyclic, then press and hold the « Weapon Release » (RALT + SPACE) button to fire rockets.



2.8 – R-60M APHID (IR MISSILE)

2.8.1 – Air-to-Air Employment

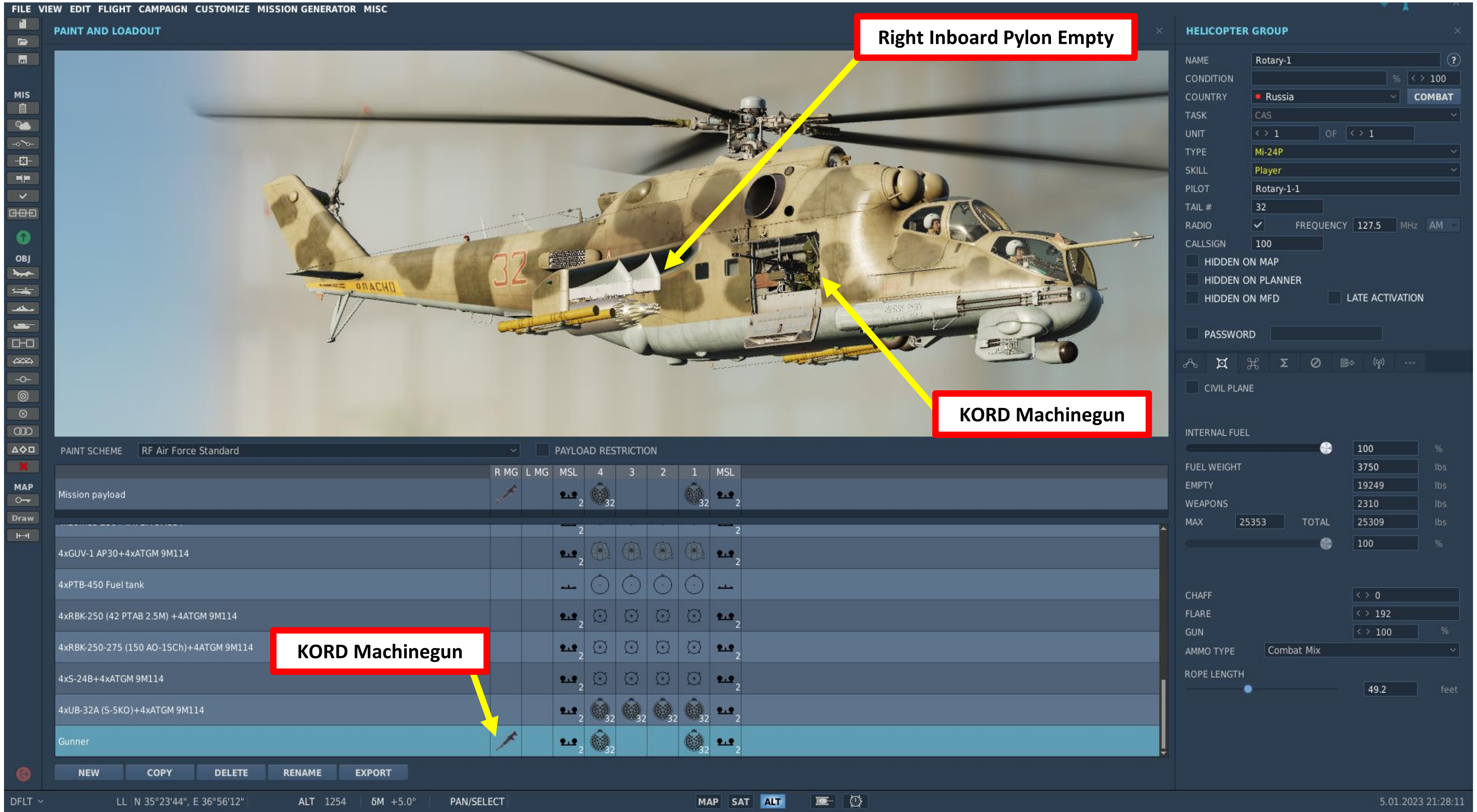
3 – GUNNER

3 – GUNNER

Loadout Considerations

In real life, Mi-24s very seldom carried gunners in the aft compartment. Why? Because it was deemed impractical. The very cramped interior and reduced field-of-view limited the gunner's effectiveness and the added weight reduced the helicopter's performance significantly.

Still, this configuration existed and is available in DCS. The KORD machinegun can be equipped on either the left or right side. However, you can only have one gunner in your crew. When equipping a KORD machinegun, you will **not be allowed to have any ordnance on the inboard pylon located on the side of this machinegun** for safety reasons. You wouldn't want to have traversing machinegun fire hit a rocket pod, wouldn't you?



3 – GUNNER

12.7 mm KORD Machinegun

By default, the 12.7 mm KORD machinegun has 12 ammunition boxes with 50 rounds each.

3 – GUNNER

How to Fire 12.7 mm KORD Machinegun as the Gunner

1. Select gunner (press "**3**").
2. By default, the gun will follow where you look in trackIR. If you prefer to aim with the mouse (recommended), press "**LALT+T**" (TrackIR Aiming ON/OFF binding). The mouse will then take over.
3. Fire using the MACHINEGUN FIRE button ("Spacebar" binding) available in the MI-24P GUNNER Options Control menu or your left mouse button.

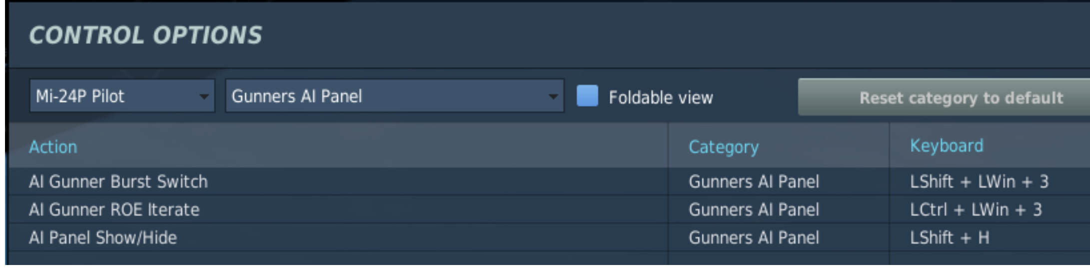
GUNNER CONTROLS

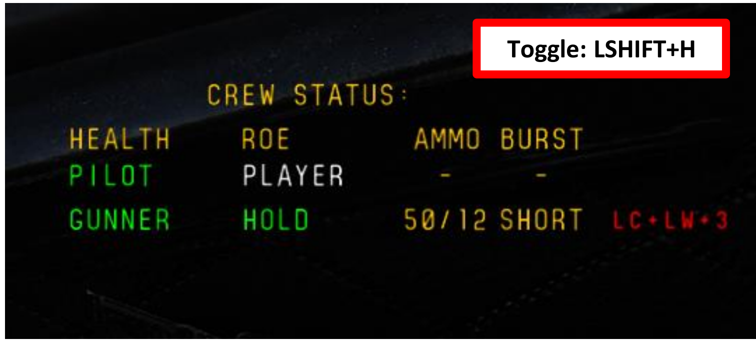
- Take Gunner Position: 3
- Set AI ROE (Rules of Engagement):LCTRL+LWIN+3
- Set AI Firing Burst Length: LSHIFT+LWIN+3
- Show AI Panel Hints: LSHIFT+H
- Show Gunner Panel Hints: RALT+RSHIFT+K
- Mouse Cursor Click Mode ON/OFF: LALT+C
- TrackIR Aiming ON/OFF: LALT+T
- Fire Gun: Spacebar / Left Mouse Button

3 – GUNNER

How to Control AI Gunner

1. You can toggle the CREW STATUS window (AI Panel) by pressing “**LSHIFT+H**”
2. By default, the AI gunner has its own ROE (Rule of Engagement) set to HOLD FIRE.
3. Change ROEs to “RETURN FIRE” or “FREE FIRE” by using “LCTRL+LWIN+3”.
4. Change firing burst length (SHORT or LONG burst) by using “LSHIFT+LWIN+3”.
5. Take note that the gunner has a very restricted angle of fire; fly as smoothly as possible.





GUNNER CONTROLS

- Take Gunner Position: 3
- Set AI ROE (Rules of Engagement):LCTRL+LWIN+3
- Set AI Firing Burst Length: LSHIFT+LWIN+3
- Show AI Panel Hints: LSHIFT+H
- Show Gunner Panel Hints: RALT+RSHIFT+K
- Mouse Cursor Click ON/OFF: LALT+C
- TrackIR Aiming ON/OFF: LALT+T
- Fire Gun: Spacebar / Left Mouse Button

4 – ORDNANCE JETTISON

Weapon Pylon Stores Jettison

1. If bomb pylons are jettisoned, set the Emergency Jettison Bomb Arming Switch – SAFE (DOWN).
2. Select Stores Pylon Jettison Switch – ON (UP).
3. Weapon stations on Pylons 1, 2, 3 and 4 are jettisoned.

4 – ORDNANCE JETTISON

Missile Pylon Jettison

1. Select Missile Launcher Jettison Switch – ON (UP).
2. Outer missile station pylons on are jettisoned.

COUNTERMEASURES – INTRODUCTION

Countermeasures are very simple to use in the Mi-24. You have two countermeasure types at your disposal: flares and chaff. We will explore together what is used against what, and how.

Missiles can generally track you using 2 things: radar signature (radar waves are sent on you and you reflect them, which is called a “radar signature”) and heat signature (like the exhaust of your engines). Countermeasures will only be effective against the kind of weapon it was meant to counter; a heat-seeking missile will not care if you deploy electronic countermeasures against it since it tracks heat, not radar signatures. This is why it is important to know what is attacking you in order to counter it properly. This is what the RWR (Radar Warning Receiver) is for: to help you know what is firing at you so you can take the adequate action to counter it.

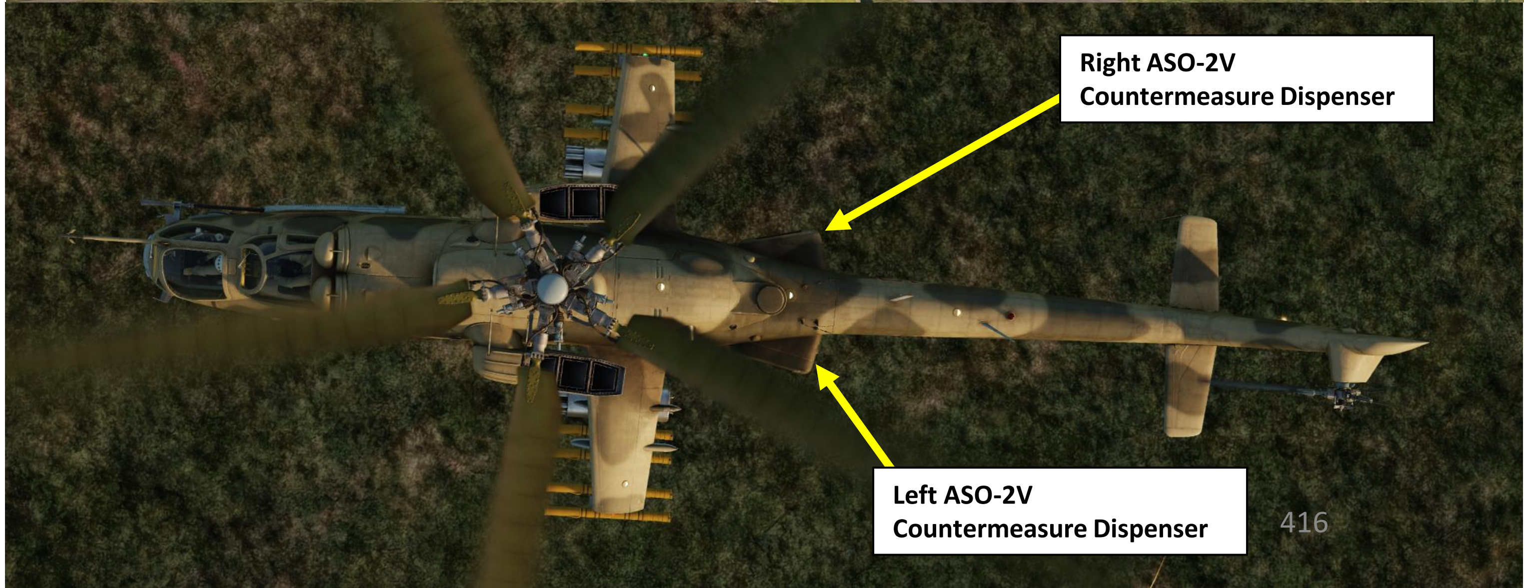
- **Flares** are used against missiles that track heat (infrared/IR) signatures. Instead of going for the heat signature generated by your engines, a missile will go for a hotter heat source like flares.

- **Chaff** is a form of “passive” jamming. Passive (reflected) jamming is when a deceptive object or device reflects radar waves. Chaff is simply a bundle of small pieces of metal foil with reflective coating, which creates clusters of radar signatures that prevent a radar to get a solid lock on the aircraft itself.

Here is a great youtube tutorial on the RWR and countermeasures made by Redkite: https://youtu.be/FrHCZ0Pxhvg

COUNTERMEASURES – INTRODUCTION

The Mi-24 is equipped with ASO-2V Countermeasure Dispensers (three cassettes on each side of the fuselage). Each cassette contains 32 slots that only allow a single countermeasure type. As an example, a single cassette can fit either 32 chaff, or 32 flares… but it cannot have 10 chaff and 22 flares.



COUNTERMEASURES – INTRODUCTION

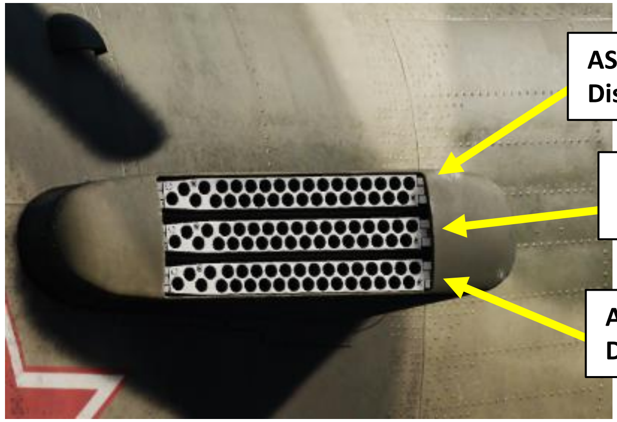
Take note that chaff cassettes will always take priority to be installed on the uppermost rack. Countermeasures need to be installed by the ground crew.

COUNTERMEASURES – INTRODUCTION

The countermeasures system needs to be powered on in the front cockpit of the Co-Pilot/Gunner. Countermeasure programs are available

Countermeasures can be dispensed either from:

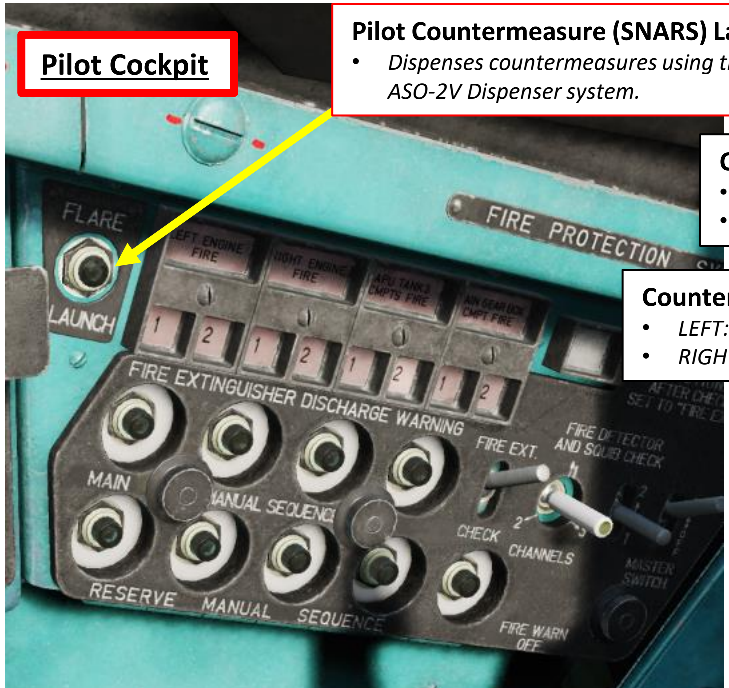
- The Pilot-Commander's cockpit (Pilot Countermeasure SNARS Launch Button)
- The Co-Pilot/Gunner's cockpit (Launch Countermeasures SNARS Pushbutton)



ASO-2V Countermeasure Dispenser Cassette Set I

ASO-2V Countermeasure Dispenser Cassette Set II

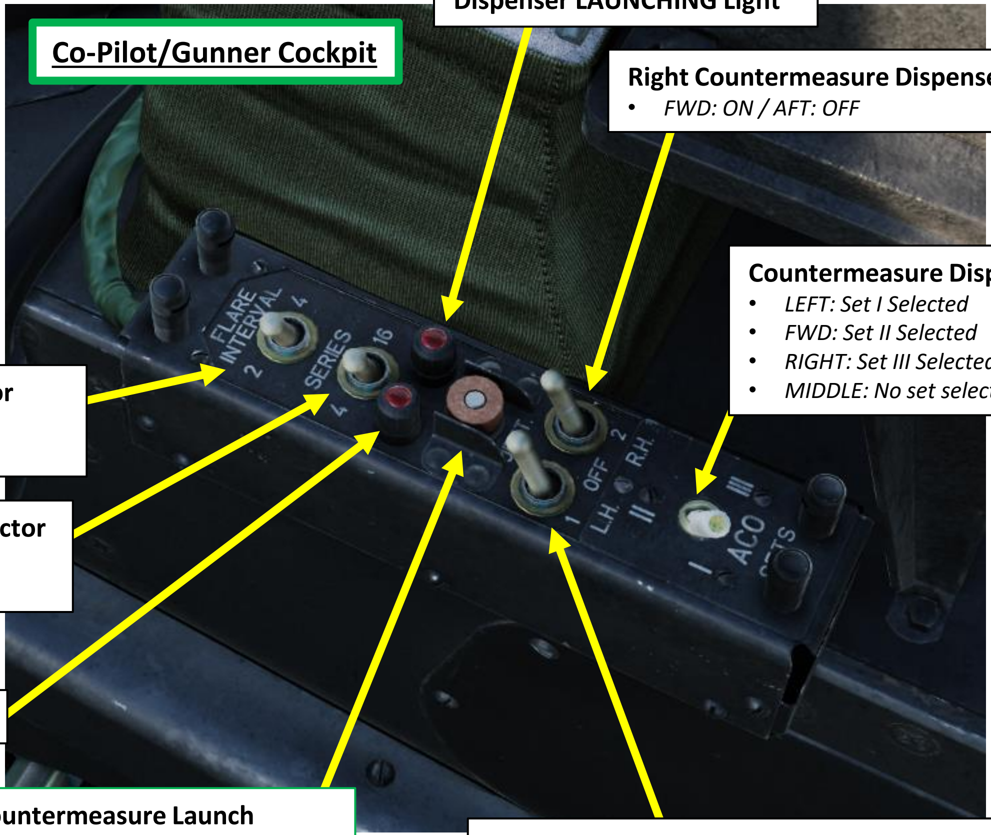
ASO-2V Countermeasure Dispenser Cassette Set III



Pilot Cockpit

Pilot Countermeasure (SNARS) Launch Button

- *Dispenses countermeasures using the SNARS / ASO-2V Dispenser system.*



Co-Pilot/Gunner Cockpit

Right Countermeasure Dispenser LAUNCHING Light

Right Countermeasure Dispenser Selector

- *FWD: ON / AFT: OFF*

Countermeasure Dispenser Set Selector

- *LEFT: Set I Selected*
- *FWD: Set II Selected*
- *RIGHT: Set III Selected*
- *MIDDLE: No set selected*

Countermeasure Flare Interval Selector

- *LEFT: 2 seconds between flare launches*
- *RIGHT: 4 seconds between flare launches*

Countermeasure Program Series Setting Selector

- *LEFT: Countermeasure Program is run 4 times*
- *RIGHT: Countermeasure Program is run 16 times*

Signal Lamps OPER Light

Countermeasure Launch Pushbutton (LAUNCH SNARS)

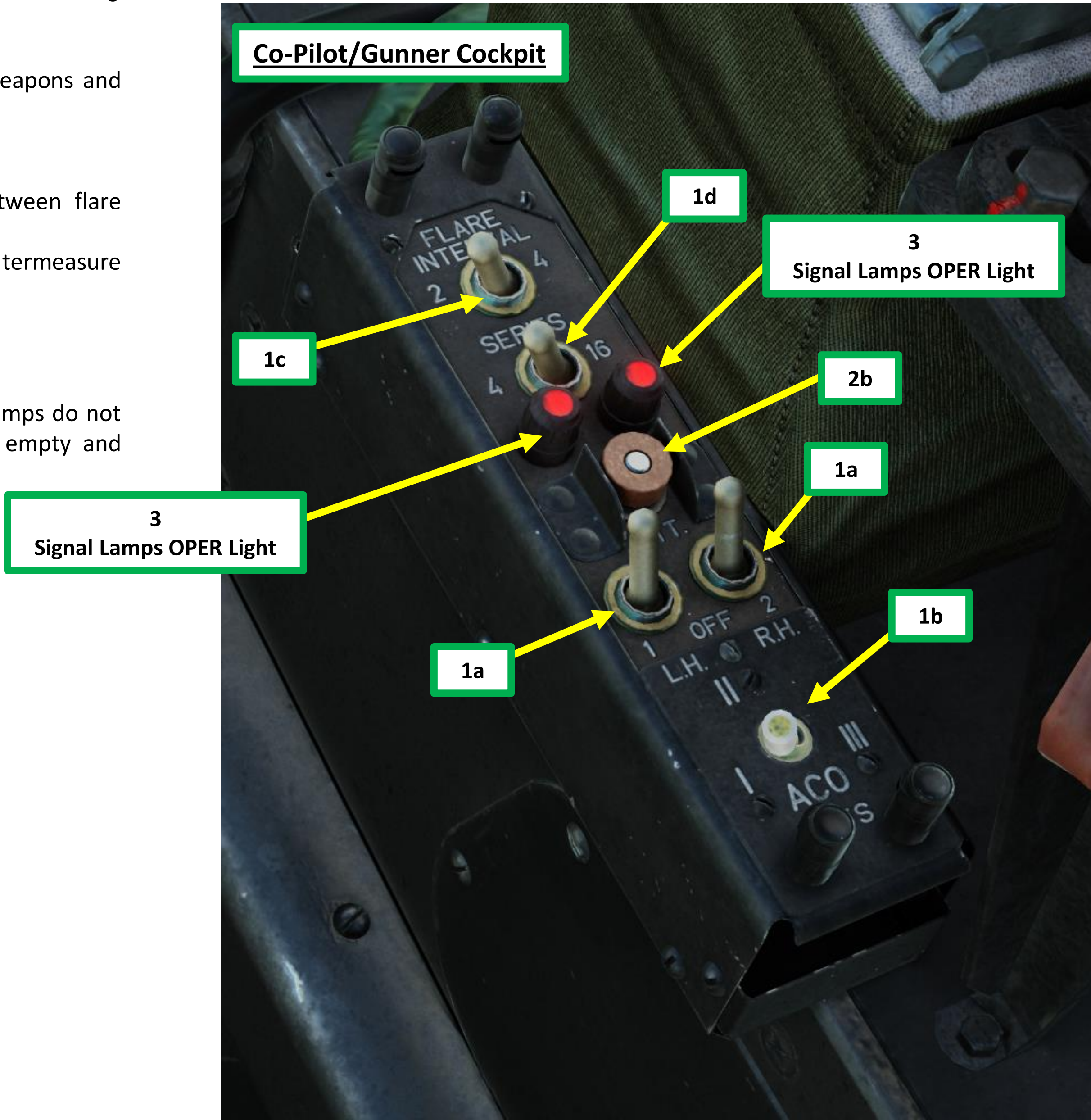
Left Countermeasure Dispenser Selector

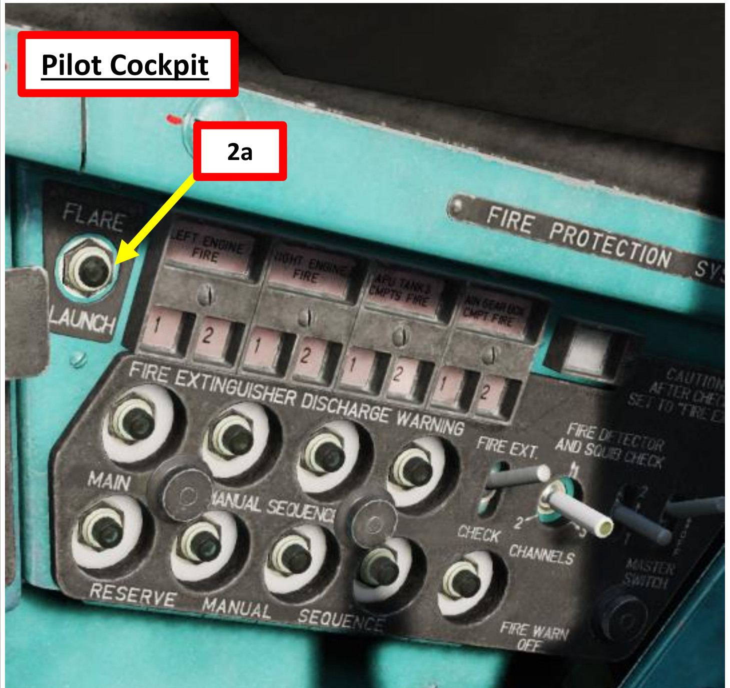
- *FWD: ON / AFT: OFF*

CHAFF & FLARES TUTORIAL

- *Steps preceded by [PC] are performed by the Pilot-Commander.*
- *Steps preceded by [CPG] are performed by the Co-Pilot Gunner (or the Petrovich AI if no player is manning the operator station).*

1. [PC] If using the Petrovich AI as the Co-Pilot/Gunner, request Petrovich AI to power up weapons and countermeasures (LCTRL+W). This procedure is explained in the following steps.
   a) [CPG] Set Left and Right Countermeasure Dispenser Selectors – ON (FWD)
   b) [CPG] Set Countermeasure Dispenser Set Selector – I, II or III
   c) [CPG] Set Countermeasure Flare Interval Selector – As desired (2 or 4 sec between flare launches)
   d) [CPG] Set Countermeasure Program Series Setting Selector – As desired (countermeasure program is run 4 times or 16 times)
2. Launch countermeasures using either:
   a) [PC] The Pilot Countermeasure SNARS Launch Button, or
   b) [CPG] The Co-Pilot/Gunner's cockpit (Launch Countermeasures SNARS Pushbutton)
3. [CPG] While countermeasure program is running, the OPER Signal lamps illuminate. If the lamps do not illuminate after pressing the Countermeasure Launch button, it means the dispenser is empty and another Countermeasure Dispenser Set should be selected (step 1b).



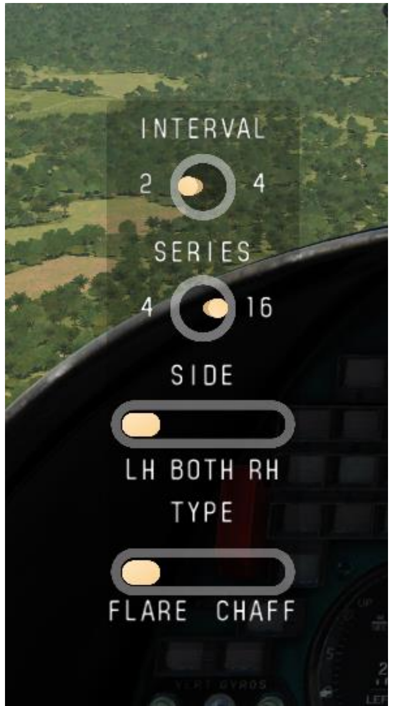


CHAFF & FLARES TUTORIAL

It is good practice to launch countermeasures pre-emptively when performing attack runs. Take note that the Petrovich AI can program countermeasures for you when you are flying as the Pilot-Commander.

When Petrovich is in the normal Target Designation Mode **(LCTRL+V)**, it is possible to make him select a countermeasure program by **pressing "A" (AI Menu LEFT)**. Here is a breakdown of Petrovich's CPG functions in ***Countermeasure Programming Mode***.

- **W: AI Menu UP**
  - **SHORT PRESS:** Toggles Flare Interval Setting (2 or 4).
  - **LONG PRESS:** No Function.
- **A: AI Menu LEFT:**
  - **SHORT PRESS:** Shows/Hides Petrovich countermeasure menu.
- **S: AI Menu DOWN:**
  - **SHORT PRESS:** Toggles Dispenser Side Setting (Left, Both or Right).
  - **LONG PRESS**: Toggles Flare or Chaff Dispenser.
- **D: AI Menu RIGHT:**
  - **SHORT PRESS:** Toggles Series Setting (4 or 16).
  - **LONG PRESS:** No Function.



SPO-10 RWR (RADAR WARNING RECEIVER)

The S3M-5M indicator is part of the SPO-10 Radar Warning Receiver system. There are four lights: one for each 90 deg quadrant surrounding the aircraft. The RWR is a top-down view. For example, a light that flashes on the top right means that a contact between your 12 o'clock and your 3 o'clock is "painting" you with radar. The RWR has blinking lights to warn you, but also sounds. Pay attention to them: from irregular beeps you can guess that you are being "painted" by more than one contacts. Knowing is half the battle.

- **Blinking Light (Regular Frequency)** = one aircraft radar or ground radar station has detected you (but not locked). Don't panic.
- **Blinking Light (Irregular Frequency)** = two (or more) aircraft radar or ground radar stations have detected you (but not locked). You may feel a bit tense.
- **Continuous Light** = you are being locked by radar. Immediate action needs to be taken. You may need to change your underwear.

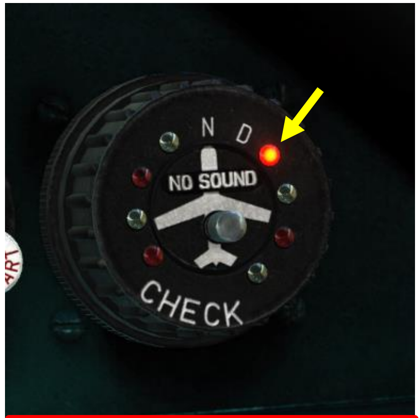
SPO-10 RWR (RADAR WARNING RECEIVER)

RWR operation requires the SPO-10 RWR (Radar Warning Receiver) Power Switch to be ON (UP) and the SPO-10 Radar Warning Signal Switch to SOUND ON (UP).

Day or Night setting is available by clicking on the D and N to switch the RWR filter.

SPO-10 RWR Day/Light Mode Selector

RWR – Day Mode (during day)



RWR – Night Mode (during day)

RWR – Day Mode (during night)

RWR – Night Mode (during night)

SPO-10 Radar Warning System Power Switch
- *UP: ON / DOWN : OFF*

SPO-10 Radar Warning Signal Switch
- *UP: SOUND ON*
- *DOWN : SOUND OFF (MUTE)*

RADIO SYSTEM OVERVIEW

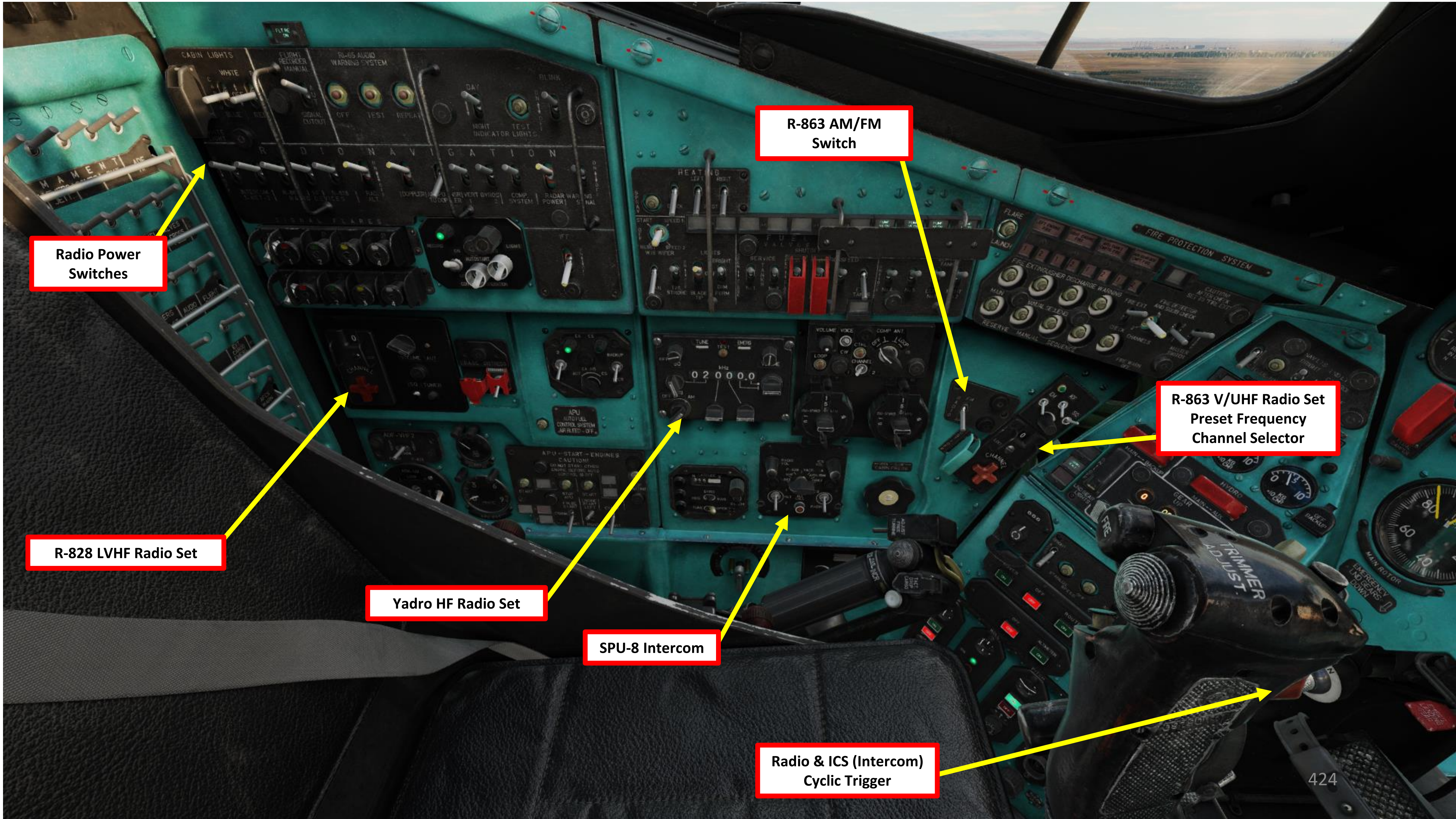
The Mi-24 has three radio sets that can be used for communications.

- The **VHF/UHF R-863** command radio set is used for Air-to-Air and Air-to-Ground primary communications (flight & Air Traffic Control calls).
- The **HF YaDRO-1** radio set is used for very long range Air-to-Air and Air-to-Ground communications.
- The **LVHF (Lower Very High Frequency) R-828** radio set is used for Air-to-Air and Air-to-Ground alternate communications.
    - Note: Can also be used for ADF (Automatic Direction Finding) radio navigation
- The **SPU-8 ICS** (Intercom Set) panel allows you to choose which radio set you communicate on.

