DCS GUIDE

MiG-21BIS

By Chuck

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

The **Mikoyan-Gurevich MiG-21** (Russian: Микоян и Гуревич МиГ-21) is a supersonic frontline fighter jet designed by the Mikoyan-Gurevich Design Bureau in the Soviet Union. Its nicknames include: "*fishbed*" by NATO; "balalaika", because its planform resembles the stringed musical instrument of the same name; "*Ołówek*", Polish for "pencil", due to the shape of its fuselage; and "Én Bạc", meaning "silver swallow", in Vietnamese.

The MiG-21 was a continuation of Soviet jet fighters, starting with the subsonic MiG-15 and MiG-17, and the supersonic MiG-19. A number of experimental Mach 2 Soviet designs were based on nose intakes with either swept-back wings, such as the Sukhoi Su-7, or tailed deltas, of which the MiG-21 would be the most successful.

Development of what would become the MiG-21 began in the early 1950s when Mikoyan OKB finished a preliminary design study for a prototype designated Ye-1 in 1954. This project was very quickly reworked when it was determined that the planned engine was underpowered; the redesign led to the second prototype, the Ye-2. Both these and other early prototypes featured swept wings. The first prototype with delta wings as found on production variants was the Ye-4. It made its maiden flight on 16 June 1955 and its first public appearance during the Soviet Aviation Day display at Moscow's Tushino airfield in July 1956.

In the West, due to the lack of available information, early details of the MiG-21 often were confused with those of similar Soviet fighters of the era. In one instance, Jane's All the World's Aircraft 1960–1961 listed the "Fishbed" as a Sukhoi design and used an illustration of the Su-9 'Fishpot'.

The aircraft became much “relevant” to the western world once the MiG-21 entered the Vietnam War against American F-105 Thunderchiefs and F-4 Phantoms. It rapidly became apparent that the MiG-21 was a plane that was operated with the “interceptor” mindset within an integrated air defense, even if it could perform a number of other mission types as well. Despite its limited radar capabilities, MiG-21 pilots could easily be vectored by ground radar controllers.

The “Fishbed” is a lightweight fighter, achieving Mach 2 with a relatively low-powered afterburning turbojet, and thus comparable to the American Lockheed F-104 Starfighter, Northrop F-5 Freedom Fighter and the French Dassault Mirage III. Like many aircraft designed for frontline operations, the MiG-21 has a short range. The issue of the short endurance and low fuel capacity of the MiG-21F, PF, PFM, S/SM and M/MF variants — though each had somewhat greater fuel capacity than the previous — led to the development of the MT and SMT variants. These had an increased range of 250 km (155 mi) compared to the MiG-21SM, but at the cost of other performance degradation, such as the lower service ceiling and slower climb.

The MiG-21bis 75AP (МиГ-21бис Изделие 75) was the ultimate development of the MiG-21, fitted with a Tumansky R25-300 turbojet engine and a great number of other advances over previous types. Those MiG-21bis that were constructed for the Soviet PVO (Air Defense Force) were equipped with the Lazur GCI (Ground-Controlled Interception) system (NATO: "Fishbed-L"), while those for the Soviet Air Force were fitted with the *Polyot* ILS system (NATO: "Fishbed-N"). It's fitted with instruments and electronic equipment ensuring safe flights by day and at night under all weather conditions.

The MiG-21bis is considered to be a third-generation jet fighter. Some 50 countries over four continents have flown the MiG-21, and it still serves many nations a half-century after its maiden flight. Several companies offer upgrade programs for MiG-21, designed to bring the aircraft up to modern standards, with greatly upgraded avionics and armaments. The MiG-21 broke a number of aviation records and is still the most produced supersonic jet aircraft in aviation history (13,996 jets total).

Interestingly, India is the largest operator of MiG-21s. In 1961, the Indian Air Force (IAF) opted to purchase the MiG-21 over several other Western competitors. As part of the deal, the Soviet Union offered India full transfer of technology and rights for local assembly. In 1964, the MiG-21 became the first supersonic fighter jet to enter service with the IAF. Due to limited induction numbers and lack of pilot training, the IAF MiG-21 played a limited role in the Indo-Pakistani War of 1965. However, the IAF gained valuable experience while operating the MiG-21 for defensive sorties during the war. The positive feedback from IAF pilots during the 1965 war prompted India to place more orders for the fighter jet and also invest heavily in building the MiG-21's maintenance infrastructure and pilot training programs. Since 1963, India has introduced more than 1,200 MiG fighters into its air force. As of 2019, 113 upgraded MiG-21s are known to be in operation in the IAF.

The fuselage is semi-monocoque with an elliptical profile and a maximum width of 1.24 m. The air flow to the engine is regulated by an inlet cone in the air intake. On early model MiG-21s, the cone has three positions. For speeds up to Mach 1.5, the cone is fully retracted to the maximum aft position. For speeds between Mach 1.5 and Mach 1.9 the cone moves to the middle position. For speeds higher than Mach 1.9 the cone moves to the maximum forward position. On the later model MiG-21PF, the intake cone moves to a position based on the actual speed. The cone position for a given speed is calculated by the UVD-2M system using air pressures from in front and behind the compressor of the engine. On both sides of the nose, there are gills to supply the engine with more air while on the ground and during takeoff. In the first variant of the MiG-21, the pitot tube was attached to the bottom of the nose. After the MiG-21P variant, this tube became attached to the top of the air intake. Later versions shifted the pitot tube attachment point 15 degrees to the right, as seen from the cockpit, and had an emergency pitot head on the right side, just ahead of the canopy and below the pilot's eyeline.

The cabin is pressurized and air-conditioned. On variants prior to the MiG-21PFM, the cabin canopy is hinged at the front. When ejecting, the SK-1 ejection seat connects with the canopy to make a capsule that encloses the pilot. The capsule protects the pilot from the high-speed airflow encountered during high-speed ejections. After ejection, the capsule opens to allow the pilot to parachute to the ground. However, ejecting at low altitudes can cause the canopy to take too long to separate, sometimes resulting in pilot death.

The MiG-21 was exported widely and it is still in use in several more or less modified versions. While technologically inferior to the advanced fighters it often faced in the last three decades, low production and maintenance costs made it a favorite of nations buying Eastern Bloc military hardware.

The MiG-21 saw action in many conflicts: the Iran-Iraq War, Syrian Civil War, Egyptian-Syrian-Israeli conflicts, Vietnam War, Indo-Pakistan War, Lybian-Egyptian War, Angola's Civil War… it has an impressive track record and plenty of history behind it.

Now… where does this all fit in DCS?

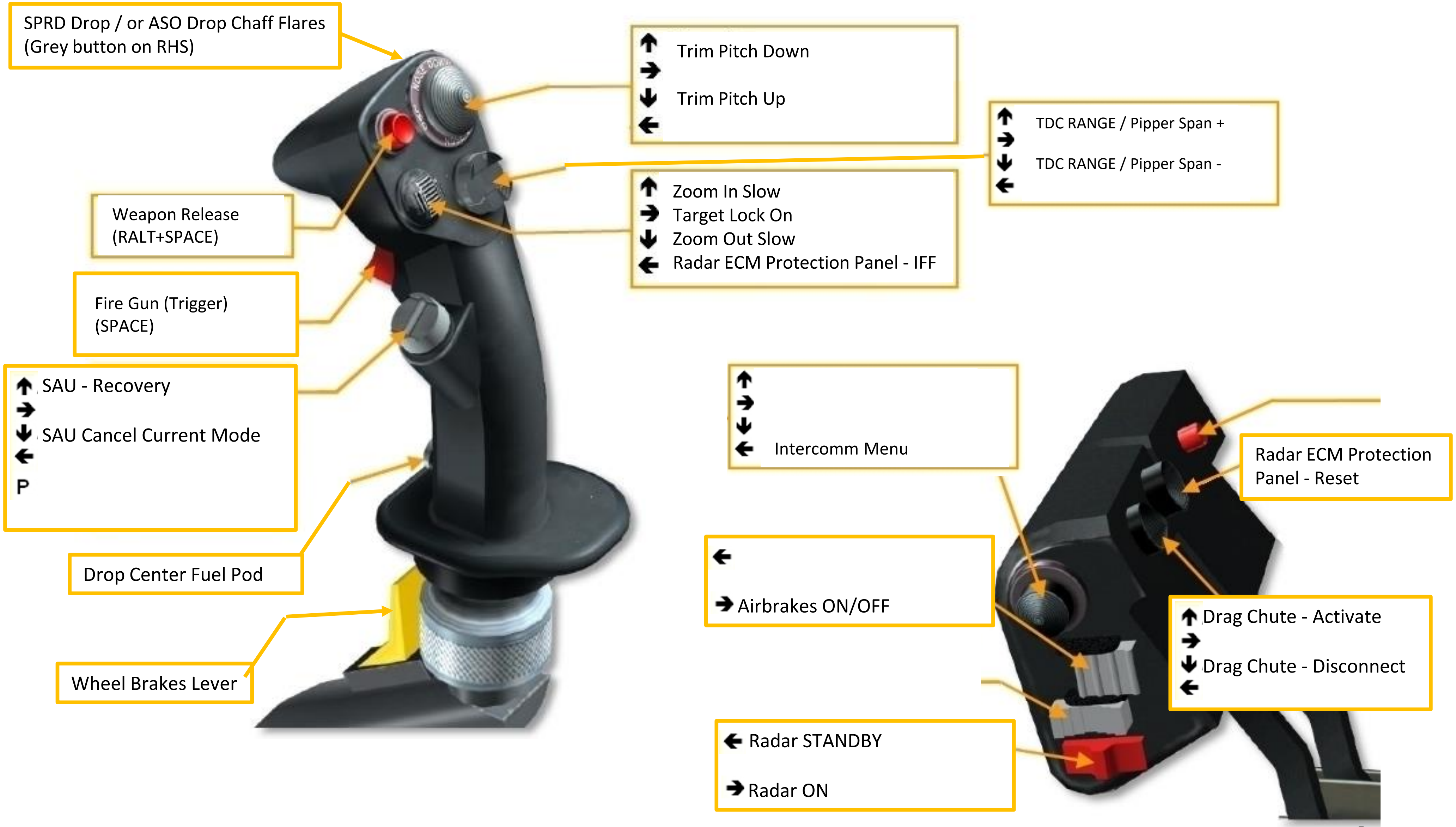
Leatherneck Simulations (now known as Magnitude 3 LLC) has simulated one of the most immersive and influential Cold War jets of its time. The fuselage shakes and rattles as the wings desperately struggle to generate lift, the pitot probe flutters, the afterburner kicks like being hit by a truck… It's one of the most delightful experiences I've had in all my years spent flying flight simulators. I've also had plenty of scary moments; merciless engine flameouts, brutal stalls, low visibility landings at breakneck speed… The aircraft is a temperamental beast that will absolutely attempt to murder you if you don't fly within its prescribed parameters.

The cockpit is as russian as it gets; full of switches spread everywhere, cramped and uncomfortable, and with very limited canopy visibility. Space is a luxury in this plane. Having once been in a MiG-21 cockpit in a museum, the best way I can describe this very specific "feeling" is that you are basically a meat bag strapped on a rocket ship taking you to hell and back.

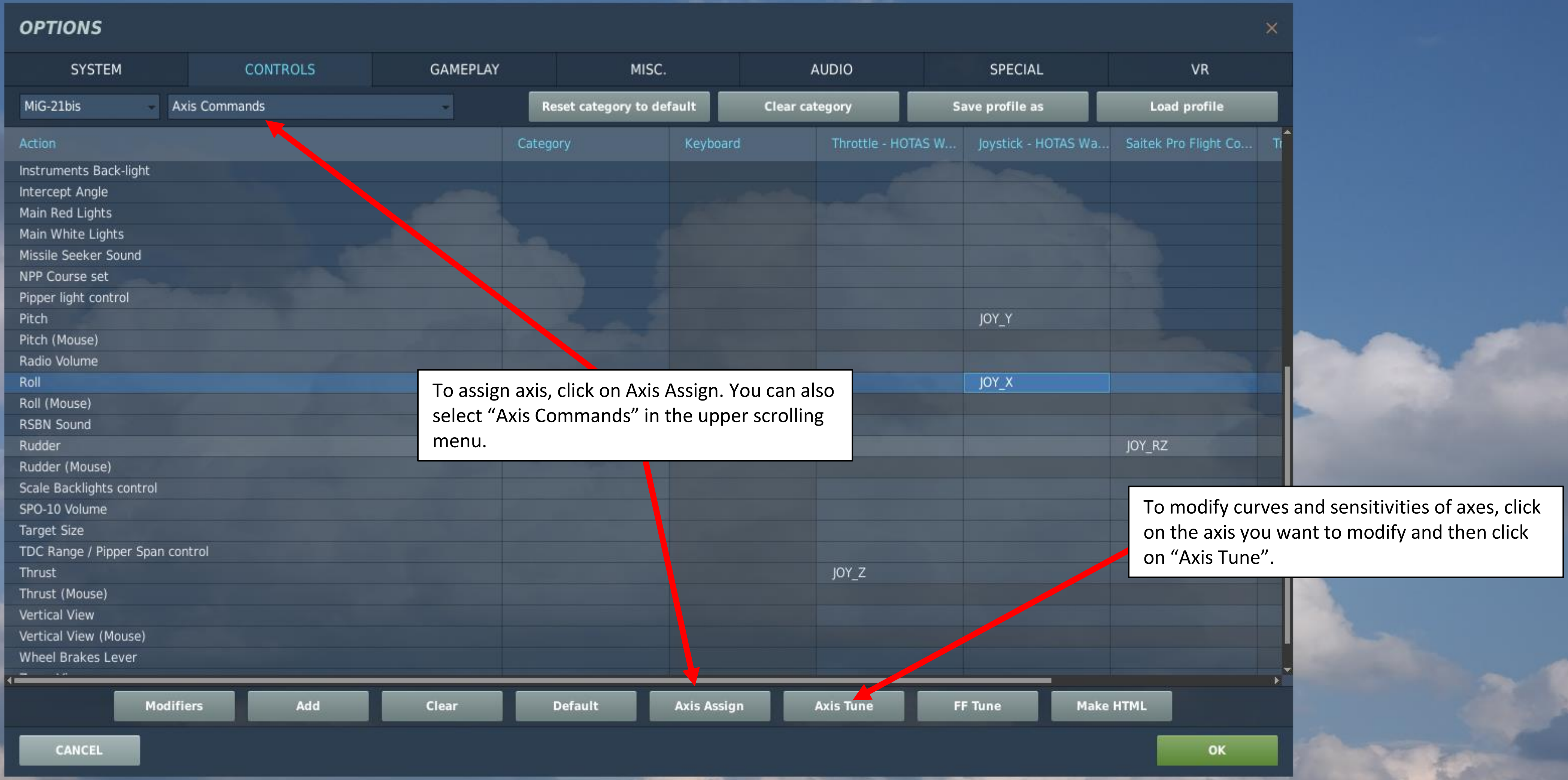
When flying in multiplayer, don't expect to accomplish miracles in modern combat scenarios against F/A-18s, F-16s and other aircraft bristling with modern weapons and avionics. It is an unfair deal, just like it was in real life. However, the *real* fun lies in missions specifically designed with 1960's-1970's scenarios in mind. Operating with a ground controller, visually identifying targets, performing quick climbs to intercept incoming flights before they see you, performing ground strikes with dumb bombs and rockets… this is the MiG's bread and butter. As DCS eventually grows, let us hope that more era-appropriate modules will be simulated to fight with or against the mighty MiG.

With that said, flying the DCS MiG-21bis is both a terrifying and an incredibly rewarding experience. I hope you will enjoy it as much as I do.

WHAT YOU NEED MAPPED

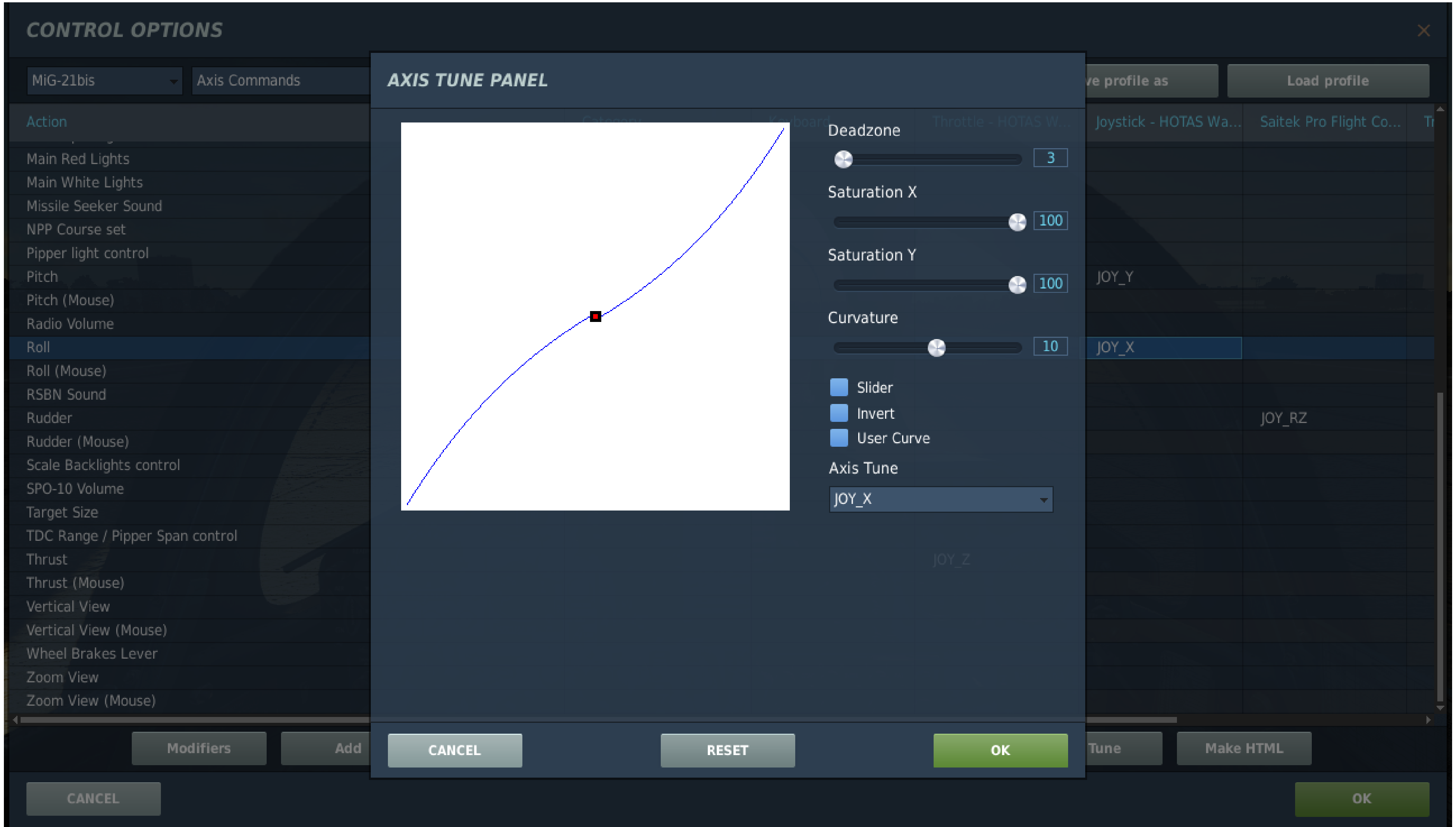


Note: In your controls, make sure you check your "Trim" controls since the default version of the game has your trim hat set to changing your view rather than trim the aircraft. Since most of you are probably equipped with a TRACKIR already, I suggest you make sure the Trim Hat Switch is set up properly.

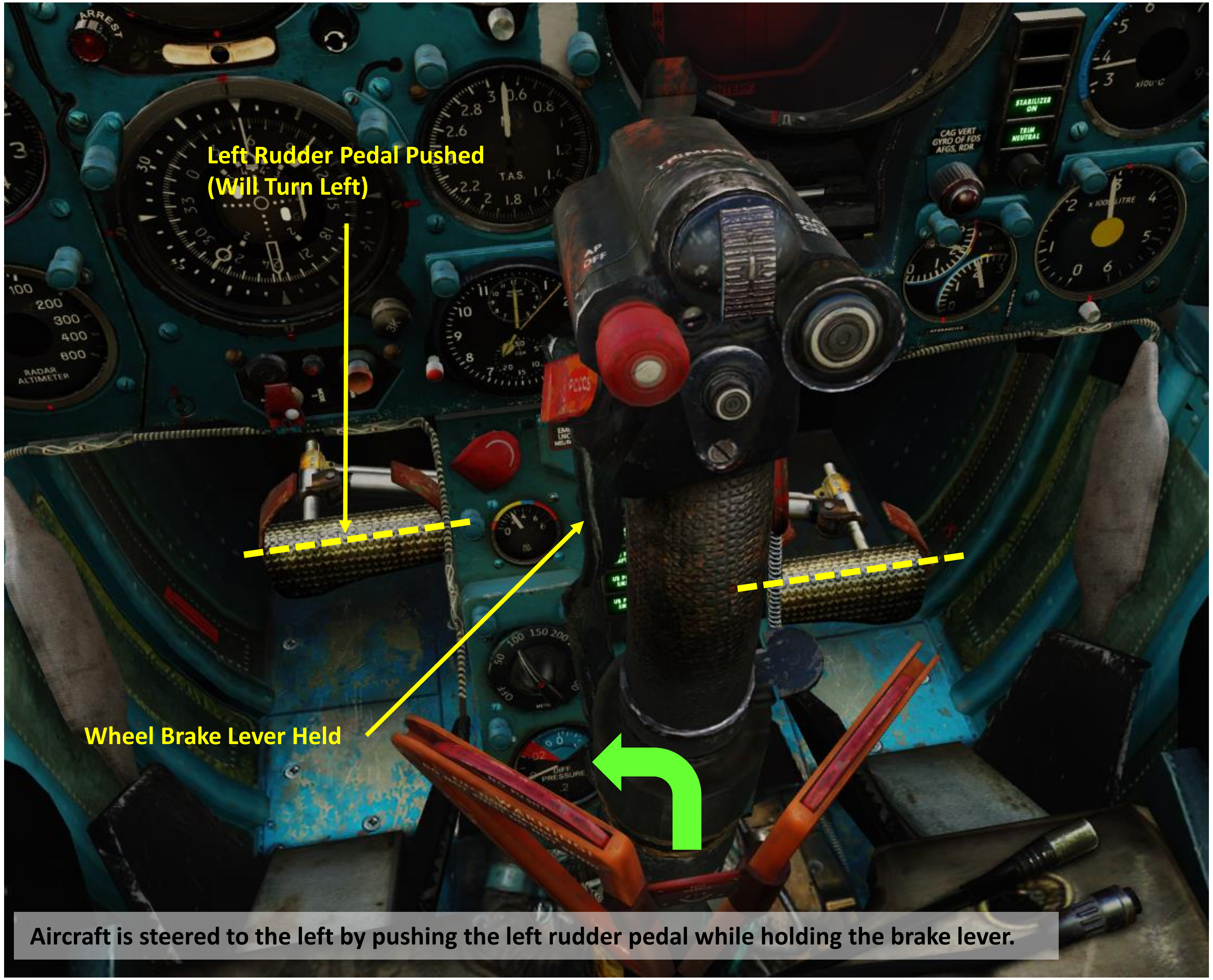


Bind the following axes:

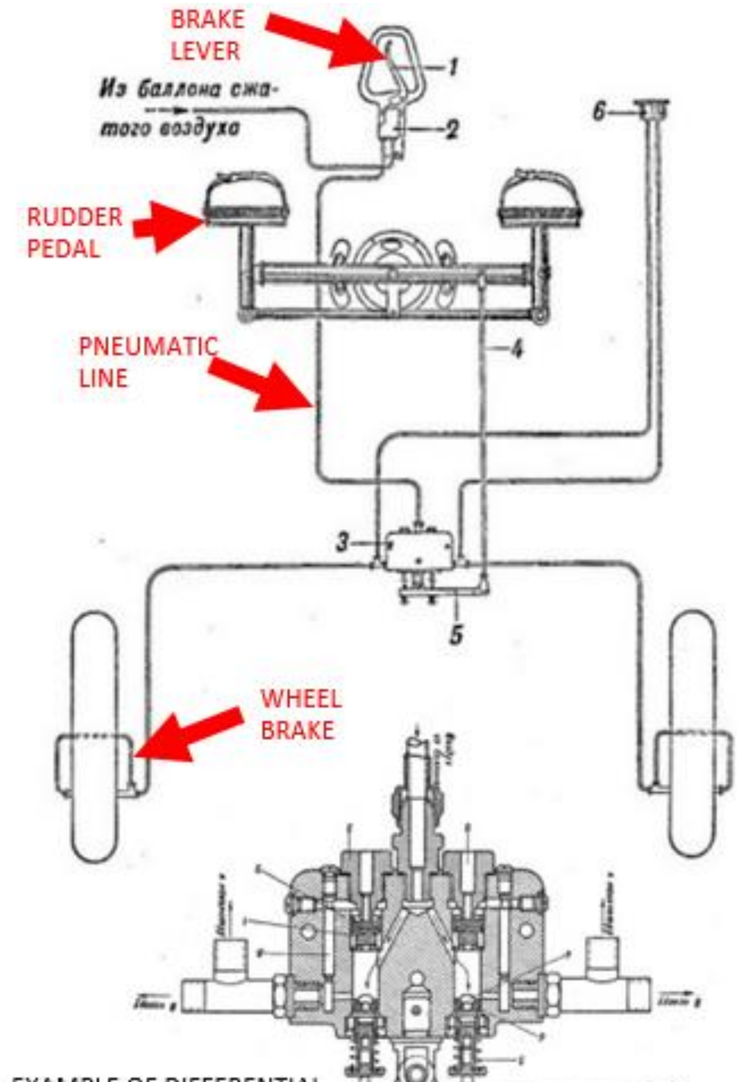
- PITCH (DEADZONE AT 3, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 20)
- ROLL (DEADZONE AT 3, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 10)
- RUDDER (DEADZONE AT 5, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 20)
- THROTTLE – Controls Engine RPM



Braking is done by holding the braking lever while giving rudder input to steer the aircraft in the direction you want to turn. Make sure you have adequate RPM settings or your turn radius will suffer. The best way to move safely on the tarmac is to give very gentle throttle input to ensure you maintain control of the aircraft while steering left and right once in a while to check for obstacles. It is best to turn while moving and then straighten nose wheel prior to stopping.



Aircraft is steered to the left by pushing the left rudder pedal while holding the brake lever.



EXAMPLE OF DIFFERENTIAL
BRAKING SYSTEM ADAPTED
FROM RUSSIAN LAGG-3

1 Disposition of internal fuel tankage, total capacity 896 Imp gal (2,280 lit)
2 Pitot head
3 Pitch vanes
4 Yaw vanes
5 Air data boom
6 Intake centre-body, forward position
7 Moveable intake shock cone centre-body/radome
8 Engine air intake
9 Glass-fibre antenna housing
10 Radar antenna
11 Scanner mounting and tracking mechanism
12 Forward SRZO-21 IFF antennae
13 Angle-of-attack transmitter
14 Radar unit withdrawal rail
15 RP-22 SMA Safir radar equipment module
16 Bifurcated intake duct
17 Windscreen de-icing fluid reservoir
18 Boundary layer spill duct, above and below
19 Dynamic pressure probe
20 Avionics bay access hatch
21 Forward avionics equipment bay
22 Nosewheel housing
23 Intake overpressure spill door
24 Nosewheel doors
25 Nosewheel levered suspension
26 Forward retracting nosewheel
27 Nosewheel pneumatic disc brake
28 Hydraulic steering unit
29 Port intake ducting
30 Nose undercarriage leg pivot mounting
31 Hydraulic retraction jack

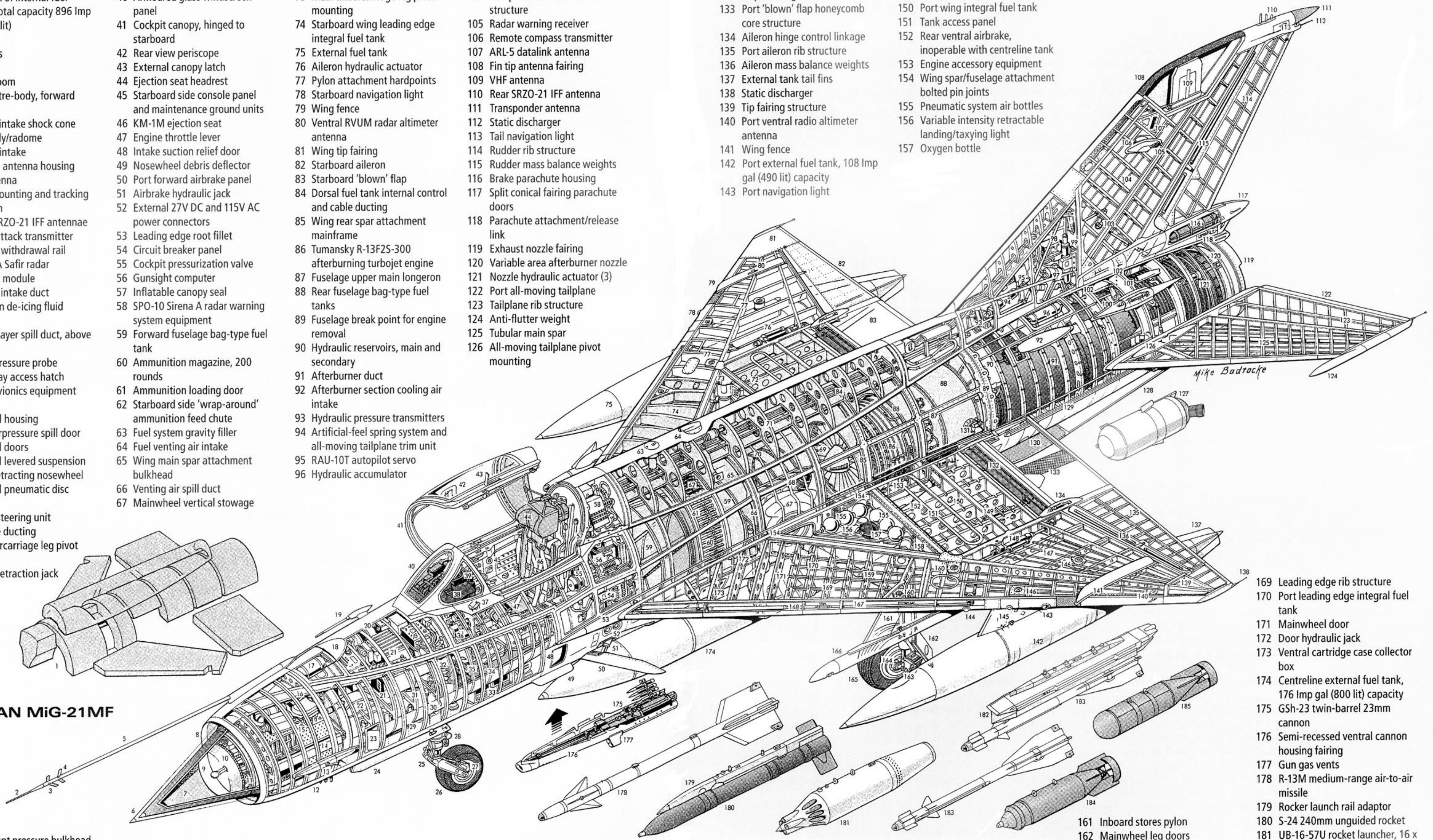
40 Armoured glass windscreen panel
41 Cockpit canopy, hinged to starboard
42 Rear view periscope
43 External canopy latch
44 Ejection seat headrest
45 Starboard side console panel and maintenance ground units
46 KM-1M ejection seat
47 Engine throttle lever
48 Intake suction relief door
49 Nosewheel debris deflector
50 Port forward airbrake panel
51 Airbrake hydraulic jack
52 External 27V DC and 115V AC power connectors
53 Leading edge root fillet
54 Circuit breaker panel
55 Cockpit pressurization valve
56 Gunsight computer
57 Inflatable canopy seal
58 SPO-10 Sirena A radar warning system equipment
59 Forward fuselage bag-type fuel tank
60 Ammunition magazine, 200 rounds
61 Ammunition loading door
62 Starboard side 'wrap-around' ammunition feed chute
63 Fuel system gravity filler
64 Fuel venting air intake
65 Wing main spar attachment bulkhead
66 Venting air spill duct
67 Mainwheel vertical stowage

73 Main undercarriage leg pivot mounting
74 Starboard wing leading edge integral fuel tank
75 External fuel tank
76 Aileron hydraulic actuator
77 Pylon attachment hardpoints
78 Starboard navigation light
79 Wing fence
80 Ventral RVUM radar altimeter antenna
81 Wing tip fairing
82 Starboard aileron
83 Starboard 'blown' flap
84 Dorsal fuel tank internal control and cable ducting
85 Wing rear spar attachment mainframe
86 Tumansky R-13F2S-300 afterburning turbojet engine
87 Fuselage upper main longeron
88 Rear fuselage bag-type fuel tanks
89 Fuselage break point for engine removal
90 Hydraulic reservoirs, main and secondary
91 Afterburner duct
92 Afterburner section cooling air intake
93 Hydraulic pressure transmitters
94 Artificial-feel spring system and all-moving tailplane trim unit
95 RAU-10T autopilot servo
96 Hydraulic accumulator

104 Fin spar and rib torsion box structure
105 Radar warning receiver
106 Remote compass transmitter
107 ARL-5 datalink antenna
108 Fin tip antenna fairing
109 VHF antenna
110 Rear SRZO-21 IFF antenna
111 Transponder antenna
112 Static discharger
113 Tail navigation light
114 Rudder rib structure
115 Rudder mass balance weights
116 Brake parachute housing
117 Split conical fairing parachute doors
118 Parachute attachment/release link
119 Exhaust nozzle fairing
120 Variable area afterburner nozzle
121 Nozzle hydraulic actuator (3)
122 Port all-moving tailplane
123 Tailplane rib structure
124 Anti-flutter weight
125 Tubular main spar
126 All-moving tailplane pivot mounting

132 Flap blowing air duct
133 Port 'blown' flap honeycomb core structure
134 Aileron hinge control linkage
135 Port aileron rib structure
136 Aileron mass balance weights
137 External tank tail fins
138 Static discharger
139 Tip fairing structure
140 Port ventral radio altimeter antenna
141 Wing fence
142 Port external fuel tank, 108 Imp gal (490 lit) capacity
143 Port navigation light

149 Ventral flap hydraulic actuator
150 Port wing integral fuel tank
151 Tank access panel
152 Rear ventral airbrake, inoperable with centreline tank
153 Engine accessory equipment
154 Wing spar/fuselage attachment bolted pin joints
155 Pneumatic system air bottles
156 Variable intensity retractable landing/taxying light
157 Oxygen bottle



MIKOYAN MiG-21MF

169 Leading edge rib structure
170 Port leading edge integral fuel tank
171 Mainwheel door
172 Door hydraulic jack
173 Ventral cartridge case collector box
174 Centreline external fuel tank, 176 Imp gal (800 lit) capacity
175 GSh-23 twin-barrel 23mm cannon
176 Semi-recessed ventral cannon housing fairing
177 Gun gas vents
178 R-13M medium-range air-to-air missile
179 Rocker launch rail adaptor
180 S-24 240mm unguided rocket
181 UB-16-57U rocket launcher, 16 x 57mm rockets
182 APU2R-60 twin missile carrier/launch rail
183 R-60 close-range air-to-air missiles
184 FAB-250TS 250kg (551lb) HE bomb
185 RBK-250 250kg (551lb) cluster bomb

32 Cockpit front pressure bulkhead
33 Twin 24V, 45Ah batteries in hinged ventral compartment
34 Cockpit pressure enclosure
35 Rudder pedals
36 Pilot's instrument panel
37 Control column
38 Instrument panel shroud
39 ASP-PF-21 gunsight and recording camera

68 Engine airborne re-start oxygen bottle, fire extinguisher in starboard mainwheel bay
69 Intake compressor face
70 Detachable dorsal integral fuel tank
71 Dorsal tank welded structure
72 Starboard wing aft integral fuel tank

97 Emergency hydraulic pump
98 SARPP flight recorder
99 All-moving tailplane hydraulic actuator
100 Tailplane control linkage
101 Afterburner nozzle-jack cooling air intake
102 Fin spar attachment joints
103 Rudder control links

127 SPRD jettisonable assisted take-off rocket, port and starboard mounting
128 Ventral fin
129 External hydraulic pipe duct
130 HF aerial panel
131 Engine bleed-air connector and control valve

144 Radar warning receiver
145 Outboard 'wet' stores pylon
146 Pylon attachment hardpoints
147 Outer wing panel rib and stringer structure
148 Port aileron hydraulic actuator

158 Main undercarriage leg pivot mounting
159 Hydraulic retraction jack/lock strut
160 Inboard pylon attachment hardpoints

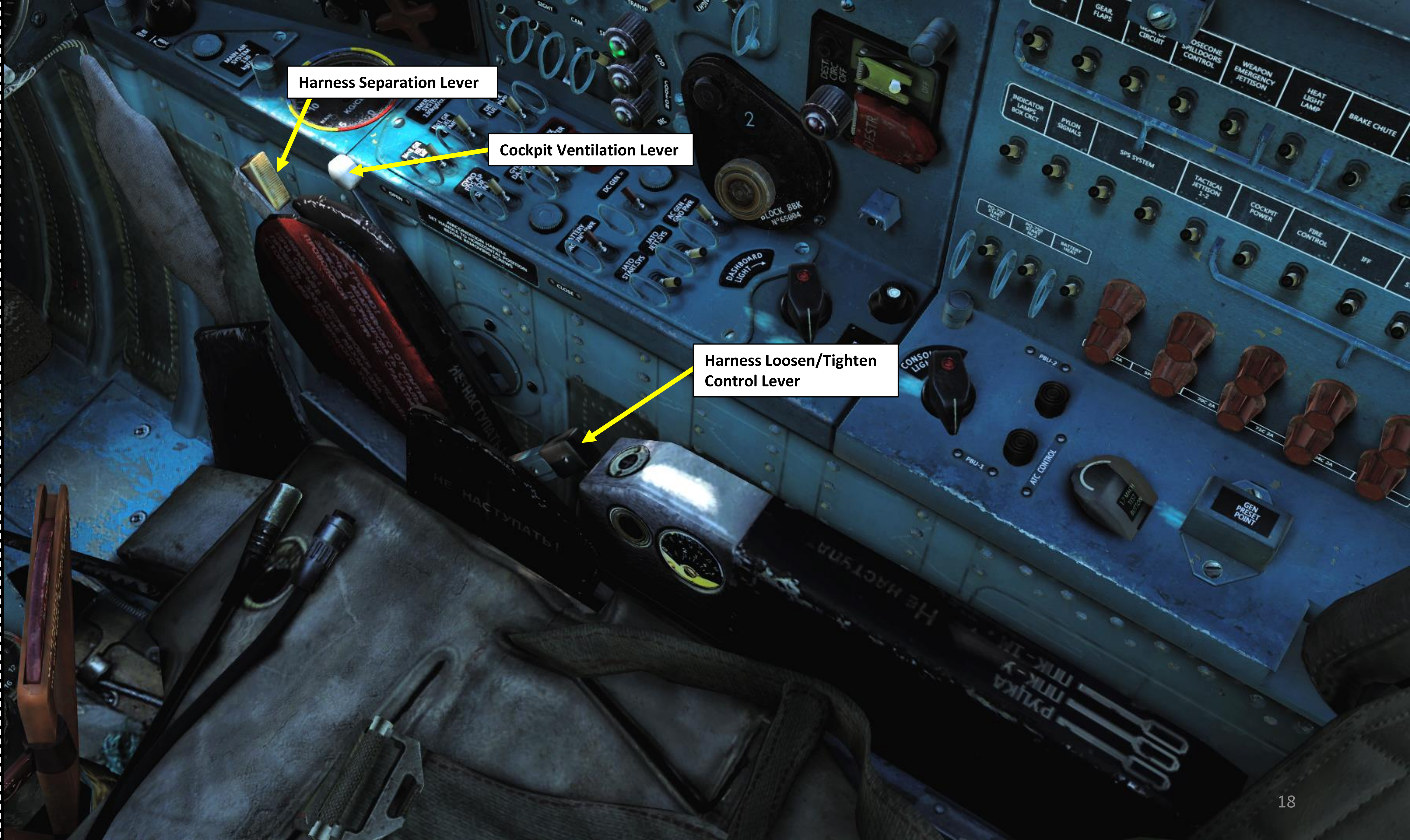
161 Inboard stores pylon
162 Mainwheel leg doors
163 Torque scissor links and hinged axle linkage, wheel remains upright on retraction
164 Pneumatic multi-disc brake unit
165 Port mainwheel
166 APU-13M missile carrier and launch rail
167 Auxiliary front spar
168 Aileron control rod linkage

SYSTEM	DESCRIPTION
AGD/GYRO	Attitude Indicator / Artificial Horizon
ARC (ARK)	Automatic Radio Compass
ARU	Horizontal Tail Movement Control System
ASP	Optical Aiming Device (Gunsight)
ILS	Instrument Landing System
IR	Infrared (refers to IR-seeking missiles)
KPP (AGD/GYRO)	Artificial Horizon (AGD/GYRO)
KSI/FDS	Course Indicator / Flight Directional System
NPP (KSI/FDS)	Course Indicator / Flight Directional System (KSI/FDS)
PO-750	DC to AC Converter (Inverter)
PRMG	Russian equivalent of Instrument Landing System (ILS)
RP-22	Radar
RSBN	Tactical Short-Range Radio-navigation System (similar to TACAN)
SARPP	“Black Box” (Flight Recorder)
SAU	Autopilot
SOD	Transponder
SPO	Radar Warning Receiver (RWR)
SPS	Flaps BLC (Boundary Layer Control) Blowing System
SRZO	Identification Friend-or-Foe (IFF) System
SPRD (JATO)	Jet-Assisted Takeoff Rocket Boosters
SUA	Dangerous Angle of Attack (AoA) Warning Lights
TDC	Target Designation Cue (on Radar Screen)
UUA	Angle of Attack (AoA) Indicator


И ЗАГРЯЗНЕНИЯ
ХРАНИ КРЕСЛО ПОД
ЧЕХЛОМ

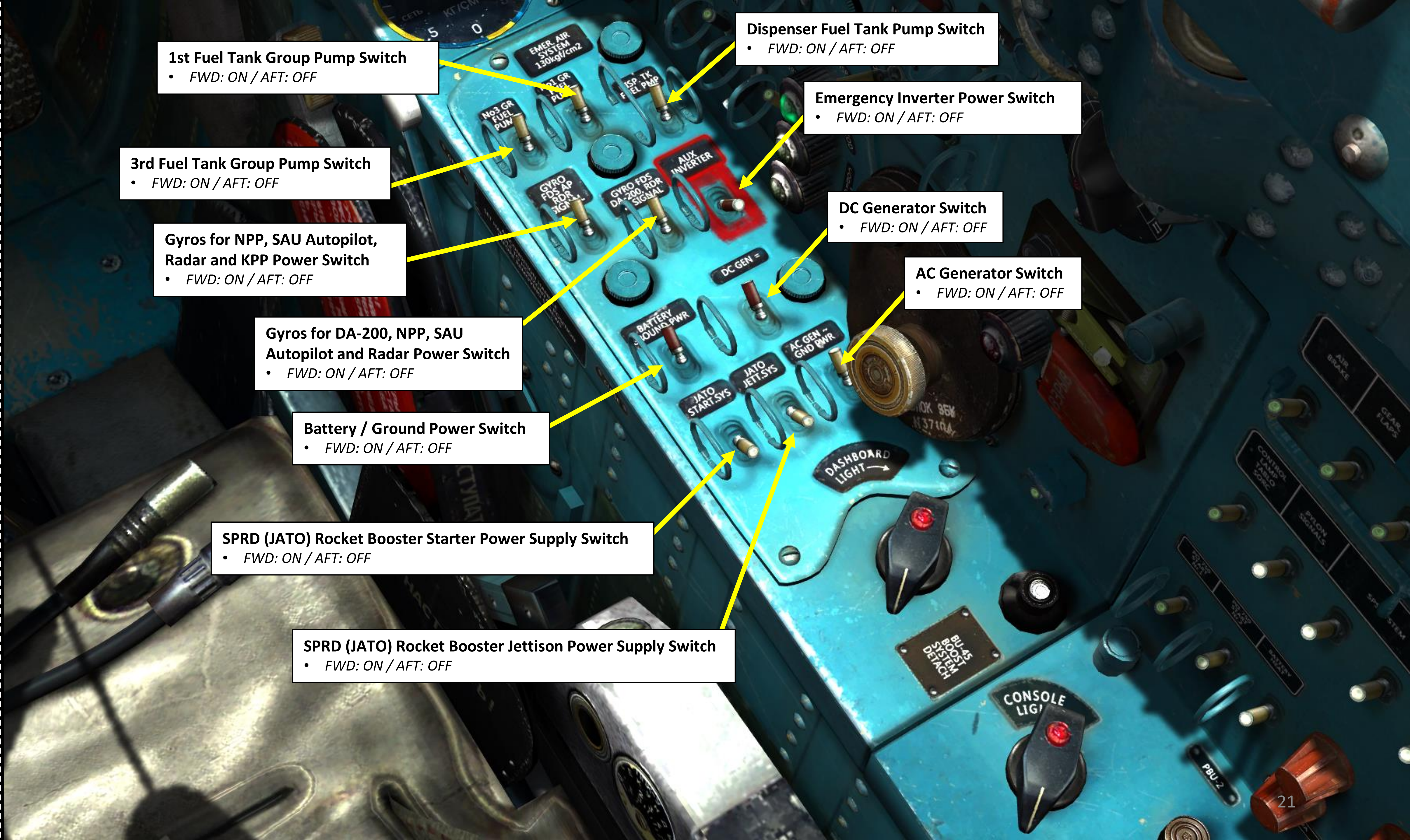

CANOPY JETTISON

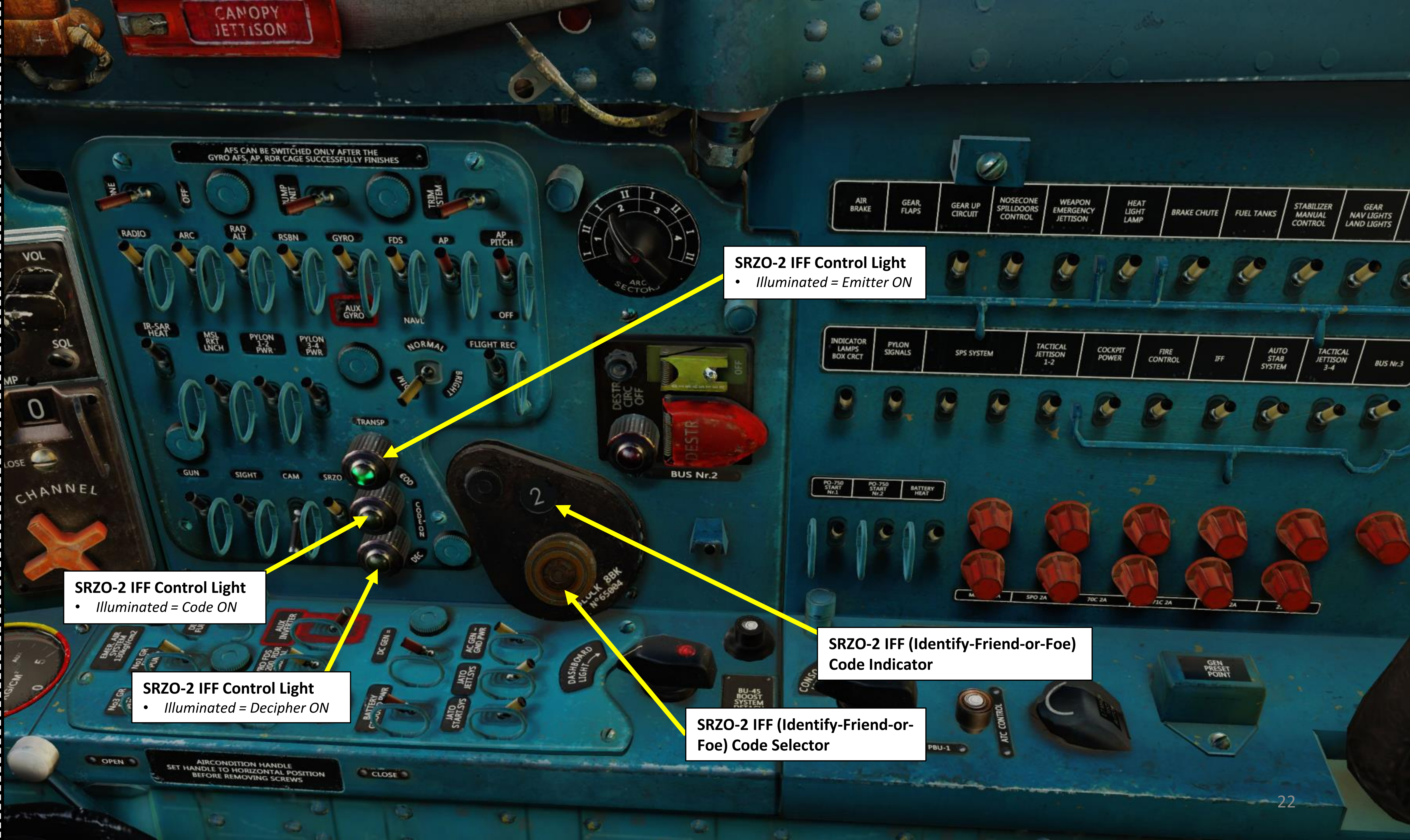

Canopy Emergency Release Handle
CANOPY JETTISON
Вынимая стопорные шпильки, проверь их целостность.

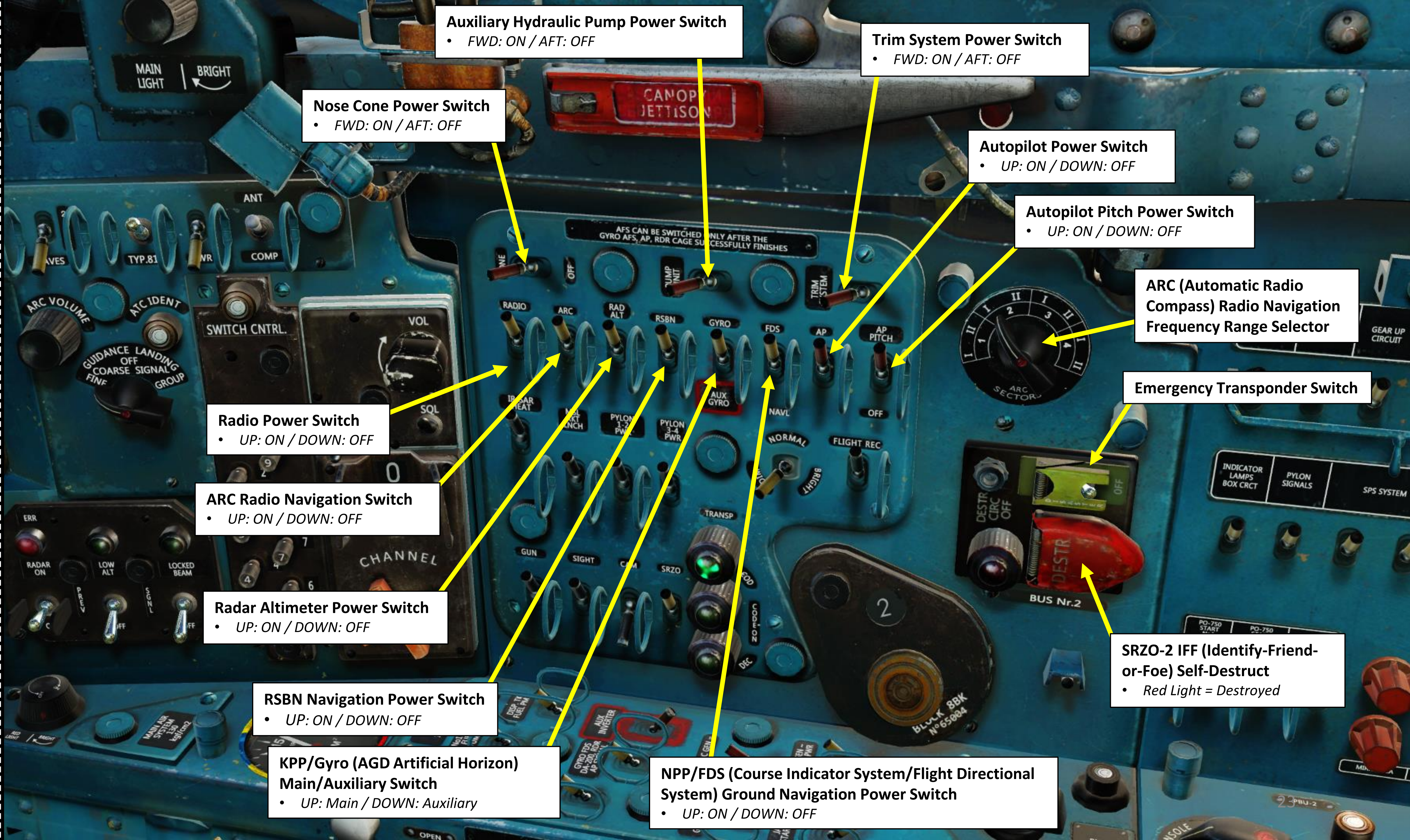

Harness Separation Lever
Cockpit Ventilation Lever
Harness Loosen/Tighten Control Lever

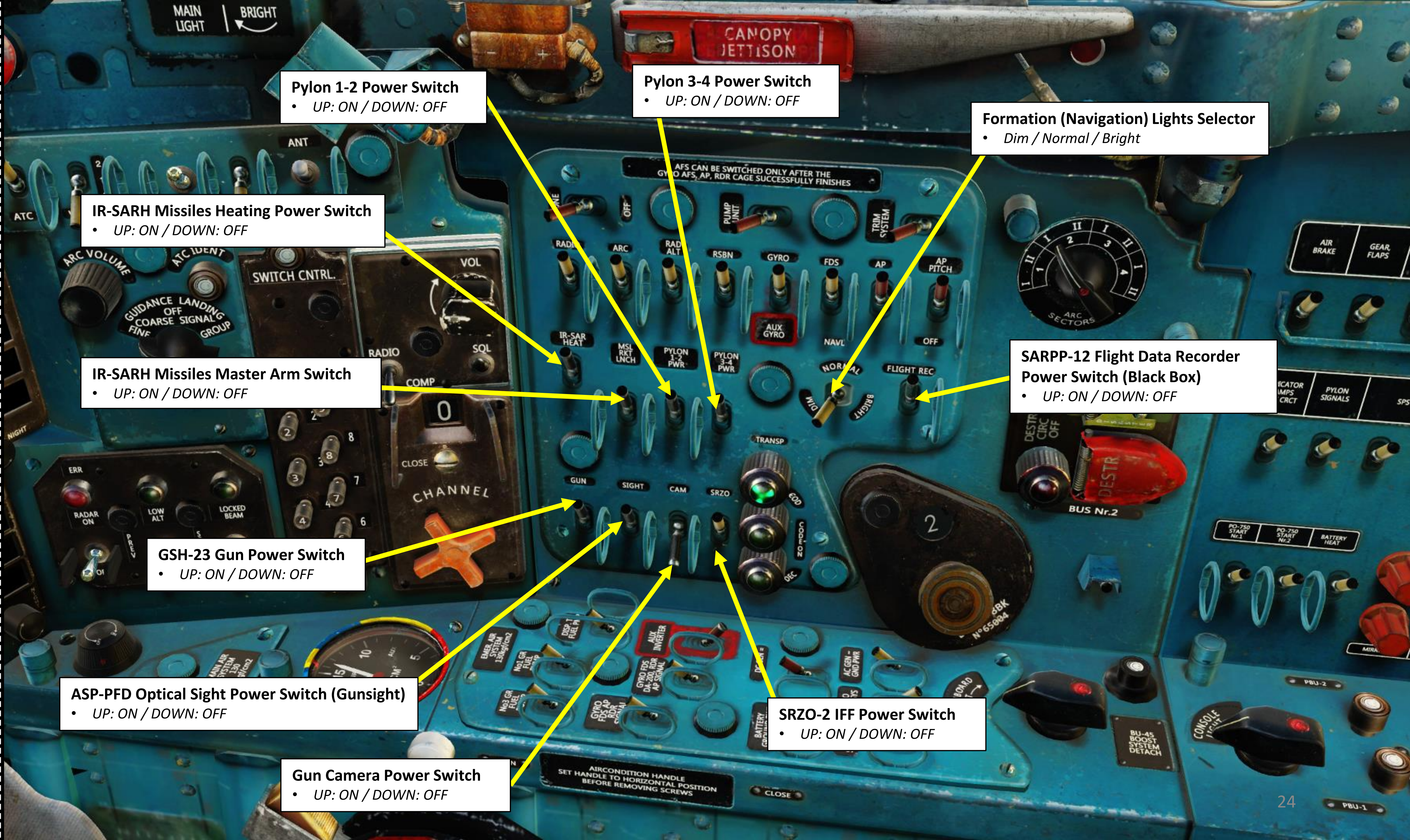

Circuit Breakers
(Not Simulated)
AIR BRAKE
GEAR, FLAPS
GEAR UP CIRCUIT
NOSECONE SPILLDOORS CONTROL
WEAPON EMERGENCY JETTISON
HEAT LIGHT LAMP
BRAKE CHUTE
FUEL TANKS
STABILIZER MANUAL CONTROL
GEAR NAV LIGHTS LAND LIGHTS
BOOSTER HYD SYS SIGNALS
EDM HYDSYS
INDICATOR LAMPS BOX CRCT
PYLON SIGNALS
SPS SYSTEM
TACTICAL JETTISON 1-2
COCKPIT POWER
FIRE CONTROL
IFF
AUTO STAB SYSTEM
TACTICAL JETTISON 3-4
BUS Nr.3
BUS Nr.2
PO-750 START Nr.1
PO-750 START Nr.2
BATTERY HEAT
BLOCK 88K
BU-45 BOOST SYSTEM DETACH
PBU-2
PBU-1
ATC CONTROL
GEN PRESET POINT

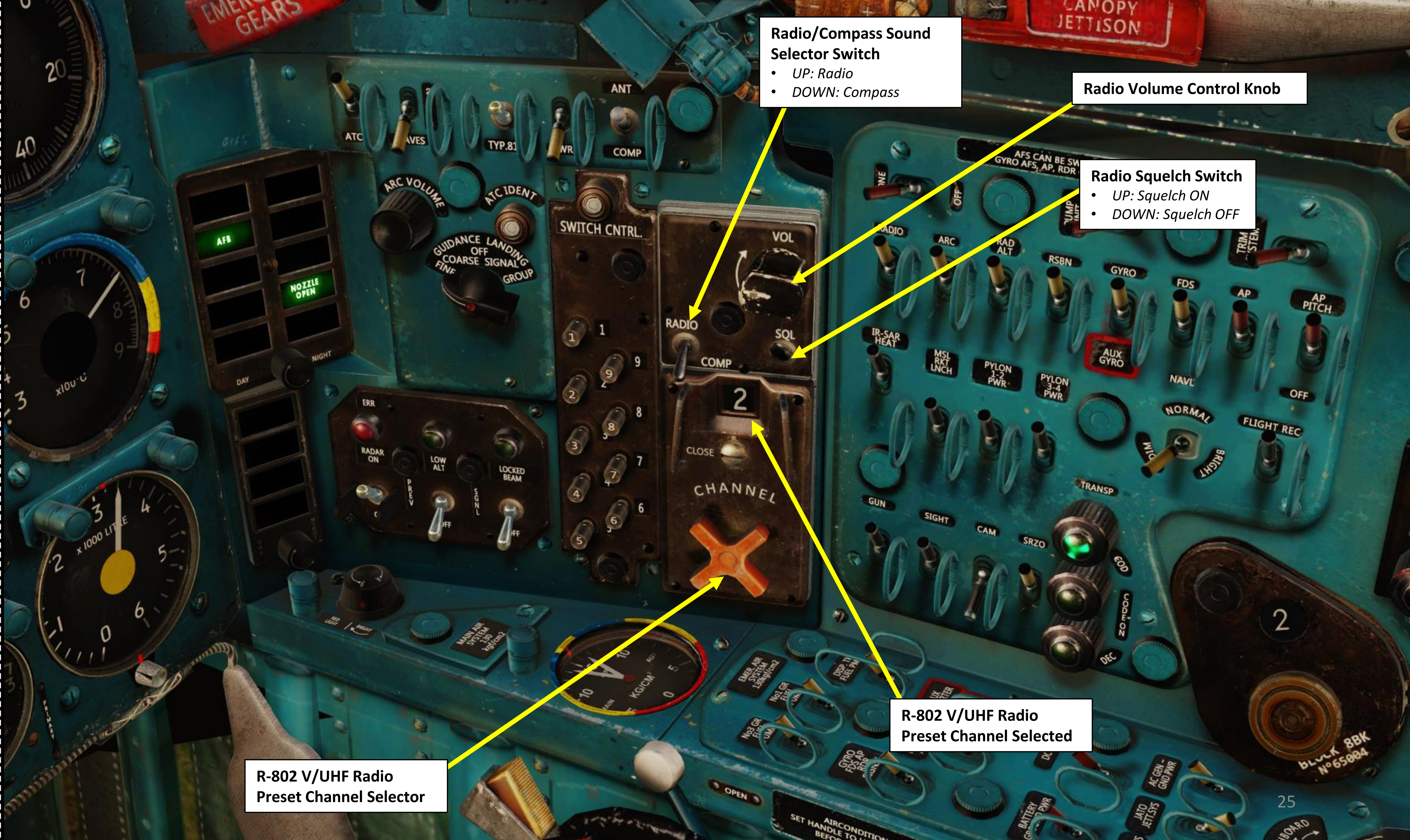

PO-750 # 2 Inverter Switch
• FWD: ON / AFT: OFF
Battery Heat
• FWD: ON / AFT: OFF
PO-750 # 1 Inverter Switch
• FWD: ON / AFT: OFF
SOD-57 Aircraft Distance Transponder PBU-1 & PBU-2 Test Buttons
Aileron Booster Disengage Button
Air Bleed Door 1.5 Mach Test Button
Instruments Backlighting Control
Cockpit Console Text Backlights Control

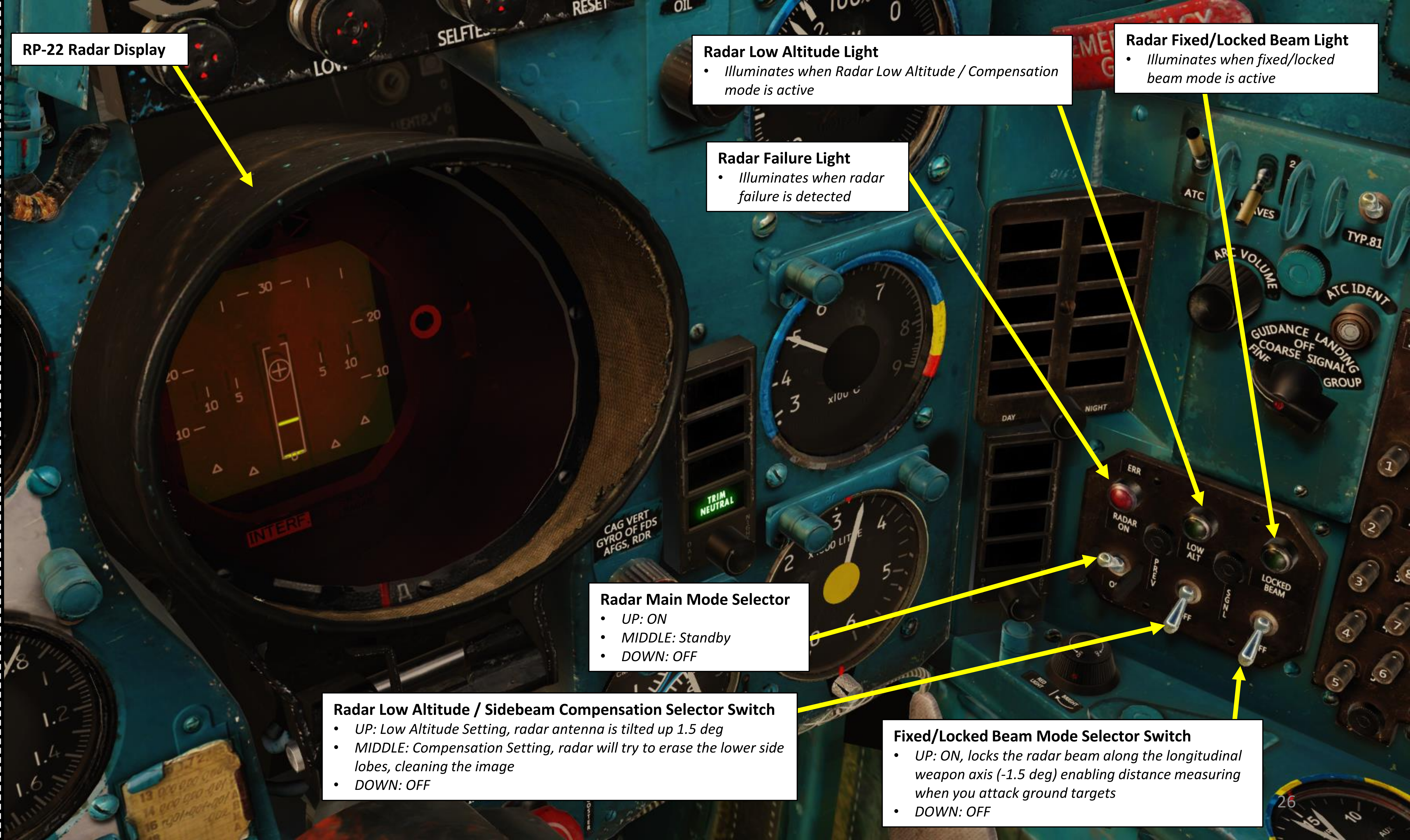

1st Fuel Tank Group Pump Switch
• FWD: ON / AFT: OFF
3rd Fuel Tank Group Pump Switch
• FWD: ON / AFT: OFF
Gyros for NPP, SAU Autopilot, Radar and KPP Power Switch
• FWD: ON / AFT: OFF
Gyros for DA-200, NPP, SAU Autopilot and Radar Power Switch
• FWD: ON / AFT: OFF
Battery / Ground Power Switch
• FWD: ON / AFT: OFF
SPRD (JATO) Rocket Booster Starter Power Supply Switch
• FWD: ON / AFT: OFF
SPRD (JATO) Rocket Booster Jettison Power Supply Switch
• FWD: ON / AFT: OFF
Dispenser Fuel Tank Pump Switch
• FWD: ON / AFT: OFF
Emergency Inverter Power Switch
• FWD: ON / AFT: OFF
DC Generator Switch
• FWD: ON / AFT: OFF
AC Generator Switch
• FWD: ON / AFT: OFF


SRZO-2 IFF Control Light
• Illuminated = Emitter ON
SRZO-2 IFF Control Light
• Illuminated = Code ON
SRZO-2 IFF Control Light
• Illuminated = Decipher ON
SRZO-2 IFF (Identify-Friend-or-Foe) Code Indicator
SRZO-2 IFF (Identify-Friend-or-Foe) Code Selector


Auxiliary Hydraulic Pump Power Switch
• FWD: ON / AFT: OFF
Trim System Power Switch
• FWD: ON / AFT: OFF
Nose Cone Power Switch
• FWD: ON / AFT: OFF
Autopilot Power Switch
• UP: ON / DOWN: OFF
Autopilot Pitch Power Switch
• UP: ON / DOWN: OFF
ARC (Automatic Radio Compass) Radio Navigation Frequency Range Selector
Emergency Transponder Switch
Radio Power Switch
• UP: ON / DOWN: OFF
ARC Radio Navigation Switch
• UP: ON / DOWN: OFF
Radar Altimeter Power Switch
• UP: ON / DOWN: OFF
RSBN Navigation Power Switch
• UP: ON / DOWN: OFF
KPP/Gyro (AGD Artificial Horizon) Main/Auxiliary Switch
• UP: Main / DOWN: Auxiliary
NPP/FDS (Course Indicator System/Flight Directional System) Ground Navigation Power Switch
• UP: ON / DOWN: OFF
SRZO-2 IFF (Identify-Friend-or-Foe) Self-Destruct
• Red Light = Destroyed


Pylon 1-2 Power Switch
• UP: ON / DOWN: OFF
Pylon 3-4 Power Switch
• UP: ON / DOWN: OFF
Formation (Navigation) Lights Selector
• Dim / Normal / Bright
IR-SARH Missiles Heating Power Switch
• UP: ON / DOWN: OFF
IR-SARH Missiles Master Arm Switch
• UP: ON / DOWN: OFF
SARPP-12 Flight Data Recorder Power Switch (Black Box)
• UP: ON / DOWN: OFF
GSH-23 Gun Power Switch
• UP: ON / DOWN: OFF
ASP-PFD Optical Sight Power Switch (Gunsight)
• UP: ON / DOWN: OFF
SRZO-2 IFF Power Switch
• UP: ON / DOWN: OFF
Gun Camera Power Switch
• UP: ON / DOWN: OFF


Radio/Compass Sound Selector Switch
• UP: Radio
• DOWN: Compass
Radio Volume Control Knob
Radio Squelch Switch
• UP: Squelch ON
• DOWN: Squelch OFF
R-802 V/UHF Radio Preset Channel Selected
R-802 V/UHF Radio Preset Channel Selector



RP-22 Radar Display

Radar Low Altitude Light
- *Illuminates when Radar Low Altitude / Compensation mode is active*

Radar Fixed/Locked Beam Light
- *Illuminates when fixed/locked beam mode is active*

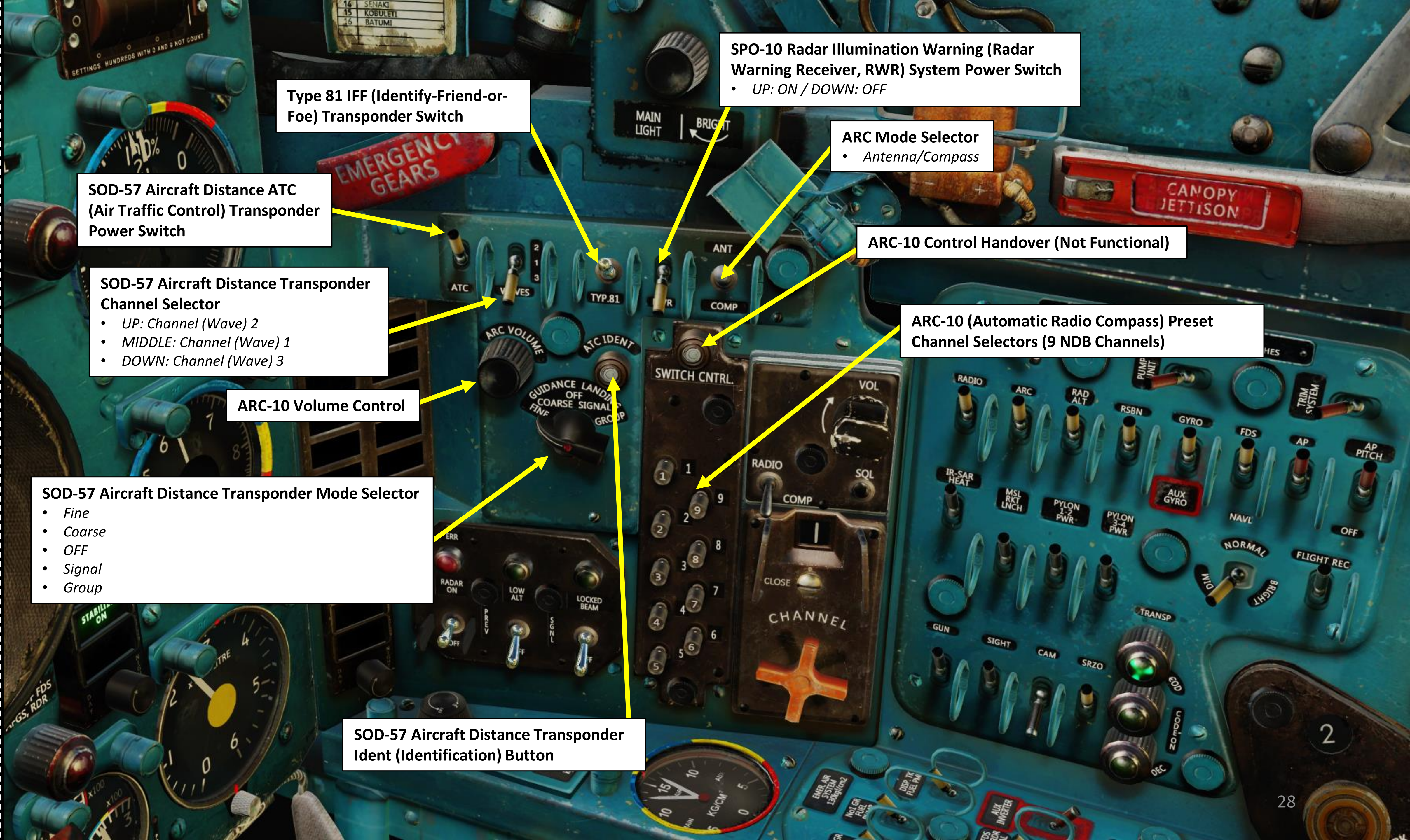
Radar Failure Light
- *Illuminates when radar failure is detected*

Radar Main Mode Selector
- *UP: ON*
- *MIDDLE: Standby*
- *DOWN: OFF*

Radar Low Altitude / Sidebeam Compensation Selector Switch
- *UP: Low Altitude Setting, radar antenna is tilted up 1.5 deg*
- *MIDDLE: Compensation Setting, radar will try to erase the lower side lobes, cleaning the image*
- *DOWN: OFF*

Fixed/Locked Beam Mode Selector Switch
- *UP: ON, locks the radar beam along the longitudinal weapon axis (-1.5 deg) enabling distance measuring when you attack ground targets*
- *DOWN: OFF*


Cockpit Red Lights Control Knob
Main & Auxiliary Pneumatic Systems Air Pressure Gauge (kg/cm²)


Type 81 IFF (Identify-Friend-or-Foe) Transponder Switch
SPO-10 Radar Illumination Warning (Radar Warning Receiver, RWR) System Power Switch
• UP: ON / DOWN: OFF
ARC Mode Selector
• Antenna/Compass
SOD-57 Aircraft Distance ATC (Air Traffic Control) Transponder Power Switch
ARC-10 Control Handover (Not Functional)
SOD-57 Aircraft Distance Transponder Channel Selector
• UP: Channel (Wave) 2
• MIDDLE: Channel (Wave) 1
• DOWN: Channel (Wave) 3
ARC-10 (Automatic Radio Compass) Preset Channel Selectors (9 NDB Channels)
ARC-10 Volume Control
SOD-57 Aircraft Distance Transponder Mode Selector
• Fine
• Coarse
• OFF
• Signal
• Group
SOD-57 Aircraft Distance Transponder Ident (Identification) Button

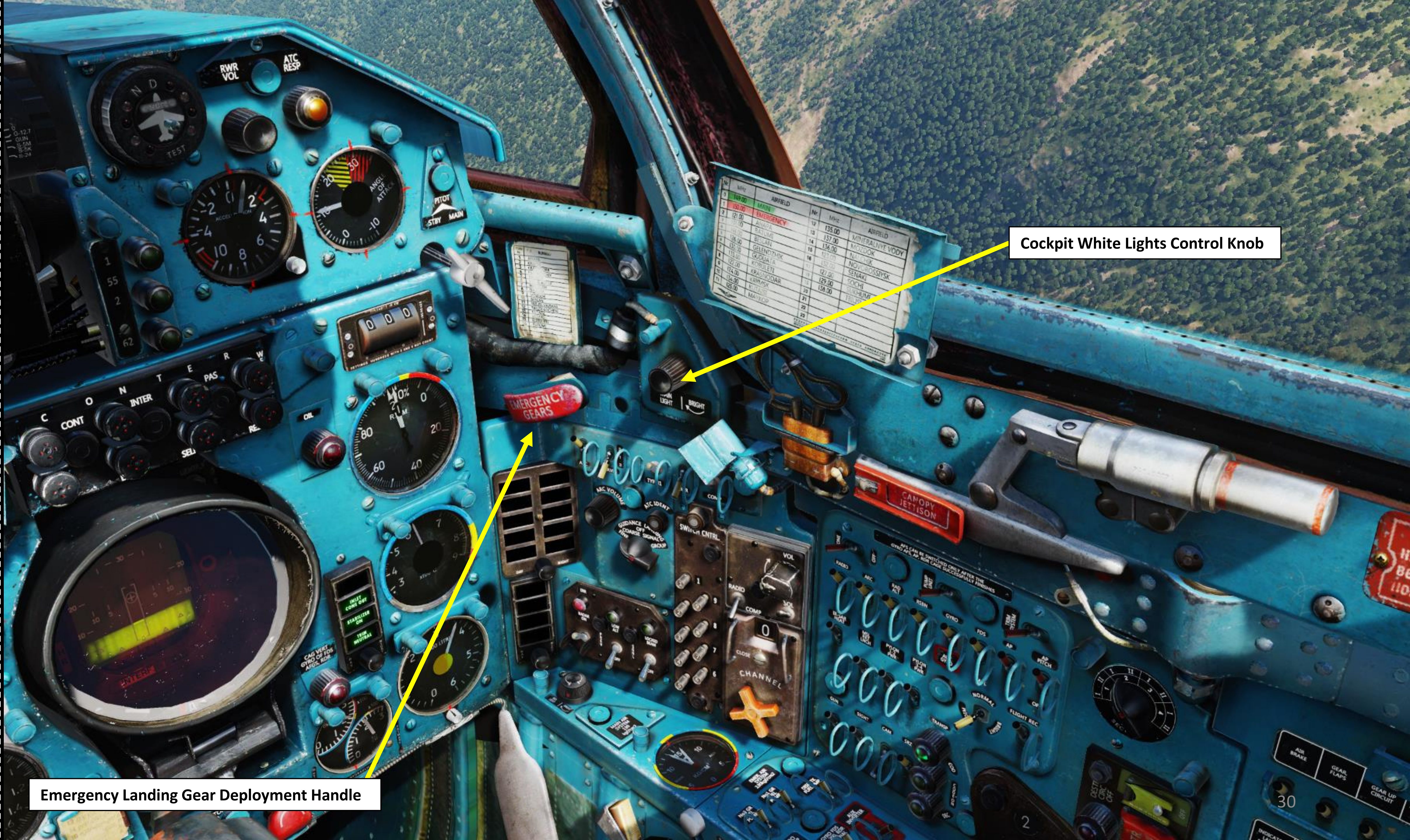
You can see the list of radio channels for different airfields using your kneeboard (RCTRL+UP) and cycle through the pages to find this one by using RCTRL+LEFT or RCTRL+RIGHT.

Or even better: you can go to the Radio section and print a nice list.

RADIO

rev: Mar. 2017

CAUCASUS (chnl. order)	NEVADA (chnl. order)	NEVADA (freq. order)
0 – Main	0 – 124.0	2 – 121.0
1 – Aux	1 – 150.0	8 – 122.0
2 – ANAPA – VITYAZEVO	2 – 121.0	15 – 123.0
3 – BATUMI	3 – 131.0	0 – 124.0
4 – BESLAN	4 – 141.0	9 – 124.0
5 – GELENDZIK	5 – 126.0	11 – 125.0
6 – GUDAUTA – BAMBORA	6 – 130.0	5 – 126.0
7 – KOBULETI	7 – 133.0	17 – 127.0
8 – KRASNODAR – CENTER	8 – 122.0	18 – 129.0
9 – KRYMSK	9 – 124.0	6 – 130.0
10 – KUTAISI – KOPITNARI	10 – 134.0	3 – 131.0
11 – MAYKOP – KHANSKAYA	11 – 125.0	16 – 132.0
12 – MINERALNYE VODY	12 – 135.0	7 – 133.0
13 – MOZDOK	13 – 137.0	10 – 134.0
14 – NALCHIK	14 – 136.0	12 – 135.0
15 – NOVOROSSIYSK	15 – 123.0	14 – 136.0
16 – SENAKI – KOLKHI	16 – 132.0	13 – 137.0
17 – SOCHI – ADLER	17 – 127.0	19 – 138.0
18 – SUKHUMI – BABUSHARA	18 – 129.0	4 – 141.0
19 – TBILISI – LOCHINI	19 – 138.0	1 – 150.0


Cockpit White Lights Control Knob
Emergency Landing Gear Deployment Handle
EMERGENCY GEARS
CANOPY JETTISON

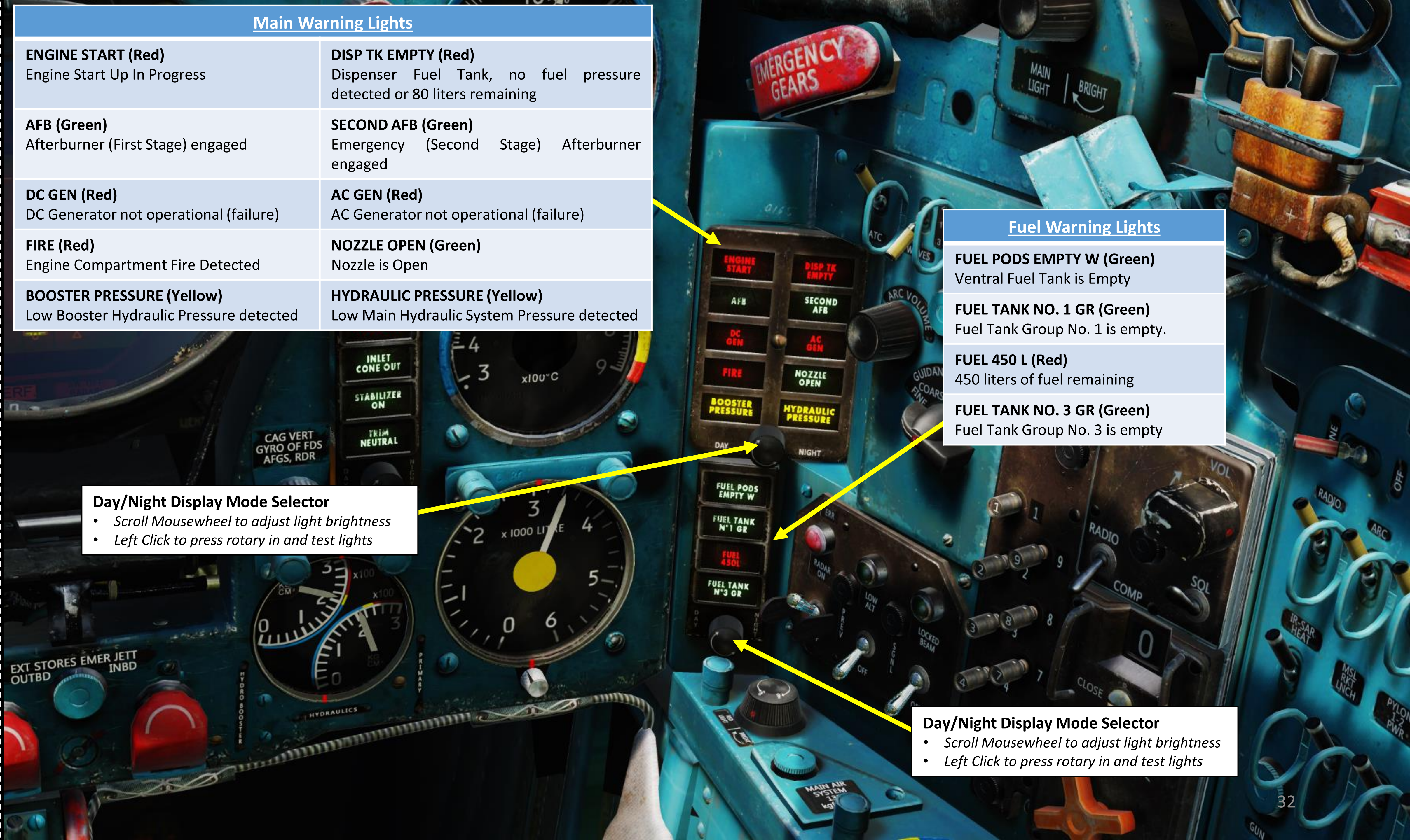
RSBN Preset Frequency Chart

You can see the list of RSBN channels for different airfields using your kneeboard (RCTRL+UP) and cycle through the pages to find this one by using RCTRL+LEFT or RCTRL+RIGHT.

RSBN CAUCASUS

rev: Mar. 2017

nrb	NAME	ALTITUDE [m]	RWY	RWY length [m]	MORSE	
1	ANAPA	45	42	2900	.- -. .-	ANA_
2	KRIMSK	20	40	2600	-.- .-. ..	KRI_
3	KRASNODAR	30	87	2500	-.- ... -..	KSD_
4	PASHKOVSKIY	30	87	2500	-.- ... -..	PAS_
5	MAYKOP	180	39	3200	-- .- -.--	MAY_
6	ADLER	30	62	3100	.- -.. .-..	ADL_
7	MINERALNYE VODY	320	115	4000	-- .. -.	MIN_
8	NALCHIK	430	56	2300	-. .- .-..	NAL_
9	MOZDOK	155	83	3500	-- --- --..	MOZ_
10	BESLAN	540	94	3100	-...	BES_
11	TBILISI VAZIANI	455	135	2500	- ...- .-	TVA_
12	TBILISI LOCHINI	470	128	3000	- .-.. ---	TLO_
13	KUTAISI	45	74	2500	-.- ..- -	KUT_
14	SENAKI KOLKHI	13	95	2400	... . -.-	SEK_
15	KOBULETI	18	70	2400	-.- --- -...	KOB_
16	BATUMI	10	126	2450	-... .- -	BAT_
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						



Main Warning Lights

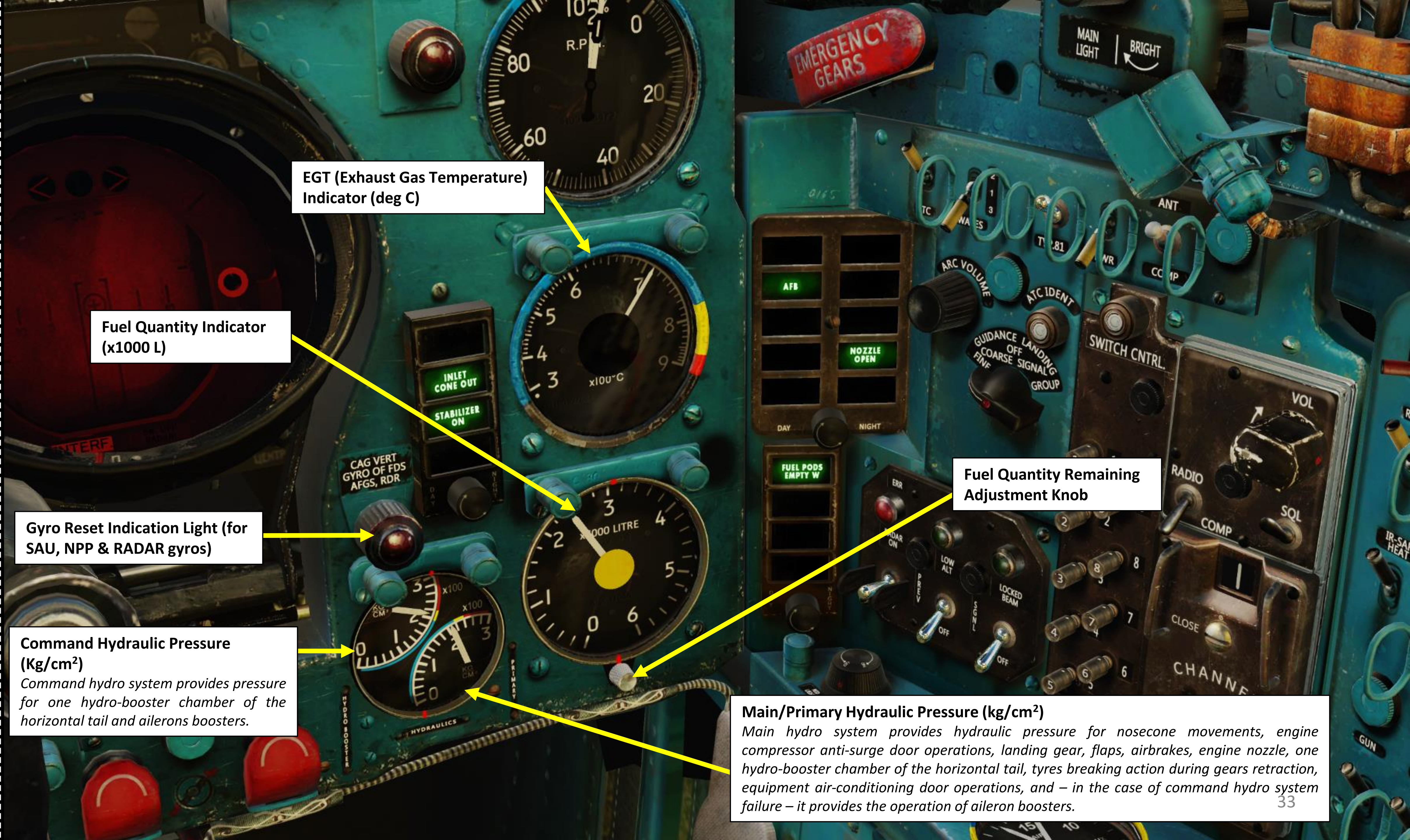
ENGINE START (Red) Engine Start Up In Progress	**DISP TK EMPTY (Red)** Dispenser Fuel Tank, no fuel pressure detected or 80 liters remaining
AFB (Green) Afterburner (First Stage) engaged	**SECOND AFB (Green)** Emergency (Second Stage) Afterburner engaged
DC GEN (Red) DC Generator not operational (failure)	**AC GEN (Red)** AC Generator not operational (failure)
FIRE (Red) Engine Compartment Fire Detected	**NOZZLE OPEN (Green)** Nozzle is Open
BOOSTER PRESSURE (Yellow) Low Booster Hydraulic Pressure detected	**HYDRAULIC PRESSURE (Yellow)** Low Main Hydraulic System Pressure detected

Fuel Warning Lights

FUEL PODS EMPTY W (Green) Ventral Fuel Tank is Empty
FUEL TANK NO. 1 GR (Green) Fuel Tank Group No. 1 is empty.
FUEL 450 L (Red) 450 liters of fuel remaining
FUEL TANK NO. 3 GR (Green) Fuel Tank Group No. 3 is empty

Day/Night Display Mode Selector
- *Scroll Mousewheel to adjust light brightness*
- *Left Click to press rotary in and test lights*

Day/Night Display Mode Selector
- *Scroll Mousewheel to adjust light brightness*
- *Left Click to press rotary in and test lights*


EGT (Exhaust Gas Temperature) Indicator (deg C)
Fuel Quantity Indicator (x1000 L)
Gyro Reset Indication Light (for SAU, NPP & RADAR gyros)
Command Hydraulic Pressure (Kg/cm^2)
Command hydro system provides pressure for one hydro-booster chamber of the horizontal tail and ailerons boosters.
Fuel Quantity Remaining Adjustment Knob
Main/Primary Hydraulic Pressure (kg/cm^2)
Main hydro system provides hydraulic pressure for nosecone movements, engine compressor anti-surge door operations, landing gear, flaps, airbrakes, engine nozzle, one hydro-booster chamber of the horizontal tail, tyres breaking action during gears retraction, equipment air-conditioning door operations, and – in the case of command hydro system failure – it provides the operation of aileron boosters.

Warning Lights

MARKER (Red)
Illuminates when flying over a marker beacon

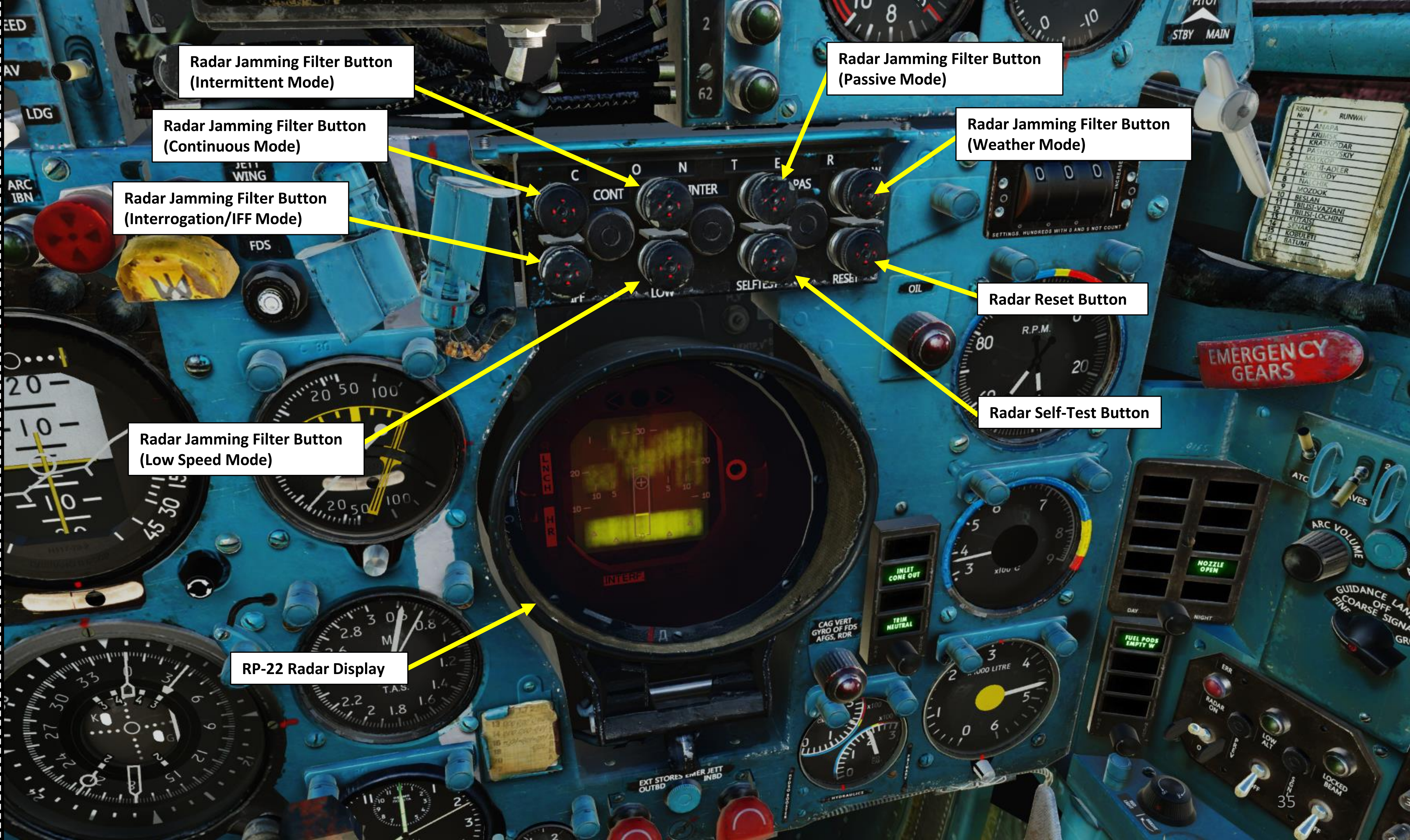
INLET CONE OUT (Green)
Indicates nose cone is operational. As a general rule, cone should be in only when landing gear is extracted.

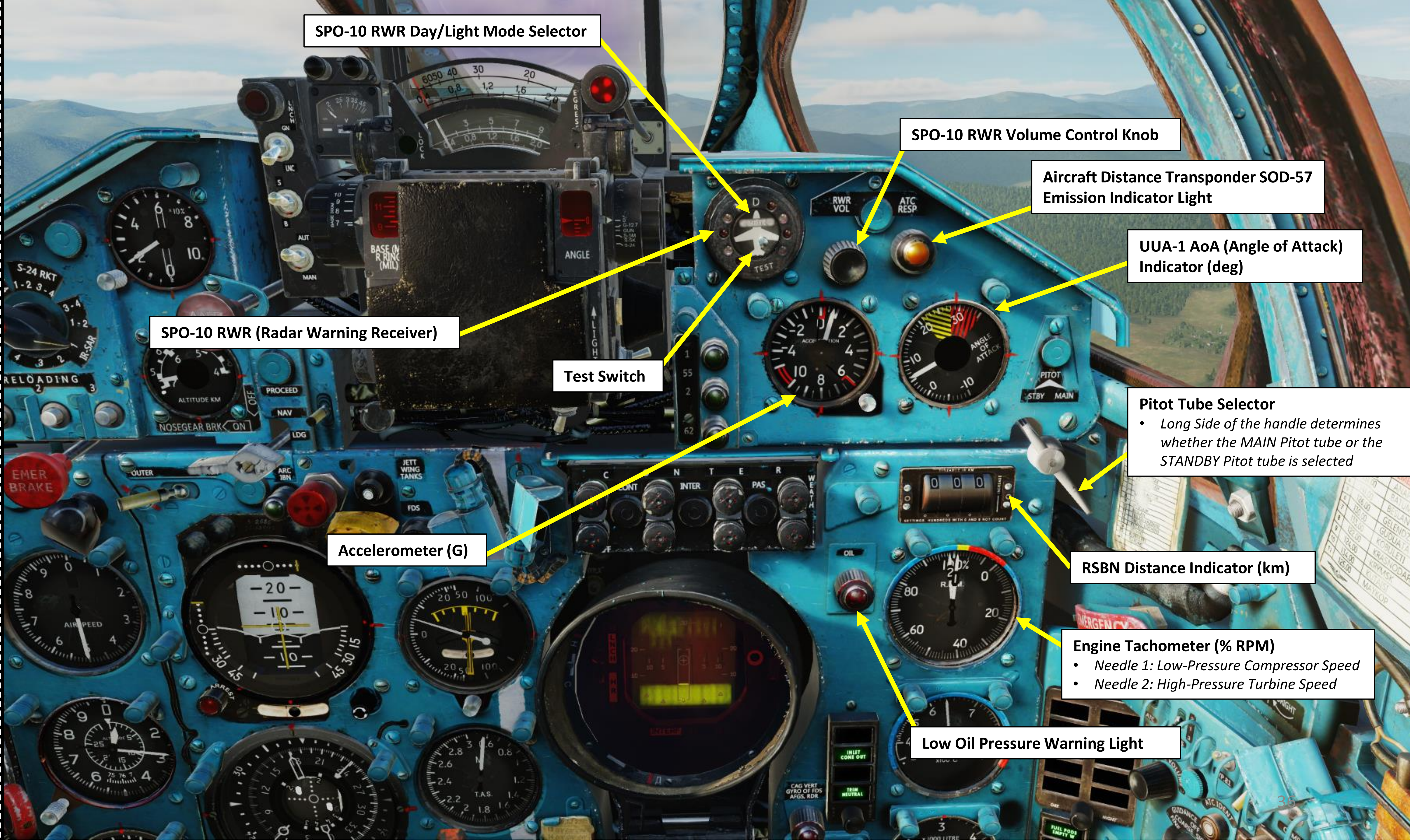
STABILIZER ON (Green)
Indicates ARU (horizontal tail movement control system) is set-up for low speed tail movements (max movements). If this signal is ON and you have an airspeed greater than 450 km/h, your ARU system is broken.

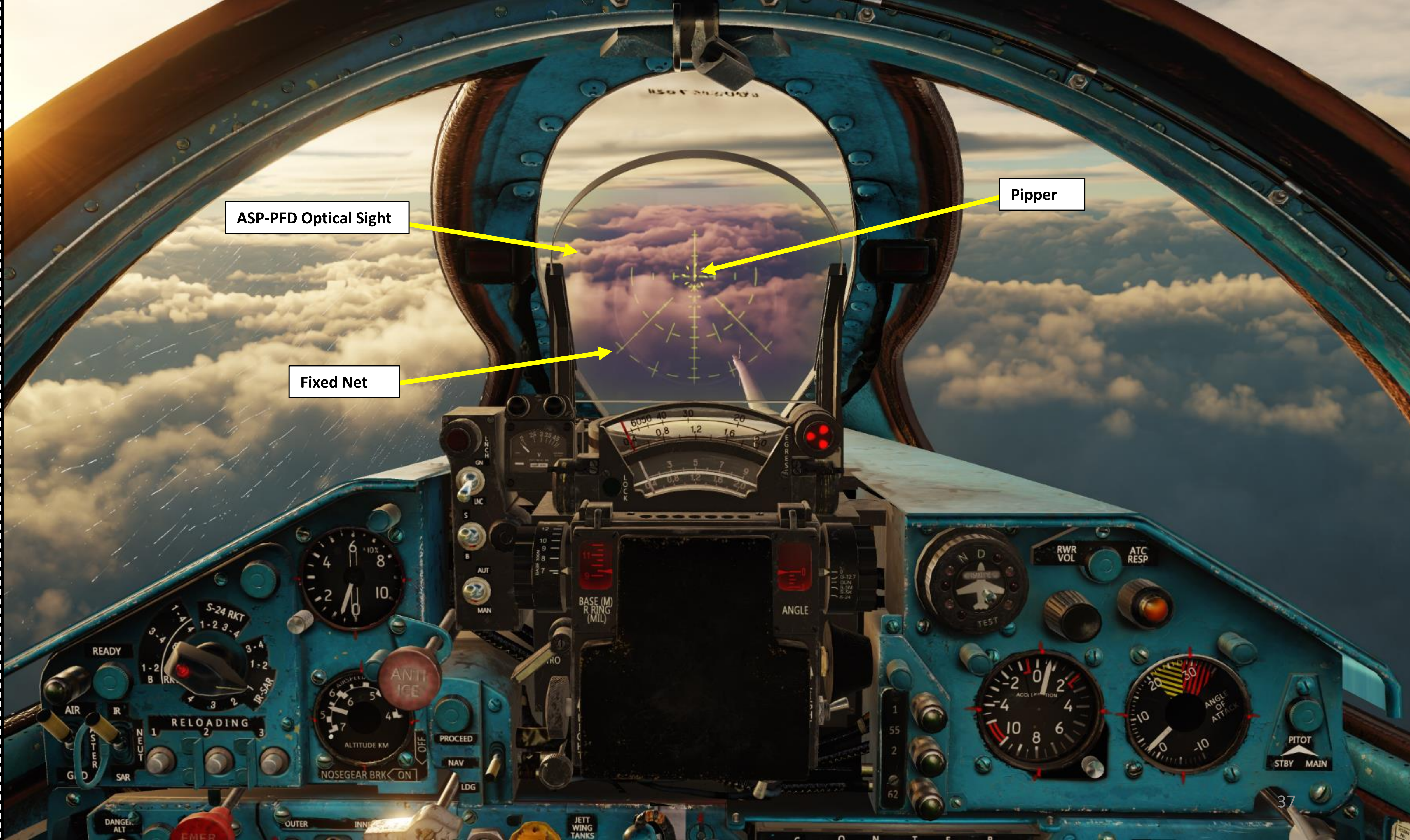
TRIM NEUTRAL (Green)
Indicates trimmer is in neutral position.

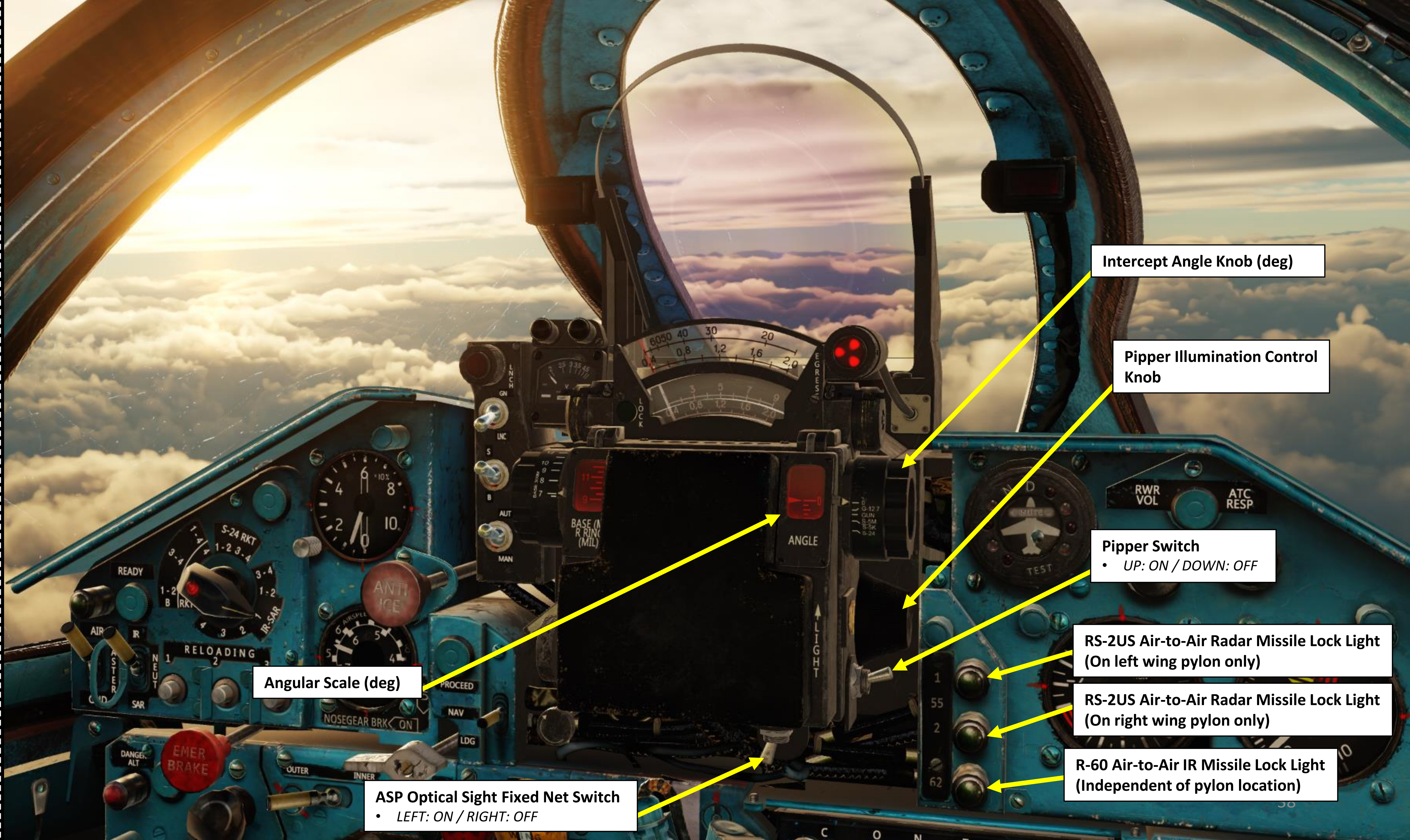
Day/Night Display Mode Selector

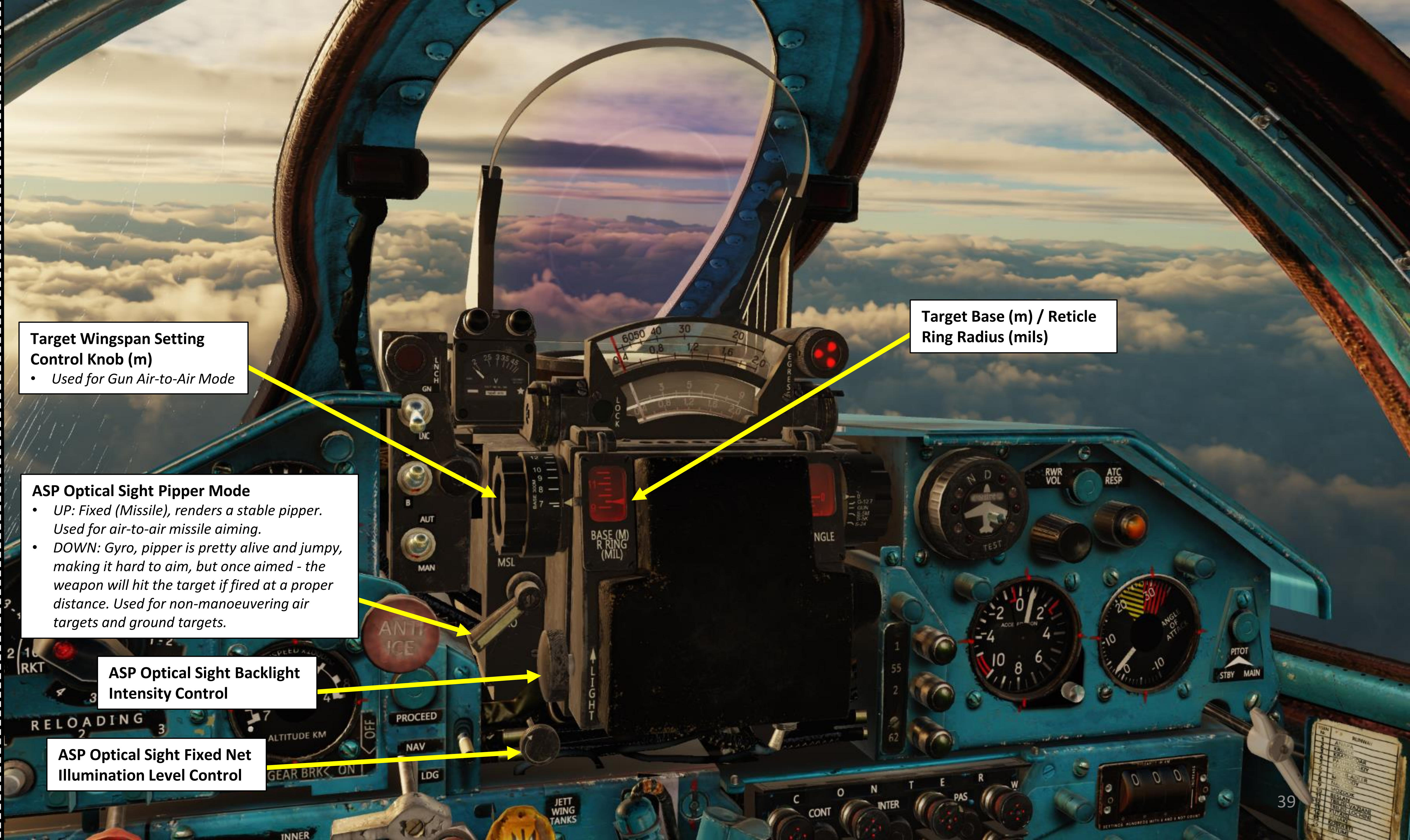
- *Scroll Mousewheel to adjust light brightness*
- *Left Click to press rotary in and test lights*

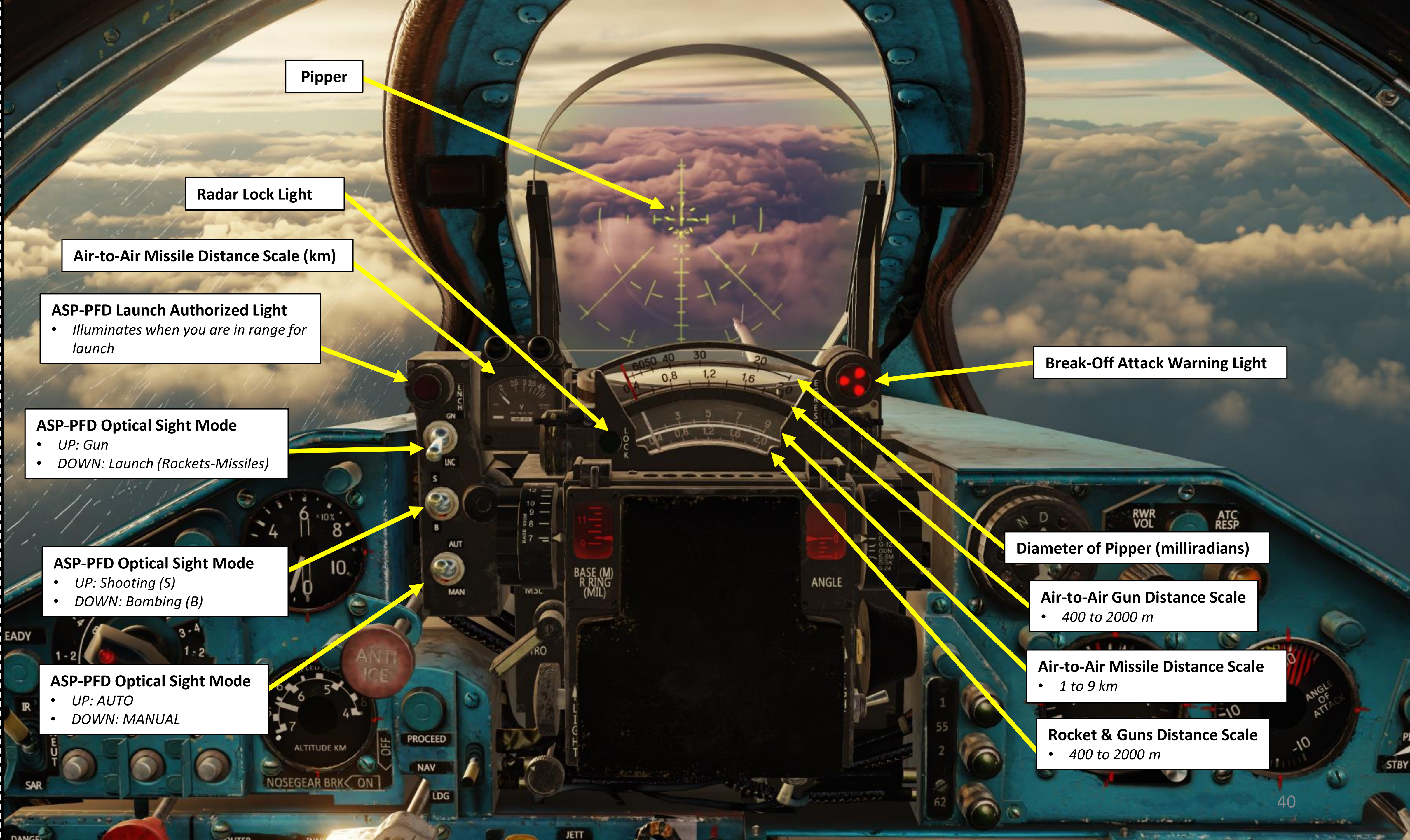

Radar Jamming Filter Button (Intermittent Mode)
Radar Jamming Filter Button (Continuous Mode)
Radar Jamming Filter Button (Interrogation/IFF Mode)
Radar Jamming Filter Button (Low Speed Mode)
RP-22 Radar Display
Radar Jamming Filter Button (Passive Mode)
Radar Jamming Filter Button (Weather Mode)
Radar Reset Button
Radar Self-Test Button

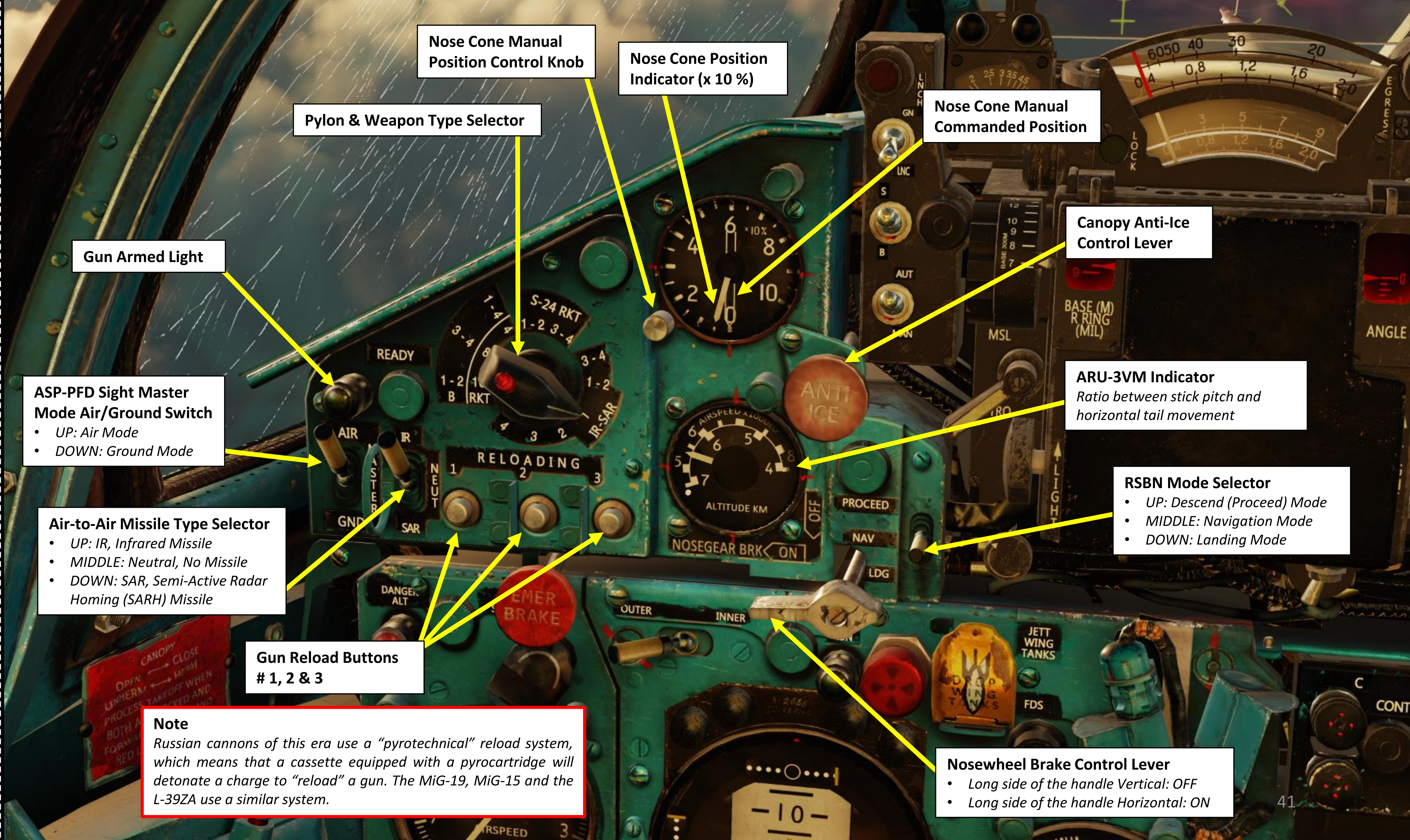

SPO-10 RWR Day/Light Mode Selector
SPO-10 RWR Volume Control Knob
Aircraft Distance Transponder SOD-57 Emission Indicator Light
UUA-1 AoA (Angle of Attack) Indicator (deg)
SPO-10 RWR (Radar Warning Receiver)
Test Switch
Pitot Tube Selector
• Long Side of the handle determines whether the MAIN Pitot tube or the STANDBY Pitot tube is selected
Accelerometer (G)
RSBN Distance Indicator (km)
Engine Tachometer (% RPM)
• Needle 1: Low-Pressure Compressor Speed
• Needle 2: High-Pressure Turbine Speed
Low Oil Pressure Warning Light


ASP-PFD Optical Sight
Pipper
Fixed Net


Intercept Angle Knob (deg)
Pipper Illumination Control Knob
Pipper Switch
• *UP: ON / DOWN: OFF*
RS-2US Air-to-Air Radar Missile Lock Light (On left wing pylon only)
RS-2US Air-to-Air Radar Missile Lock Light (On right wing pylon only)
R-60 Air-to-Air IR Missile Lock Light (Independent of pylon location)
Angular Scale (deg)
ASP Optical Sight Fixed Net Switch
• *LEFT: ON / RIGHT: OFF*


Target Wingspan Setting Control Knob (m)
• Used for Gun Air-to-Air Mode
ASP Optical Sight Pipper Mode
• UP: Fixed (Missile), renders a stable pipper. Used for air-to-air missile aiming.
• DOWN: Gyro, pipper is pretty alive and jumpy, making it hard to aim, but once aimed - the weapon will hit the target if fired at a proper distance. Used for non-manoeuvering air targets and ground targets.
ASP Optical Sight Backlight Intensity Control
ASP Optical Sight Fixed Net Illumination Level Control
Target Base (m) / Reticle Ring Radius (mils)
BASE (M)
R RING
(MIL)
LIGHT
MSL
ANTI ICE
RWR VOL
ATC RESP
ALTITUDE KM
RELOADING
PROCEED
NAV
LDG
JETT WING TANKS
GEAR BRK ON
PITOT
STBY MAIN
TEST


Pipper
Radar Lock Light
Air-to-Air Missile Distance Scale (km)
ASP-PFD Launch Authorized Light
• Illuminates when you are in range for launch
ASP-PFD Optical Sight Mode
• UP: Gun
• DOWN: Launch (Rockets-Missiles)
ASP-PFD Optical Sight Mode
• UP: Shooting (S)
• DOWN: Bombing (B)
ASP-PFD Optical Sight Mode
• UP: AUTO
• DOWN: MANUAL
Break-Off Attack Warning Light
Diameter of Pipper (milliradians)
Air-to-Air Gun Distance Scale
• 400 to 2000 m
Air-to-Air Missile Distance Scale
• 1 to 9 km
Rocket & Guns Distance Scale
• 400 to 2000 m



Note

Russian cannons of this era use a "pyrotechnical" reload system, which means that a cassette equipped with a pyrocartridge will detonate a charge to "reload" a gun. The MiG-19, MiG-15 and the L-39ZA use a similar system.

ARU-3VM Indicator

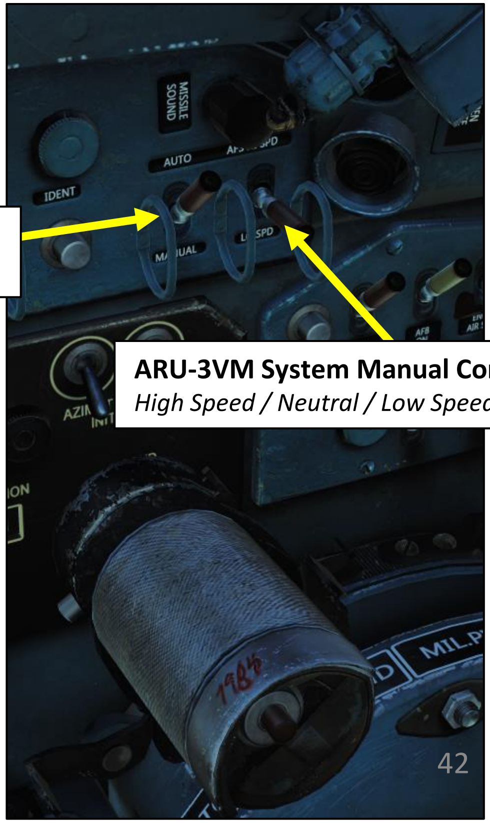
The ARU (Horizontal Tail Movement Control System) is a device that controls the ratio between stick pitch and horizontal tail movement. The ARU-3VM gauge shows the current position of the ARU arm transpositioned to a speed-altitude scale.

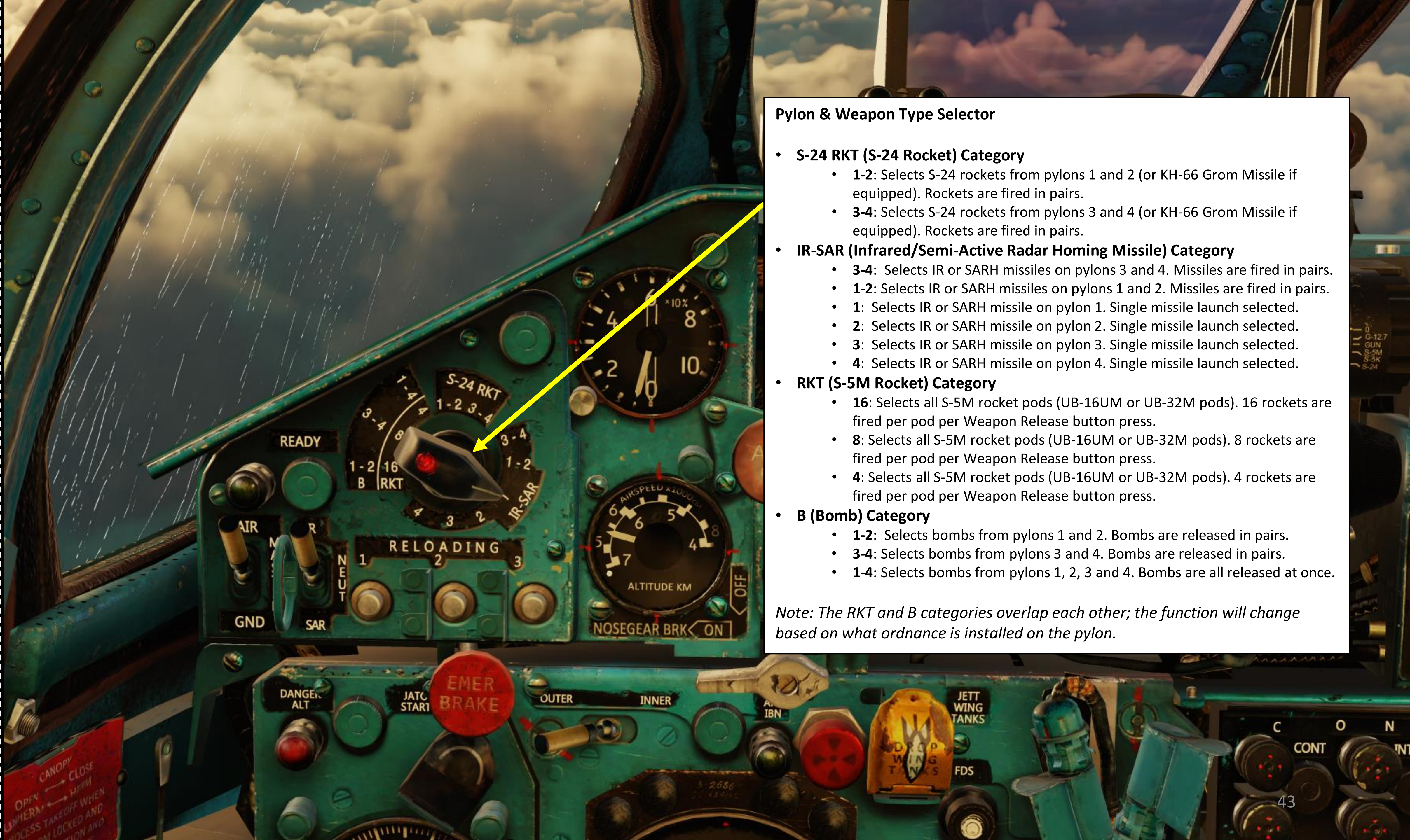
The Speed scale and altitude scale serve to provide a rough orientation whether the ARU system functions as expected. For example, the ARU should be at "long arm" (needle to utmost left, maximum horizontal tail deflection available) if the speed is <=450 km/h, and at "short arm" (needle to utmost right, partial horizontal tail deflection available) if the speed is >850 km/h. Reverse logic follows the altitude rules (the higher the altitude, the longer the arm). However, the ARU works by combining IAS and altitude in a complex way, so most of the time the needle will be between extreme positions. The ARU is designed to operate in an automatic mode; if needed, the pilot can switch it to manual mode.

The ARU, while not prone to failures, can do so. In that case, the pilot should start decreasing IAS (indicated airspeed) immediately, and change the ARU operational mode to "MANUAL" using the ***ARU-3VM operation mode switch***, and using the ***ARU-3VM manual control switch.*** Then, use the ARU indicator to set the ARU arm to the appropriate position according to IAS criteria.

For example, if IAS is 600 km/h, the pilot should move the needle to index 6 at the outer scale, abort the mission and perform an emergency landing.

Precautions: The ARU should be at the "long arm" (needle outmost left) position prior to landing and when flying at altitudes >7000m. ARU failure – especially total failure including inability of manual control – is a very dangerous situation: two worst case scenarios is landing with only partial functionality of the horizontal tail (aircraft is non-responsive, rough landing or crash), and in-flight horizontal tail over-functionality (aircraft is over-responsive, dangerous g-loads and uncontrollable oscillations around Y axis).

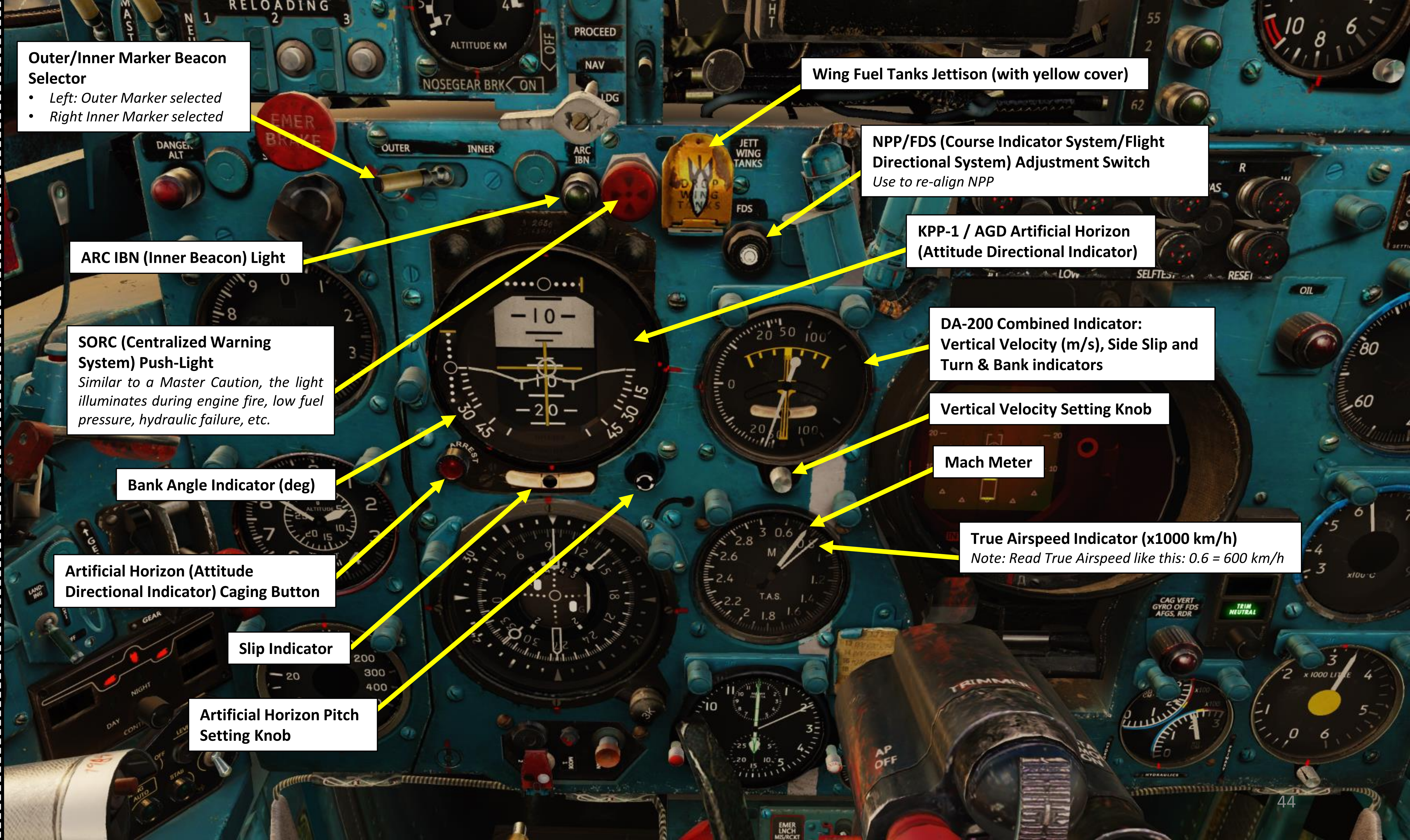


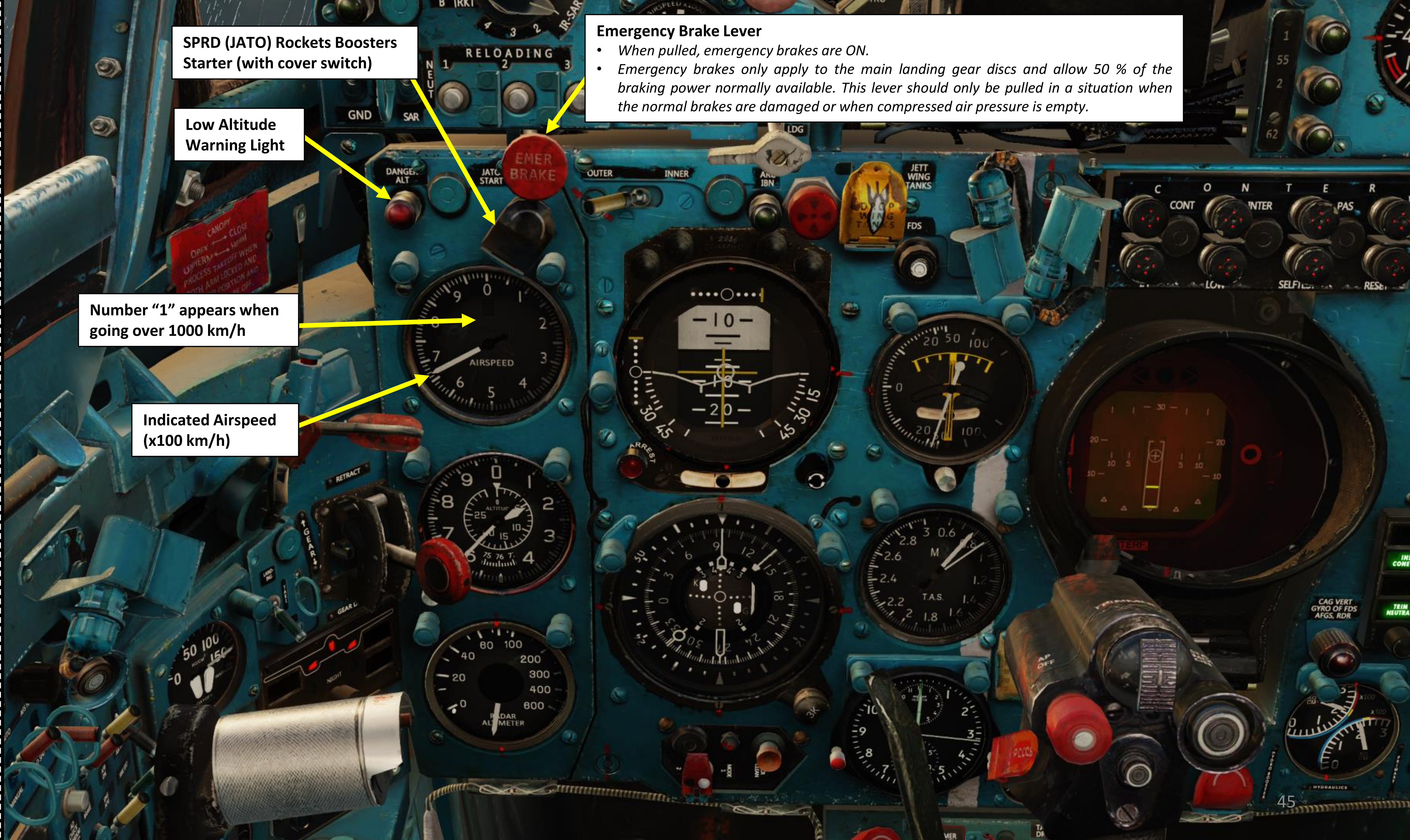


Pylon & Weapon Type Selector

- **S-24 RKT (S-24 Rocket) Category**
  - **1-2**: Selects S-24 rockets from pylons 1 and 2 (or KH-66 Grom Missile if equipped). Rockets are fired in pairs.
  - **3-4**: Selects S-24 rockets from pylons 3 and 4 (or KH-66 Grom Missile if equipped). Rockets are fired in pairs.
- **IR-SAR (Infrared/Semi-Active Radar Homing Missile) Category**
  - **3-4**: Selects IR or SARH missiles on pylons 3 and 4. Missiles are fired in pairs.
  - **1-2**: Selects IR or SARH missiles on pylons 1 and 2. Missiles are fired in pairs.
  - **1**: Selects IR or SARH missile on pylon 1. Single missile launch selected.
  - **2**: Selects IR or SARH missile on pylon 2. Single missile launch selected.
  - **3**: Selects IR or SARH missile on pylon 3. Single missile launch selected.
  - **4**: Selects IR or SARH missile on pylon 4. Single missile launch selected.
- **RKT (S-5M Rocket) Category**
  - **16**: Selects all S-5M rocket pods (UB-16UM or UB-32M pods). 16 rockets are fired per pod per Weapon Release button press.
  - **8**: Selects all S-5M rocket pods (UB-16UM or UB-32M pods). 8 rockets are fired per pod per Weapon Release button press.
  - **4**: Selects all S-5M rocket pods (UB-16UM or UB-32M pods). 4 rockets are fired per pod per Weapon Release button press.
- **B (Bomb) Category**
  - **1-2**: Selects bombs from pylons 1 and 2. Bombs are released in pairs.
  - **3-4**: Selects bombs from pylons 3 and 4. Bombs are released in pairs.
  - **1-4**: Selects bombs from pylons 1, 2, 3 and 4. Bombs are all released at once.

Note: The RKT and B categories overlap each other; the function will change based on what ordnance is installed on the pylon.


Outer/Inner Marker Beacon Selector
• Left: Outer Marker selected
• Right Inner Marker selected
ARC IBN (Inner Beacon) Light
SORC (Centralized Warning System) Push-Light
Similar to a Master Caution, the light illuminates during engine fire, low fuel pressure, hydraulic failure, etc.
Bank Angle Indicator (deg)
Artificial Horizon (Attitude Directional Indicator) Caging Button
Slip Indicator
Artificial Horizon Pitch Setting Knob
Wing Fuel Tanks Jettison (with yellow cover)
NPP/FDS (Course Indicator System/Flight Directional System) Adjustment Switch
Use to re-align NPP
KPP-1 / AGD Artificial Horizon (Attitude Directional Indicator)
DA-200 Combined Indicator: Vertical Velocity (m/s), Side Slip and Turn & Bank indicators
Vertical Velocity Setting Knob
Mach Meter
True Airspeed Indicator (x1000 km/h)
Note: Read True Airspeed like this: 0.6 = 600 km/h



SPRD (JATO) Rockets Boosters Starter (with cover switch)

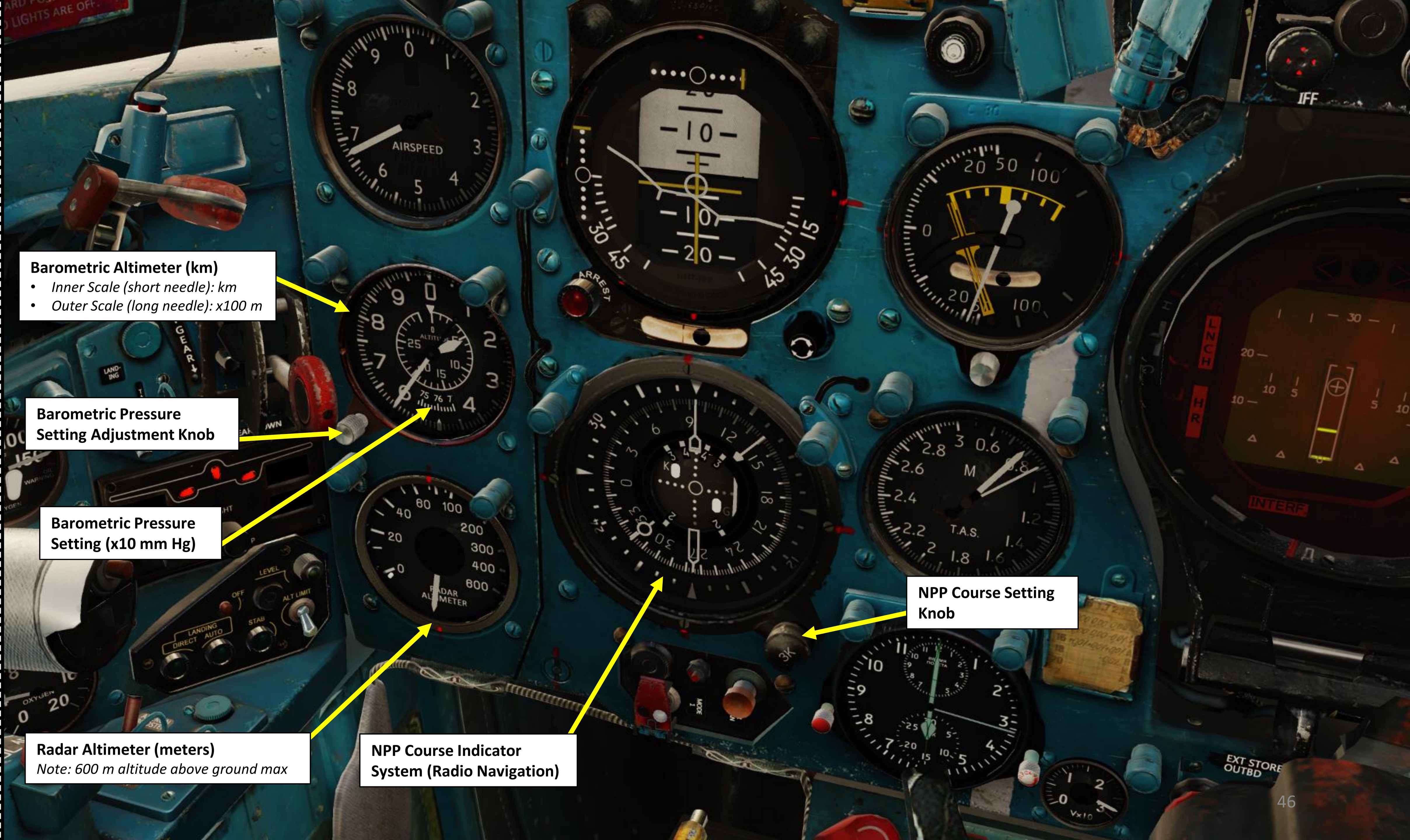
Low Altitude Warning Light

Number “1” appears when going over 1000 km/h

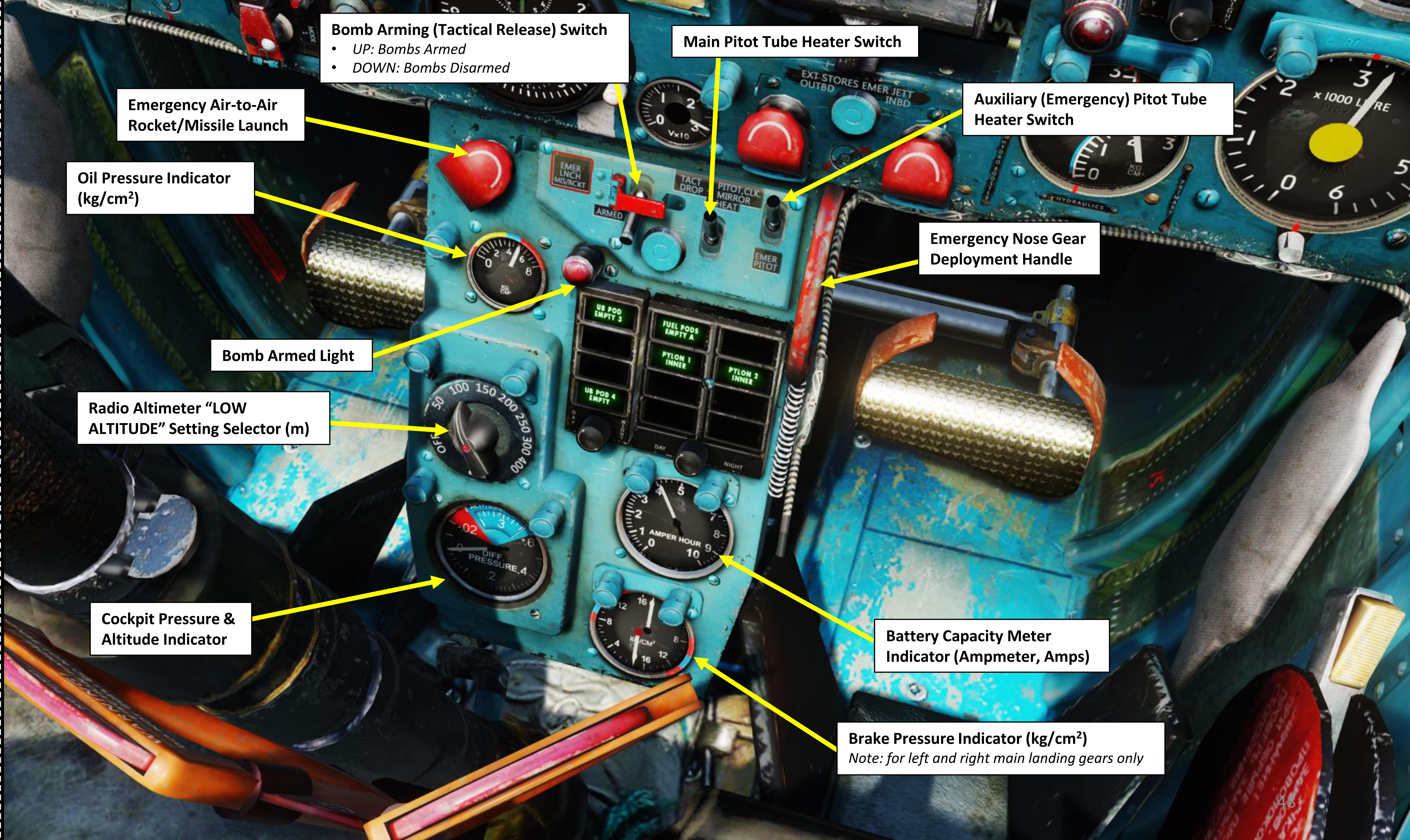
Indicated Airspeed (x100 km/h)

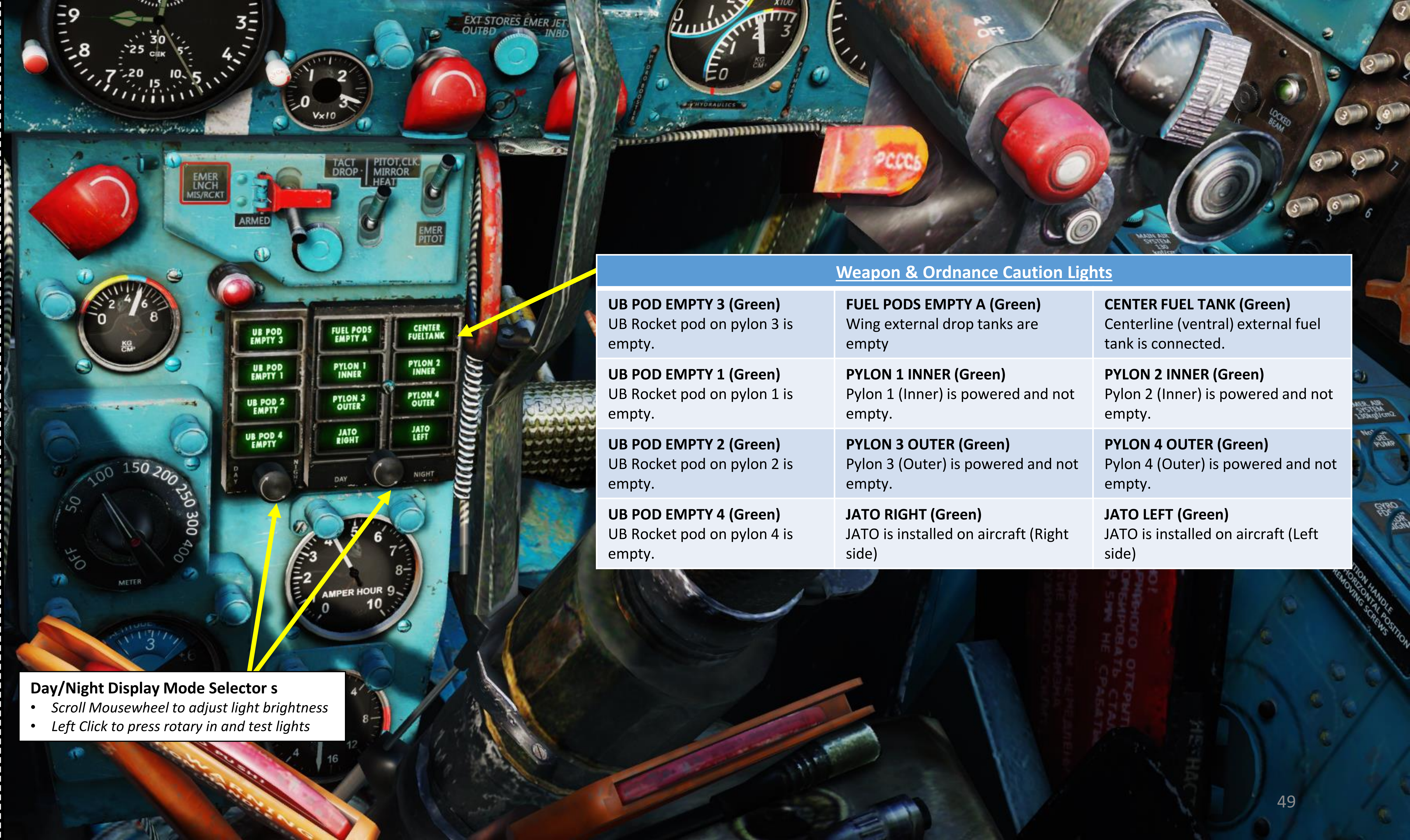
Emergency Brake Lever

- *When pulled, emergency brakes are ON.*
- *Emergency brakes only apply to the main landing gear discs and allow 50 % of the braking power normally available. This lever should only be pulled in a situation when the normal brakes are damaged or when compressed air pressure is empty.*