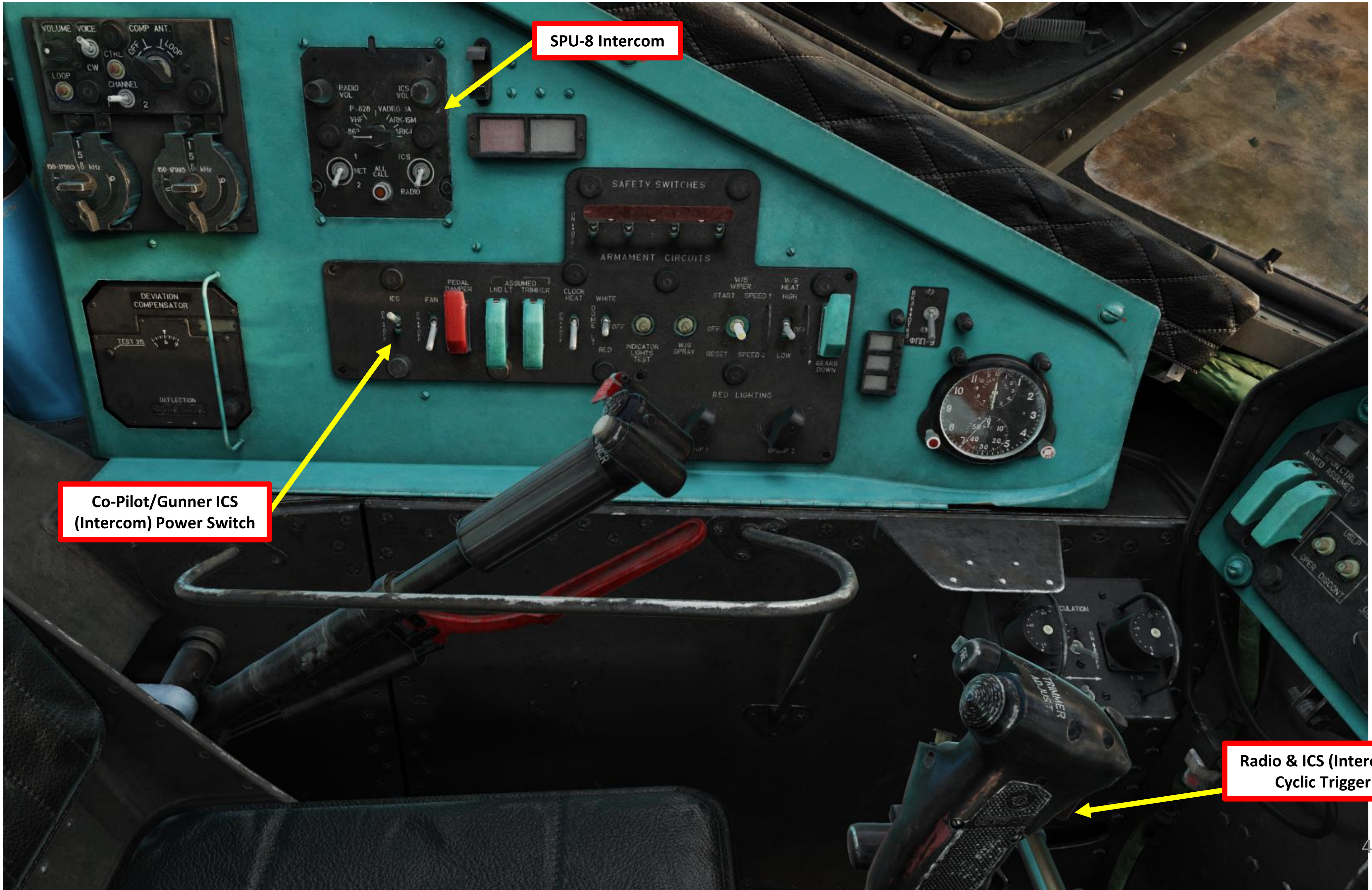
Most of the time, you will be using the R-863 radio.

Radio Set	Frequency Range
R-863 VHF/UHF	100 to 149.975 MHz 220 to 399.975 MHz
Yadro-1 HF	2 to 17.999 MHz
R-828 LVHF	20 to 59.975 MHz

RADIO SYSTEM OVERVIEW (PILOT-COMMANDER)



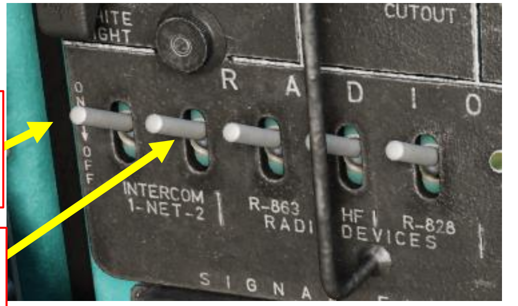
RADIO SYSTEM OVERVIEW (CO-PILOT/GUNNER)



SPU-8 ICS (INTERCOM SET)

The SPU-8 panel is what you use to select which radio you want to communicate on. It is available in both the **Pilot-Commander** and **Co-Pilot/Gunner** cockpits. To transmit via the Intercom:

1. Set SPU-8 NET 1 and NET 2 ICS Power Switches – ON (UP)
2. Set Co-Pilot/Gunner ICS Power Switch – ON (UP)
3. Set ICS/Radio Selector to ICS (UP)
4. Adjust ICS Volume
5. Select NET 1 or NET 2 – As Desired
6. Transmit on Intercom by holding the first stage detent of the Cyclic's SPU Radio Trigger (RSHIFT+SPACE)

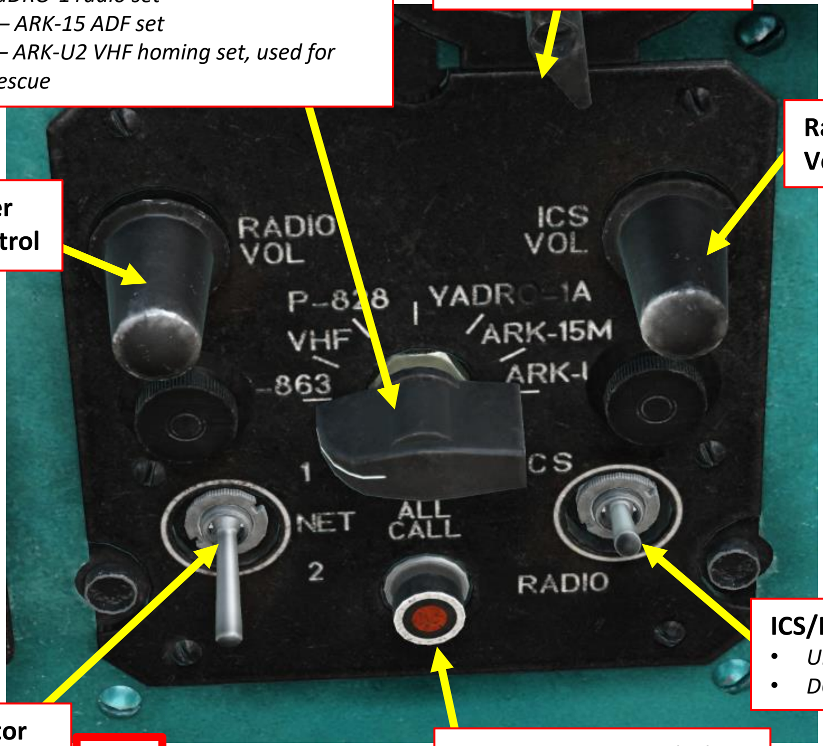


1 **SPU-8 Intercom (ICS) Power Switch – NET 1**
- *UP: ON / DOWN : OFF*

1 **SPU-8 Intercom (ICS) Power Switch – NET 2**
- *UP: ON / DOWN : OFF*

SPU-8 Radio Selector (Pilot-Commander)
- *"VK1" (V/UHF) – R-863 V/UHF radio set*
- *"VK2" (VHF) – Not Functional*
- *"KP" (VHF) – R-828 LVHF radio set*
- *"CP" (HF) – YaDRO-1 radio set*
- *"PK 1" (ADF) – ARK-15 ADF set*
- *"PK 2" (SAR) – ARK-U2 VHF homing set, used for Search and Rescue*

SPU-8 Intercom (ICS) Control Panel



Radio Master Volume Control

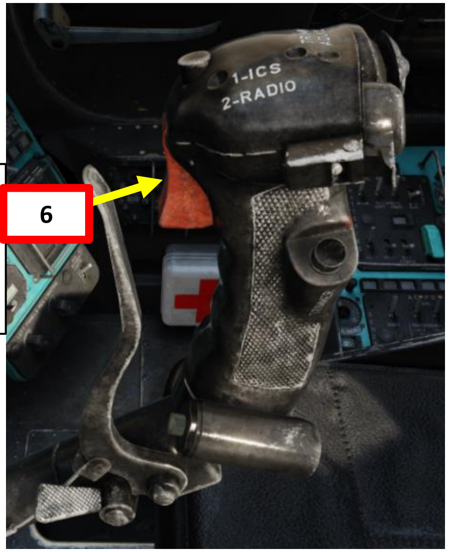
Radio ICS (Intercom) Volume Control **4**

NET 1-2 Selector (CETЬ 1-2) **5**

Emergency Transmission (ALL CALL) Button

3 **ICS/Radio Selector**
- *UP: СПУ (ICS Intercomm Switch)*
- *DOWN: РАД (Radio)*

SPU-8 Radio Selector (Co-Pilot/Gunner)
- *"VK1" (V/UHF) – R-863 V/UHF radio set*
- *"VK2" (VHF) – Not Functional*
- *"KP" (VHF) – R-828 LVHF radio set*
- *"CP" (HF) – YaDRO-1 radio set*
- *"PK 1" (ADF) – ARK-15 ADF set*
- *"PK 2" (SAR) – ARK-U2 VHF homing set, used for Search and Rescue*



SPU Radio Trigger **6**
- *First Stage Detent: Transmits on ICS (Intercom)*
- *Second Stage Detent: Transmits on Radio*

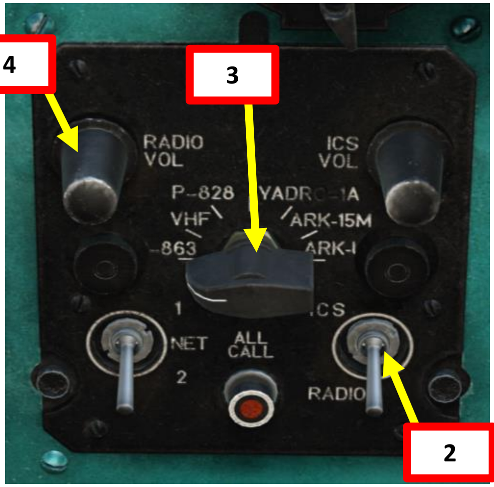
2 **SPU-8 Co-Pilot Intercom (ICS) Power Switch**
- *UP: ON / DOWN : OFF*

R-863 VHF/UHF COMMAND RADIO SET

The R-863 VHF/UHF radio has 20 preset channels, which can only be modified through the Mission Editor. To transmit on the R-863 radio:

1. Set R-863 Radio Power Switch – ON (UP)
2. Set ICS/Radio Selector to RADIO (DOWN)
3. On ICS panel, select R-863 radio.
4. Adjust Radio Volume – As required
5. On R-863 control panel, set Squelch to ON (UP) position for noise cancellation. If radio signal reception is not good, set to OFF (DOWN) to increase reception range.
6. On R-863 control panel, select AM or FM switch based on desired channel.
7. Select desired preset channel on the R-863 control panel
8. Transmit on radio by holding the second stage detent of the Cyclic's SPU Radio Trigger (RALT+\)

1 **R-863 V/UHF Radio Power Switch**
- *UP: ON / DOWN : OFF*



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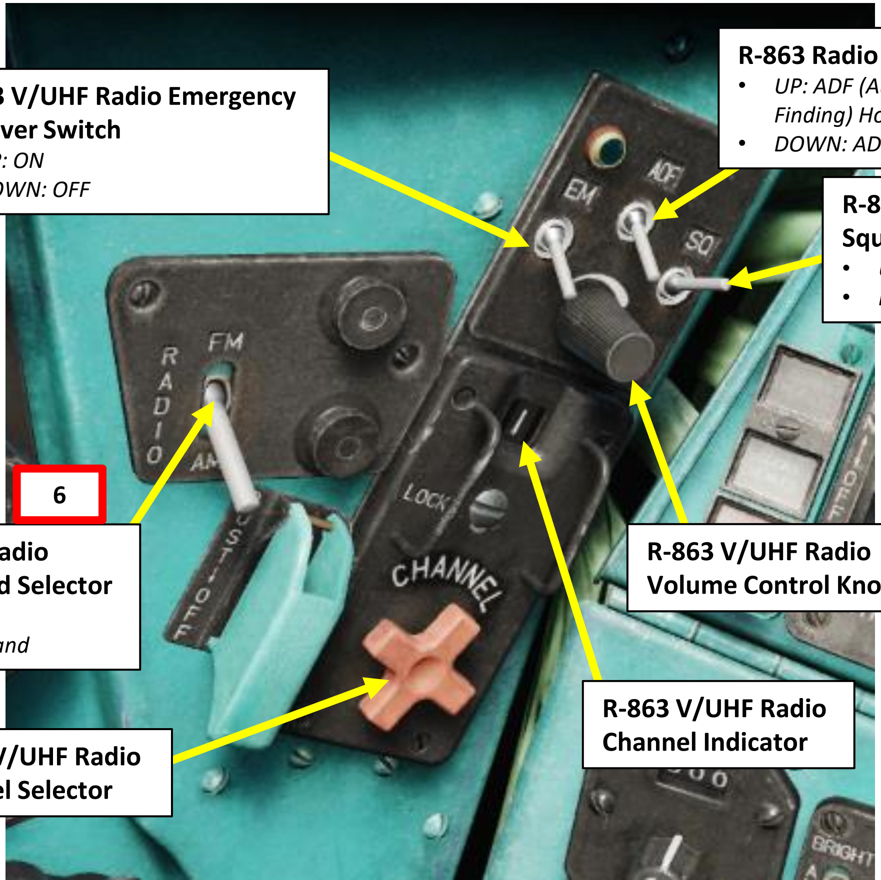


R-863 V/UHF Radio Emergency Receiver Switch
- *UP: ON*
- *DOWN: OFF*

R-863 Radio Homing Mode Switch
- *UP: ADF (Automatic Directional Finding) Homing with ARK-U2 Set*
- *DOWN: ADF Homing OFF*

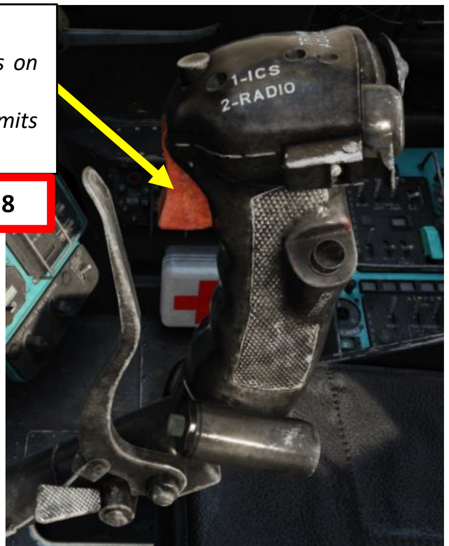
5 **R-863 V/UHF Radio Squelch Switch**
- *UP: Squelch ON*
- *DOWN: Squelch OFF*

6 **R-863 V/UHF Radio Frequency Band Selector**
- *UP: FM Band*
- *DOWN: AM Band*

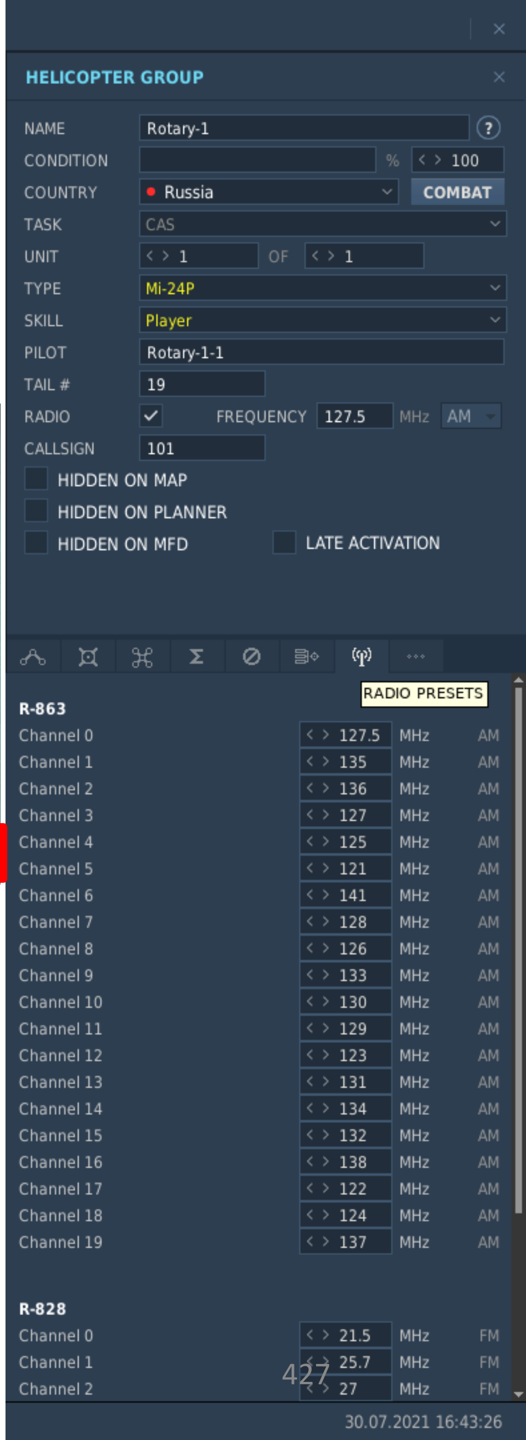
4 **R-863 V/UHF Radio Volume Control Knob**

R-863 V/UHF Radio Channel Indicator

7 **R-863 V/UHF Radio Channel Selector**

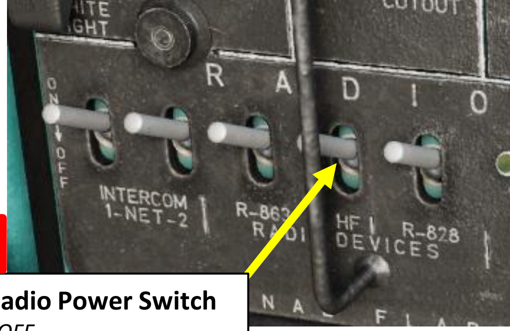


8 **SPU Radio Trigger**
- *First Stage Detent: Transmits on ICS (Intercom)*
- *Second Stage Detent: Transmits on Radio*



YADRO-1 HF RADIO SET

1. Set Yadro Radio Power Switch – ON (UP)
2. Set ICS/Radio Selector to RADIO (DOWN)
3. On ICS panel, select Yadro radio.
4. Adjust Radio Volume – As required
5. On Yadro control panel, set Squelch knob to ON (SQ) position for noise cancellation. If radio signal reception is not good, set knob to OFF to increase reception range.
6. On Yadro control panel, set power knob to ON (AM).
7. Select desired channel using the frequency selection knobs. The TUNING (HACT) light will illuminate.
8. Transmit on radio by holding the second stage detent of the Cyclic's SPU Radio Trigger (RALT+\)



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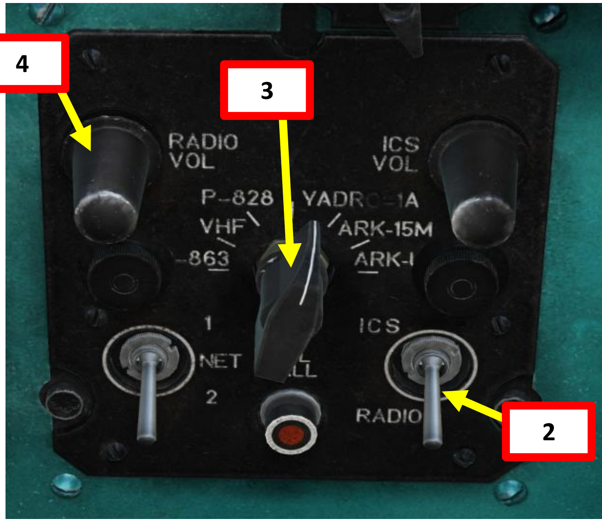
Yadro (*Jadro*) HF Radio Power Switch
- *UP: ON / DOWN : OFF*



4

3

2

7b

Tuning Light
- *The light illuminates while the radio is trying to automatically tune on the set frequency*

YaDRO-1 Test Switch

YaDRO-1 Emergency Light
- *The light illuminates if the radio becomes inoperative*

YaDRO-1 Squelch Knob

5

YaDRO-1 Volume Control

4

6

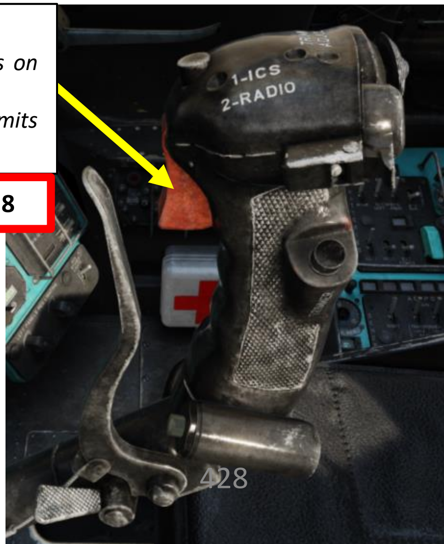
YaDRO-1 (*JADRO*) HF Radio Mode Selector
- *"ВЫКЛ" (OFF)*
- *"OM" (SSB, Single Sideband)*
- *"AM" (AM)*

YaDRO-1 Frequency Setters

7a

SPU Radio Trigger
- *First Stage Detent: Transmits on ICS (Intercom)*
- *Second Stage Detent: Transmits on Radio*

8



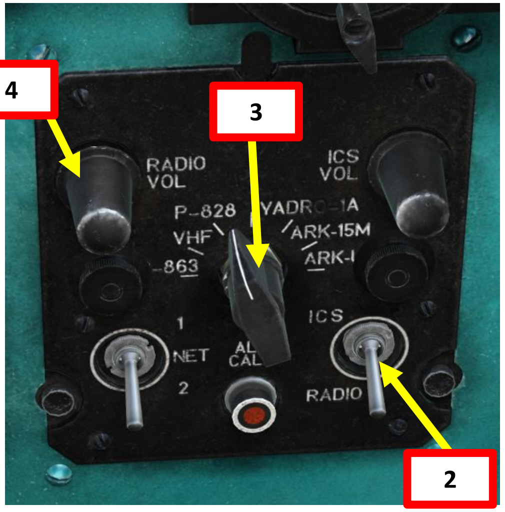
R-828 LVHF RADIO SET

The R-828 LVHF radio has 10 preset channels, which can only be modified through the Mission Editor. To transmit on the R-828 radio:

1. Set R-828 Radio Power Switch – ON (UP)
2. Set ICS/Radio Selector to RADIO (DOWN)
3. On ICS panel, select R-828 radio.
4. Adjust Radio Volume – As required
5. On ADF-VHF 2 control panel, set ADF-VHF 2 Source Selector – COMMUNICATIONS (MIDDLE).
6. On R-828 control panel, set Squelch to ON (UP) position.
7. On R-828 control panel, select desired preset channel.
8. On R-828 control panel, press Automatic Gain Control TUNE button (АСУ/ACG). TUNER (НАСТР) light will illuminate once radio is set.
9. Transmit on radio by holding the second stage detent of the Cyclic's SPU Radio Trigger (RALT+\)

1

R-828 LVHF Radio (M24 "Eucalyptus") Power Switch
- *UP: ON / DOWN : OFF*



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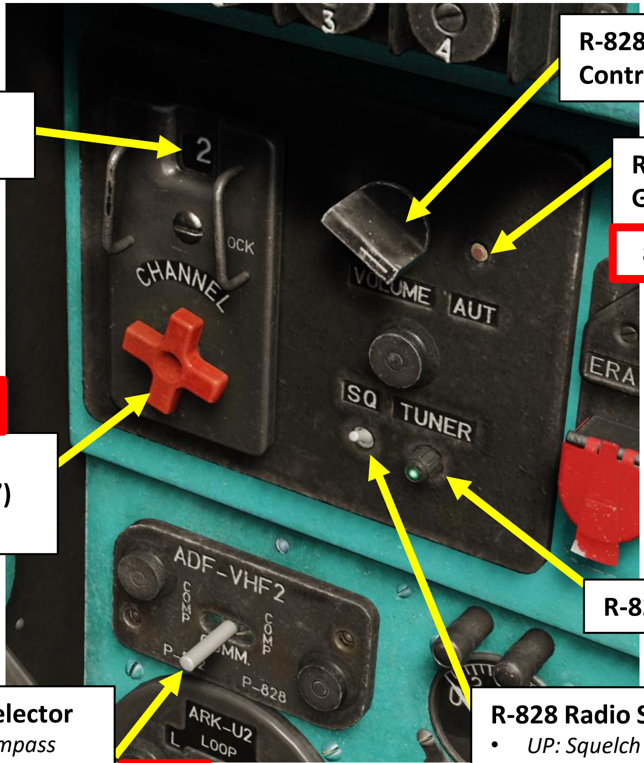


R-828 LVHF Radio Channel Indicator

R-828 Radio Volume Control Knob 4

R-828 Radio ACG (Automatic Gain Control) Button 8a

7 **R-828 LVHF Radio (M24 "Eucalyptus") Channel Selector**

R-828 Radio Tuner Light 8b

ADF-VHF 2 Source Selector
- *AFT: R-852 Radio Compass*
- *MIDDLE: Communication*
- *FWD: R-828 Radio Compass*

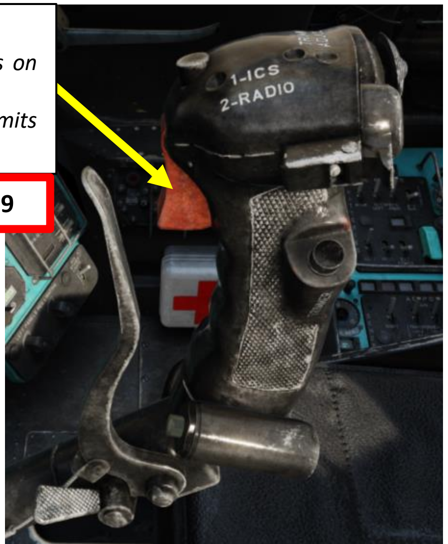
5

R-828 Radio Squelch Switch
- *UP: Squelch ON / DOWN : Squelch OFF*

6

SPU Radio Trigger
- *First Stage Detent: Transmits on ICS (Intercom)*
- *Second Stage Detent: Transmits on Radio*

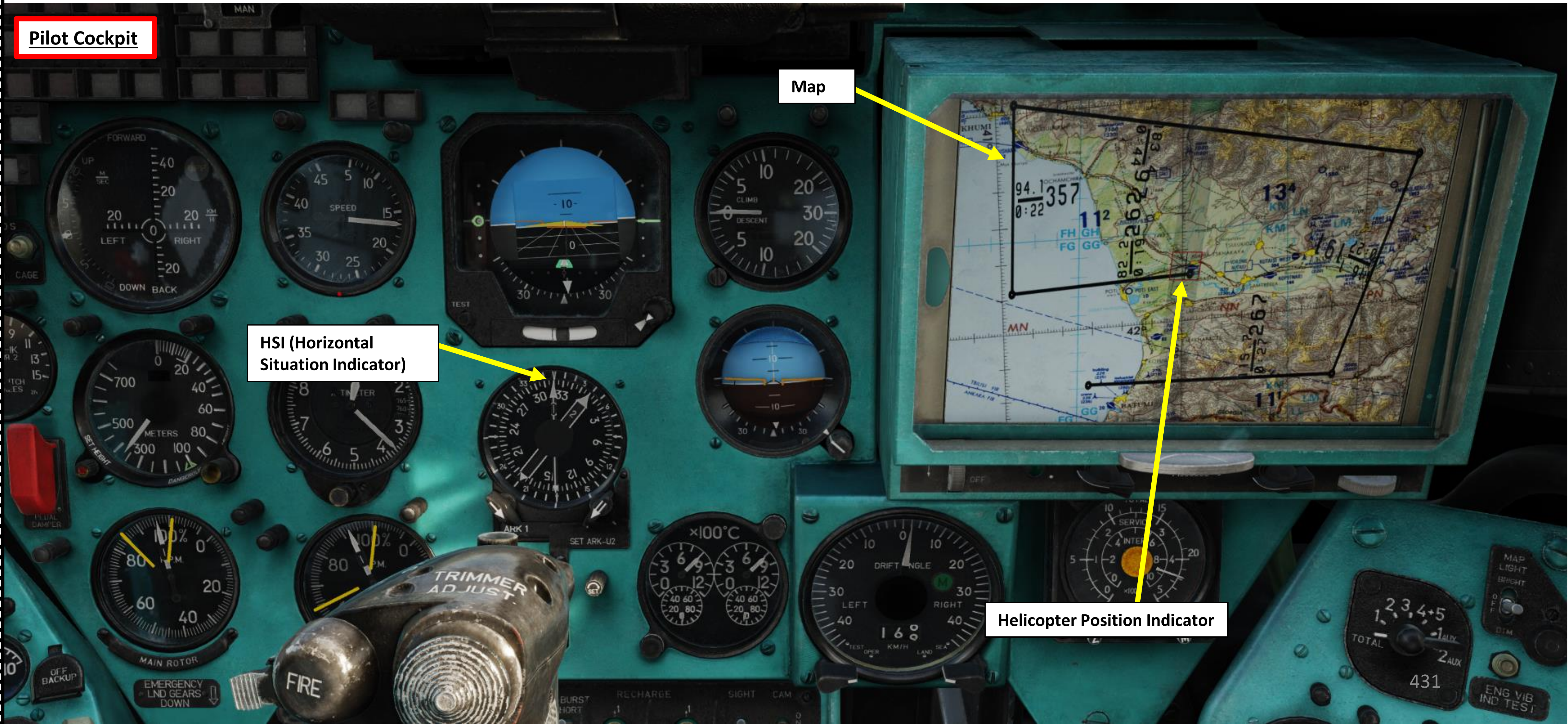
9



SECTION SUMMARY

1 – NAVIGATION SYSTEMS
1.1 – Primary Navigation Systems

The Mi-24 uses two primary devices for navigation: the HSI (Horizontal Situation Indicator) and the Map, which has a Helicopter Position Indicator (red square) that follows the helicopter position based on Doppler system inputs.



1 – NAVIGATION SYSTEMS
1.1 – Primary Navigation Systems

GREBEN-1 Course Control / Flight Director System Power Switch
- *UP: ON / DOWN : OFF*

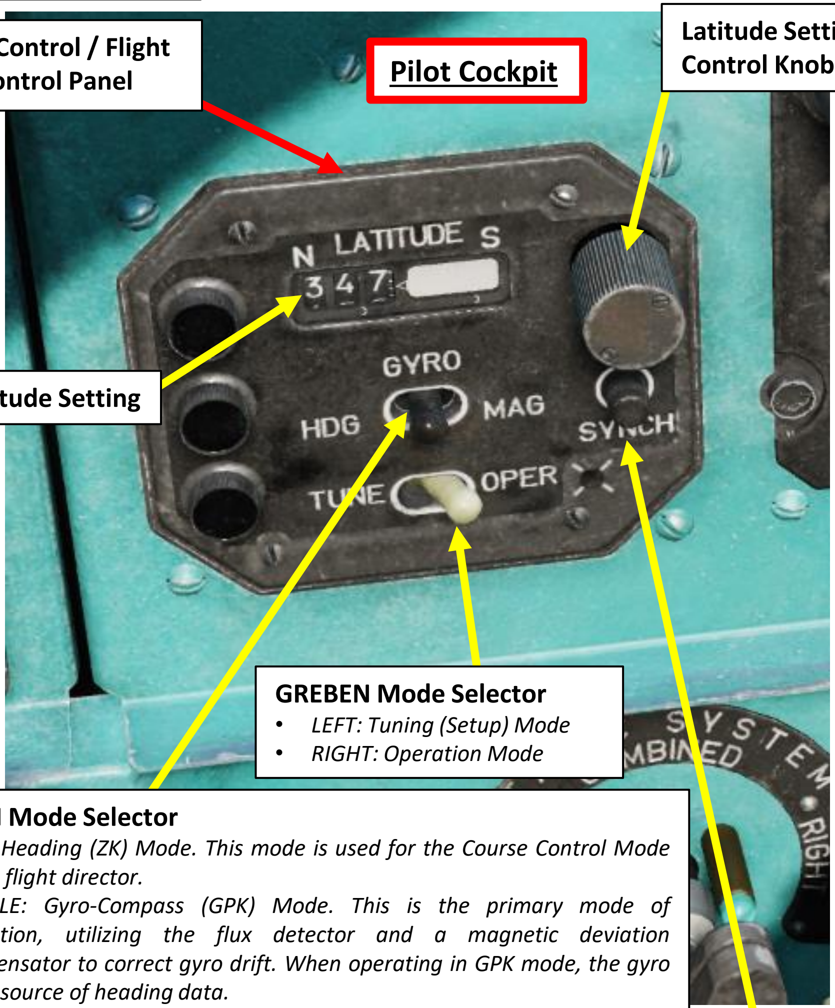
GREBEN-1 Course Control / Flight Director System Control Panel

Pilot Cockpit

Pilot Cockpit

Standby Magnetic Compass

HSI (Horizontal Situation Indicator)



Latitude Setting Control Knob

Latitude Setting

GREBEN Mode Selector
- *LEFT: Tuning (Setup) Mode*
- *RIGHT: Operation Mode*

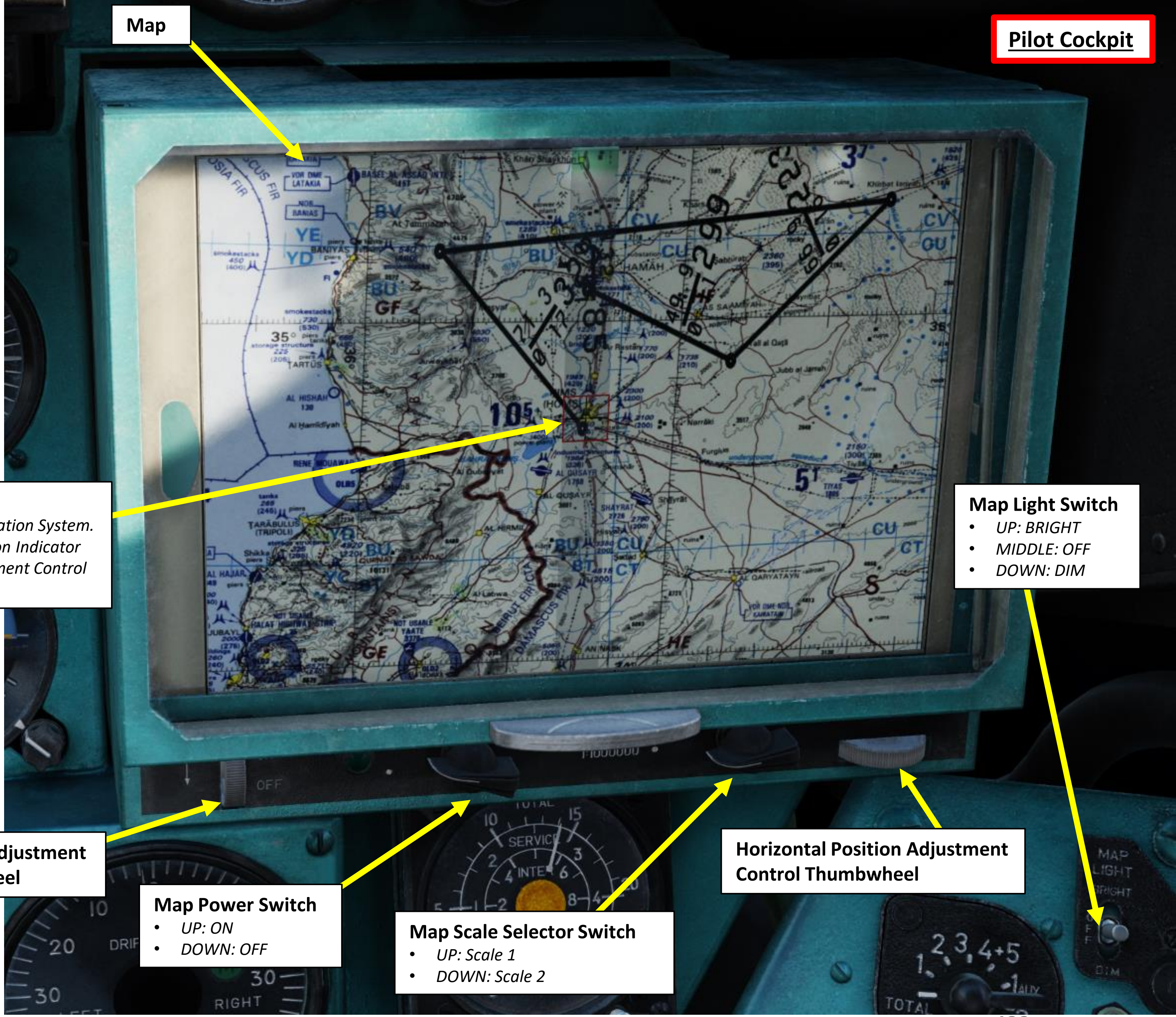
GREBEN Mode Selector
- *LEFT: Heading (ZK) Mode. This mode is used for the Course Control Mode of the flight director.*
- *MIDDLE: Gyro-Compass (GPK) Mode. This is the primary mode of operation, utilizing the flux detector and a magnetic deviation compensator to correct gyro drift. When operating in GPK mode, the gyro is the source of heading data.*
- *RIGHT: Magnetic (MK) Mode. MK mode is used to align the gyro to the signal provided by the flux detector and magnetic deviation compensator. The system is initialized in MK mode to allow the unit to establish baseline heading data. Automatic fast alignment occurs whenever the operating mode is switched from GPK (Gyro-Compass) to MK (Magnetic).*

GREBEN Synchronize (SYNC) Button
- *Commands alignment of the GREBEN based on the flux valve*

1 – NAVIGATION SYSTEMS
1.1 – Primary Navigation Systems

The Mi-24 has a **paper map** with a **Helicopter Position Indicator** that follows your own position.