Barometric Altimeter (km)
• Inner Scale (short needle): km
• Outer Scale (long needle): x100 m
Barometric Pressure Setting Adjustment Knob
Barometric Pressure Setting (x10 mm Hg)
Radar Altimeter (meters)
Note: 600 m altitude above ground max
NPP Course Indicator System (Radio Navigation)
NPP Course Setting Knob


Voltmeter (Volts)
SARH Missile Radar Frequency Selector (Training/Live)
Note: Red Cover
Radar Screen Illumination Gain (Not for pilot's use)
Radar Screen Magnetic Reset
Clock
Emergency Jettison (Inner Pylons 1-2)
Emergency Jettison (Outer Pylons 3-4)


Bomb Arming (Tactical Release) Switch
• UP: Bombs Armed
• DOWN: Bombs Disarmed
Main Pitot Tube Heater Switch
Emergency Air-to-Air Rocket/Missile Launch
Auxiliary (Emergency) Pitot Tube Heater Switch
Oil Pressure Indicator (kg/cm²)
Emergency Nose Gear Deployment Handle
Bomb Armed Light
Radio Altimeter "LOW ALTITUDE" Setting Selector (m)
Cockpit Pressure & Altitude Indicator
Battery Capacity Meter Indicator (Ampmeter, Amps)
Brake Pressure Indicator (kg/cm²)
Note: for left and right main landing gears only
EXT STORES EMER JETT
OUTBD
INBD
EMER LNCH MIS/RCKT
ARMED
TACT DROP
PITOT,CLK, MIRROR HEAT
EMER PITOT
UB POD EMPTY 3
FUEL PODS EMPTY A
PYLON 1 INNER
PYLON 2 INNER
UB POD 4 EMPTY
DAY
NIGHT
AMPER HOUR
DIFF PRESSURE
HYDRAULICS
x 1000 L



Weapon & Ordnance Caution Lights		
UB POD EMPTY 3 (Green) UB Rocket pod on pylon 3 is empty.	**FUEL PODS EMPTY A (Green)** Wing external drop tanks are empty	**CENTER FUEL TANK (Green)** Centerline (ventral) external fuel tank is connected.
UB POD EMPTY 1 (Green) UB Rocket pod on pylon 1 is empty.	**PYLON 1 INNER (Green)** Pylon 1 (Inner) is powered and not empty.	**PYLON 2 INNER (Green)** Pylon 2 (Inner) is powered and not empty.
UB POD EMPTY 2 (Green) UB Rocket pod on pylon 2 is empty.	**PYLON 3 OUTER (Green)** Pylon 3 (Outer) is powered and not empty.	**PYLON 4 OUTER (Green)** Pylon 4 (Outer) is powered and not empty.
UB POD EMPTY 4 (Green) UB Rocket pod on pylon 4 is empty.	**JATO RIGHT (Green)** JATO is installed on aircraft (Right side)	**JATO LEFT (Green)** JATO is installed on aircraft (Left side)

Day/Night Display Mode Selector s

- *Scroll Mousewheel to adjust light brightness*
- *Left Click to press rotary in and test lights*


SUA-1 (Dangerous Angle of Attack Warning System) Light
Open/Close Canopy Handle
SUA-1 (Dangerous Angle of Attack Warning System) Light

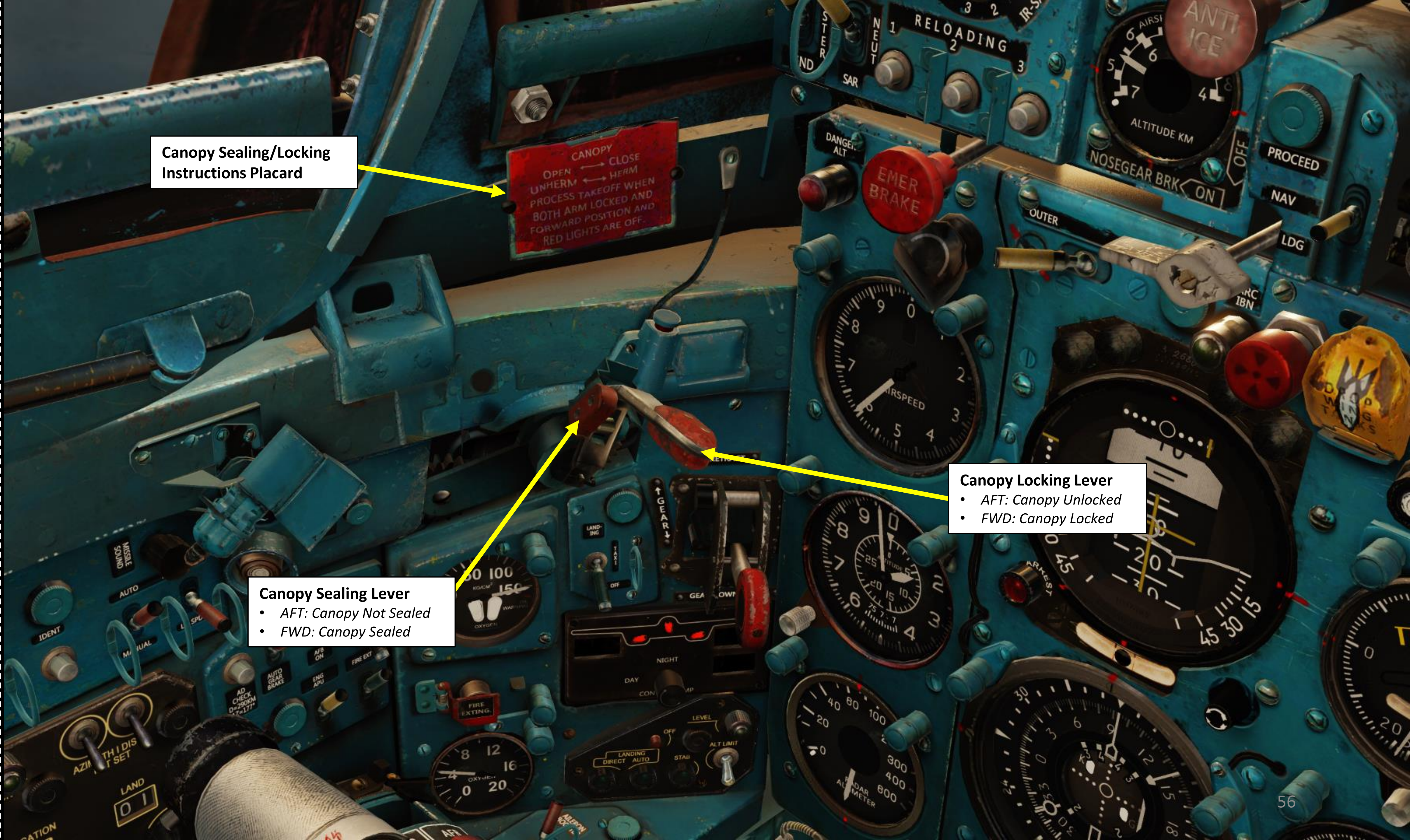

Mirror (Periscope)

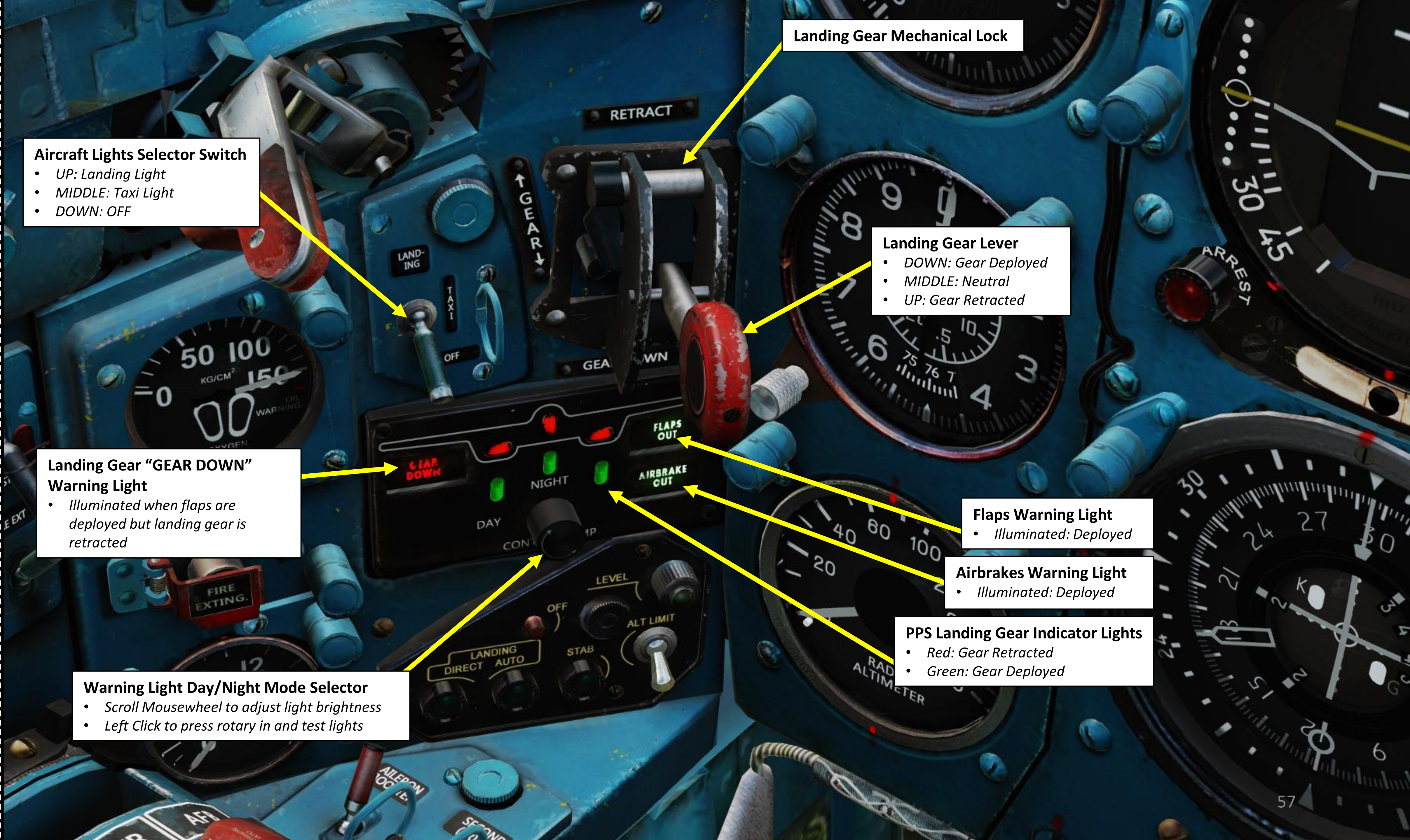
Gun Camera
- *Installed when Camera switch is ON (UP)*

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


READY
RELOADING
S-24 RKT
ANTI ICE
ALTITUDE KM
NOSEGEAR BRK
PROCEED
NAV
LDG
EMER BRAKE
OUTER
JETT WING TANKS
FDS
BASE (M) R RING (MIL)
ANGLE
MSL
LIGHT
CONT
INTER
PAS


ARC-10 (Automatic Radio Compass)
Sector & Preset Channel Chart
WARNING!
LIST NEED TO BE CHECK
BEFORE TAKEOFF
MISSILE SOUND
AUTO
IDENT
SPS
LO SPD
MANUAL


Canopy Sealing/Locking Instructions Placard
CANOPY
OPEN ⟷ CLOSE
UNHERM ⟷ HERM
PROCESS TAKEOFF WHEN BOTH ARM LOCKED AND FORWARD POSITION AND RED LIGHTS ARE OFF.
Canopy Locking Lever
• AFT: Canopy Unlocked
• FWD: Canopy Locked
Canopy Sealing Lever
• AFT: Canopy Not Sealed
• FWD: Canopy Sealed



Landing Gear Mechanical Lock

Aircraft Lights Selector Switch
- *UP: Landing Light*
- *MIDDLE: Taxi Light*
- *DOWN: OFF*

Landing Gear Lever
- *DOWN: Gear Deployed*
- *MIDDLE: Neutral*
- *UP: Gear Retracted*

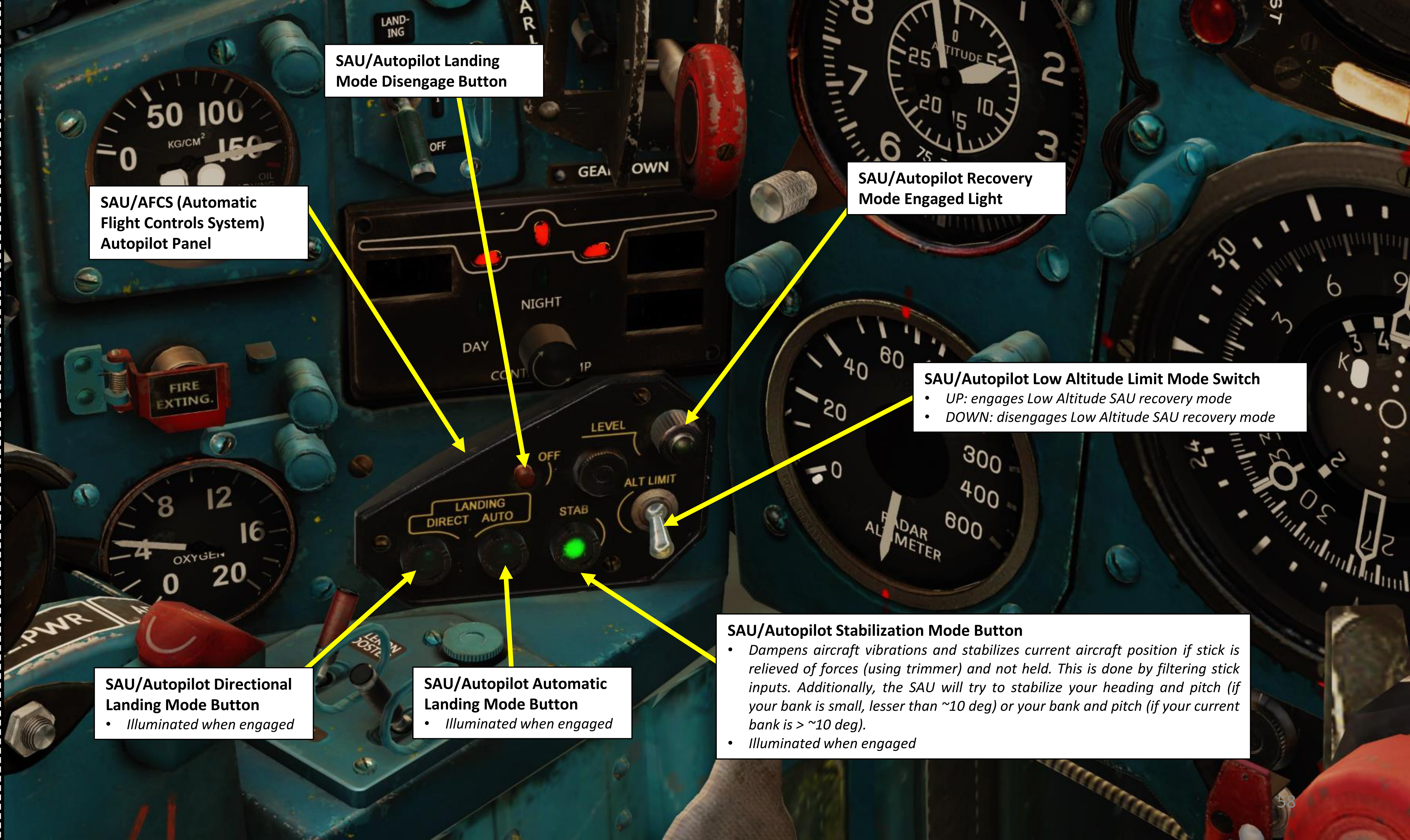
Landing Gear "GEAR DOWN" Warning Light
- *Illuminated when flaps are deployed but landing gear is retracted*

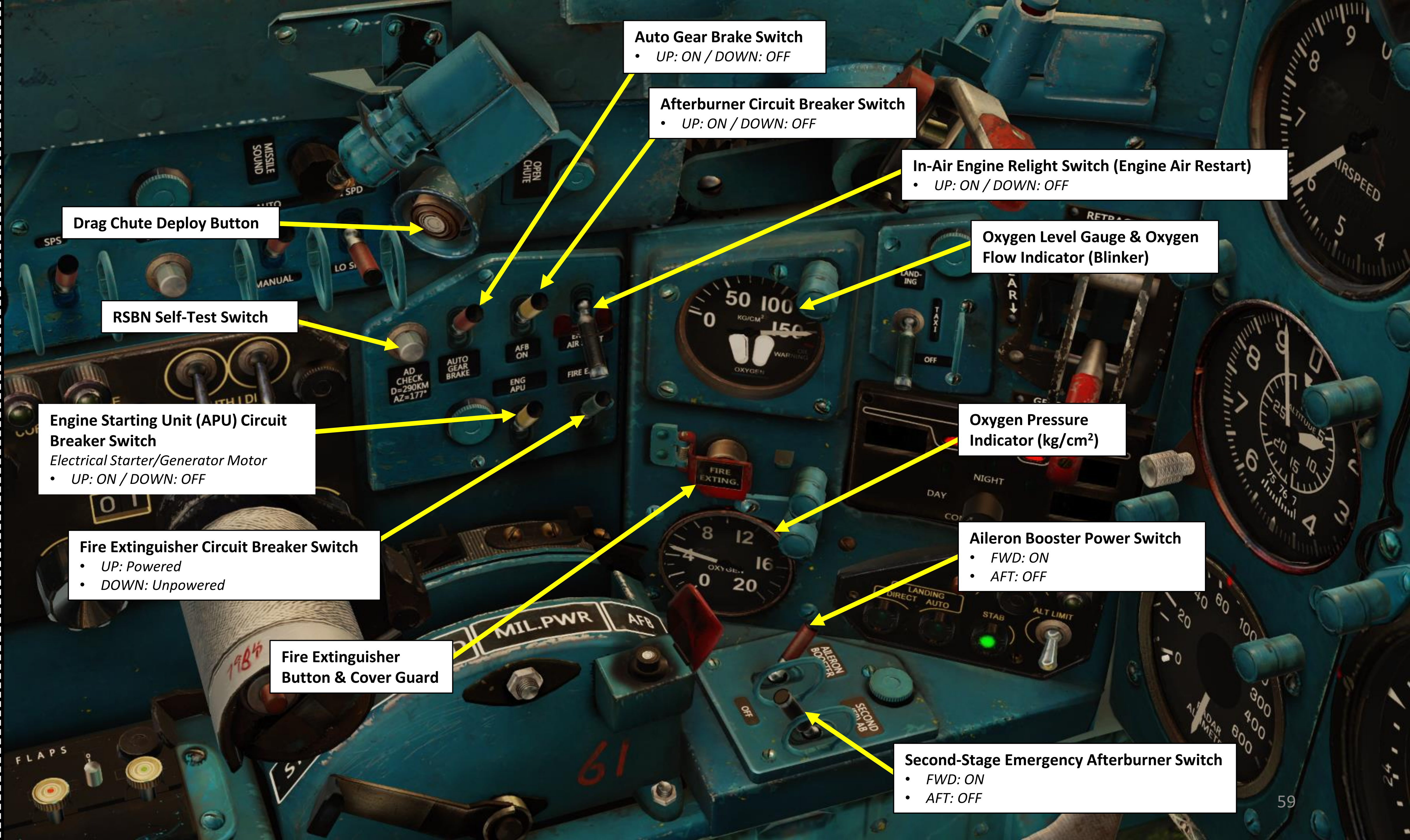
Flaps Warning Light
- *Illuminated: Deployed*

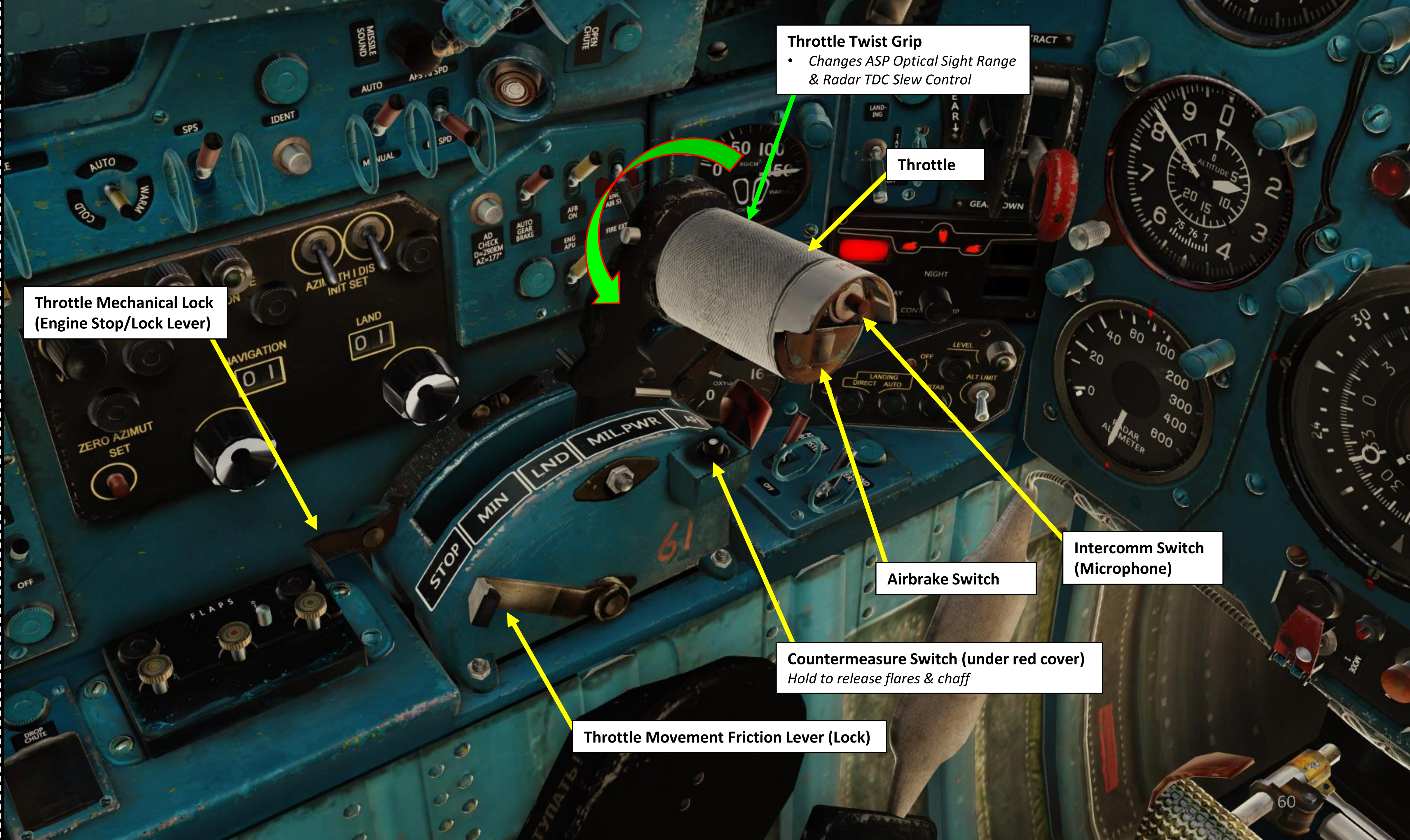
Airbrakes Warning Light
- *Illuminated: Deployed*

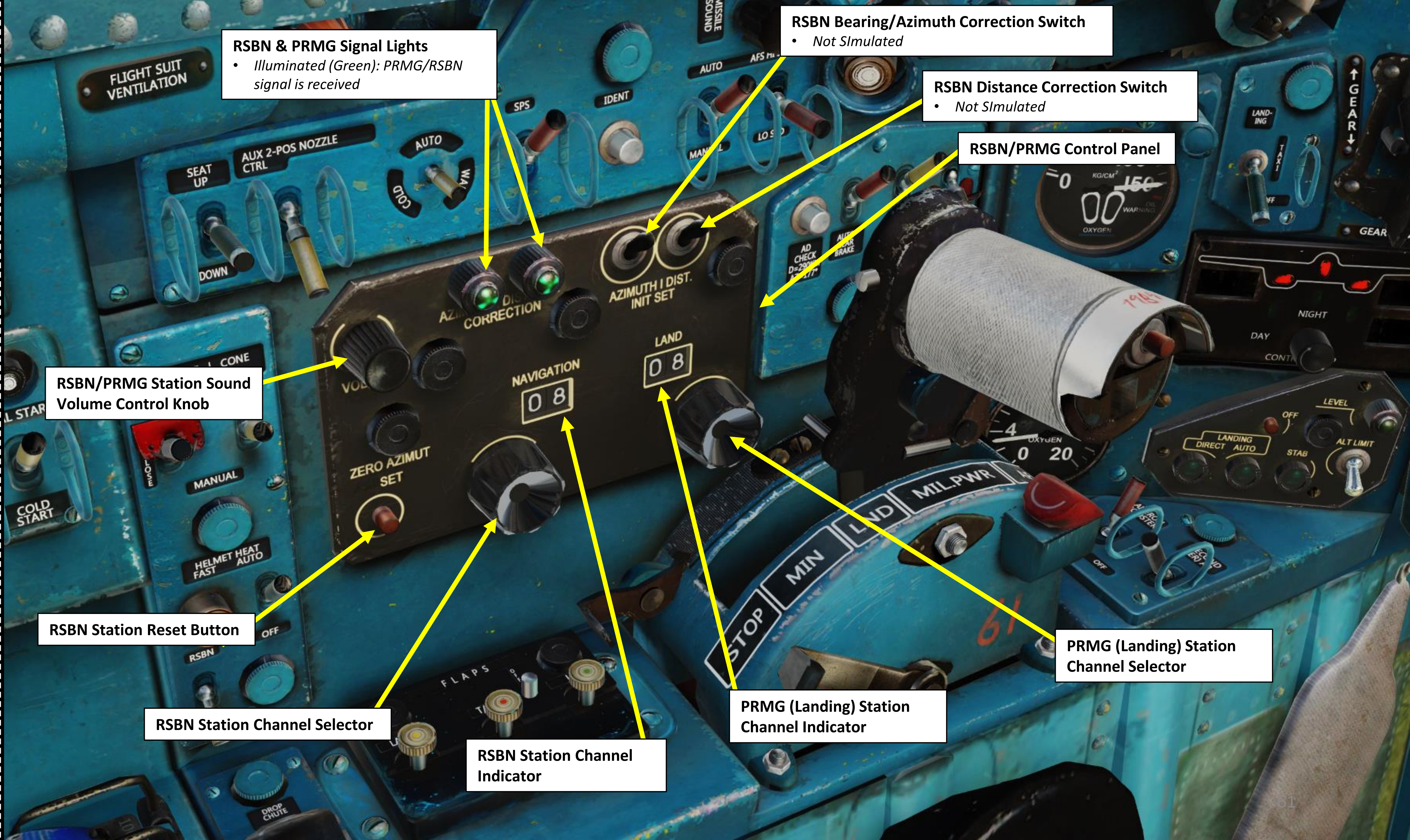
PPS Landing Gear Indicator Lights
- *Red: Gear Retracted*
- *Green: Gear Deployed*

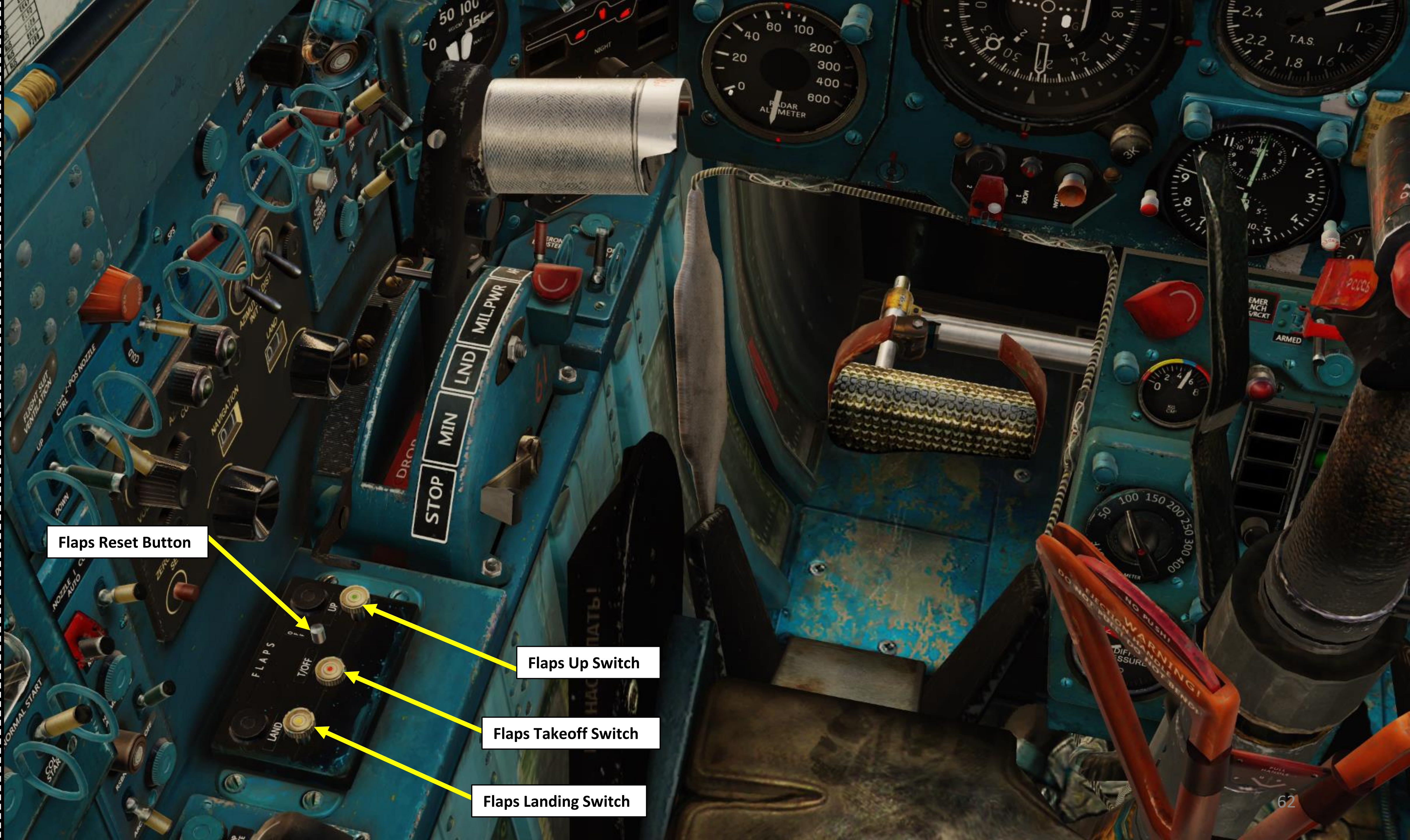
Warning Light Day/Night Mode Selector
- *Scroll Mousewheel to adjust light brightness*
- *Left Click to press rotary in and test lights*

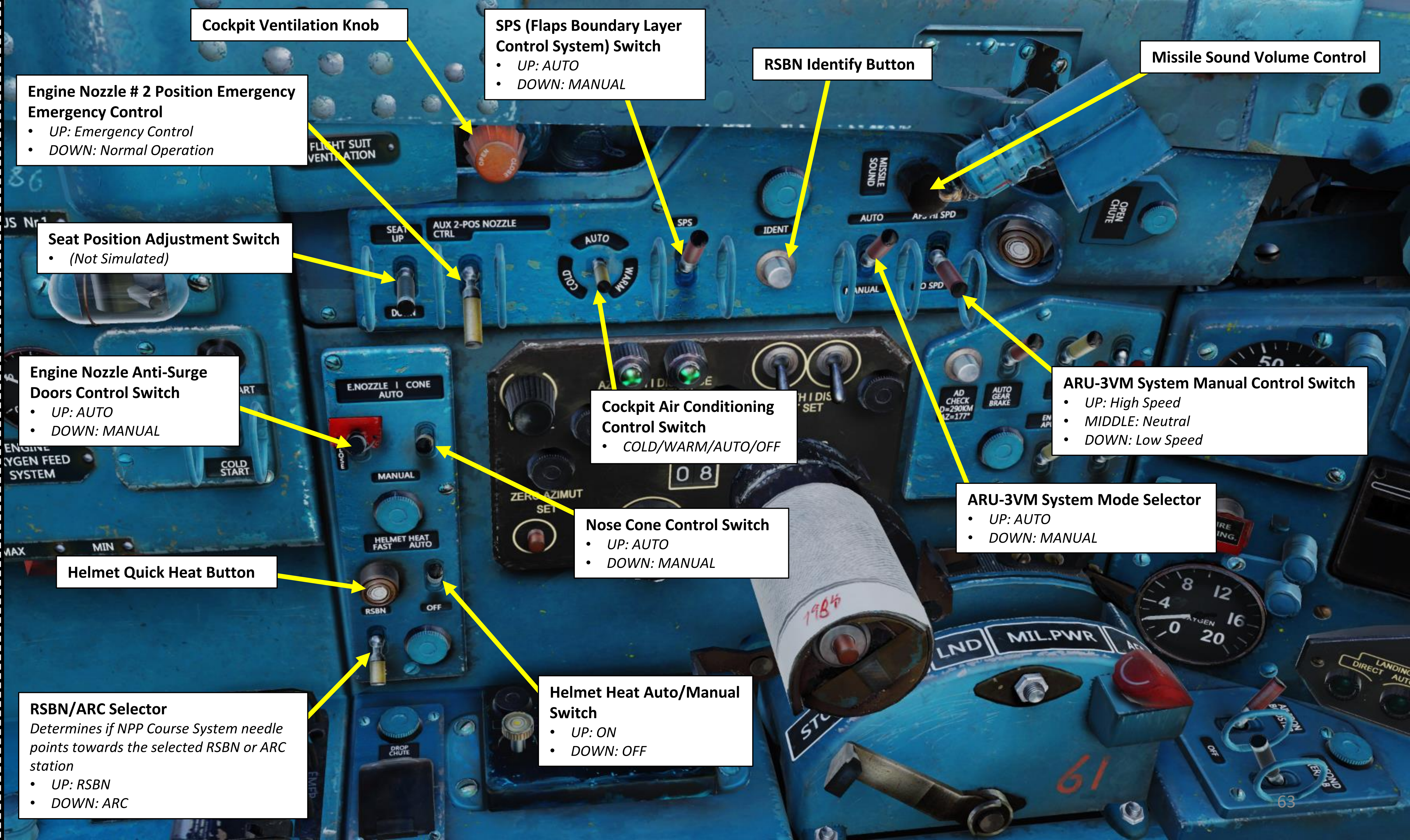

SAU/Autopilot Landing Mode Disengage Button
SAU/AFCS (Automatic Flight Controls System) Autopilot Panel
SAU/Autopilot Recovery Mode Engaged Light
SAU/Autopilot Low Altitude Limit Mode Switch
• UP: engages Low Altitude SAU recovery mode
• DOWN: disengages Low Altitude SAU recovery mode
SAU/Autopilot Stabilization Mode Button
• Dampens aircraft vibrations and stabilizes current aircraft position if stick is relieved of forces (using trimmer) and not held. This is done by filtering stick inputs. Additionally, the SAU will try to stabilize your heading and pitch (if your bank is small, lesser than ~10 deg) or your bank and pitch (if your current bank is > ~10 deg).
• Illuminated when engaged
SAU/Autopilot Directional Landing Mode Button
• Illuminated when engaged
SAU/Autopilot Automatic Landing Mode Button
• Illuminated when engaged

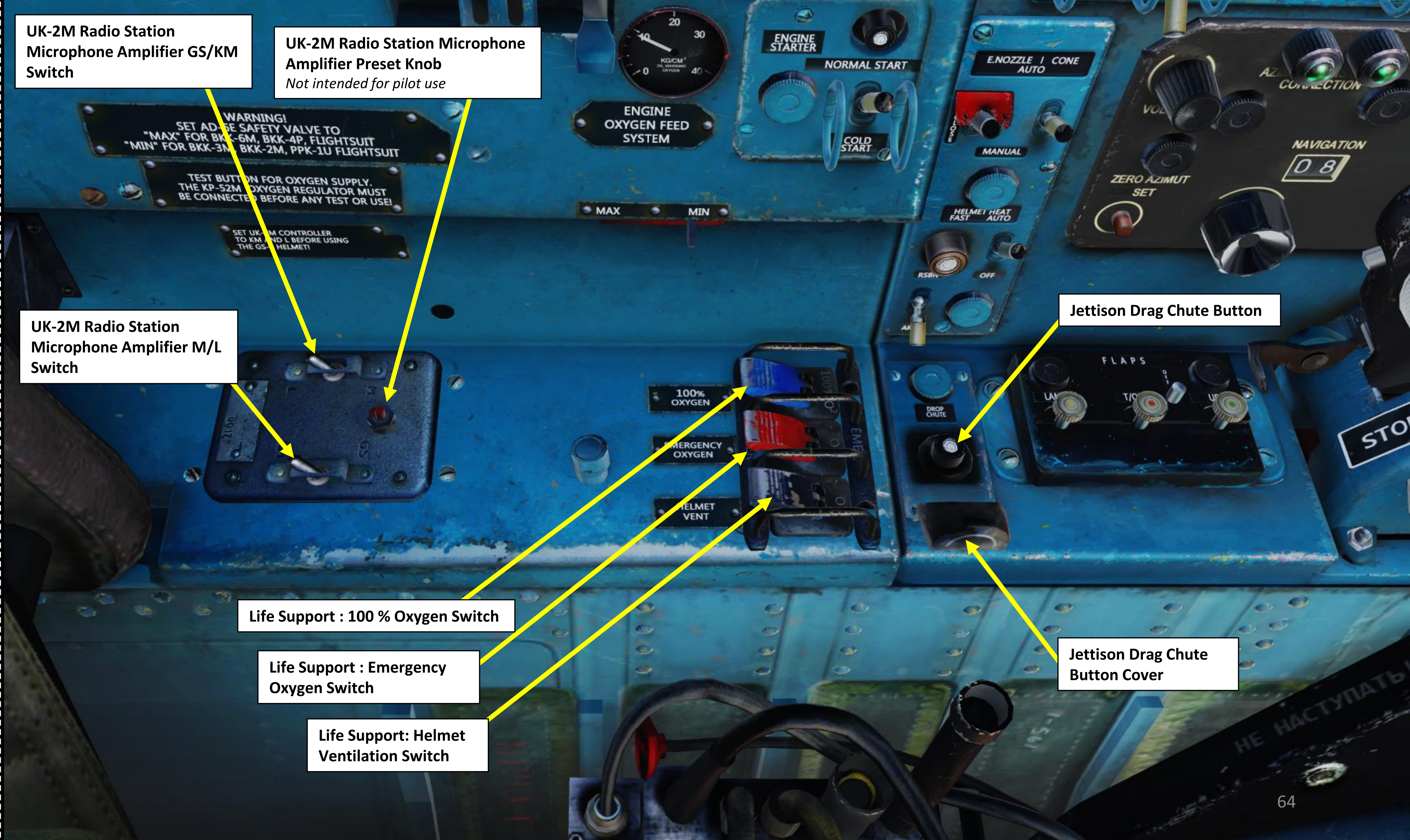

Auto Gear Brake Switch
• UP: ON / DOWN: OFF
Afterburner Circuit Breaker Switch
• UP: ON / DOWN: OFF
In-Air Engine Relight Switch (Engine Air Restart)
• UP: ON / DOWN: OFF
Drag Chute Deploy Button
Oxygen Level Gauge & Oxygen Flow Indicator (Blinker)
RSBN Self-Test Switch
Engine Starting Unit (APU) Circuit Breaker Switch
Electrical Starter/Generator Motor
• UP: ON / DOWN: OFF
Oxygen Pressure Indicator (kg/cm²)
Fire Extinguisher Circuit Breaker Switch
• UP: Powered
• DOWN: Unpowered
Aileron Booster Power Switch
• FWD: ON
• AFT: OFF
Fire Extinguisher Button & Cover Guard
Second-Stage Emergency Afterburner Switch
• FWD: ON
• AFT: OFF

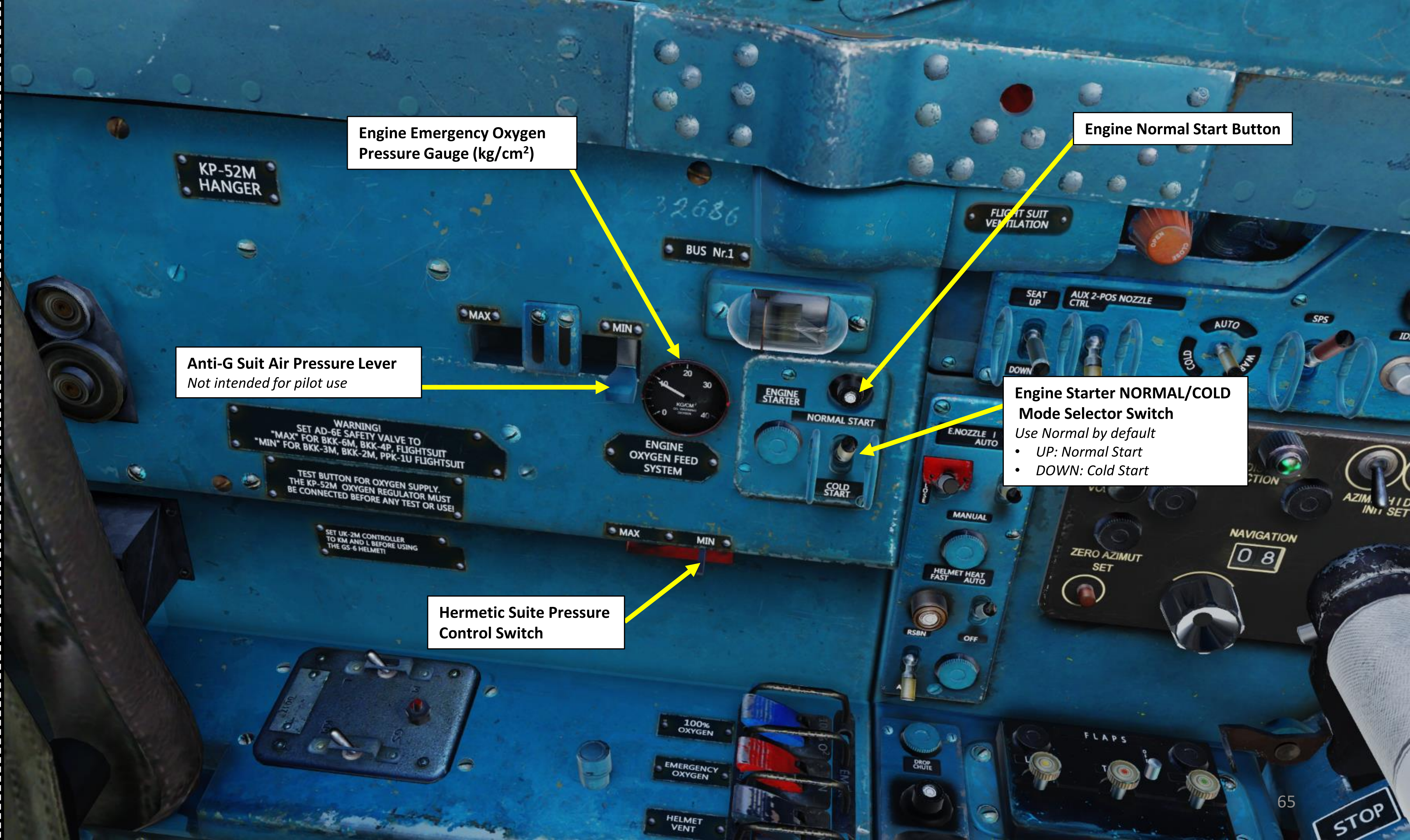

Throttle Twist Grip
• Changes ASP Optical Sight Range & Radar TDC Slew Control
Throttle
Throttle Mechanical Lock (Engine Stop/Lock Lever)
Intercomm Switch (Microphone)
Airbrake Switch
Countermeasure Switch (under red cover)
Hold to release flares & chaff
Throttle Movement Friction Lever (Lock)
STOP
MIN
LND
MIL.PWR
FLAPS
ZERO AZIMUT SET
NAVIGATION
LAND


RSBN & PRMG Signal Lights
• Illuminated (Green): PRMG/RSBN signal is received
RSBN Bearing/Azimuth Correction Switch
• Not SImulated
RSBN Distance Correction Switch
• Not SImulated
RSBN/PRMG Control Panel
RSBN/PRMG Station Sound Volume Control Knob
RSBN Station Reset Button
RSBN Station Channel Selector
RSBN Station Channel Indicator
PRMG (Landing) Station Channel Indicator
PRMG (Landing) Station Channel Selector
NAVIGATION
LAND
ZERO AZIMUT SET
AZIMUTH I DIST. INIT SET
CORRECTION
FLIGHT SUIT VENTILATION
AUX 2-POS NOZZLE CTRL
SEAT UP
DOWN
IDENT
SPS
AUTO
MANUAL
COLD START
HELMET HEAT FAST AUTO
RSBN
OFF
FLAPS
STOP
MIN
MIL.PWR
NIGHT
DAY
GEAR
OXYGEN
LEVEL
STAB
ALT LIMIT
LANDING DIRECT AUTO


Flaps Reset Button
Flaps Up Switch
Flaps Takeoff Switch
Flaps Landing Switch
STOP
MIN
LND
MIL.PWR
FLAPS
UP
T/OFF
LAND
RADAR ALTIMETER


Cockpit Ventilation Knob
SPS (Flaps Boundary Layer Control System) Switch
• UP: AUTO
• DOWN: MANUAL
RSBN Identify Button
Missile Sound Volume Control
Engine Nozzle # 2 Position Emergency Emergency Control
• UP: Emergency Control
• DOWN: Normal Operation
Seat Position Adjustment Switch
• (Not Simulated)
Engine Nozzle Anti-Surge Doors Control Switch
• UP: AUTO
• DOWN: MANUAL
Cockpit Air Conditioning Control Switch
• COLD/WARM/AUTO/OFF
ARU-3VM System Manual Control Switch
• UP: High Speed
• MIDDLE: Neutral
• DOWN: Low Speed
ARU-3VM System Mode Selector
• UP: AUTO
• DOWN: MANUAL
Nose Cone Control Switch
• UP: AUTO
• DOWN: MANUAL
Helmet Quick Heat Button
Helmet Heat Auto/Manual Switch
• UP: ON
• DOWN: OFF
RSBN/ARC Selector
Determines if NPP Course System needle points towards the selected RSBN or ARC station
• UP: RSBN
• DOWN: ARC


UK-2M Radio Station Microphone Amplifier GS/KM Switch
UK-2M Radio Station Microphone Amplifier Preset Knob
Not intended for pilot use
UK-2M Radio Station Microphone Amplifier M/L Switch
Jettison Drag Chute Button
Life Support : 100 % Oxygen Switch
Life Support : Emergency Oxygen Switch
Life Support: Helmet Ventilation Switch
Jettison Drag Chute Button Cover

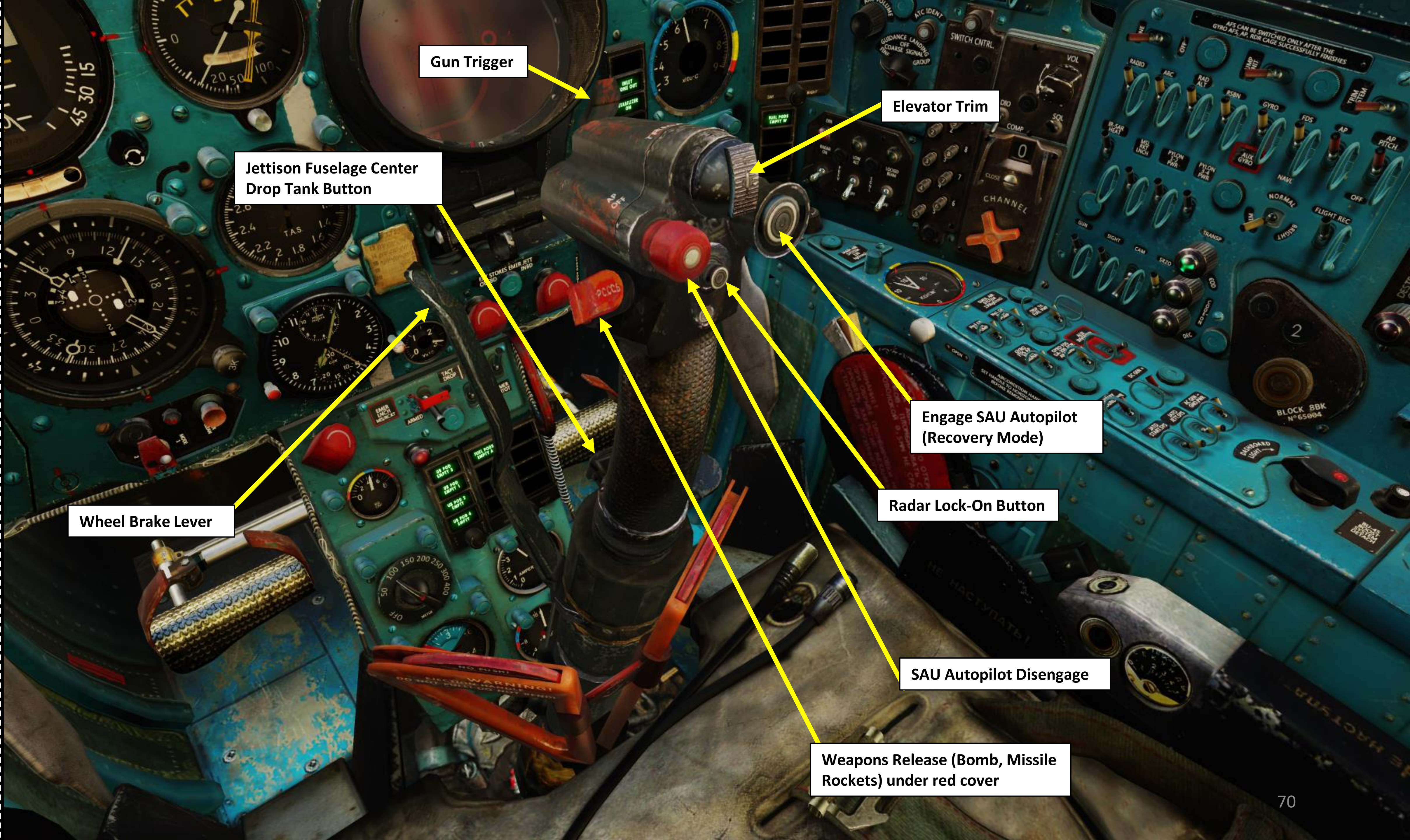

Engine Emergency Oxygen Pressure Gauge (kg/cm²)
Engine Normal Start Button
Anti-G Suit Air Pressure Lever
Not intended for pilot use
Engine Starter NORMAL/COLD Mode Selector Switch
Use Normal by default
• UP: Normal Start
• DOWN: Cold Start
Hermetic Suite Pressure Control Switch


KP-52M
HANGER
ENGINE
OXYGEN FEED
SYSTEM
BUS Nr.1
STOP
MIN
LND
MIL.PWR
FLAPS
EMER
BRAKE
READY
AIR
RELOADING
100%
OXYGEN
EMERGENCY
OXYGEN
HELMET
VENT


ENGINE OXYGEN FEED SYSTEM
COLD START
MANUAL
WARNING!
AT AD-6E SAFETY VALVE TO
FOR BKK-6M, BKK-4P, FLIGHTSUIT
BKK-3M, BKK-2M, PPK-1U FLIGHTSUIT
MAX
MIN
TEST BUTTON FOR OXYGEN SUPPLY.
THE KP-52M OXYGEN REGULATOR MUST
BE CONNECTED BEFORE ANY TEST OR USE!
SET UK-2M CONTROLLER
TO KM AND L BEFORE USING
THE GS-6 HELMET!
HELMET HEAT
FAST AUTO
RSBN
OFF
ZERO AZIMUT SET
NAVIGATION
LAND
FLAPS
UP
DROP CHUTE
100% OXYGEN
EMERGENCY OXYGEN
HELMET VENT
STOP
MIN
LND
MIL.PWR
DAY
NIGHT
LEVEL
LANDING
DIRECT
AUTO
STAB
ALT LIMIT
OFF
НЕ НАСТУПАТЬ!
Ejection Seat Emergency Oxygen


3547

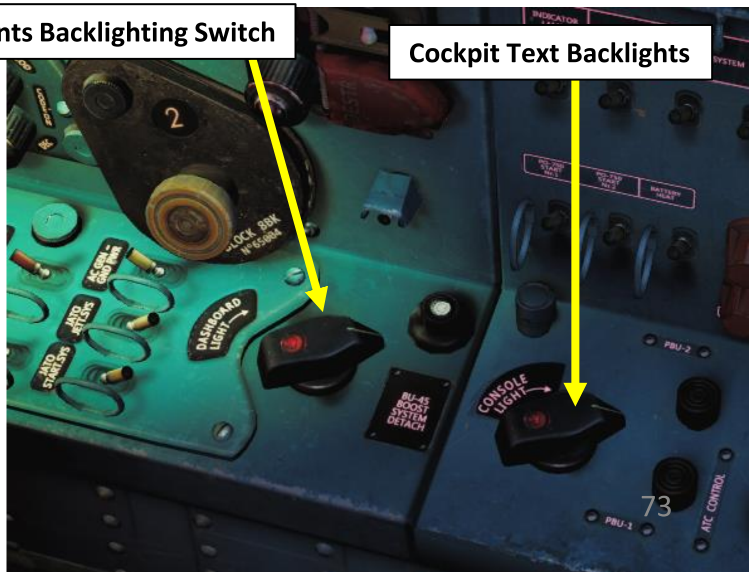

Храни кресло под
чехлом
3547


Gun Trigger
Elevator Trim
Jettison Fuselage Center Drop Tank Button
Engage SAU Autopilot (Recovery Mode)
Radar Lock-On Button
Wheel Brake Lever
SAU Autopilot Disengage
Weapons Release (Bomb, Missile Rockets) under red cover

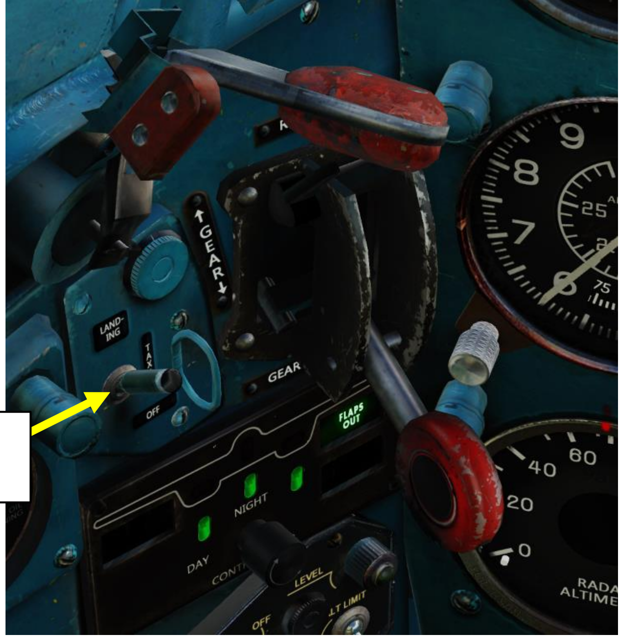

Ejection Handle

Use RCTRL+L binding to use flashlight inside cockpit.

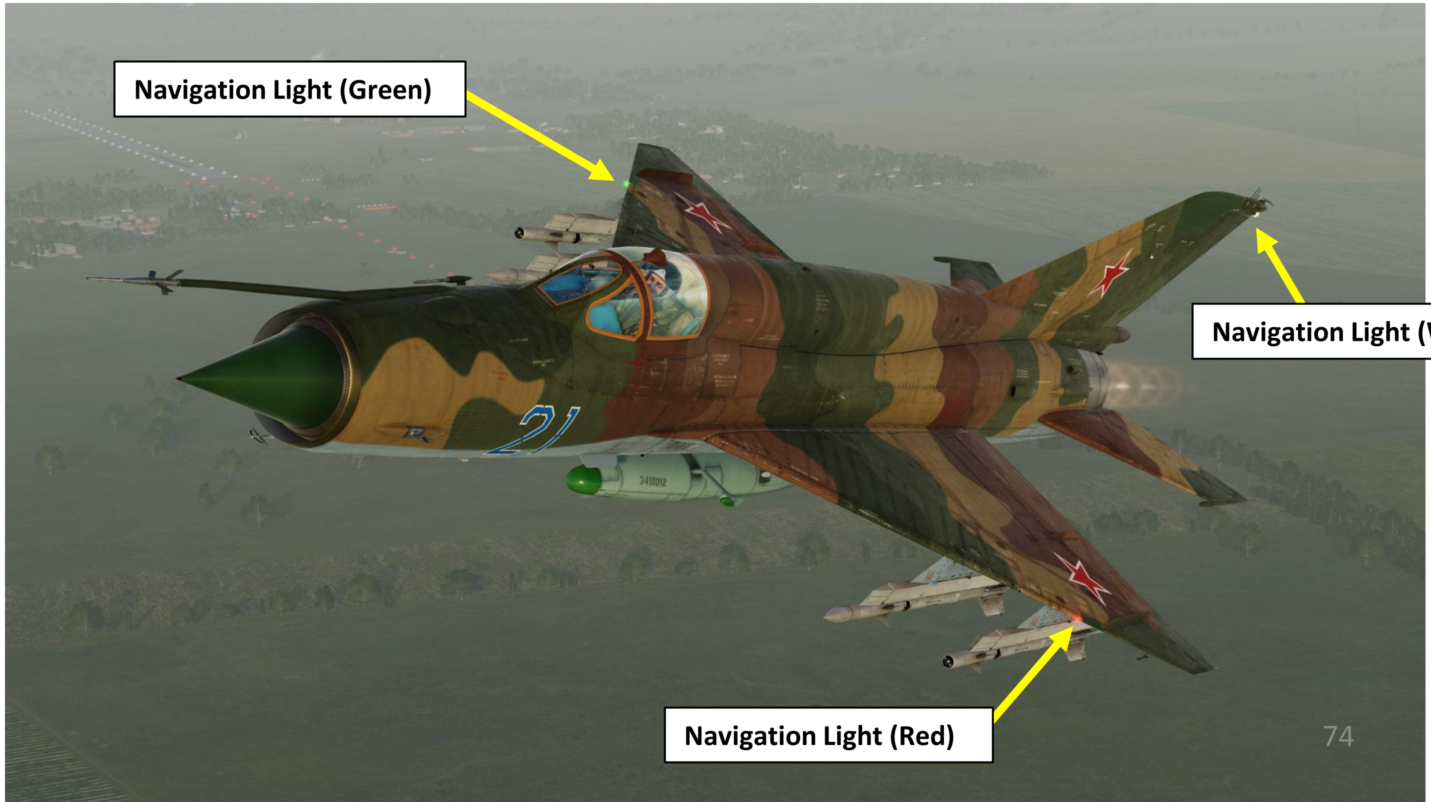

Cockpit White Light Knob
Cockpit Red Light Knob


Instruments Backlighting Switch
Cockpit Text Backlights


Landing/Taxi Light


Landing/Taxi Lights Selector Switch
GEAR
NIGHT
DAY


Formation (Navigation) Lights Selector
GYRO
FDS
AP
AP PITCH
AUX GYRO
NAVL
OFF
NORMAL
FLIGHT REC
DIM
TRANSP


Navigation Light (Green)
Navigation Light (White)
Navigation Light (Red)


Drag Chute Nacelle Doors
Doors require pneumatic pressure to open
Engine Nozzle
51


Nose Cone
• Hydraulically Actuated

Landing Gear

- *Landing Gear Hydraulically Actuated*
- *Wheel Brakes are Pneumatically Actuated*

Note: Setting the Landing Gear Lever in the UP position will activate the wheel brakes to stop the wheel from spinning. While doing so, pneumatic pressure will constantly be expended. Remember to set your landing gear lever to NEUTRAL (Middle) position once the landing gear is raised to "release" wheel brakes.

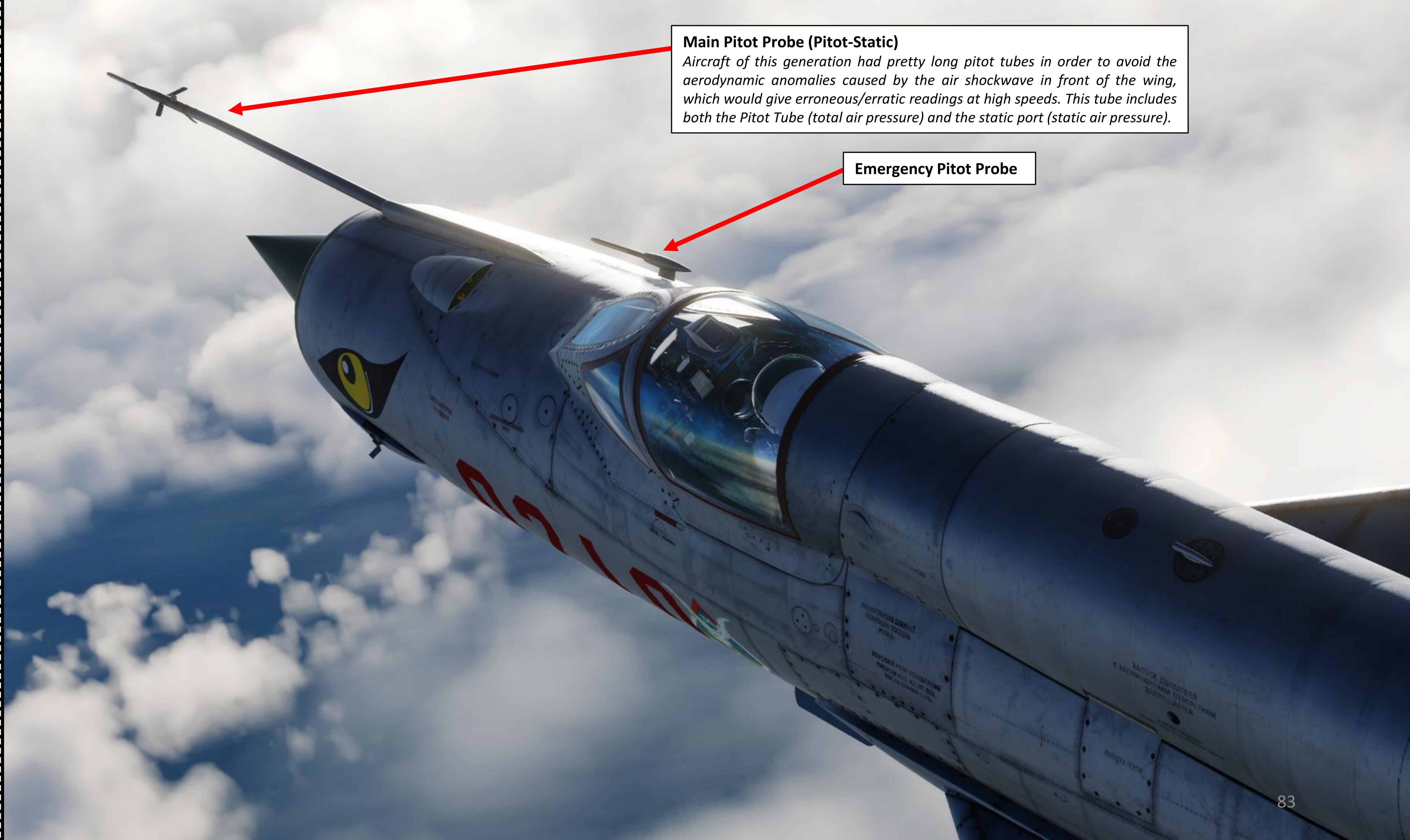

Flaps
• Hydraulically Actuated


Airbrakes
• Hydraulically actuated

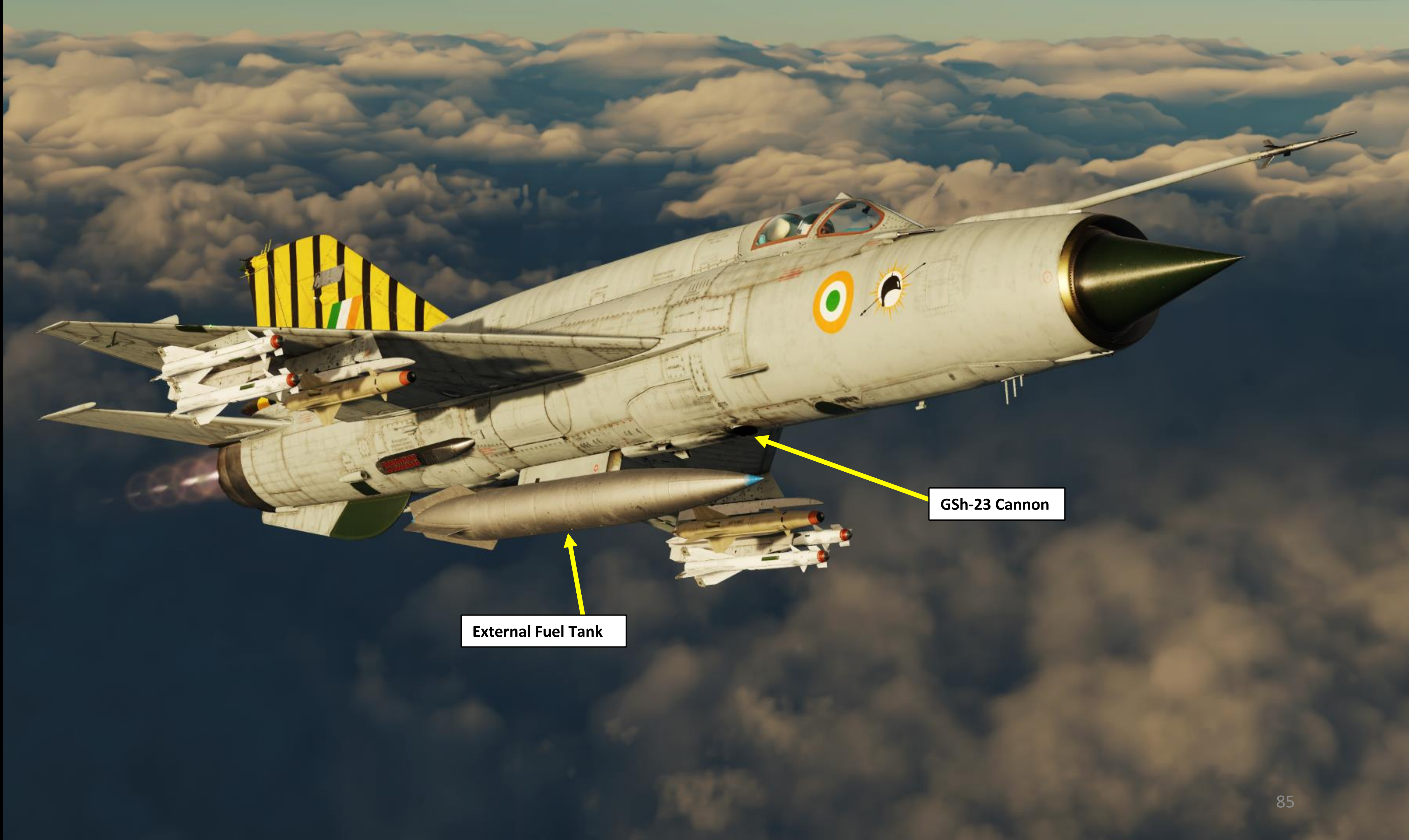

Airbrakes
Ventral Fin
Improves aircraft stability at high angles of attack

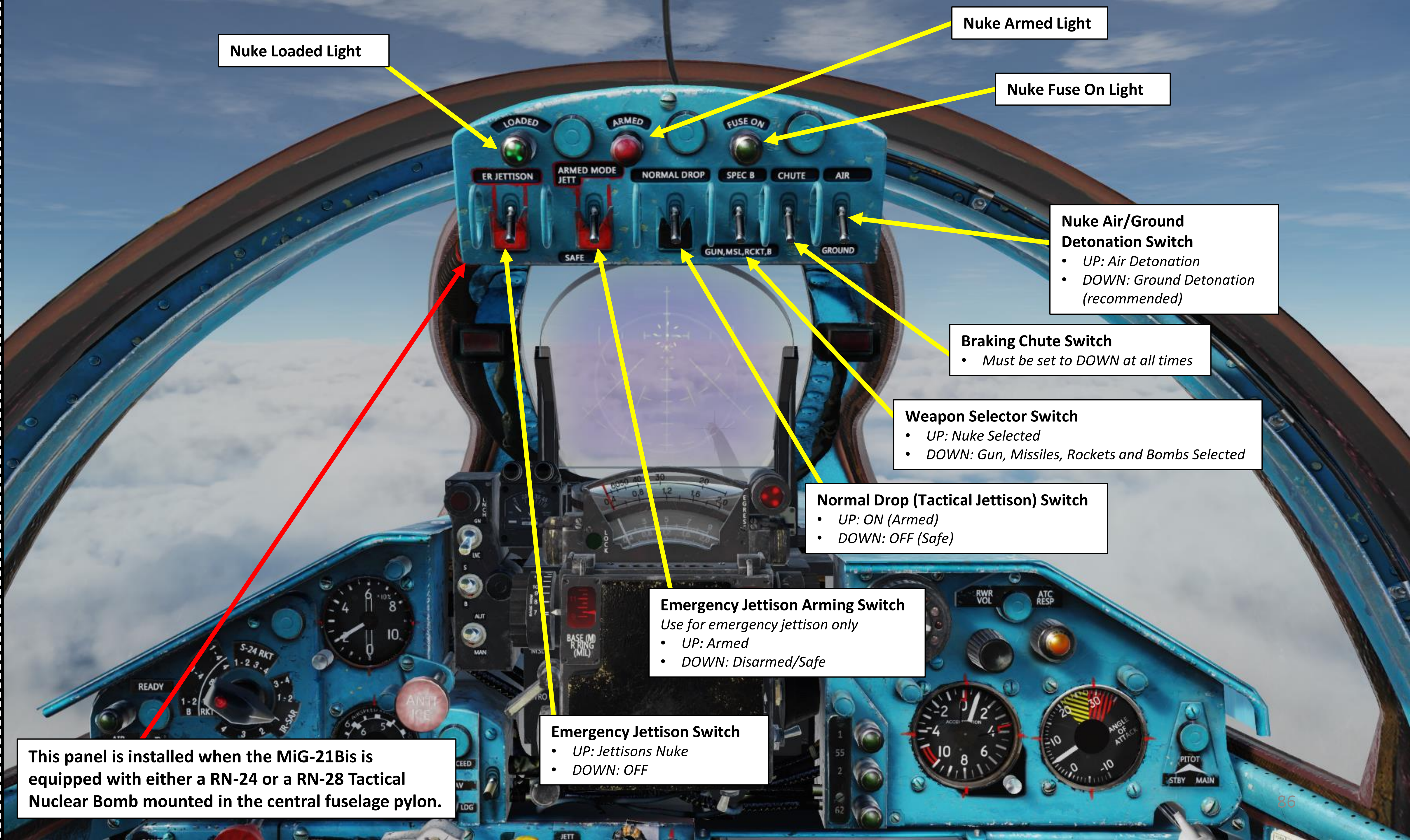

Drag Chute

The delta wing, while excellent for fast acceleration and supersonic speeds, was not the best option for low speed flying and close air-to-air (AA) combat. This was partially improved with the introduction of an emergency afterburner, which improved thrust/weight ratio at altitudes up to 4000m, enabling the plane to fly at low speeds while performing sharp maneuvers and to quickly recover from low speed stall conditions.