- The Position Indicator is driven by the Doppler System.
    - The **Doppler System Power Switch** must be ON.
    - The **Map Power Switch** must be ON (UP)
    - During normal operation, the **Air Data Sensor to Doppler Power Switch** is left OFF.
- As positional error accumulates, the Position Indicator can be updated using the **Horizontal and Vertical Position Adjustment Control Thumbwheels**.
- The **Map Scale Selector switch** is used to open the map casing and install another paper map of another scale.

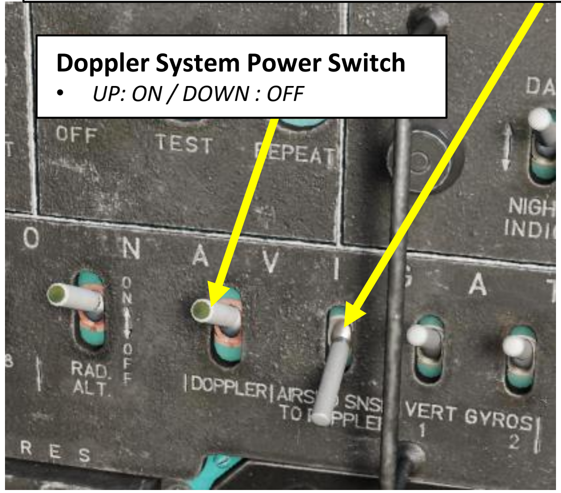


Map

Helicopter Position Indicator
- *The Position Indicator is moved on the map by the DISS-15 Doppler Navigation System.*
- *The helicopter's position can accumulate error/drift over time. The Position Indicator can be adjusted with the Vertical Position and Horizontal Position Adjustment Control thumbwheels.*

Map Light Switch
- *UP: BRIGHT*
- *MIDDLE: OFF*
- *DOWN: DIM*

DVS (Air Data Sensor) to Doppler Power Switch
- *UP: ON / DOWN : OFF*



Doppler System Power Switch
- *UP: ON / DOWN : OFF*

Vertical Position Adjustment Control Thumbwheel

Map Power Switch
- *UP: ON*
- *DOWN: OFF*

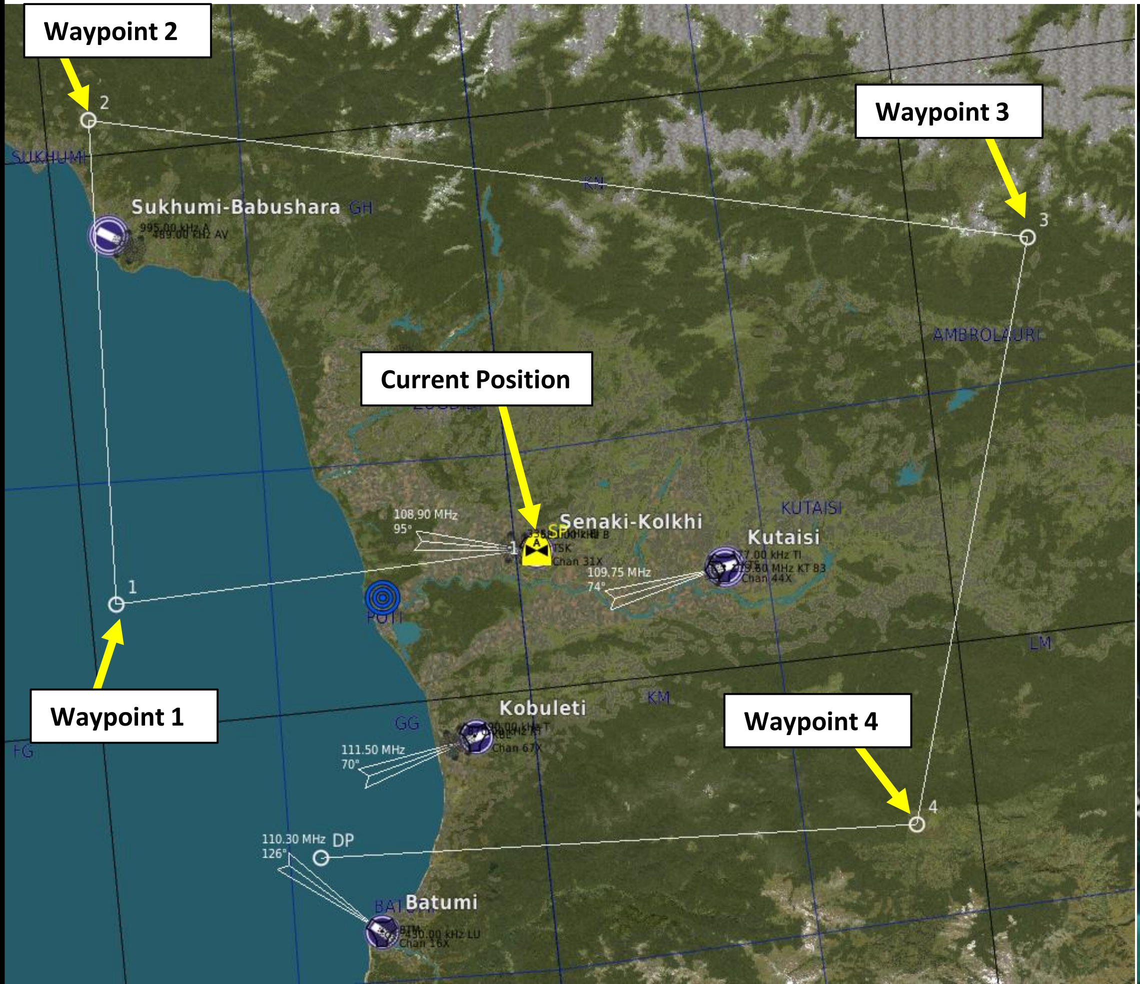
Map Scale Selector Switch
- *UP: Scale 1*
- *DOWN: Scale 2*

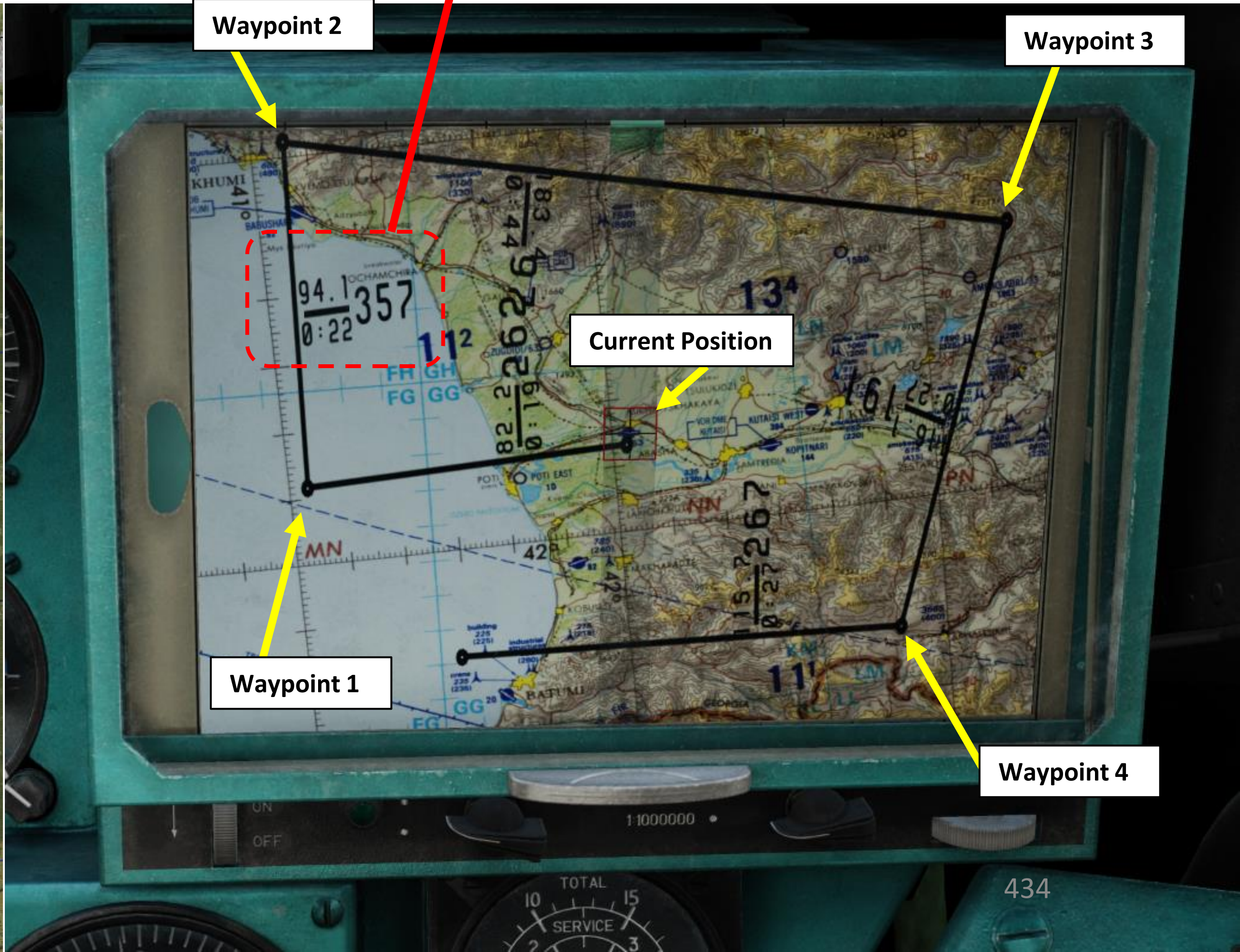
Horizontal Position Adjustment Control Thumbwheel

1 – NAVIGATION SYSTEMS
1.1 – Primary Navigation Systems

As waypoints are created in the Mission Editor, these waypoints are also drawn on the paper map with distance, heading and flight time information for each leg of the flight plan.

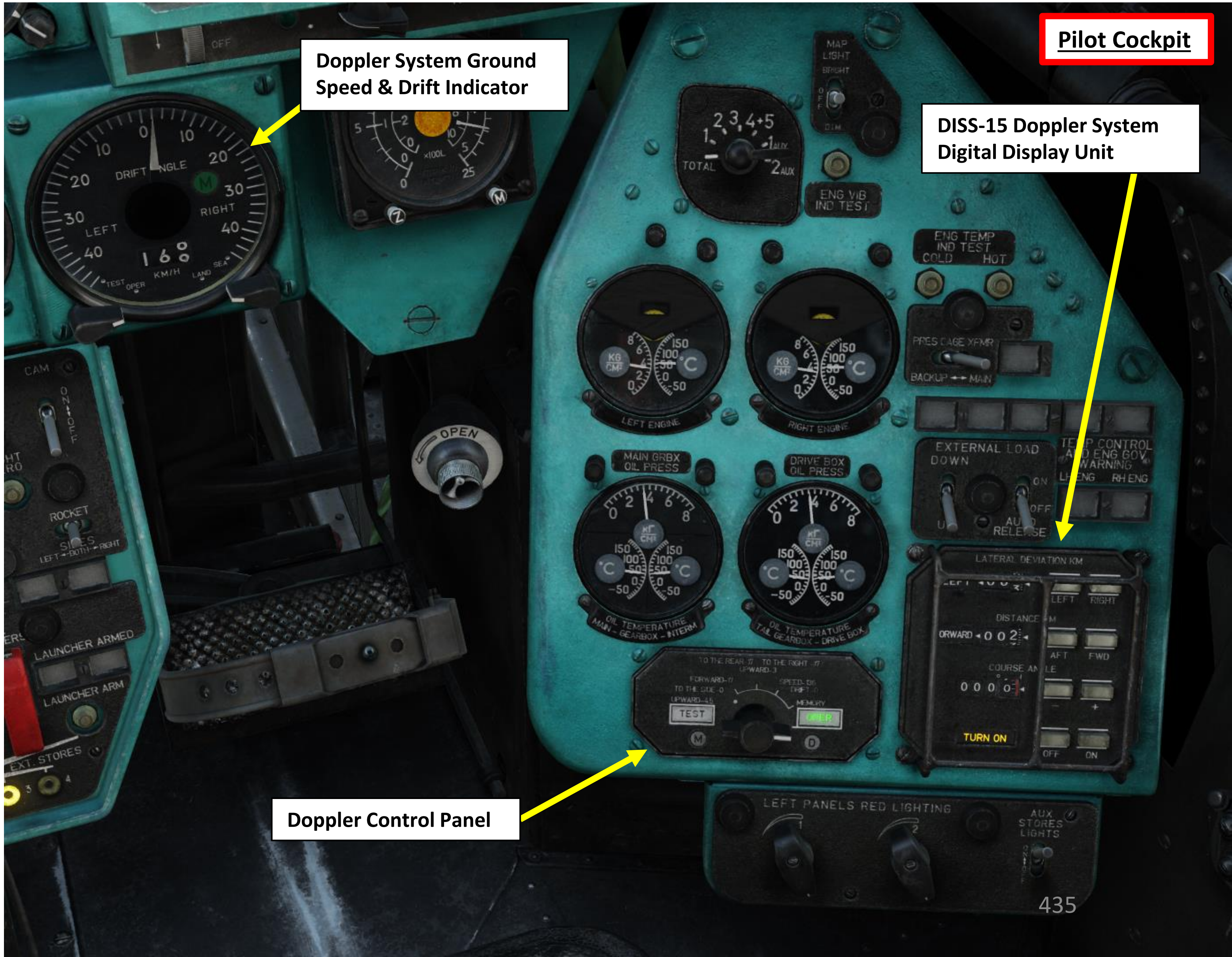
Leg 2 (Waypoint 1 – Waypoint 2) Data
- 94.1 – Leg distance in km
- 0:22 – Time required for segment (22 minutes)
- 357 – Heading between Waypoint 1 and Waypoint 2





1 – NAVIGATION SYSTEMS
1.1 – Primary Navigation Systems

The Doppler Control Panel and Doppler System Ground Speed & Drift Indicators will be further explained in section 2.



1 – NAVIGATION SYSTEMS

1.1 – Primary Navigation Systems

1 – NAVIGATION SYSTEMS
1.2 – Radio-Navigation Systems

1 – NAVIGATION SYSTEMS
1.2 – Radio-Navigation Systems

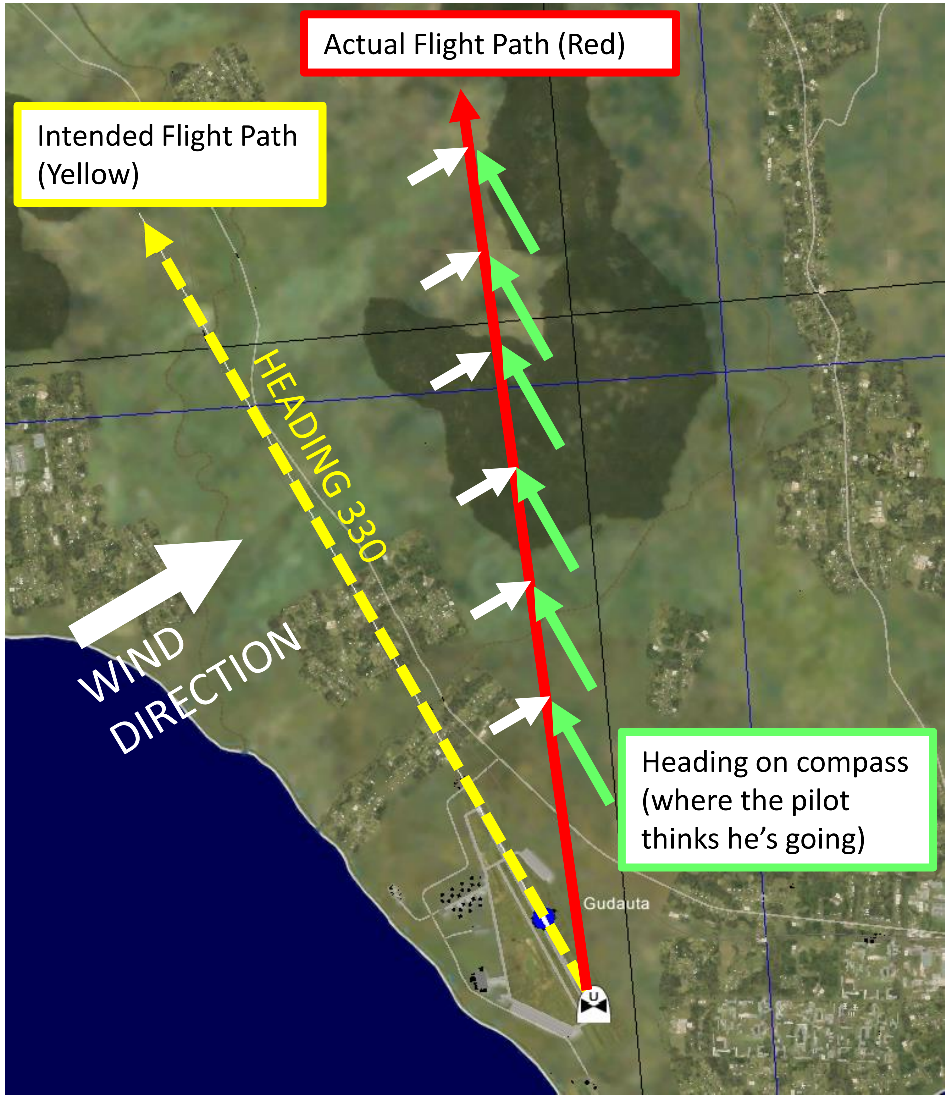
2 – DISS-15 DOPPLER SYSTEM
2.1 - Summary

Old generation aircraft traditionally navigate using a magnetic compass and a directional gyro. A needle points somewhere, and by staying the course they expect to arrive to their destination. However, real life is not so simple. Wind can have a dramatic effect on navigation, especially on long-distance flights. If a pilot follows a certain heading and wind is pushing him sideways, he can start drifting and be completely off course. The compass will tell him that he is going in a certain direction (and in a certain sense, he is facing a direction that is parallel to the direction he intends to take) but in reality he will be drifting away.

This is why Doppler navigation systems were conceived: it allowed the pilot to fly to a certain heading and detect whether or not the wind is pushing him off course.

The Doppler effect is probably that boring phenomenon you heard about in high school and didn't care about at the time. Basically, the Doppler effect is the reason why airplane fly-bys in airshows are so awesome to listen to: a moving object (like a plane) is emitting waves (like sound waves) that are received by an observer (you), and the frequency of this wave (like the sound pitch) will change the closer or farther the aircraft comes to you.

A Doppler system installed on the Mi-24 transmits and receives waves, and a computer calculates your ground speed and drift angle. It also gives a more responsive approximation of your vertical speed, which is very useful to know if you are sinking too quickly during precision approaches. Pretty cool, eh?



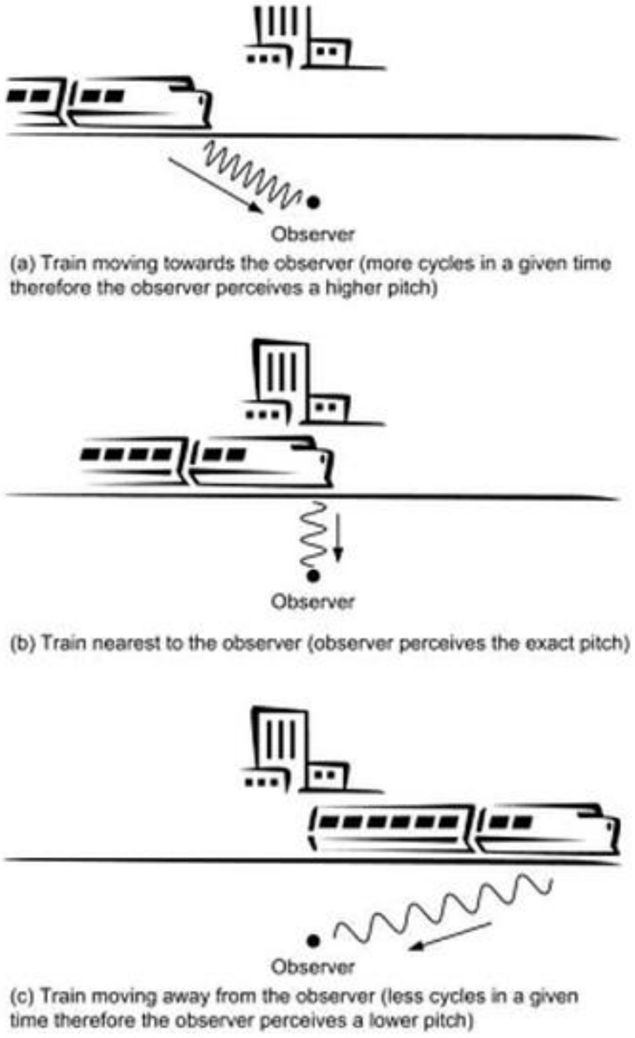
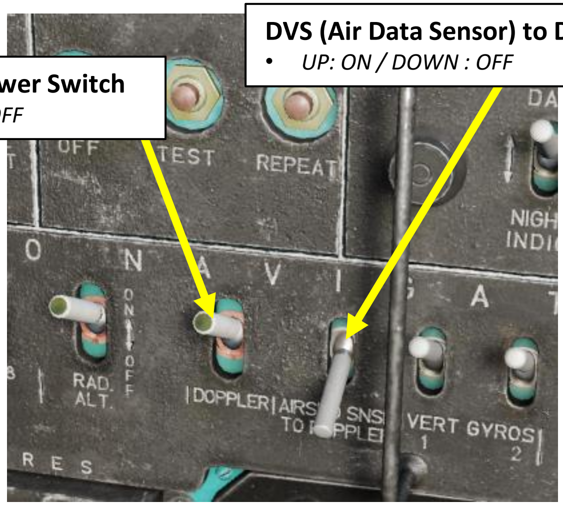
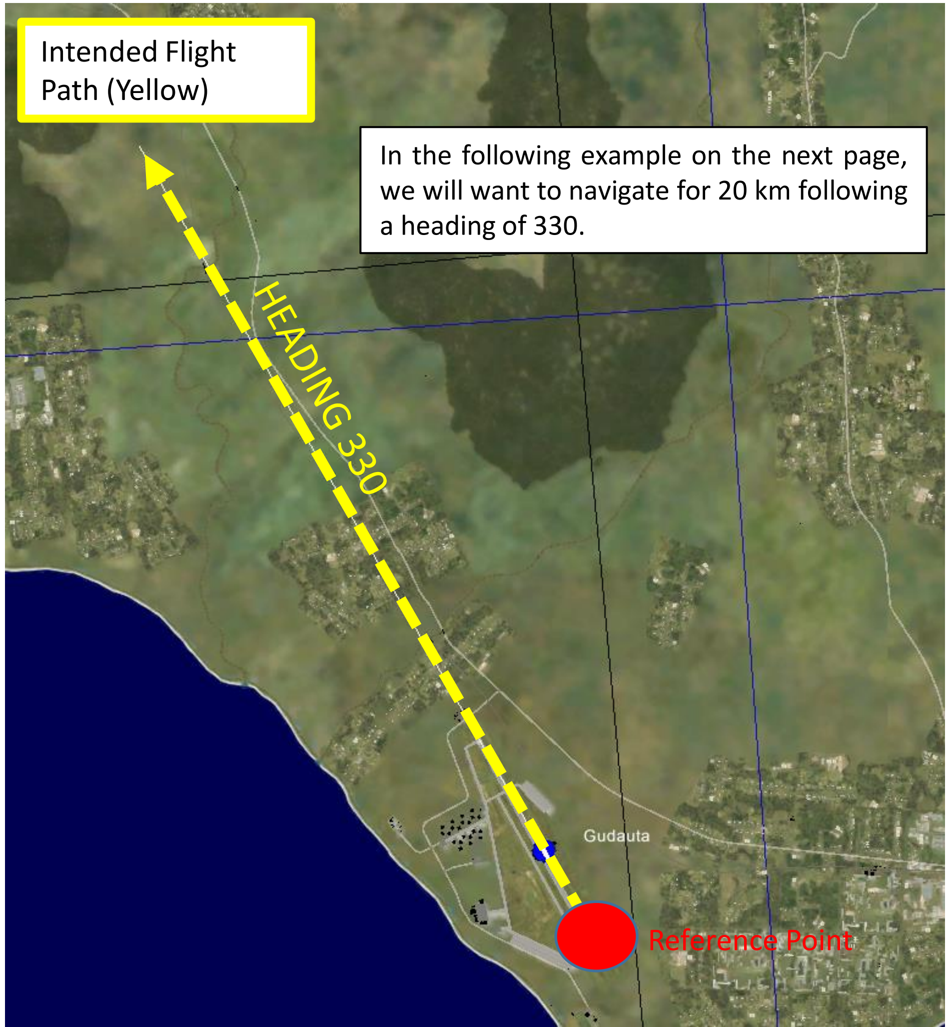


Figure 15.1 The Doppler effect

2 – DISS-15 DOPPLER SYSTEM
2.2 - Basics

The Doppler System is used for leg navigation (i.e. navigating from point A to point B, and then to point C…). If you have a map and a set of waypoints, you can create a flight plan from a starting reference point (i.e. fly for 20 km at a 330 heading, then fly for 30 km at a 090 heading…) and use the Doppler system to monitor the distance you travelled from the reference point and how far you are drifting from your real intended flight path. Using the Doppler system is very simple: you turn it on and set your reference point, follow the heading using the HSI (Horizontal Situation Indicator) and make sure the drift displayed is equal to 0.





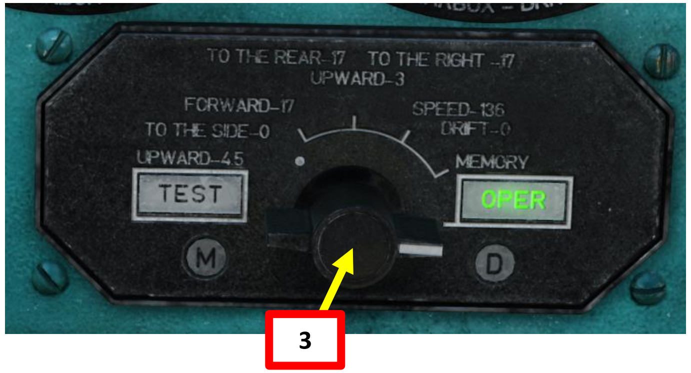
2 – DISS-15 DOPPLER SYSTEM

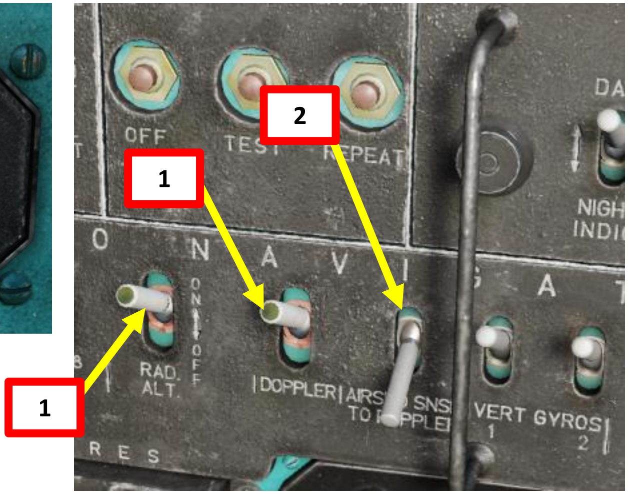
2.2 - Basics

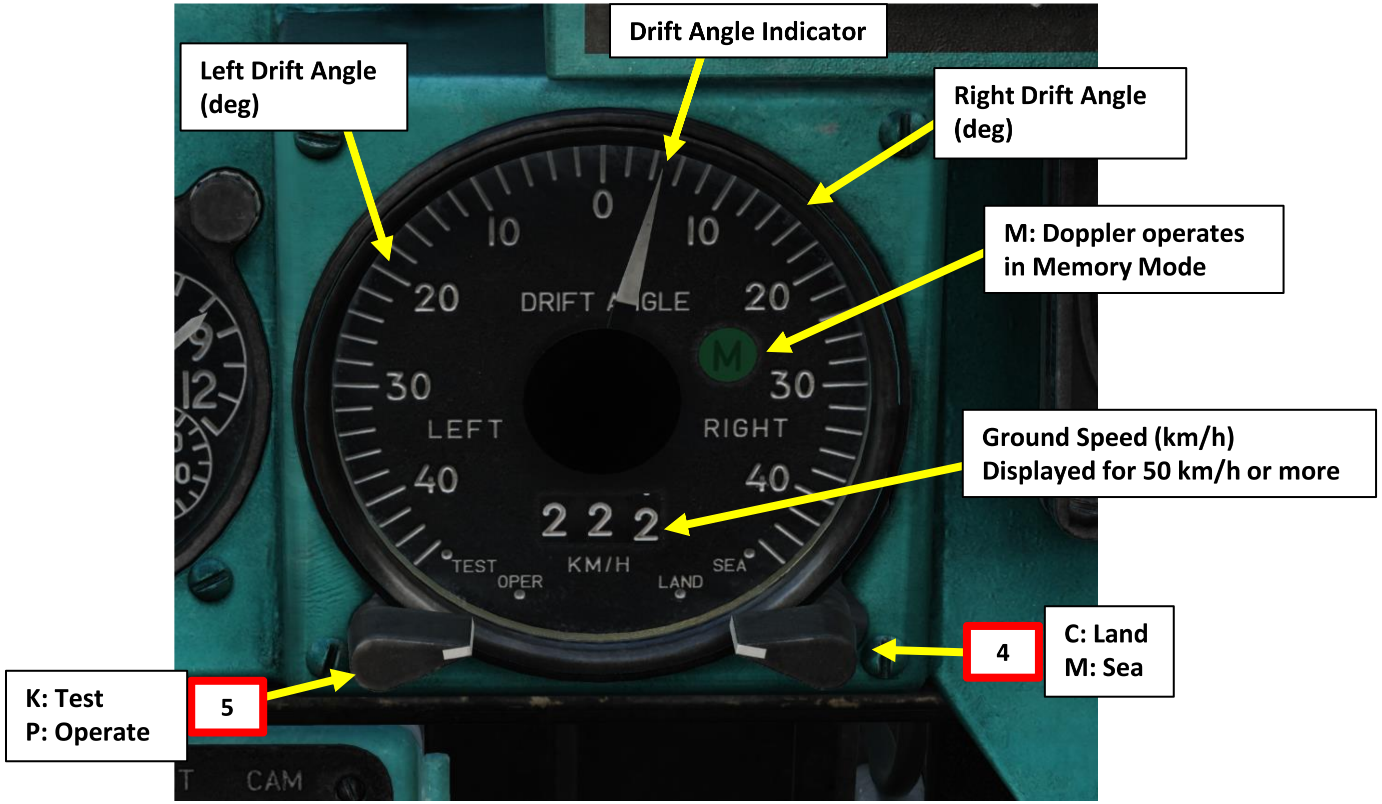
This light indicates that data is being transmitted from the DISS-15 Doppler System to the Map.

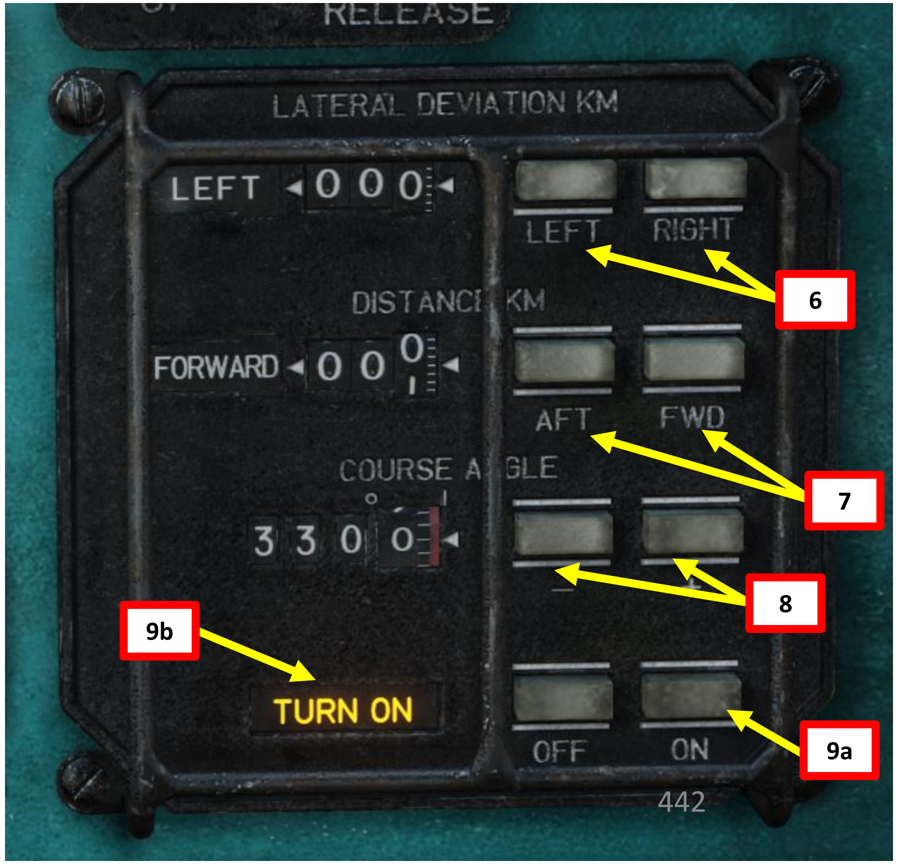
2 – DISS-15 DOPPLER SYSTEM
2.3 – Doppler Navigation Tutorial

1. Set Doppler Power Switch and Radar Altimeter Power Switches – ON (UP)
2. Set DVS (Air Data Sensor) to Doppler Power Switch - OFF (DOWN)
3. Set Doppler System mode to OPERATE (РАБОТА).
4. Set your Doppler ground speed & drift indicator to “C” (LAND) or “M” (SEA) depending on where you will fly over.
5. Set your Doppler ground speed & drift indicator to “P” (OPERATE).
6. Set your LATERAL DRIFT (km) to 0 using the LEFT and RIGHT buttons.
7. Set your DISTANCE (km) to either 0 (if you want to have a counter of the distance you travelled so far) or to the distance you want to travel using the “H” (AFT) button (if you want to have a counter that tells you how close you are to your waypoint).
8. Set your HEADING ANGLE (degrees) to 330 deg & 0 minute.
9. Set Doppler System to ON to tell the system to take your current location as your reference point.









2 – DISS-15 DOPPLER SYSTEM
2.3 – Doppler Navigation Tutorial

10. Set HSI (Horizontal Situation Indicator) Mode Selector – LEFT (ZK, Course/Heading Mode).
11. Set your HSI (Horizontal Situation Indicator) course setter (Needle 2) to 330. This is useful to have a reference heading to consult to compare the aircraft actual heading against the actual course deviation.
12. Fly on desired course by using the HSI heading as a rough reference for direction (keep in mind that the heading and course of the HSI may not correspond to the desired course if you have to fly “crabbed” due to winds) and the Drift Angle indicator to know how much you deviate from the programmed course plotted. You can monitor your drift angle and your speed using the Ground Speed & Drift Angle Indicator.

Current Heading

Needle 2 (Course Setting 330)

11

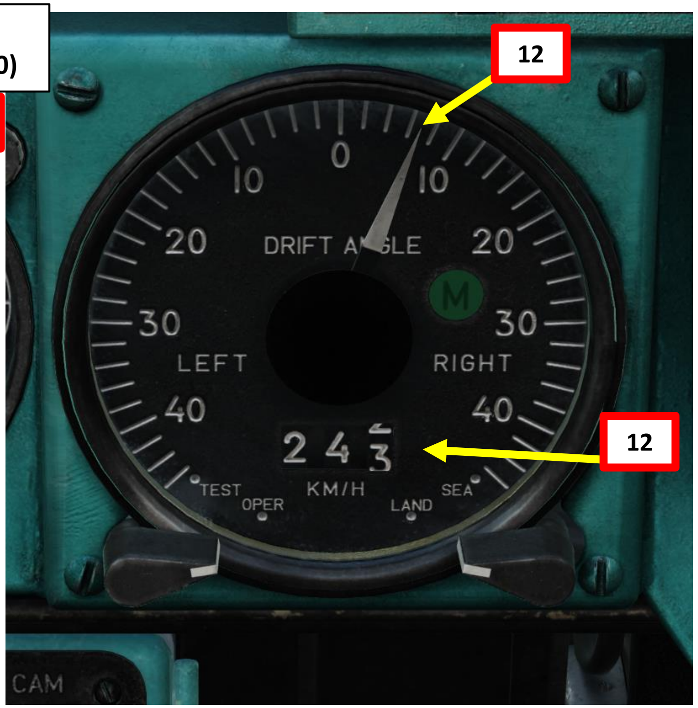
10

HSI (Horizontal Situation Indicator) Mode Selector
- *LEFT: ZK (Course/Heading Mode), Needle 2 points towards the course set by the HSI Course Set Knob*
- *RIGHT: ARK-U2 (Homing Mode), Needle 2 points towards radio emitter tracked by ARK-U2 system*

11

HSI (Horizontal Situation Indicator) Course Set Knob

12



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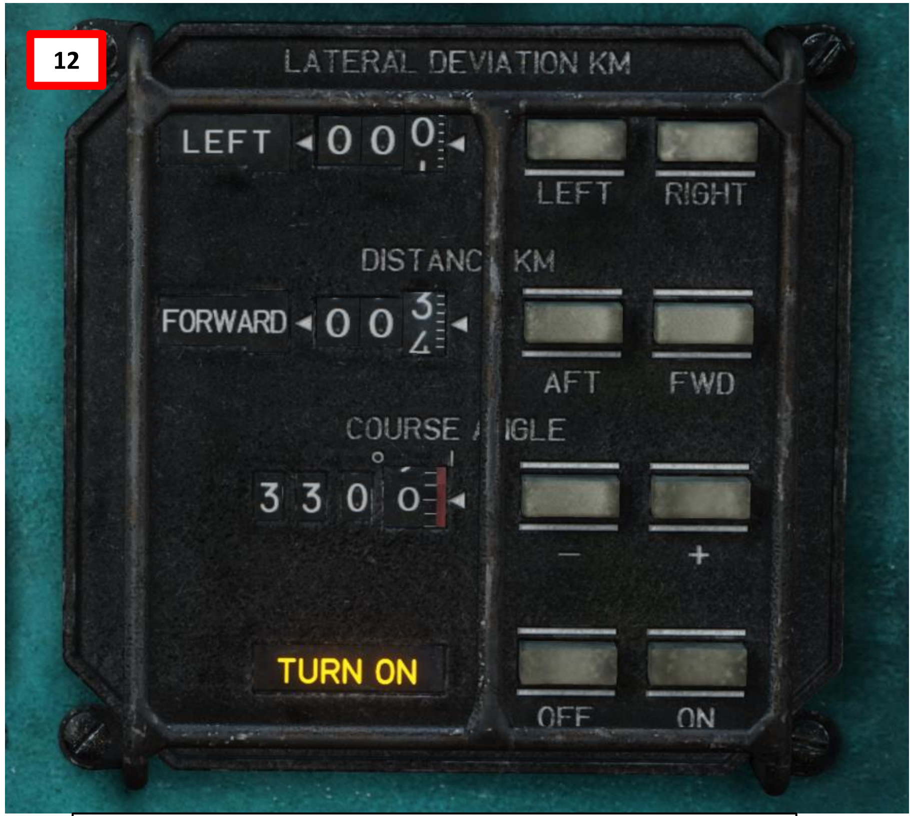
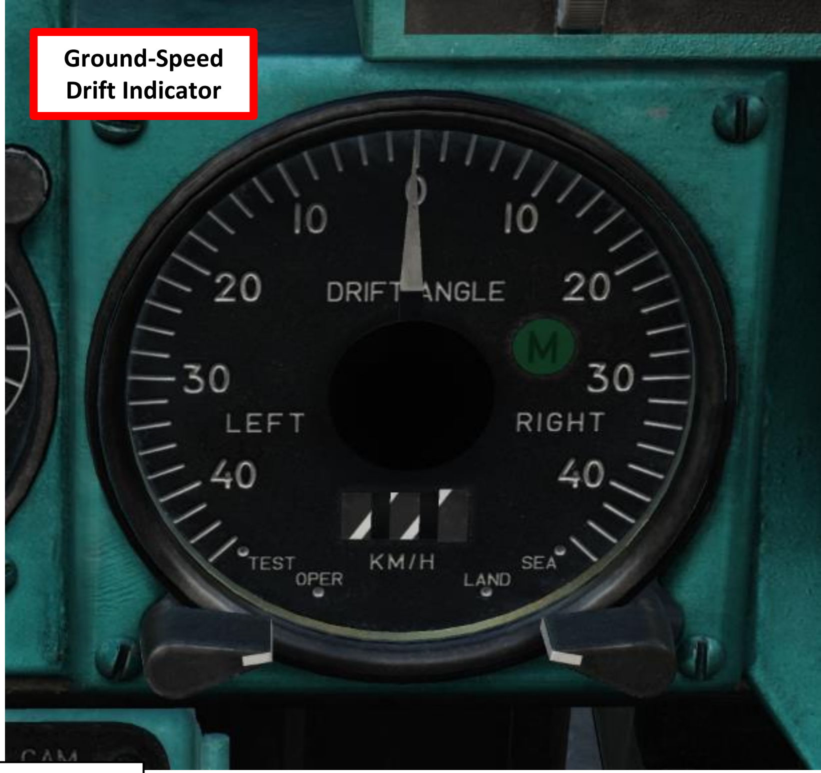


In this example, we are 8 degrees off course. This is what the HSI (Horizontal Situation Indicator) and the Doppler Ground Speed & Drift Angle indicators are saying.

2 – DISS-15 DOPPLER SYSTEM
2.3 – Doppler Navigation Tutorial

- Note: During normal flight, the DVS (Air Data Sensor) to Doppler Power Switch is set to OFF.
- However, in cases where the Doppler System is heavily compromised/damaged on the tailboom or the Doppler System is unavailable due to a high altitude or water (which can sometimes give faulty radar altimeter returns in certain conditions)… this can severely affect forward speed and lateral speed computation, which are necessary inputs for the optical sight and autopilot.
- In that situation, the DVS (Air Data Sensor) to Doppler Power Switch can be set to ON. This will use airspeed data from the Air Data Sensor to calculate forward and lateral speed based on the airspeed, slip and angle of attack measured by the front air data sensor probe. This allows a degraded use of mission critical systems.
- When DVS Doppler Power is ON, ground speed and drift angle indications on the Ground Speed & Drift Indicator become increasingly inaccurate and are eventually disabled. Navigation or Precision flying becomes nearly impossible, and the airspeed error can easily increase beyond 20 km/h.
- Keep in mind that this is mostly a “Hail Mary, I need a gunsight now!” kind of procedure and is very rarely used.



DVS (Air Data Sensor) to Doppler Power Switch
- *UP: ON / DOWN : OFF*

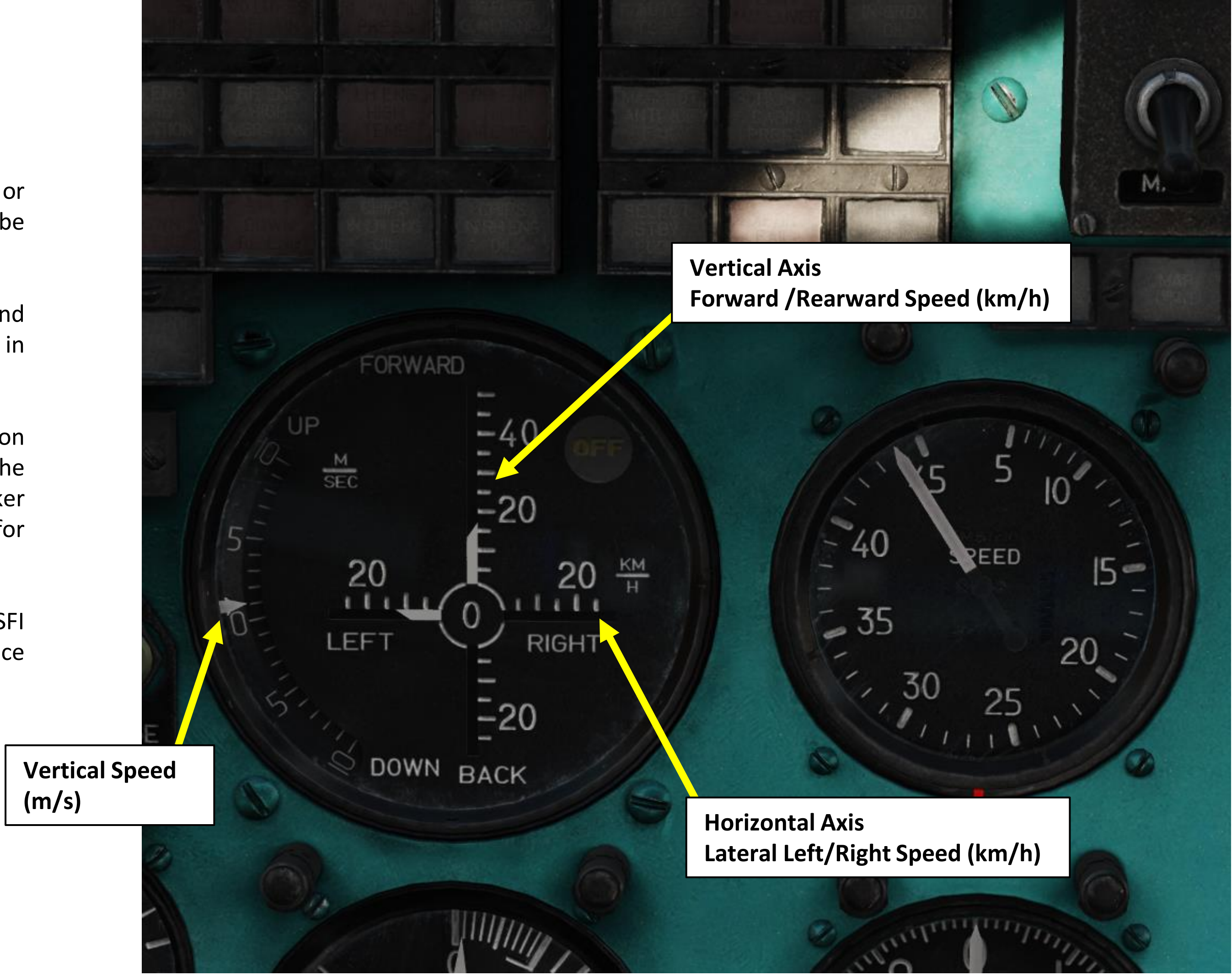
2 – DISS-15 DOPPLER SYSTEM
2.4 – Stationary Flight Indicator

The Doppler system is not only useful for ground speed: it is also useful for low speed or stationary flight (hover). The Stationary Flight Indicator needs the Doppler system to be set to OPERATE (РАБОТА) as shown in previous Doppler Tutorials.

Why would you need this Doppler indicator if you already have vertical velocity and airspeed indicators? Well, normal airspeed gauges rely on pitot tubes and air pressure in order to derive an airspeed from pressure values.

The Doppler System does not rely on air pressure: it is a separate system that relies on the wave transmitter and receivers installed on the airframe itself. The advantage of the Doppler System is that it is much more responsive (meaning that you will have a quicker approximation of your actual velocity), which is very useful when you are coming for precision approaches.

You can do the test yourself and compare the vertical velocity indicator under the SFI with the vertical speed value displayed on the Stationary Flight Indicator. You will notice that the SFI gives you a quicker and better approximation.



3.1 – ADF & NDB NAVIGATION INTRODUCTION

Navigation is an extensive subject. You can check chapter 15 of FAA manual for more details on navigation.

LINK: http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/media/PHAK%20-%20Chapter%2015.pdf

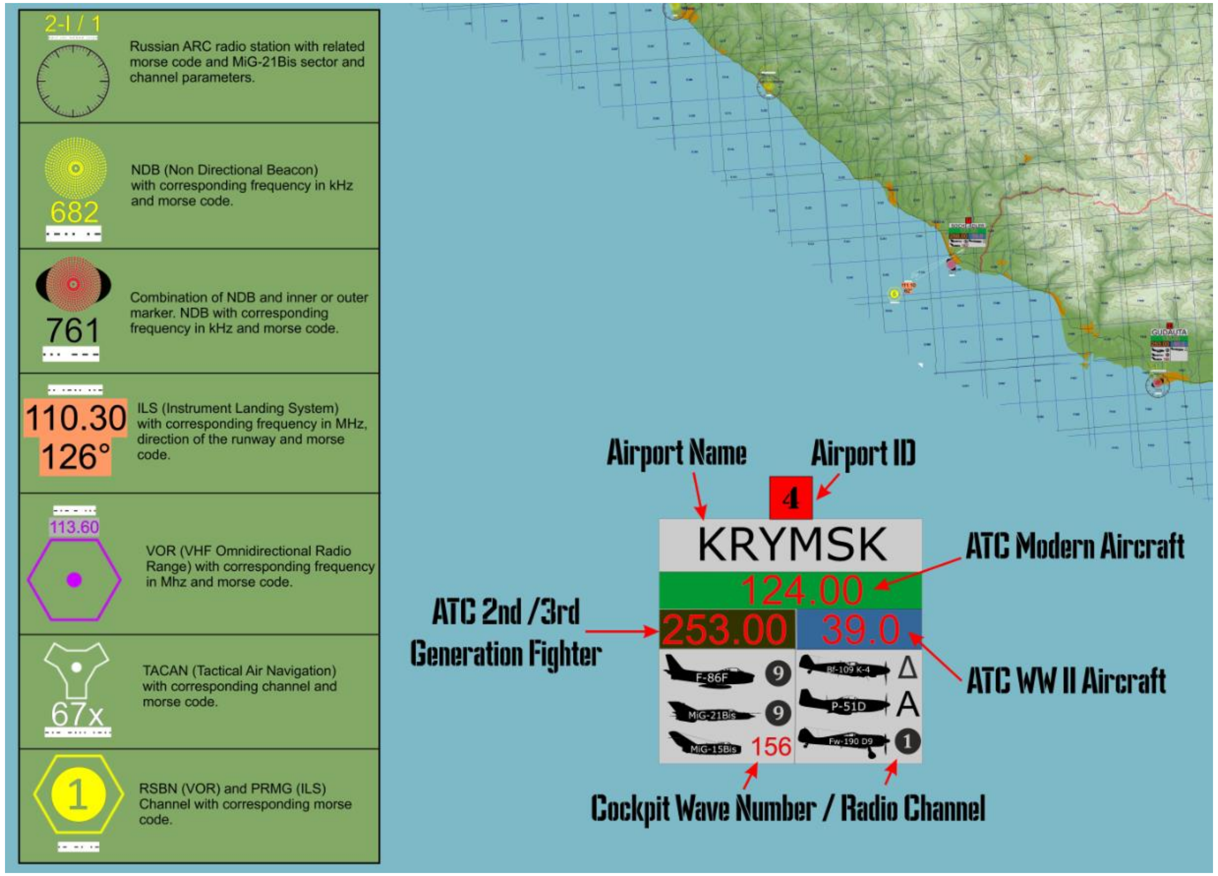
- “NDB” is what we call a non-directional beacon. It transmits radio waves on a certain frequency on long distances. These waves are read by an ADF (automatic direction finder). NDBs are typically used for radio navigation.
- “VOR” is what we call a VHF Omnidirectional Range system. It transmits radio waves on a certain frequency. These waves are read by a VOR receiver. VOR systems, just like NDBs, can be used for radio navigation.
- NDB and VOR are used just like lighthouses were used to guide ships. This way, air corridors and airways are created to help control an increasingly crowded sky.

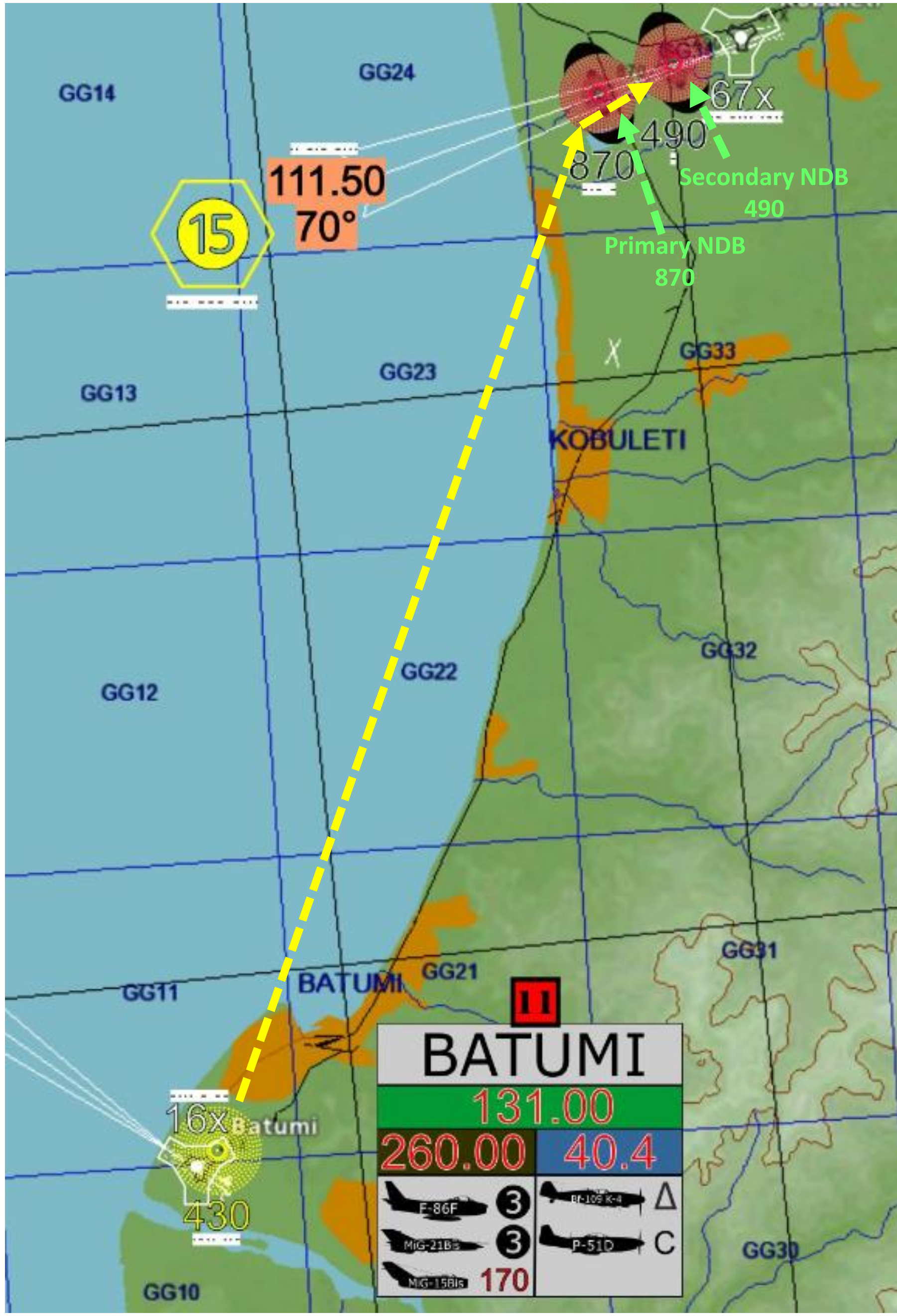
- The Mi-24 can navigate using the following radio-navigation equipment:
  - **ARK-15M ADF radio set:** you can track NDB (non-directional beacons), which are scattered throughout the map. The ADF will give you a direction to follow, but not a range.
  - **ARK-U2 VHF radio set:** Emergency radio navigation system used for search and rescue. Useful for units that transmit emergency signal on VHF frequency.
  - **ARK-U2 and R-828 UHF/FM radio set:** Emergency radio navigation system used for search and rescue. Useful for ground units that transmit emergency signal on UHF/FM frequency.
  - **ARK-U2 and R-852 VHF/AM radio set:** Emergency radio navigation system used for search and rescue. Useful for units that transmit emergency signal on VHF/AM frequency.
  - **DISS-15 Doppler Navigation System:** Navigation system to help you maintain a heading (useful to counter the effects of wind drift). Used for leg navigation.

3.1 – ADF & NDB NAVIGATION INTRODUCTION

Lino_Germany created a **wonderful** HD map containing all NDB stations and VOR/ILS stations scattered throughout the map. Use this to know the NDB and VOR channel frequencies you need to set.
LINK: https://drive.google.com/open?id=0B-uSpZROuEd3YWJBUmZTazBGajQ&authuser=0

In the following example, we will take off from Batumi and navigate towards NDB 870, and then we will turn towards NDB 490.

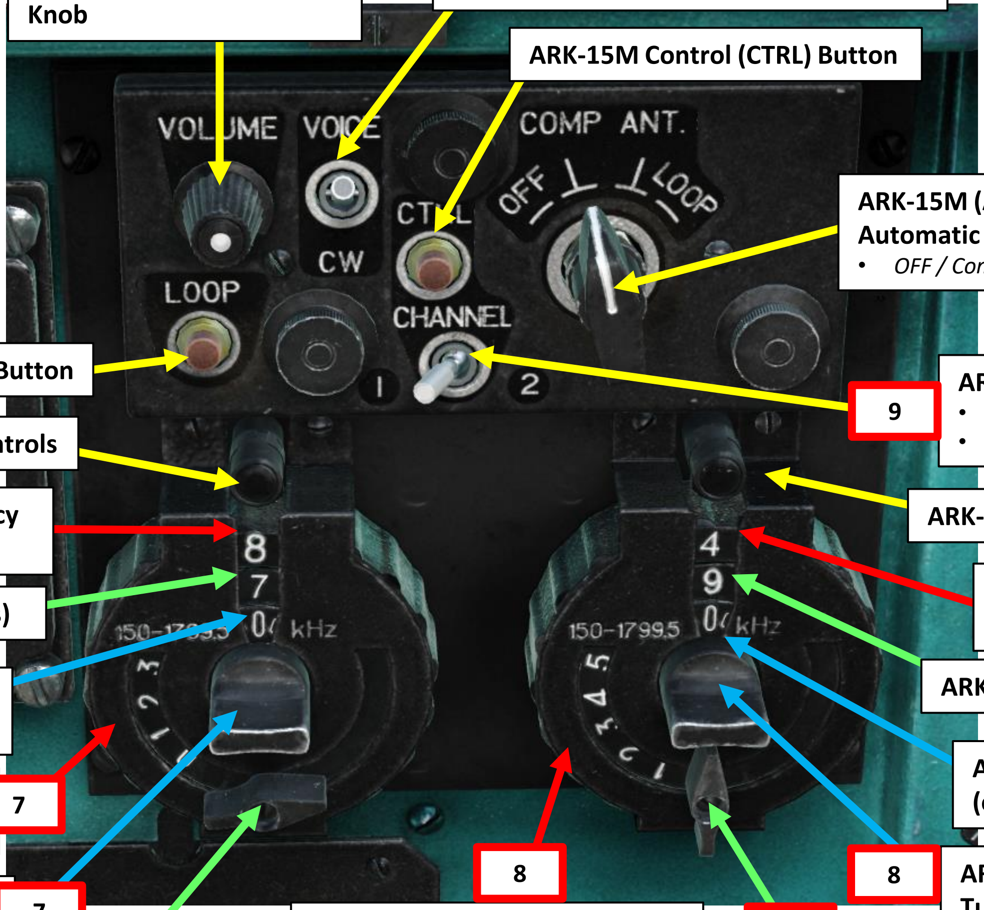


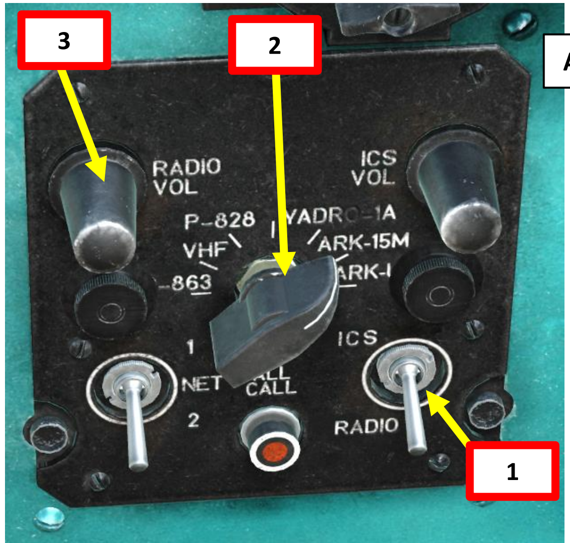


3.2 – ARK-15M ADF (AUTOMATIC DIRECTION FINDER)

In this example, we will be tracking a primary NDB (freq. 870) and then track a secondary NDB (freq. 490). Once you have set up both your frequencies, you can easily switch ADF tracking between your primary and secondary NDB using the switch mentioned at step 9.

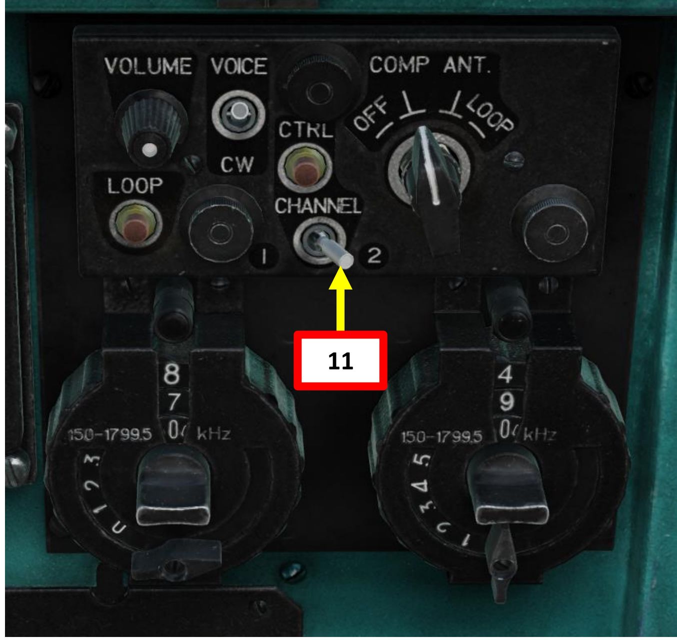
1. Set ICS/Radio Selector to RADIO (DOWN)
2. On ICS panel, select ARK-15M radio.
3. Adjust Radio Volume – As required
4. Set ARK-15 mode to KOMP (Compass)
5. Set ARK-15 Receiver Mode Selector – VOICE/TELEPHONY (UP)
6. Adjust ARK-15 Volume – As desired
7. Set Frequency for first NDB (870 kHz) using the three rotaries for primary NDB.
8. Set Frequency for second NDB (490 kHz) using the three rotaries for secondary NDB.
9. Use ARK-15M Channel Selector to select Primary (LEFT) NDB to make the ADF track the primary (870 kHz) NDB.

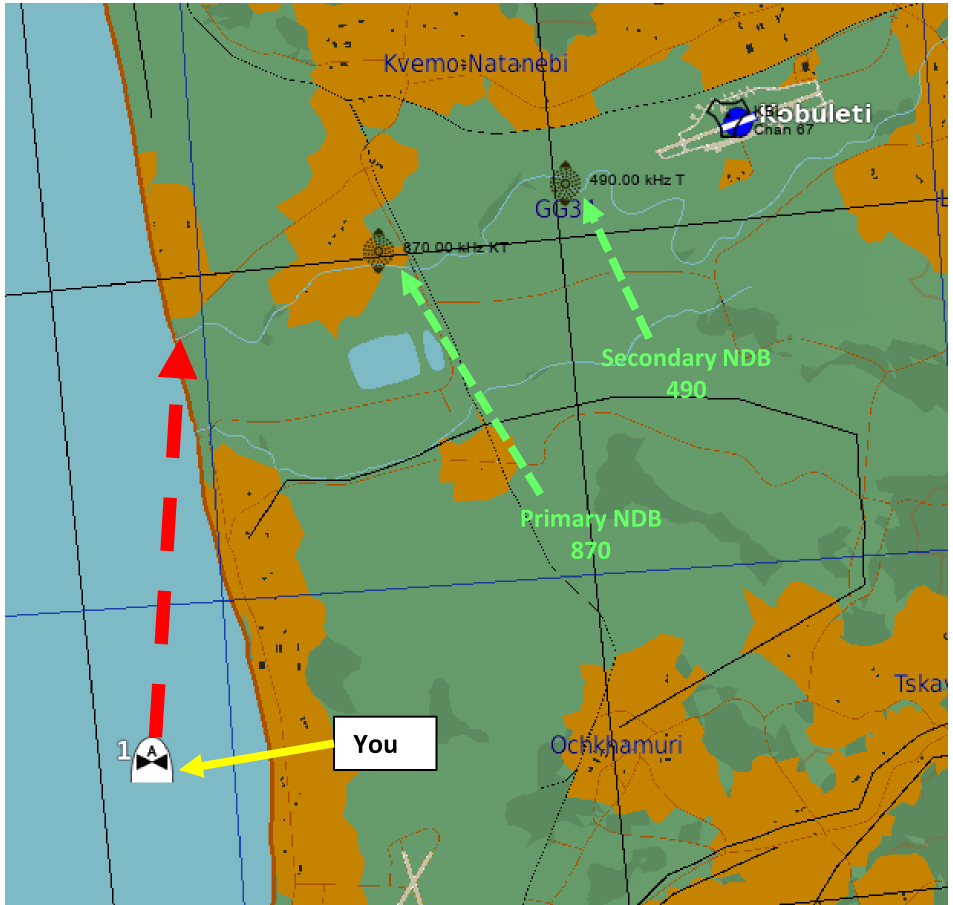


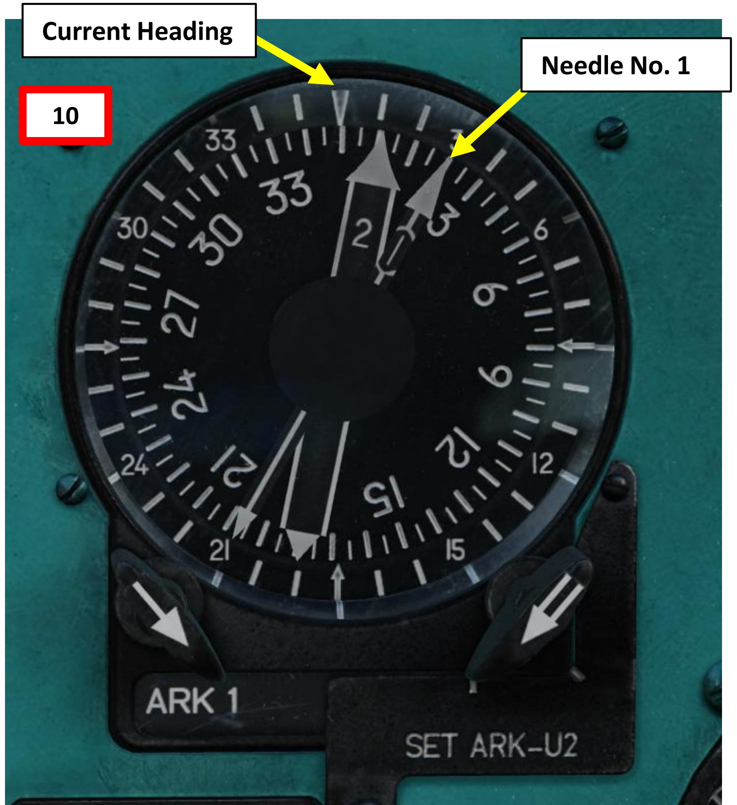


3.2 – ARK-15M ADF (AUTOMATIC DIRECTION FINDER)

10. Align needle No. 1 with white triangle (current heading) on the HSI (Horizontal Situation Indicator) and you will be heading towards the selected NDB.
11. Use the ARK-15M Channel Selector to select the Secondary (RIGHT) to track the Secondary (490 kHz) NDB.
12. Needle No. 1 will then track the Secondary NDB.