Main Pitot Probe (Pitot-Static)
Aircraft of this generation had pretty long pitot tubes in order to avoid the aerodynamic anomalies caused by the air shockwave in front of the wing, which would give erroneous/erratic readings at high speeds. This tube includes both the Pitot Tube (total air pressure) and the static port (static air pressure).
Emergency Pitot Probe


ASO-2 Countermeasure Cartridge Dispenser
3210


GSh-23 Cannon
External Fuel Tank



Nuke Loaded Light

Nuke Armed Light

Nuke Fuse On Light

Nuke Air/Ground Detonation Switch
- *UP: Air Detonation*
- *DOWN: Ground Detonation (recommended)*

Braking Chute Switch
- *Must be set to DOWN at all times*

Weapon Selector Switch
- *UP: Nuke Selected*
- *DOWN: Gun, Missiles, Rockets and Bombs Selected*

Normal Drop (Tactical Jettison) Switch
- *UP: ON (Armed)*
- *DOWN: OFF (Safe)*

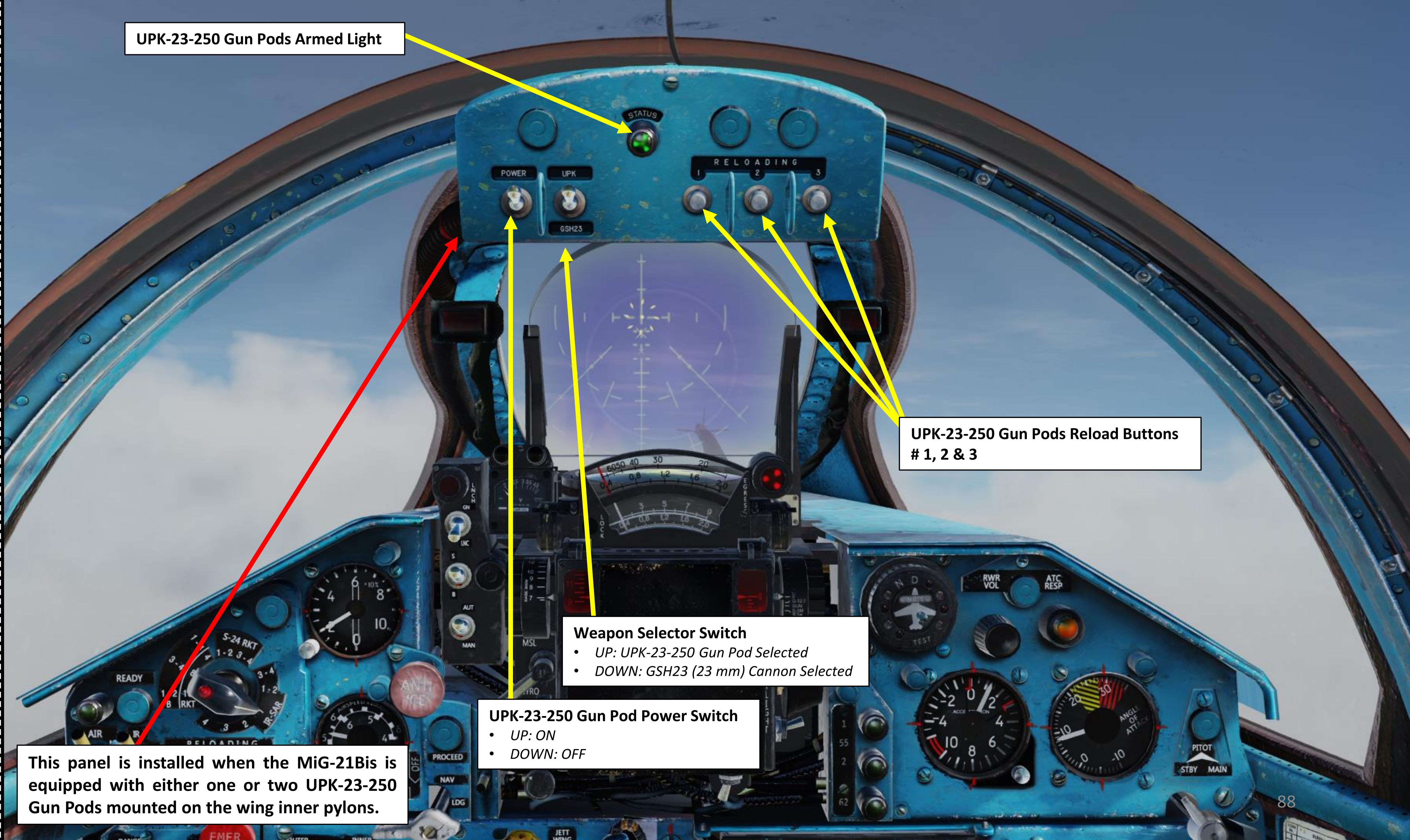
Emergency Jettison Arming Switch

Use for emergency jettison only
- *UP: Armed*
- *DOWN: Disarmed/Safe*

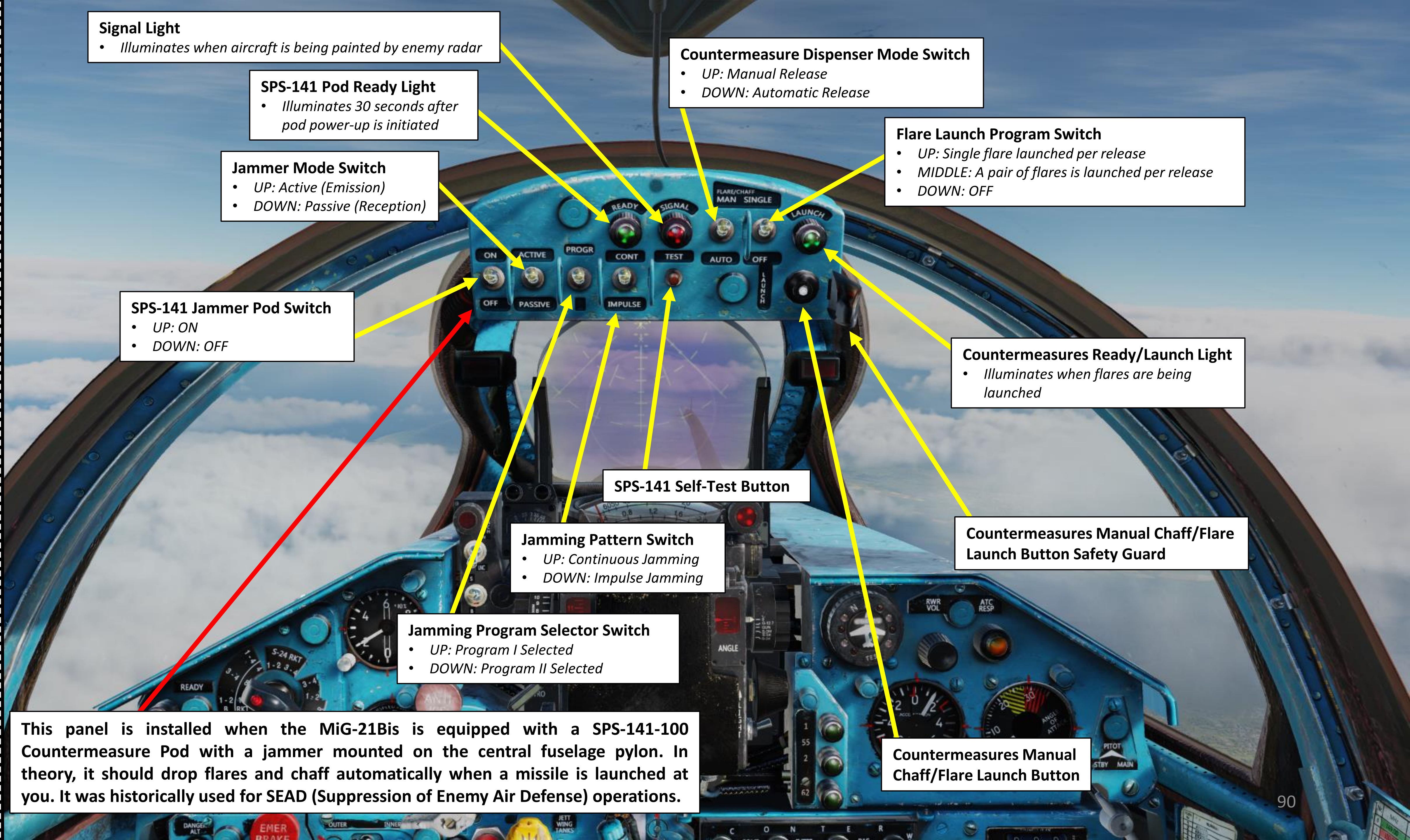
Emergency Jettison Switch
- *UP: Jettisons Nuke*
- *DOWN: OFF*

This panel is installed when the MiG-21Bis is equipped with either a RN-24 or a RN-28 Tactical Nuclear Bomb mounted in the central fuselage pylon.


RN-24 Nuclear Bomb


UPK-23-250 Gun Pods Armed Light
STATUS
POWER
UPK
GSH23
RELOADING
1 2 3
UPK-23-250 Gun Pods Reload Buttons # 1, 2 & 3
Weapon Selector Switch
• UP: UPK-23-250 Gun Pod Selected
• DOWN: GSH23 (23 mm) Cannon Selected
UPK-23-250 Gun Pod Power Switch
• UP: ON
• DOWN: OFF
This panel is installed when the MiG-21Bis is equipped with either one or two UPK-23-250 Gun Pods mounted on the wing inner pylons.


UPK-23-250 Gun Pod
UPK-23-250 Gun Pod

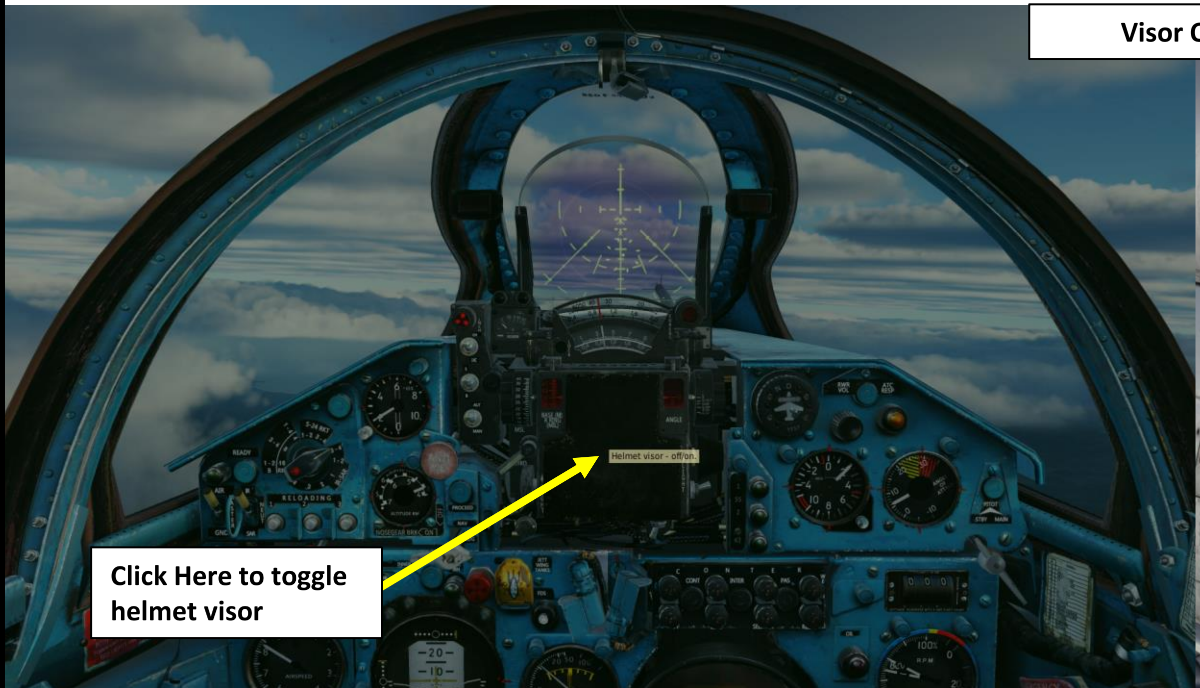


This panel is installed when the MiG-21Bis is equipped with a SPS-141-100 Countermeasure Pod with a jammer mounted on the central fuselage pylon. In theory, it should drop flares and chaff automatically when a missile is launched at you. It was historically used for SEAD (Suppression of Enemy Air Defense) operations.


SPS-141 Jammer Pod

Visor OFF

Visor ON



Click Here to toggle helmet visor


ОПАСНО
19
Москва

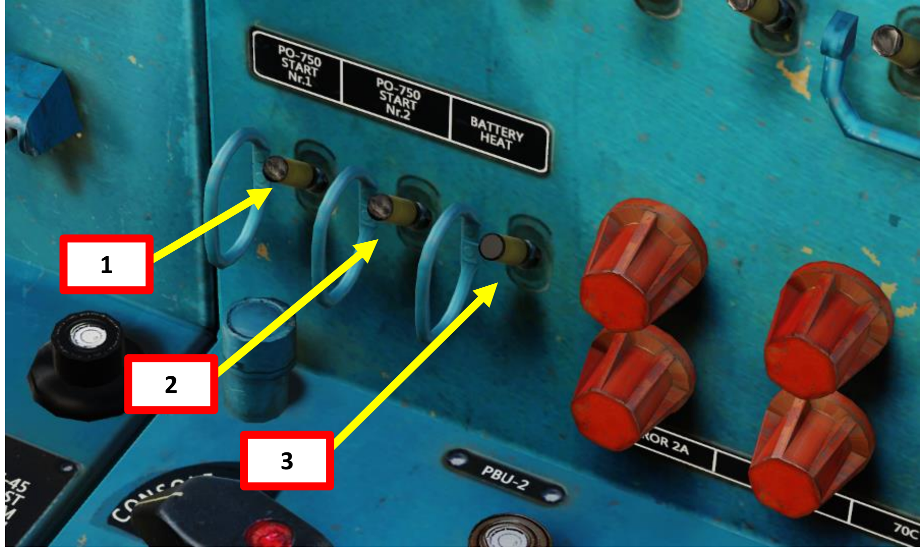
Excerpt from the developer manual: “*Known for its short start-up time, the MiG-21 was often used in last minute during emergency operations: usually, early warning (EW) crews postpone the decision to scramble MiG-21 fighters until the last moment. This usually led to a “rush” among MiG-21 crews who were trying to spare some time during the start-up and taxi procedures in order to compensate the EW crews’ lost time. Sometimes, this led to problems in aircraft systems operations eventually causing a mission abortion.*

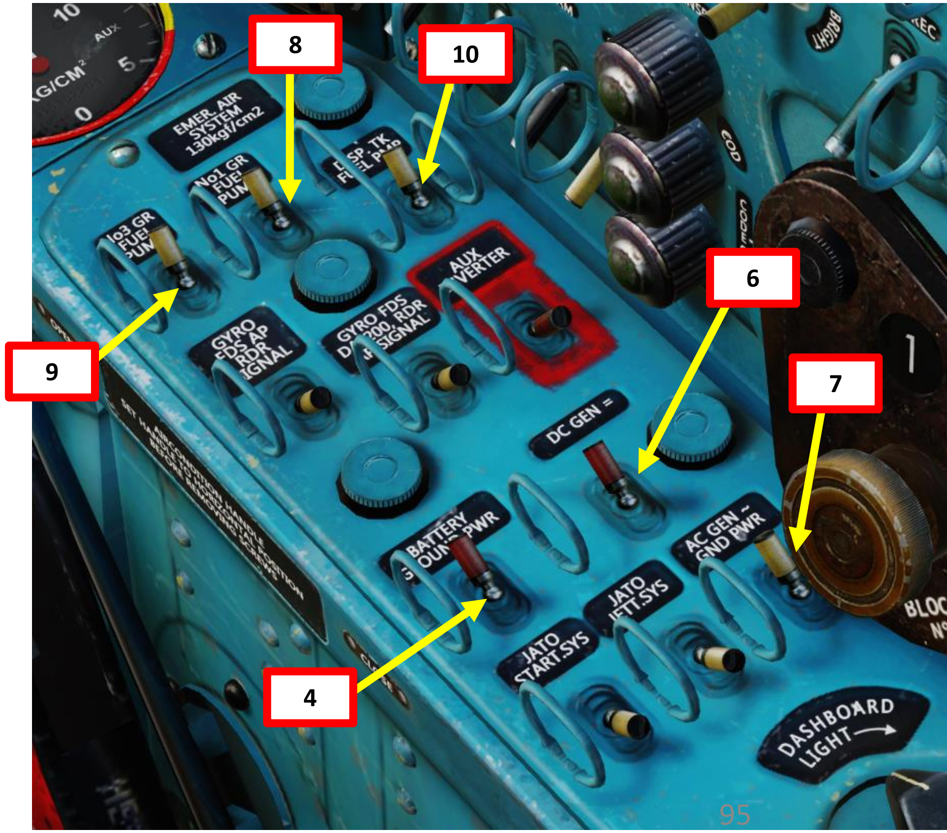
After many such occasions, MiG-21 pilots adopted a rule: “You can not compensate time that someone else already wasted. Never rush.”

Note: **Steps preceded by [P] can be skipped since the aircraft spawns with the switch/selector already preset at the correct position**.

A – BEFORE START-UP

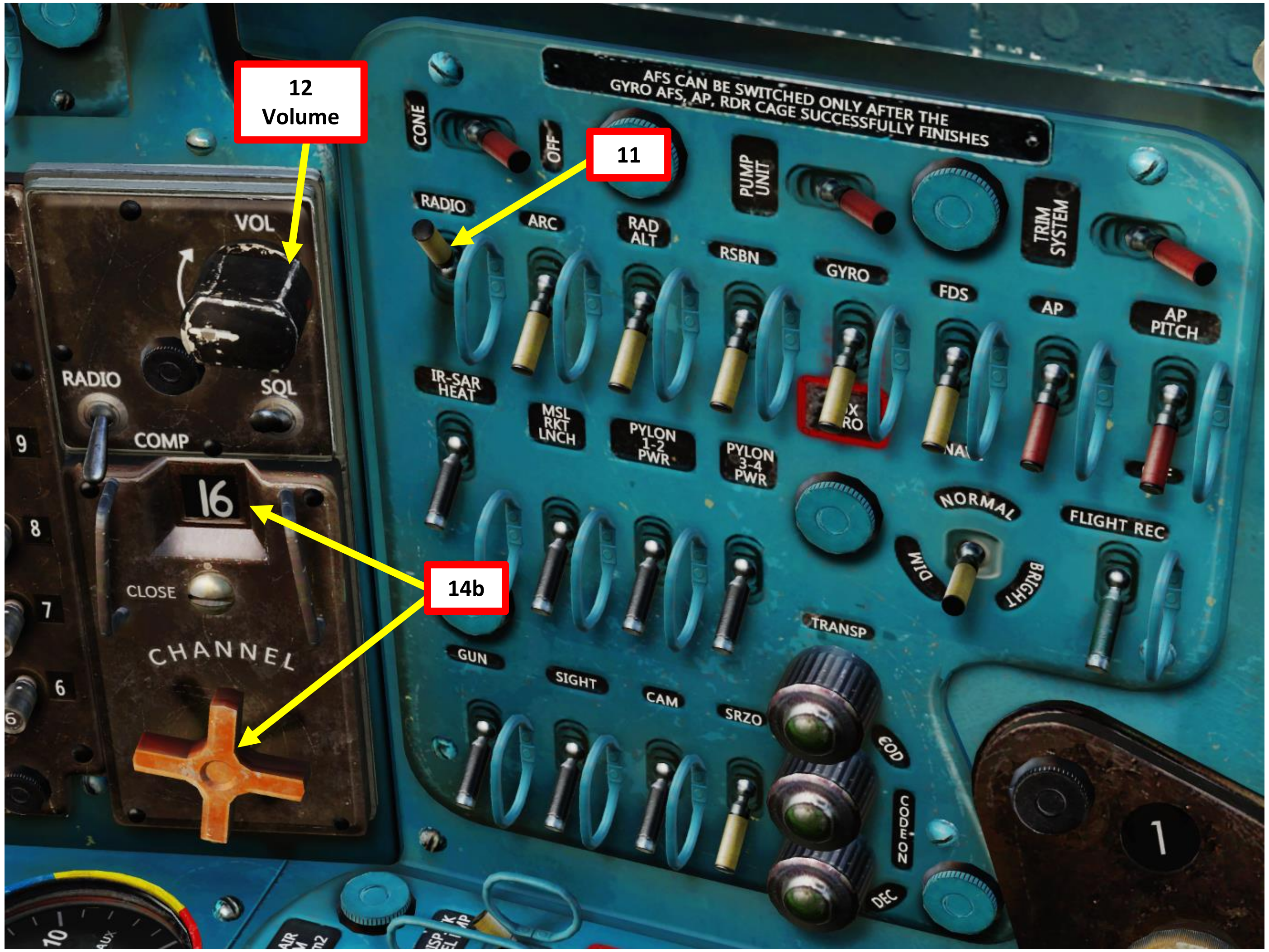
1. Set PO-750 Inverter #1 Switch – ON (UP)
2. Set PO-750 Inverter #2 Switch – ON (UP)
3. Set Battery Heat Switch – ON (UP)
4. Set Battery Switch – ON (FWD)
5. Check that on-board battery voltage is at least 24.5 Volts.
   - Note: Low battery voltage will require you to contact the ground crew and request ground power.
6. Set DC Generator Switch – ON (FWD)
7. Set AC Generator Switch – ON (FWD)
8. Set 1st Fuel Tank Group Pump Switch – ON (FWD)
9. Set 3rd Fuel Tank Group Pump Switch – ON (FWD)
10. Set Dispenser Fuel Tank Pump Switch – ON (FWD)

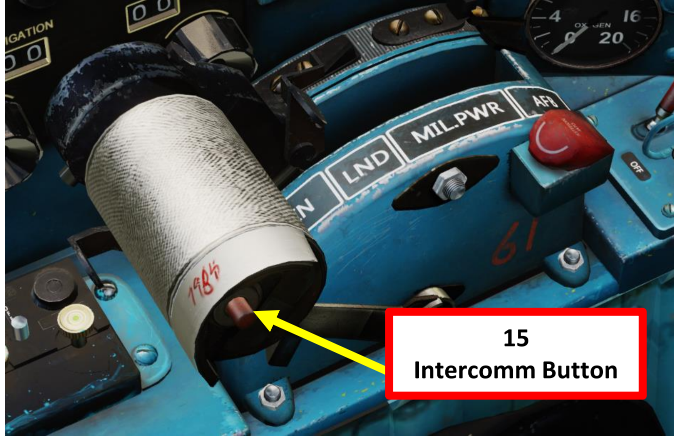




A – BEFORE START-UP

11. Set Radio Power Switch – ON (UP). The radio requires a 5-second warm-up period.
12. Adjust radio volume as required.
13. Open your kneeboard (RCTRL+UP) and find the RADIO page (RCTRL+LEFT and RCTRL+RIGHT to change pages). You can hide the kneeboard by using "RCTRL+UP" again.
14. Select radio preset channel of airfield tower. We are at Senaki-Kolkhi, so the preset channel is "16".
15. Communicate with tower and request clearance for start-up. Communication is performed by pressing the "Intercomm" button on the throttle ("\" binding by default.)





RADIO

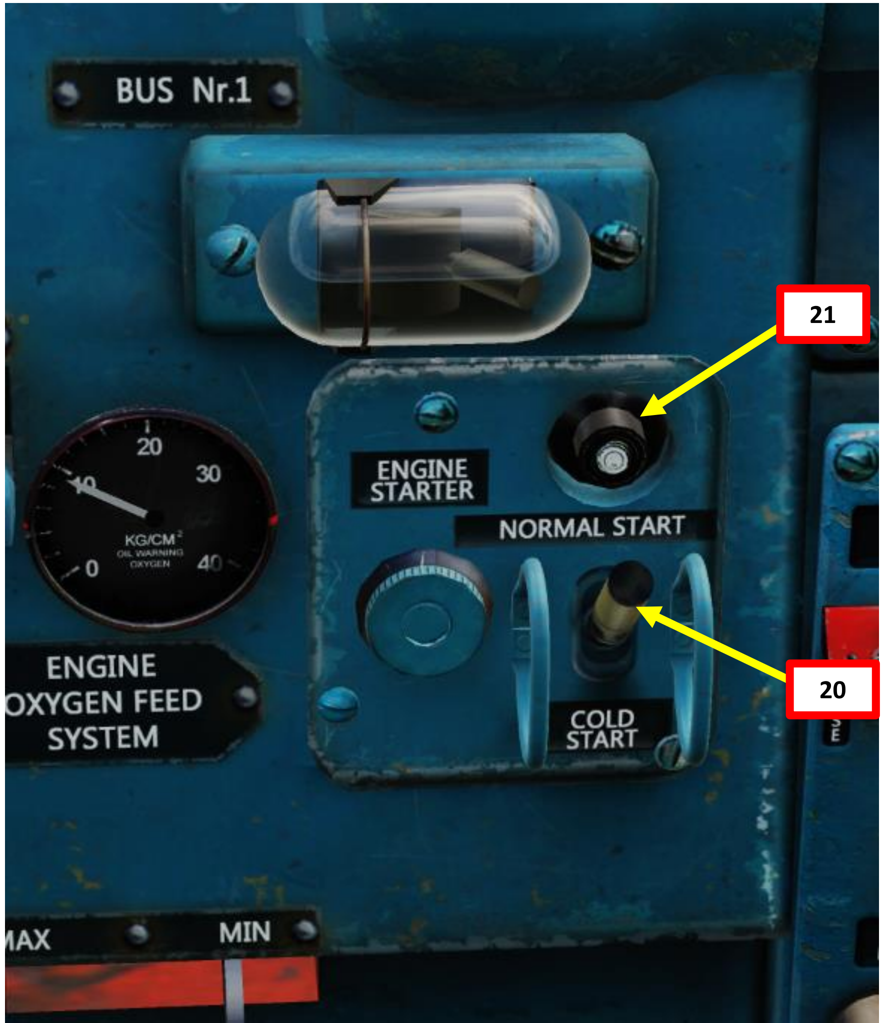
rev: Mar. 2017

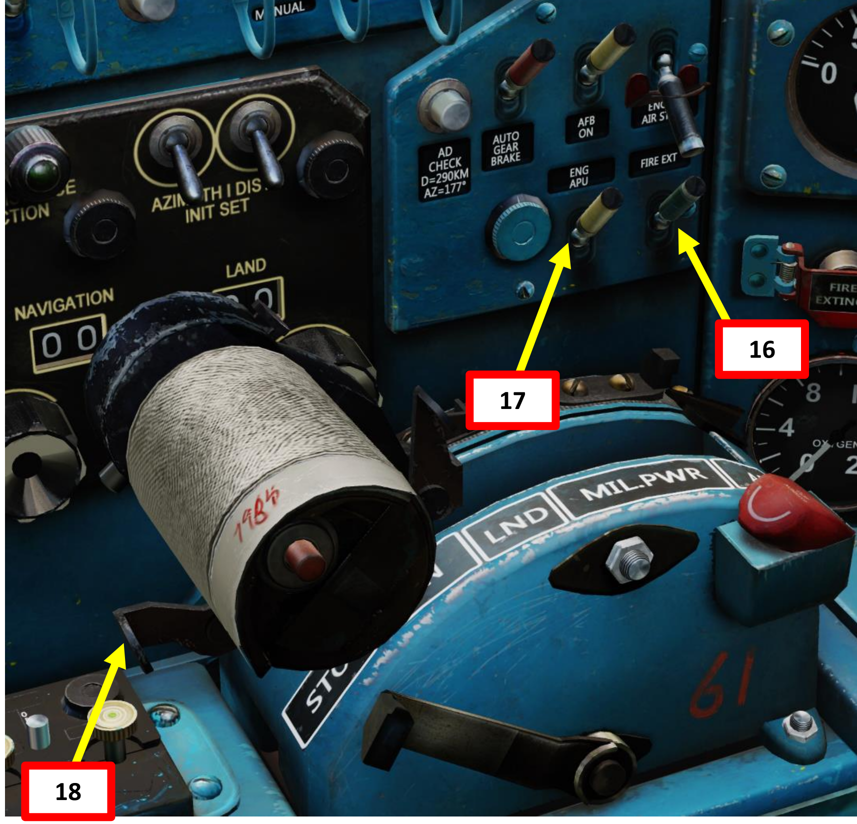
CAUCASUS (chnl. order)	NEVADA (chnl. order)	NEVADA (freq. order)
0 – Main	0 – 124.0	2 – 121.0
1 – Aux	1 – 150.0	8 – 122.0
2 – ANAPA – VITYAZEVO	2 – 121.0	15 – 123.0
3 – BATUMI	3 – 131.0	0 – 124.0
4 – BESLAN	4 – 141.0	9 – 124.0
5 – GELENDZIK	5 – 126.0	11 – 125.0
6 – GUDAUTA – BAMBORA	6 – 130.0	5 – 126.0
7 – KOBULETI	7 – 133.0	17 – 127.0
8 – KRASNODAR – CENTER	8 – 122.0	18 – 129.0
9 – KRYMSK	9 – 124.0	6 – 130.0
10 – KUTAISI – KOPITNARI	10 – 134.0	3 – 131.0
11 – MAYKOP – KHANSKAYA	11 – 125.0	16 – 132.0
12 – MINERALNYE VODY	12 – 135.0	7 – 133.0
13 – MOZDOK	13 – 137.0	10 – 134.0
14 – NALCHIK	14 – 136.0	12 – 135.0
15 – NOVOROSSIYSK	15 – 123.0	14 – 136.0
16 – SENAKI – KOLKHI	16 – 132.0	13 – 137.0
17 – SOCHI – ADLER	17 – 127.0	19 – 138.0
18 – SUKHUMI – BABUSHARA	18 – 129.0	4 – 141.0
19 – TBILISI – LOCHINI	19 – 138.0	1 – 150.0

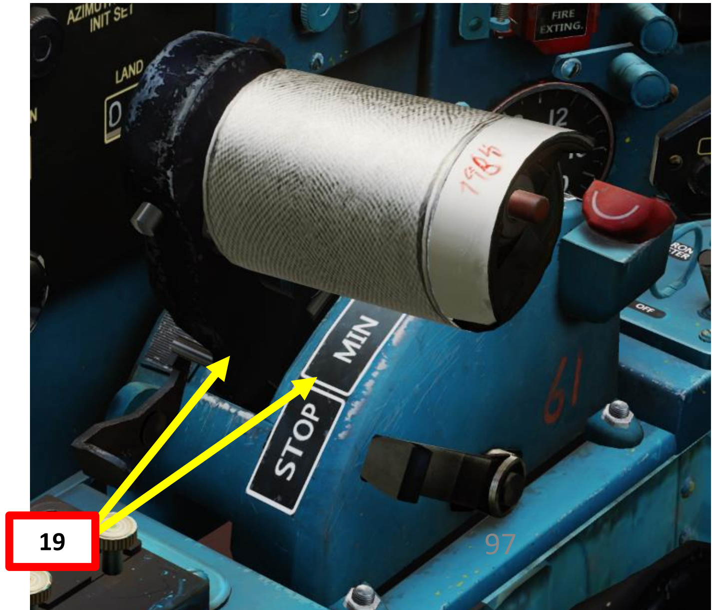
14a
Channel 16

B – ENGINE START

16. Set Fire Extinguisher Switch – ON (UP). This will close the circuit breaker of the fire extinguisher system.
17. Set Engine Starting Unit (APU) Switch - ON (UP). This will close the circuit breaker of the Electrical Starter/Generator Motor of the engine.
18. Unlock throttle by clicking on Engine Stop/Lock lever.
19. Move throttle to **MIN** position
20. [P] Set Starter Mode Switch – NORMAL (UP)
21. Press and hold Engine Starter Button for at least 4 seconds.
22. When engine start-up sequence is active, the “ENGINE START” advisory light illuminates.

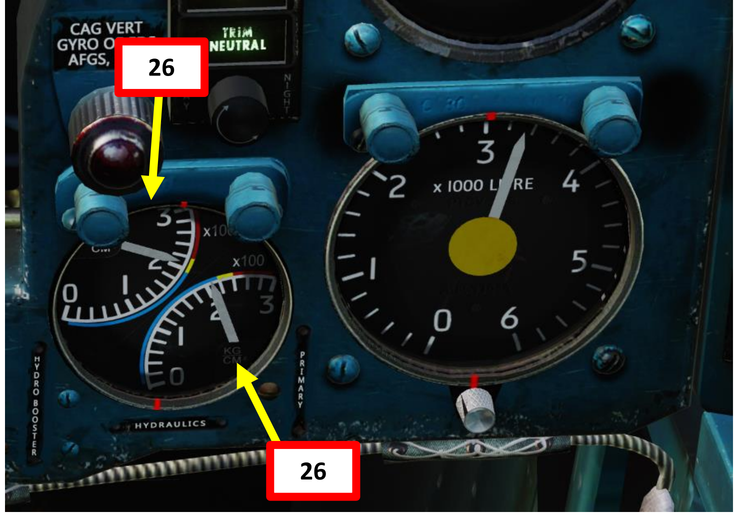


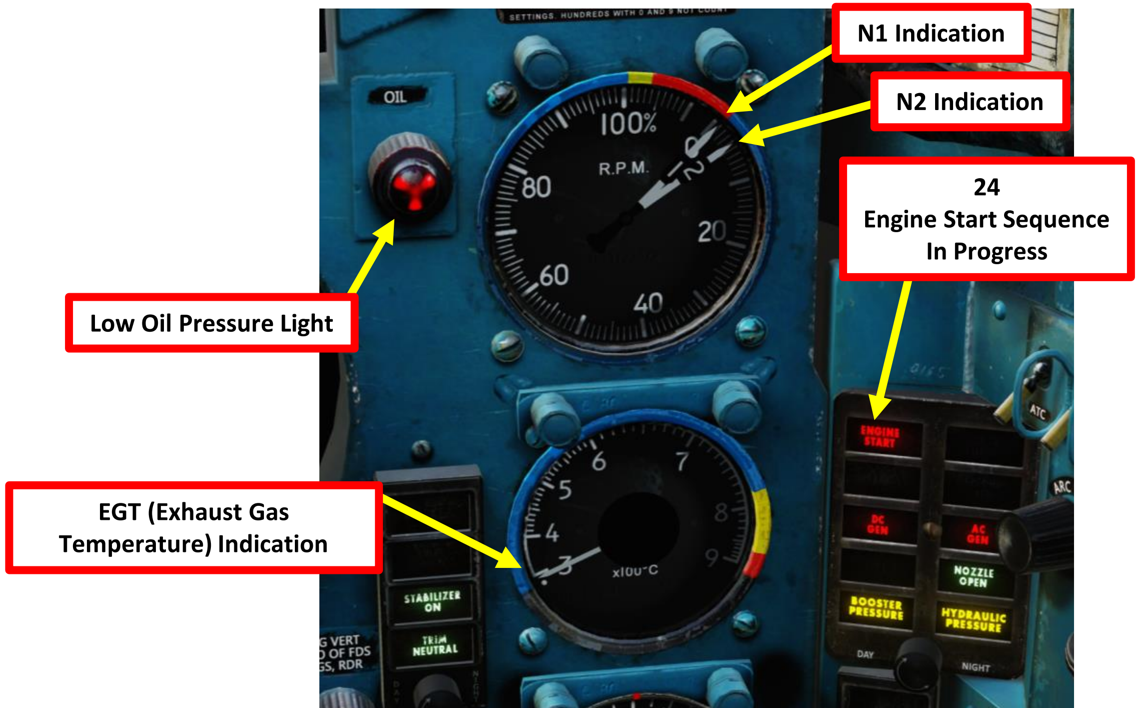


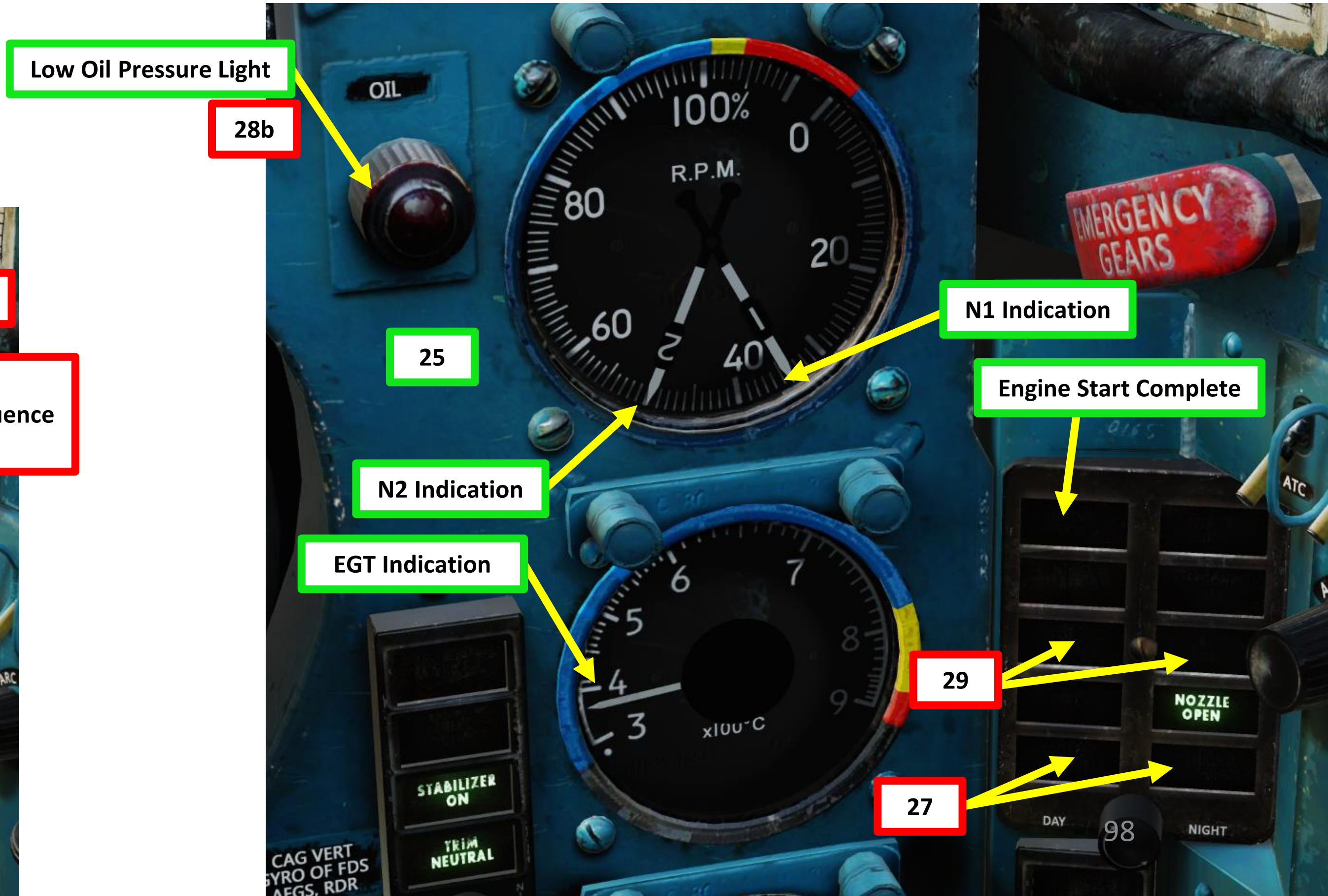


B – ENGINE START

23. Once engine RPM starts to increase, move throttle half an inch forward of the MIN detent.
24. During normal conditions, the engine idle state is reached within approx. 45 seconds.
    - If EGT (Exhaust Gas Temperature) exceeds 700 °C, oil pressure fails to rise, no engine instrument indications appear, or if an engine fire or unusual vibration occurs, abort the start by moving the throttle back to the shut-off position (click on the Engine Stop/Lock Lever).
25. Wait until Engine start sequence is complete. IDLE RPM is reached when:
    - N1 (Low-Pressure Compressor Speed) has reached 35 % RPM
    - N2 (High-Pressure Turbine Speed) has reached 50 % RPM
    - “ENGINE START” advisory light extinguishes
26. Confirm that hydraulic pressure increases to 170 km/cm² or higher.
27. Confirm that “BOOSTER PRESSURE” and “HYDRAULIC PRESSURE” warning lights extinguish.
28. Confirm that engine oil pressure increases above 1 kg/cm² at IDLE setting.
    - Low Oil Pressure Warning light should be extinguished above 1 kg/cm².
29. Confirm that DC GEN and AC GEN Warning lights extinguish.

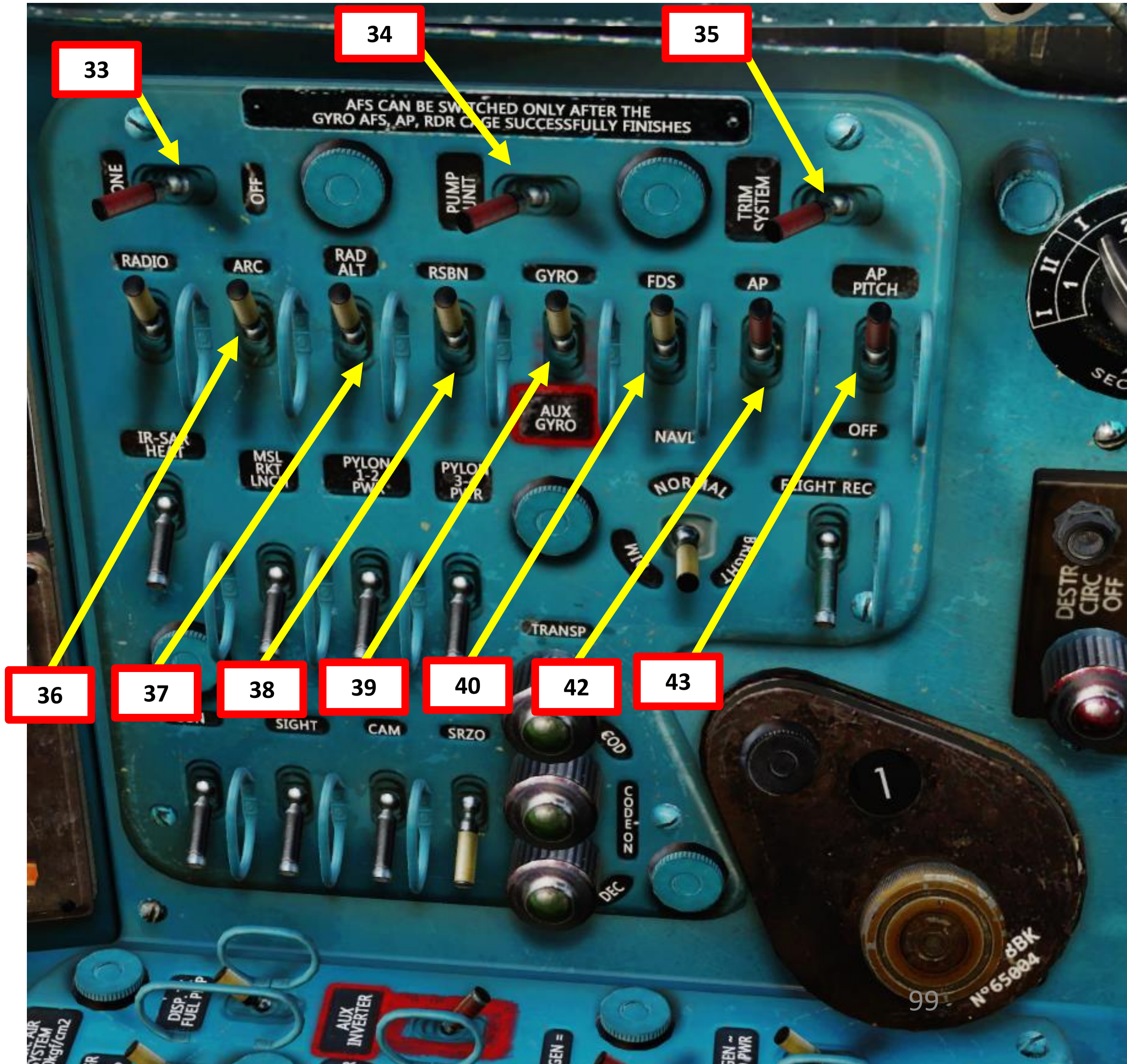


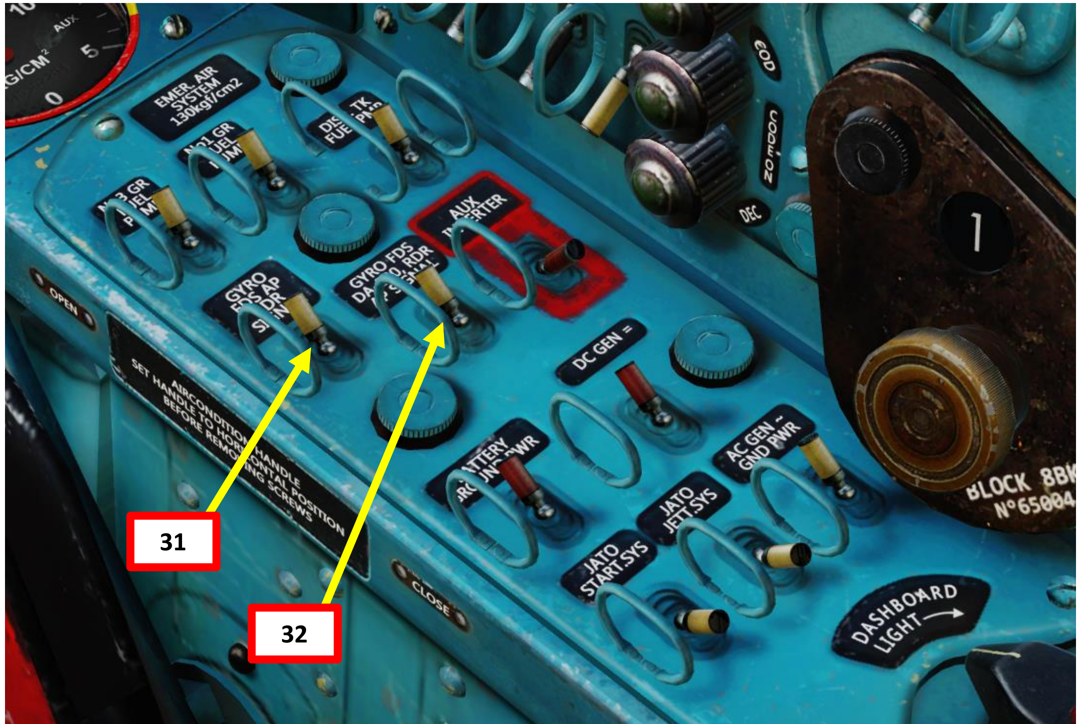




C – POST-START

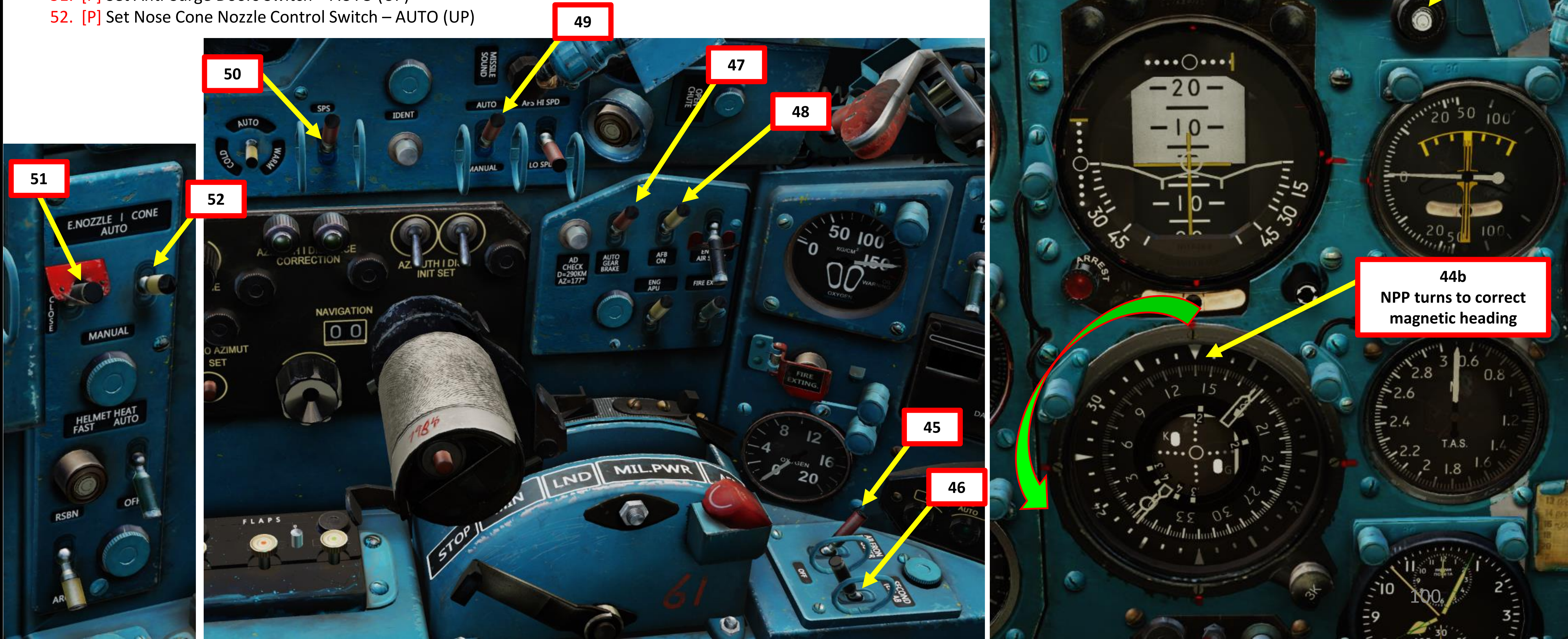
30. Confirm that "ENGINE START" advisory light is extinguished before performing the following steps. **Powering on these systems while the start sequence is running may interrupt it by overloading the electrical system.**
31. Set Gyro #1 (NPP, SAU Autopilot, Radar, & KPP) Switch – ON (FWD)
32. Set Gyro #2 (DA-200 Combined Indicator, NPP, SAU & Radar) Switch – ON (FWD)
33. Set Nose Cone Power Switch – ON (FWD)
34. Set Auxiliary Hydraulic Pump Power Switch – ON (FWD)
35. Set Trim System Power Switch – ON (FWD)
36. Set ARC (Automatic Radio Compass) Power Switch – ON (UP)
37. Set Radar Altimeter Power Switch – ON (UP)
38. Set RSBN Navigation Power Switch – ON (UP)
39. Set KPP/Gyro (AGD Artificial Horizon) Main/Auxiliary Switch – MAIN (UP)
40. Set NPP/FDS (Course Indicator System/Flight Directional System) Power Switch – ON (UP)
41. As KPP (Artificial Horizon) and NPP (Course Indicator System) gyros start spinning, the KPP and NPP indications start self-aligning.
42. Set Autopilot Power Switch – ON (UP)
43. Set Autopilot Pitch Power Switch – ON (UP)





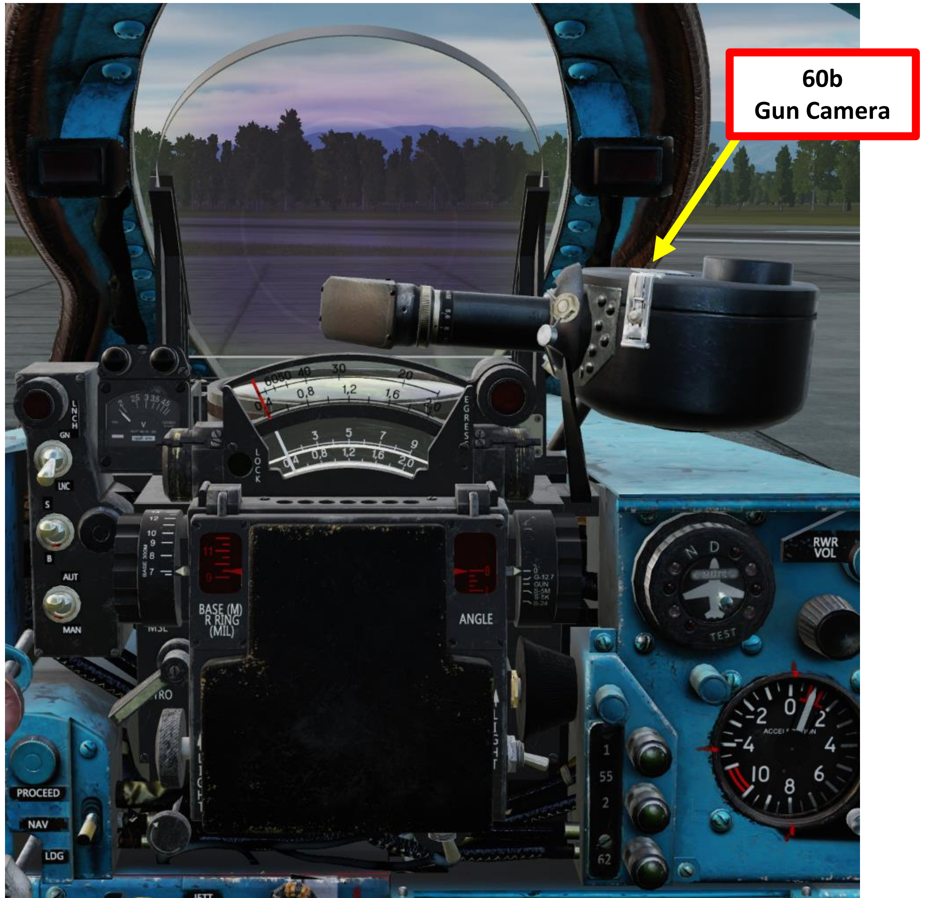
C – POST-START

44. Press and hold the FDS (Flight Directional System) Adjustment Button for approx. 5 seconds. This will provide magnetic course correction to the NPP (Course Indicator System), which will turn and eventually align with the correct magnetic heading.
45. [P] Set Aileron Booster Power Switch – ON (FWD)
46. [P] Set Second-Stage Emergency Afterburner Switch – OFF (AFT)
47. [P] Set Auto Gear Brake Switch – ON (UP)
48. [P] Set Afterburner Circuit Breaker Switch – ON (UP)
49. [P] Set ARU-3 (Horizontal Tail Movement Control System) Mode Selector Switch – AUTO (UP)
50. [P] Set SPS (Flaps Boundary Layer Control System) Mode Selector Switch – AUTO (UP)
51. [P] Set Anti-Surge Doors Switch – AUTO (UP)
52. [P] Set Nose Cone Nozzle Control Switch – AUTO (UP)



C – POST-START

53. Set IR-SARH Missiles Heating Power Switch – ON (UP)
54. Set IR-SARH Missiles Master Arm Switch – OFF (DOWN)
55. Set Pylon 1-2 Power Switch – ON (UP)
56. Set Pylon 3-4 Power Switch – ON (UP)
57. Optional: Set SARPP-12 Flight Data Recorder Switch – ON (UP)
58. Set GSh-23 Gun Power Switch – ON (UP)
59. Set ASP-PFD Optical Sight Power Switch – ON (UP)
60. Set Gun Camera Power Switch – ON (UP).
    - This will also install the gun camera next to the optical sight.
61. Set SRZO-2 IFF (Identify-Friend-or-Foe) Power Switch – ON (UP)
62. Set SRZO-2 IFF Code – As required by the mission briefing.
    - If no code is mentioned in the briefing, set code to 1.

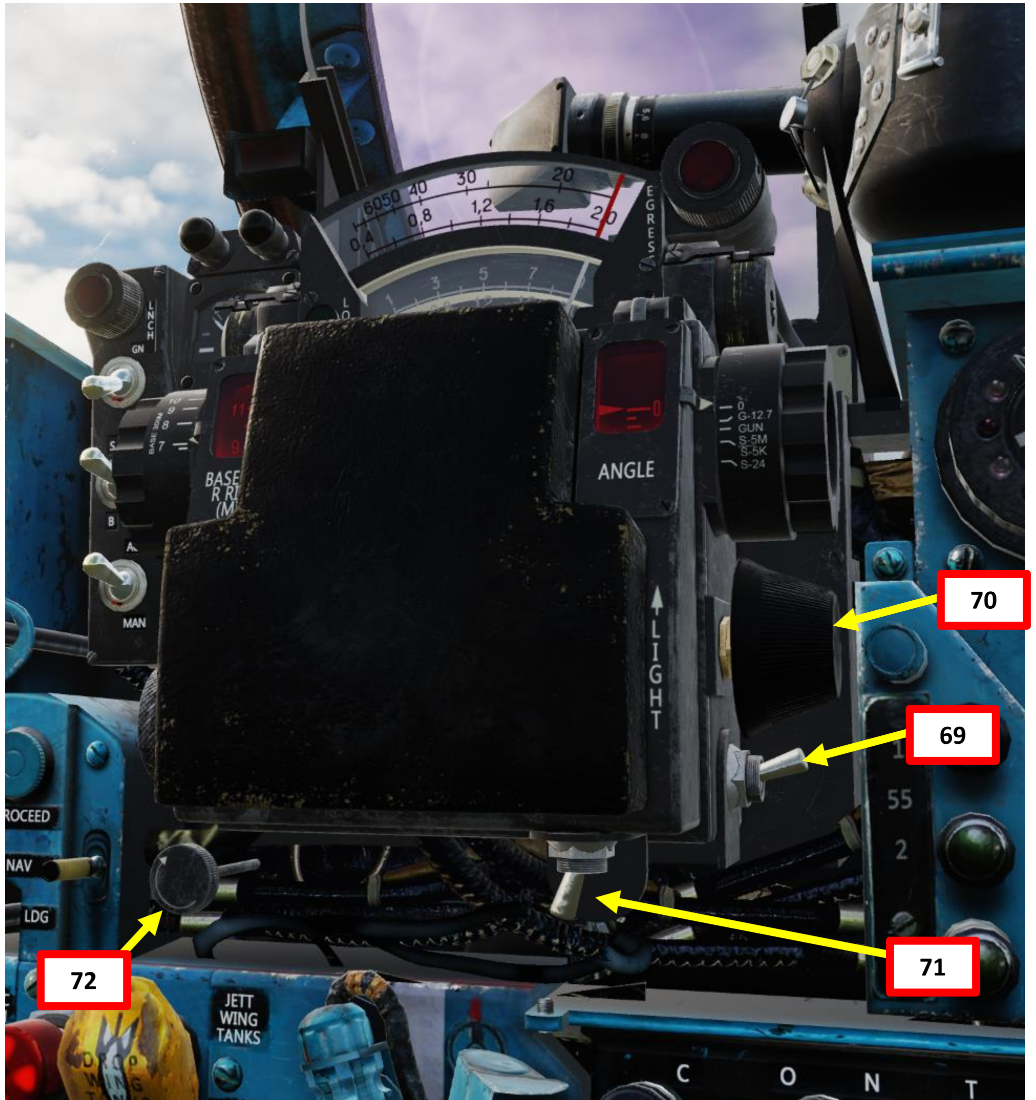


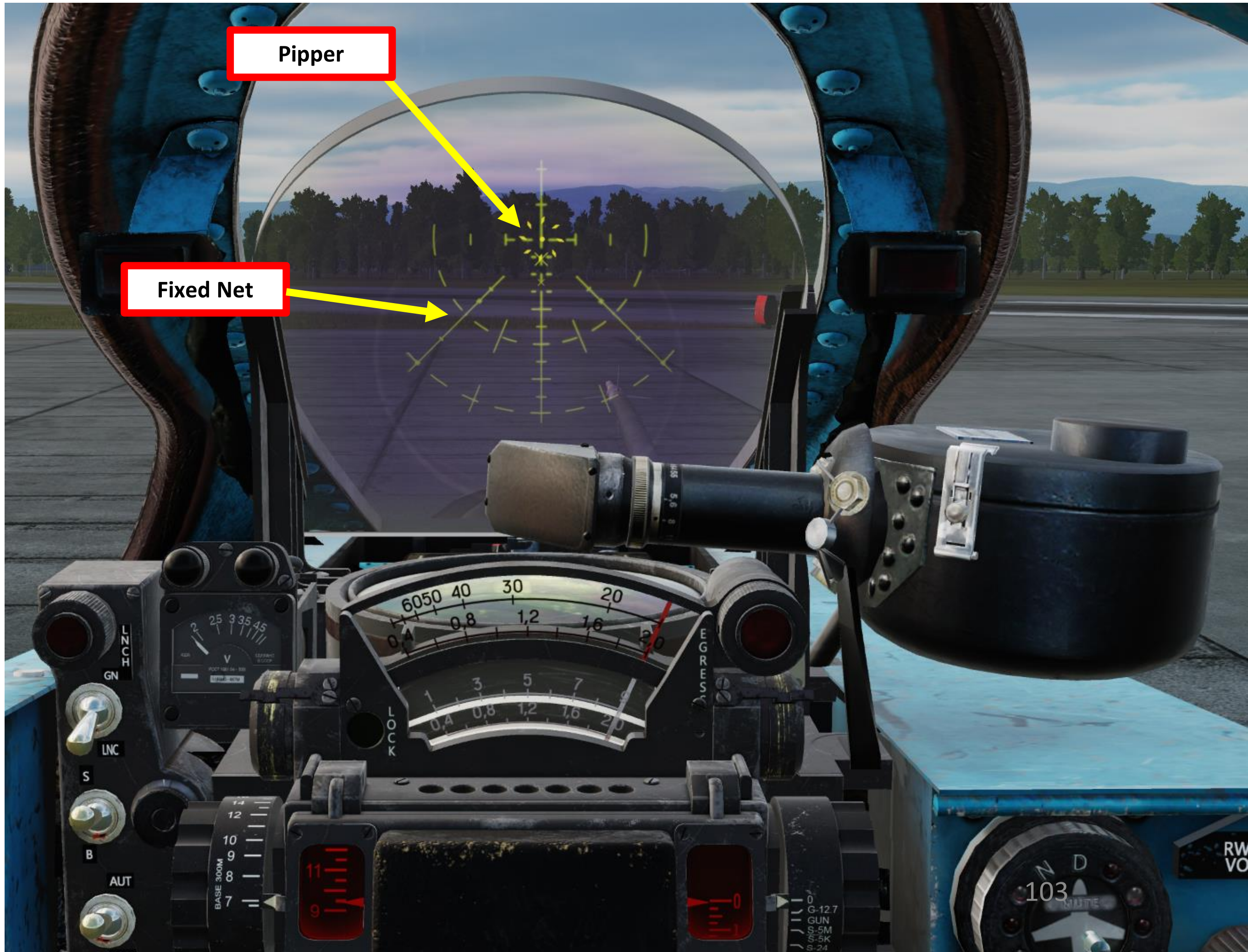
C – POST-START

63. Set SOD-57 Aircraft Distance ATC Transponder Power Switch – ON (UP)
64. Set SOD-57 Aircraft Distance ATC Transponder Channel Selector – As Specified in Mission Briefing or as requested by air traffic controller.
    - If no particular Channel (Wave) is mentioned, leave switch as is.
65. Set Type 81 IFF Transponder Switch – ON (UP)
66. Set SPO-10 Radar Illumination Warning (Radar Warning Receiver, RWR) System Power Switch – ON (UP)
67. Set Radar Main Mode Selector Switch – STANDBY (MIDDLE). This will perform a 5-minute warm-up of the radar system.
68. [P] Set Fuel Quantity if required. The ground crew should already have it set up to the correct quantity by default.
    - With no external fuel tanks (100 % fuel): **2850** Liters
    - With 490 L centerline tank: **3340** Liters
    - With 490 L centerline tank + 2 x 490 Liters wing tanks: **4320** Liters
    - With 800 L centerline tank: **3650** Liters
    - With 800 L centerline tank + 2 x 490 L wing tanks: **4630** Liters

C – POST-START

69. Set Pipper Switch – ON (UP)
70. Adjust Pipper Brightness – As Required
71. Set ASP Optical Sight Fixed Net Switch – ON (LEFT)
72. Adjust Fixed Net Brightness – As Required



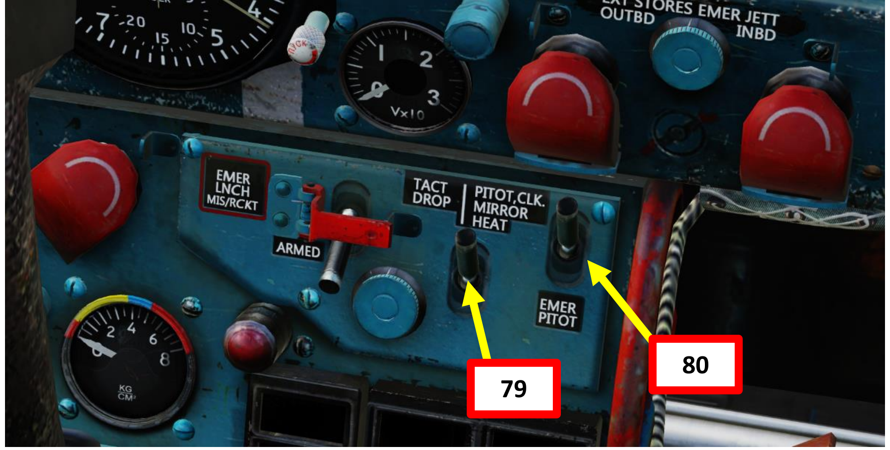


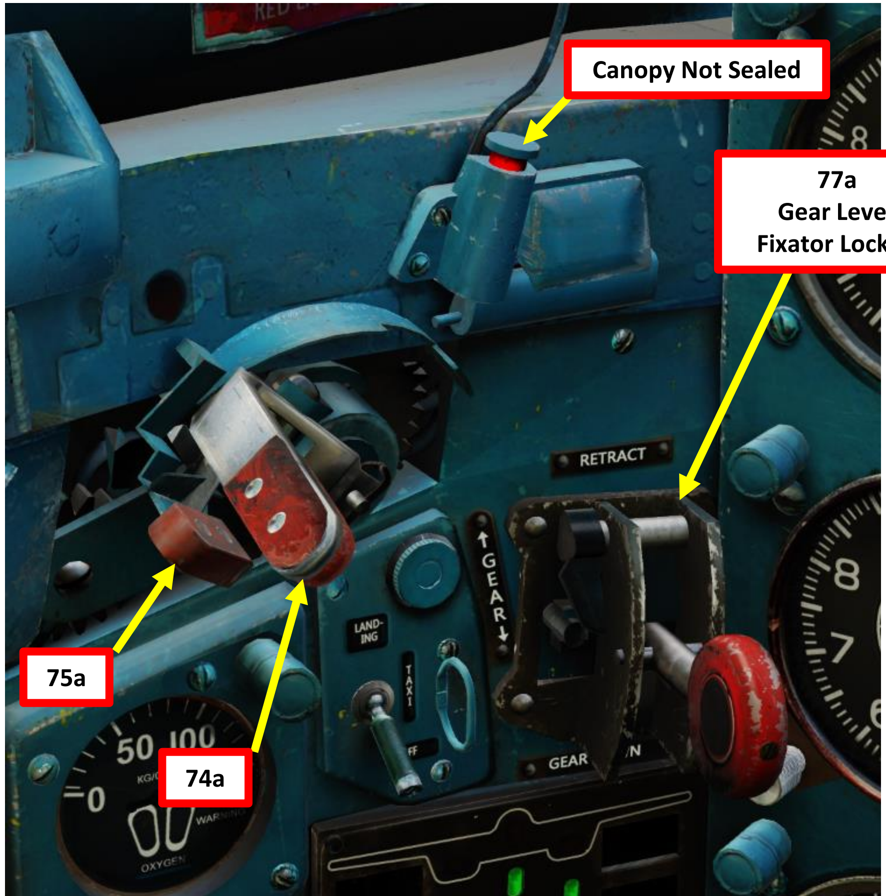
C – POST-START

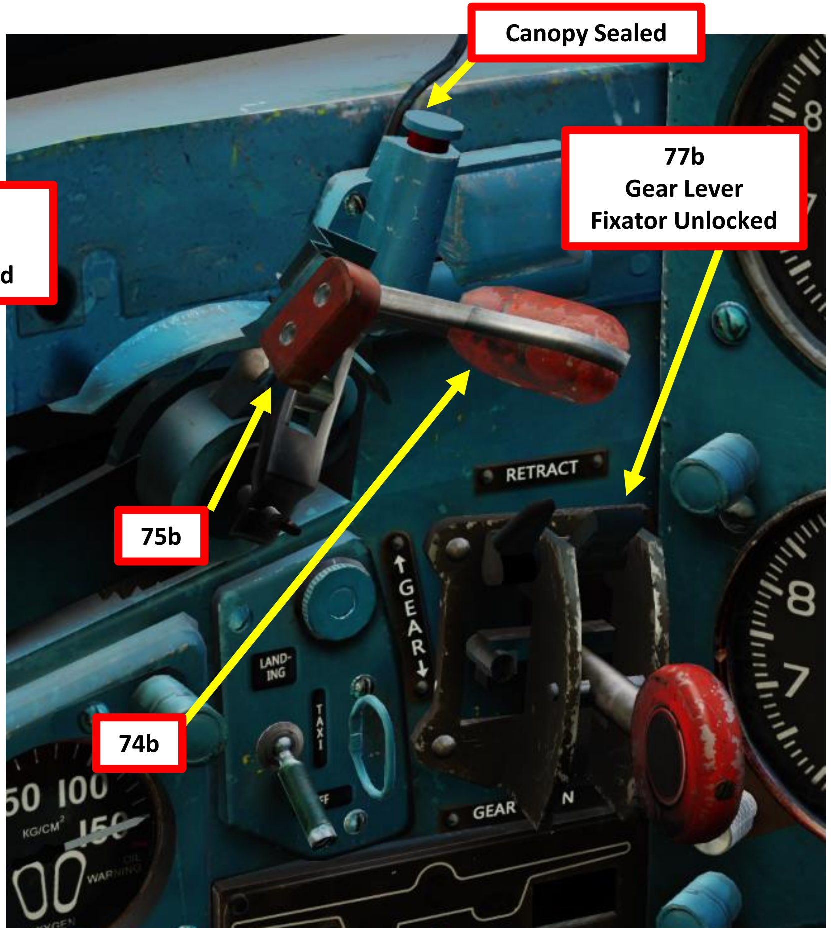
73. Close Canopy

C – POST-START

74. Set Canopy Locking Lever – LOCKED (FWD)
75. Set Canopy Sealing Lever – SEAL (FWD)
76. Once Canopy is locked and sealed (pressurized), the SORC (Master Caution) light should extinguish.
77. Set Landing Gear Lever Fixator/Lock – UNLOCKED (UP)
78. Set Pitot Tube Selector Handle – Main Pitot (Long side of the handle RIGHT)
79. Set Main Pitot, Clock & Mirror Heat Switch – ON (UP)
80. Set Emergency (Standby) Pitot Heat Switch – ON (UP)
81. If ground power is connected, request ground crew to disconnect ground power.





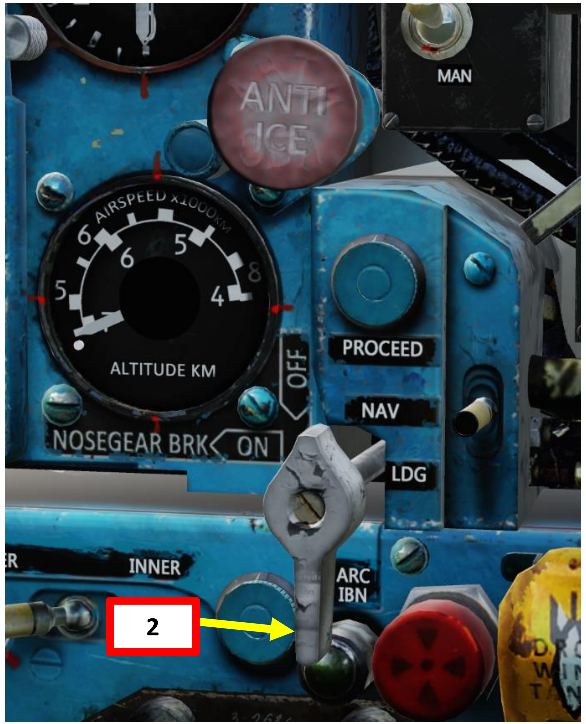


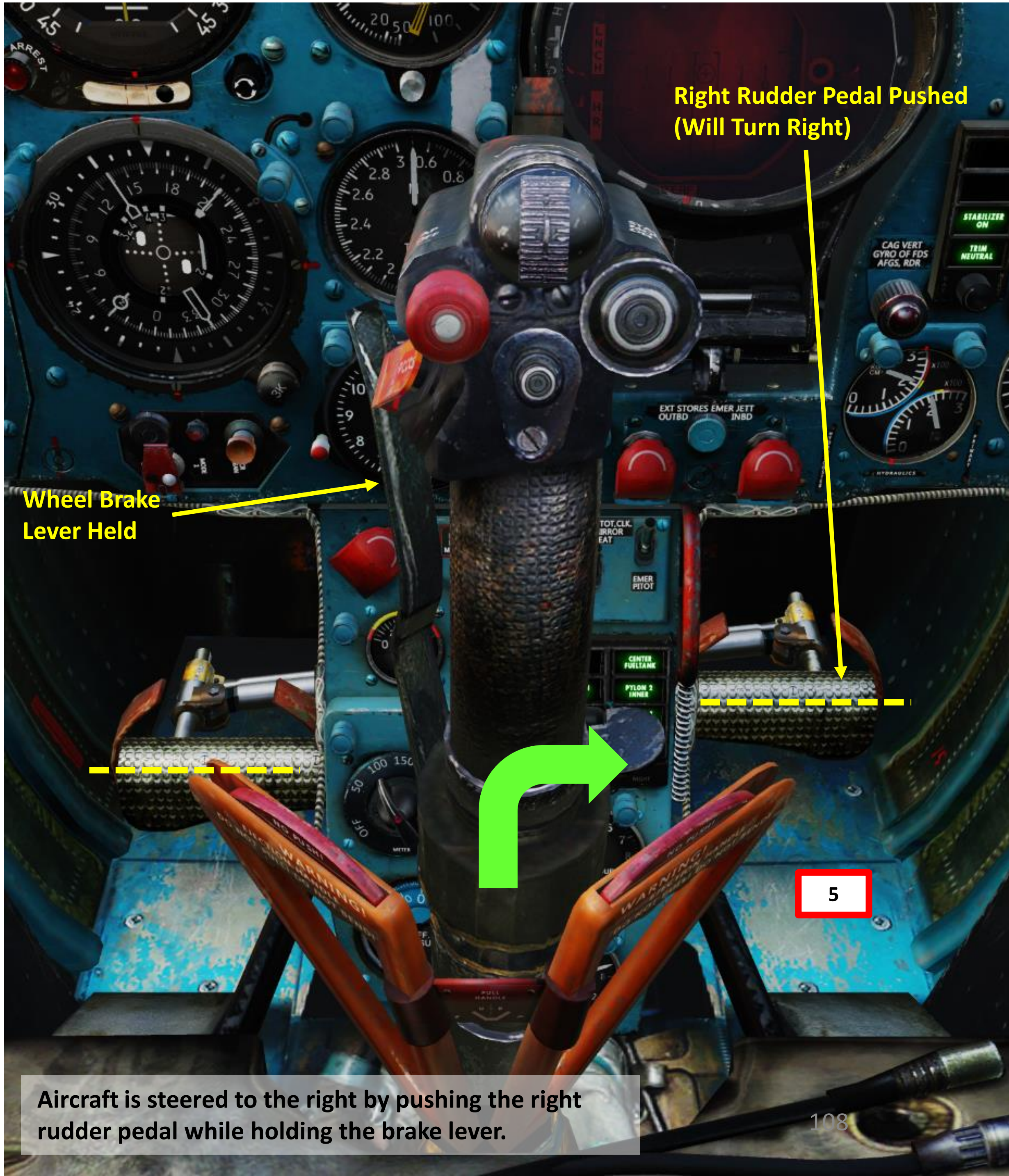
C – POST-START

82. You may now contact the tower and start taxiing once you receive clearance.

TAXI

1. Set Landing/Taxi Light Switch – Taxi (MIDDLE)
2. Set Nosewheel Brake Control Lever – OFF (Vertical)
3. Check that you have sufficient air pressure (above 10 kg/cm²) on the Main Air Pressure Gauge. This is essential for effective brake operation.
4. Increase throttle to start taxiing.
5. Turn by holding the Wheel Brake lever and using the rudder pedals to steer the aircraft. As an example, you can steer right by holding the brake lever while pushing the right rudder pedal.