3.3 – ARK-U2 HOMING - SEARCH & RESCUE

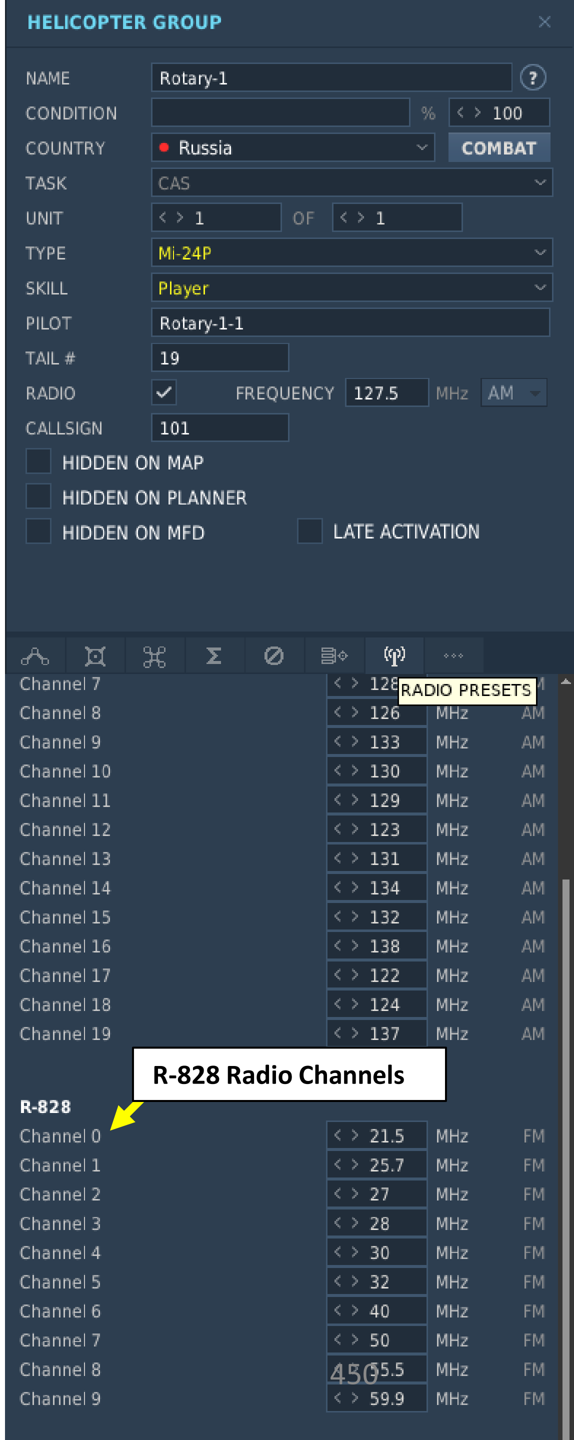
The ARK-U2 is an emergency radio navigation system used for search and rescue. A ground unit on the ground can broadcast on an emergency frequency, and the ARK-U2 system can pick up the signal and orient the pilot to it using the HSI (Horizontal Situation Indicator), which is also used for ADF (Automated Direction Finder) radio compass navigation. This system can be used in tandem with the R-828 radio system (10 preset frequencies) or with the R-852 radio system (4 preset frequencies).

The ARK-U2 can be used for either **UHF FM (R-828 radio)** or **VHF AM (R-852 radio)** frequencies.

The available frequencies for the R-828 radio are preset and appropriate frequencies from broadcasting units need to be set in the mission editor accordingly. The R-852 radio frequencies are fixed and currently cannot be configured in the mission editor.

R-852 Radio Channels

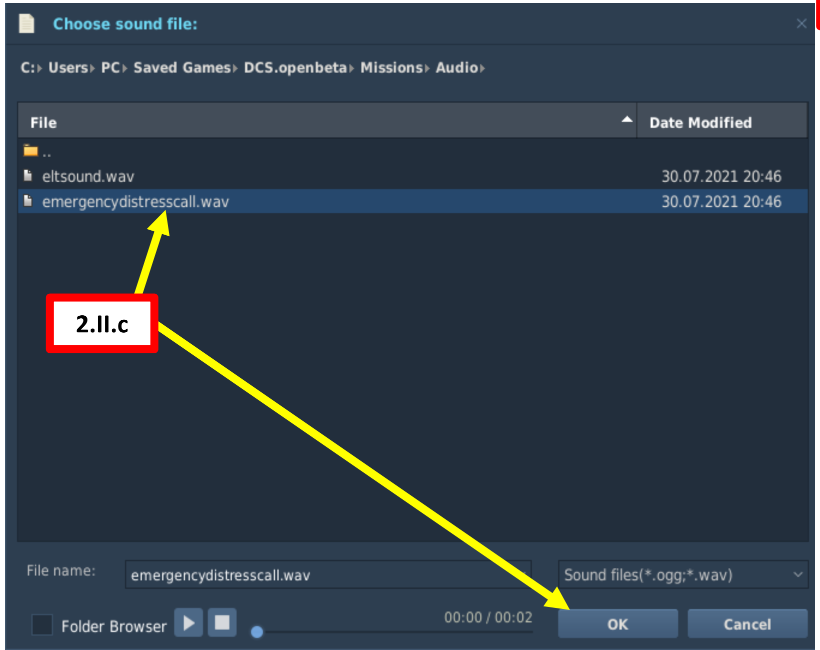
BAND	FREQUENCY (MHz)	PRESET CHANNEL
VHF/AM	114.115	1
VHF/AM	114.335	2
VHF/AM	114.585	3
VHF/AM	121.500	4

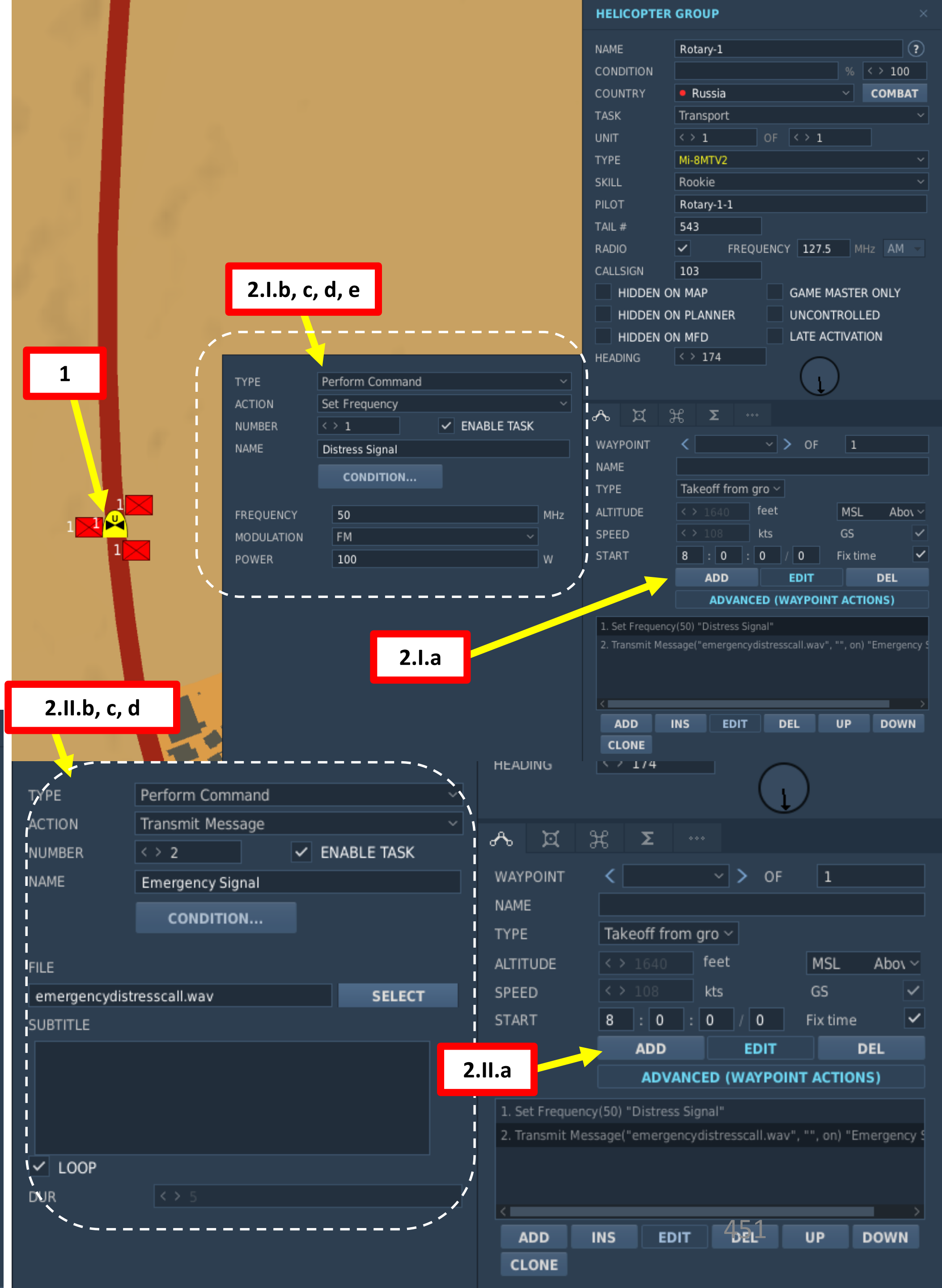


3.3 – ARK-U2 HOMING - SEARCH & RESCUE
3.3.1 – ARK-U2 & R-828 UHF FM HOMING

The R-828 radio is often used to communicate with ground troops. Another interesting functionality is that the ARK-U2 system can home on the transmission emitter. In this case, we will simulate a Search and Rescue mission to recover a stranded Mi-8 helicopter crew. We will first need to set up a mission with a unit that transmits a distress call on a **UHF FM frequency of 50 MHz**.

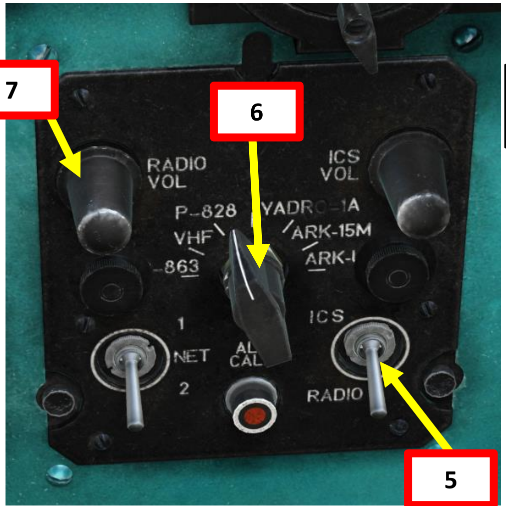
1. Create Unit that will transmit the distress signal
2. In ADVANCED (WAYPOINT ACTIONS) of Waypoint 0
   - I. Click on ADD
     - a) Select Type - PERFORM COMMAND
     - b) Select ACTION – SET FREQUENCY
     - c) Set Frequency to a valid frequency (50 MHz)
     - d) Select FM Band
     - e) Select Power (i.e. 100 W)
   - II. Click on ADD
     - a) Select Type - PERFORM COMMAND
     - b) Select ACTION – TRANSMIT MESSAGE
     - c) Select a valid .wav or .ogg audio file with the distress call. Add subtitles if desired.
     - d) Select LOOP

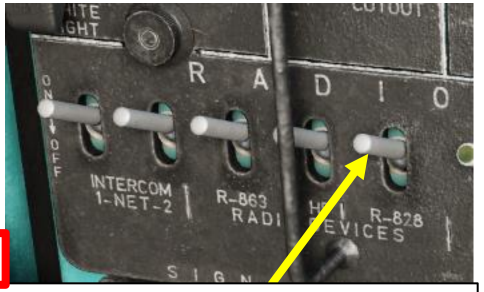




3.3 – ARK-U2 HOMING - SEARCH & RESCUE
3.3.1 – ARK-U2 & R-828 UHF FM HOMING

3. Check mission briefing to know which preset channel you need to use. We will use R-828 Channel No. 2, which is set to 50 MHz via the Mission Editor.
4. Set R-828 Radio Power Switch – ON (UP)
5. Set ICS/Radio Selector to RADIO (DOWN)
6. On ICS panel, select R-828 radio.
7. Adjust Radio Volume – As required
8. On ADF-VHF 2 control panel, set ADF-VHF 2 Source Selector – R-828 COMPASS (FWD).
9. On R-828 control panel, set Squelch to ON (UP) position.
10. On R-828 control panel, select desired preset channel.
11. On R-828 control panel, press Automatic Gain Control TUNE button (АСУ/ACG). TUNER (НАСТР) light will illuminate once radio is set.
12. Set ARK-U2 Power Switch – ON (UP)

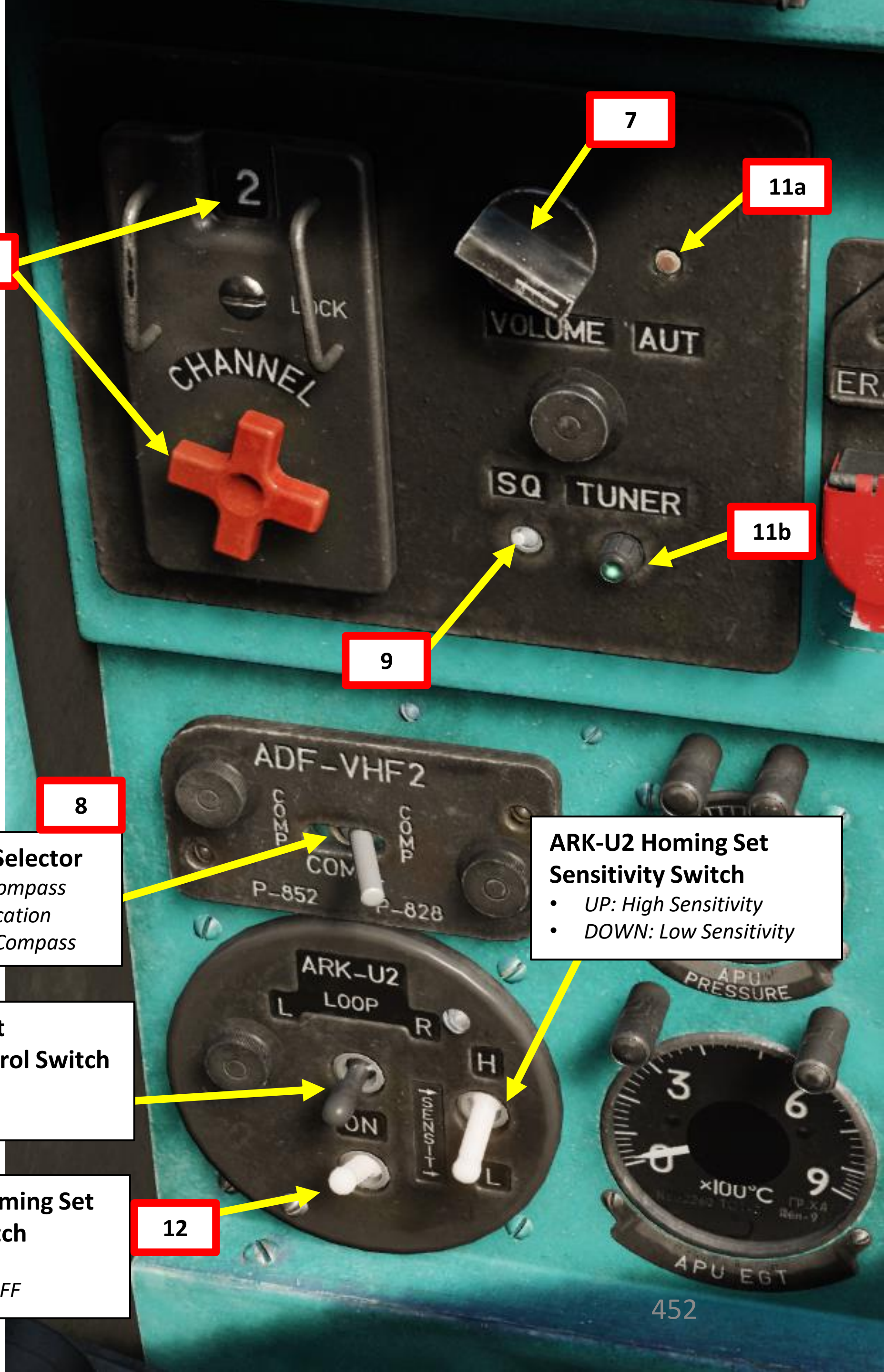




R-828 LVHF Radio (M24 "Eucalyptus") Power Switch
- *UP: ON / DOWN : OFF*

R-828

Channel 0	21.5	MHz	FM
Channel 1	25.7	MHz	FM
Channel 2	50	MHz	FM
Channel 3	28	MHz	FM
Channel 4	30	MHz	FM
Channel 5	32	MHz	FM
Channel 6	40	MHz	FM
Channel 7	50	MHz	FM
Channel 8	55.5	MHz	FM
Channel 9	59.9	MHz	FM



ADF-VHF 2 Source Selector
- *AFT: R-852 Radio Compass*
- *MIDDLE: Communication*
- *FWD: R-828 Radio Compass*

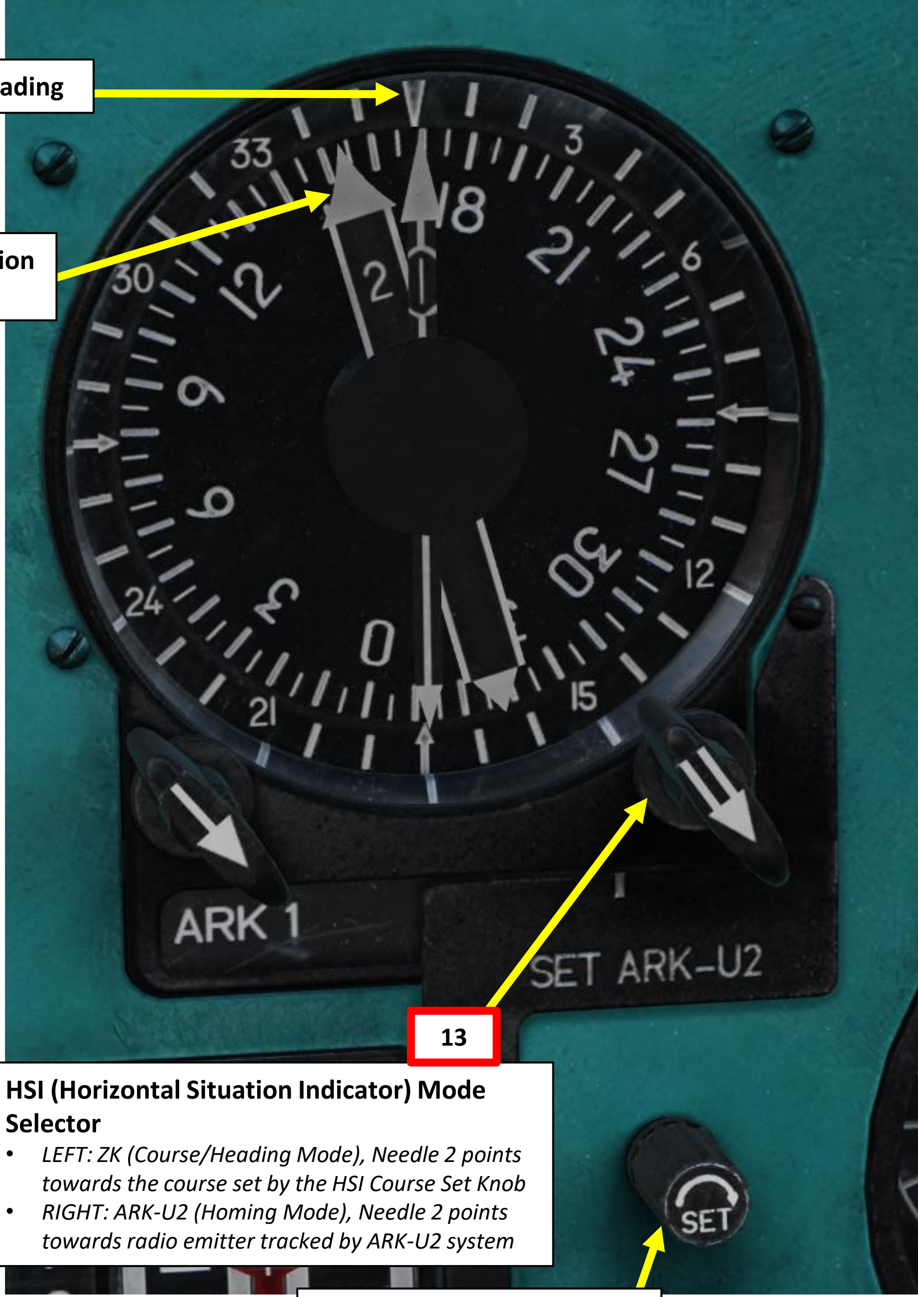
ARK-U2 Homing Set Sensitivity Switch
- *UP: High Sensitivity*
- *DOWN: Low Sensitivity*

ARK-U2 Homing Set Loop Antenna Control Switch
- *AFT: Left*
- *FWD: Right*

ARK-U2 Homing Set Power Switch
- *UP: ON*
- *DOWN: OFF*

3.3 – ARK-U2 HOMING - SEARCH & RESCUE
3.3.1 – ARK-U2 & R-828 UHF FM HOMING

13. Set HSI (Horizontal Situation Indicator) Mode Selector to ARK-U2 (RIGHT)
14. Needle No. 2 on the HSI (Horizontal Situation Indicator) will point towards the radio emitter transmitting on the R-828 radio frequency selected previously.

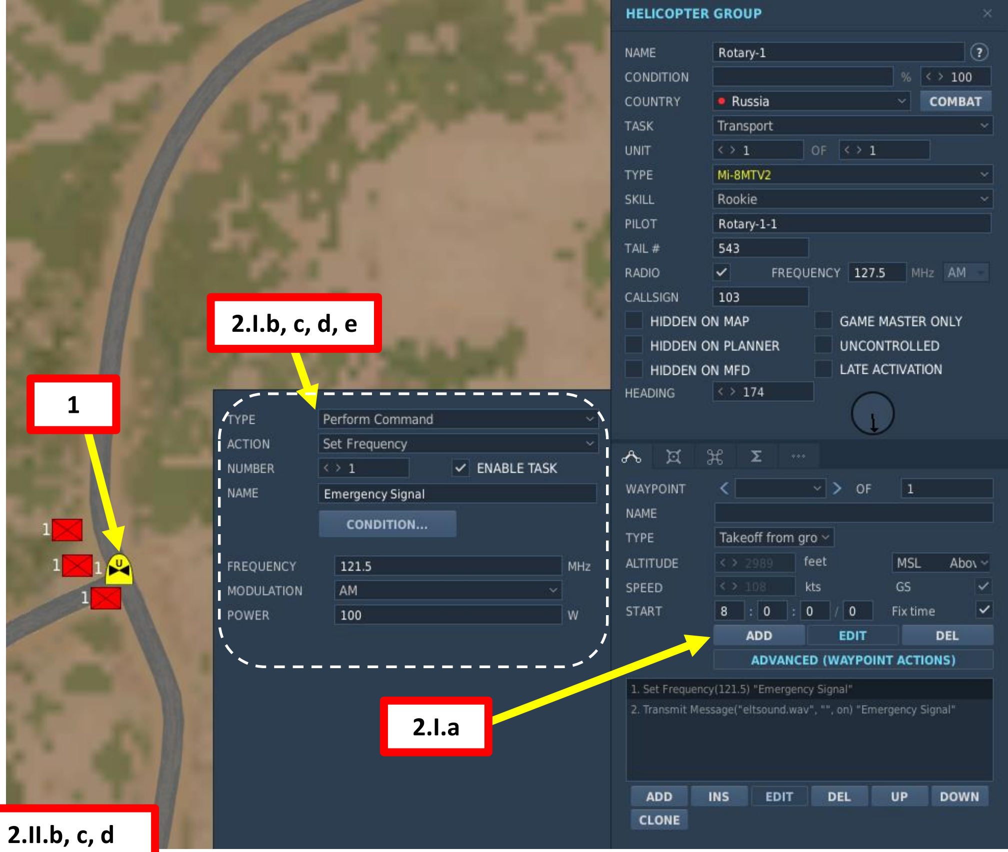


3.3 – ARK-U2 HOMING - SEARCH & RESCUE
3.3.1 – ARK-U2 & R-828 UHF FM HOMING

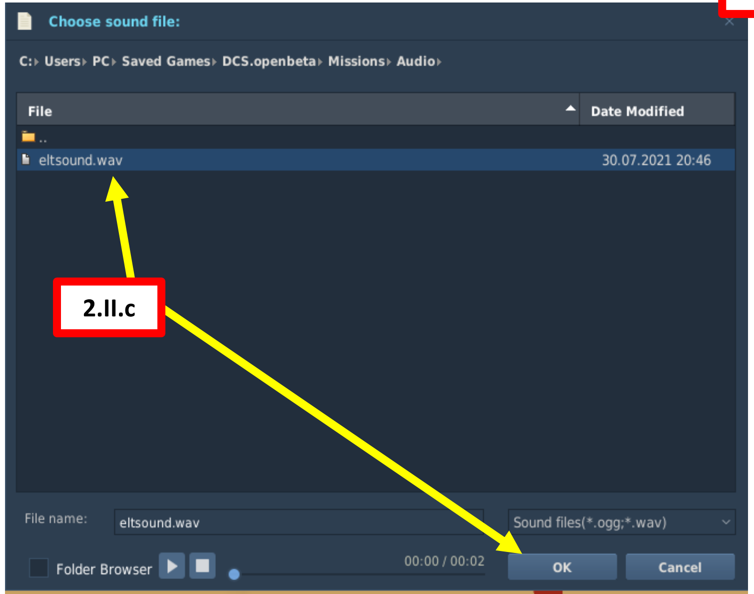
3.3 – ARK-U2 HOMING - SEARCH & RESCUE
3.3.2 – ARK-U2 & R-852 VHF AM HOMING

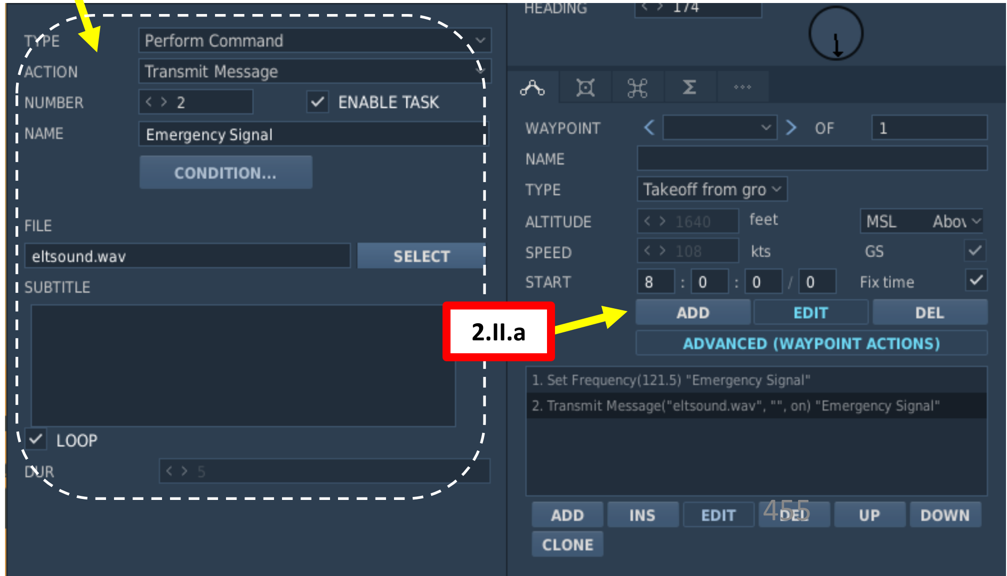
The R-852 radio is primarily a Search & Rescue radio system that is meant to home on standard emergency frequencies (like an ELT, Emergency Locator Transmitter). The ARK-U2 system can home on the ELT transmission emitter, but the frequency has to correspond to one of the four preset frequencies of the R-852 radio. In this case, we will simulate a Search and Rescue mission to recover a crashed Mi-8 helicopter with its ELT transmitting on a **VHF AM frequency of 121.500 MHz**. We will first need to set up a mission with a unit that transmits a signal on this specific VHF AM frequency.

1. Create Unit that will transmit the distress signal
2. In ADVANCED (WAYPOINT ACTIONS) of Waypoint 0
   - I. Click on ADD
     - a) Select Type - PERFORM COMMAND
     - b) Select ACTION – SET FREQUENCY
     - c) Set Frequency to a valid frequency (121.5 MHz)
     - d) Select AM Band
     - e) Select Power (i.e. 100 W)
   - II. Click on ADD
     - a) Select Type - PERFORM COMMAND
     - b) Select ACTION – TRANSMIT MESSAGE
     - c) Select a valid .wav or .ogg audio file with the ELT signal. Add subtitles if desired.
     - d) Select LOOP



R-852 Radio Channels		
BAND	FREQUENCY (MHz)	PRESET CHANNEL
VHF/AM	114.115	1
VHF/AM	114.335	2
VHF/AM	114.585	3
VHF/AM	121.500	4



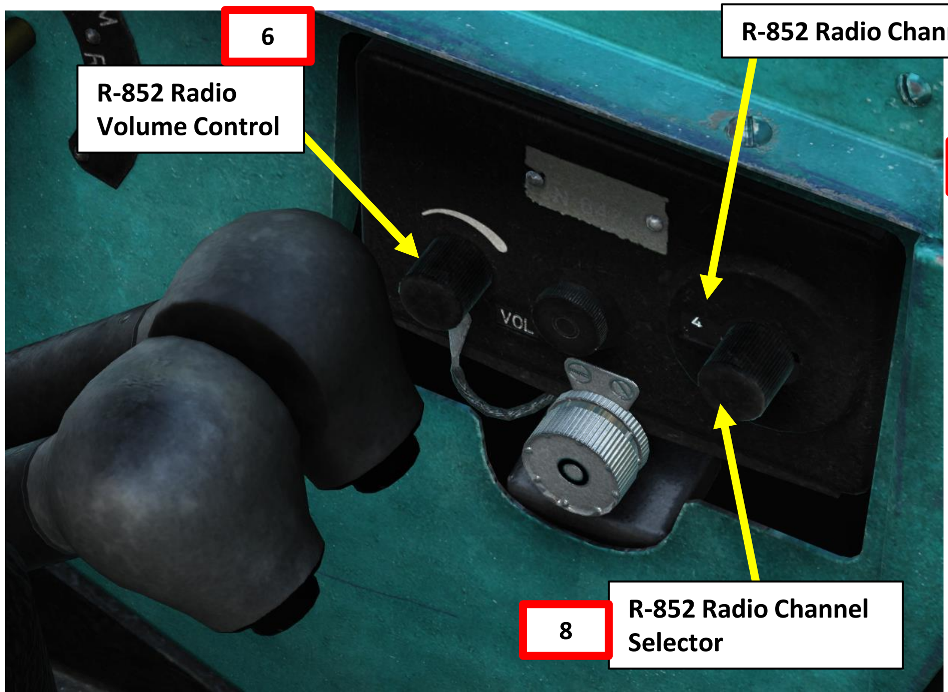


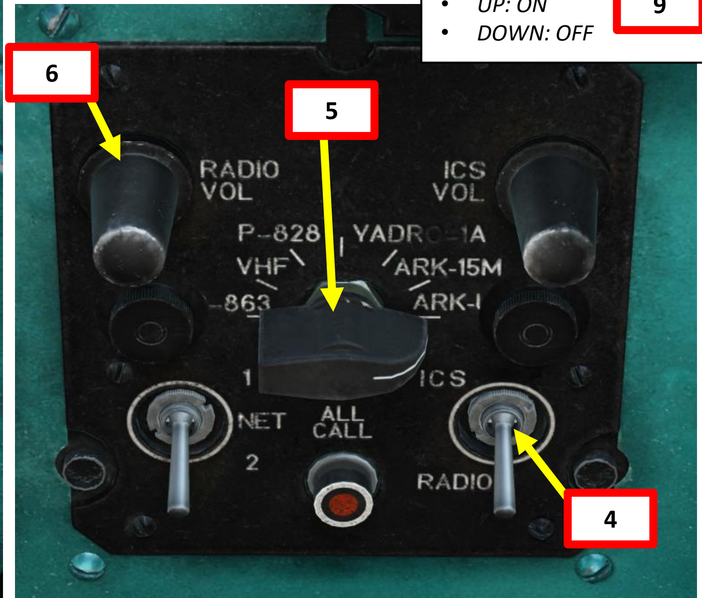
3.3 – ARK-U2 HOMING - SEARCH & RESCUE
3.3.2 – ARK-U2 & R-852 VHF AM HOMING

3. Check mission briefing to know which preset channel you need to use. We will use R-852 Channel No. 4, which is preset to 121.500 MHz.
4. Set ICS/Radio Selector to RADIO (DOWN)
5. On ICS panel, select ARK-U2 radio.
6. Adjust Radio Volume – As required
7. On ADF-VHF 2 control panel, set ADF-VHF 2 Source Selector – R-852 COMPASS (AFT).
8. On R-852 control panel, select desired preset channel (No. 4 in this case).
9. Set ARK-U2 Power Switch – ON (UP)

R-852 Radio Channels

BAND	FREQUENCY (MHz)	PRESET CHANNEL
VHF/AM	114.115	1
VHF/AM	114.335	2
VHF/AM	114.585	3
VHF/AM	121.500	4





3.3 – ARK-U2 HOMING - SEARCH & RESCUE
3.3.2 – ARK-U2 & R-852 VHF AM HOMING

10. Set HSI (Horizontal Situation Indicator) Mode Selector to ARK-U2 (RIGHT)
11. Needle No. 2 on the HSI (Horizontal Situation Indicator) will point towards the radio emitter transmitting on the R-852 radio frequency selected previously.