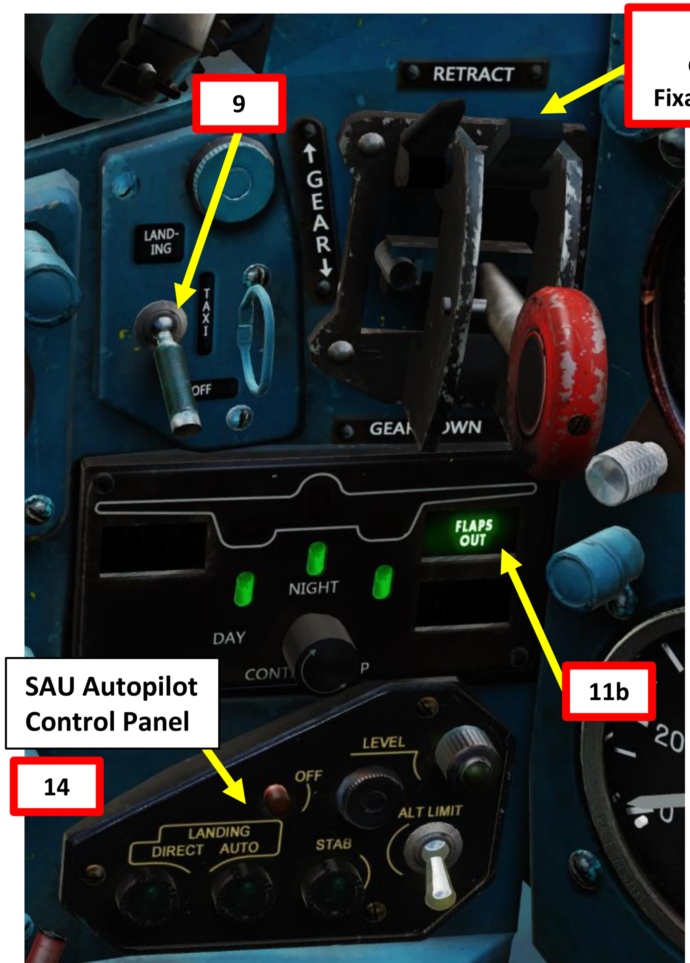
Aircraft is steered to the right by pushing the right rudder pedal while holding the brake lever.

TAXI

6. If taxiing straight, throttle up to 80 % RPM N1 (“1” needle on the engine tachometer) and allow aircraft to gather 40-60 km/h airspeed, then decrease power to maintain that speed (65 % RPM N1). At this speed, you will be able to use the rudder to maintain direction, so you’ll avoid wasting compressed air when braking to maintain direction.
7. If making turns, decelerate to 15-20 km/h and use rudder controls and brakes to turn the aircraft.

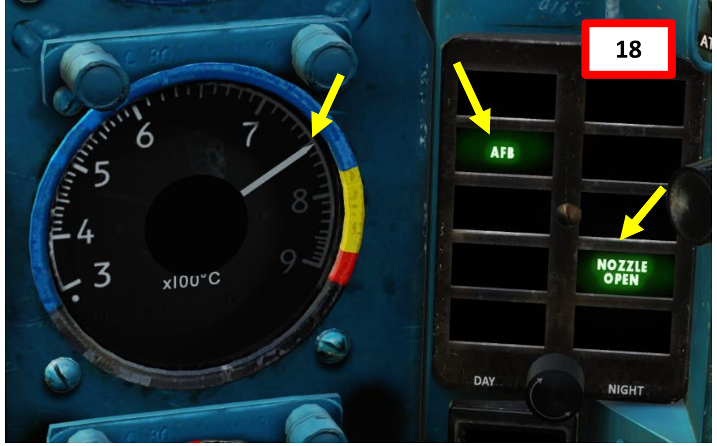
TAKEOFF

8. Line up on the runway.
9. Set Landing/Taxi Light Switch – OFF (DOWN)
10. Set Navigation Lights Selector – BRIGHT (As Required)
11. Set Flaps – Takeoff Position (25 deg). Confirm that FLAPS OUT light illuminates.
12. Set Elevator Trim to NEUTRAL. Confirm that “TRIM NEUTRAL” light illuminates.
13. Set Nosewheel Brake Control Lever – ON (Horizontal). This will maximize your braking capability in case of a rejected takeoff.
14. Verify that no Autopilot Modes are selected on the SAU Control Panel; all lights should be OFF/extinguished. If any mode is engaged, press the “SAU Autopilot Disengage” Button on the stick.
15. Verify that Landing Gear Lever Fixator/Lock is UNLOCKED (UP)



TAKEOFF

16. Hold brakes.
17. Throttle up to Max Power (AFB, Afterburner zone).
18. Confirm that AFB and NOZZLE OPEN lights illuminate, then release brakes.
19. Let the aircraft accelerate, and steer the aircraft using the rudder. Do not use brakes to steer.
20. When aircraft airspeed reaches 250 km/h, pull aft on the stick to lift the aircraft's nose to an angle of 4-5 deg on the KPP (Artificial Horizon) or 10 deg of Angle of Attack (UUA).
21. Rotate aircraft at around 250-300 km/h.
22. Takeoff should occur around 350-360 km/h. During an average day, takeoff run without external loads should take about 15 to 17 seconds.

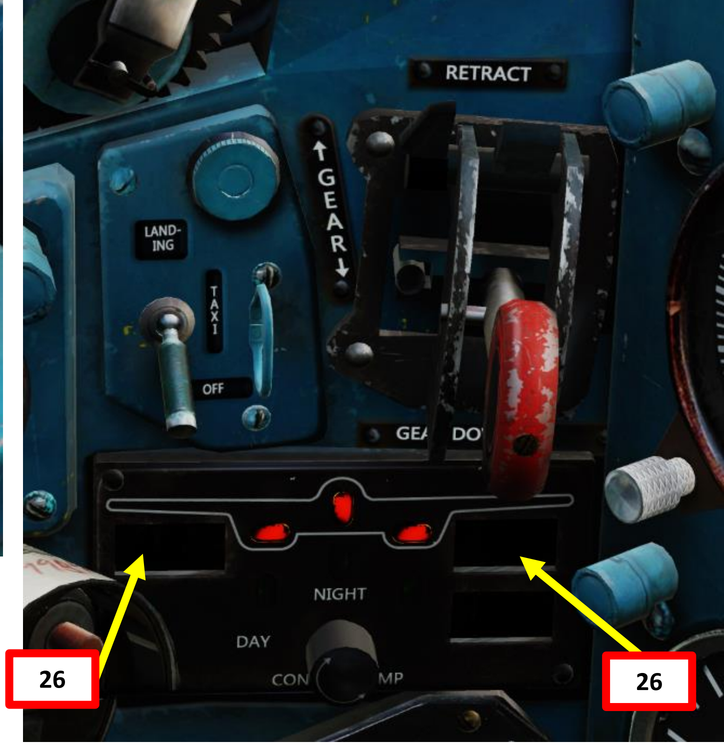


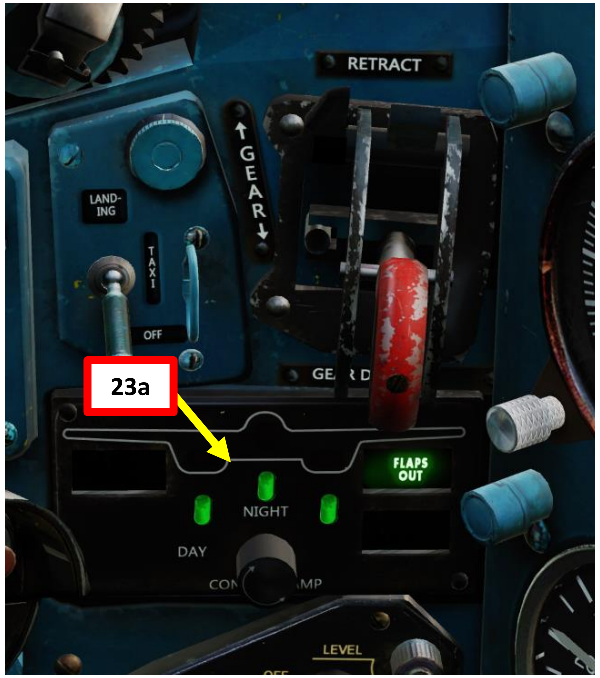
20
KPP (Artificial Horizon)

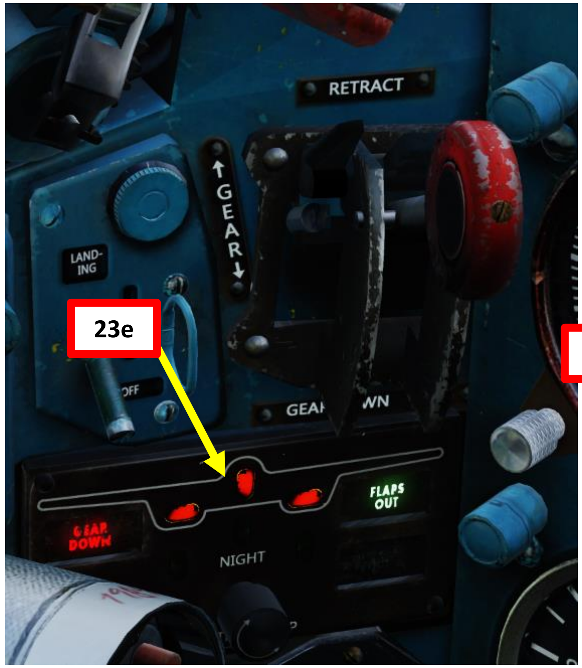
20
UUA (Angle of Attack)

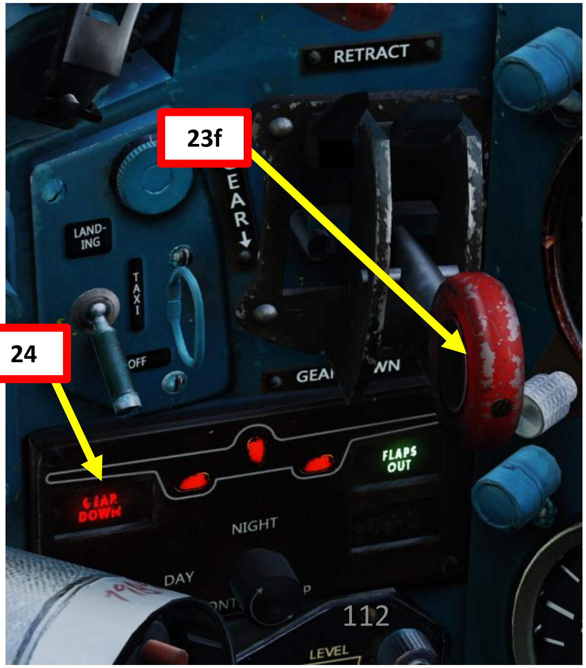
TAKEOFF

23. When climbing above 10 m, retract landing gear.
    a) Green gear status lights indicate the landing gear is down & locked
    b) Set Landing Gear Lever – UP (Retract)
    c) While Landing gear lever is in the UP position, the wheel brakes will apply pressure to stop the wheels from spinning. Air pressure is consumed throughout the process.
    d) While landing gear is in transition, gear status lights extinguish
    e) When landing gear is fully retracted, gear status lights turn red.
    f) Set Landing Gear Lever – MIDDLE (Neutral)
24. GEAR DOWN warning light illuminates when the landing gear is retracted and the flaps are still deployed
25. When climbing above 100 m, set Flaps – UP Position.
26. Confirm that FLAPS OUT light and GEAR DOWN warning light extinguish









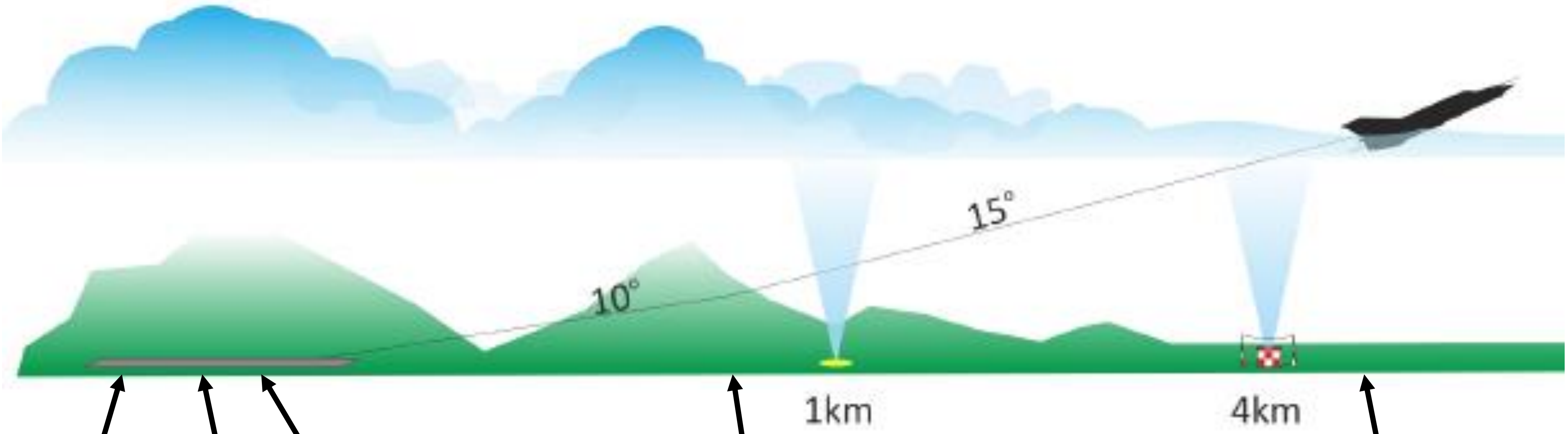
TAKEOFF

TAKEOFF

27. Maintain an initial climb at 360-380 km/h and 15 deg.
28. Keep a minimum altitude of 600 m above ground (check radar altimeter) and maintain a minimum speed of 600 km/h.
29. Throttle back to 95 % N1 to disengage afterburner.

TAKEOFF

Here is a brief summary of the takeoff procedure.



A – Takeoff Run. Flaps 25 deg, full afterburner.

B – Rotate. Nose up to 4-5 deg pitch at 250-300 km/h.

C – Takeoff. Airspeed 360-380 km/h, initial climb at 10 deg pitch. Retract gears above 10 m above ground level.

D – Altitude 100 m, flaps in, climb 15 deg pitch.

E – Minimum altitude 600 m, minimum airspeed 600 km/h, afterburner OFF, adjust power and climb.

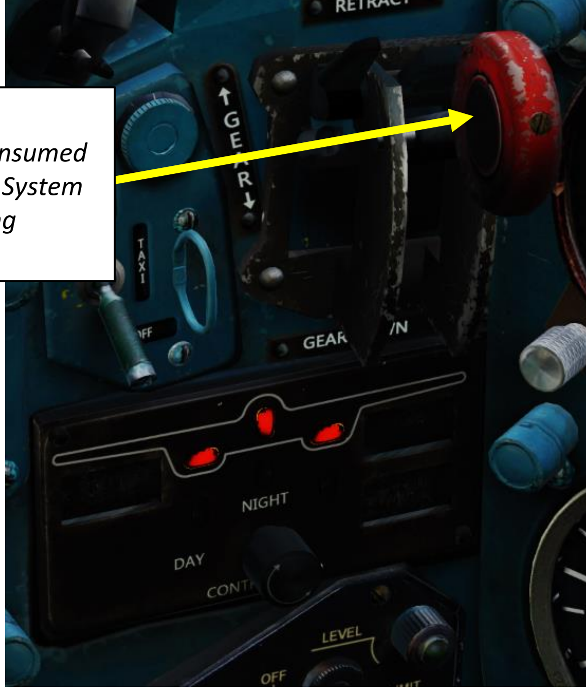
IMPORTANT NOTES

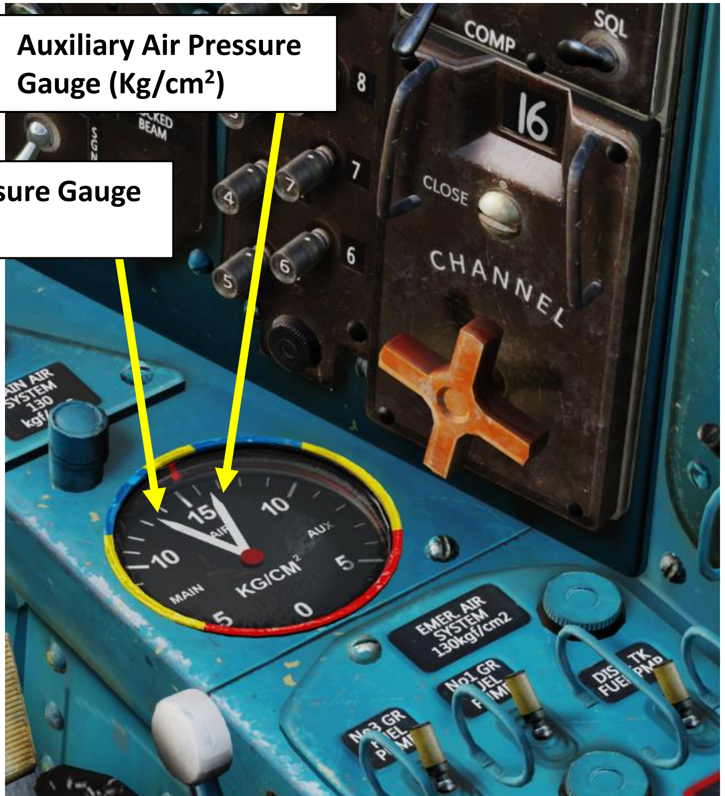
Make sure to rotate before 300 km/h or you may end up bursting your tyres!

IMPORTANT NOTES

It is **MANDATORY** to set the Landing Gear lever back to NEUTRAL (Middle) position once the landing gears are retracted. The landing gear retracts or deploys with hydraulic pressure, but the Automatic Gears Braking System consumes pneumatic (air) pressure. This Braking System automatically brakes the gears rotation when the gears start to retract.

When the landing gear lever is UP, the Automatic Gears Braking System is engaged and will consume air pressure from the Main Pneumatic system **for as long as the lever is UP**. If you forget to set it back to NEUTRAL to disengage the Braking System, you will consume all your available pneumatic pressure in a matter of minutes. This means: no more brakes on landing since they use pneumatic pressure. Pneumatic pressure also controls the drag chute nacelle doors.

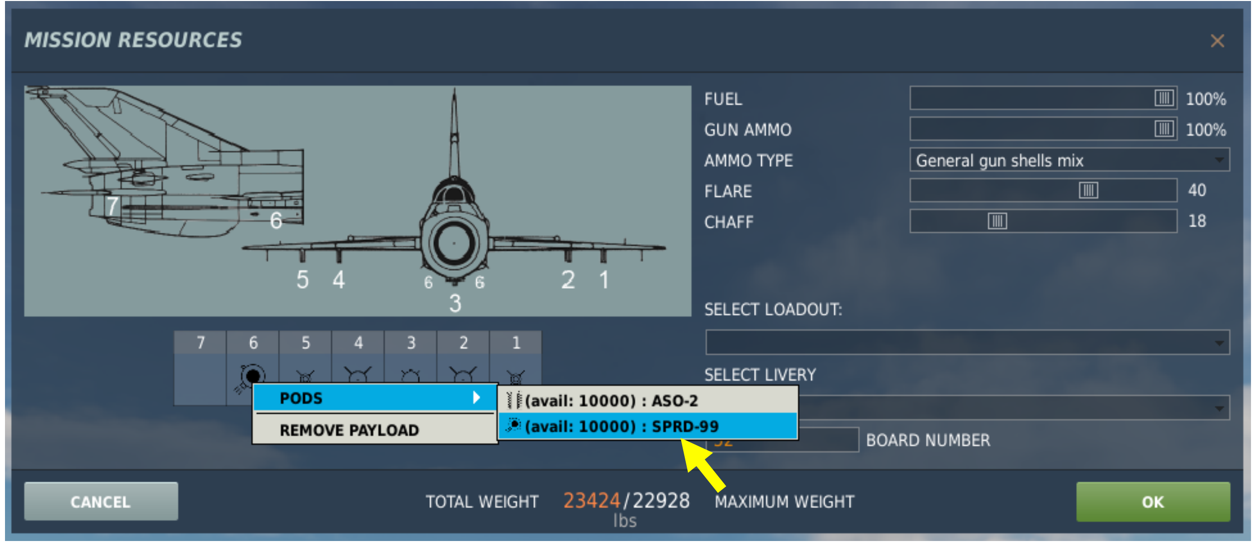


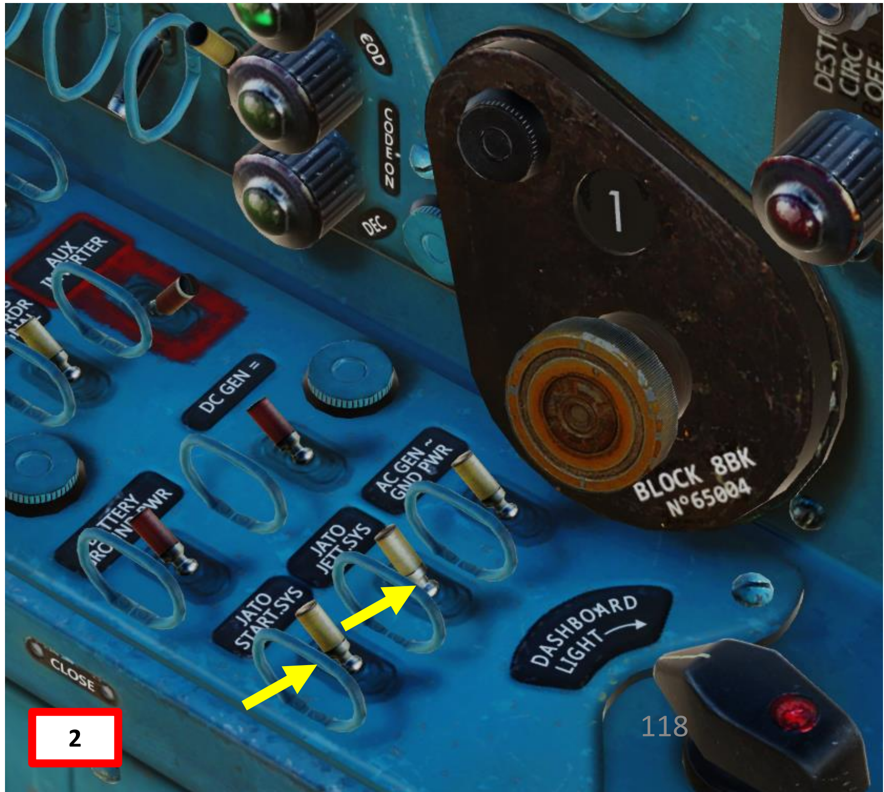


SPRD JET-ASSISTED TAKEOFF (JATO)

JATO is a type of assisted take-off for helping overloaded aircraft into the air by providing additional thrust in the form of small rockets. The term JATO is used interchangeably with the (more specific) term RATO, for *rocket-assisted takeoff*. JATO can be used on short runways at high altitude or with heavy loadouts.

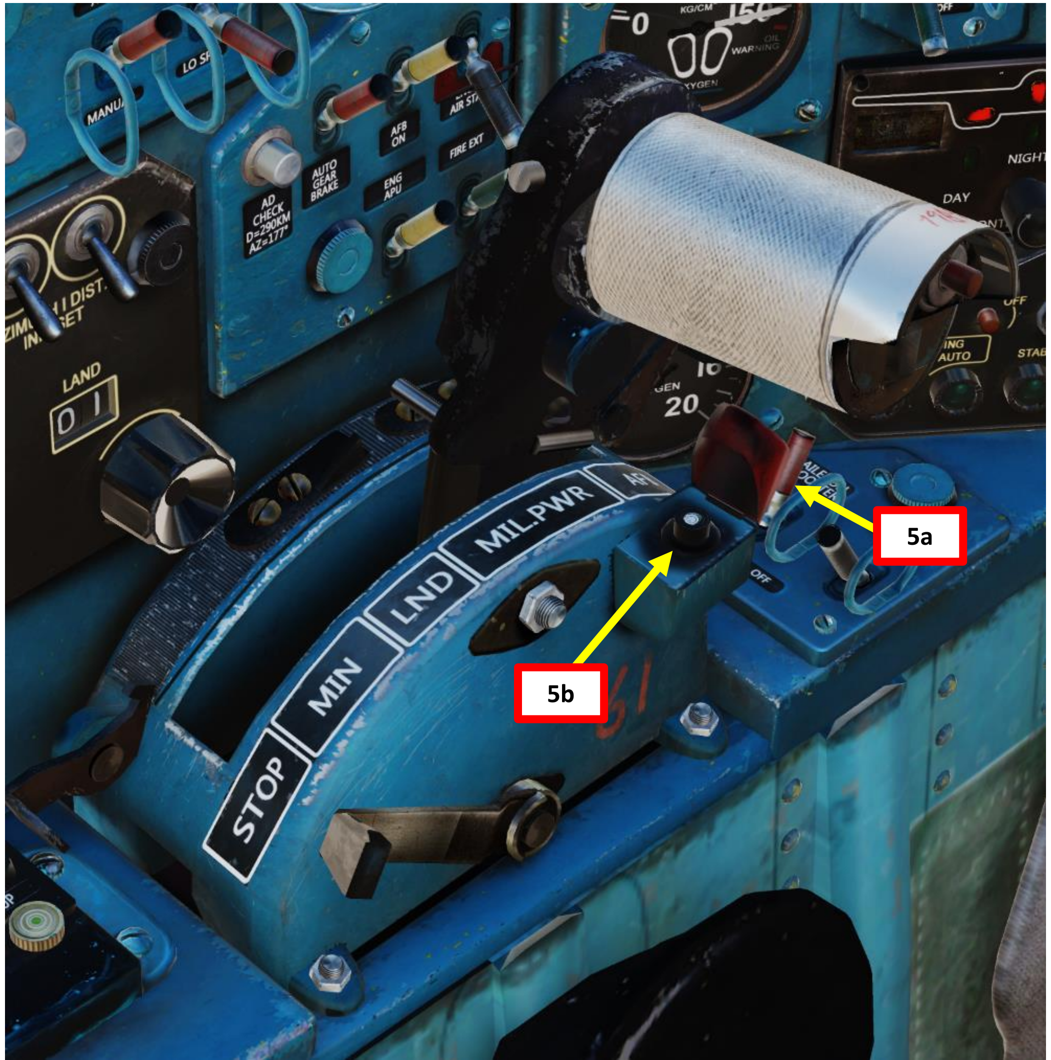
1. Equip SPRD-99 rockets on pylon 6 (this is usually where you have your ASO-2 countermeasure pod for your chaff and flares) and do the same start-up procedure we did previously.
2. When you are lined up on the runway, make sure JATO (SPRD) START & JETTISON switches are set to ON (FWD).
3. Throttle up to full power (with full afterburner).
4. When you reach 120-150 km/h, the rockets will ignite automatically and give you a significant thrust increase during 7 seconds.





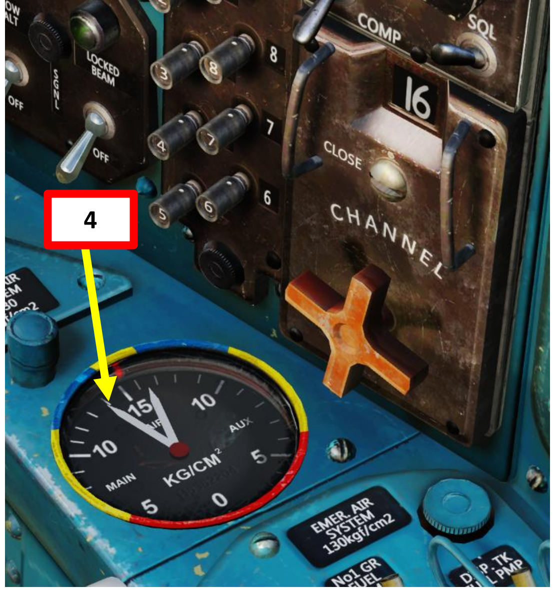
SPRD JET-ASSISTED TAKEOFF (JATO)

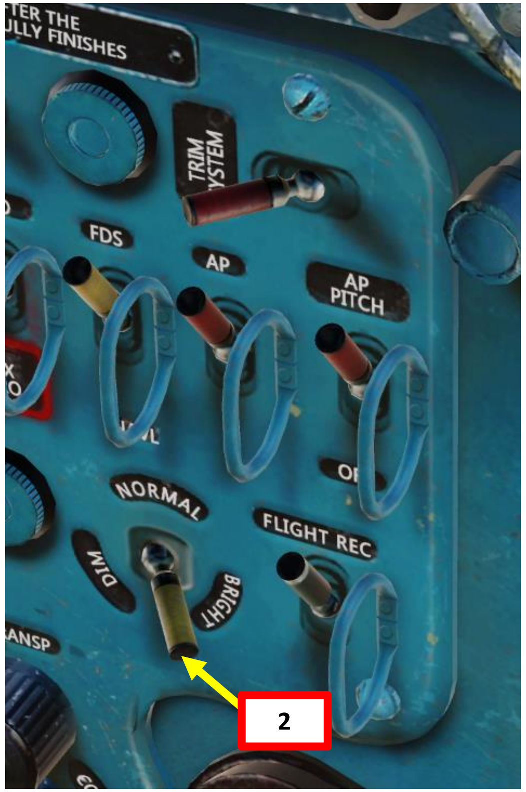
5. When you are up, you can jettison the rockets by flipping up the red countermeasure switch cover and hold the countermeasure switch during 1 second.
6. Raise landing gear and flaps as seen previously in normal takeoff procedure.
7. You may now buy a pair of new underwear.



VISUAL APPROACH

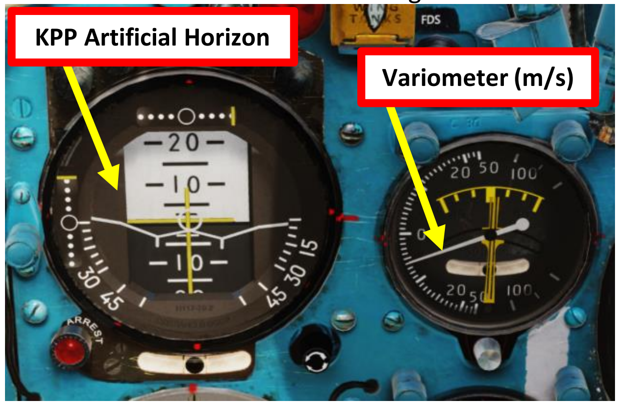
1. Set Landing/Taxi Light Switch – Landing (UP)
2. Set Navigation Lights Selector – BRIGHT (As Required)
3. Set Nosewheel Brake Control Lever – ON (Horizontal). This will maximize your braking capability for landing if you have a short runway.
4. Check that you have sufficient air pressure (above 10 kg/cm^2) on the Main Air Pressure Gauge. This is essential for effective brake operation.
5. Start your descent towards the airbase by maintaining 600-700 km/h with a 10 m/s descent rate
6. If desired, engage Autopilot Stabilization Mode. This is not mandatory but it will help dampen the pitch and bank oscillations.

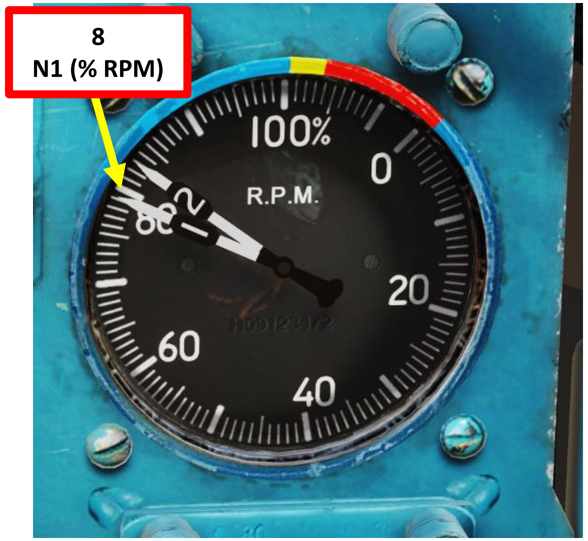


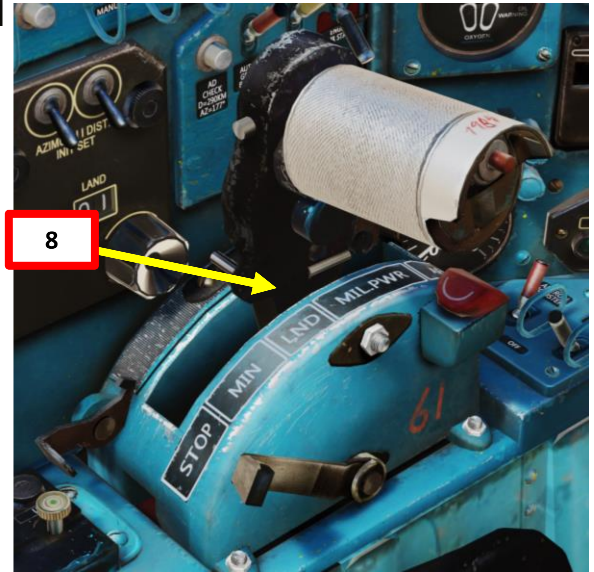


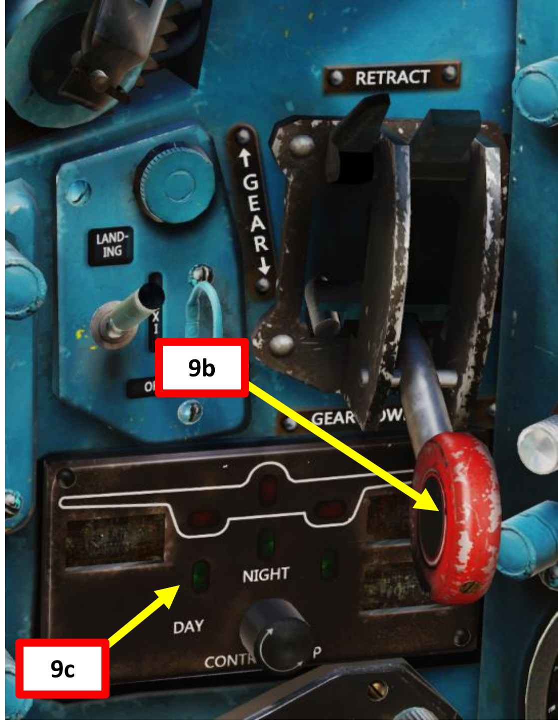
VISUAL APPROACH

7. Level off at 1000 m AGL and maintain 600 km/h.
8. Set power to 80 % N1 RPM. Throttle should be within the LND (Landing) zone.
9. Deploy landing gear at 1000 m AGL at 500 km/h.
    a) When landing gear is fully retracted, gear status lights is red.
    b) Set Landing Gear Lever – DOWN (Deploy)
    c) While landing gear is in transition, gear status lights extinguish
    d) Green gear status lights indicate the landing gear is down & locked
10. Perform descent with a descent rate between 5 and 10 m/s (check variometer). Speed can be allowed to drop below 500 km/h but not below 400 km/h.
11. When reaching 600 m AGL and airspeed is below 500 km/h, set Flaps – Takeoff Position (25 deg).
12. Confirm that FLAPS OUT light illuminates.









VISUAL APPROACH

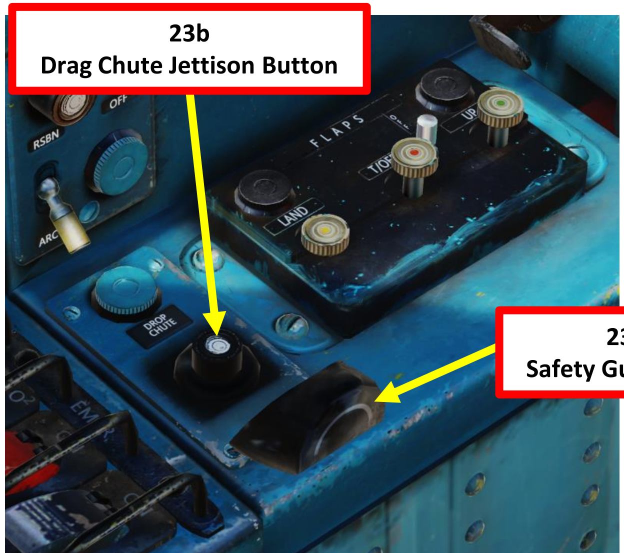
13. Maintain a descent rate of about 6 m/s and allow a further speed decrease to 380 km/h.
    - Adjust airspeed with throttle.
    - Do not use Airbrakes.
14. If the airfield is equipped with an Outer and an Inner Marker beacon, the MARKER light will illuminate and marker signal sound (a short series of « beeps ») will be audible as you overfly these markers. For russian airfields:
    - The outer marker is typically set 4 km from the runway threshold
    - The inner marker is typically set 1 km from the runway threshold
15. When reaching the Outer Marker (4 km from the runway threshold) and maintaining 300 m AGL altitude and 380 km/h airspeed, set Flaps – Landing Position (45 deg).

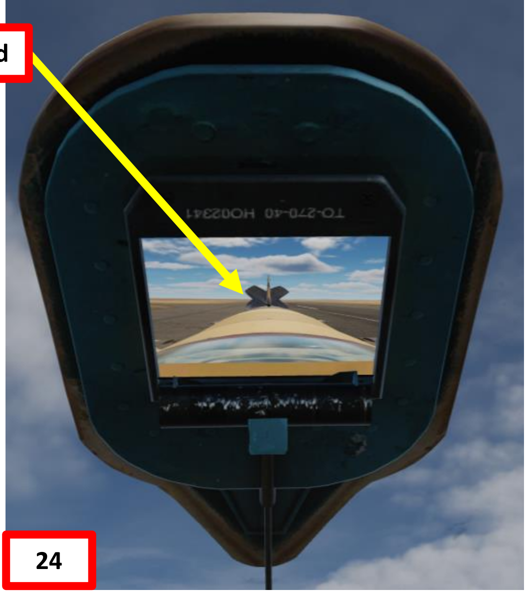
LANDING

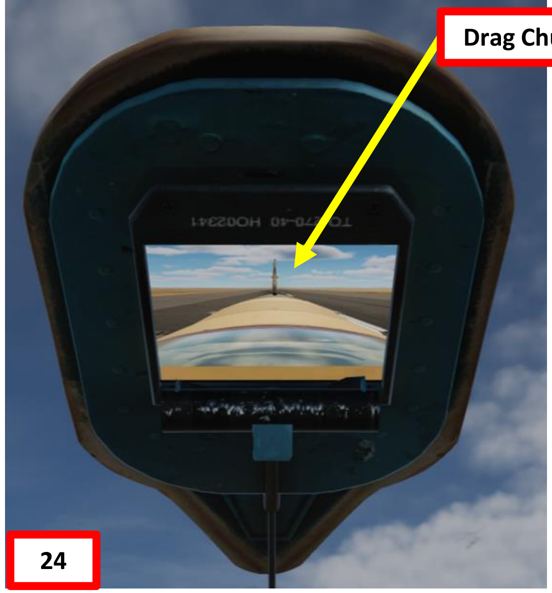
16. Place the visible part of the aircraft's nose just below the runway threshold. If the runway is not visible, reduce angle of attack (AoA) and increase airspeed with throttle. Avoid using afterburner.
17. Adjust throttle to maintain N1 RPM between 83 % and 87 %.
18. When you are 1 km from the runway, you should be flying at the following parameters:
    - Altitude: 80 m AGL
    - Descent rate: 5 m/s
    - Airspeed: decreasing to 340 km/h (do not fly any slower than this).
19. You should be over the runway's touchdown point at 2 m altitude AGL. Decrease power and gently touch the runway by making small stick inputs. At this point, the aircraft will still have some lift reserve; increasing pitch could make you bounce.
    - Note: It is better to touch the runway gently at a higher speed than to hit the runway harder at a slower speed.
20. When the aircraft main wheels touch the ground, throttle back to IDLE and keep the nose up at about 5 deg pitch on the KPP (Artificial Horizon). Let the aircraft slow down by itself.

LANDING

21. When aircraft has slowed down below 320 km/h and the main wheels are firmly on the ground, deploy drag chute by pressing the Drag Chute Deploy Button. The drag chute will quickly bleed off your speed.
22. Start tapping your wheel brake lever to gradually slow down.
23. When you have decelerated to taxi speed (15-20 km/h), jettison drag chute by flipping the safety cover, then pressing the Drag Chute Jettison button.
24. Confirm that Drag Chute is jettisoned by checking the Mirror (Periscope).

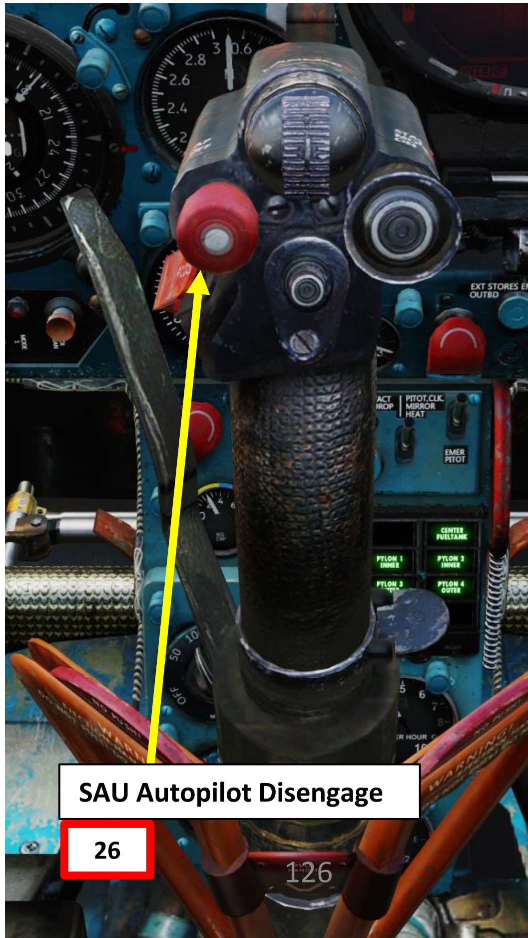






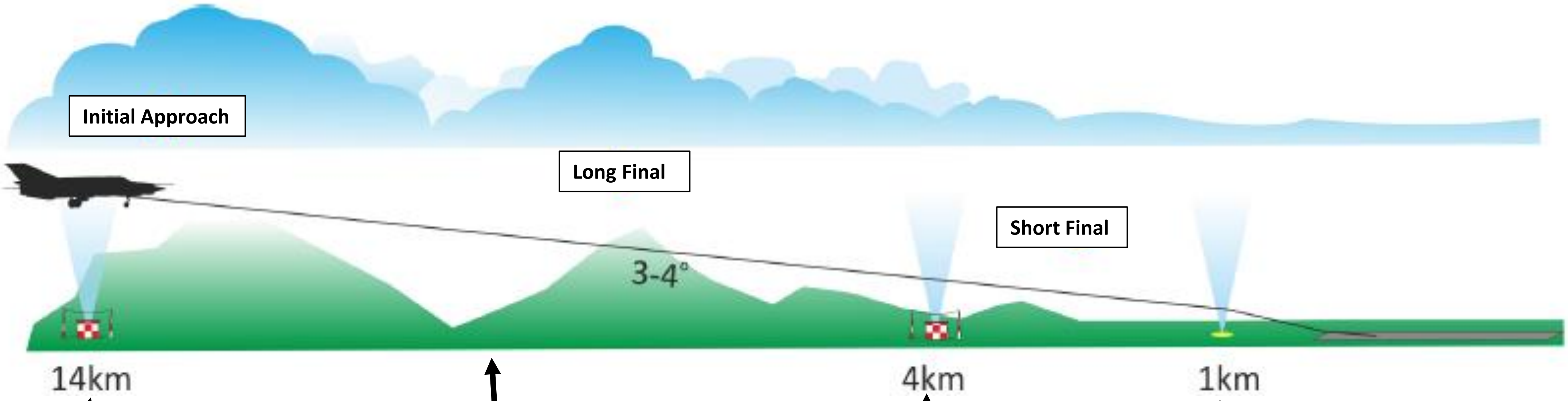
LANDING

25. Set nosewheel brake OFF (vertical) to taxi down the runway.
26. If SAU Autopilot Stabilization mode is engaged, press the “SAU Autopilot Disengage” Button on the stick to disengage it.



LANDING

Here is a brief summary of the landing procedure.



Phase A
- Altitude 1000 m
- Airspeed 500 km/h
- Deploy Landing Gear
- Initial Descent 7 m/s (between 5 and 10 m/s)

Phase B
- Altitude 600 m
- Airspeed 500 km/h
- Flaps 25 deg (Takeoff Position)
- Allow slow speed drop

Phase C
- Altitude 300 m
- Airspeed 380 km/h
- Flaps 45 deg (Landing Position)
- Always maintain airspeed above 340 km/h

Phase D
- Altitude 100 m
- Airspeed 360-340 km/h
- Airspeed above threshold: below 340 km/h
- Let aircraft "glide" on runway

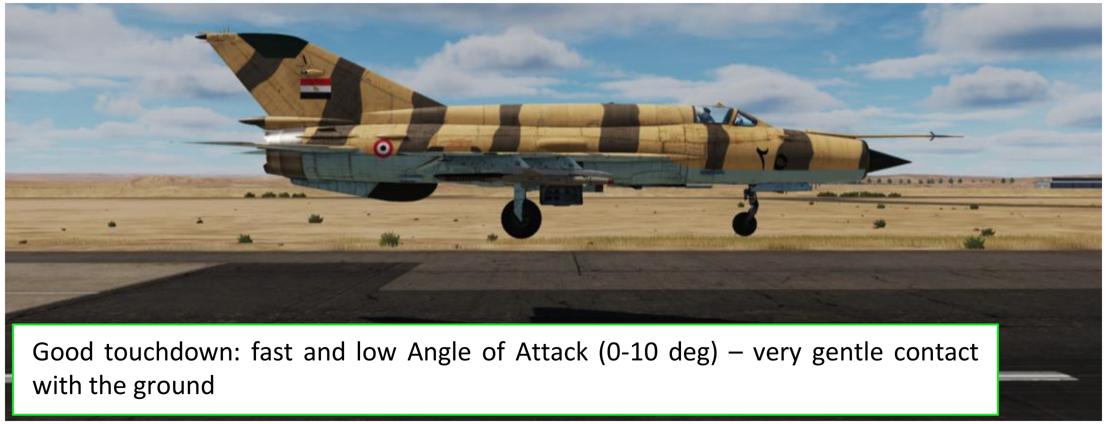
IMPORTANT NOTES

Coming in too fast

While the MiG-21 is easier to handle at high speeds than at low speeds, coming in too fast can cause a number of issues, such as landing gear jamming in an intermediate position, or the aircraft bouncing and "refusing" to land due to excess lift due to airspeed.

Coming in too slow

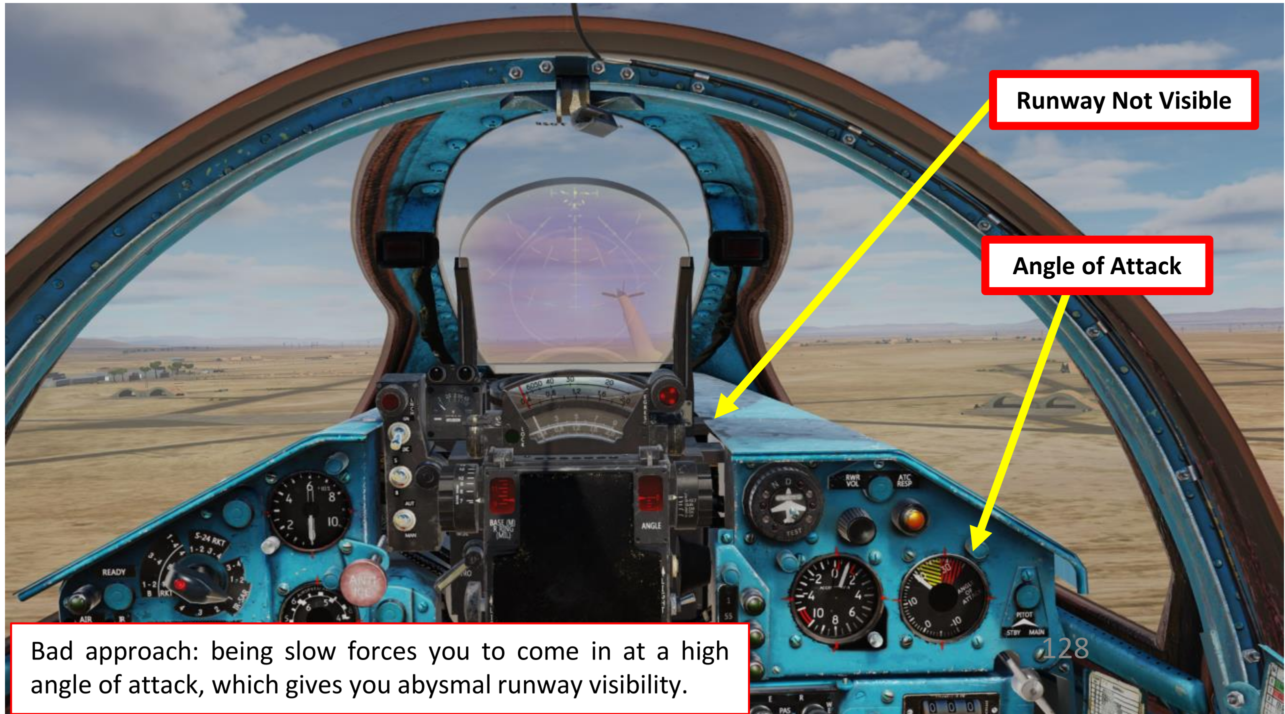
Being too slow will force the aircraft to increase its angle of attack, which is a death sentence in the MiG-21. Delta wings do not generate much lift at low speeds and high angle of attack. Staying "fast" means that the behaviour of the aircraft remains predictable and increases runway visibility. One mistake new players often make is that they deploy the landing gear too early in the approach and waste aircraft airspeed too far from the runway threshold… forcing the pilot to use excessive power to maintain runway visibility and correct angle of attack.



Good touchdown: fast and low Angle of Attack (0-10 deg) – very gentle contact with the ground

Bad touchdown: slow and high Angle of Attack (20 deg). You are likely to violently smack your tail on the ground.

Good approach: being fast allows you to come in at a low angle of attack, which gives you good runway visibility



Bad approach: being slow forces you to come in at a high angle of attack, which gives you abysmal runway visibility.

IMPORTANT NOTES

Cutting power

Throttling fully back to IDLE in order to reduce speed is not recommended. At a certain point, the engine won't be able to provide enough power/thrust to sustain flight and this situation is known as the "**second regime**" (or "**region of reversed command**"); in this situation, inexperienced pilots normally try to increase the angle of attack in order to keep the aircraft flying or even make it climb. However, this only complicates the situation since the engine cannot provide more power to overcome increasing drag (the plane "sinks" when at high angle of attack and engine RPM). This could often end with a crash if it happens on low altitude. This is a dangerous situation, which can be overcome only by decreasing the angle of attack, losing some altitude in order to increase airspeed so that drag decreases and lift increases, after which the pilot should carefully set up a slow climb with a further speed increase. For the MiG-21Bis, **maneuvering below 400 km/h requires attention**, not only because of this danger, but because of slow attitude changes (aircraft's reaction to pilot's inputs).

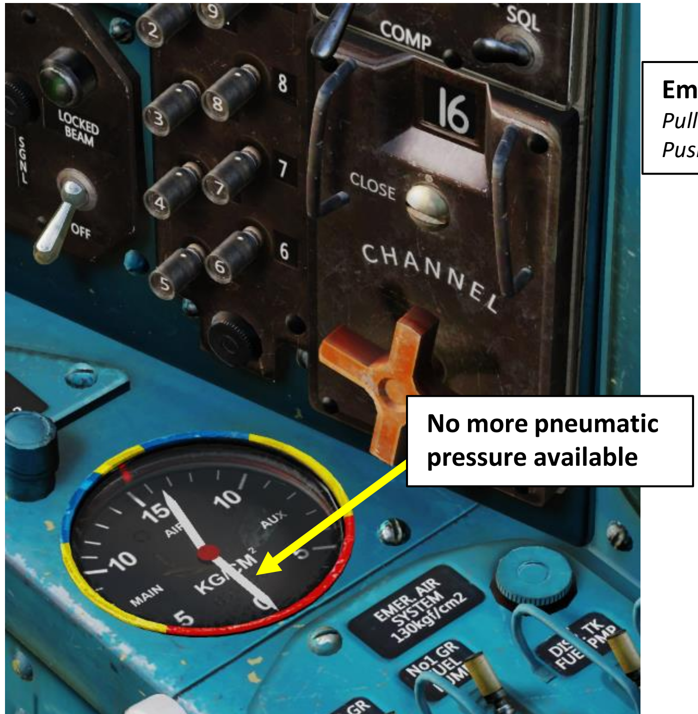
Touching down too fast

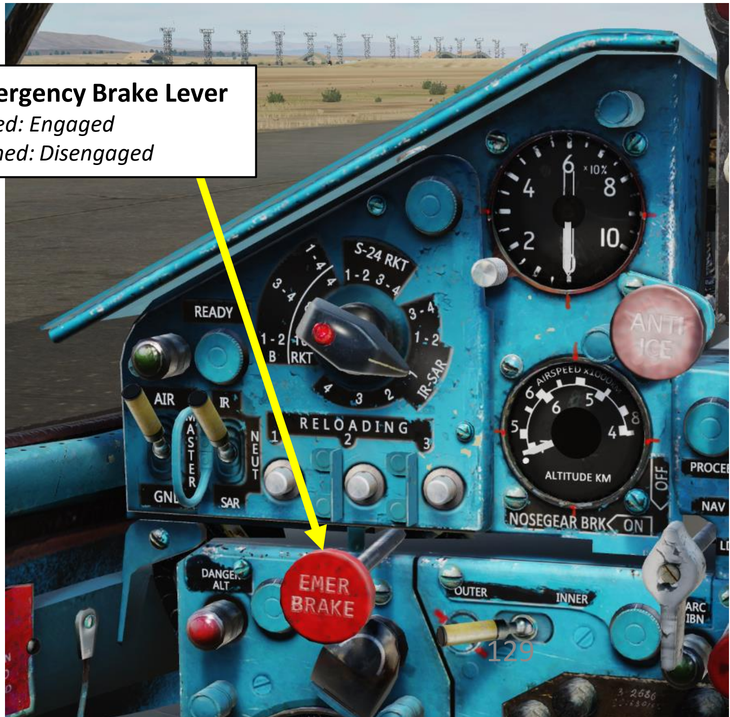
If you happen to touchdown at a high airspeed (above 360 km/h), there is a risk that your tyres might burst. Make sure to "glide" over the runway until you are slow enough for touchdown. Additionally, do not start using brakes when you are above 300 km/h; your tyres might burst. Make sure to use the drag chute for the initial deceleration, then use the brakes to slow down to taxi speed below 300 km/h.

No pneumatic pressure for brakes

In the case where you have no more pneumatic pressure for your wheel brakes, the drag chute nacelle doors will also be stuck shut, preventing you from deploying the drag chute to slow down.

In that case, pull the Emergency Brake Lever. Emergency brakes only apply to the main landing gear discs and allow 50 % of the braking power normally available.





IMPORTANT NOTES

Deploying drag chute too early

Deploying the drag chute while the aircraft is still in the air or when the airspeed is above 320 km/h will snap the cable.

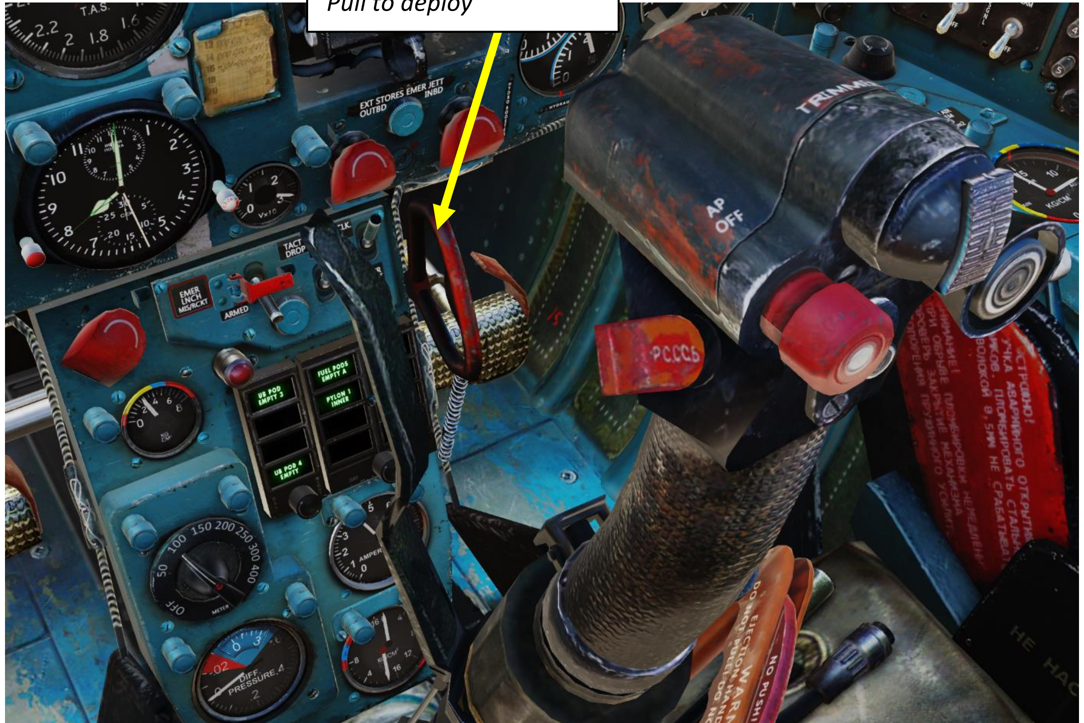
Landing Gear fails to deploy

If your landing gear fails to deploy, you can:

- Rotate (scroll mousewheel) the Emergency Landing Gear Deployment Handle for the Main Landing Gear
- Pull (left click) the Emergency Nose Gear Deployment Handle

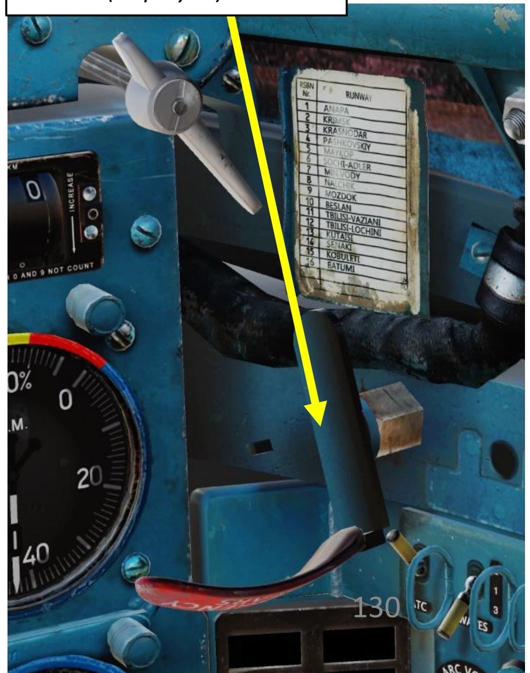
Drag Chute Cable Snapped… oh snap!

Emergency Nose Gear Deployment Handle
Pull to deploy



Emergency Landing Gear Deployment Handle
Not Deployed

Emergency Landing Gear Deployment Handle
Turned (Deployed)



IMPORTANT NOTES

After Landing

If you have landed and want to go on another mission, don’t forget to use the ground crew for refueling and re-arming. Once refueling/rearming is complete, the ground crew will perform the following:

- Refill radar coolant (alcohol)
- Refill pilot oxygen
- Refill engine oxygen
- Refill air for pneumatic systems

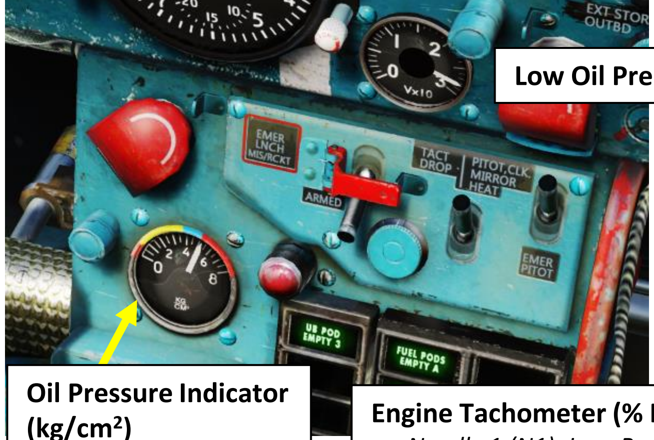
TUMANSKY R25-300 ENGINE

The MiG-21bis is powered by the Tumansky R25-300. The R-25 was designed as a replacement for Tumansky R-13 in MiG-21 fighters. R-25 is a two-spool axial-flow turbojet featuring a new compressor with increased overall pressure ratio and airflow, variable two-stage afterburner, and greater use of titanium.

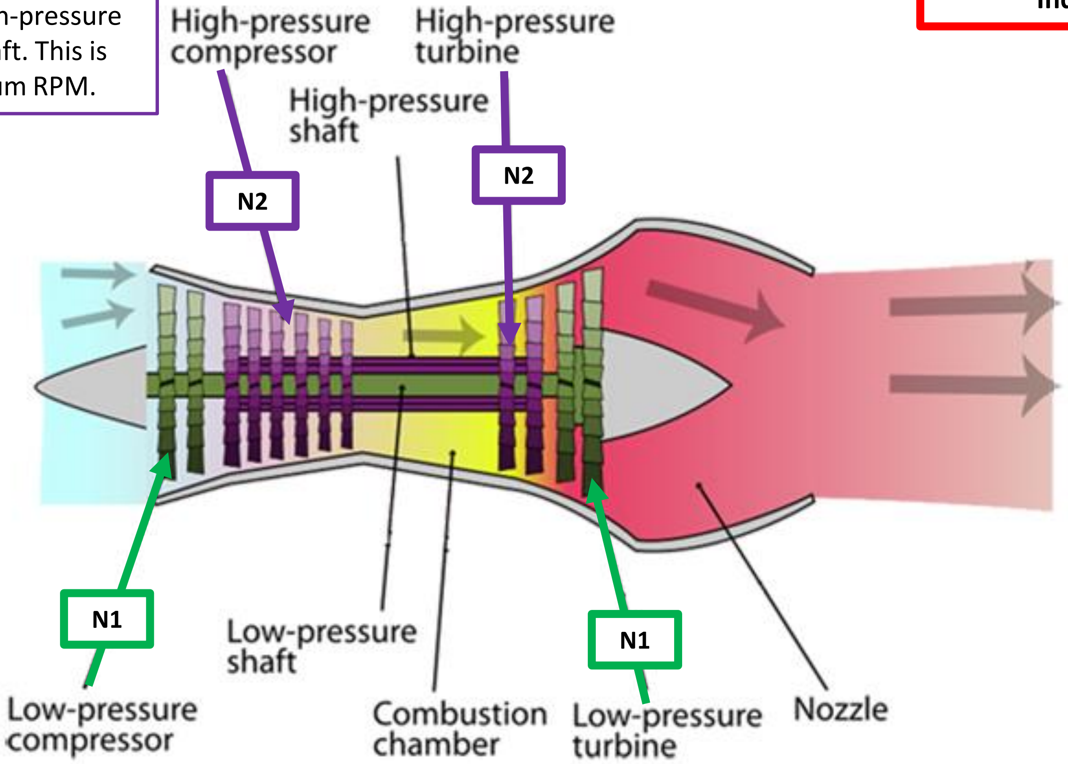
The R-25 jet engine's specialty was the addition of a second fuel pump in the afterburning stage. Activating the ЧР (rus. "чрезвычайный режим" - emergency mode) booster feature allows the engine to develop 97.4 kN (21,900 lbf) of thrust under an altitude of 4,000 meters (13,000 ft). The limit of operation is 1 minute for dogfight practice and 3 minutes for an actual wartime emergency, as further use causes the engine to overheat and potentially explode. Use of CSR (second-stage afterburner) requires engine take-out inspection upon landing and every minute of its use counts as one full hour of engine runtime on the logbook. This further shortens the already limited cycle time of Soviet made engines between industrial-level overhauls and adds great cost, but the extreme thrust of CSR allowed the MiG-21bis to reach a better than 1:1 thrust-to-weight ratio for dogfight and theoretically outclimb the F-16.

ENGINE PARAMETERS

- **N1** (% RPM): Low-Pressure Compressor Speed. Used as a power/thrust reference.
- **N2** (%RPM): High-Pressure Turbine Speed.
- **EGT** (deg C): Exhaust Gas Temperature, also referred to as "Jet Pipe Temperature (JPT)".
- **Oil Pressure** (kg/cm^2): Engine oil pressure, with a steady-state normal value expected around 3-4 kg/cm^2. The Low Pressure Warning light illuminates when oil pressure is below 1 kg/cm^2 or when metal chips or particles are detected in the oil.

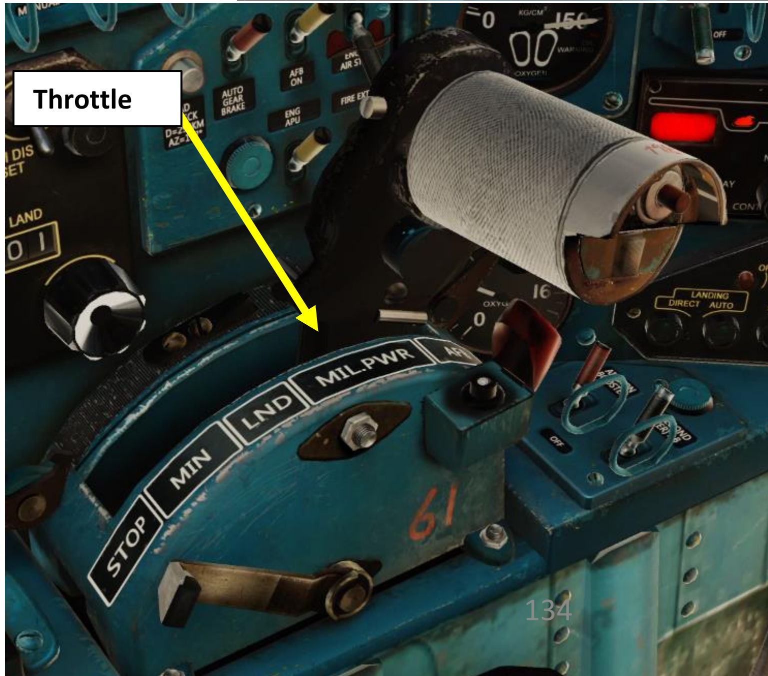


High-pressure compressor and high-pressure turbine are driven by the same shaft. This is N2 speed in percentage of maximum RPM.



Twin-Spool Turbojet Concept
from K. Aainsqatsi

Low-pressure compressor and low-pressure turbine are driven by the same shaft. This is N1 speed in percentage of maximum RPM.



NOSE CONE CONTROL

The MiG-21 is a supersonic aircraft that has a nose cone inlet for the engine, which is designed to modulate oncoming airflow behaviours and reduce aerodynamic drag in the process.

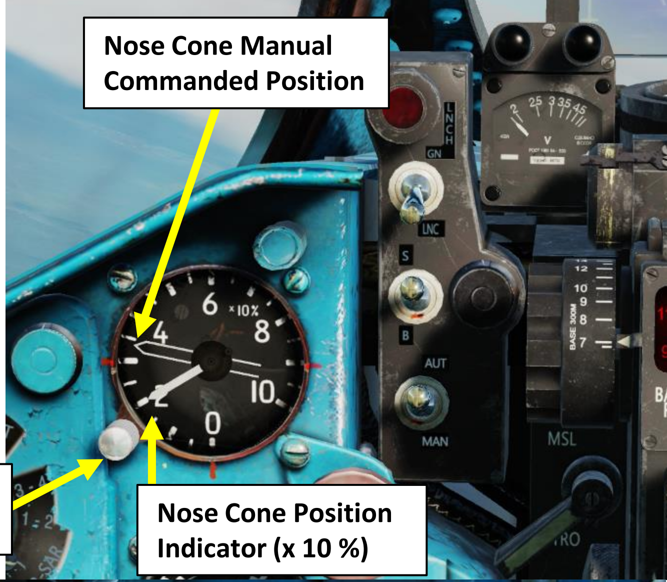
The nose cone position is variable; its commanded position is based on aircraft airspeed and the status of the landing gear.

During flight, the Nose Cone Control switch is left in the AUTOMATIC CONTROL position, which means the system does its own thing throughout all phases of flight.

The MANUAL CONTROL is just used in a case of emergency where the nose cone governing unit has failed and you have to manually set the door position in order to avoid an engine flameout caused by mismanagement of airflow entry through the engine inlet.

- Nose Cone Manual Control is performed by setting the Control Switch to MANUAL (DOWN), then setting the Manual Position Control Knob to the desired position.

Nose Cone Power Switch
- *FWD: ON / AFT: OFF*

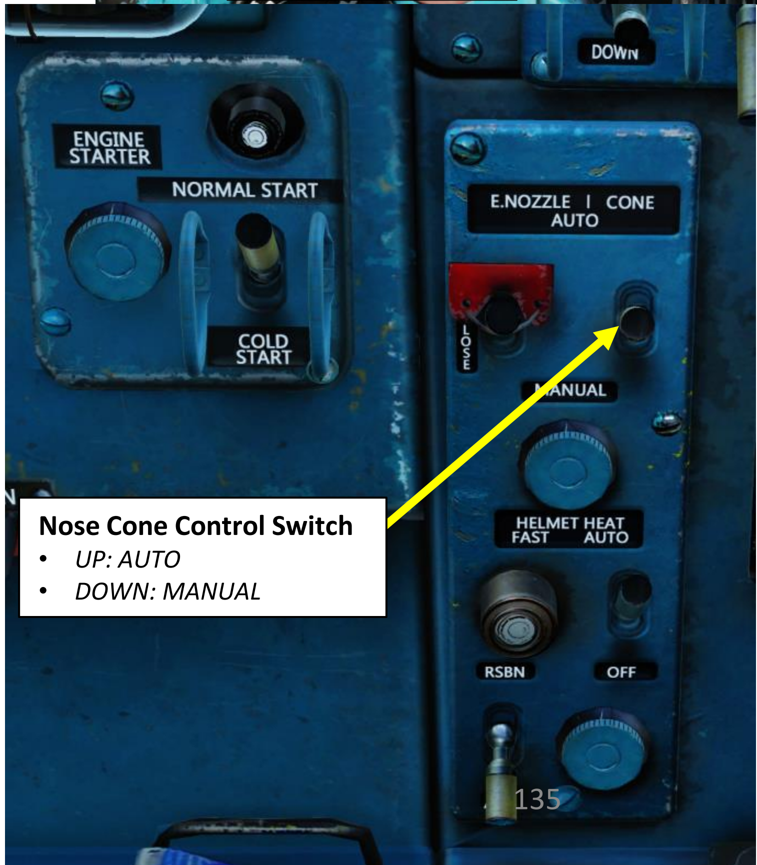


Nose Cone Manual Commanded Position

Nose Cone Manual Position Control Knob

Nose Cone Position Indicator (x 10 %)

Inlet Nose Cone OUT Light
Indicates nose cone is operational. As a general rule, cone should be in only when landing gear is extracted.



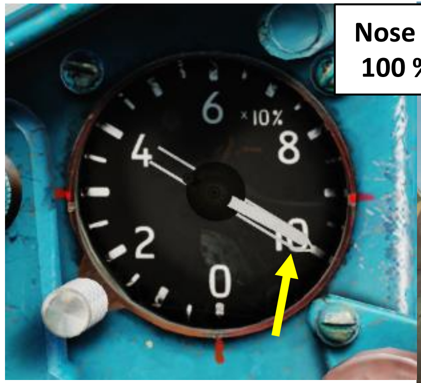
Nose Cone Control Switch
- *UP: AUTO*
- *DOWN: MANUAL*

NOSE CONE CONTROL

Here is an example of maximum and minimum nose cone positions when controlled manually. As you can see, the 100 % setting can potentially cause compressor stall and should be avoided.

Below is a table of recommended Nose Cone positions if operating it manually:

Recommended Nose Cone Position Command (%)				
Landing (Gears Extended)	Airspeed Below Mach 1.4	Airspeed Mach 1.4-1.6	Airspeed Mach 1.7	Airspeed Above Mach 1.8
0 %	20 %	25 %	35 %	40 %

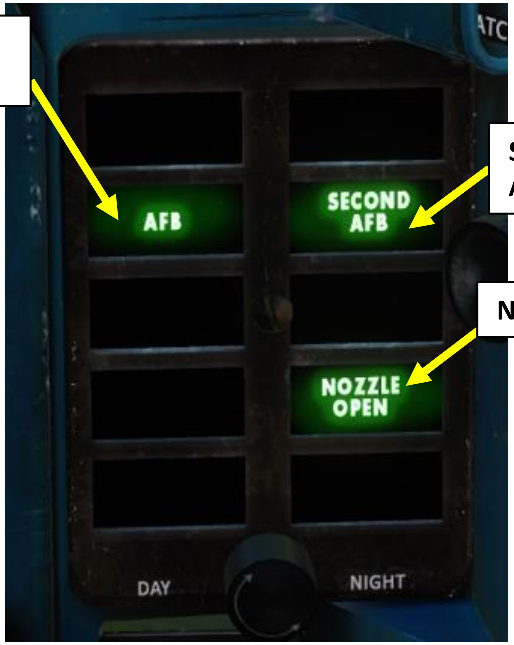


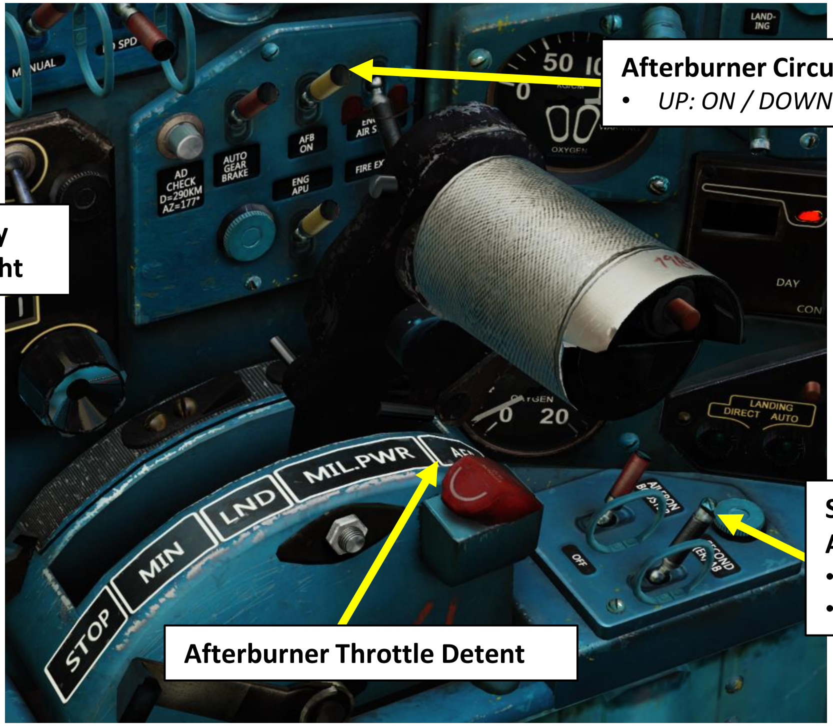
AFTERBURNER (REHEATER)

The delta wing, while excellent for fast acceleration and supersonic speeds, was not the best option for low speed flying and close air-to-air combat. This was partially improved with the introduction of an emergency afterburner (also referred to as “second-stage afterburner”, which improved thrust/weight ratio at altitudes up to 4000 m, enabling the plane to fly at low speeds while performing sharp maneuvers and to quickly recover from low speed stall conditions.

The afterburner (also called “reheater”) is engaged by throttling up to the AB (Afterburner/Reheat) detent. There is a “Second-Stage Emergency Afterburner” switch that can be activated (FWD = ON) to use the emergency afterburner (CSR). The “AFB” and “SECOND AFB”, and “NOZZLE OPEN” lights indicate whether the first or second afterburner stage is engaged.

Keep in mind that the Engine run at FULL REHEAT and SECOND REHEAT at airspeeds in excess of 1000 km/h at low and medium altitudes is allowed as long as fuel amount in tanks is at least 800 L. **Maximum time of engine continuous run at second reheat setting is not over 3 min. Repeated selection of this setting is allowed after at least 30 s interval.**

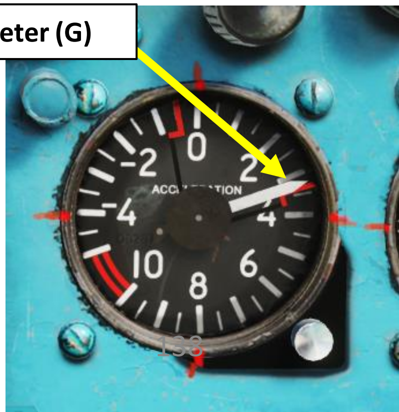




ENGINE LIMITS

Engine Limits

Engine Parameter	Limit
N1 (Low Pressure Compressor Speed, % RPM)	Max 101.5 % - Without Afterburner Max 103.5 % - With Afterburner
N2 (High Pressure Turbine Speed, % RPM)	Max 107.5 %
EGT (Exhaust Gas Temperature, deg C)	Max 780 deg C – Without Afterburner Max 850 deg C – With Afterburner
Oil Pressure (kg/cm^2)	Minimum – 1 kg/cm^2 at IDLE setting Minimum – 3 kg/cm^2 for N1 above 88 % RPM • Note: Low Pressure Warning Light can momentarily illuminate when negative g-loads are applied, but should not illuminate for more than 17 seconds.
Afterburner Operation	• FULL and SECOND Afterburner at airspeeds above 1000 km/h at low and medium altitudes is allowed as long as **fuel amount in tanks is at least 800 Liters**. • Maximum time of engine continuous run at SECOND afterburner setting is not over 3 min. Repeated selection of this setting is allowed after at least 30 sec interval.
Negative G Loads	Maximum Allowed: • 15 s without afterburner • 5 s with first afterburner • 3 s with second afterburner
0 G Load (+/- 0.2 G)	Not Allowed for more than 1-2 s Not Allowed if fuel amount is below 500 L Repeated application of negative or near-zero G-load is allowed only after at least 30 s is spent flying at positive G-load
Engine Acceleration/Deceleration	• Engine run in flight is allowed at all sustained and transient power settings at airspeeds above 400 km/h. Quick throttle movements below 400 km/h risk causing an engine flameout or a compressor stall. • It is allowed to accelerate engine to full throttle and to throttle it down from afterburner to any required setting at altitudes above 15000 m and airspeeds no less than 600 km/h. • Engine run is allowed at afterburner setting at altitudes above 18000 m, and it is permissible to cancel afterburner by moving throttle to FULL THROTTLE at airspeeds above 500 km/h.



ENGINE FLAMEOUT – RELIGHT PROCEDURE

Engine flameout can happen for a number of reasons: **throttling too abruptly, flying inverted for too long, doing negative G manoeuvers for too long, flying at an AoA higher than 33 deg for too long…** Treat your engine like you treat your significant other: with care and attention.

To restart the engine, you need sufficient airspeed (airflow) and a re-ignition.

1. Throttle fully back (SHUT-OFF/MIN)
2. Point your nose down and gain some airspeed ASAP.
   a) If your altitude is 8,000 m or higher, speed up to 550 km/h MINIMUM
   b) If your altitude is below 8,000 m, speed up to 450 km/h MINIMUM
3. Set the AIR RELIGHT switch ON (UP) and confirm engine starter is running (ENGINE START light).
4. Confirm engine N1 (RPM) spools back up, and when engine RPM stabilizes to IDLE, slowly throttle up.
5. Once N1 is over 60-70 % RPM, smoothly throttle back up to Military Power (MIL) and make sure the engine is running correctly.
6. If engine is running correctly, turn OFF the AIR RELIGHT switch and resume flight. Otherwise, turn OFF the AIR RELIGHT and restart procedure from step 1.

Note 1: It is prohibited to leave the AIR RELIGHT circuit breaker ON for longer than 45 seconds.

Note 2: The engine oxygen supply system will permit five attempts at engine relight, provided the AIR RELIGHT circuit breaker is kept closed (ON) for not more than 30 seconds.

Engine Emergency Oxygen Pressure Gauge (kg/cm²)

ENGINE START Light

In-Air Engine Relight Switch (Engine Air Restart)
- *UP: ON / DOWN: OFF*

Throttle MIN/IDLE Detent

COMPRESSOR SURGE

Most of the time, engine flameout occurs when there is not enough airflow going through the engine (which is generally caused by manoeuvers generating low airspeed/airflow or manoeuvers dragging fuel away from the combustion chamber). But what if you go **too fast**? Well, your engine can also flameout, but for a different reason. Imagine trying to drink water from a water cannon. Doesn't sound very fun, does it? Well, you now know how an engine feels like when too much air is trying to go through its compressor at the same time. An excessive airflow will choke the engine. This is what we call a "compressor surge/stall", which is noticeable by a loud BANG!, aircraft vibration, a sudden EGT drop, loss of engine power and black smoke coming out of the engine nozzle. This typically happens at high altitudes at Mach 1.8 or higher.

<u>Symptoms of Compressor Surge:</u>

- Sharp multiple pops in the nose portion of the aircraft, owing to air intake surge
- Multiple (or separate) pops in the aircraft tail portion, owing to engine surge
- Abrupt decrease of the engine speed and jet-pipe temperature, accompanied by engine flameout, occurring, as a rule, during powerplant surge at Mach numbers in excess of 1.8 M
- Fluctuation of the engine speed and jet-pipe temperature, associated with power-plant surge at Mach numbers of less than 1.8 M
- Abrupt decrease of the engine speed and of the jet-pipe temperature (owing to use of the armament, etc.).

Video Example:
https://www.youtube.com/watch?v=MQWYhsYfMxE

<u>Now, what do you do?</u>

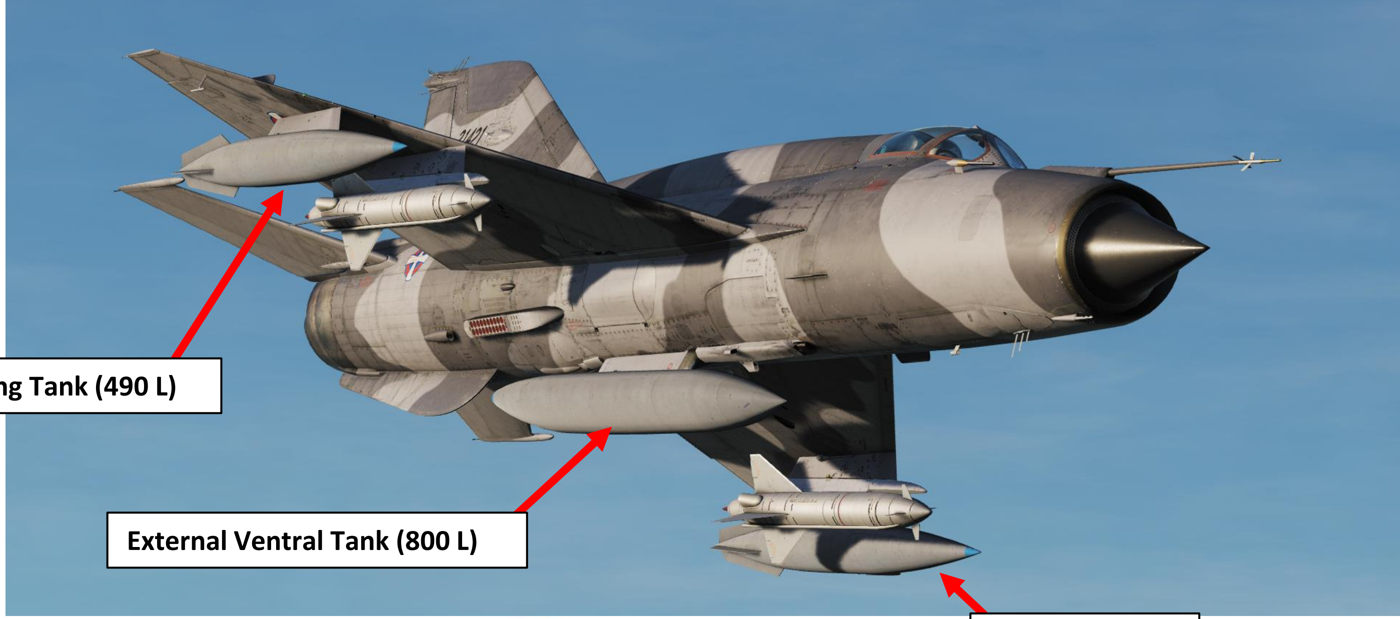
1. Set ANTI-SURGE SHUTTERS control switch to MANUAL (DOWN).
2. Turn off afterburner as soon as possible.
3. Reduce airspeed (you bleed airspeed by reducing throttle, climbing or using airbrakes)
4. When surge ceases (engine RPM & EGT go back to normal and "pop" sounds in nose and nozzle areas are gone), set ANTI-SURGE SHUTTERS control switch to AUTO (UP). This will close the anti-surge shutter doors.
5. Smoothly shift your throttle to desired power setting and resume flight.

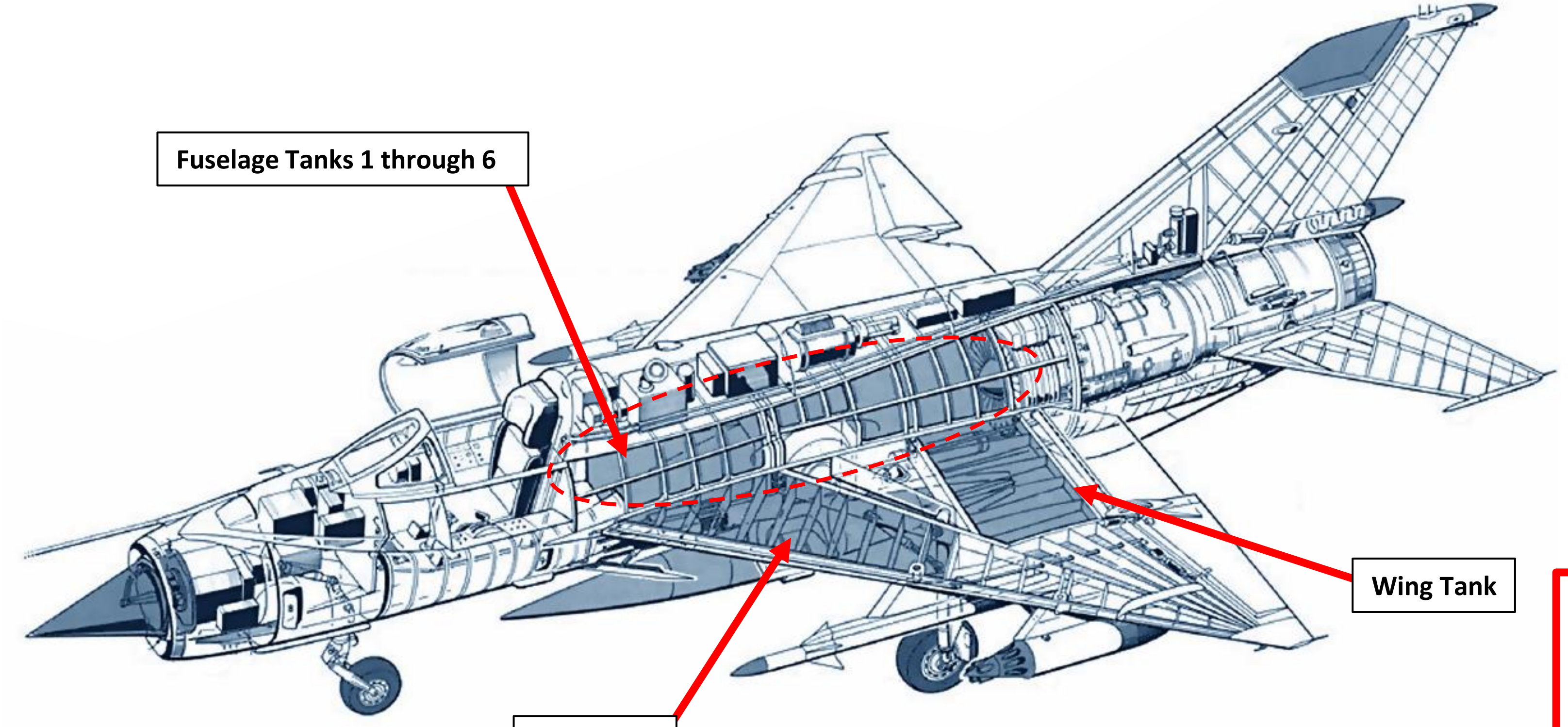
Engine Nozzle Anti-Surge Doors Control Switch
- *UP: AUTO (Anti-Surge Doors closed)*
- *DOWN: MANUAL (Anti-Surge Doors open)*

FUEL SYSTEM OVERVIEW

The MiG-21 fuel system is composed of:

- Six Fuselage Tanks
- Four Internal Wing Tanks
- Two External Wing-Mounted Drop Tanks – 490 L Each
- One External Ventral Drop Tank – either 490 L or 800 L



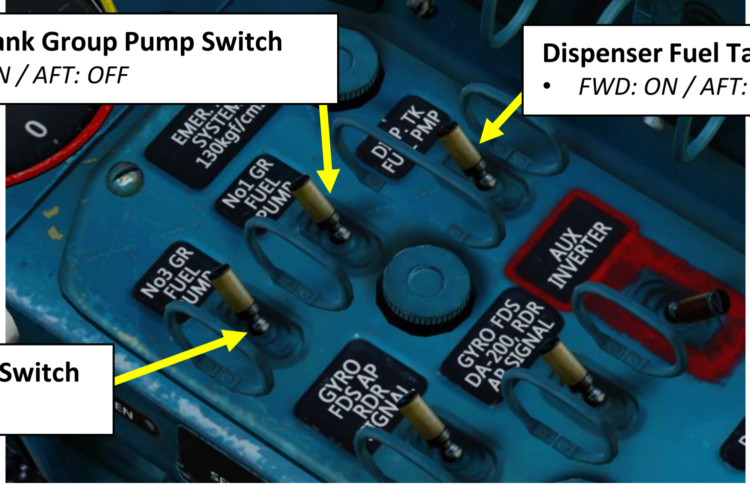


Total Internal Fuel Capacity:
2840 Liters (5027 lbs / 2280 kg)

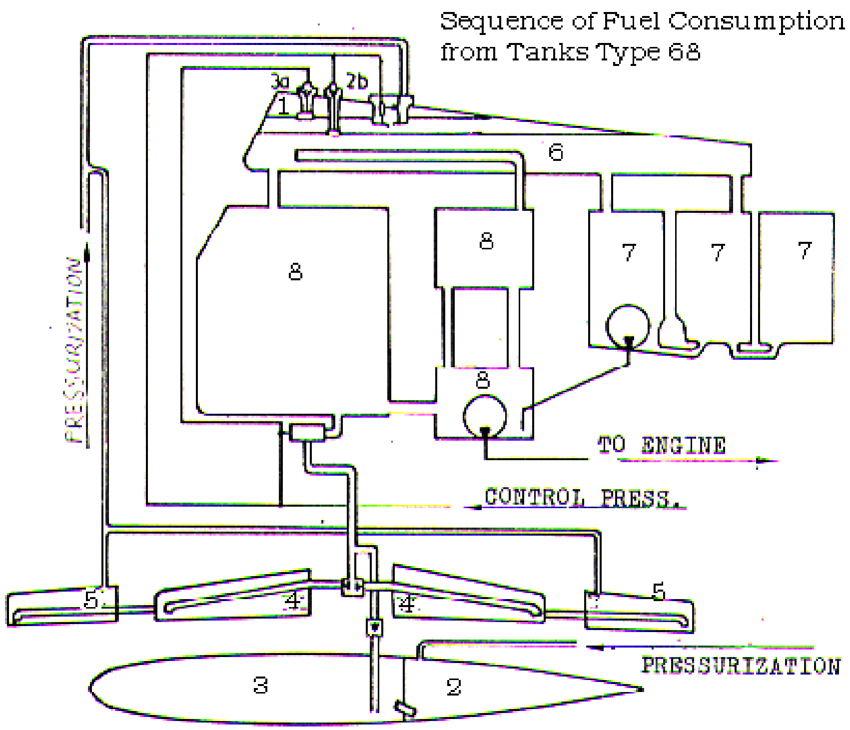
Total Capacity with External Tanks:
4620 Liters (8140 lbs / 3700 kg)

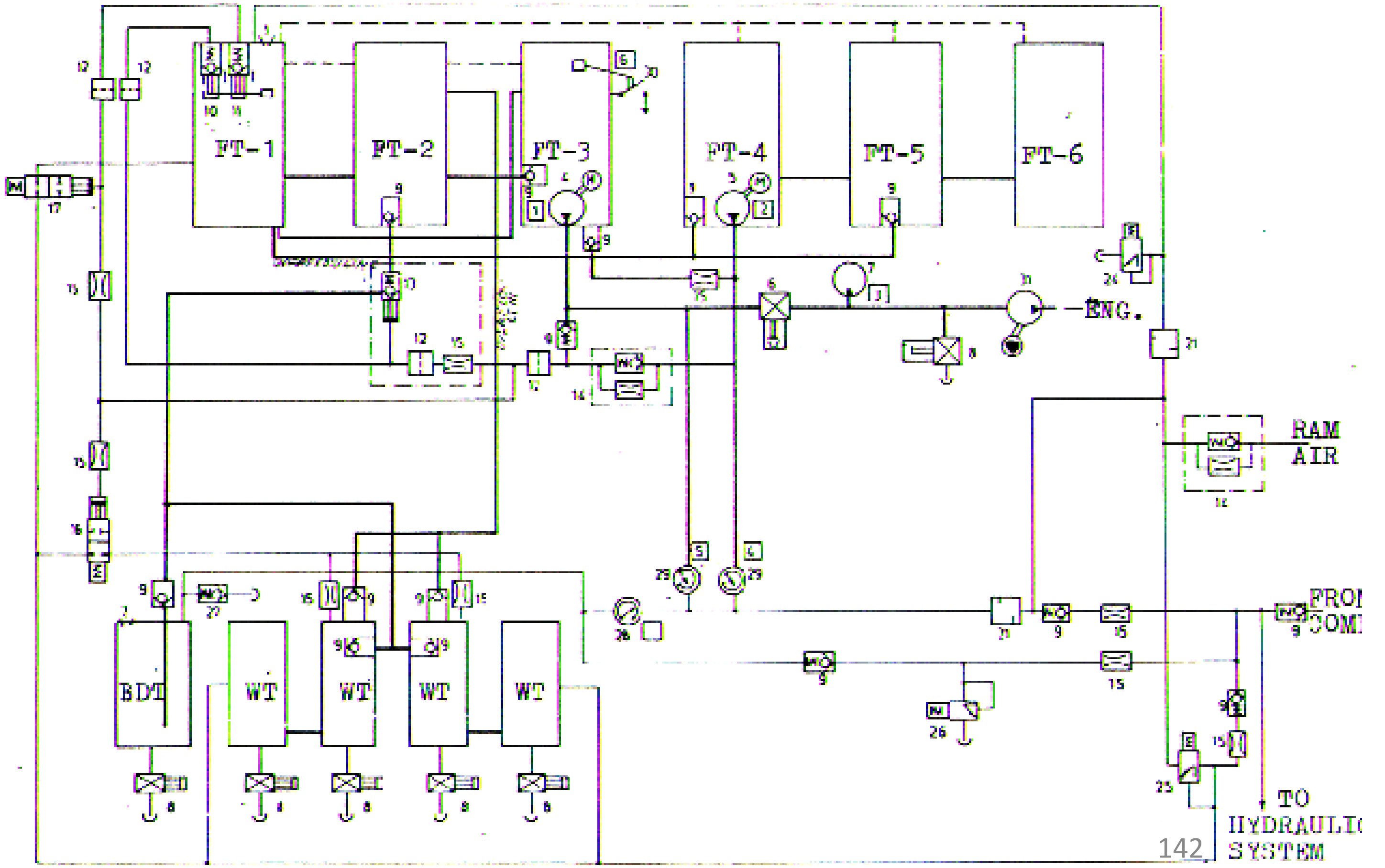
FUEL SYSTEM OVERVIEW

The pressurization system consists of a compressed bleed air which is fed to each of the tanks. The pressure varies from tank to tank, highest pressure being bled to the belly drop tank (BDT) followed by the wing tanks (WT) and the fuselage tanks (FT) respectively. The system works under the principal that the fuel under highest pressure is transferred first.



Diagrams are for the MiG-21US from:
http://www.topedge.com/panels/aircraft/sites/kraft/fuel.htm

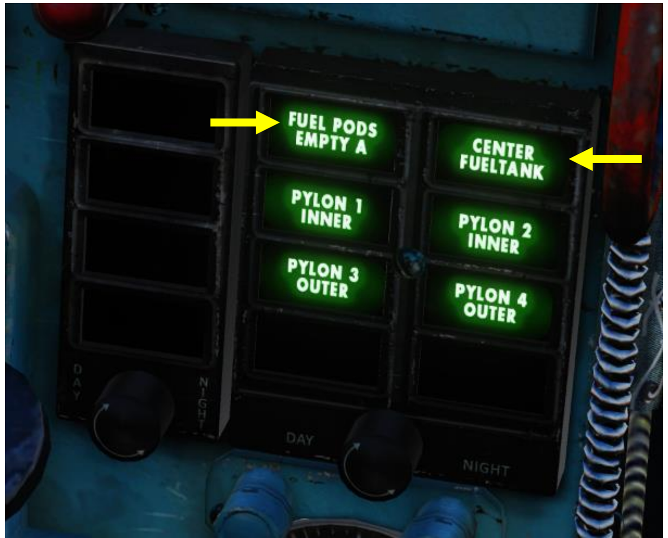


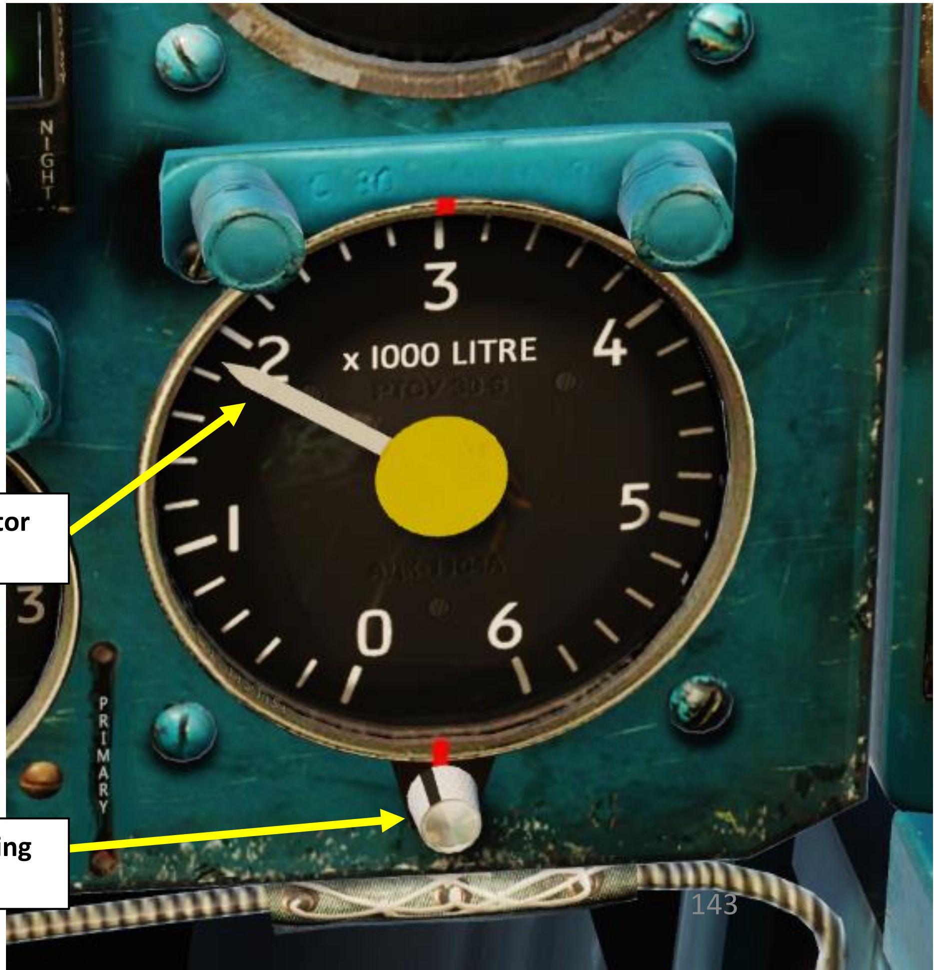


FUEL MANAGEMENT

The Fuel Quantity Indicator cannot actually measure the actual amount of fuel remaining; not all fuel tanks have fuel measuring sensors. Instead, there are signal lights of the wing, ventral and No. 1 Fuel Tank Group when they are actually empty. The pilot is expected to adjust the fuel quantity reading if necessary.

- If you jettison external fuel tanks while you still have fuel remaining in them, a quick adjustment to the fuel gauge to indicate 2750 Liters (maximum internal fuel quantity) is necessary in order to have an accurate reading. Otherwise, the fuel quantity indicator will display a misleading value that could make you think you have more fuel than you actually carry.
- When you refuel the aircraft at an airfield, the ground crew will automatically set the correct fuel quantity for you once the refueling/rearming process is complete.





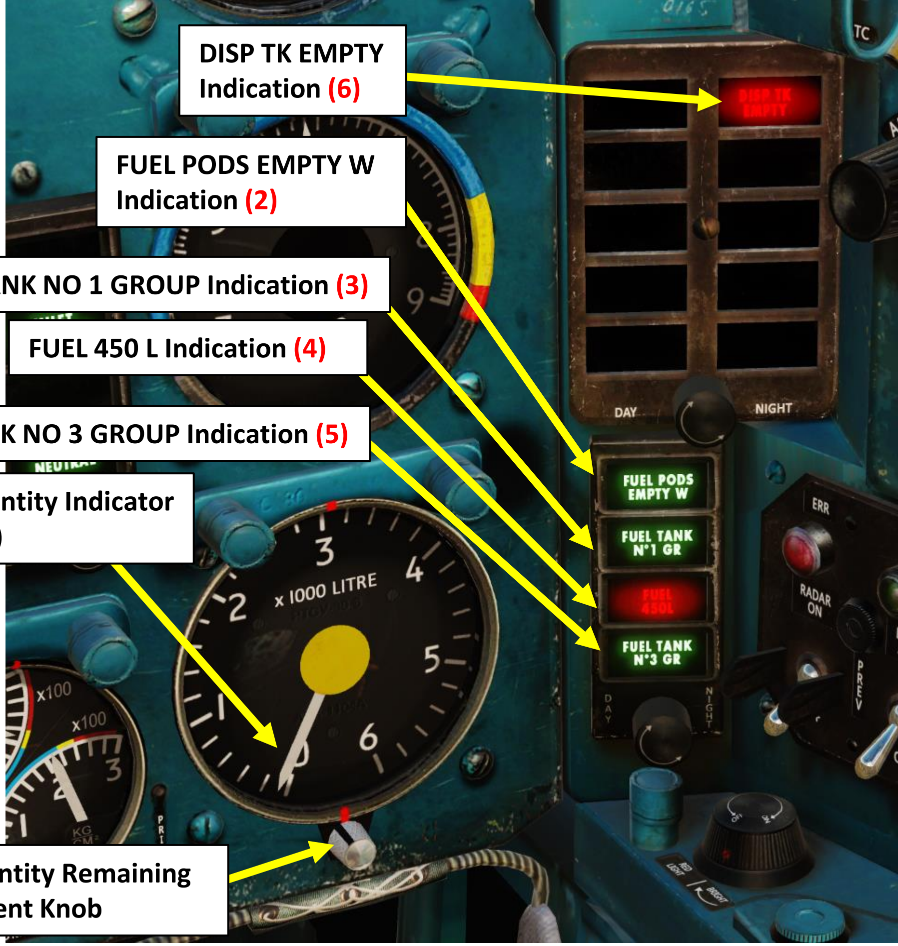
Fuel Quantity Indicator (x1000 L)

Fuel Quantity Remaining Adjustment Knob

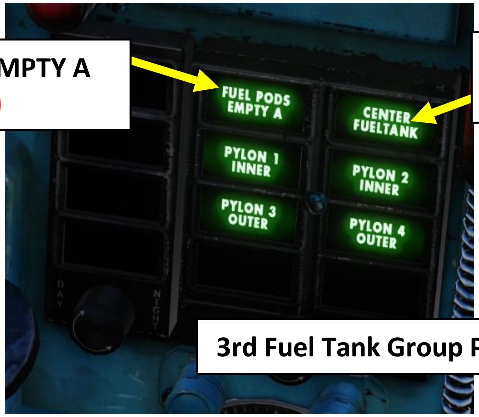
FUEL MANAGEMENT

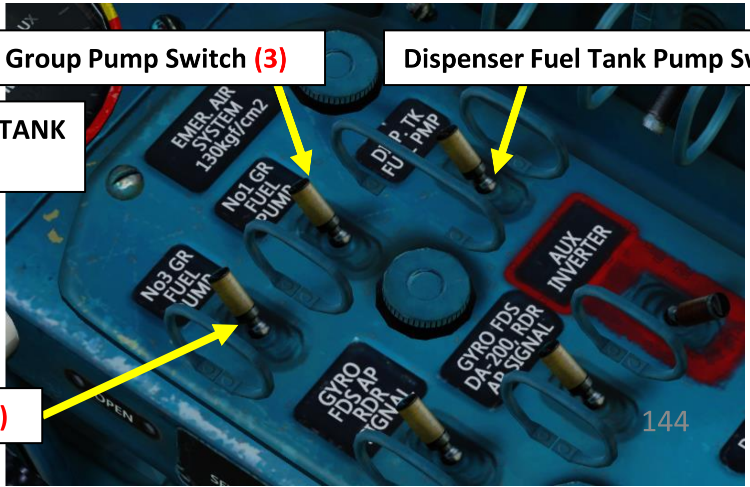
When coming in to land with a fuel remainder of less than 200 L, switch on the 1st Fuel Tank Group Pump circuit breaker in order to transfer fuel that may happen to remain in the first tank group into the service (dispenser) tank. Then, this circuit breaker shall be switched off only after landing. The order of appearance of cautions is shown in **red** numbers.

Message & Light Color	Meaning
FUEL PODS EMPTY A (1)	Indicates external wing fuel tanks are empty. • If plane has ventral tank, remaining fuel state is 3200-3000 L. • If plane does not have external ventral tank, remaining fuel state is 2700-2500 L.
FUEL PODS EMPTY W (2)	Indicates external ventral fuel tank is empty. Remaining fuel state is 2700-2500 L.
FUEL TANK NO 1 GROUP (3)	First fuel tank group is empty; turn off 1st Fuel Tank Group Pump switch. Remaining fuel state is 700-1000 L.
FUEL 450 L (4)	Minimum fuel; around 12 minutes of flight remaining. Land immediately. Remaining fuel state is 450-550 L.
FUEL TANK NO 3 GROUP (5)	Third fuel tank group is empty; turn off 3rd fuel group pump; around 7 minutes of flight remaining. Land immediately. Remaining fuel state is 250-350 L.
DISP TK EMPTY (6)	Low fuel pressure or no fuel in the dispenser (service) tank; engine fuel starvation is imminent.
CENTER FUEL TANK (A)	Indicates a ventral external fuel tank is installed under the fuselage. Extinguishes when fuel tank is jettisoned.



Note:
Fuel consumption from the wing fuel cells can be monitored indirectly by the fuel amount remaining at the moment when the FUEL TANK NO 1 GROUP signal light comes on. Illumination of the FUEL TANK NO 1 GROUP light (3) at a time when the fuel remainder is 1300-1600 L testifies to the fact that fuel has not been consumed from the wing fuel cells. The actually consumable remainder will in this case be 700-1000 L.



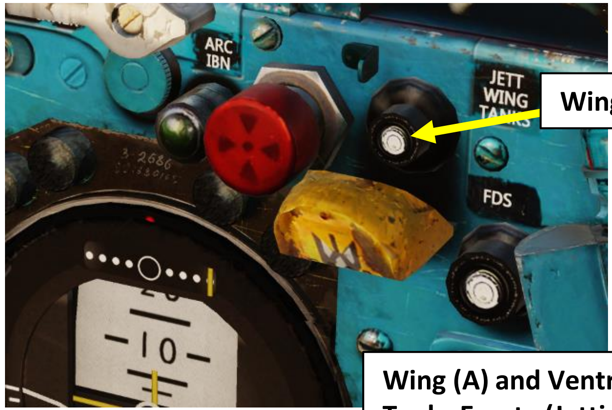


WING & FUSELAGE FUEL DROP TANKS JETTISON

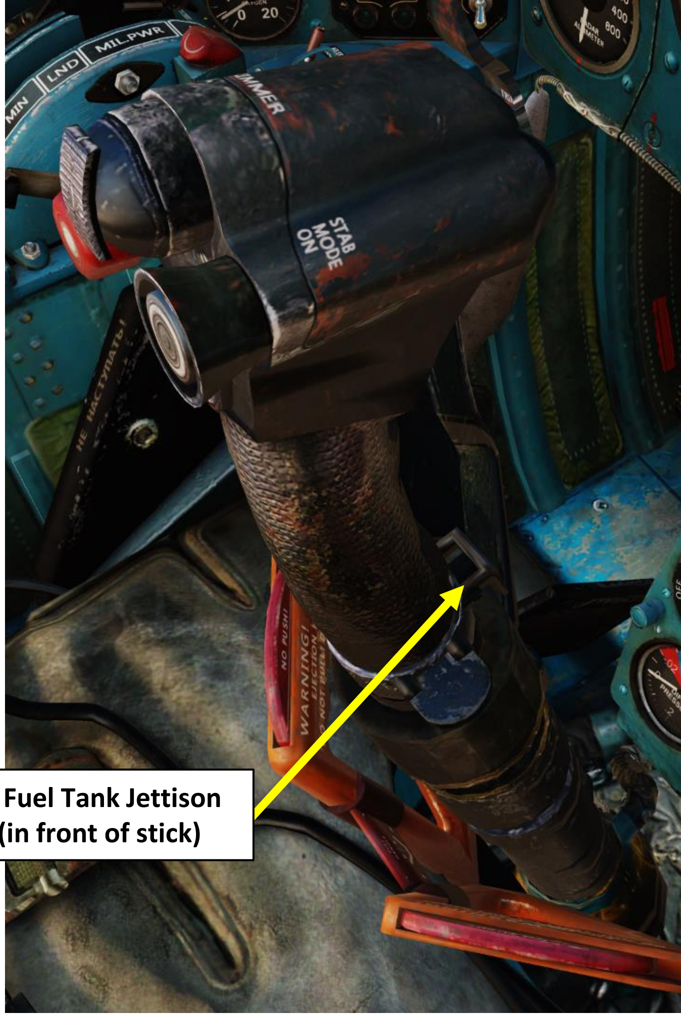
Fuel is critical for the MiG-21bis. The MiG-21 is very fast, but consumes a lot of fuel very quickly. Therefore, the use of fuel drop tanks mounted on wing pylons and the center fuselage are essential if you don't want your mission to be a one-way-trip.

- Wing drop tanks are useful if you fly for very long distances, but personally I would recommend having a few extra missiles instead since the 800 L ventral fuselage drop tank has enough fuel to get you pretty much anywhere.
- Jettison wing drop tanks when entering combat (don't forget to flip the yellow cover switch beforehand).
- You can still fight effectively if you keep your ventral fuselage tank. Think about it: more fuel = more afterburner time!
- Map a key binding for the ventral fuel tank jettison switch: the switch is in front of the stick and very hard to access.

Wing Fuel Tank Jettison Button Cover



Wing Fuel Tank Jettison Button



Ventral Fuel Tank Jettison Button (in front of stick)

Center (Ventral) Fuselage Tank Attached

Wing (A) and Ventral (W) Fuel Tanks Empty (Jettisoned)

Center (Ventral) Fuselage Tank Jettisoned

WING & FUSELAGE FUEL DROP TANKS JETTISON

PART 8 – AIRCRAFT LIMITATIONS

AIRCRAFT LIMITATIONS

GENERAL RULES

- Do not exceed an angle of Attack (AoA) of +33 deg (red section on UUA) or a -20 AoA in descent.
- Maintain an airspeed above 500 km/h IAS at all times, especially in combat.
- It is forbidden to turn on the SPS BLC system in approach with the cone extended.

AIRSPEED RULES

- Do not deploy landing gear at speeds higher than 600 km/h IAS.
- Do not perform touchdown at speeds higher than 330 km/h IAS.
- Do not deploy drag chute at speeds higher than 320 km/h IAS.
- Maximum permissible airspeed for going around with SPS BLC (Boundary Layer Control) flaps system operating is 360 km/h.

- With no fuel drop tanks, missiles only: 1300 km/h IAS, Mach 2.05
- With no fuel drop tanks, gun/rocket pods only: Mach 1.0
- With no fuel drop tanks, bombs only: 800 km/h IAS, Mach 1.0
- With fuel drop tanks only: Mach 1.6

MANOEUVERING RULES

- With no fuel drop tanks, missiles only: +7 G
- With no fuel drop tanks, gun/rocket pods only: +5 G
- With no fuel drop tanks, bombs only: +5 G
- With fuel drop tanks: +5 G (490 L tank) or + 4 G (800 L tank)
- Negative G: 5 s MAX

OPERATION TIPS:

- Airspeed for maximum range: 650-600 km/h IAS (Indicated Airspeed)
- Airspeed for maximum endurance: 480 km/h IAS
- Relative fuel consumption at 0 m: 100 %
- Relative fuel consumption at 3000 m: 80 %
- Relative fuel consumption at 6000 m: 65 %
- Relative fuel consumption at 9000 m: 60 %
- Relative fuel consumption at 11000 m: 55 %

Since the majority of your time will be spent on intercept missions and that you will most likely equip fuel drop tanks and missiles, I suggest you follow this simple rule:

- **+ 5G MAX**
- **Continuous Negative G for 5 s MAX**
- **500 km/h IAS MIN**
- **Mach 1.6 MAX**

SPS (Flaps Boundary Layer Control System) Switch
- *UP: AUTO*
- *DOWN: MANUAL*

SECTION SUMMARY

1 – RP-22 "Sapfir" Radar
1.1 - Introduction

The RP-22SM "SAPFIR" (Sapphire) radar, codenamed "Jay Bird" by NATO, was introduced in 1968 with the MiG-21SM. By the standards of the time, it wasn't a particularly ground-breaking radar technologically speaking… but one has to keep in mind that the radar was mainly meant to be used in conjunction with steering commands given by the GCI (Ground Control Intercept) stations on the ground. The radar was mainly meant to be used once you already had a general idea of where the target to intercept was (within 30 km). The RP-22 is stabilized with the horizon, but the scanning cone azimuth is fixed and the elevation can be tilted slightly up to avoid scanning ground clutter at low altitude. The radar has uses both for air-to-air and air-to-ground missiles.

1 – RP-22 "Sapfir" Radar
1.2 - Radar Performance

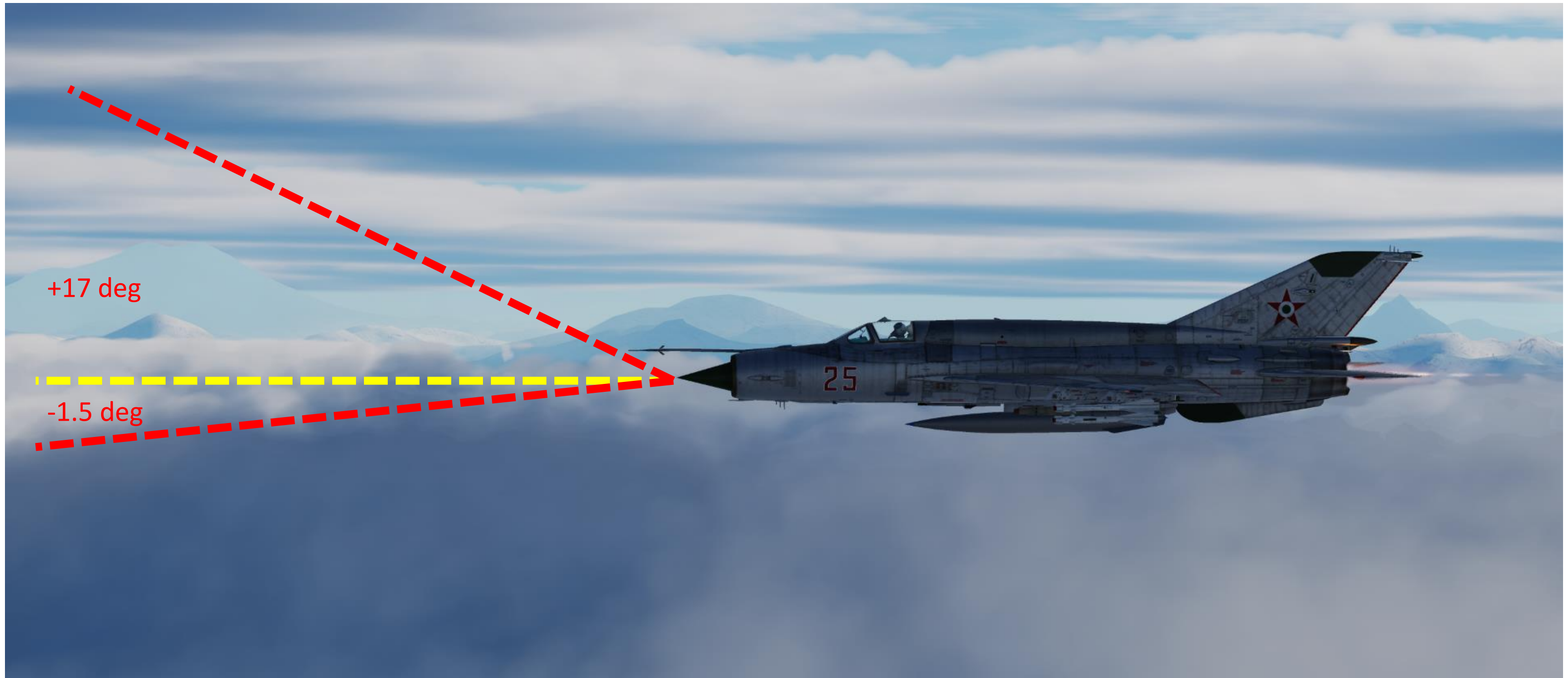
The RP-22 radar has a **range of 30 km**. The Sapphire's antenna cannot be manually moved up, down, left or right like in modern fighters; you have to steer the aircraft to move the scanning cone.

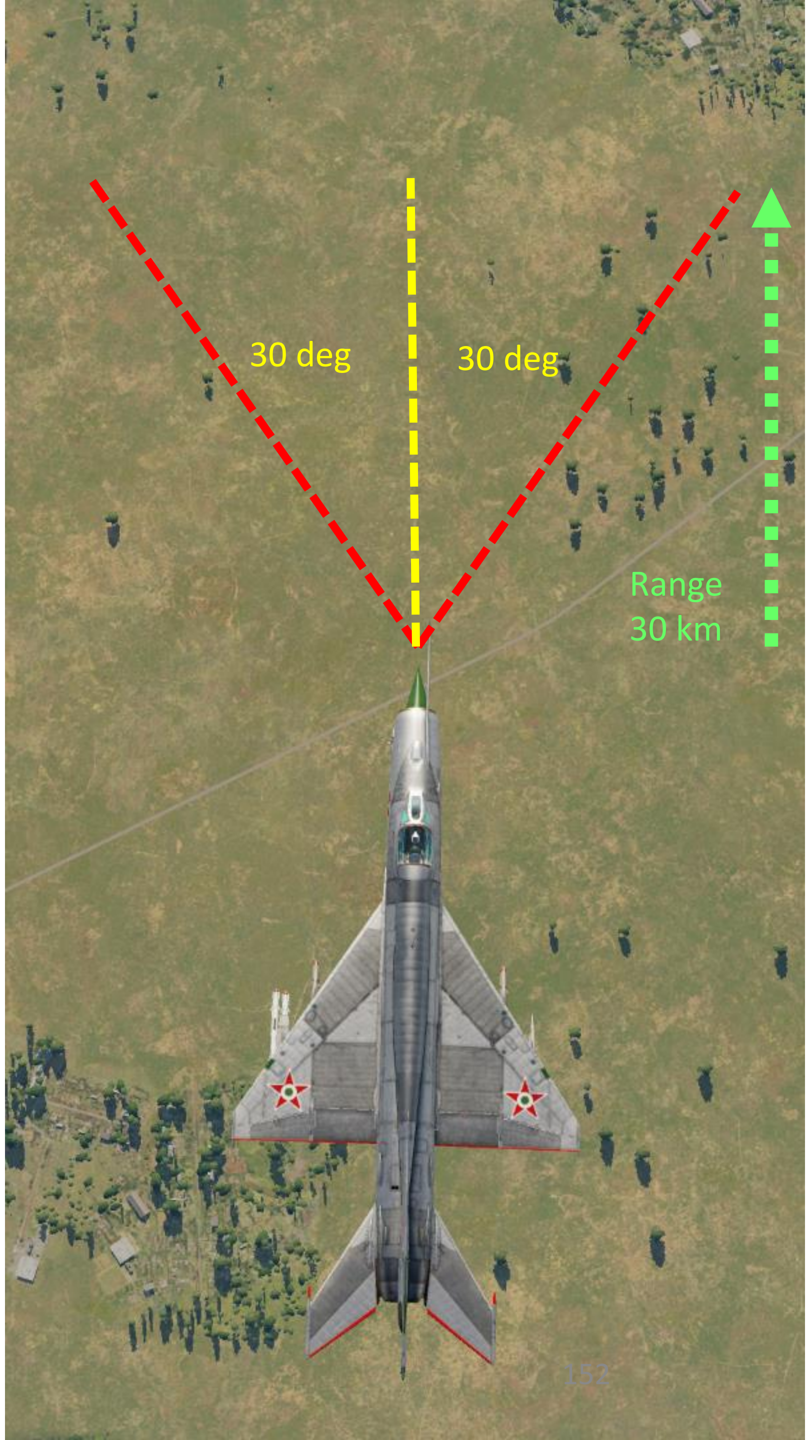
The radar **scans ±30 deg in azimuth, and -1.5 deg and +17 deg in elevation**, Basically, you don't need to do anything except to fly at an appropriate altitude in order to actually spot the target with your radar.

The radar needs **3 seconds to perform a full scan** while in Search mode. When searching for targets, fly for 10-15 seconds in one direction and allow a thorough search of an illuminated volume of airspace. If you don't find what you are looking for, change your heading by about 20-30 deg and repeat the search.

Keep in mind that the radar can only be used for a limited time, so you have to possess valid information (or a very good guess) about the enemy's altitude so that you can position your fighter at the appropriate altitude and minimize time spent scanning for targets. When flown as an interceptor, the MiG-21 strongly relies on information provided by ground radar crews in order to intercept.

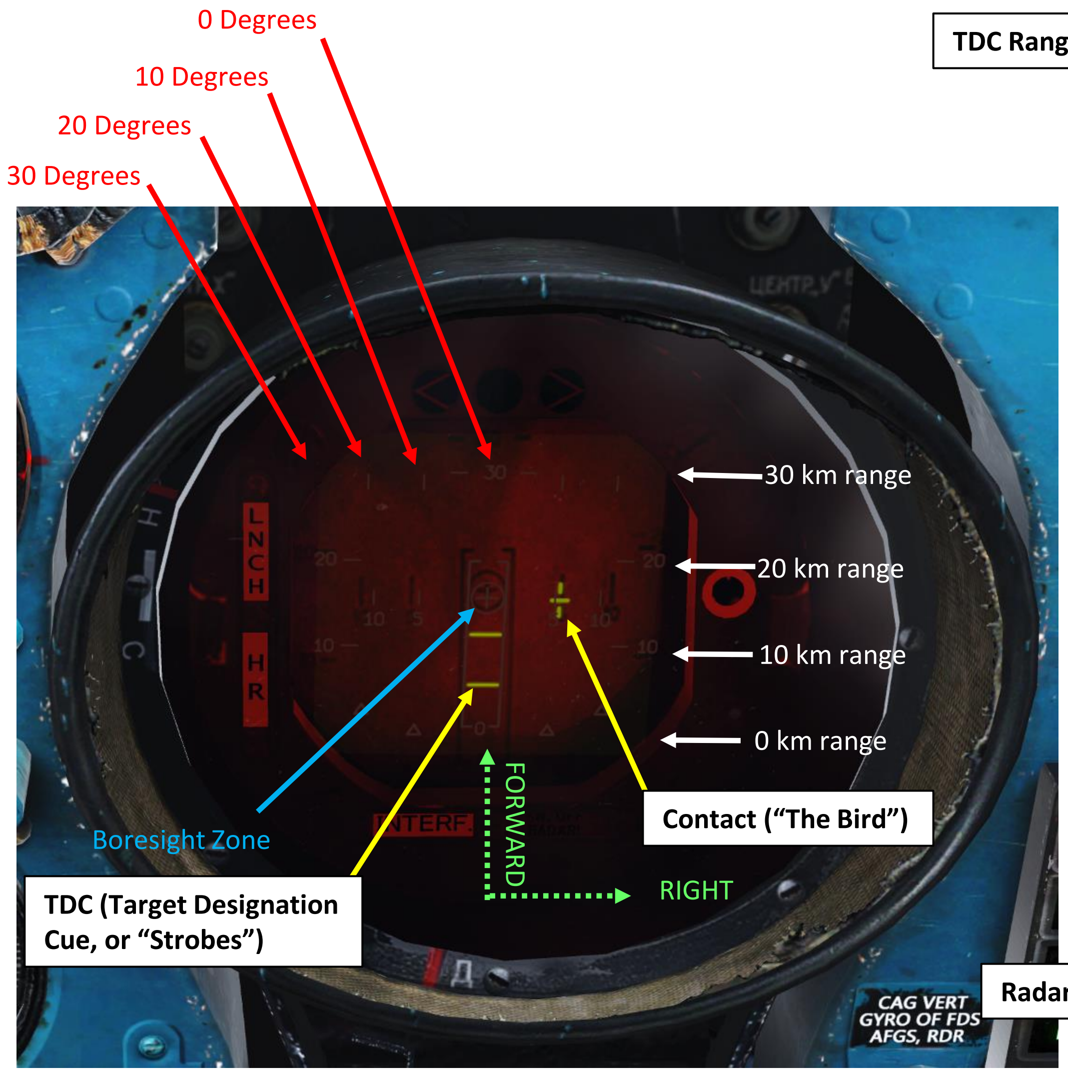
The RP-22 requires a **3 to 5 minute warm-up period** (STANDBY) before being functional (ON). While in **Standby Mode**, the radar **alcohol coolant lasts for 35 to 40 minutes**, while in **ON Mode** the **coolant lasts for 20-25 minutes**.





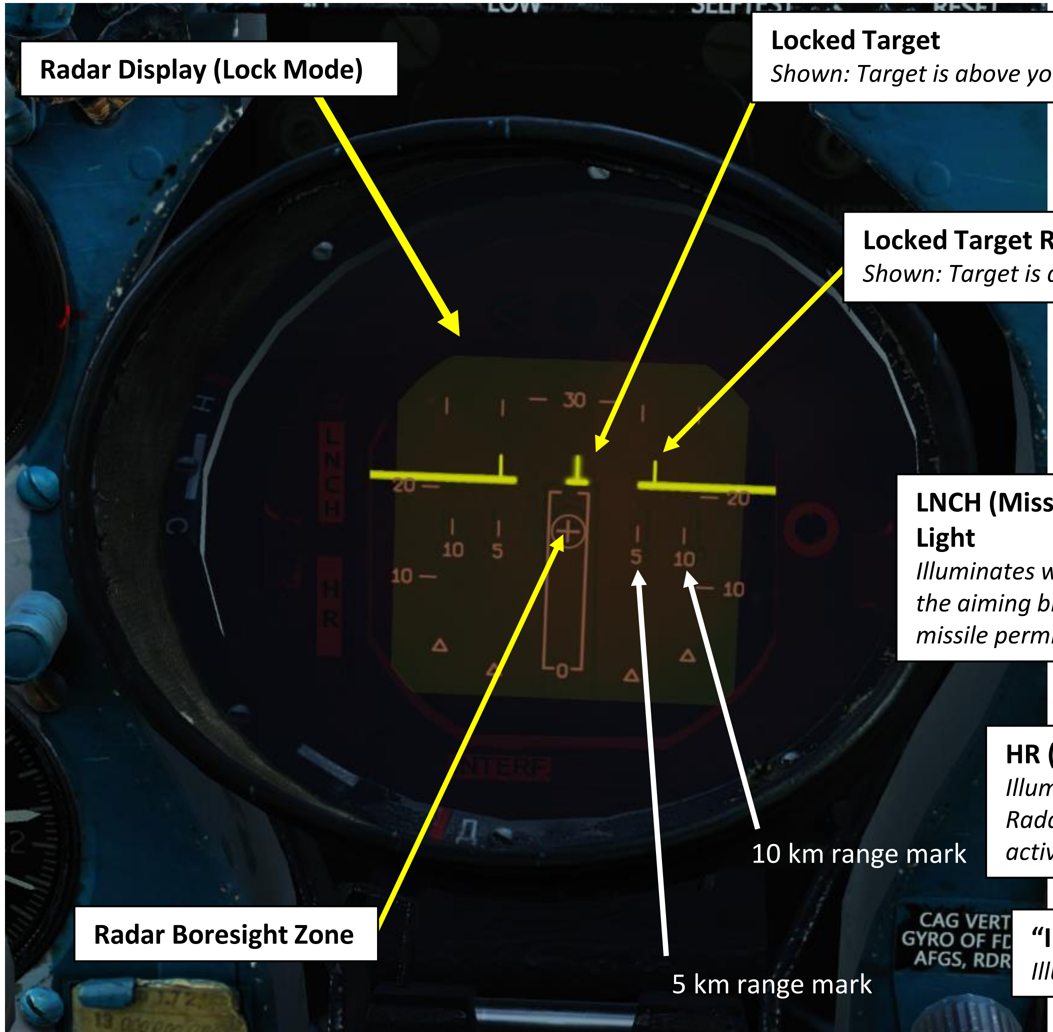
1 – RP-22 “Sapfir” Radar
1.3 - Radar Display

Here is an overview of the radar display symbology when in **Search Mode**.



1 – RP-22 "Sapfir" Radar
1.3 - Radar Display

Here is an overview of the radar display symbology when in **Locked Mode**.



Radar Display (Lock Mode)

Locked Target
Shown: Target is above you

Locked Target Range Indicator
Shown: Target is at 7 km

Radar Boresight Zone

10 km range mark

5 km range mark

Radar Display (Lock Mode)

Radar "Break Off" Light
Illuminates when you are about to collide with radar locked target.

LNCH (Missile Launch Ready) Light
Illuminates when range marks on the aiming blip have entered the missile permissible launch zone.

HR (Missile Head Ready) Light
Illuminates when SARH (Semi-Active Radar Homing) missile heads are active and ready to track the target.

"Interference" (Jamming) Detected Light
Illuminates when enemy radar jamming is active.

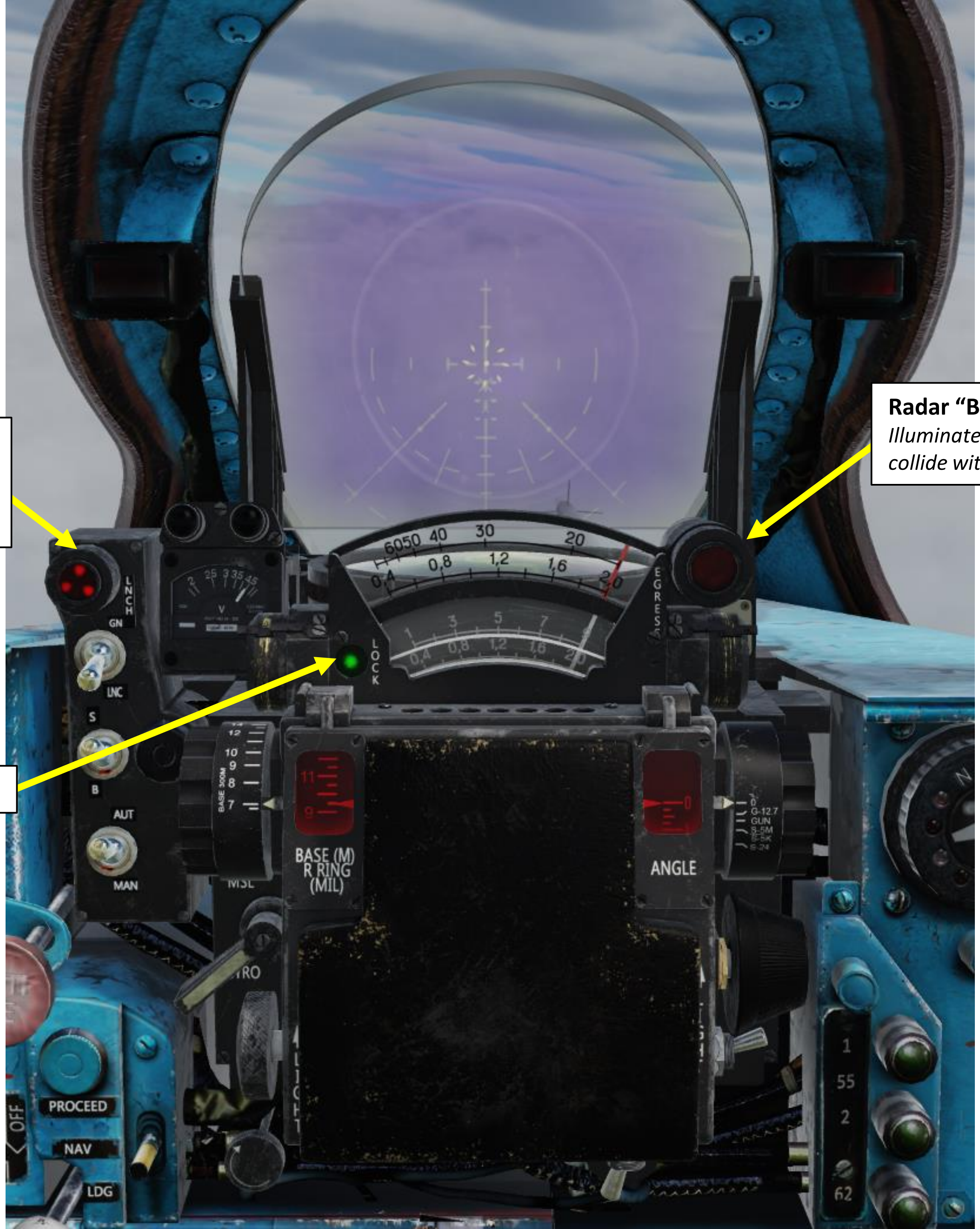
Switch OFF Radar Light
Turn off radar when you see this light

1 – RP-22 "Sapfir" Radar
1.3 - Radar Display

The ASP Optical Sight has also some functionality integrated with the radar, such as the Radar Lock Light for example.

LNCH (Missile Launch Ready) Light
Illuminates when range marks on the aiming blip have entered the missile permissible launch zone.

Radar Lock Light

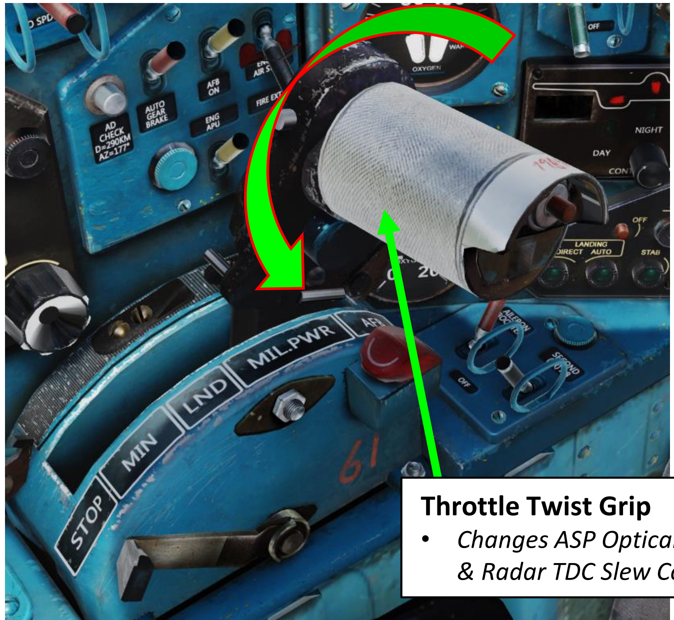


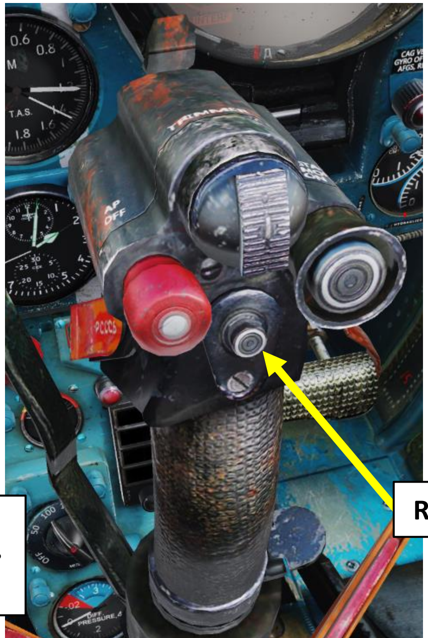
Radar "Break Off" Light
Illuminates when you are about to collide with radar locked target.

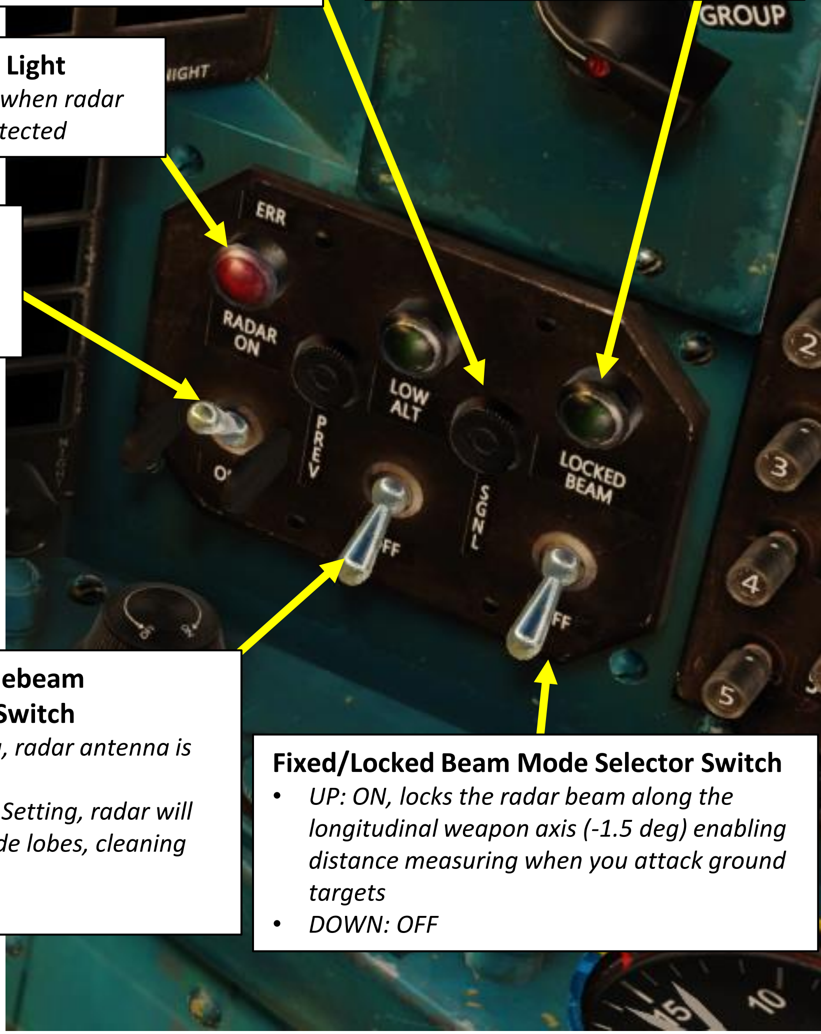
1 – RP-22 "Sapfir" Radar
1.4 - Radar Controls

Here is an overview of radar controls:

- **Radar Main Mode Selector**
  - Selects radar operating mode: OFF, standby (warm-up) or ON.
- **Radar Low Altitude / Sidebeam Compensation Selector**
  - Selects special radar settings for low altitude operation to filter up ground clutter radar returns.
- **Fixed/Locked Beam Mode Selector**
  - Used for radar ranging while performing ground attacks.
- **Radar Lock-On Button**
  - Performs a radar lock when the TDC (Target Designation Cue) is over a target ("bird").
- **Throttle Twist Grip**
  - When radar is ON, the twist grip acts as a Radar TDC Slew control.

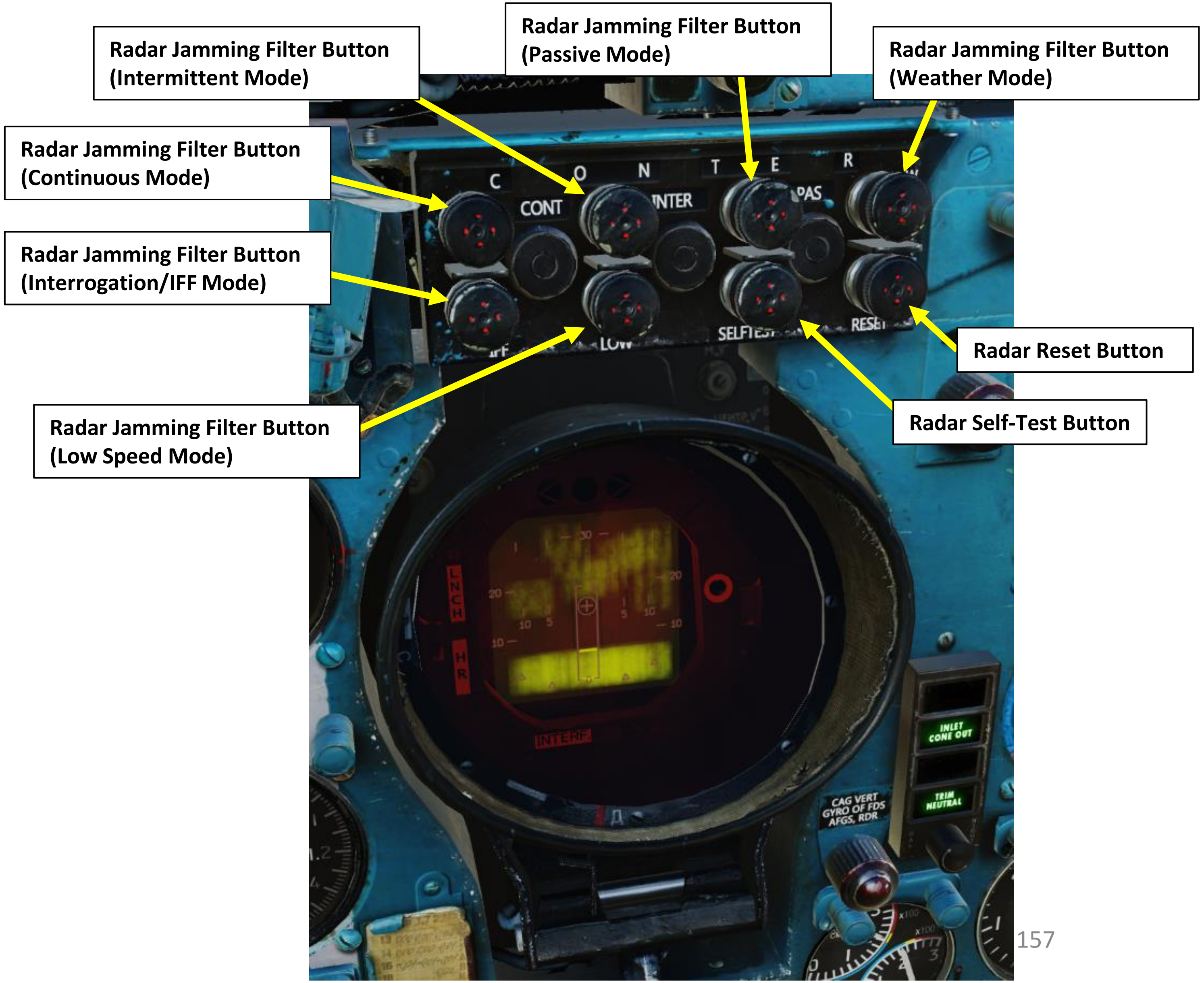






1 – RP-22 "Sapfir" Radar
1.4 - Radar Controls

- **<u>Radar Jamming Filter- Continuous Mode Button</u>**
  - Filters out radar jamming (continuous).
- **<u>Radar Jamming Filter- Intermittent Mode Button</u>**
  - Filters out radar jamming (intermittent).
- **<u>Radar Jamming Filter- Passive Mode Button</u>**
  - Filters out radar jamming (passive).
- **<u>Radar Jamming Filter- Weather Mode Button</u>**
  - Filters out cloud radar returns.
- **<u>Radar Jamming Filter- Interrogation/IFF Mode Button</u>**
  - Interrogates radar contacts and displays whether their transponder responds with a "friendly" code (=) or does not respond with a friendly code (-).
  - Interrogation can only be performed while radar is in Search Mode (no radar lock has been performed).
- **<u>Radar Jamming Filter- Low Speed Mode Button</u>**
  - Use this radar mode for slow targets (helicopters).
- **<u>Radar Self-Test Button</u>**
  - Performs a radar self-test.
- **<u>Radar Reset Button</u>**
  - Resets radar and unlocks a target that was previously locked.



1 – RP-22 "Sapfir" Radar

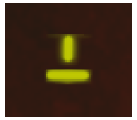
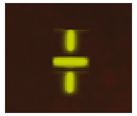
1.5 - Radar Modes

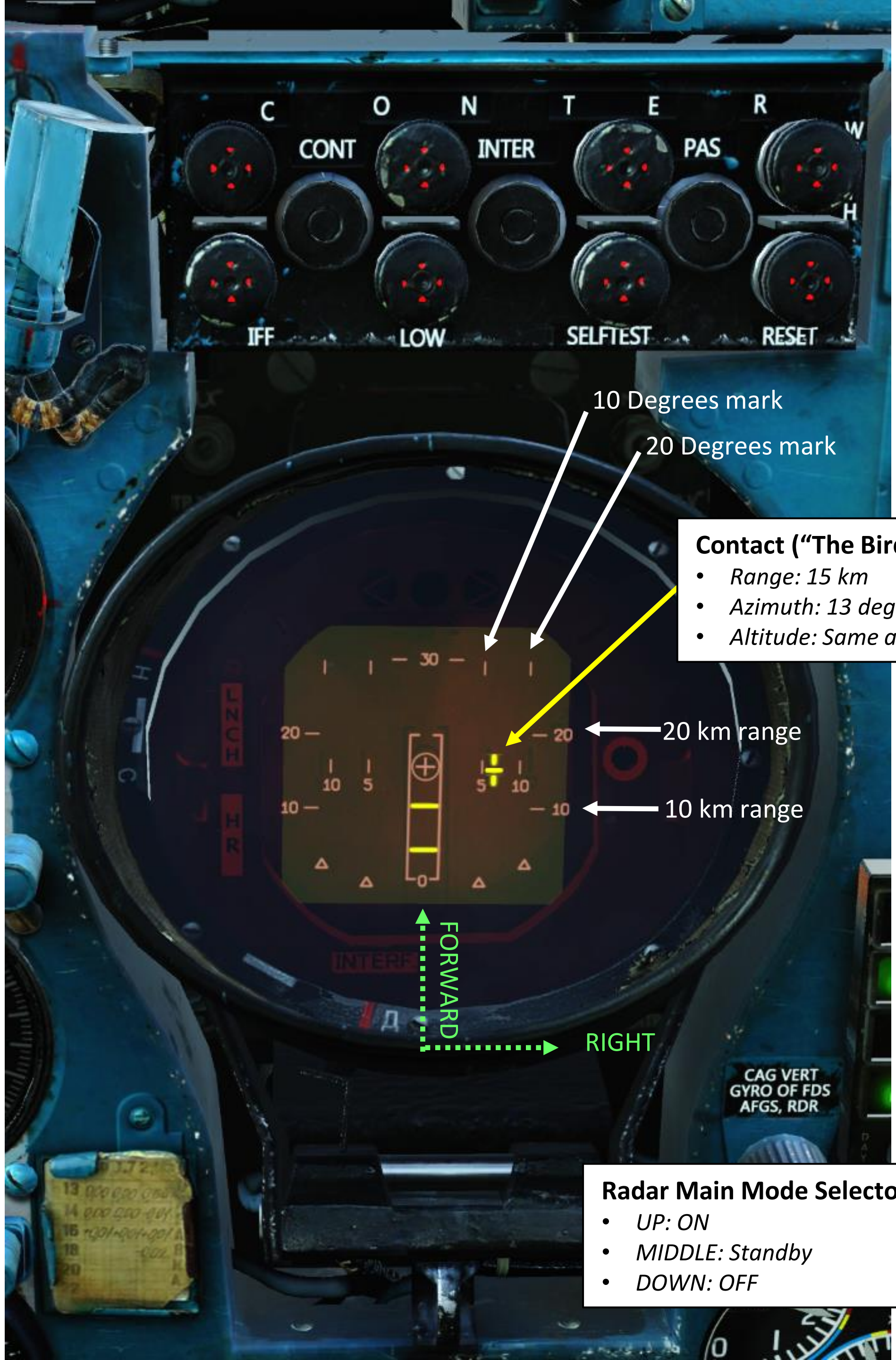
1.5.1 – Search Mode

Radar is in Search Mode when the Radar Main Mode Selector is ON and no radar lock is acquired. Radar contacts are displayed in a top-down view.