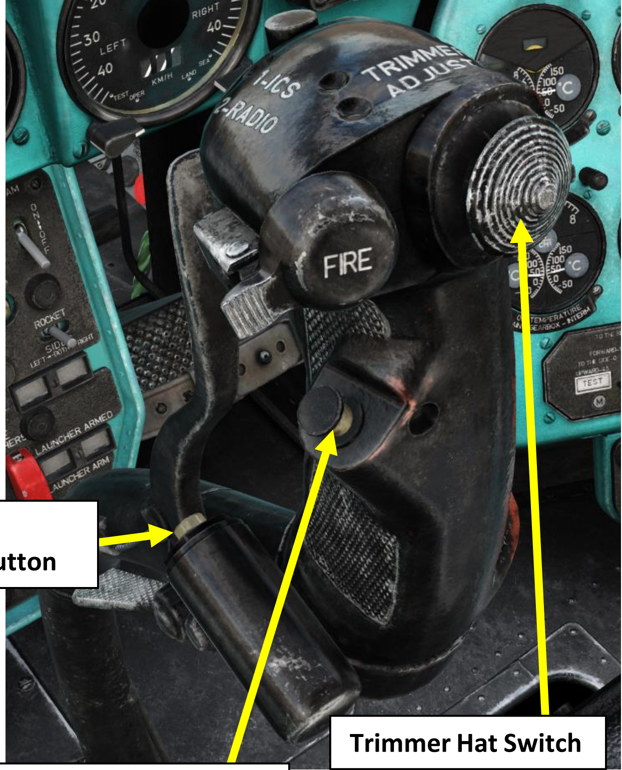
3.3 – ARK-U2 HOMING - SEARCH & RESCUE
3.3.2 – ARK-U2 & R-852 VHF AM HOMING

AUTOPILOT OVERVIEW

The VUAP-1 Autopilot system is a four-channel autopilot system designed to stabilized control of the helicopter in roll, pitch, heading altitude and airspeed. Its main components are:

- SAU-V24-1 AFCS (Automatic Flight Control System), with 4 channels
- Trimmer Hat Switch and Force Trim Switch (on Cyclic)
- Autopilot Disconnect Button (on Cyclic)
- Hover Control Mode
- Route/Course Control Mode
- Altitude Hold Control Mode
- GREBEN-1 Flight Computer
- Radar altimeter coupler
- Airspeed correction unit
- Altitude correction unit

Collective Brake Release Button



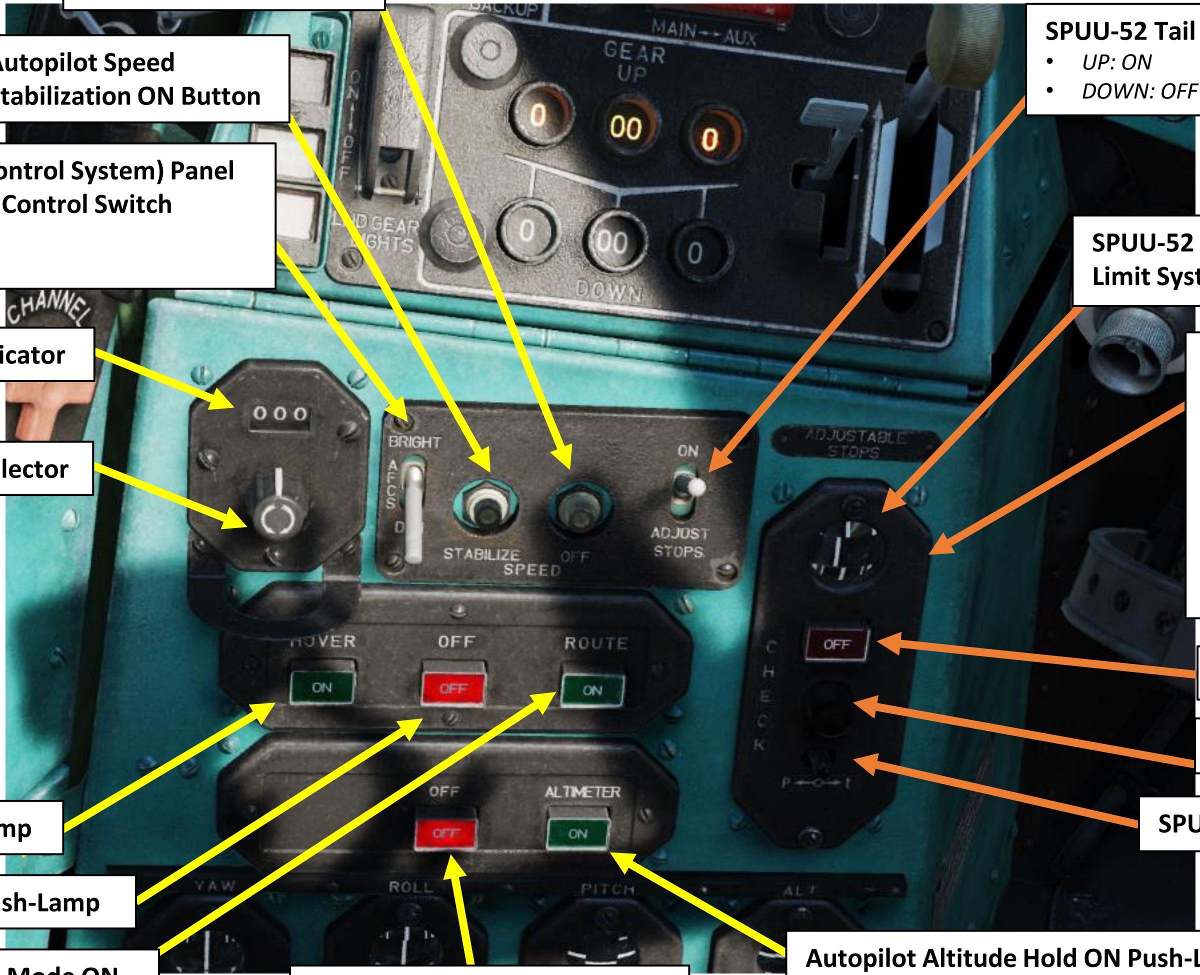
Autopilot Disconnect Button

Trimmer Hat Switch

Trimmer (Force Trim) Button

Automatic Flight Control System (AFCS) Control Panel

AUTOPILOT OVERVIEW



Autopilot Speed Stabilization OFF Button

Autopilot Speed Stabilization ON Button

AFCS (Automatic Flight Control System) Panel Button/Lights Brightness Control Switch
- *UP: Bright*
- *DOWN: Dim*

Autopilot Course Indicator

Autopilot Course Selector

Autopilot Hover Mode ON Push-Lamp

Hover / Course Mode OFF Push-Lamp

Autopilot Course/Route Mode ON Push-Lamp

Altitude Hold OFF Push-Lamp

Autopilot Altitude Hold ON Push-Lamp

SPUU-52 Tail Rotor Pitch Limit System Power Switch
- *UP: ON*
- *DOWN: OFF*

SPUU-52 Tail Rotor Pitch Limit System Indicator

SPUU-52 Tail Rotor Pitch Limit System

Uses a linear actuator linked to a mechanical stop to adjust the maximum tail rotor blade pitch angle within a range of 16°20' to 20°30'. The adjustment is based on air temperature and density:
- *increased density (low altitude or/and low temperature)results in a decrease in the maximum blade pitch angle,*
- *decreased density (high altitude or/and high temperature) results in a increase in the maximum blade pitch angle.*

SPUU-52 OFF Button

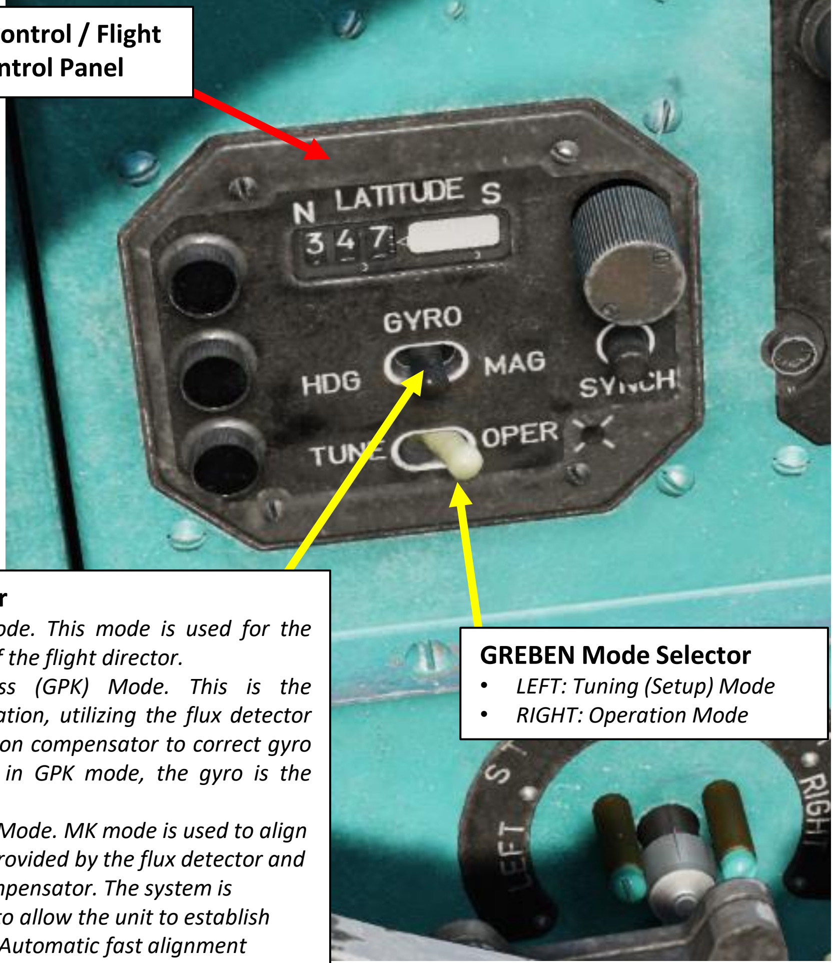
SPUU-52 Control Adjustment

SPUU-52 Left/Right Control P/t

AUTOPILOT OVERVIEW

Take note that the autopilot system requires the following components to be powered and working correctly as a prerequisite:

- Radar Altimeter – ON
- Doppler System Power – ON
- Vertical Gyros 1 & 2 – ON
- GREBEN-1 Flight Director System – ON



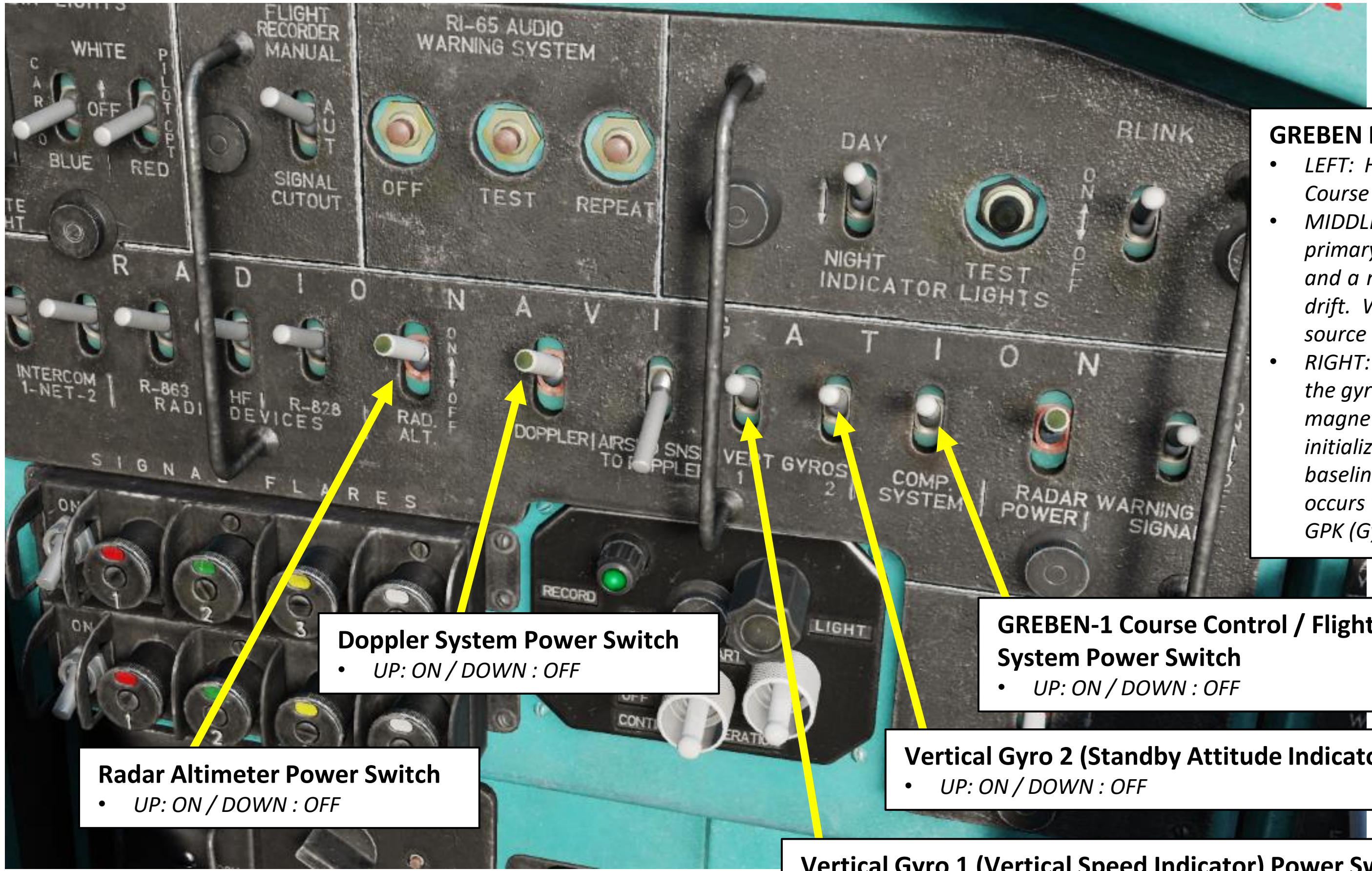
GREBEN-1 Course Control / Flight Director System Control Panel

GREBEN Mode Selector

- *LEFT: Heading (ZK) Mode. This mode is used for the Course Control Mode of the flight director.*
- *MIDDLE: Gyro-Compass (GPK) Mode. This is the primary mode of operation, utilizing the flux detector and a magnetic deviation compensator to correct gyro drift. When operating in GPK mode, the gyro is the source of heading data.*
- *RIGHT: Magnetic (MK) Mode. MK mode is used to align the gyro to the signal provided by the flux detector and magnetic deviation compensator. The system is initialized in MK mode to allow the unit to establish baseline heading data. Automatic fast alignment occurs whenever the operating mode is switched from GPK (Gyro-Compass) to MK (Magnetic).*

GREBEN Mode Selector

- *LEFT: Tuning (Setup) Mode*
- *RIGHT: Operation Mode*



GREBEN-1 Course Control / Flight Director System Power Switch

- *UP: ON / DOWN : OFF*

Doppler System Power Switch

- *UP: ON / DOWN : OFF*

Vertical Gyro 2 (Standby Attitude Indicator) Power Switch

- *UP: ON / DOWN : OFF*

Radar Altimeter Power Switch

- *UP: ON / DOWN : OFF*

Vertical Gyro 1 (Vertical Speed Indicator) Power Switch

- *UP: ON / DOWN : OFF*

AFCS (AUTOMATIC FLIGHT CONTROL SYSTEM) OVERVIEW

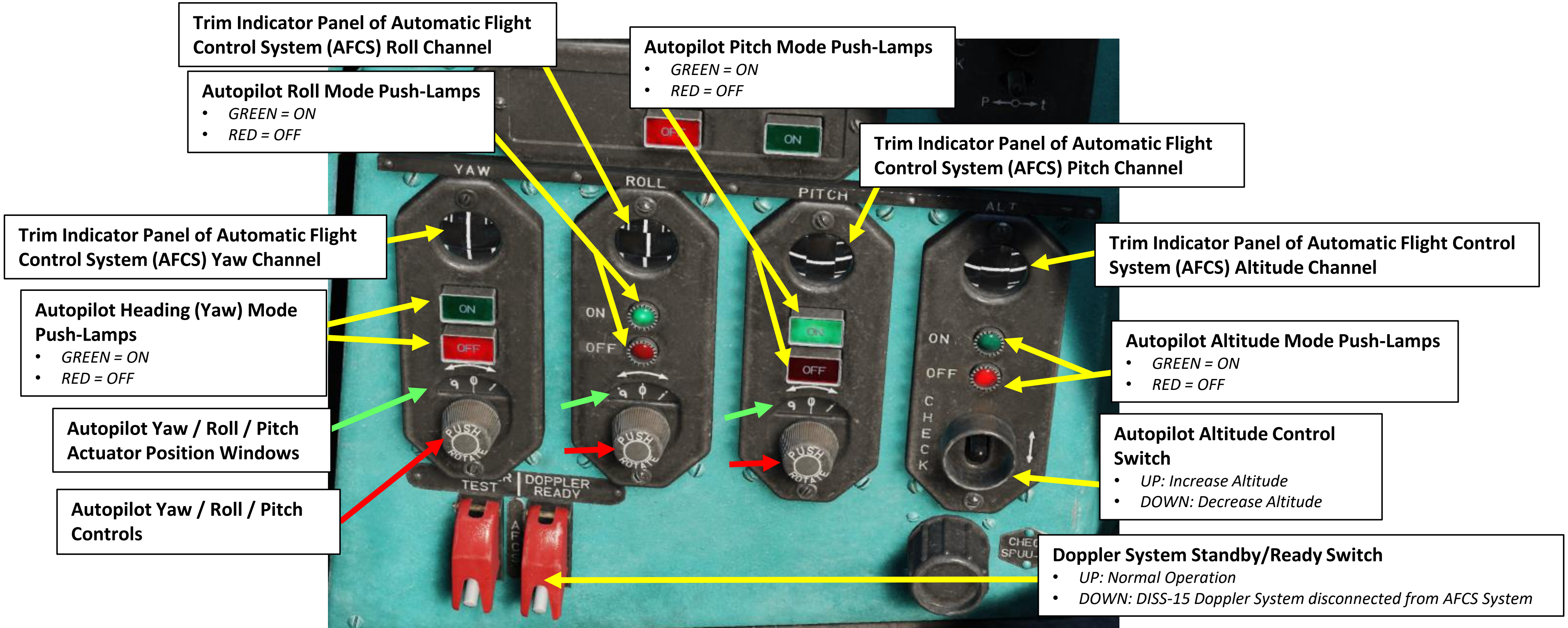
The four autopilot channels (roll, pitch, yaw, altitude) provide:

- Stabilization of helicopter attitude in three axes (longitudinal, lateral, vertical)
- Stabilization of altitude in forward flight and hover
- Stabilization of indicated airspeed

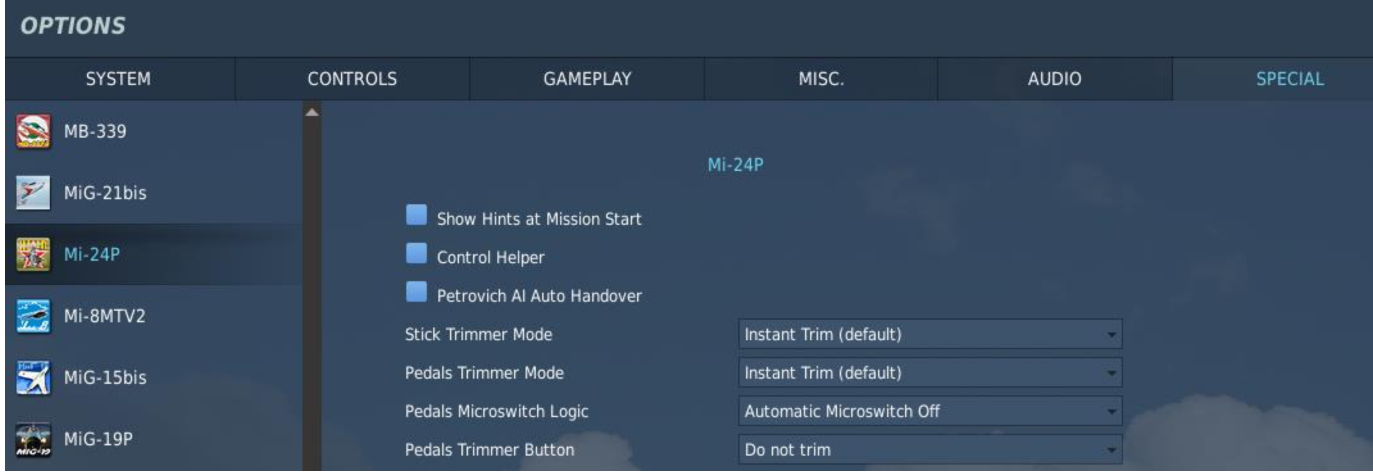
The pilot may intervene at any time while the autopilot is engaged to make manual corrections by operating the flight controls.

The hydraulic flight control servos apply autopilot corrections to the flight controls surfaces and provide feedback signals to the autopilot channels. **Autopilot roll, pitch, and altitude correction signals are limited to a maximum of approximately 20% of control travel for flight safety in the event of false signals or system failure**.

Yaw, Roll, Pitch and Altitude Channels can be engaged or disengaged individually with the ON and OFF buttons on the AFCS (Automatic Flight Control System) panel. The autopilot system is engaged for all normal flight operations. The pitch, roll, and yaw channels are engaged throughout the flight from takeoff to landing.

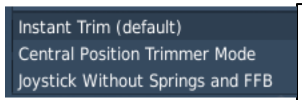


TRIM OPTIONS



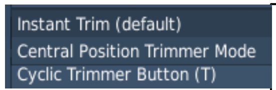
Here is an overview of various trim options available to you.

- I recommend setting Stick Trimmer Mode and Pedals Trimmer Mode to "Instant Trim", and to have the Pedals Microswitch Logic to "Automatic Microswitch OFF".
- I also recommend setting Pedals Trimmer Button to "Do Not Trim" in order to have as much pedal authority as possible when flying.



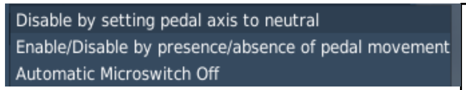
Cyclic Trimmer Modes:

- **Instant Trim (FFB Friendly)** – As soon as the Force Trim Release button (trimmer) is released, the new trimmed position of the player's stick will be applied immediately.
- **Central Position Trimmer Mode** – After the Force Trim Release button (trimmer) is released, the new trimmed position of the player's stick will be applied immediately; however any further control inputs will only be applied in each axis after the stick is returned to the neutral position in that axis (pitch and roll are read separately).
- **Joystick Without Springs and FFB** – This option is used for joysticks lacking any spring resistance or Force-Feedback (FFB).



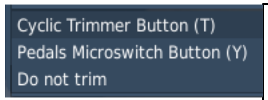
Pedals Trimmer Modes:

- **Instant Trim (FFB Friendly)** – As soon as the Force Trim Release button (trimmer) is released, the new trimmed position of the player's pedals will be applied immediately.
- **Central Position Trimmer Mode** – After the Force Trim Release button (trimmer) is released, the new trimmed position of the player's pedals will be applied immediately; however any further pedal inputs will only be applied after the pedals are returned to the neutral position.



Pedals Microswitch Logic:

- **Disable by setting pedal axis to neutral** – Microswitch is enabled by moving the anti-torque pedals away from the neutral position and disengaged when pedals are returned back to the neutral position.
- **Enable/Disable by presence/absence of pedal movement** – Microswitch is enabled only when pedals are moving and disabled when pedals are not moving.
- **Automatic Microswitch OFF** – Disables Microswitch logic from your pedals; Microswitch is instead a function of a fictional control binding that allows you to enable/disable it at will.



Pedals Trimmer Button:

- **Cyclic Trimmer Button (T)** – Pedals are automatically trimmed when pressing the cyclic trimmer button (not as per aircraft)
- **Pedals Microswitch Button (Y)** – Pedals are trimmed separately from cyclic trimmer button by using the pedals microswitch logic or Microswitch control binding (as per aircraft)
- **Do not Trim** – Anti-Torque pedals are not trimmed at all.

ANTI-TORQUE PEDAL MICROSWITCHES

The “Microswitches” are basically switches that are activated when you apply some pressure on the anti-torque pedals with your feet. But what do these microswitches do and why does it matter?

If the pilot’s feet are not on the pedals:

1. The autopilot maintains the preset yaw angle, switching the directional flight control servo to displacement mode as needed to introduce large corrections.
2. The speed of pedal movement in displacement mode is controlled by the hydraulic pedal damper in the directional control system.
3. The yaw channel includes a relay which prevents the servo from switching to displacement mode if the pedal damper is disengaged.

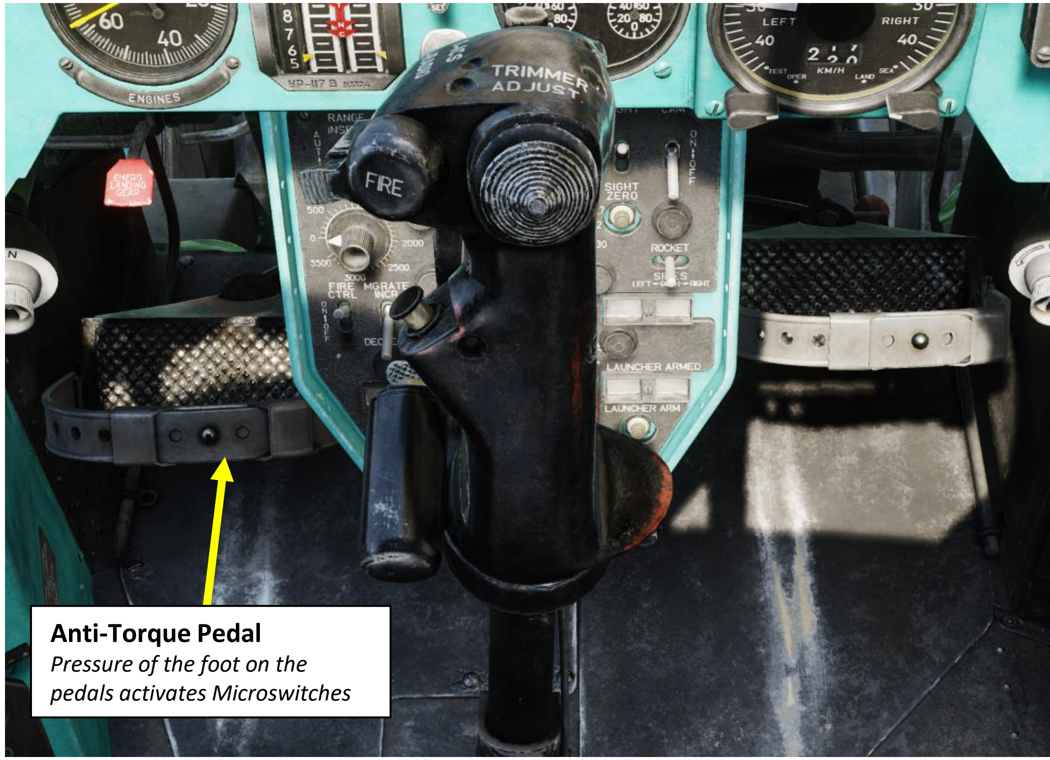
If the pilot’s feet are on the pedals:

1. The sub-pedal **microswitches activate**
2. The yaw channel operates in stabilization mode (you can consider that as a form of “standby” mode).
3. The yaw rate signal passes through a low-pass filter to prevent the servo from drifting to the stops while executing manual turns with the yaw channel engaged.

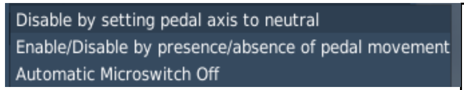
In other words, microswitches being activated allow the pilot to manoeuver the helicopter with the anti-torque pedals without having the yaw channel interfere with his control inputs. If the autopilot yaw channel kept interfering, it would likely result in a situation where the pilot has to “fight” the autopilot to control the helicopter.

Once microswitches are disengaged, the autopilot will automatically be re-engaged.

Microswitch activation logic can be selected in the Special Options tab, as shown below.



Anti-Torque Pedal
Pressure of the foot on the pedals activates Microswitches



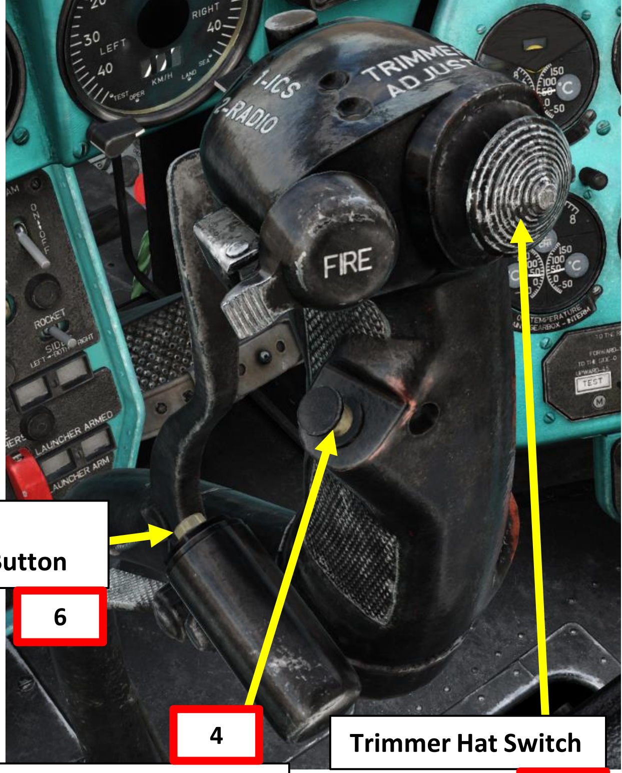
Pedals Microswitch Logic:

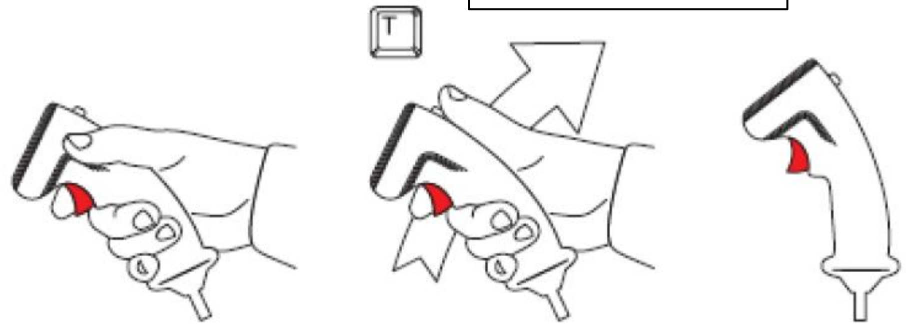
- **Disable by setting pedal axis to neutral** – Microswitch is enabled by moving the anti-torque pedals away from the neutral position and disengaged when pedals are returned back to the neutral position.
- **Enable/Disable by presence/absence of pedal movement** – Microswitch is enabled only when pedals are moving and disabled when pedals are not moving.
- **Automatic Microswitch OFF** – Disables Microswitch logic from your pedals; Microswitch is instead a function of a fictional control binding that allows you to enable/disable it at will.

AUTOPILOT OPERATION
FLYING WITH TRIM

During normal flight, I typically engage the Yaw, Roll and Pitch autopilot channels. Using trim can make your life much easier and greatly decrease the workload required to fly the helicopter.

1. Engage desired autopilot channels
2. Adjust power with the collective and set helicopter to the desired attitude using the cyclic anti-torque pedals
3. The helicopter is rarely flown with either the cyclic or pedals in the neutral position. In the real Mi-24P, the pilot can press a trim button on the cyclic to hold the controls in their current position, creating a new center point for the cyclic and pedals. However, because most PC controllers don't have a corresponding trim capability, a special trim function is available in the simulation.
4. To trim the controls in their current position, press and release the Trimmer (Force Trim) button (T), then immediately return the stick and pedals to their neutral positions. You can reset trim at any time by pressing (LCtrl + T).
5. You can use the Trimmer Hat Switch UP/DOWN/LEFT/RIGHT to "fine-tune" helicopter attitude as desired.
6. To disengage autopilot channels, you can use the Autopilot Disconnect Button on the Cyclic. This will disengage all AFCS channels.





1. Establish a stabilized flight attitude

2. Press and release the Trimmer button, return the stick to neutral

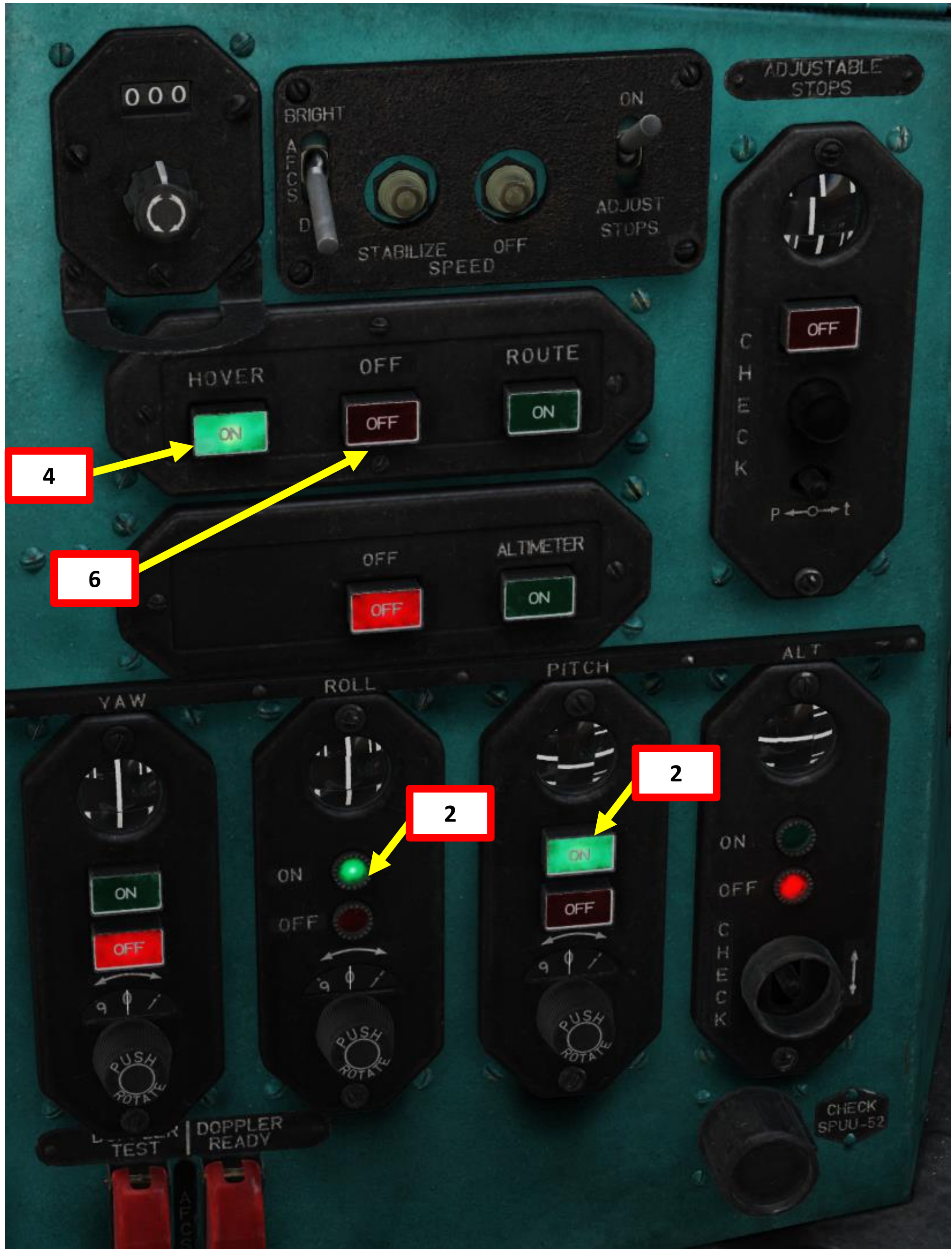
3. The helicopter will continue to fly in the trimmed attitude

Trimming Procedure

AUTOPILOT OPERATION
HOVER CONTROL MODE

The "Hover Control Mode" is primarily a "hover assist" function rather than a "auto-hover" one. This means that the helicopter should already be very close to a trimmed hover state before engaging the Hover Mode… otherwise the autopilot will automatically disengage.

1. Verify that GREBEN Flight Computer, Vertical Gyros 1 & 2, the Doppler System and the Radar Altimeter are all powered ON.
2. Engage Roll and Pitch Channels at a minimum.
    - Engaging altitude channel is not mandatory, but it does help.
    - Do not engage yaw channel; you might have to "fight" the yaw trim while trying to hover.
3. Stabilize helicopter over a desired hover point using Trim, Cyclic, Collective and Anti-Torque pedal input. Ensure forward speed, lateral speed and vertical speed are all close to 0 on the Stationary Flight Indicator.
4. Press the HOVER Push-Lamp to engage the autopilot Hover Control Mode.
5. The AFCS flight computer receives lateral and longitudinal ground speed signals from the Doppler system, then converts these signals into "correction" signals to compensate for deviations. The flight computer sends these signals to the autopilot PITCH and ROLL control panels, which will then attempt to maintain the helicopter in a hover state. The correction signals are **limited to a maximum of 5 deg as a safety measure in case of Doppler system failure**.
6. You can disengage Hover Control Mode using the OFF button on the Hover/Route Panel.
    - Note: You could also use the Autopilot Disconnect button on the Cyclic, but it disengages all autopilot channels at once… which can make the helicopter unstable.