The radar scale displays a range of up to 30 km, and its scanning is horizontally stabilized. Its gimbal limits are ±30 deg in azimuth, and -1.5 deg and +17 deg in elevation. The relative altitude of the contact In relationship to your aircraft is indicated on the radar contact symbol itself (see legend on the right).

The antenna cannot be manually moved up, down, left or right like in modern fighters; you have to steer the aircraft to move the scanning cone.

Contact is under you	
Contact is above you	
Contact is at your altitude	

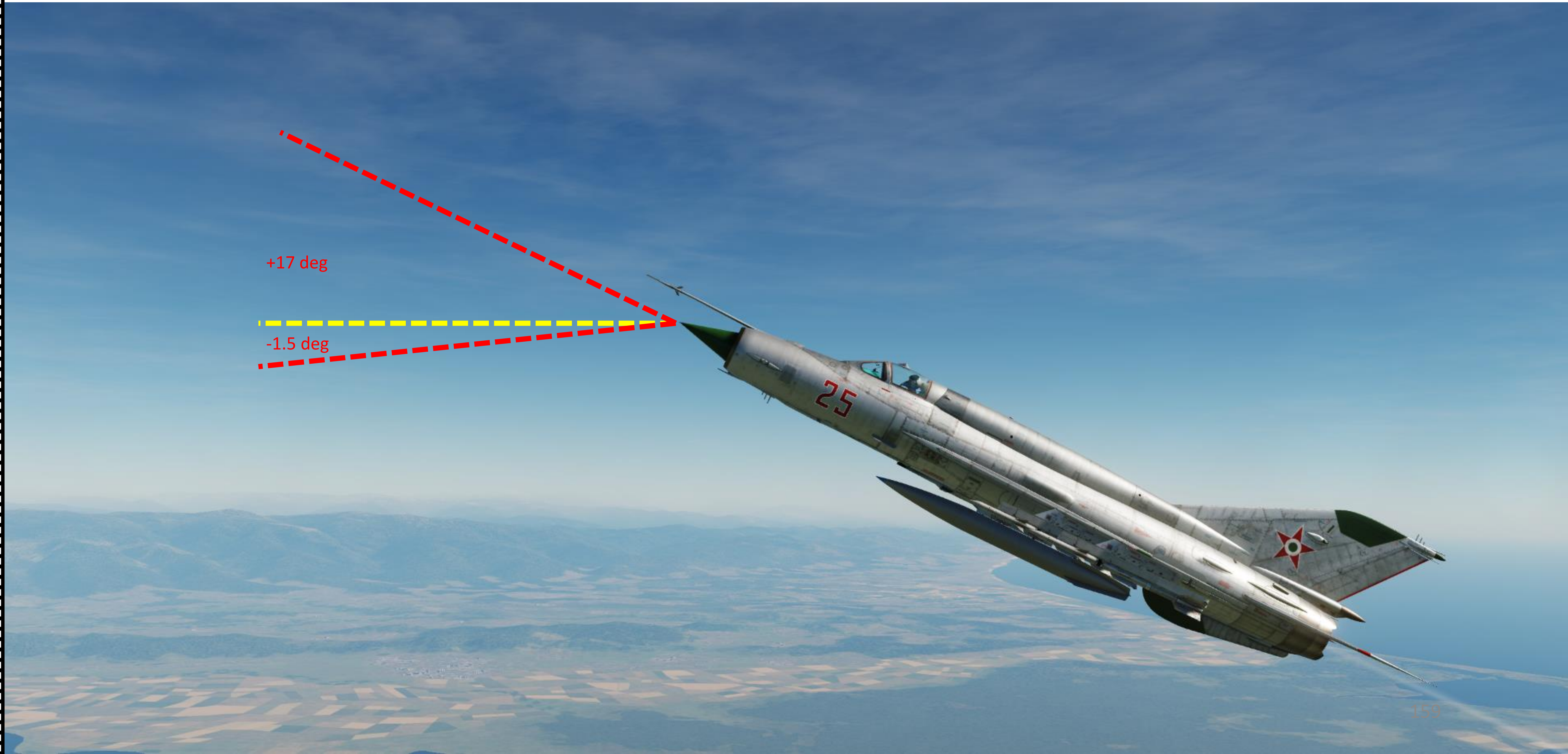


1 – RP-22 "Sapfir" Radar

1.5 - Radar Modes

1.5.1 – Search Mode

While in Search Mode, the radar is stabilized with the horizon.



1 – RP-22 "Sapfir" Radar

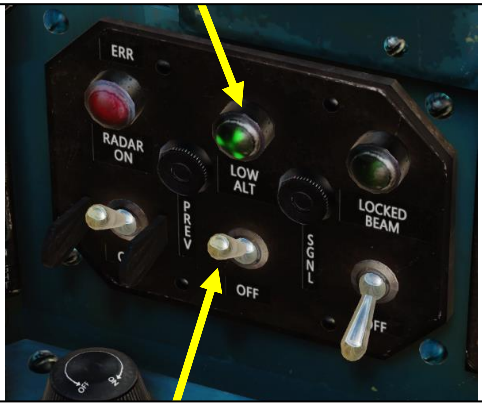
1.5 - Radar Modes

1.5.1 – Search Mode

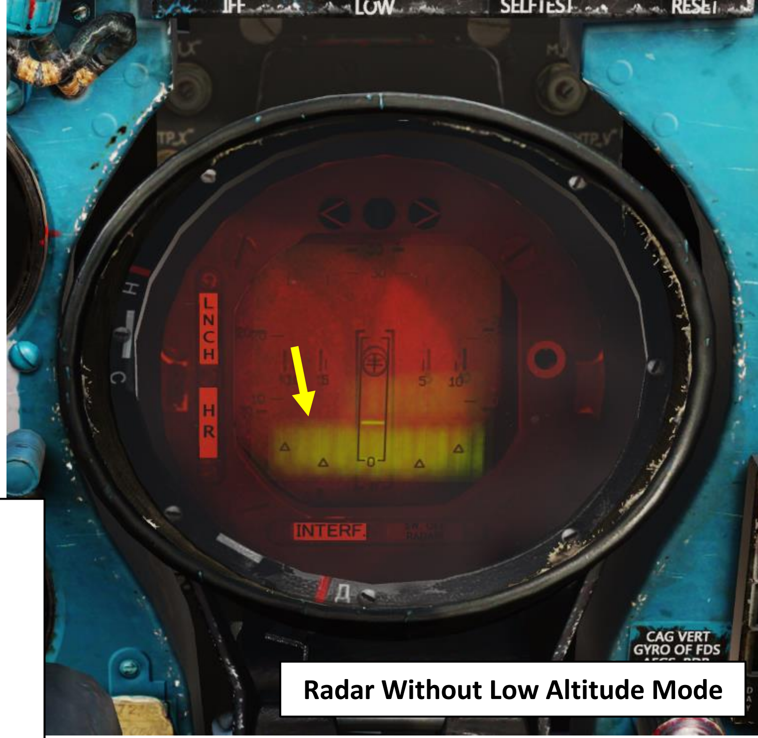
When flying below 1500 m above ground level, the radar tends to display radar returns from the ground that tend to clutter the display. The Radar Low Altitude / Sidebeam Compensation Selector switch can help you to filter out these ground returns.

- When the switch is set to **DOWN**: the radar performs normal search pattern and operates with full gain.
- When the switch is set to **MIDDLE**: the radar performs normal search pattern with a reduced gain. This "**SIDEBEAM COMPENSATION**" setting reduces detection range a bit, but filters out part of the radar side lobes (similar to radar "false returns").
- When the switch is set to **UP**: the radar performs a reduced search pattern with a reduced gain. This "**LOW ALT**" setting reduces detection range, but also tilts the radar antenna up by 1.5 deg. Similarly to Sidebeam Compensation, this setting filters out part of the radar side lobes.

Radar Low Altitude Light
- *Illuminates when Radar Low Altitude / Compensation mode is active*

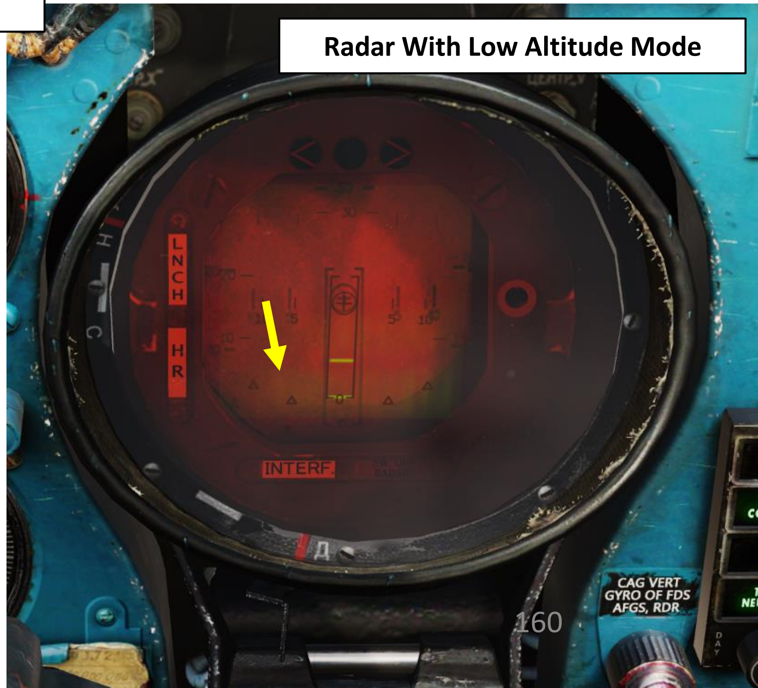


Radar Low Altitude / Sidebeam Compensation Selector Switch
- *UP: Low Altitude Setting, radar antenna is tilted up 1.5 deg*
- *MIDDLE: Compensation Setting, radar will try to erase the lower side lobes, cleaning the image*
- *DOWN: OFF*



Radar Without Low Altitude Mode

Radar With Low Altitude Mode



1 – RP-22 "Sapfir" Radar

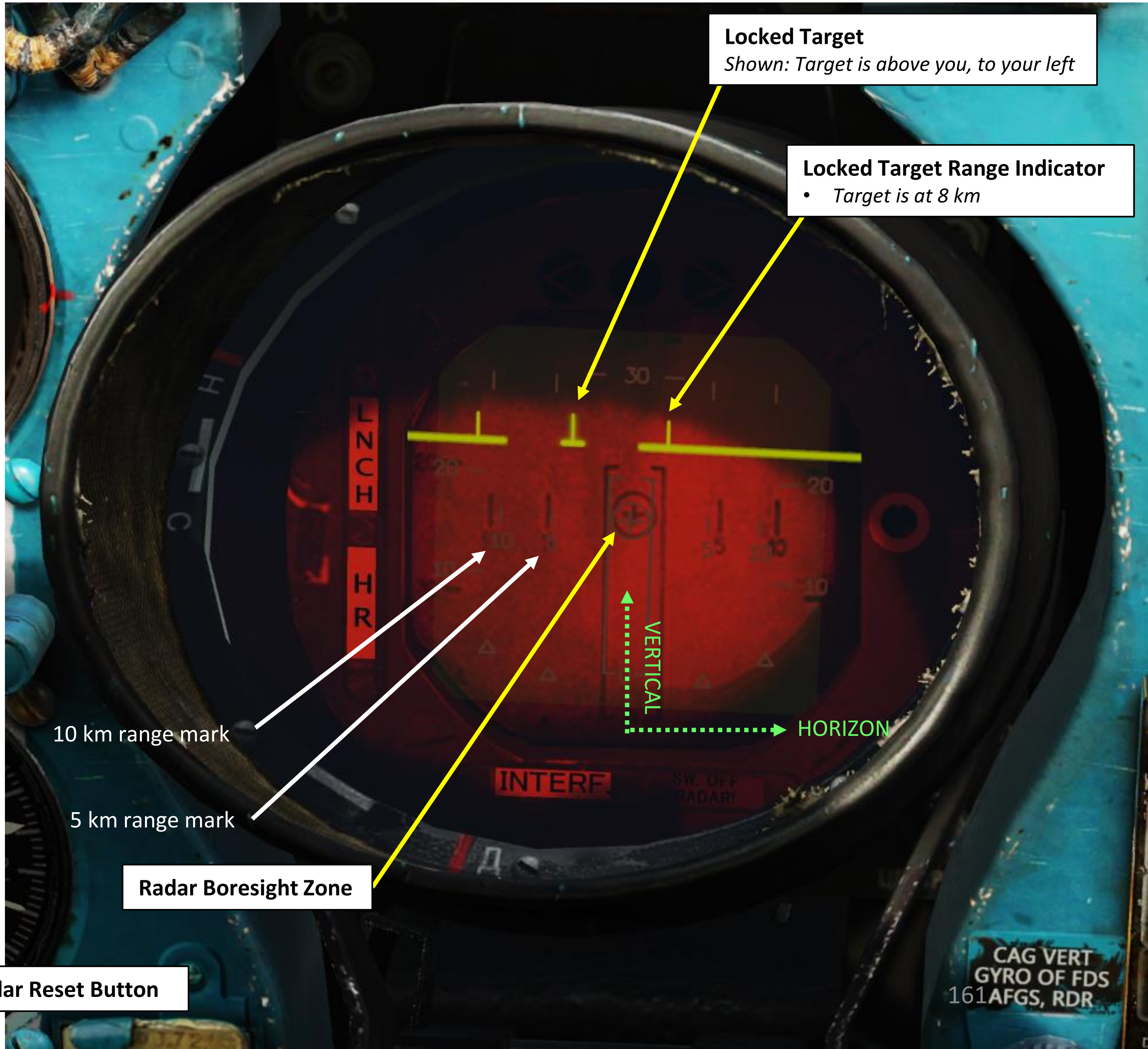
1.5 - Radar Modes

1.5.2 – Lock Mode

Radar is in Lock Mode when the Radar Main Mode Selector is ON and a radar lock is acquired with the throttle's TDC (Target Designation Cue) Slew control and Radar Lock-On button (see Air-to-Air Operation sub-section for more details). In this mode, the radar is in a "chase" view where the Locked Target symbol indicates relative azimuth, altitude and range in relationship to you.

Note: to get a good missile firing solution, steer the aircraft to place the Locked Target Symbol over the Radar Boresight Zone (center of the radar display).

Radar Lock Mode is exited by pressing the Radar Reset Button.



1 – RP-22 "Sapfir" Radar
1.5 - Radar Modes
1.5.3 – Fixed/Locked Beam Mode

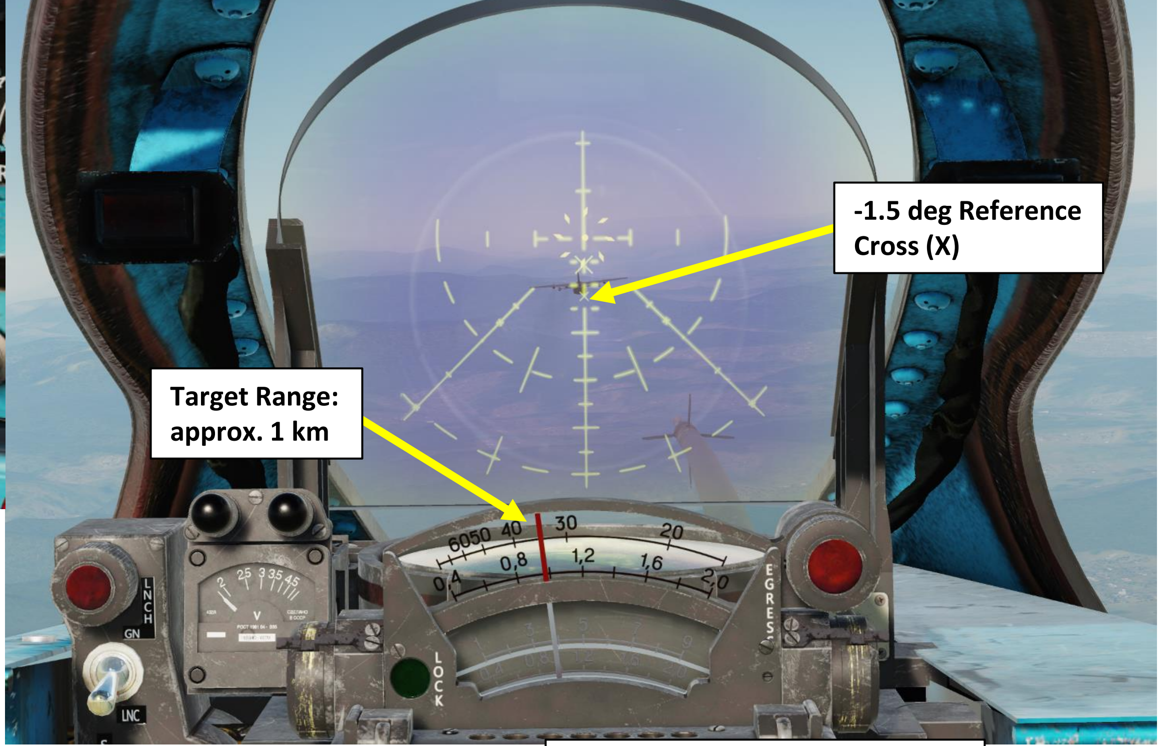
Fixed Beam - Radar Ranging (Air Targets)

When the radar is ON and the Fixed/Locked Beam Mode Selector Switch is ON, the radar can be used to estimate the range to a target.

When in Fixed Beam, the radar locks the beam along the longitudinal weapon axis (-1.5 deg, marked as the bottom-most "X" on the ASP Fixed Net). Place the Reference Cross on the target and the range will be indicated on the radar display (fixed beam length) for long distances and on the ASP Sight for distances below 2 km.

Take note that you do not require a radar lock to get ranging information.

Master Mode Switch
- *UP: Air*
- *DOWN: Ground*

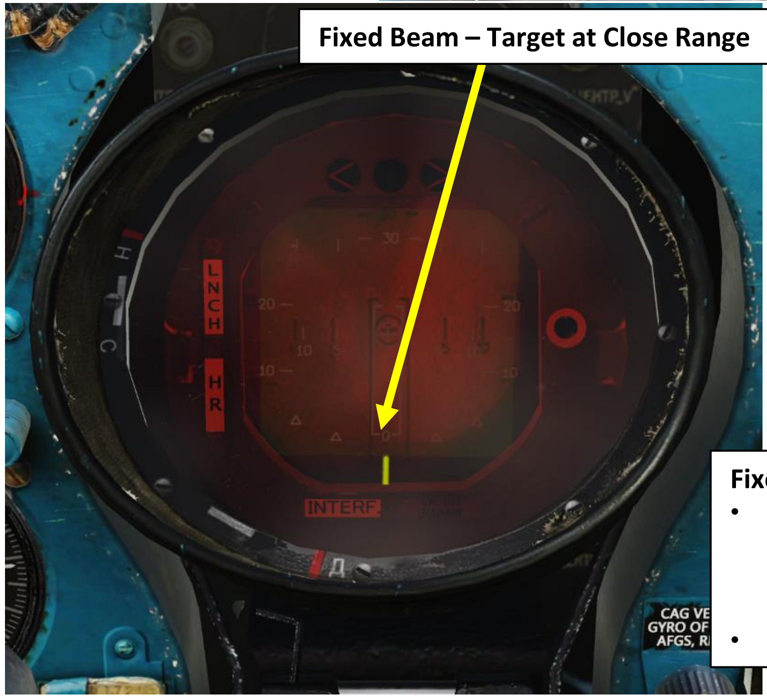


-1.5 deg Reference Cross (X)

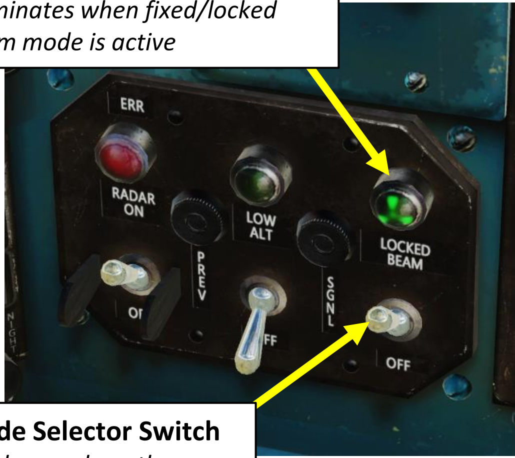
Target Range: approx. 1 km

Fixed Beam – Target at Long Range

Fixed Beam – Target at Close Range



Radar Fixed/Locked Beam Light
- *Illuminates when fixed/locked beam mode is active*



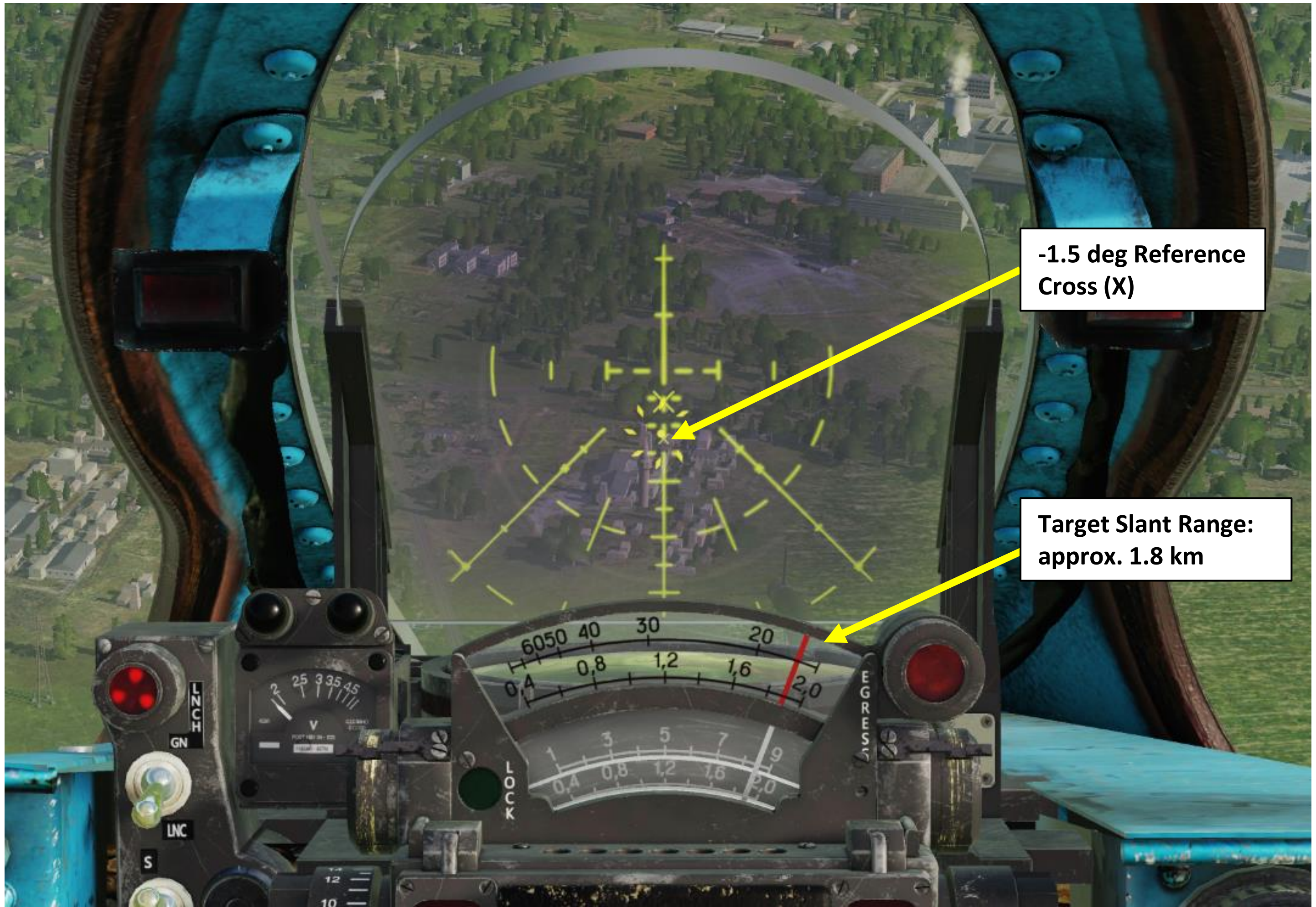
Fixed/Locked Beam Mode Selector Switch
- *UP: ON, locks the radar beam along the longitudinal weapon axis (-1.5 deg) enabling distance measuring when you attack ground targets*
- *DOWN: OFF*

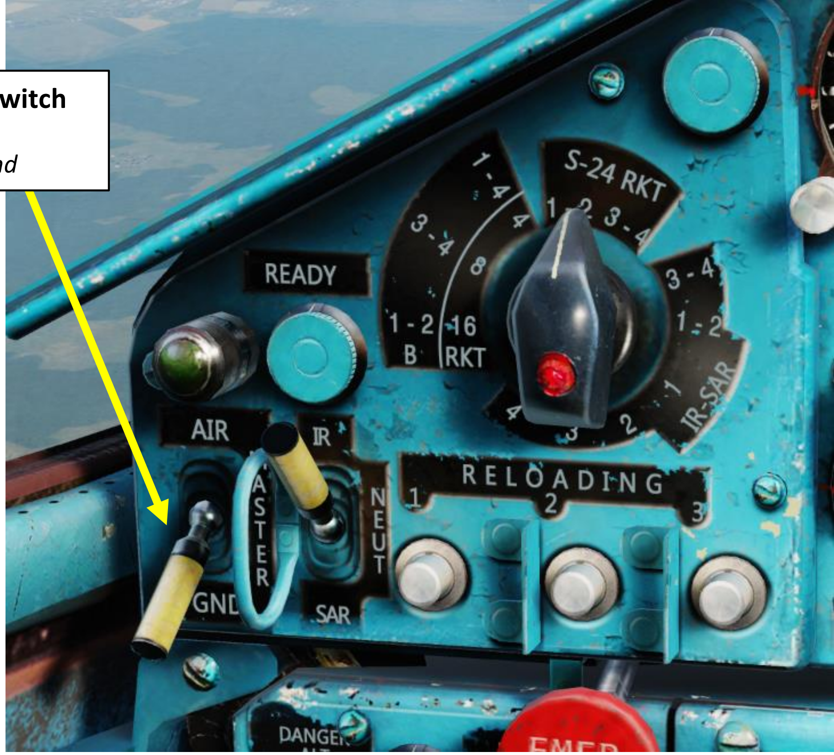
1 – RP-22 "Sapfir" Radar
1.5 - Radar Modes
1.5.3 – Fixed/Locked Beam Mode

Fixed Beam - Radar Ranging (Ground Targets)

When Fixed Beam mode is used with Ground Master Mode selected, radar ranging allows you to get ranging distance from the ground. This is used for rocket strikes.

Take note that you do not require a radar lock to get ranging information.



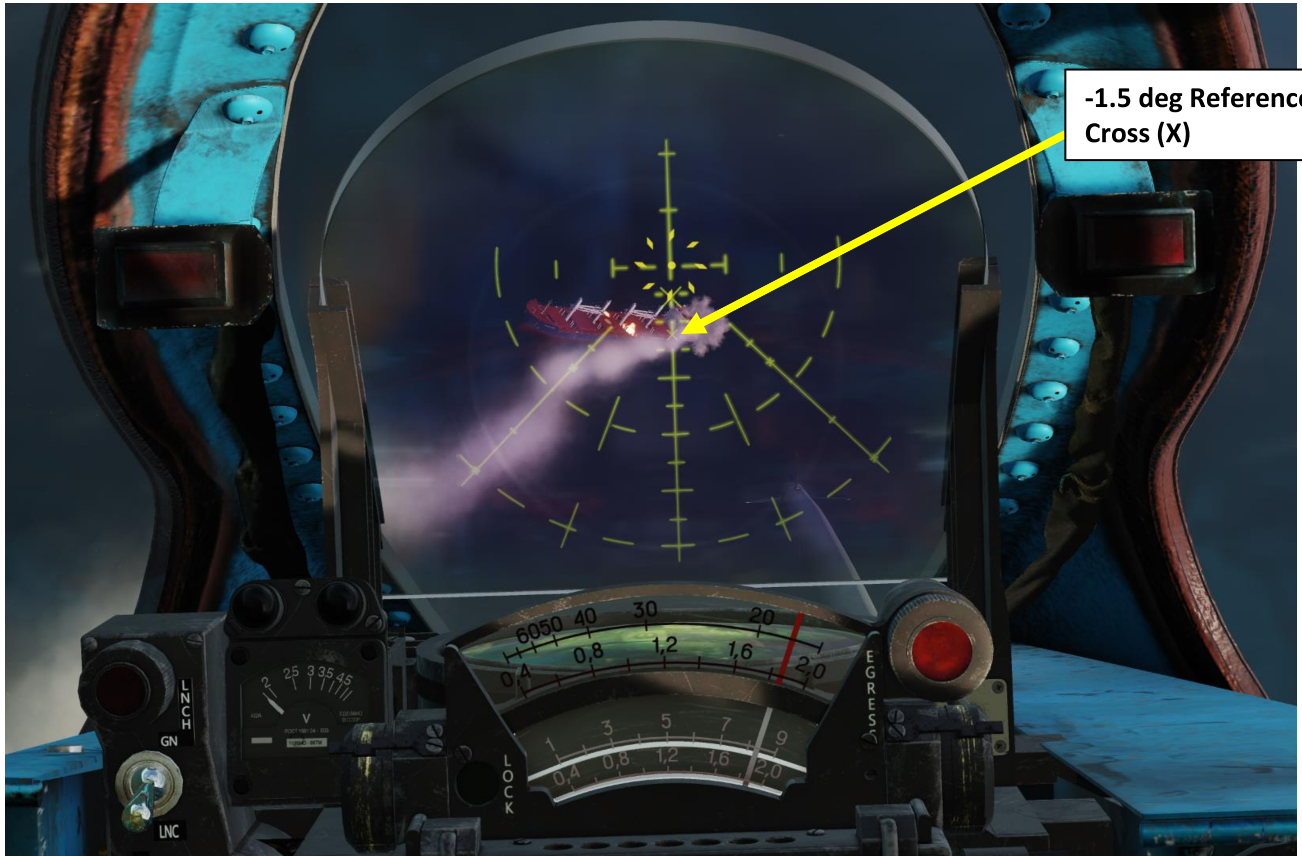


1 – RP-22 “Sapfir” Radar
1.5 - Radar Modes
1.5.3 – Fixed/Locked Beam Mode

Fixed Beam - Radar Beam Riding (KH-66 GROM Missile)

Another function of the Fixed Beam mode is the ability to use radar beam riding weapons such as the KH-66 GROM. The missile “rides” (tracks) the radar beam, which follows the longitudinal weapon axis (-1.5 deg, marked as the bottom-most “X” on the ASP Fixed Net).

Note: The way the radar beam riding is simulated for the RP-22 radar is not exactly as per real life; the way it is simulated in DCS is a gameplay concession to allow the use of the KH-66 GROM.

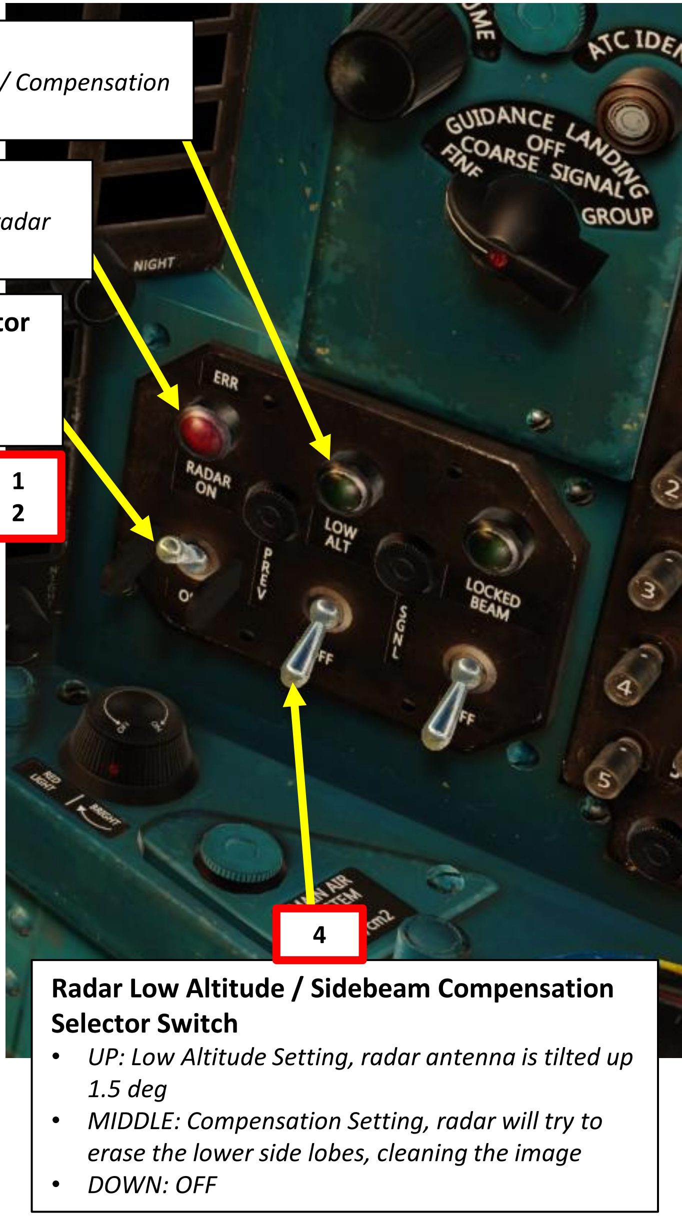


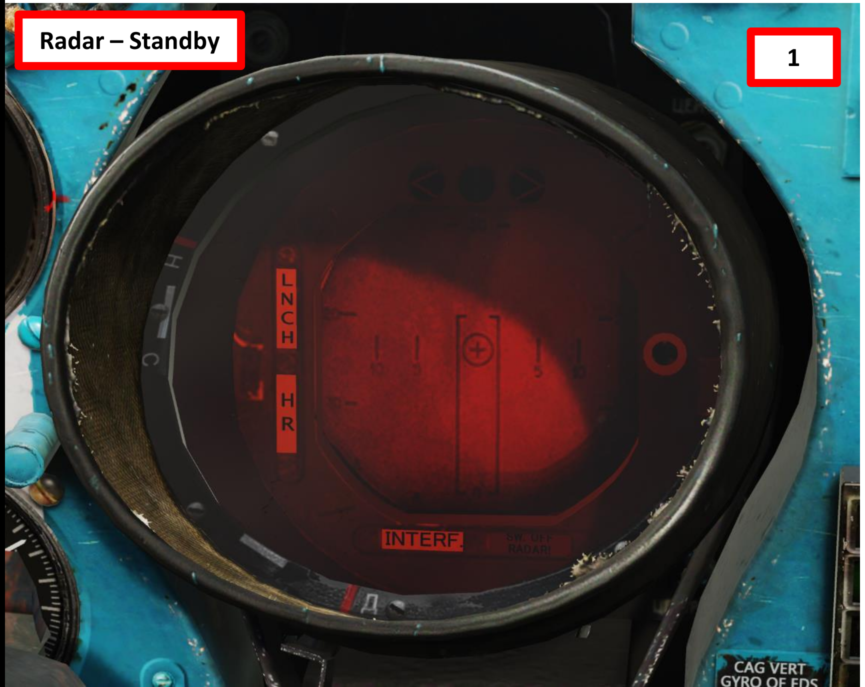
1 – RP-22 "Sapfir" Radar

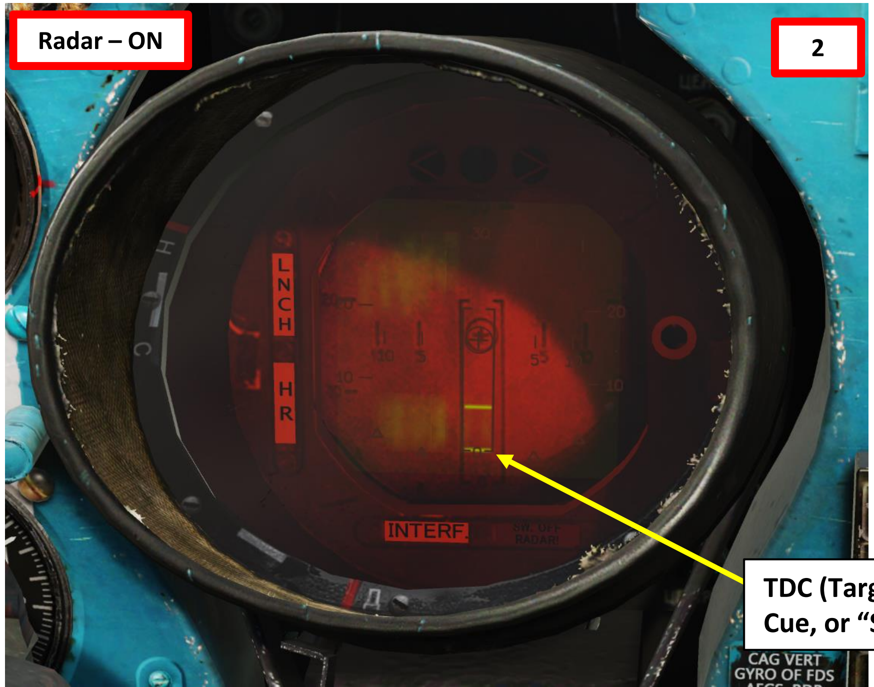
1.6 - Radar Operation

1.6.1 – Air-to-Air Operation

1. Set Radar Main Mode Selector to MIDDLE (STANDBY) to start radar warm-up. The RP-22 requires a 3 to 5 minute warm-up period before being functional. While in Standby Mode, the radar alcohol coolant lasts for 35 to 40 minutes.
2. Set Radar Main Mode Selector to UP (ON) to start scanning for targets in Search Mode. While radar is in Search Mode (ON), the coolant lasts for 20-25 minutes.
   - If radar is warm up properly, the TDC (Target Designation Cue) will be visible.
   - If the radar warm-up is not complete, the TDC will not be visible.
3. Set Master Mode Switch – Air (UP)
4. If scanning for targets below 1500 m, it is recommended to set the Radar Low Altitude Switch UP to LOW ALT. This will tilt the radar antenna 1.5 deg upwards to filter out ground clutter radar returns. Keep in mind that detection range is reduced with LOW ALT sub-mode. In our case, we expect the target to be above 1500 m, so we will leave the LOW ALT switch DOWN to OFF.
5. For slow targets like helicopters, you can use the LOW SPEED filter.





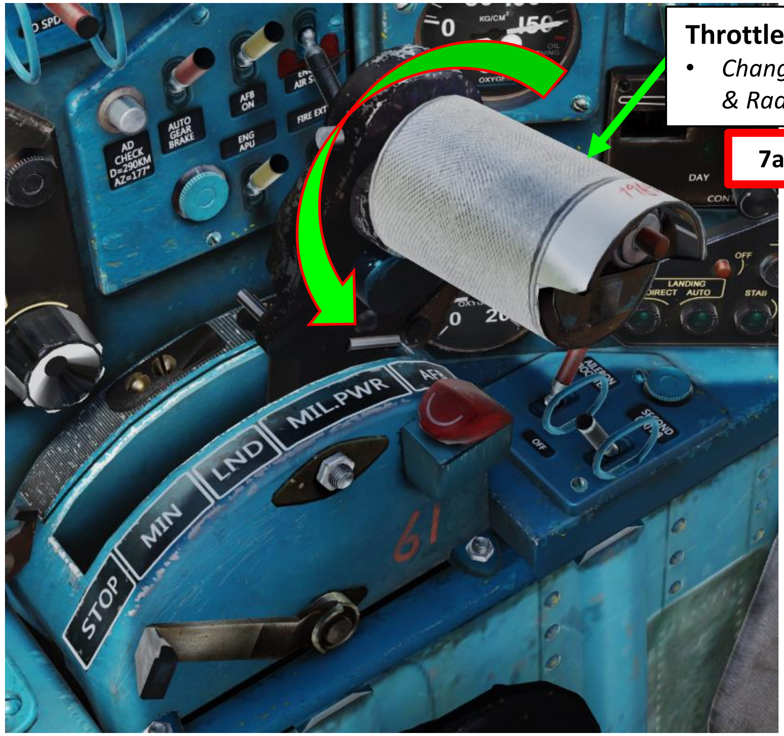


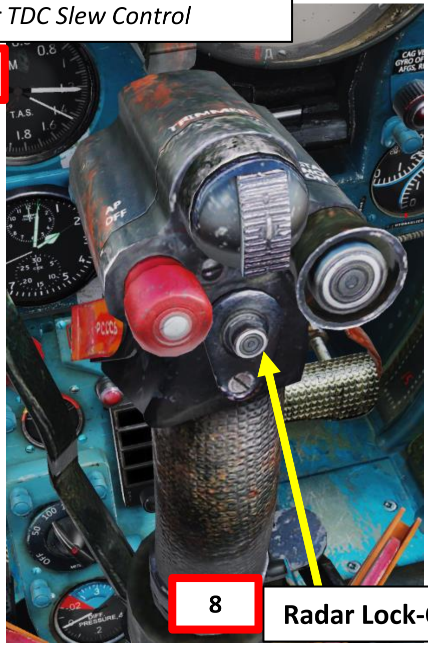
1 – RP-22 "Sapfir" Radar

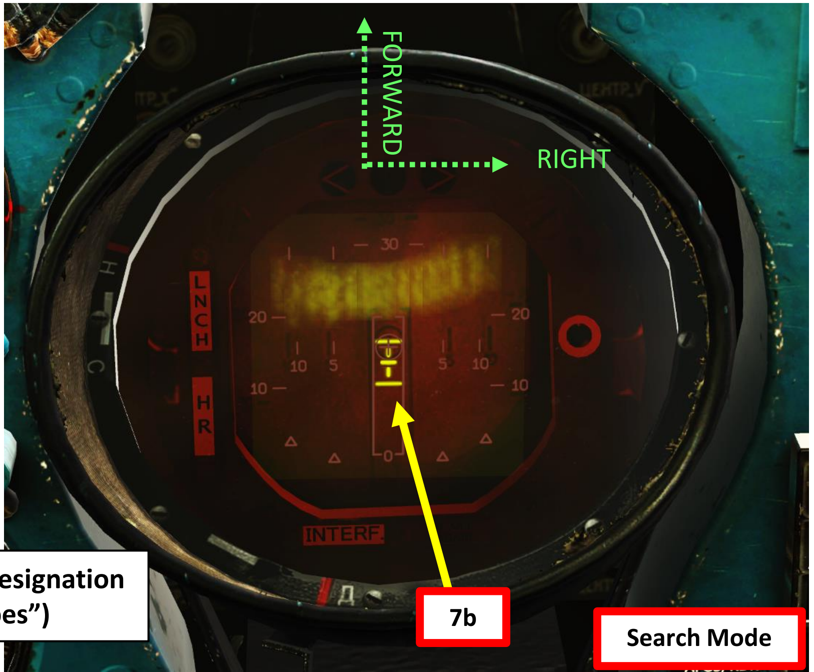
1.6 - Radar Operation

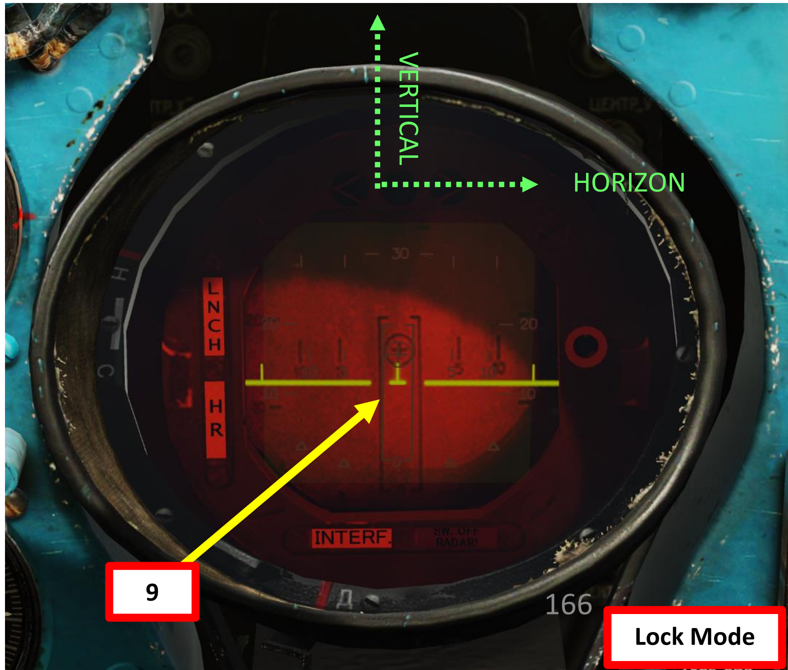
1.6.1 – Air-to-Air Operation

6. When a radar contact is visible, steer aircraft to align the contact ("bird") symbol with the centerline of the radar display. Make sure the radar contact is within the Azimuth Lock-On Zone (rectangle).
7. Slew the TDC (Target Designation Cue) over the radar contact using the Throttle Twist Grip. The TDC can only move up or down on the display and has no azimuth slew control.
8. When TDC gates are slewed over the radar contact, press and hold the Radar Lock-On button for 3 to 5 seconds; until the radar enters Lock Mode (Chase View).
9. When radar enters Lock Mode, the radar switches from a top-down view (Search Mode) to a first-person view (Lock Mode)







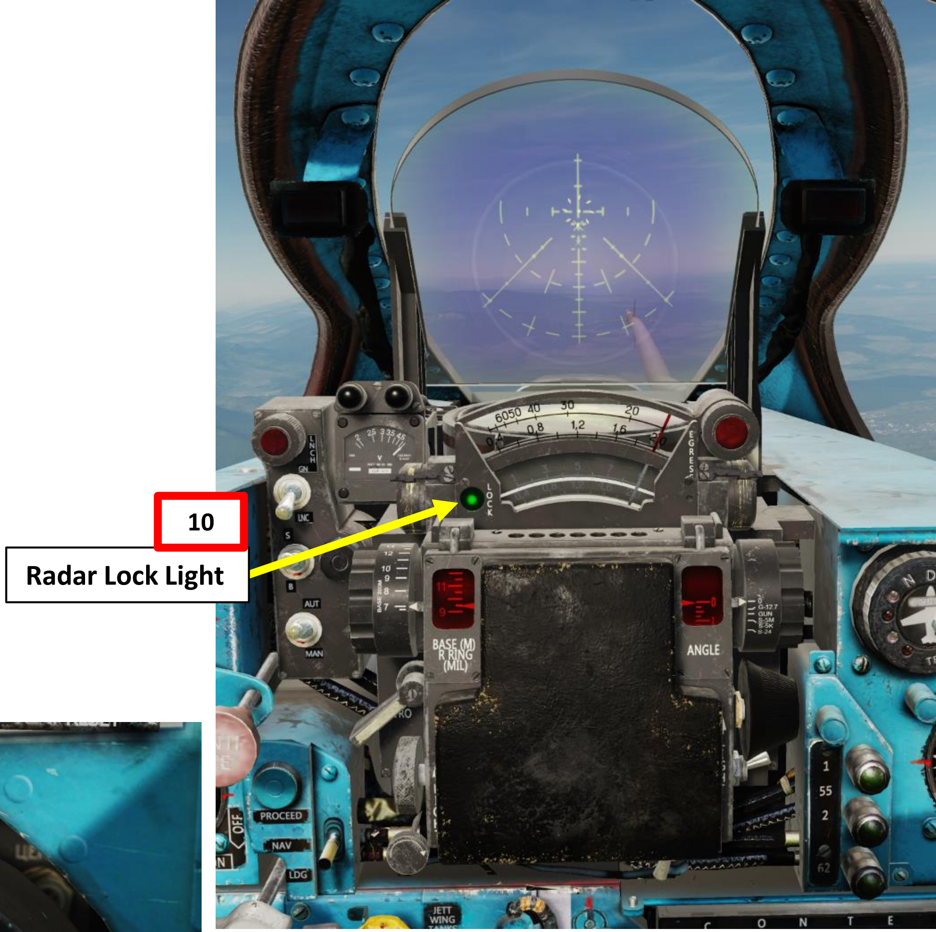


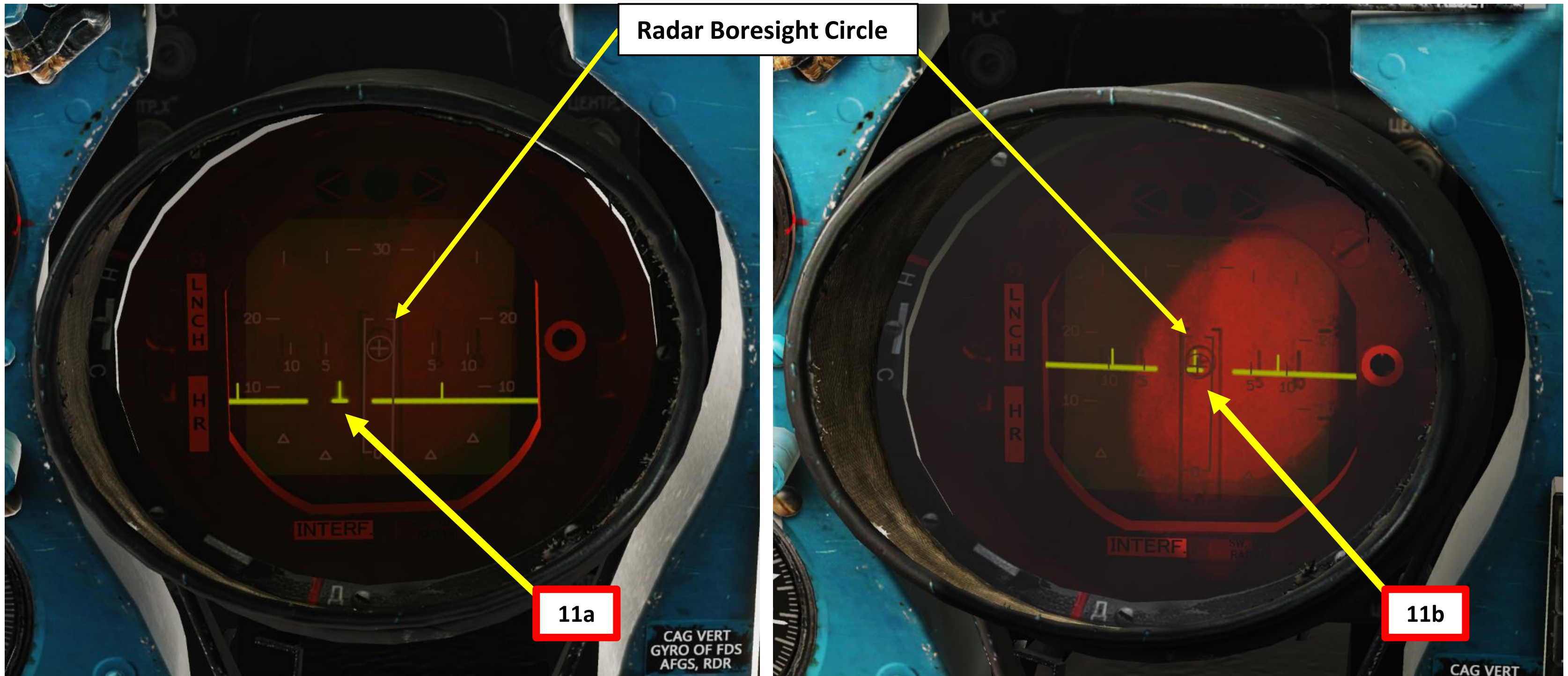
1 – RP-22 "Sapfir" Radar

1.6 - Radar Operation

1.6.1 – Air-to-Air Operation

10. When radar lock is performed, the LOCK light on the ASP Optical Sight will illuminate.
11. Steer aircraft to center the radar blip symbol on the radar boresight circle at the center of the display.
12. When a contact is spotted, you will most likely be flying under it.
13. After lock, you will generally be in radar range, but not in effective missile range.
14. You are in effective missile range when the two vertical bars are inside the max missile range zone on the RP-22 display and the two red vertical lights on the left are lit. Missile hit is not guaranteed though.





1 – RP-22 "Sapfir" Radar

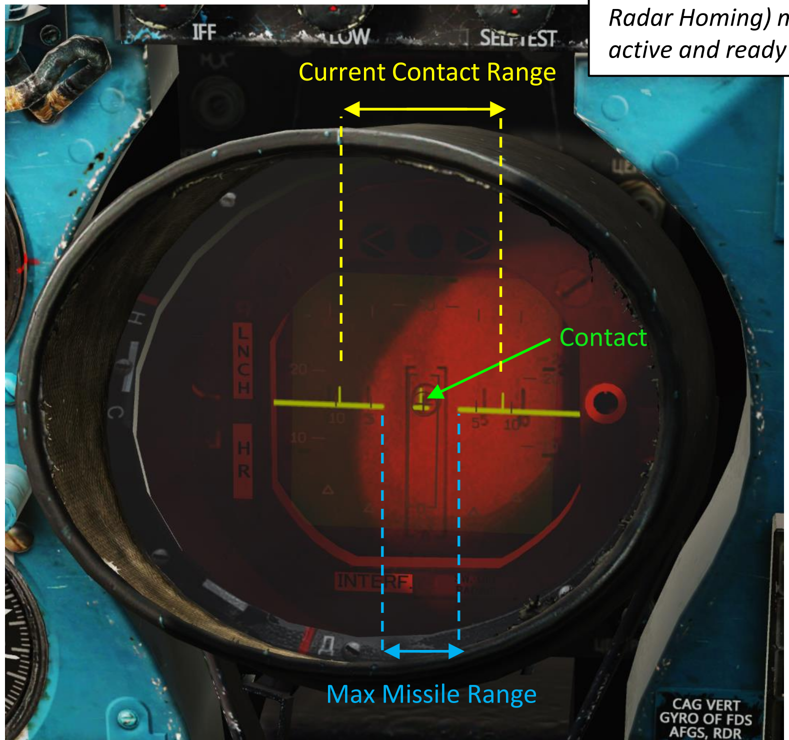
1.6 - Radar Operation

1.6.1 – Air-to-Air Operation

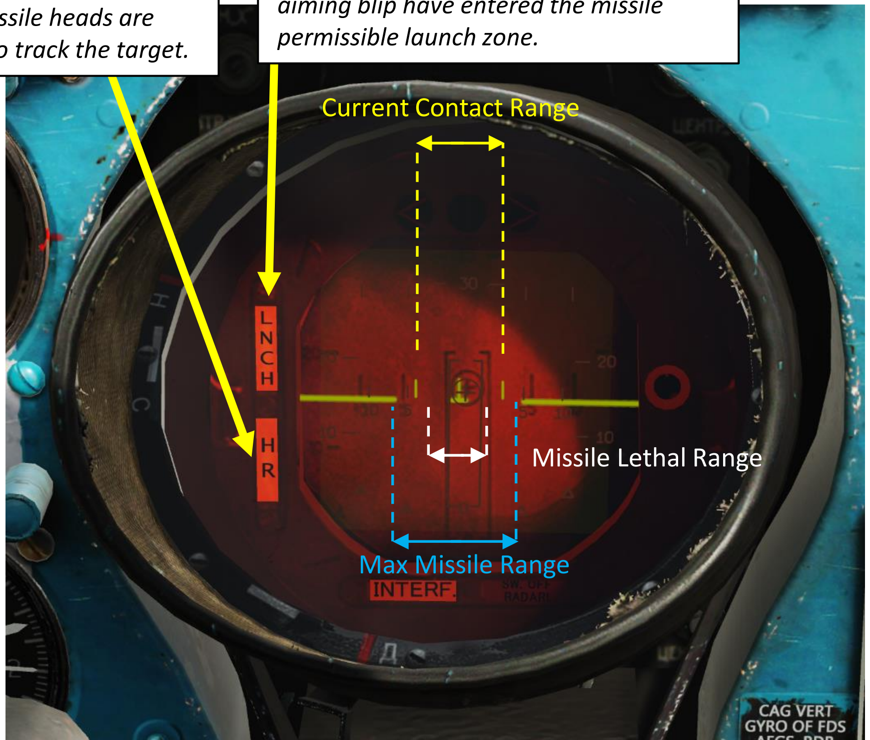
15. If you have selected a semi-active radar homing missile and are within lethal firing range, the LNCH (Launch) and HR (Head Ready) lights will illuminate on the display. The LNCH light on the ASP Optical Sight will also illuminate.
16. You are in lethal missile range when the two vertical bars are at half (or a third) of the max missile range. You can now fire missile and expect it to track your target as long as you maintain radar tracking.
17. If BREAK OFF light illuminates, you are on a collision course with the target. Perform evasive action to avoid crashing into your target.
18. To unlock a target, press on the Radar Reset button.

- Radar locking is **mandatory** for SARH (Semi-Active Radar Homing) missiles like the **R-55 or the R-3R**, which require constant radar lock to track a target.
- Radar lock does not guide **IR** (infrared) missiles like the **R-3S, R-13 and R-60**, who track targets on their own.

HR (Missile Head Ready) Light
Illuminates when SARH (Semi-Active Radar Homing) missile heads are active and ready to track the target.



LNCH (Missile Launch Ready) Light
Illuminates when range marks on the aiming blip have entered the missile permissible launch zone.



LNCH (Missile Launch Ready) Light
Illuminates when range marks on the aiming blip have entered the missile permissible launch zone.

Radar "Break Off" Light
Illuminates when you are about to collide with radar locked target.

18

1 – RP-22 "Sapfir" Radar

1.6 - Radar Operation

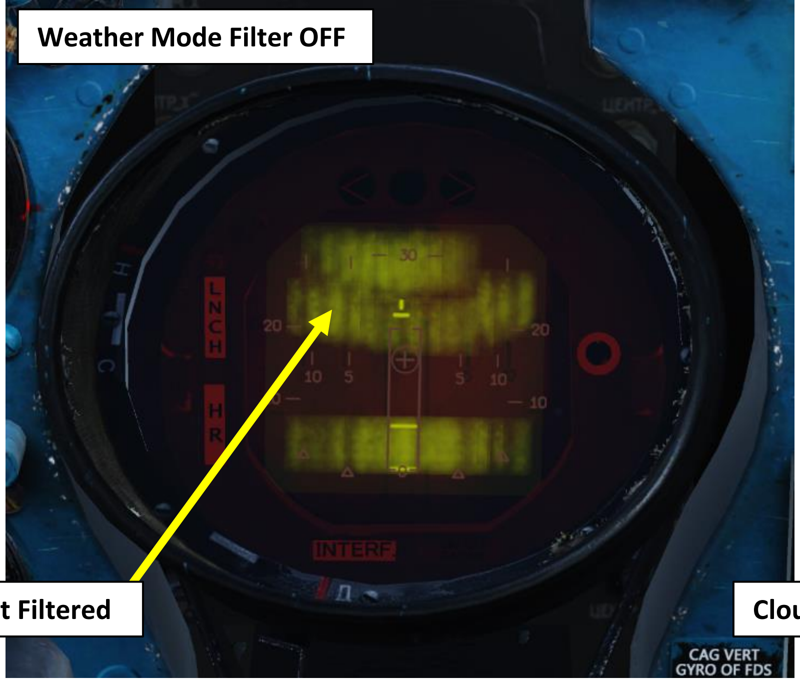
1.6.2 – Air-to-Ground Operation

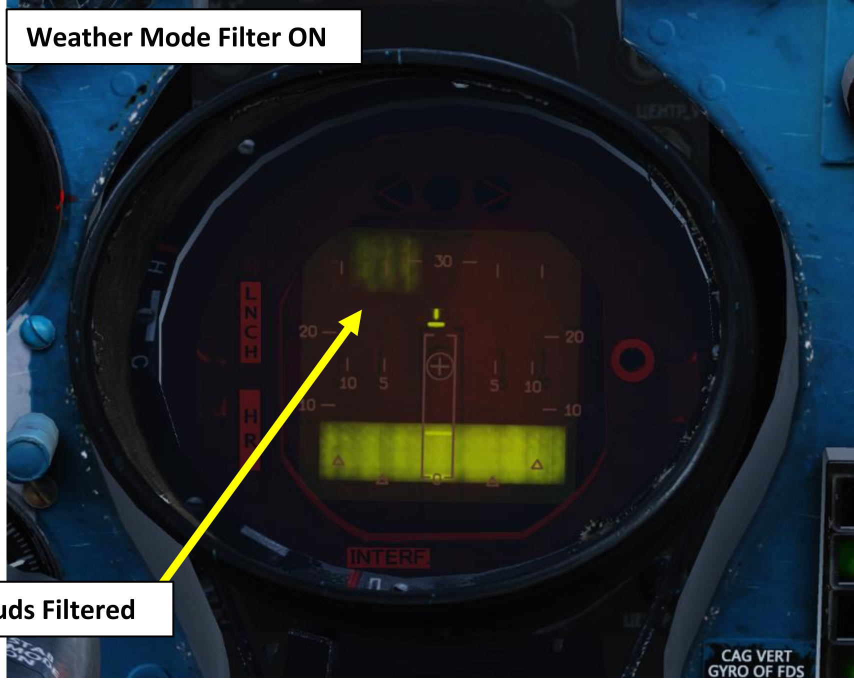
The RP-22 radar as simulated in DCS can be used for three primary functions:

- Air Target Radar Ranging (Fixed Radar Beam Selected + Master Mode set to AIR)
- Ground Target Radar Ranging for rockets (Fixed Radar Beam Selected + Master Mode set to GROUND)
- Use Radar Beam Riding weapons like the KH-66 GROM (Fixed Radar Beam Selected + Master Mode set to GROUND)

1 – RP-22 "Sapfir" Radar
1.7 - Radar Weather Filter

In cloudy weather conditions, the radar tends to pick up radar returns from cloud formations. You can filter out these clouds by pressing the Radar Jamming Filter Weather Mode Button.





1 – RP-22 "Sapfir" Radar
1.8 - Radar Jamming Filters

Operating a radar in a modern combat environment can be tricky. Most of your opponents will have jamming devices to prevent you from having a range on them. This is what we call "ECM" jamming (Electronic Countermeasures).

In a real life scenario where a MiG-21bis is pitted against modern ECM jammers like the ones used by the F-15, your radar filters from 1968 would not be of much help. Thankfully, this is a sim, not real life.

There are three jamming filter modes: CONTINUOUS, INTERMITTENT and PASSIVE.

- <u>CONTINUOUS</u> will filter out active jamming. **Active (transmitted) jamming** is when a device transmits its own synchronized radar waves back at your enemy's radar receiver to simulate erroneous radar wave returns. Simply put, an active jamming device tries to drown your radar in white noise.

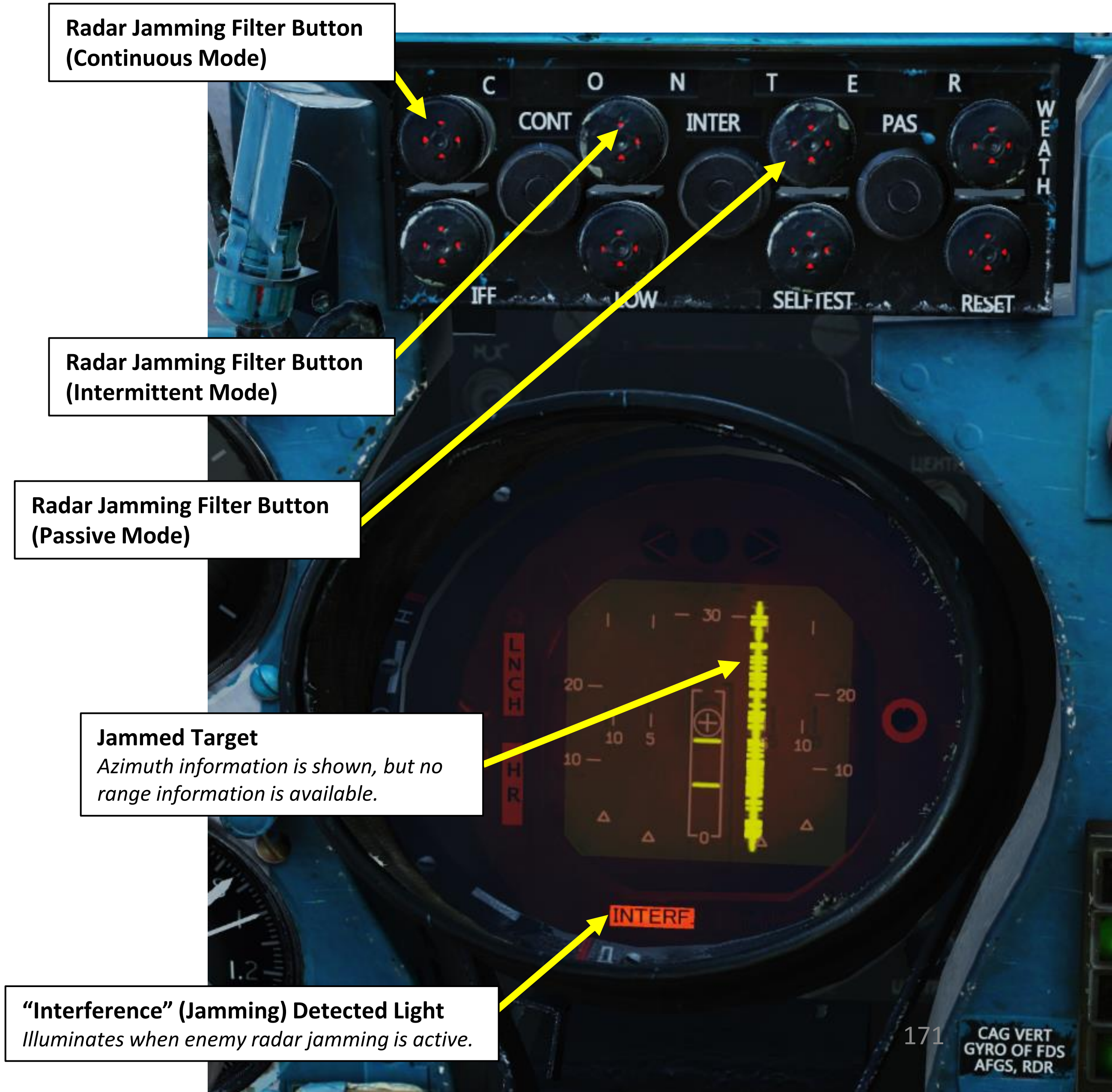
- <u>PASSIVE</u> will filter out passive noise protection. **Passive (reflected) jamming** is when a deceptive object or device reflects radar waves. Chaff is an example of passive jamming: small pieces of metal foil with reflective coating create clusters of radar signature that prevent a radar to get a solid lock on the aircraft itself.

- <u>INTERMITTENT</u> will switch back and forth between CONTINUOUS and PASSIVE filters. **Highly recommended**.

<u>If you are being jammed, apply appropriate jamming filter (I recommend using "Intermittent" most of the time and switching to other filters if it doesn't work). Use the reset switch to turn filters off.</u>

When you filter out jamming, you will not be able to move your TDC to lock your target. Therefore, you need to manoeuver your aircraft to get in a position where your TDC will be aligned to get a radar lock.

Radar jamming issues do not apply to IR (infrared) missiles like the R-3S, R-13 and R-60. IR missiles track heat signatures and do not rely on radar waves for tracking.



1 – RP-22 "Sapfir" Radar
1.9 - Radar Considerations

The RP-22 radar requires cooling by alcohol. As the radar heats up, heat is transferred from the radar to the alcohol coolant which then evaporates. This means that you can operate your radar for a limited amount of time.

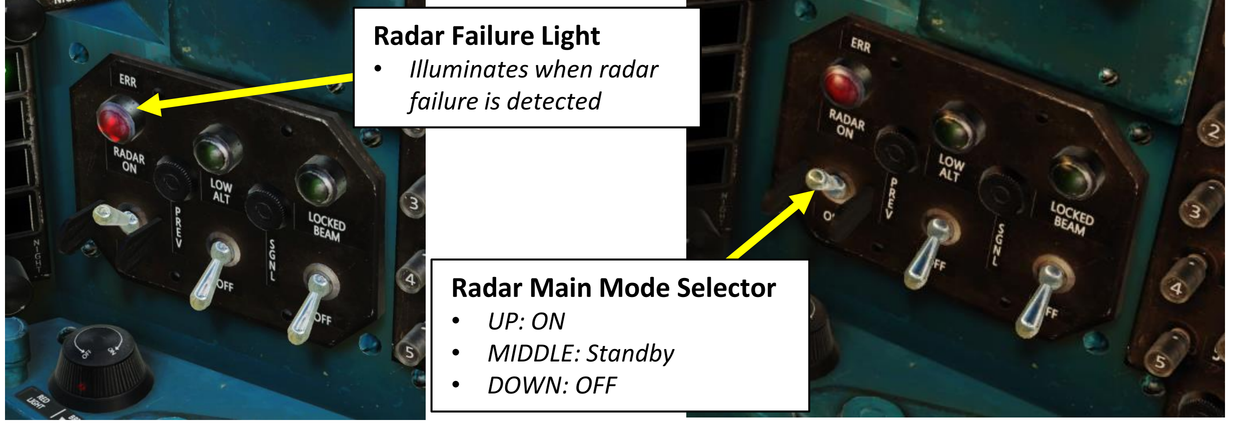
- Radar requires a 3 to 5 minute warm-up period (STANDBY) before being functional (ON).
- Radar in Standby: radar alcohol coolant lasts for 35 to 40 minutes,
- Radar ON: radar alcohol coolant lasts for 20-25 minutes.

When the "**Switch OFF Radar**" light illuminates on the radar display, set Radar Main Mode selector to OFF. This means there is no more coolant available for the radar. Failure to do so within the next few minutes will cause a complete radar failure due to overheating, indicated by the "**Radar Failure" l**ight. In that case, prepare to be yelled at by the crew chief.

But why? Isn't that limitation very restrictive, especially since most western aircraft can operate their radar all flight long? Yes, maybe, but there is a reason behind this design. Russian engineers had to work with very constraining limitations: low budget, tight schedule. At that time, the RP-22 was considered to be a very practical design. It was cheap, effective (for the time), light, used minimal space, was easy to produce, had easy maintenance, had low toxicity (western radar coolants are VERY toxic), could operate in a broad spectrum of conditions (from -60 to +60 deg C), was reliable enough to operate on bumpy field landing strips and required relatively short training periods to operate. However, alcohol coolant had to be replenished after each flight and required storage facilities (where ground crews and base personnel could often drink it safely!).

This design is practical in the sense that the USSR used interception tactics based on the GCI (Ground-Controlled Interception) model: flights of interceptors would be scrambled and directed to targets by ground controllers, like the British were during the Battle of Britain with the Dowding System. By turning on their radars in the vicinity of targets only, interceptors could minimize their detectability (since your radar radiation "warns" the enemy RWR when it is scanning) and use surprise to their advantage. This strategy proved to be rather effective during the Vietnam war.

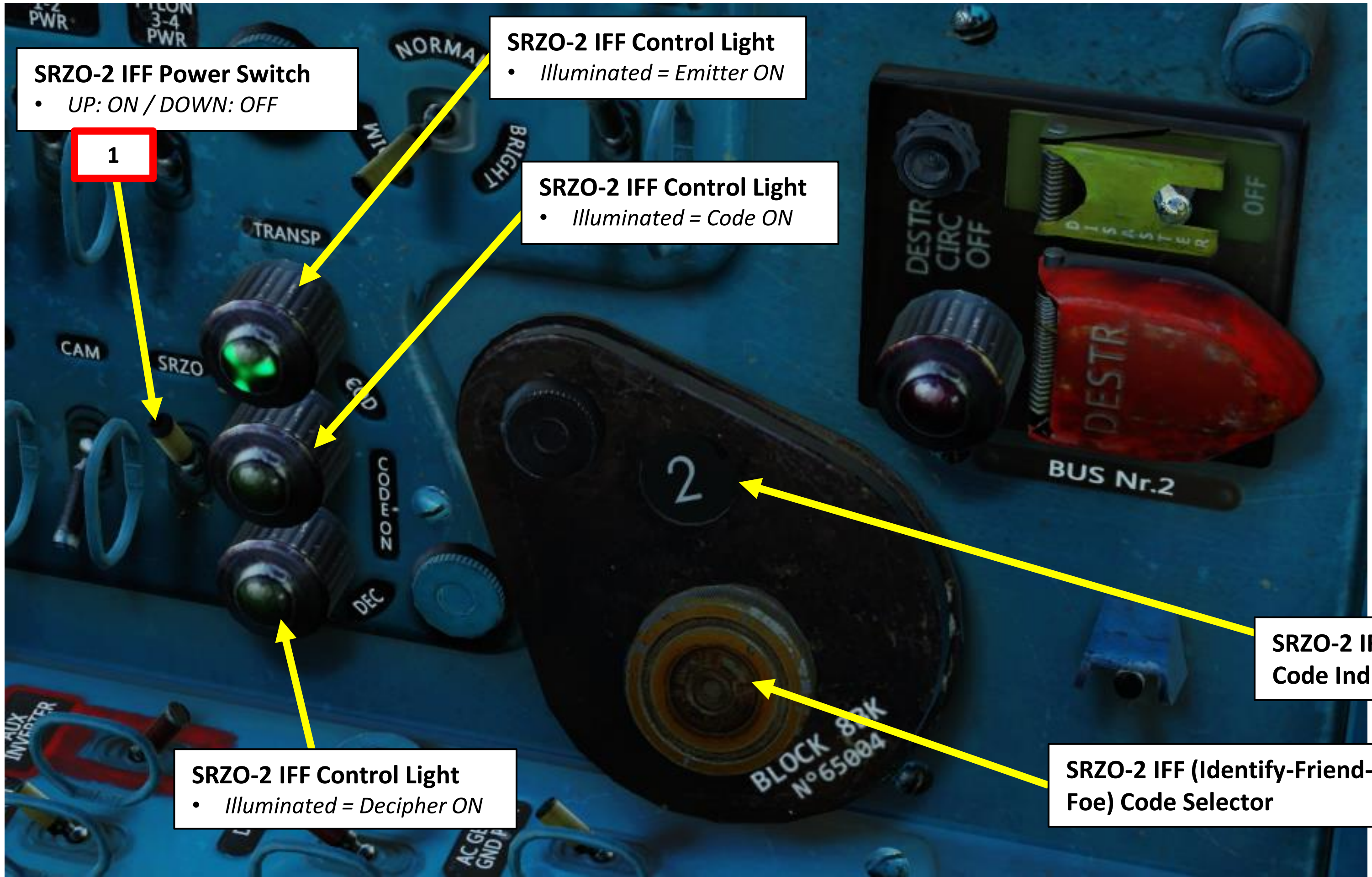
When radar coolant has run out, the SW OFF RADAR light will illuminate on the radar display. In that case, do what the light says and turn off radar.