AUTOPILOT OPERATION HOVER CONTROL MODE

The Hover Control Mode is not recommended when the helicopter is heavily loaded; to maintain a hover, a high power setting is required and the Mi-24 becomes dangerously exposed.

This mode is also not recommended when using weapons with high recoil like rockets or the fixed cannon.

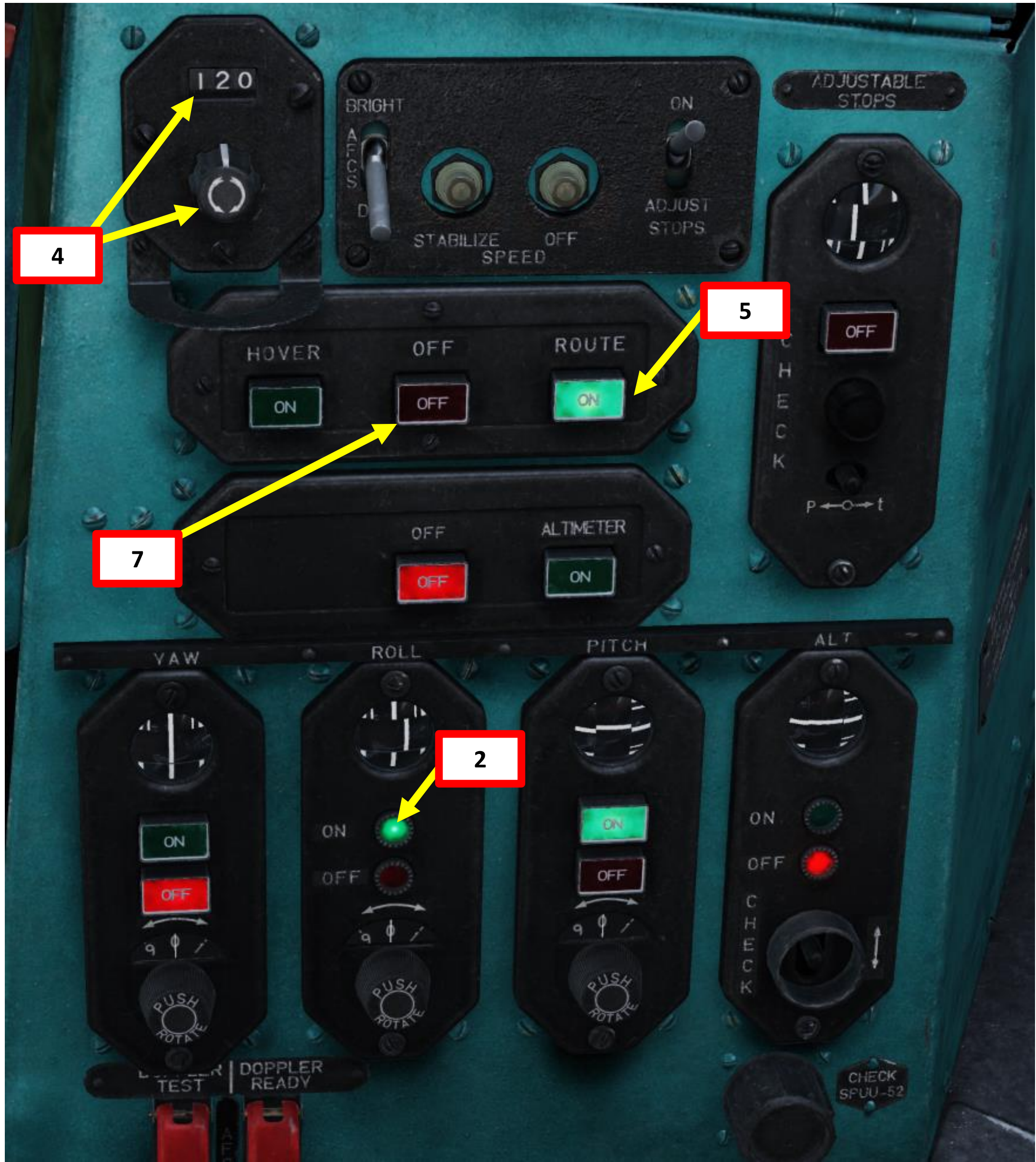
AUTOPILOT OPERATION
ALTITUDE HOLD MODE

1. Verify that GREBEN Flight Computer, Vertical Gyros 1 & 2, the Doppler System and the Radar Altimeter are all powered ON.
2. Engage Roll, Pitch & Altitude Channels at a minimum.
    - Engaging yaw channel is not mandatory.
3. Using cyclic, collective and trim, stabilize helicopter at the altitude you wish to maintain (try to maintain a vertical speed around 0 m/s).
4. Verify the radar altimeter and doppler systems operate properly, then press the ALTIMETER (Autopilot Altitude Hold ON) push-lamp to engage the autopilot Altitude Hold Mode.
5. The autopilot altitude hold mode maintains the helicopter at a selected altitude above ground level (AGL) using input signals from the Doppler system and the radar altimeter.
6. You can disengage Altitude Hold Mode using the OFF button below the Hover/Route Panel.
    - Note: You could also use the Autopilot Disconnect button on the Cyclic, but it disengages all autopilot channels at once… which can make the helicopter unstable.

AUTOPILOT OPERATION
ROUTE/COURSE MODE

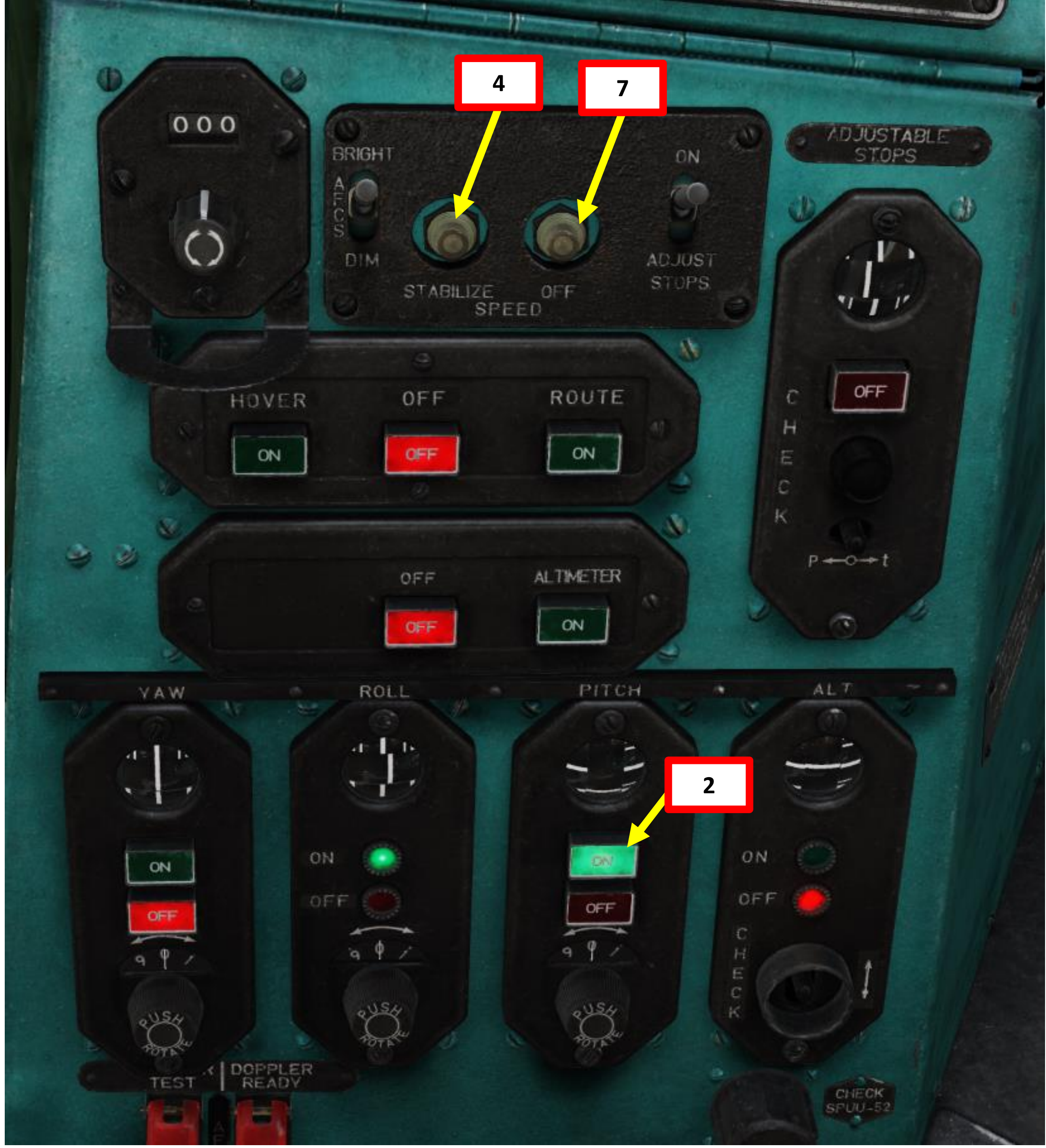
The “Route/Course Mode” is basically a “Heading Select” mode. It can be combined with other autopilot channels like the Altitude Hold.

1. Verify that GREBEN Flight Computer, Vertical Gyros 1 & 2, the Doppler System and the Radar Altimeter are all powered ON.
2. Engage Roll Channel at a minimum.
   - Engaging pitch, altitude and yaw channels is not mandatory, but it does help.
3. Stabilize helicopter in the direction you wish to take (**less than 15 deg away from the heading you want the autopilot to fly**).
4. Use the Autopilot Course Selector knob to set desired heading to intercept.
5. Press the ROUTE (Autopilot Course/Route Mode ON) push-lamp to engage the autopilot Route/Course Mode.
6. The Doppler system generates a course deviation signal using the course setting on the course selector, the current drift angle, and the current heading signal from the flight director system, then this signal is sent to the flight computer and converted to a roll correction signal. This signal is sent to the autopilot ROLL channel to fly the selected course. The **correction signal is limited to a maximum value of 15 deg as a safety measure in the event of failure of the Doppler system**.
7. You can disengage Route/Course Mode using the OFF button on the Hover/Route Panel.
   - Note: You could also use the Autopilot Disconnect button on the Cyclic, but it disengages all autopilot channels at once… which can make the helicopter unstable.



AUTOPILOT OPERATION
SPEED HOLD MODE

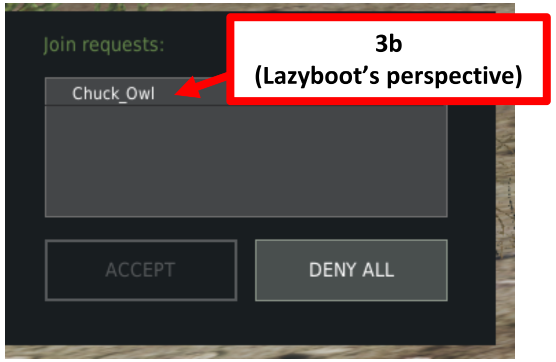
1. Verify that GREBEN Flight Computer, Vertical Gyros 1 & 2, the Doppler System and the Radar Altimeter are all powered ON.
2. Engage Pitch Channel at a minimum.
   - Engaging roll, altitude and yaw channels is not mandatory, but it does help.
3. Stabilize helicopter at the airspeed you wish to hold.
4. Press the Autopilot Speed Stabilization ON button to engage the autopilot Speed Hold Mode.
5. To maintain the preset airspeed, the autopilot uses the airspeed deviation signal from the airspeed correction unit. The correction signal is sent to the autopilot PITCH channel to maintain the current airspeed.
6. There is no specific indication to show that the Speed Hold mode is active or not. Check the airspeed indicator and see if the airspeed is maintained or not.
7. You can disengage Speed Hold Mode using the Autopilot Speed Stabilization OFF button above the Hover/Route Panel.

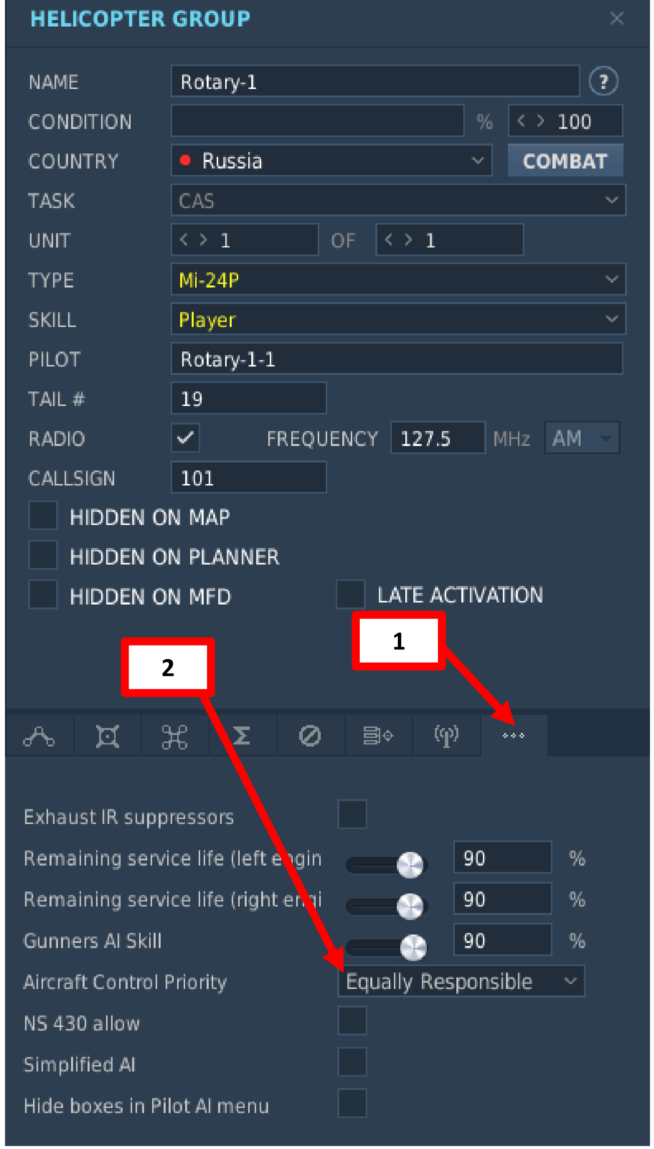


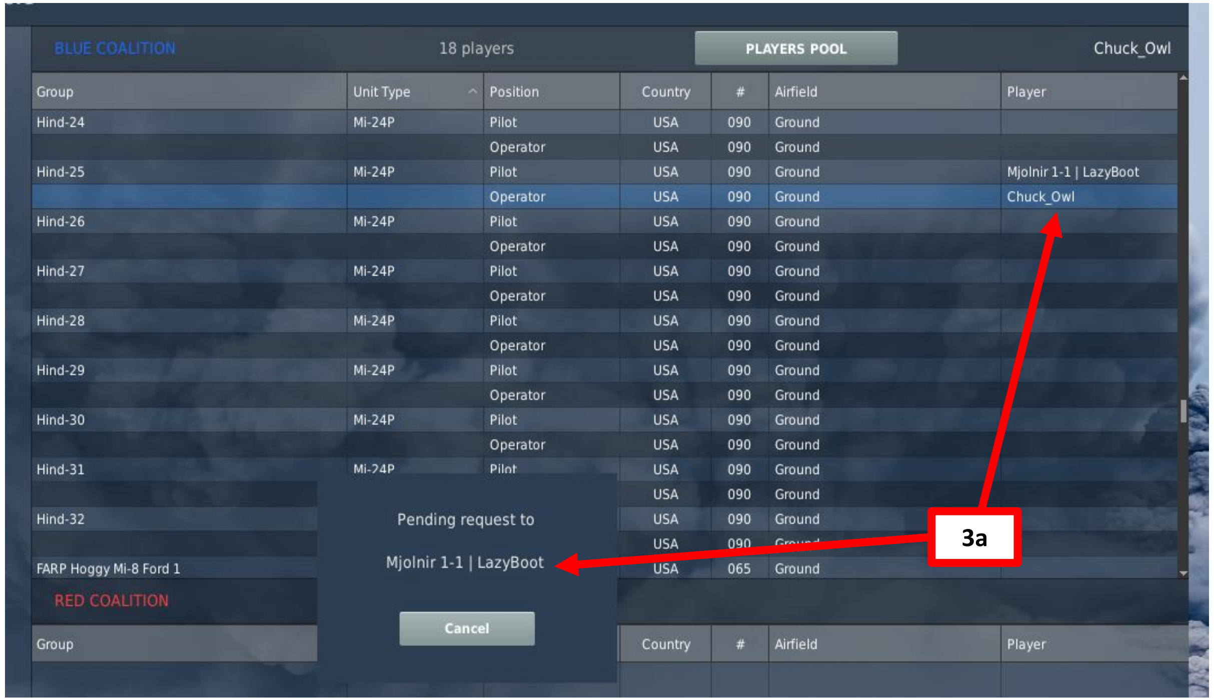
MULTICREW TUTORIAL

The Mi-24 can be flown by two players in multiplayer. However, you need to go in the Mission Editor and make sure the Mi-24 is set up in the following manner:

1. Select Mi-24P Unit and go in “Additional Properties for Aircraft” menu
2. Set “Aircraft Control Priority” to “Equally Responsible”
3. When spawning in multiplayer in any seat, the pilot will receive a request to let you take control of the other seat.

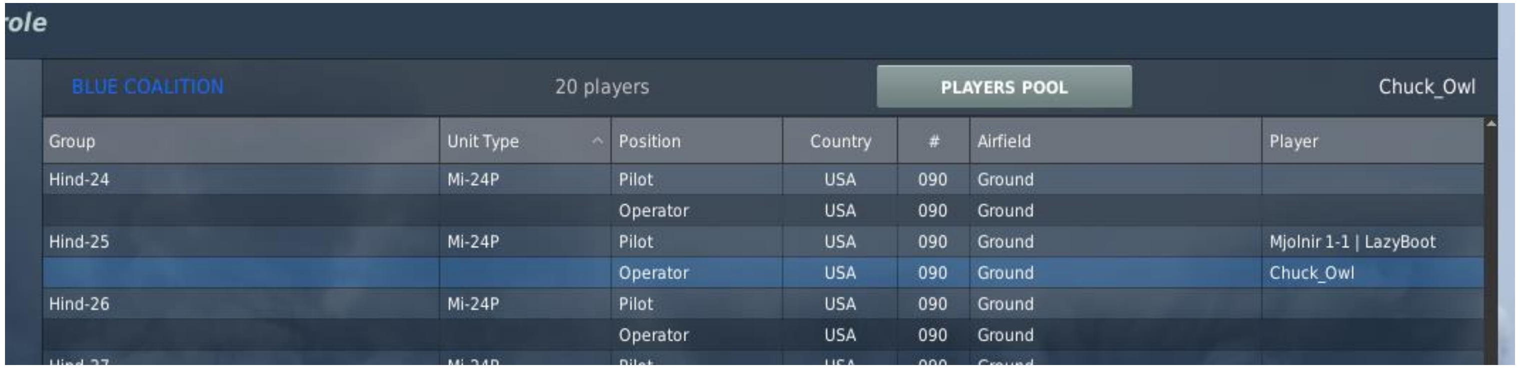


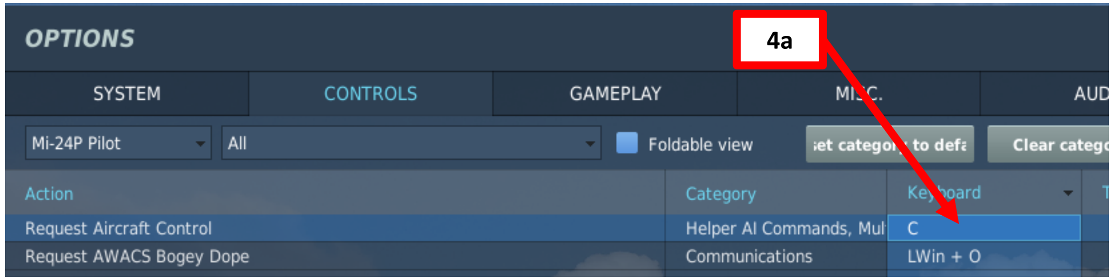




MULTICREW TUTORIAL

4. Once you are spawned, you can take control of the aircraft by pressing the "Request Aircraft Control" binding ("C" key). The other crew member you are taking controls from must accept.





MULTICREW

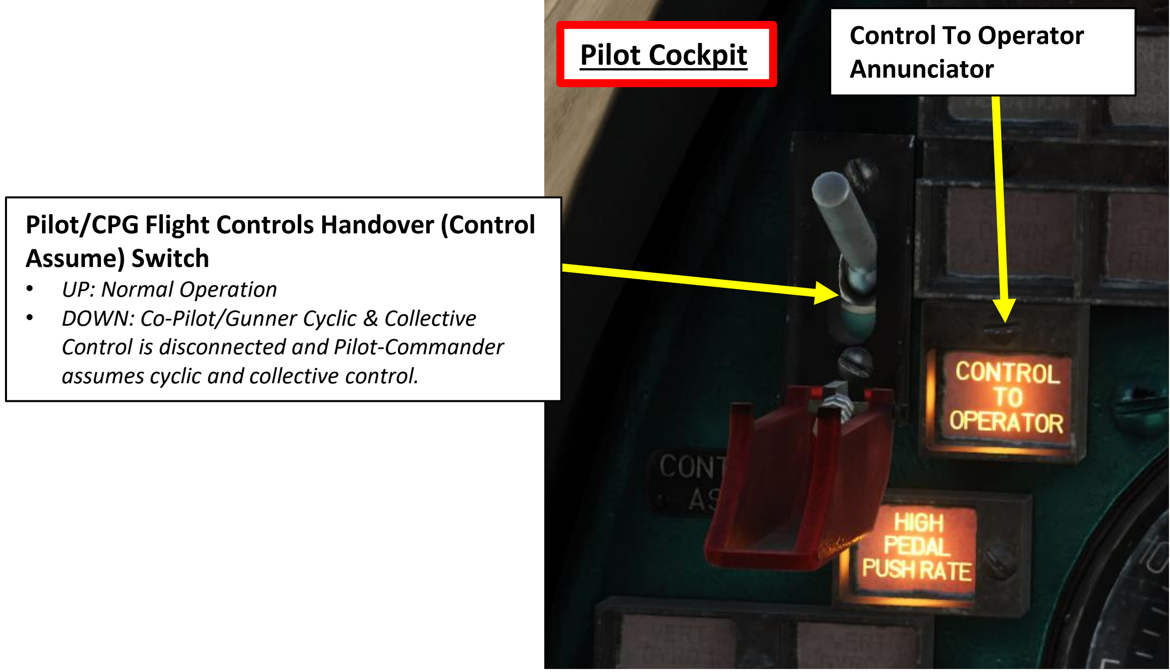
How To Engage Co-Pilot Controls

In the real helicopter, the Co-Pilot/Gunner's flight controls can be engaged by **pressing the CPG Flight Control Engagement Trigger on the collective**. The **Pilot/CPG Flight Controls Handover (Control Assume) Switch** should be set to the UP (Normal Operation) position.

The Co-Pilot's cyclic stick and pedals will then move under hydraulic pressure into the active positions corresponding to the positions of the pilot's controls.

- When Co-Pilot's controls are active, the **CONTROL TO OPERATOR** annunciator should illuminate (not simulated yet).

- Note: At the moment, these steps are automatically performed by pressing « C » (Request Aircraft Control)



MULTICREW

How To Disengage Co-Pilot Controls

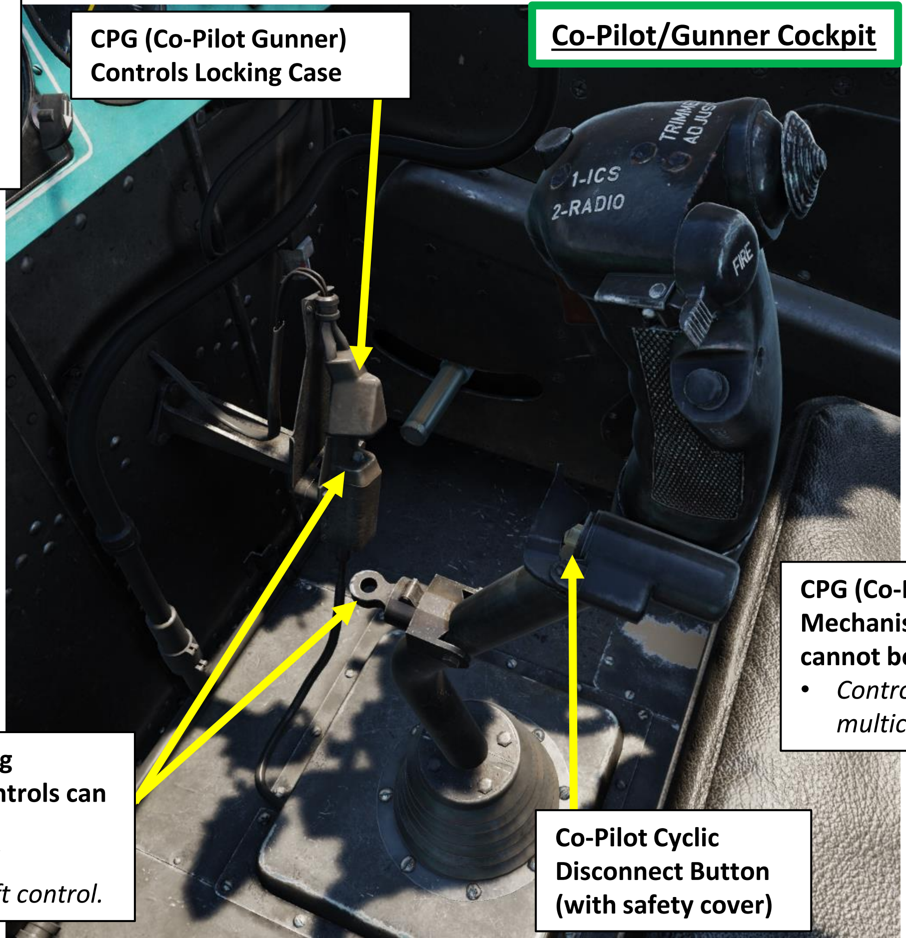
In the real helicopter, the Co-Pilot/Gunner's flight controls can be disengaged by either:

- Having the Pilot-Commander disengage the Co-Pilot Controls with the **Pilot/CPG Flight Controls Handover (Control Assume) Switch – DOWN (Pilot has Control), or;**
- Having the Co-Pilot press the **Co-Pilot Cyclic Disconnect Button (safety cover needs to be lifted first).** The cyclic can then be locked/parked on a locking case.

- Note: At the moment, these steps are automatically performed by pressing « C » (Request Aircraft Control)

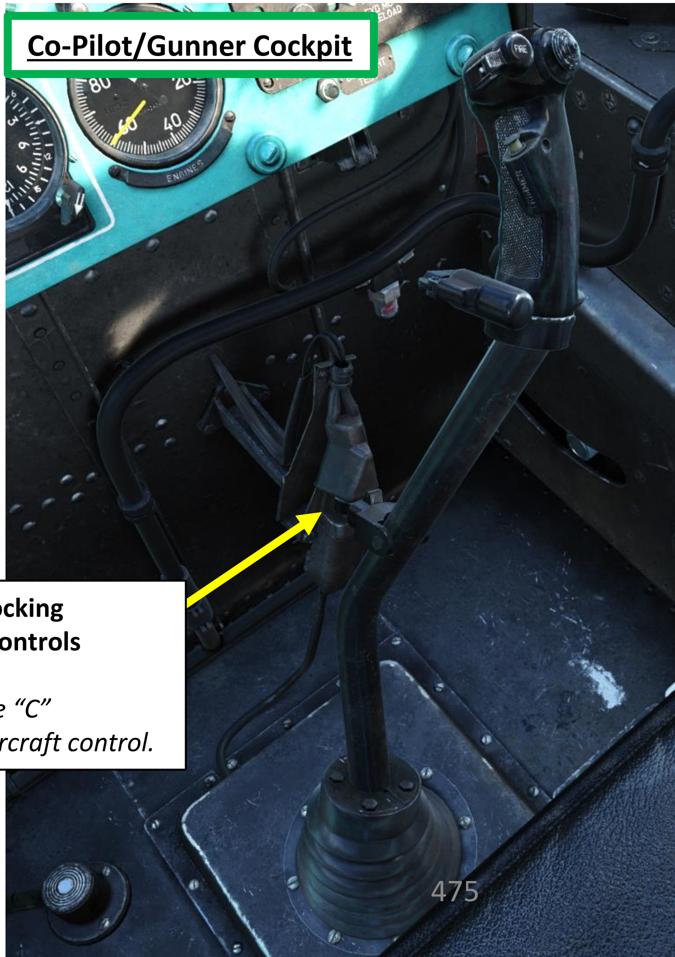
Pilot/CPG Flight Controls Handover (Control Assume) Switch
- *UP: Normal Operation*
- *DOWN: Co-Pilot/Gunner Cyclic & Collective Control is disconnected and Pilot-Commander assumes cyclic and collective control.*

CPG (Co-Pilot Gunner) Controls Locking Case



CPG (Co-Pilot Gunner) Controls Locking Mechanism (shown unlocked, CPG controls can be moved freely)
- *Control lock is toggled using the "C" multicrew binding to request aircraft control.*

Co-Pilot Cyclic Disconnect Button (with safety cover)



CPG (Co-Pilot Gunner) Controls Locking Mechanism (shown locked, CPG controls cannot be moved freely)
- *Control lock is toggled using the "C" multicrew binding to request aircraft control.*

MULTICREW

CREW RESPONSIBILITIES

Take note that this is not an exhaustive list of all crew responsibilities.

Note: Items in **bold** can be performed by both the Pilot-Commander and Co-Pilot/Gunner

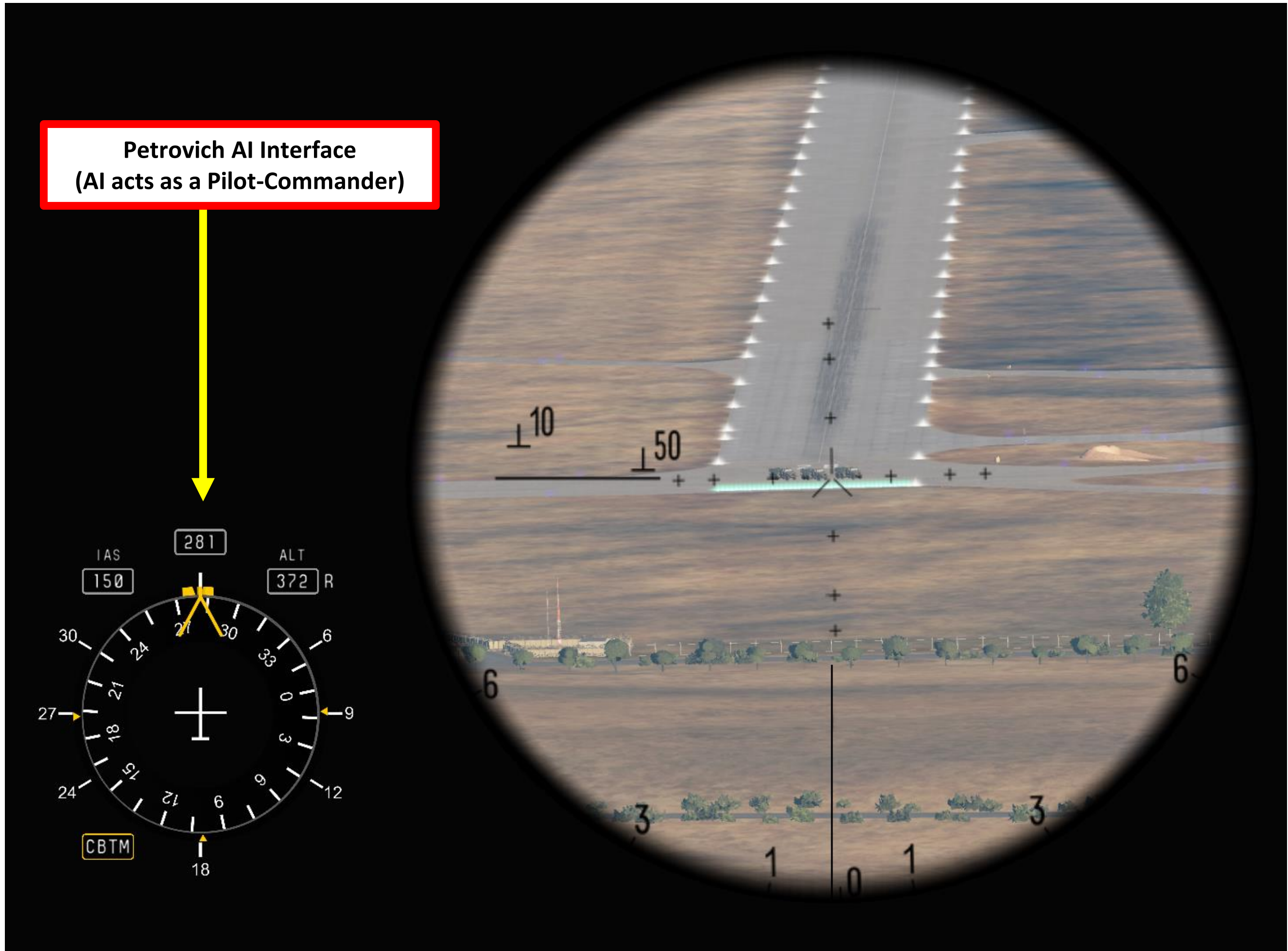
Pilot-Commander		Co-Pilot/Gunner	
Landing Gear Extend/Retract	**Flight Controls (Cyclic, Collective, Anti-Torque Pedals)**	**Landing Gear Extend/Retract**	**Flight Controls (Cyclic, Collective, Anti-Torque Pedals)**
Radio Channel/Frequency Selection (R-863, R-828, Yadro)	**Radio/Intercom Transmission**	Periscope Operation	**Radio/Intercom Transmission**
Wheel Brakes	Weapon Fire Control Power	Missile Selection	Weapon Circuit Breakers
Autopilot	**Weapon Selector**	Missile Control/Guidance	**Weapon Selector**
Hydraulic Systems Management	**Weapon Jettison**	Countermeasures Management	**Weapon Jettison**
Taxi/Search Light Control	**Weapon Delivery (Rockets, Bombs, Gunpods, Cannon)** – Uses ASP-17VP Sight	**Taxi/Search Light Control**	**Weapon Delivery (Rockets, Bombs, Gunpods, Cannon)** – Uses PKI Sight
ARK-15M Automatic Radio Compass	Anti-Ice System Management	**ARK-15M Automatic Radio Compass**	
Navigation Systems (ARK-U2, R-852, R-828, Doppler)	Fire Protection System Management		
Engine Start/Shutdown & Engine Management	Fuel System Management		
APU (Auxiliary Power Unit) Start	Electrical Systems Management		
Cabin Pressurization / Air Conditioning Management	Rotor Brake		
Circuit Breakers (Behind Seat)	External Lights (Navigation, Formation, Anti-Collision, Rotor Blade Tips)		

INTRODUCTION TO THE “PETROVICH” AI

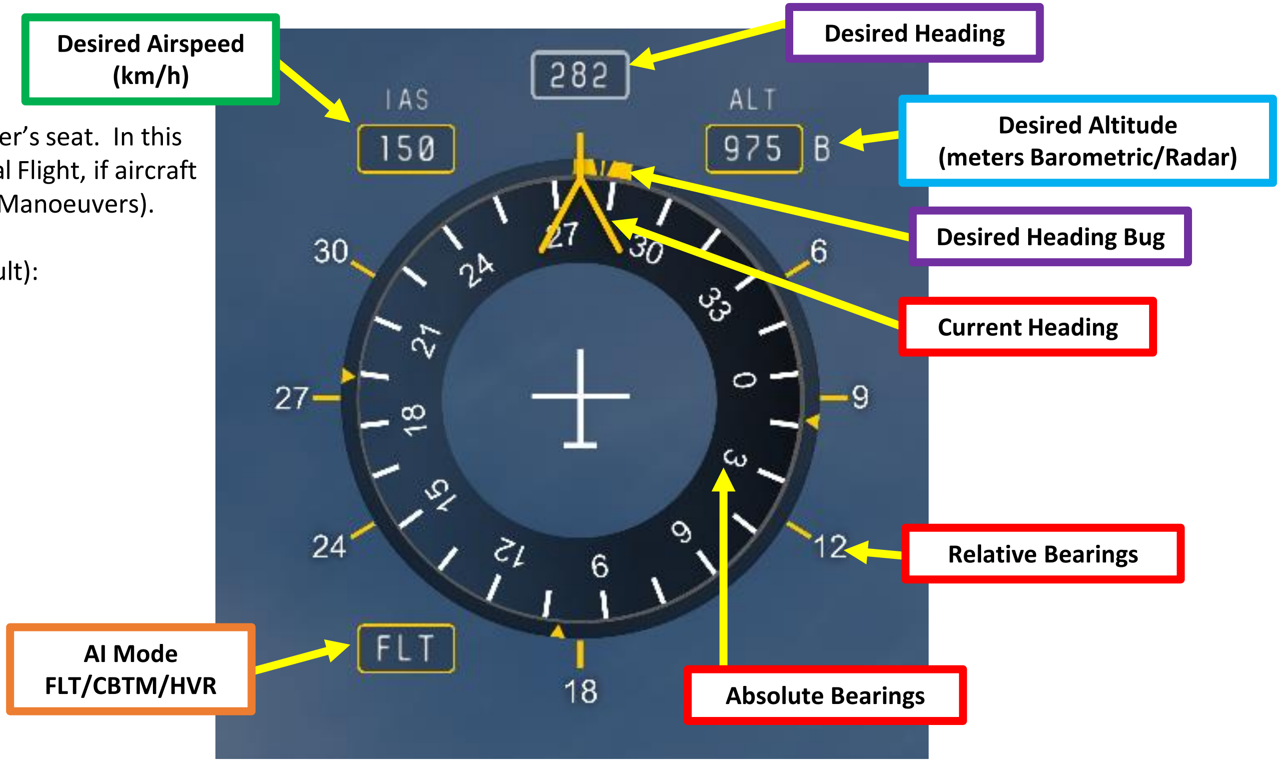
The Mi-24P is crewed by two pilots: a Pilot-Commander and a Co-Pilot/Gunner (also known as “Pilot-Operator”).

The DCS: Mi-24P module supports multicrew capability, where two players can occupy either of the two seats in a multiplayer session. To accommodate for players who fly solo, Eagle Dynamics has created “Petrovich”, a virtual artificial intelligence (AI) crew that allows pilots to control mission-critical items in the unoccupied cockpit that the player is not occupying. Petrovich was designed to mimic the real-life procedures used by Mi-24P crew members and enables single players to coordinate and control AI actions.

Petrovich can be controlled by keyboard bindings, a four-way hat on your HOTAS, or using joystick buttons. As a personal preference, I tend to use the **“W”, “A”, “S” and “D” keys to cycle through menus** UP, LEFT, RIGHT and DOWN. The Petrovich **Interface can be toggled ON or OFF** using “**LCTRL + V**”.



"PETROVICH" AI AS THE PILOT-COMMANDER



When the player is in the Co-Pilot/Gunner's seat, Petrovich takes over the Pilot-Commander's seat. In this mode, Petrovich's main task is to fly the helicopter and can fly in three modes: **FLT** (Normal Flight, if aircraft flies above 50 km/h), **HVR** (Hover Flight, if aircraft flies below 50 km/h) or **CMBT** (Combat Manoeuvers).

Here is a breakdown of Petrovich's CPG functions in ***FLT Mode*** (AI mode selected by default):

- **LCTRL+V:** Toggle AI Menu ON/OFF
- **W: AI Menu UP**
- **A: AI Menu LEFT**
- **S: AI Menu DOWN**
- **D: AI Menu RIGHT**
- **C:** Request Aircraft Control

- **UP (W) SHORT**: **Increases** desired **speed** in the IAS window. After a short delay, Petrovich will accelerate the helicopter to the new speed.
- **UP (W) LONG**: **Increases** the desired **altitude** in the ALT window. After button is released, Petrovich will increase the helicopter's altitude.

- **LEFT (A) SHORT**: Changes AI Menu mode to CMBT (Combat).
- **LEFT (A) LONG**: Moves desired **heading** bug **left**. After button is released, commands Petrovich to turn the helicopter to the new heading.

FLT Mode

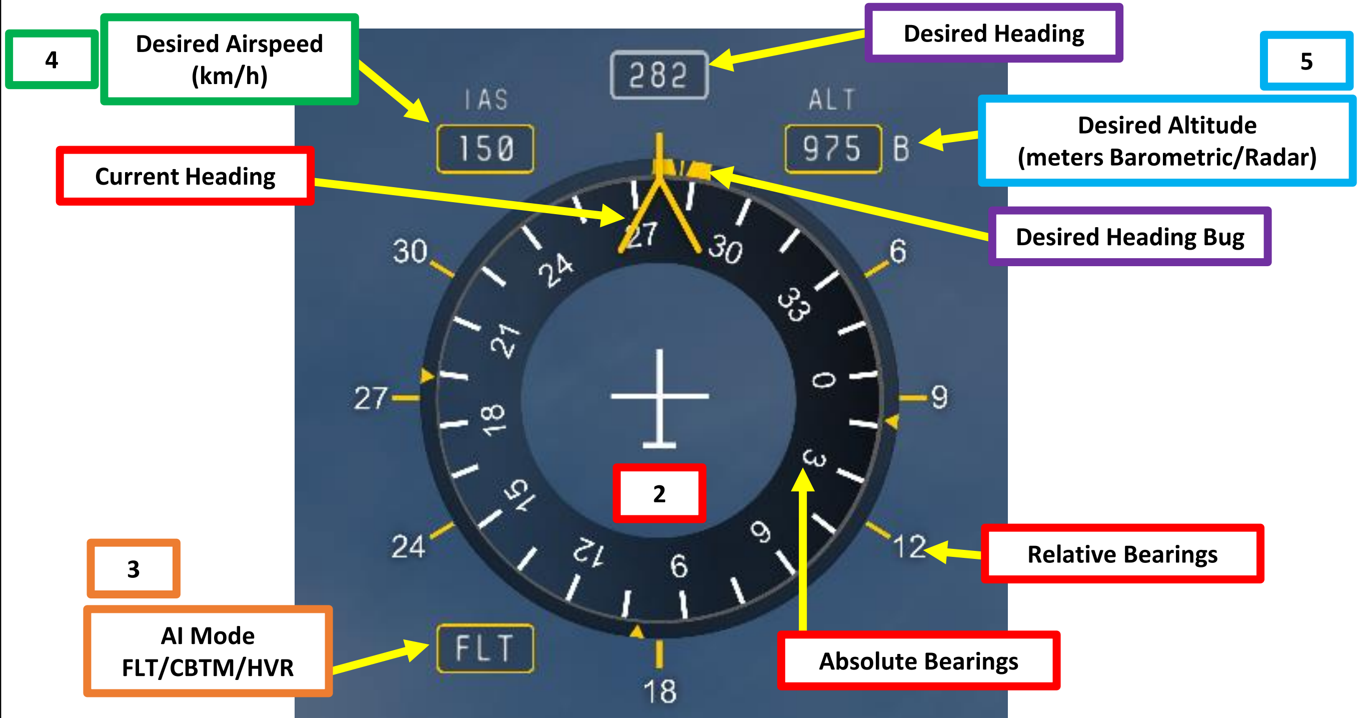
- **RIGHT (D) SHORT**: Activates **head-tracking steering**. A reticle will be displayed in the center of the screen. You can then look in the direction you wish Petrovich to fly, then press Right (D) Short again.
- **RIGHT (D) LONG**: Moves desired **heading** bug **right**. After button is released, commands Petrovich to turn the helicopter to the new heading.

- **DOWN (S) SHORT**: **Decreases** desired **speed** in the IAS window. After a short delay, Petrovich will accelerate the helicopter to the new speed. HVR (Hover) mode is activated if speed decreases below 50 km/h.
- **DOWN (S) LONG**: **Decreases** the desired **altitude** in the ALT window. After button is released, Petrovich will decrease the helicopter's altitude.

"PETROVICH" AI AS THE PILOT-COMMANDER

A designation reticle can also be used to "point and designate" a destination to the Pilot-Commander to fly to. Here is a brief example of how Petrovich is used in FLT mode.

1. *[CPG]* Release Controls using "C",
2. *[CPG]* Show the Petrovich Menu by using « LCTRL+V ». This command will display a horizontal situation indicator that can be used to give commands to Petrovich (acting as Pilot-Commander).
3. *[CPG]* If CBTM AI Mode is selected, select FLT (Flight) AI Mode with « A » Short. Otherwise, leave AI Mode to FLT.
4. *[CPG]* Set desired Airspeed by using « W » SHORT (Increase) or « S » SHORT (Decrease).
5. *[CPG]* Set desired Entry Altitude by using « W » LONG (Increase) or « S » LONG (Decrease).
6. *[CPG]* Press « D » SHORT to display a Designation Reticle. Move reticle using head tracking over the target area, then press « D » SHORT a second time to designate. Petrovich will then steer helicopter towards the target.
   - Alternatively, you can set desired heading using « A » LONG (Heading Bug Left) or « D » LONG (Heading Bug Right).



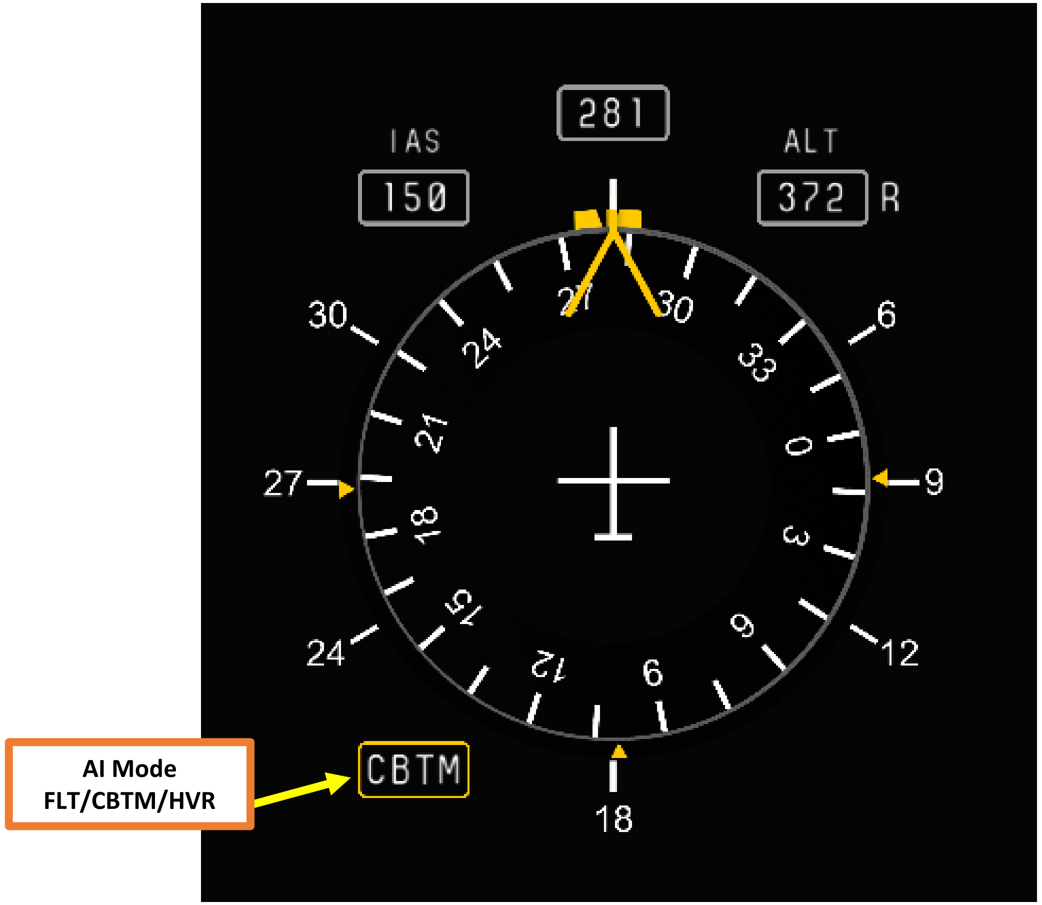
"PETROVICH" AI AS THE PILOT-COMMANDER

Here is a breakdown of Petrovich's CPG functions in ***CBTM Mode*** (AI mode selected by pressing W LONG):

- **LCTRL+V:** Toggle AI Menu ON/OFF
- **W: AI Menu UP**
- **A: AI Menu LEFT**
- **S: AI Menu DOWN**
- **D: AI Menu RIGHT**
- **C:** Request Aircraft Control

The CBTM mode is primarily used to ask the Pilot-Commander to perform an attack run on a target in order to have a valid missile firing solution. The symbology is very similar to the one used in FLT mode, but the AI flies the helicopter more "aggressively".

For more information about the employment of CBTM Mode, consult the Missile Employment tutorials.



- **UP (W) SHORT**: Commands Petrovich to **turn** the helicopter to the **current targeting periscope bearing**. This is useful for beginning attack runs.
- **UP (W) LONG**: Commands Petrovich to begin **missile attack run**. Petrovich will manoeuver the helicopter to achieve launch approval from the missile guidance system and hold these parameters until maximum airspeed is reached, at which point it will return to horizontal flight.

- **LEFT (A) SHORT**: Changes AI Menu mode to FLT (Flight) or HVR (Hover) depending on airspeed.
- **LEFT (A) LONG**: No Function.

CBTM Mode

- **RIGHT (D) SHORT**: No Function.
- **RIGHT (D) LONG**: No Function.

- **DOWN (S) SHORT**: No Function
- **DOWN (S) LONG**: Commands Petrovich to perform a 180 deg combat evasion turn. Intended to be used following an attack run. Turn off the targeting gyros (OBSERVE B2 switch DOWN) switch for a faster turn.

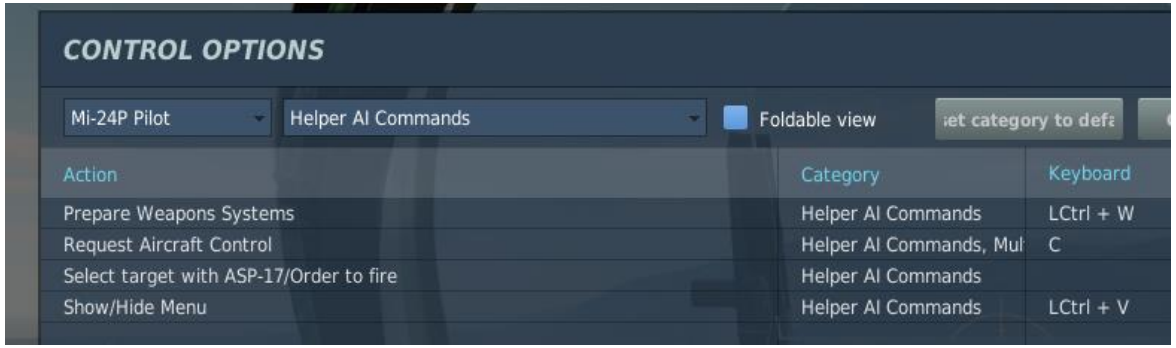
"PETROVICH" AI AS THE CO-PILOT/GUNNER

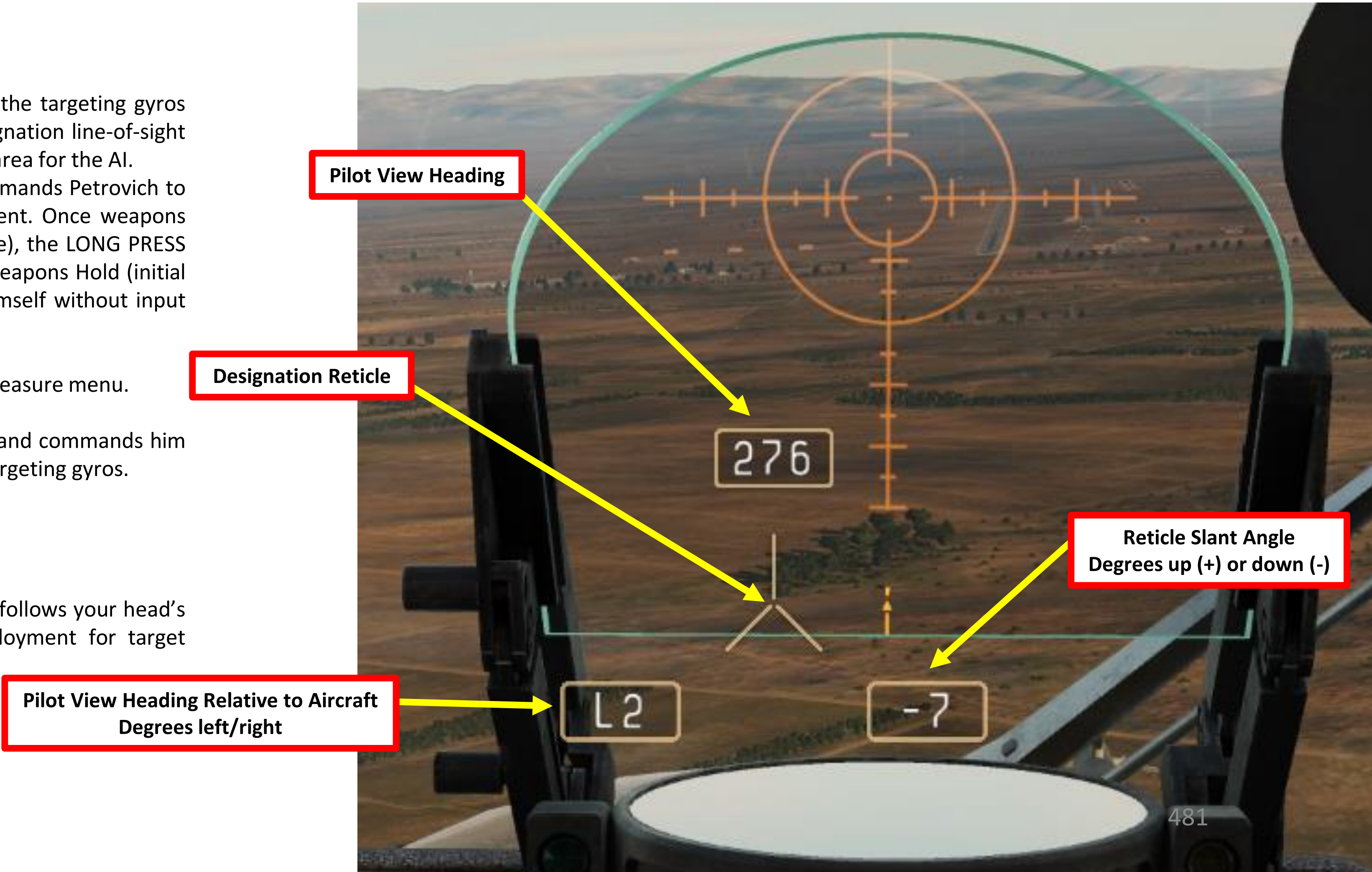
When the player is in the Pilot-Commander's seat, Petrovich takes over the Co-Pilot/Gunner seat. In this mode, Petrovich's main task is to set up weapons and countermeasures, acquire targets with the periscope and fire the air-to-ground missiles. Petrovich can also give various callouts including target ranging.

Here is a breakdown of Petrovich's CPG functions in ***Target Designation Mode*** (AI mode selected by default):

- **LCTRL+V:** Toggle AI Menu ON/OFF
- **LCTRL+W:** Prepare Weapons & Countermeasures
- **W: AI Menu UP**
    - **SHORT PRESS:** Commands Petrovich to enable the targeting gyros and use the periscope to search along the designation line-of-sight for targets. This is used to "designate" a search area for the AI.
    - **LONG PRESS:** If weapons are not enabled, commands Petrovich to set all cockpit switches for weapons employment. Once weapons are enabled (after 3-4 minutes of warm-up time), the LONG PRESS toggles between rules of engagement (ROE); Weapons Hold (initial state) and Weapons Free (Petrovich fires by himself without input from the Pilot-Commander).
- **A: AI Menu LEFT:**
    - **SHORT PRESS:** Shows/Hides Petrovich countermeasure menu.
- **S: AI Menu DOWN:**
    - **SHORT PRESS:** Undesignates Petrovich's target and commands him to retract the targeting periscope and turn off targeting gyros.
    - **LONG PRESS**: No Function.
- **D:** No Function
- **C:** Request Aircraft Control

While in Target Designation Mode, the Designation Reticle follows your head's line-of-sight. For a full demonstration of Petrovich employment for target designation, consult the Missile Employment tutorials.





"PETROVICH" AI AS THE CO-PILOT/GUNNER

The designation interface changes color depending on the active rules of engagement (ROE) and weapon status:

- **Red**: Weapons Hold, Missile is warming up
- **Yellow**: Weapons Free, Missile is warming up
- **Beige**: Weapons Hold, Missile is ready for use
- **Green**: Weapons Free, Missile is ready for use

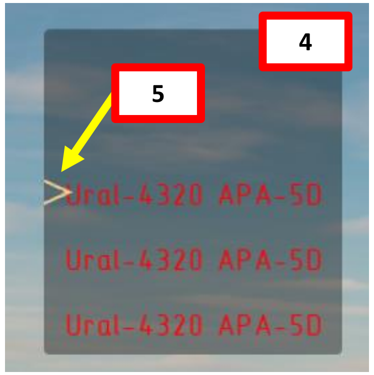
"PETROVICH" AI AS THE CO-PILOT/GUNNER

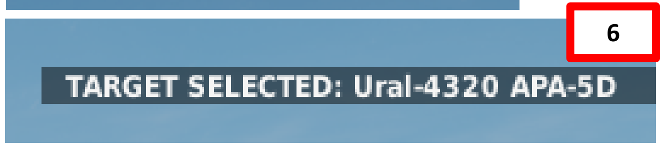
Once Petrovich has searched an area and found some targets, a list of available targets appears. Here is a breakdown of Petrovich's CPG functions in ***Target List Mode***.

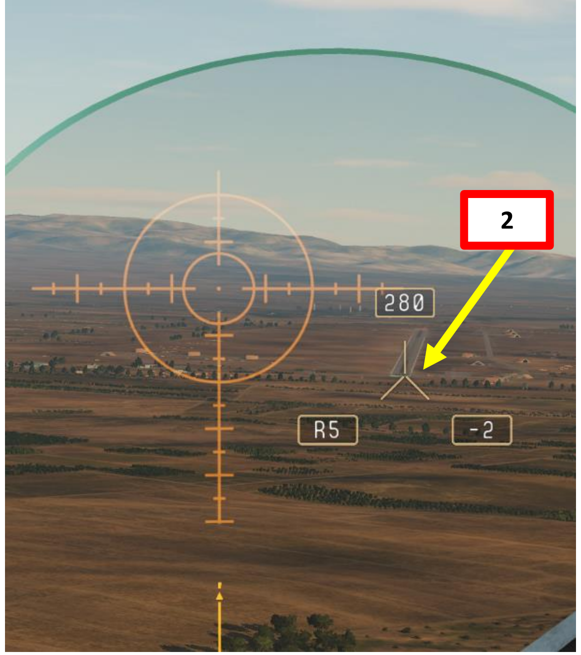
- **W: AI Menu UP**
    - **SHORT PRESS:** Moves target selection list UP.
    - **LONG PRESS:** No Function.
- **A:** No Function
- **S: AI Menu DOWN:**
    - **SHORT PRESS:** Moves target selection list DOWN.
    - **LONG PRESS**: No Function.
- **D: AI Menu RIGHT:**
    - **SHORT PRESS:** Selects target next to **> symbol**.
    - **LONG PRESS**: No Function.

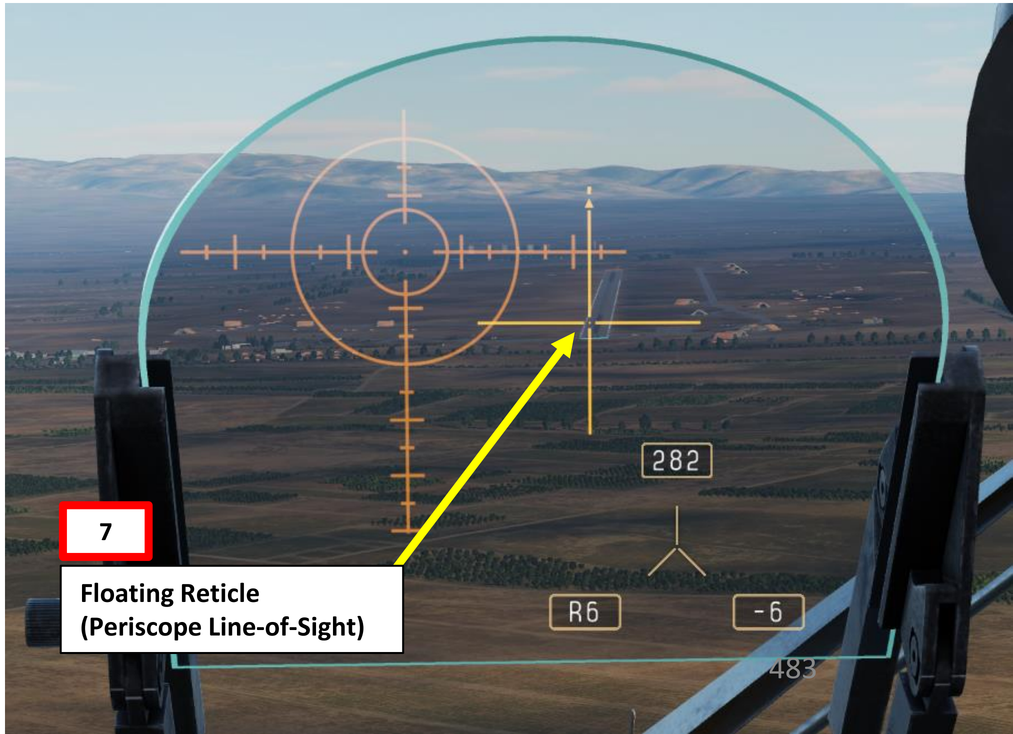
Here is a quick demo on how to designate select a target from a list (assuming all weapons are warmed up and selected properly):

1. *[PC]* Show the Petrovich Menu by using « LCTRL+V ». This command will display a Designation Reticle that can be used to identify and track targets, and give commands to Petrovich (acting as Pilot-Operator).
2. *[PC]* Move your head (Designation Reticle) near the area you want the Co-Pilot/Gunner to search for targets, then press « W » SHORT (less than 0.5 sec).
3. *[CPG]* Petrovich will first call out « Can't move sight yet »; the periscope gimbals require about 10 seconds before the periscope is uncaged and the sight can be moved by the guidance unit handles of the Co-Pilot/Gunner.
4. *[CPG]* Petrovich will then start scanning for targets in the designated area. When targets are found, a menu with a list of targets appears.
5. *[PC]* Cycle through the target list using « W » SHORT (UP) or « S » SHORT (DOWN) until desired target is selected by the **>** symbol.
6. *[PC]* Press « D » SHORT (RIGHT) to select target.
    - Note: Pressing "S" SHORT (DOWN) undesignates Petrovich's target.
7. *[CPG]* Petrovich will then select a missile station and control the periscope to set the aiming sight on the target. The periscope's line-of-sight is represented on the ASP-17VP optical sight by the Floating Reticle.



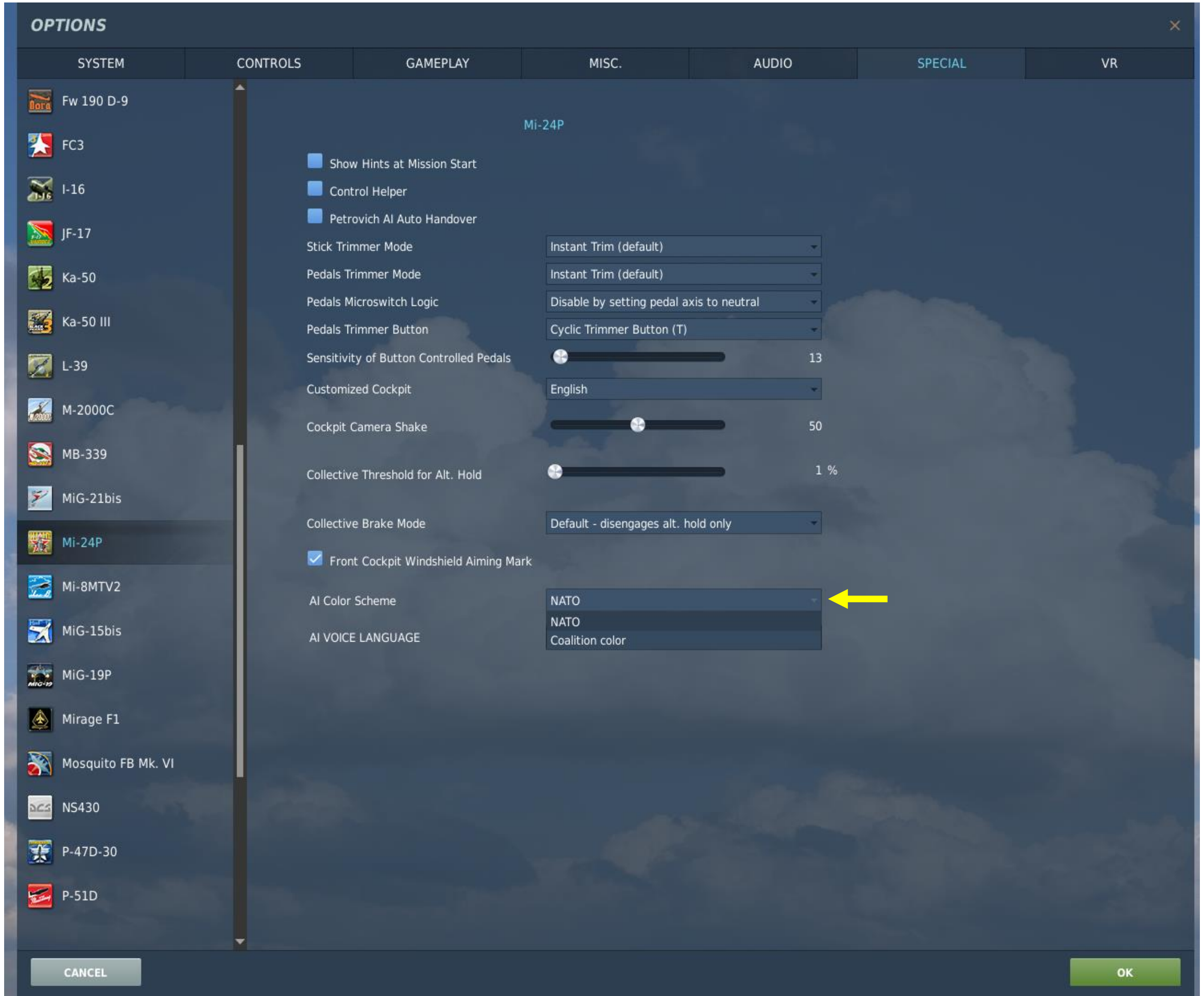


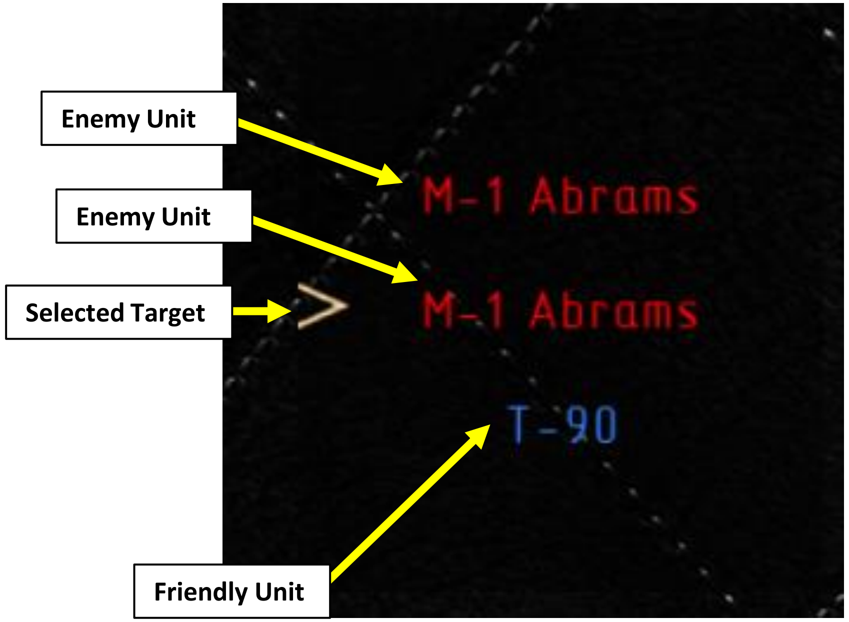




"PETROVICH" AI AS THE CO-PILOT/GUNNER

Take note that the color scheme of targets can be set in the Special Options tab.





"PETROVICH" AI AS THE CO-PILOT/GUNNER

When Petrovich is in the normal Target Designation Mode, it is possible to make him select a countermeasure program. To make the Petrovich Countermeasure interface appear, you must have the AI in ***Target Designation Mode*** first (AI mode selected by default) and **then press "A" (AI Menu LEFT)**. Here is a breakdown of Petrovich's CPG functions in ***Countermeasure Programming Mode***.

- **W: AI Menu UP**
  - **SHORT PRESS:** Toggles Flare Interval Setting (2 or 4).
  - **LONG PRESS:** No Function.
- **A: AI Menu LEFT:**
  - **SHORT PRESS:** Shows/Hides Petrovich countermeasure menu.
- **S: AI Menu DOWN:**
  - **SHORT PRESS:** Toggles Dispenser Side Setting (Left, Both or Right).
  - **LONG PRESS**: Toggles Flare or Chaff Dispenser.
- **D: AI Menu RIGHT:**
  - **SHORT PRESS:** Toggles Series Setting (4 or 16).
  - **LONG PRESS:** No Function.

RESOURCES

DCS Mi-24P Hind Quick Start Manual (English & Russian versions)

MIL Mi-24 Attack Helicopter, by Michael Normann

Erik Johnston's Hind Mi-24 Helicopter Walkaround Tour with Bruce Stringfellow (Youtube)
https://youtu.be/H17sXrWgAgQ

Mi24 Russian attack helicopter (RWA) Documentary (Youtube)
https://youtu.be/JZ5je96v8H8

Eagle Dynamics Mi-24P Tutorials (Youtube)
https://www.youtube.com/playlist?list=PLghf-HEzcSh3XxrpzFPSLHQiKwUcvLSu5

Redkite Mi-24P Tutorials (Youtube)
Countermeasures & RWR https://youtu.be/FrHCZ0Pxhvg
Moving Map Navigation https://youtu.be/F4vRTTm9jmw
ARK-15 NDB Navigation https://youtu.be/mGbAVBHfuPI
R-828 ADF Navigation https://youtu.be/04e0MNObxEc

CasmoTV Mi-24P Videos (Youtube)
https://www.youtube.com/playlist?list=PLNtUtkZqN36mTcVKczPuSeMuQY7Ky0Pym

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:

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- Hexpul
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