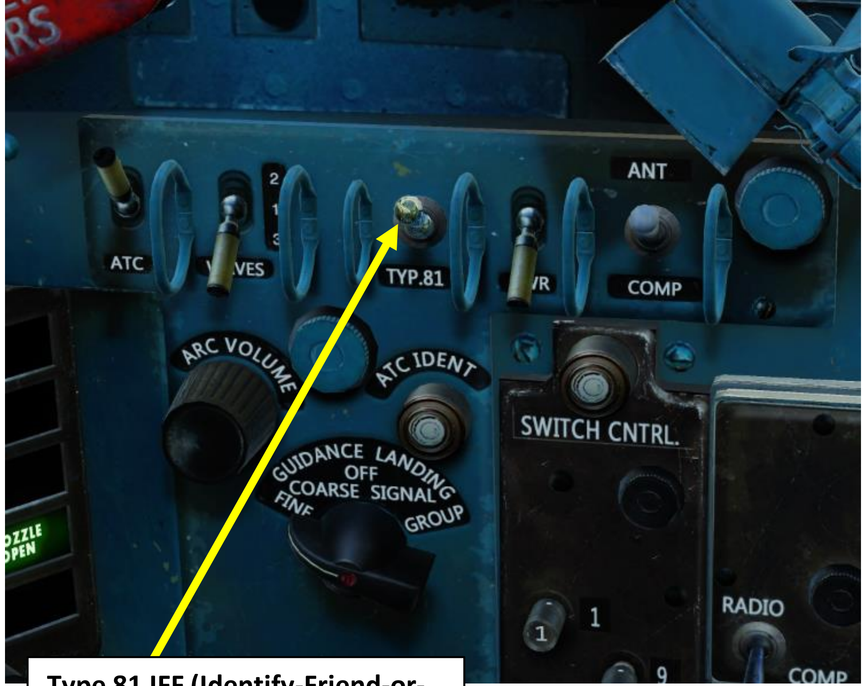


2 – Target Identification (IFF)

In order to identify whether a radar contact is friendly or not, you have to use the IFF (Identify-Friend-or-Foe) system. How does it work? An interrogation signal at a set frequency (code) is transmitted. Then, if the aircraft scanned by your radar has his transponder set to the correct frequency (code), a “friendly” response signal is transmitted to you and the symbol on your radar will display “=“. However, if the interrogated aircraft does not have a transponder or does not have the correct response signal set on his transponder, the radar contact is then considered “unknown” and will display “–”. The contact will likely have to be visually identified before engaging (unless a ground controller tells you to engage straight away).

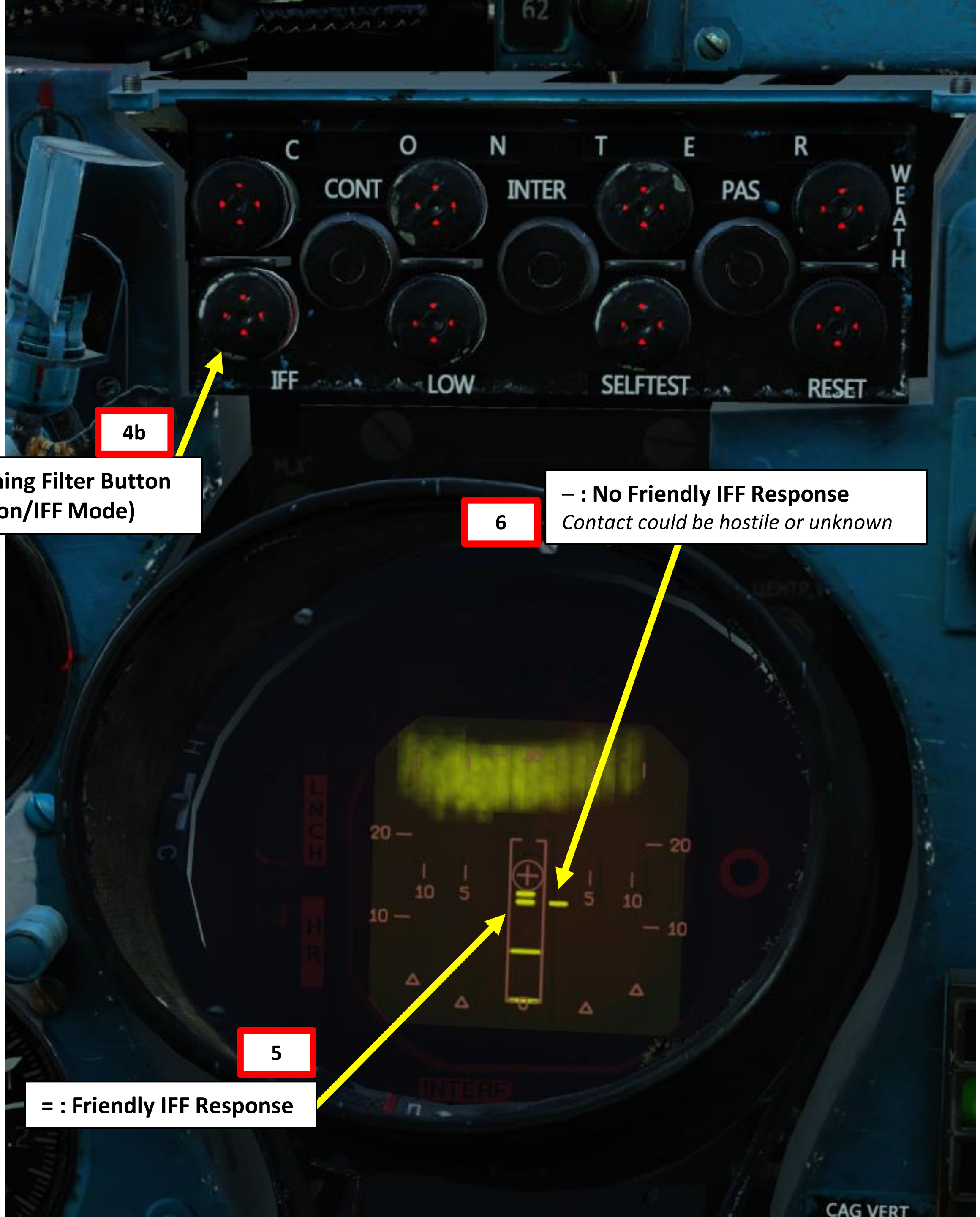
1. Set SRZO-2 IFF Power Switch – ON (UP)
2. Set SRZO-2 IFF Code – As required by the Mission Briefing (in most missions in DCS, any code will do)
3. Set Type 81 IFF Transponder Switch – ON (UP)





2 – Target Identification (IFF)

4. Press and hold Interrogation/IFF Button to interrogate all radar contacts on scope.
5. While IFF button is pressed, contacts with a friendly transponder response signal will appear as "=".
6. While IFF button is pressed, contacts that do not provide a friendly transponder response signal will appear as "–". This contact is unknown, not necessarily hostile; you will generally have to visually identify the target before engaging it.



SECTION SUMMARY

1.1 – Armament Overview

AIR-TO-AIR MISSILES

NAME	RANGE MAX/EFFECTIVE	DESCRIPTION	GOOD AGAINST
RS-2US ALKALI	5 / 3 km	Radar Beam Riding (modelled in DCS as a Semi-Active Radar Homing), 1957, Rear Aspect	Bombers (unreliable)
R-3S ATOLL	7 / 2 km	Infrared Seeker, 1962, Rear Aspect, Similar to AIM-9B (GAR-8) SIDEWINDER	Fighters (unreliable)
R-3R ATOLL	8 / 3 km	Semi-Active Radar, 1966, All Aspect	Fighters
R-55 ALKALI	5 / 3 km	Infrared Seeker, 1967, Rear Aspect	Bombers
R-13M1 ATOLL	17 / 3 km	Infrared Seeker, 1976, Rear Aspect, Similar to AIM-9G SIDEWINDER	Fighters & Bombers
R-60M APHID	8 / 4 km	Infrared Seeker, 1982, All Aspect	Fighters & Bombers

MISSILE TERMINOLOGY

GUIDANCE/HOMING MODE	DESCRIPTION
ACTIVE RADAR HOMING	Code: FOX THREE. Fire & Forget. Has active radar system on missile to track target on its own. Ex: AIM-120 AMRAAM
SEMI-ACTIVE RADAR HOMING **(SARH)**	Code: FOX ONE. Aircraft radar has to maintain lock for missile to track target. Ex: AIM-7 SPARROW
RADAR BEAM RIDING	Early form of radar guidance: missile follows beam cone sent from aircraft radar. Beam has to be locked ON target… it was historically very difficult to track air targets this way. However, laser-guided bombs = one of its direct applications.
INFRARED SEEKER HOMING	Code: FOX TWO. Missile tracks heat produced by enemy aircraft. No radar lock needed. Ex: AIM-9 SIDEWINDER

ASPECT	DESCRIPTION
REAR ASPECT	Target can only be tracked from the rear.
ALL ASPECT	Target can be tracked in all directions.

1.1 – Armament Overview

AIR-TO-GROUND MISSILE

NAME	RANGE MAX/EFFECTIVE	DESCRIPTION	GOOD AGAINST
KH-66 GROM	10 / 10 km	Radar Beam Riding, 1968, Rear Aspect, can be used on both air and ground targets.	Ground Targets Ships Bombers

BOMBS (UNGUIDED)

NAME	DESCRIPTION	GOOD AGAINST
FAB-100/250/500	100, 250 and 500 kg general purpose bombs	Single Ground Targets
RBK-250/500	250 and 500 kg bomblet dispensers	Clusters of targets
SAB-100	Night Illumination Flare	A night dark and full of terrors
RN-24 /28	Tactical nuclear bomb (nuke), detonates on impact, no drag parachute.	Clusters of targets

INTERNAL CANNON, EXTERNAL GUNPOD & ROCKETS

NAME	DESCRIPTION	GOOD AGAINST
GSh-23	Gryazev-Shipunov 23 mm cannon (250 rounds)	Fighters, Bombers, Soft Ground Targets
UPK-23-250	23 mm external cannon gunpod (250 rounds).	Fighters, Bombers, Soft Ground Targets
S-16	16 X S-5 rockets	Soft Ground Targets
S-32	32 X S-5 rockets	Soft Ground Targets
S-24A/B	Single rocket for hard targets. Warheads: A= Fragmentation / B= Anti-Bunker	Hard Ground Targets

1.2 – ASP-PFD Optical Sight

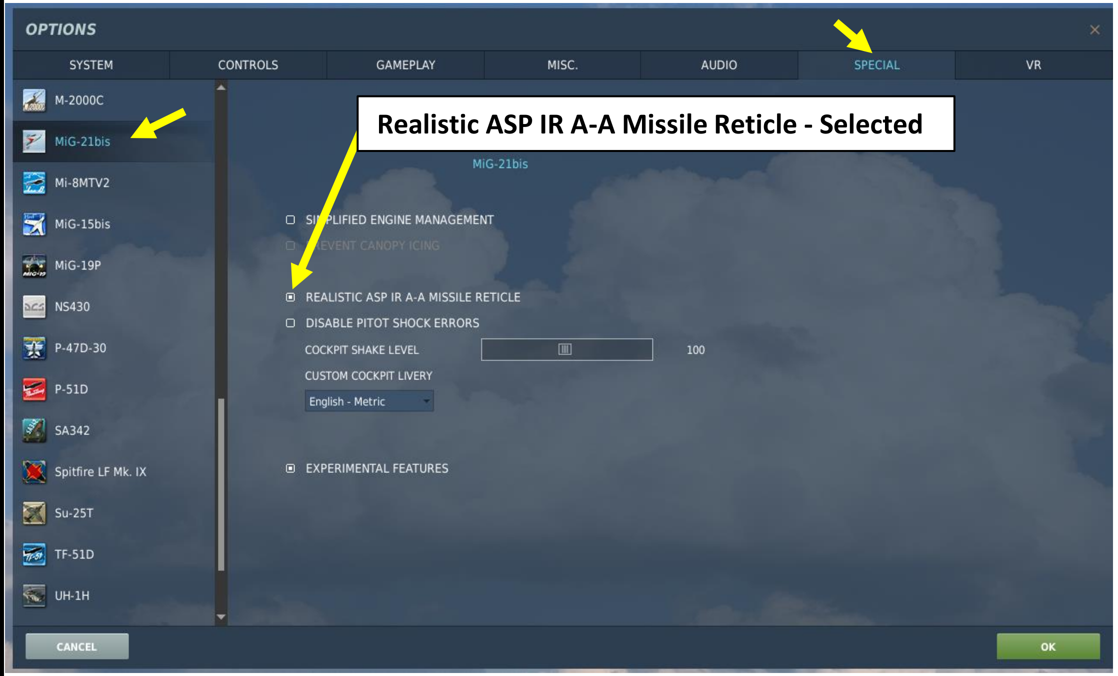
Introduction

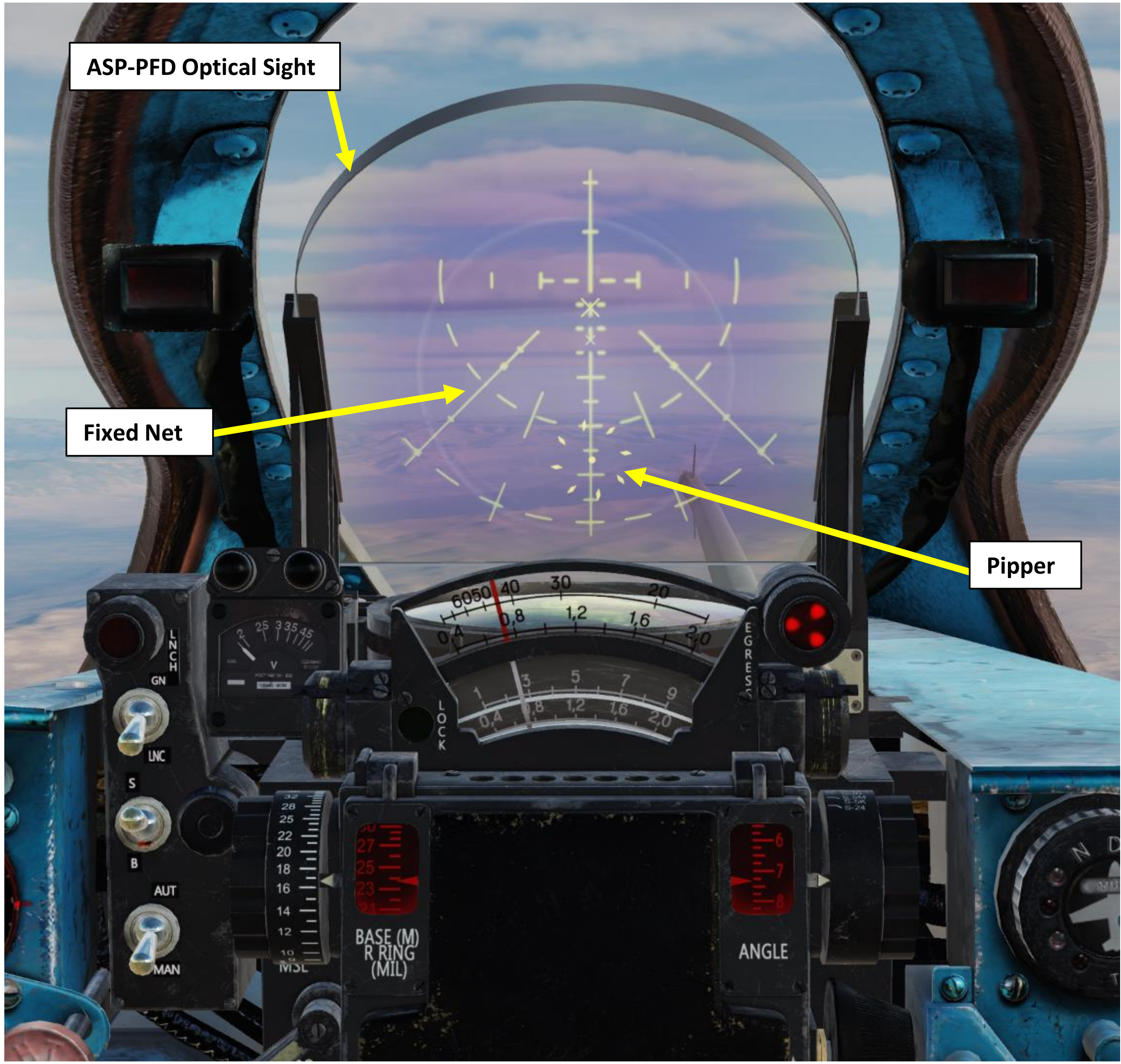
The ASP-PFD Optical Sight in the MiG-21Bis has two main components:

- **Pipper**, which has a customizable size in order to take into account target size/wingspan. The pipper is mostly used for cannon use against non-manoeuvering targets pulling less than 3 Gs.

- **Fixed Net**, which is used for bombing, rocket attacks, and cannon use against manoeuvering targets pulling more than 3-4 Gs.

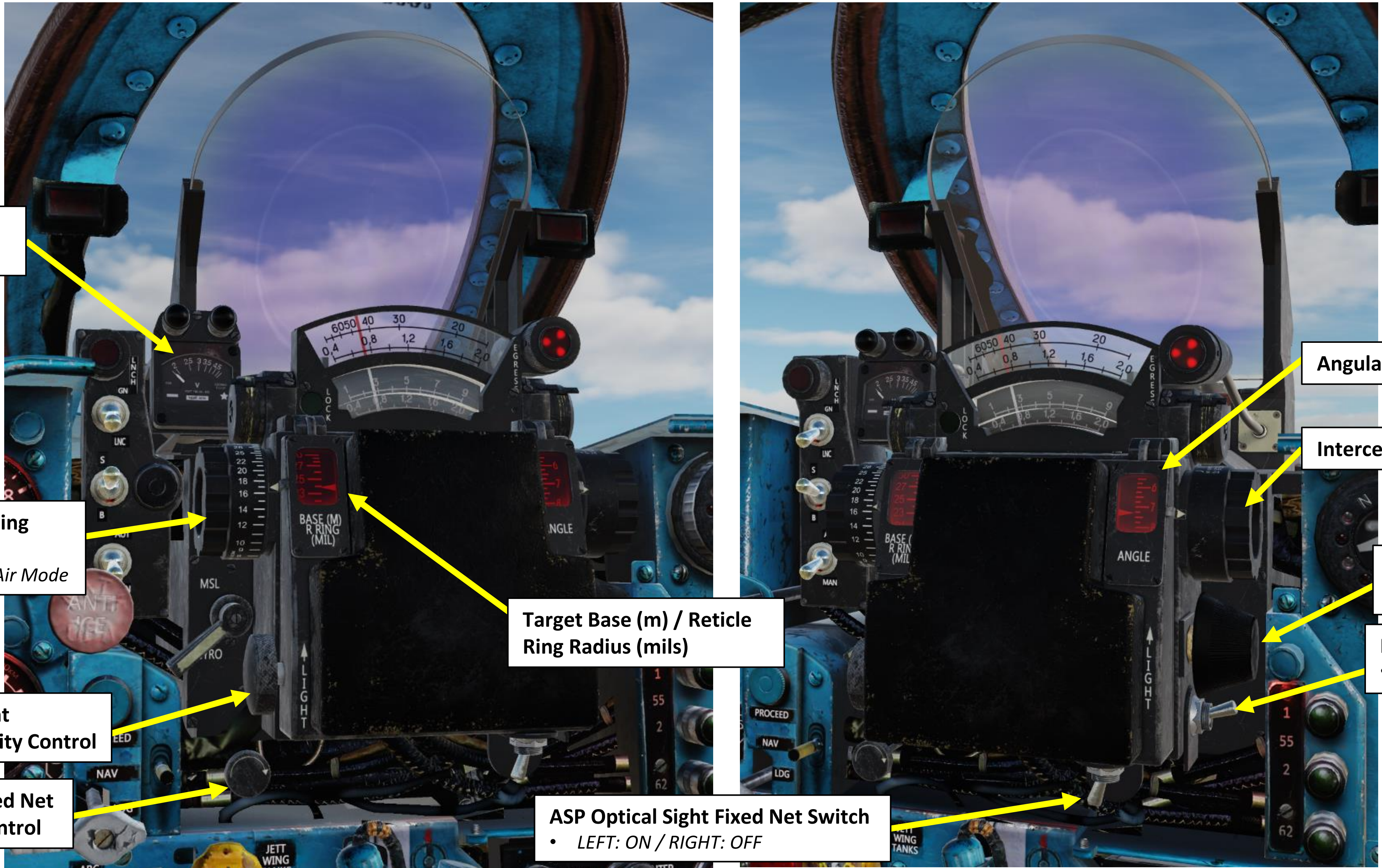
Note: do not forget to have the "Realistic ASP IR A-A Missile Reticle" option ticked (ON) on the MiG-21bis Special Options tab.





1.2 – ASP-PFD Optical Sight

ASP Components

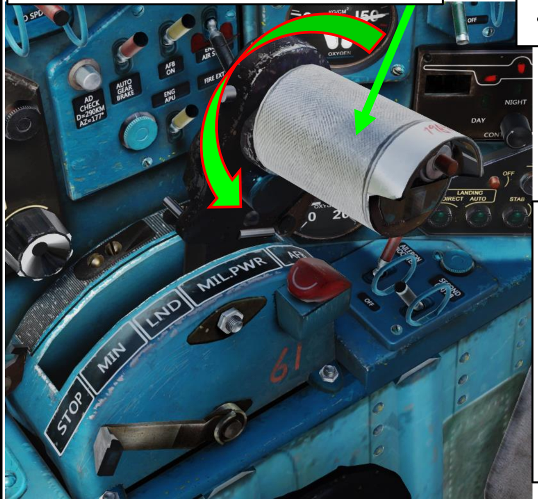


1.2 – ASP-PFD Optical Sight

ASP Components

ASP-PFD Sight Master Mode Air/Ground Switch
- *UP: Air Mode*
- *DOWN: Ground Mode*

Throttle Twist Grip
- *Changes ASP Optical Sight Range & Radar TDC Slew Control*



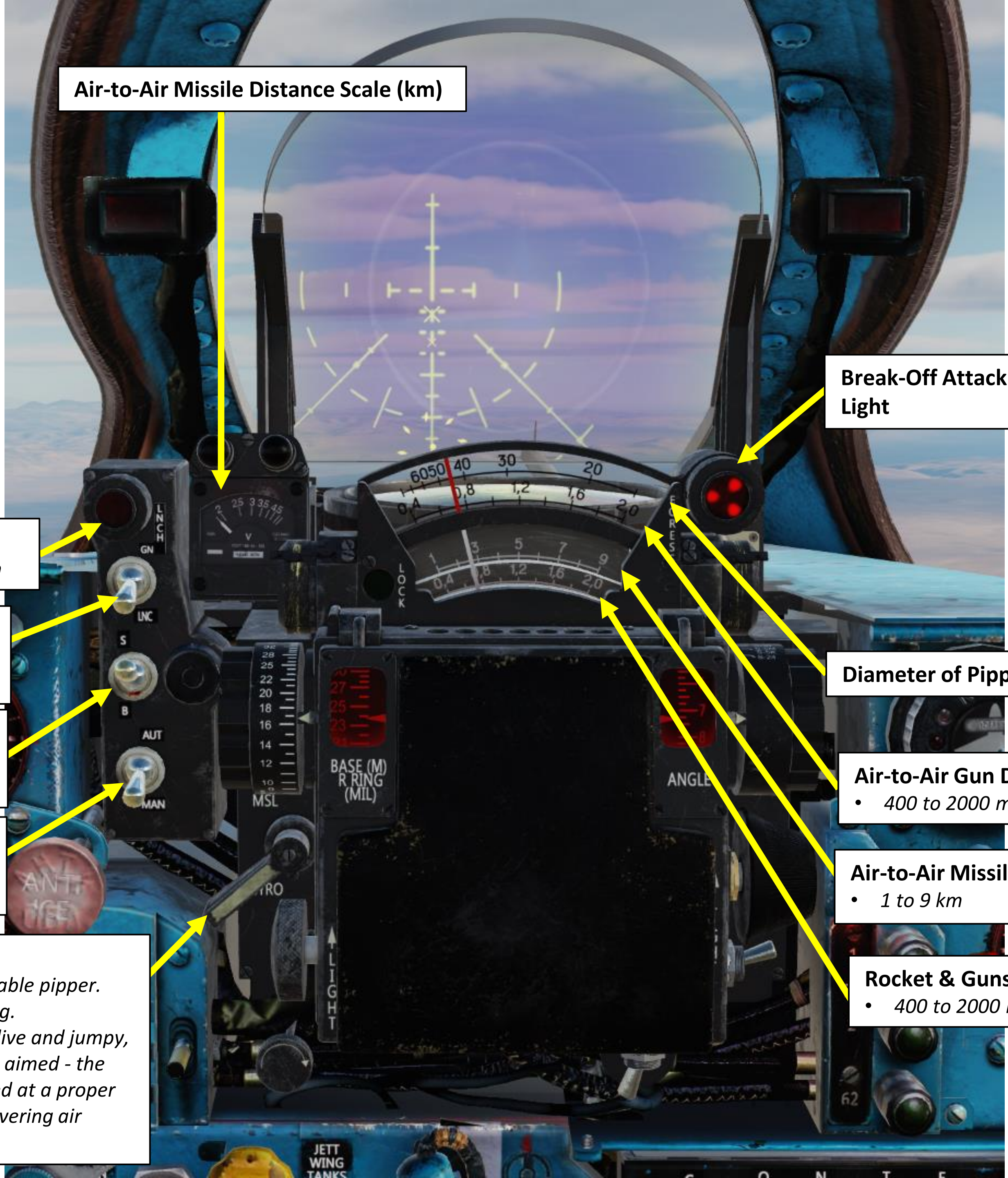
ASP-PFD Launch Authorized Light
- *Illuminates when you are in range for launch*

ASP-PFD Optical Sight Mode
- *UP: Gun*
- *DOWN: Launch (Rockets-Missiles)*

ASP-PFD Optical Sight Mode
- *UP: Shooting (S)*
- *DOWN: Bombing (B)*

ASP-PFD Optical Sight Mode
- *UP: AUTO*
- *DOWN: MANUAL*

ASP Optical Sight Pipper Mode
- *UP: Fixed (Missile), renders a stable pipper. Used for air-to-air missile aiming.*
- *DOWN: Gyro, pipper is pretty alive and jumpy, making it hard to aim, but once aimed - the weapon will hit the target if fired at a proper distance. Used for non-manoeuvering air targets and ground targets.*



Air-to-Air Missile Distance Scale (km)

Break-Off Attack Warning Light

Diameter of Pipper (milliradians)

Air-to-Air Gun Distance Scale
- *400 to 2000 m*

Air-to-Air Missile Distance Scale
- *1 to 9 km*

Rocket & Guns Distance Scale
- *400 to 2000 m*

1.2 – ASP-PFD Optical Sight

ASP Sight Operation Modes

The Optical Sight operation modes can be broken down as follows:

Gun/Rocket Launch (GN/LNC) Modes
- LNC (Rocket/Missile Launch) is used for rocket and missile attacks
- GN is used for the internal GSh-23 cannon

Shooting/Bombing (S/B) Modes
- Shooting is used for all weapons except bombs
- Bombing is used for bombs only

Automatic/Manual (AUT/MAN) Modes
- Automatic automatically sets the angular scale correction for you based on the currently selected weapon. Gun range/distance setting is automatically set for 300 meters.
- Manual allows you to manually set sight distance/range and angular scale correction

Missile/Gyro (MSL/Gyro) Modes
- MSL renders a “stable” pipper **caged** to the center. This mode is used against manoeuvering targets, which is a situation where you are likely to use air-to-air missiles. In that case, the Fixed Net should be used for targeting because the pipper intercept angles could potentially go beyond 7 deg, and the pipper cannot be rendered within the ASP reflection glass in this situation.
- GYRO is used for non-manoeuvering targets (or targets flying at G loads lower than 3). The pipper is not “stable” (jumps around, **uncaged**) and can be used for targeting.

Master Modes
- Air Mode is used for attacking air targets
- Ground Mode is used for attacking ground targets

ASP-PFD Sight Master Mode Air/Ground Switch
- *UP: Air Mode*
- *DOWN: Ground Mode*

ASP-PFD Optical Sight Mode
- *UP: Gun*
- *DOWN: Launch (Rockets-Missiles)*

ASP-PFD Optical Sight Mode
- *UP: Shooting (S)*
- *DOWN: Bombing (B)*

ASP-PFD Optical Sight Mode
- *UP: AUTO*
- *DOWN: MANUAL*

ASP Optical Sight Pipper Mode
- *UP: Fixed (Missile), renders a stable pipper. Used for air-to-air missile aiming.*
- *DOWN: Gyro, pipper is pretty alive and jumpy, making it hard to aim, but once aimed - the weapon will hit the target if fired at a proper distance. Used for non-manoeuvering air targets and ground targets.*

Target Base (m) / Reticle Ring Radius (mils)

Angular Scale (deg)

1.2 – ASP-PFD Optical Sight

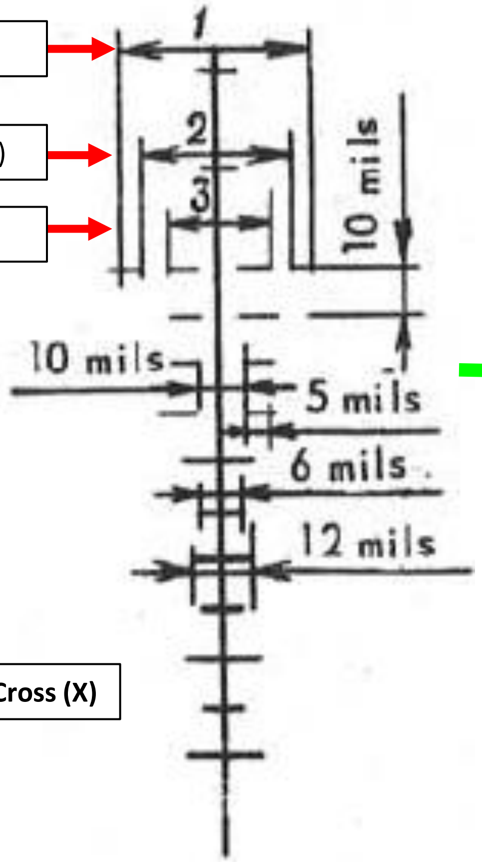
Fixed Net

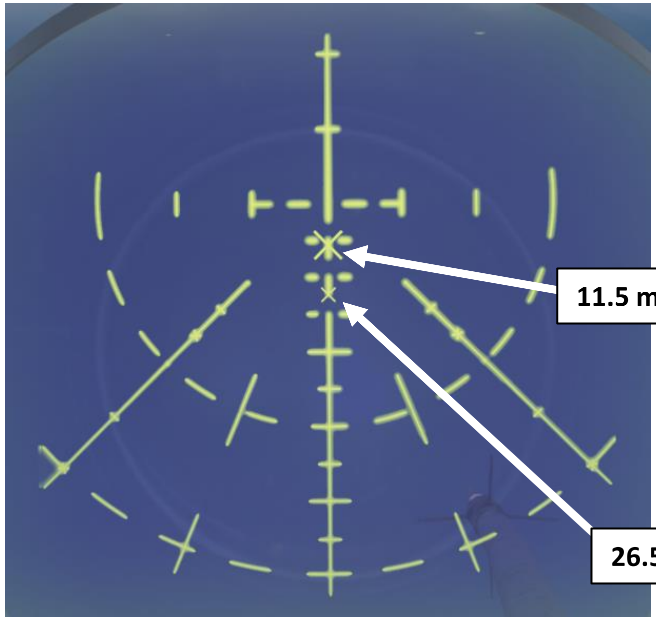
The Fixed Net is mostly used for ground attacks and manoeuvering targets.

At 400 meters Range: Wingspan = 15.1 m (*Vautour*)

At 400 meters Range: Wingspan = 11.7 m (*F-4 Phantom II*)

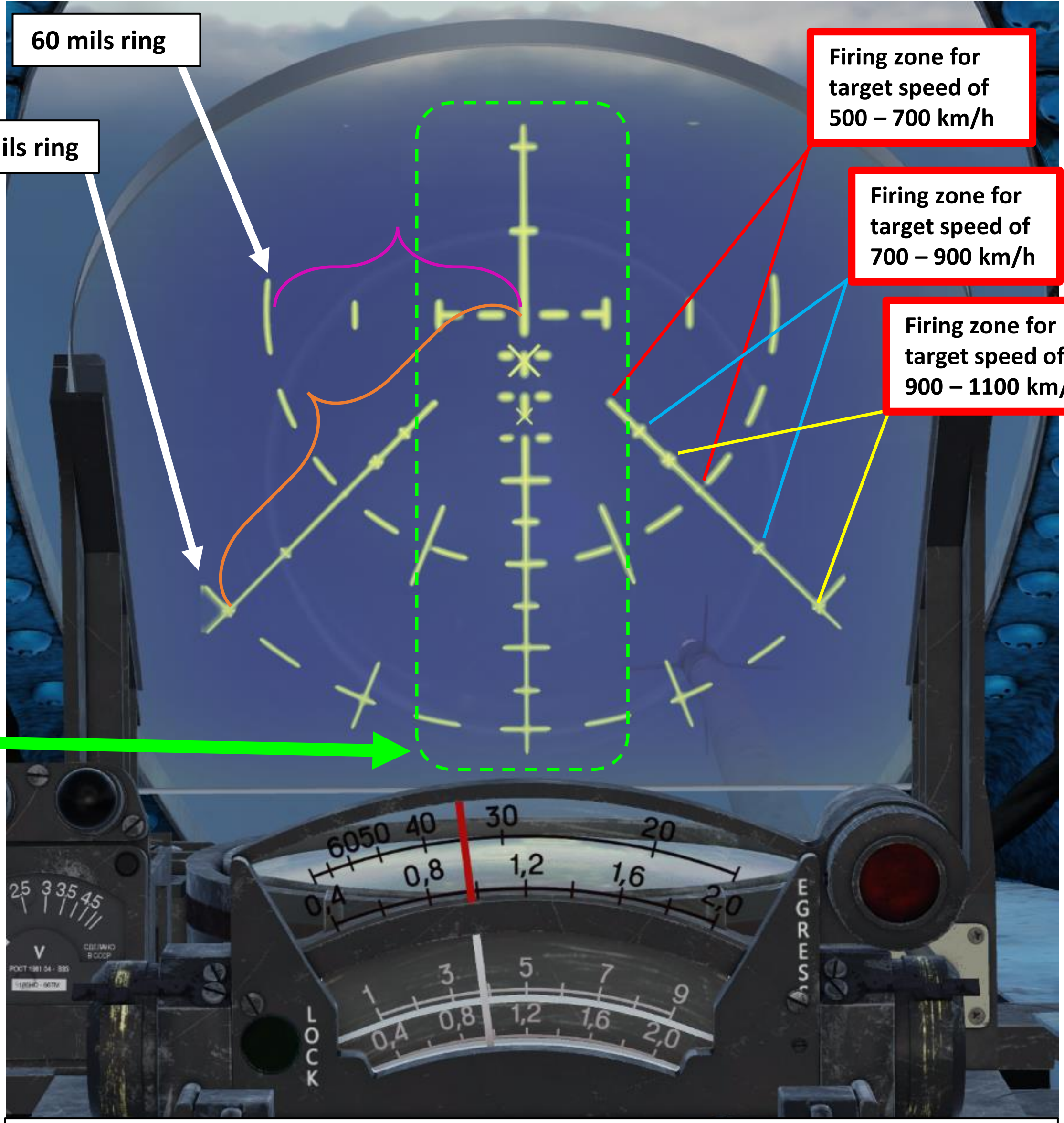
At 400 meters Range: Wingspan = 8.2 m (*Mirage III*)





11.5 mils Cross (X)

26.5 mils Cross (x)



Fixed Net

1.2 – ASP-PFD Optical Sight

Pipper Reticle

The pipper reticle can be used mostly against non-manoeuvering targets or targets that are pulling less than 3 Gs. The pipper diameter is equal to the Target Wingspan Setting (set with the Target Wingspan Setting Control Knob) for the Target Distance set by the Throttle Twist Grip.

- In this example, the pipper is set for a target:
    - with a wingspan of 8.2 meters
    - for a distance of 400 meters.
- Modes used:
    - Gyro
    - Manual
    - Shooting
    - Gun

Throttle Twist Grip
- *Changes ASP Optical Sight Range & Radar TDC Slew Control*

Pipper
(Target is at 400 meters when its wings fit within the pipper)

Diameter of Pipper (milliradians)

Air-to-Air Gun Distance Scale
- *400 m*

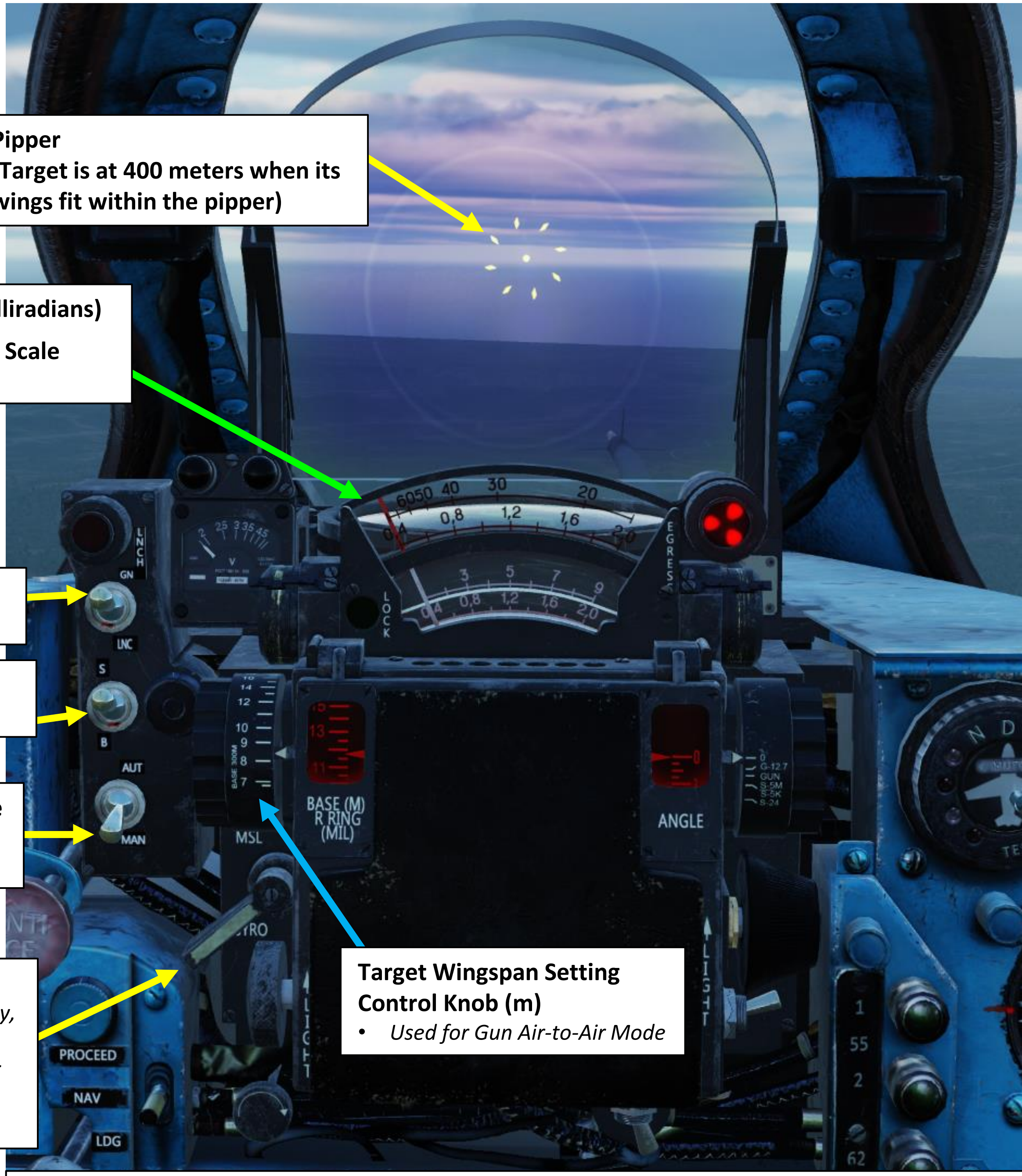
ASP-PFD Optical Sight Mode
- *UP: Gun*

ASP-PFD Optical Sight Mode
- *UP: Shooting (S)*

ASP-PFD Optical Sight Mode
- *UP: AUTO*
- *DOWN: MANUAL*

ASP Optical Sight Pipper Mode
- *DOWN: Gyro, pipper is pretty alive and jumpy, making it hard to aim, but once aimed - the weapon will hit the target if fired at a proper distance. Used for non-manoeuvering air targets and ground targets.*

Target Wingspan Setting Control Knob (m)
- *Used for Gun Air-to-Air Mode*



1.2 – ASP-PFD Optical Sight

Combining Pipper Reticle and Fixed Net – Target Ranging

With the Fixed Net… how do we know when the target is in range to fire your gun? Typically, you choose a firing range/distance first (as an example, 400 meters), then place the fixed net 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 F-5 Tiger, which has a wingspan (length) of about 26 ft (8.13 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:

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

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

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

We know the fixed net inner ring's diameter represents an angle of 60 milliradians (60 thousandths of a radian, or 3° 44' in degrees). From the equation above, we can determine what distance D_1 the target is from us when its wingspan (L_1) fits within the reticle diameter.

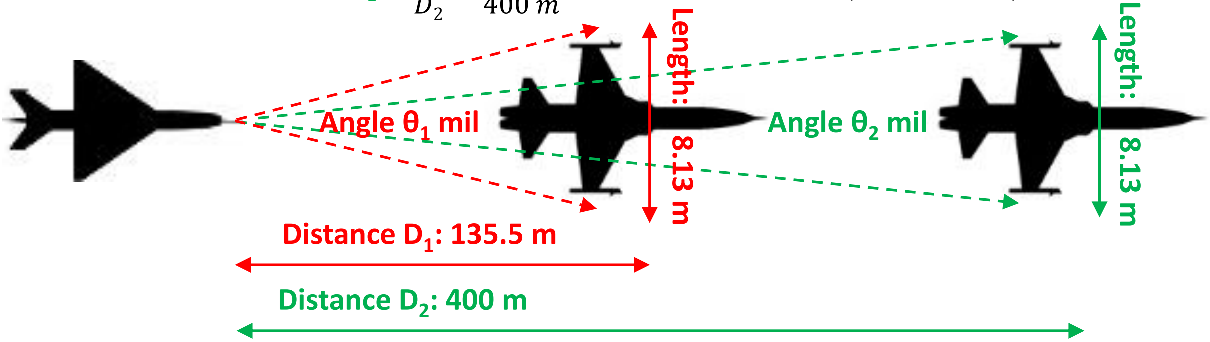
For a target with a length L_1 = 8,13 m that fits within the reticle angle θ_1 of 100 milliradians:

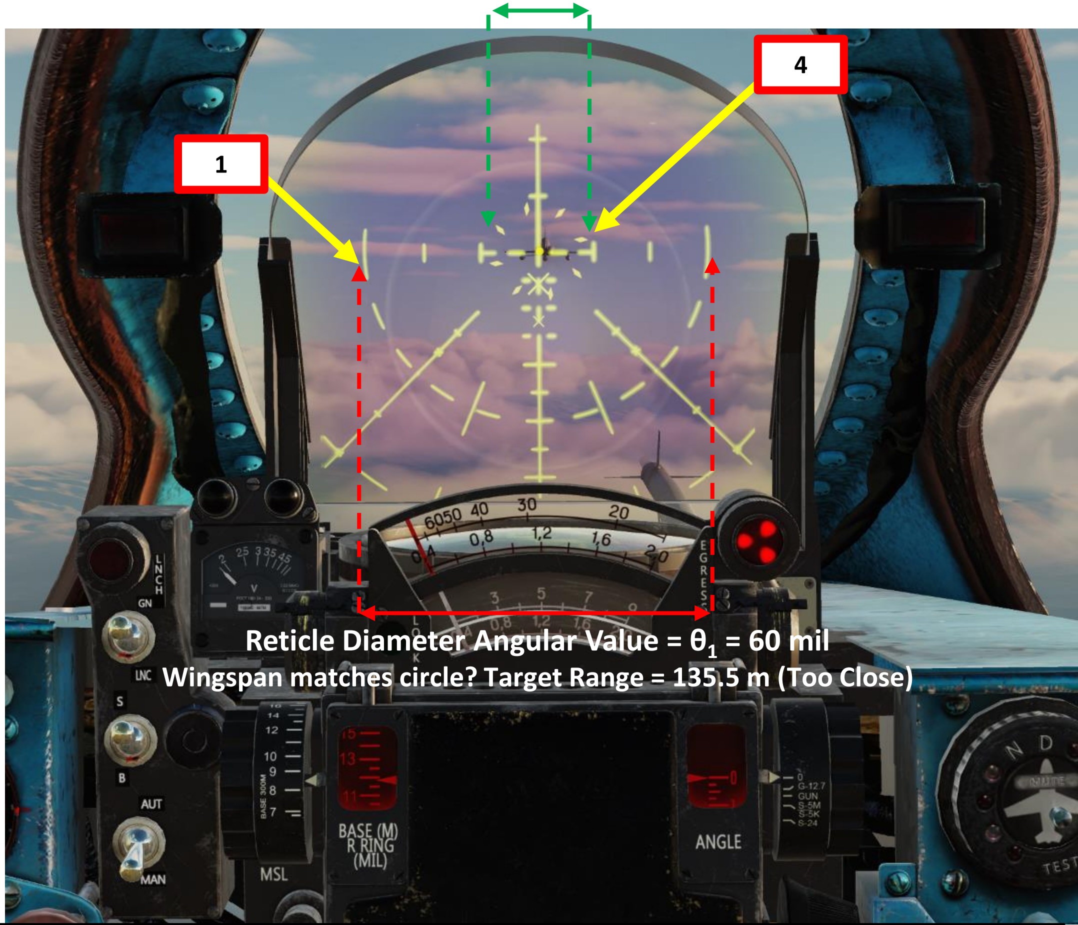
$$\theta_1 = 60\ mil = \frac{L_1}{D_1}$$

$$D_1 = \frac{L_1}{\theta_1} = \frac{8.13\ m}{0.060\ rad} = 135.5\ meters$$

For a target with a length L_2 = 8.13 m at a distance D_2 of 400 m (the range we actually want to fire at):

$$\theta_2 = \frac{L_2}{D_2} = \frac{8.13\ m}{400\ m} = 0.020\ rad \approx 20\ mil\ (milliradians)$$





Now… how do we interpret the gunsight to estimate the range of a target?

1. We know the **reticle diameter** is 60 mil (60 thousandths of a radian, or 5° 44' in degrees).
2. We calculated that when the wingspan of a target fits within the diameter of the reticle, we are at a range of approx. 135.5 meters, which is way too close.
3. Using **RANGE (Throttle Twist Grip)** and **WINGSPAN (BASE)** gunsight pipper settings in MANUAL mode, we can set the **pipper size** to a distance of 400 m (gun firing range) adjusted for a wingspan of 8.13 m.
4. When target wings fit within the **reticle inner reference marks**, we know we are at the optimal firing range of 400 meters. You may fire.

1.2 – ASP-PFD Optical Sight

ASP Sight Effective Ranges

The Optical Sight is designed for aiming at the following target ranges:

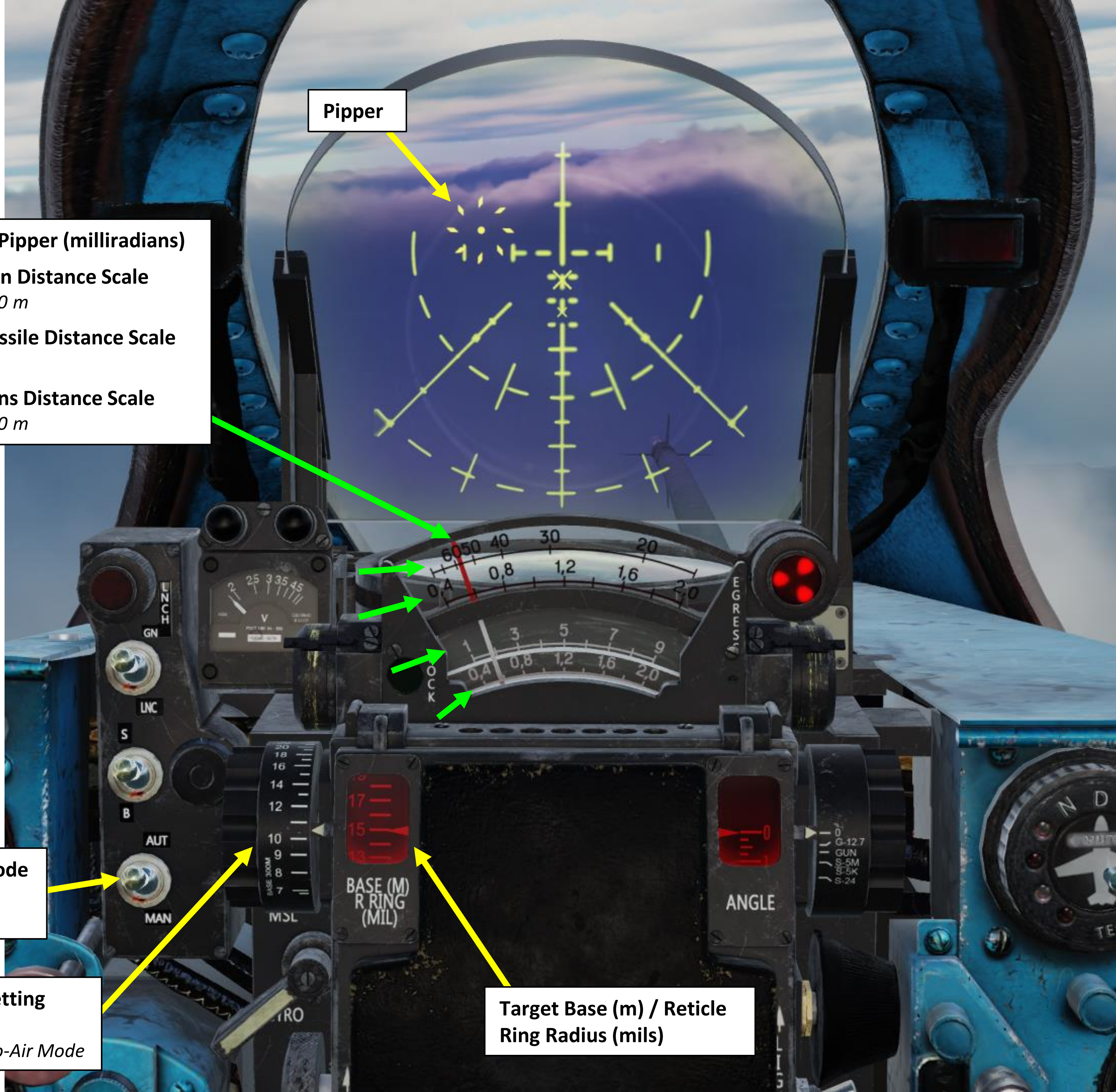
Aerial Targets
- 600 to 2000 m when launching rockets
- 1000 to 9000 m when launching missiles
- 400 to 2000 m when firing the gun in manual mode
- 300 m when firing the gun in auto mode (fixed range)

Ground Targets
- 2000 m or less when launching free rockets
- 2000 m or less when firing the gun

Only one **needle** (see **green** arrows) is used for distance indication on all four scales.

- In **Automatic** mode it will automatically move to indicate the distance for the selected weapon, but the pilot needs to know which scale to observe.

- In **Manual** mode, it will move if the pilot manually changes pipper diameter using the throttle rotator: by changing the pipper diameter, pilot actually frames the target inside the pipper and reads the distance to it on appropriate scale. This manual distance calculation is based on known (or assumed, best guessed) target dimension entered in the ASP using the Target Wingspan Setting Control knob.



1.3 – Weapon Selector

The Weapon Selector allows you to select which pylon you want to use.

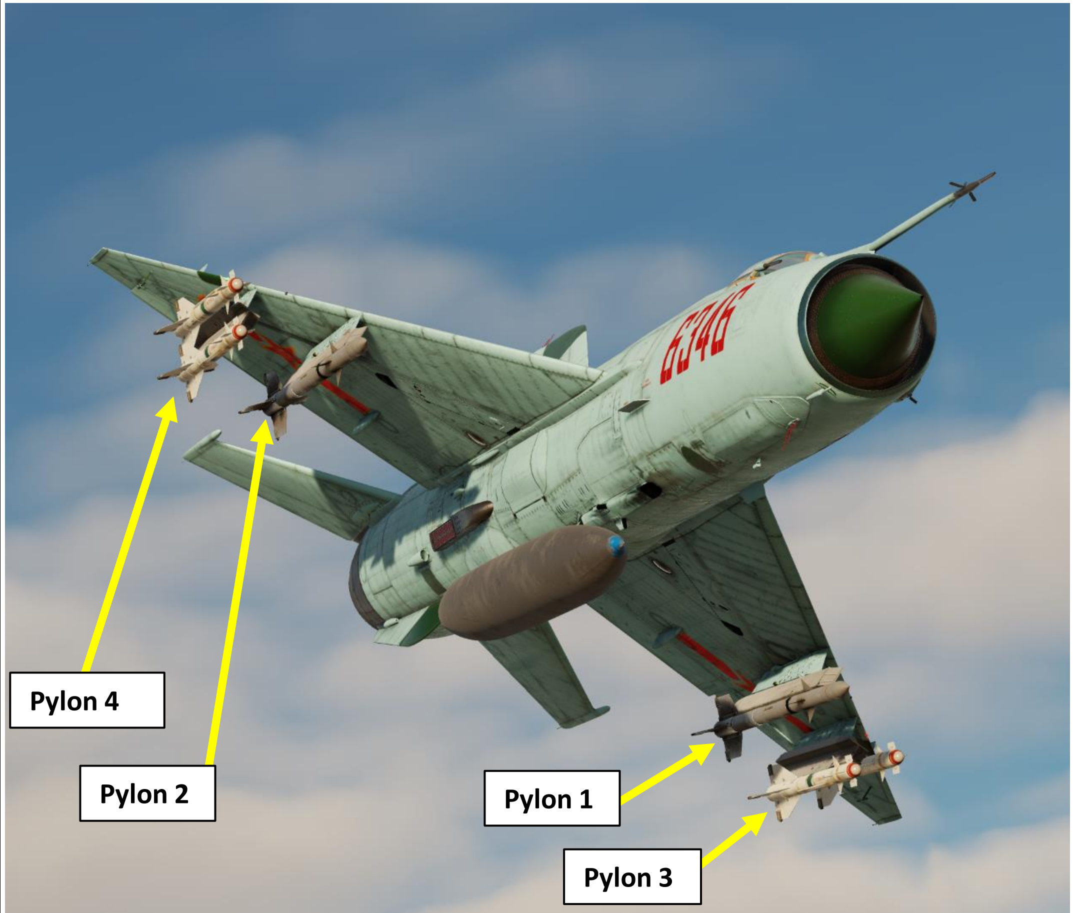
- Outer pylons are 3-4 (left-right)
- Inner pylons are 1-2 (left-right)

When using air-to-air missiles, the Air-to-Air Missile Type Selector sets the missile launch priority order based on what Pylon is selected by the Weapon Selector.

Pylon & Weapon Type Selector

- **S-24 RKT (S-24 Rocket) Category**
  - **1-2**: Selects S-24 rockets from pylons 1 and 2 (or KH-66 Grom Missile if equipped). Rockets are fired in pairs.
  - **3-4**: Selects S-24 rockets from pylons 3 and 4 (or KH-66 Grom Missile if equipped). Rockets are fired in pairs.
- **IR-SAR (Infrared/Semi-Active Radar Homing Missile) Category**
  - **3-4**: Selects IR or SARH missiles on pylons 3 and 4. Missiles are fired in pairs.
  - **1-2**: Selects IR or SARH missiles on pylons 1 and 2. Missiles are fired in pairs.
  - **1**: Selects IR or SARH missile on pylon 1. Single missile launch selected.
  - **2**: Selects IR or SARH missile on pylon 2. Single missile launch selected.
  - **3**: Selects IR or SARH missile on pylon 3. Single missile launch selected.
  - **4**: Selects IR or SARH missile on pylon 4. Single missile launch selected.
- **RKT (S-5M Rocket) Category**
  - **16**: Selects all S-5M rocket pods (UB-16UM or UB-32M pods). 16 rockets are fired per pod per Weapon Release button press.
  - **8**: Selects all S-5M rocket pods (UB-16UM or UB-32M pods). 8 rockets are fired per pod per Weapon Release button press.
  - **4**: Selects all S-5M rocket pods (UB-16UM or UB-32M pods). 4 rockets are fired per pod per Weapon Release button press.
- **B (Bomb) Category**
  - **1-2**: Selects bombs from pylons 1 and 2. Bombs are released in pairs.
  - **3-4**: Selects bombs from pylons 3 and 4. Bombs are released in pairs.
  - **1-4**: Selects bombs from pylons 1, 2, 3 and 4. Bombs are all released at once.

Note: The RKT and B categories overlap each other; the function will change based on what ordnance is installed on the pylon.



Air-to-Air Missile Type Selector

- *UP: IR, Infrared Missile*
- *MIDDLE: Neutral, No Missile*
- *DOWN: SAR, Semi-Active Radar Homing (SARH) Missile*

Note: Missile launch priority order is determined based on both the Weapon Selector and Missile Type selector. In our case the “Pylon 1 – IR” setting means that pressing the Weapon Release button will automatically cycle through pylons (order: 1, 2, 3 then 4) until an Infrared homing missile is detected, starting with Pylon 1.

1.4 – Operational Limits

Most weapons installed on pylons have a maximum acceleration limit of 4-5 Gs. Pulling more Gs may rip the weapons apart from their racks, including rockets, bombs and missiles.

1.4 – Operational Limits

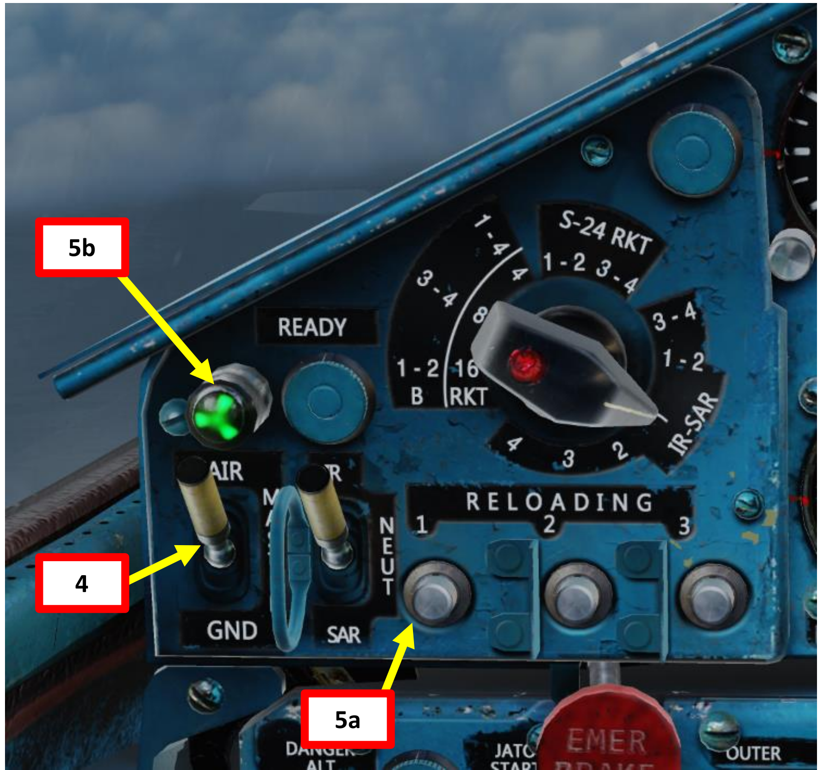
Parameter	External load variants					
	No external loads, or missiles only	Pods, type		Bombs, rockets S-24, inc. 500 kg bombs	Drop tanks	Eight bombs OFAB-100
		UB-16-57	UB-32			
Airspeed (km/h)	1300			1000		800 (or 1000 with reinforced racks BD3-60-21D1)
Mach number	2.05	1.7	1	1.3	1.6	1
G-load	At M≤0.8: with two missiles 8g at G_{fuel}≤1300L otherwise 7g at G_{fuel}>1300L At M>0.8: 7g at G_{fuel}≤800L with two missiles otherwise 6g with two or four missiles.		5g		5g with 490L drop tank or 4g with 800L drop tank	5g

2.1 – GSh-23 23 mm Cannon (Air-to-Air)

2.1 – GSh-23 23 mm Cannon (Air-to-Air)

Note: the following tutorial is for a non-manoeuvering target or a target that is pulling less than 3 Gs. Targets that require high angle deflection shooting are not covered in this tutorial.

1. Set GSH-23 Gun Power Switch – ON (UP)
2. Set ASP-PFD Optical Sight Power Switch – ON (UP)
3. (Optional) Set Gun Camera Power Switch – ON (UP).
4. Set Air/Ground Master Mode switch to AIR (UP).
5. Press and hold CANNON RELOAD button for at least 2 seconds to arm cannon. Confirm that cannon is armed with the green arming light.



Note
Russian cannons of this era use a “pyrotechnical” reload system, which means that a cassette equipped with a pyrocartridge will detonate a charge to “reload” a gun. The MiG-21bis, MiG-15, MiG-19 and the L-39ZA use a similar system.

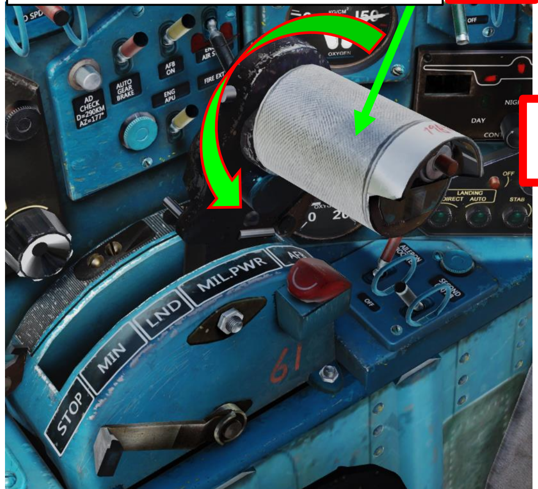
2.1 – GSh-23 23 mm Cannon (Air-to-Air)

AIMING METHOD 1: MANUAL + GYRO + PIPPER (CUSTOM RANGE)

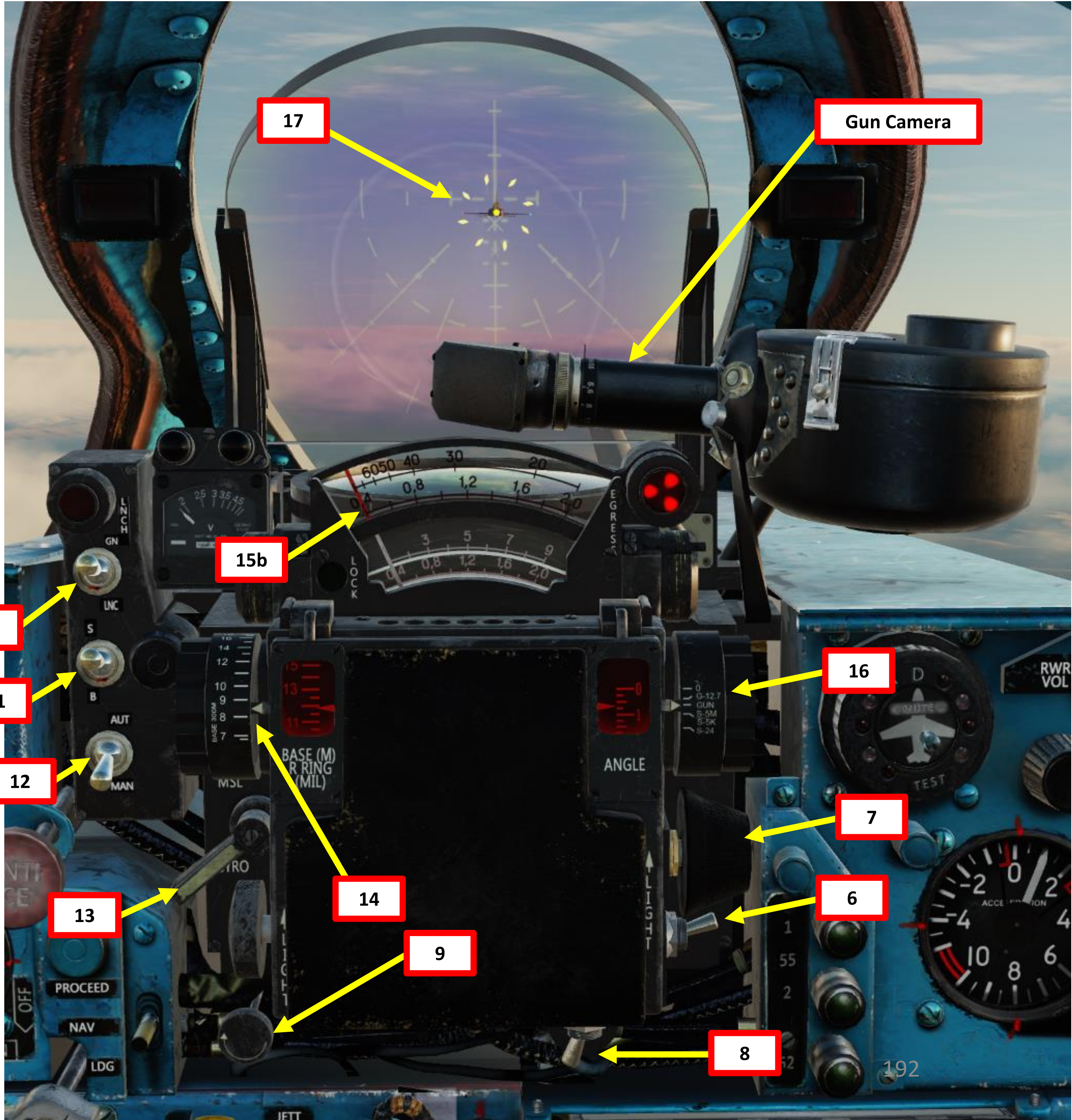
6. Set Pipper Switch – ON (UP).
7. Adjust Pipper brightness as desired.
8. Set Fixed Net Switch – ON (LEFT).
9. Adjust Fixed net brightness as desired. In this case, we will set the fixed net dimmed.
10. Set Optical Sight GN/LNC Mode switch – GUN (UP)
11. Set Optical Sight S/B Mode switch – SHOOT (UP)
12. Set Optical Sight AUT/MAN Mode switch – MANUAL (DOWN)
13. Set Optical Sight MSL/GYRO Mode switch – GYRO (DOWN)
14. Rotate Target Wingspan Setting Control Knob to enter the target's wingspan (for a F-5, a target wingspan of 8.1 m is adequate). Pipper size will adjust accordingly.
15. Adjust Throttle Twist Grip to set the Target Distance setting to 400 m (0.4 km).
16. Rotate Intercept Angle knob to GUN position (0.6 deg approx.).
17. Steer aircraft to fit the target's wings between the pipper reticle lines and place the reticle dot on the target.
18. Fire when ready using the gun trigger.

Throttle Twist Grip
- *Changes ASP Optical Sight Range & Radar TDC Slew Control*

15a



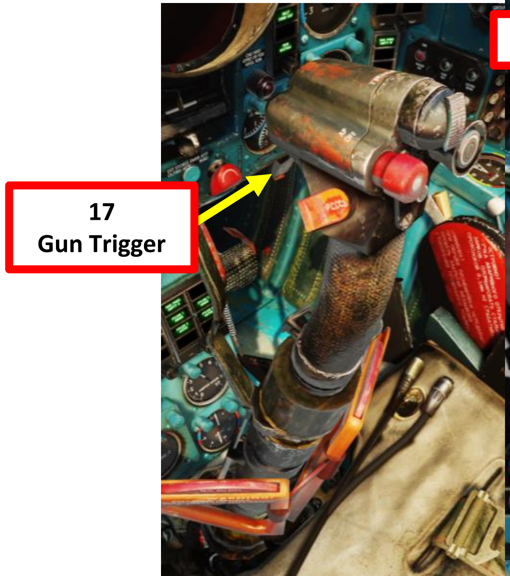
18
Gun Trigger

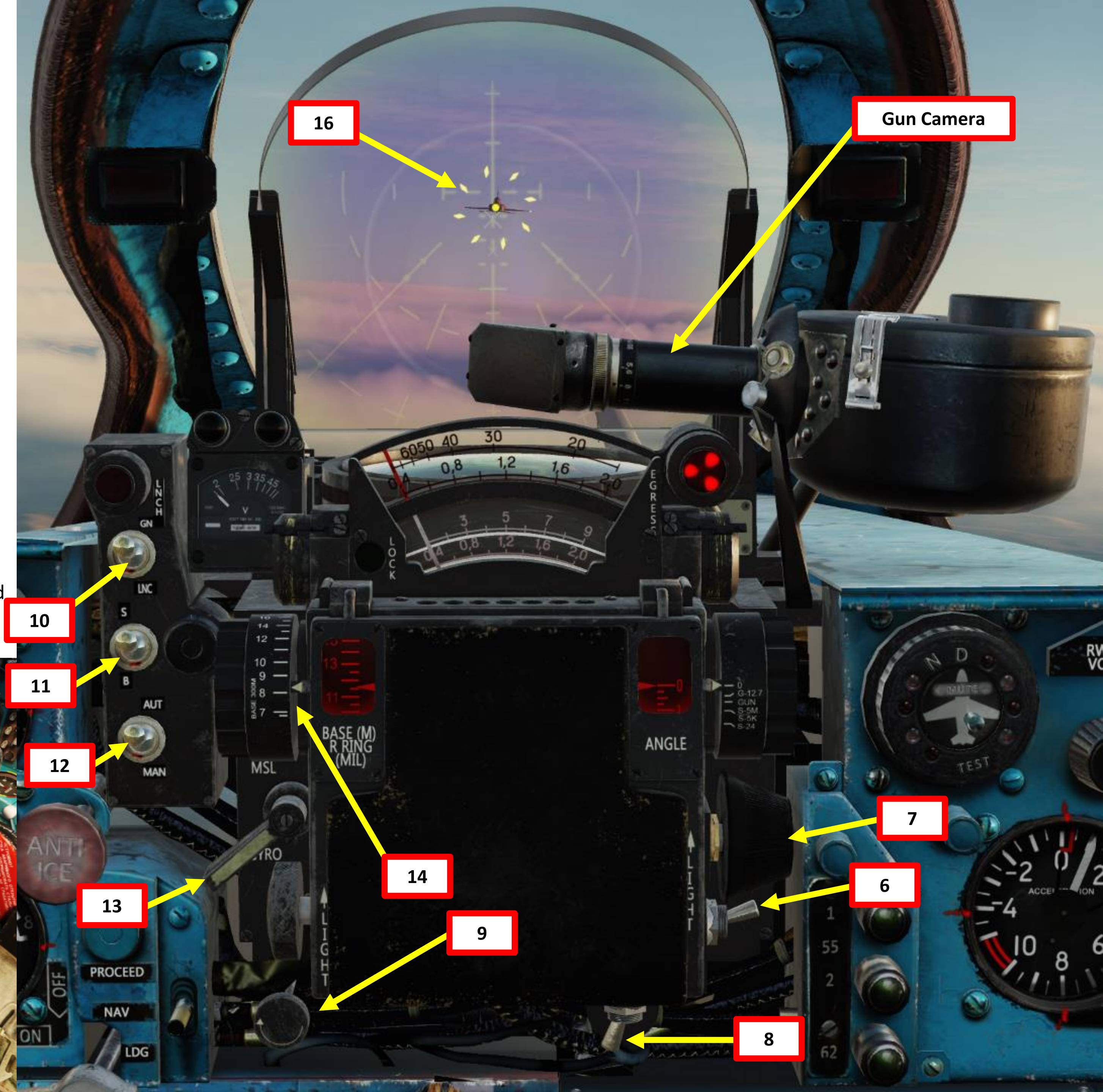


2.1 – GSh-23 23 mm Cannon (Air-to-Air)

AIMING METHOD 2: AUTO + GYRO (FIXED RANGE 300 M)

6. Set Pipper Switch – ON (UP).
7. Adjust Pipper brightness as desired.
8. Set Fixed Net Switch – ON (LEFT).
9. Adjust Fixed net brightness as desired. In this case, we will set the fixed net dimmed.
10. Set Optical Sight GN/LNC Mode switch – GUN (UP)
11. Set Optical Sight S/B Mode switch – SHOOT (UP)
12. Set Optical Sight AUT/MAN Mode switch – AUTO (UP)
13. Set Optical Sight MSL/GYRO Mode switch – GYRO (DOWN)
14. Rotate Target Wingspan Setting Control Knob to enter the target's wingspan (for a F-5, a target wingspan of 8.1 m is adequate). Pipper size will adjust accordingly.
15. In Auto Mode, the Target Distance setting is automatically set to 300 m. The Intercept Angle value is automatically selected for you based on the selected weapon.
16. Steer aircraft to fit the target's wings between the pipper reticle lines and place the reticle dot on the target.
17. Fire when ready using the gun trigger.

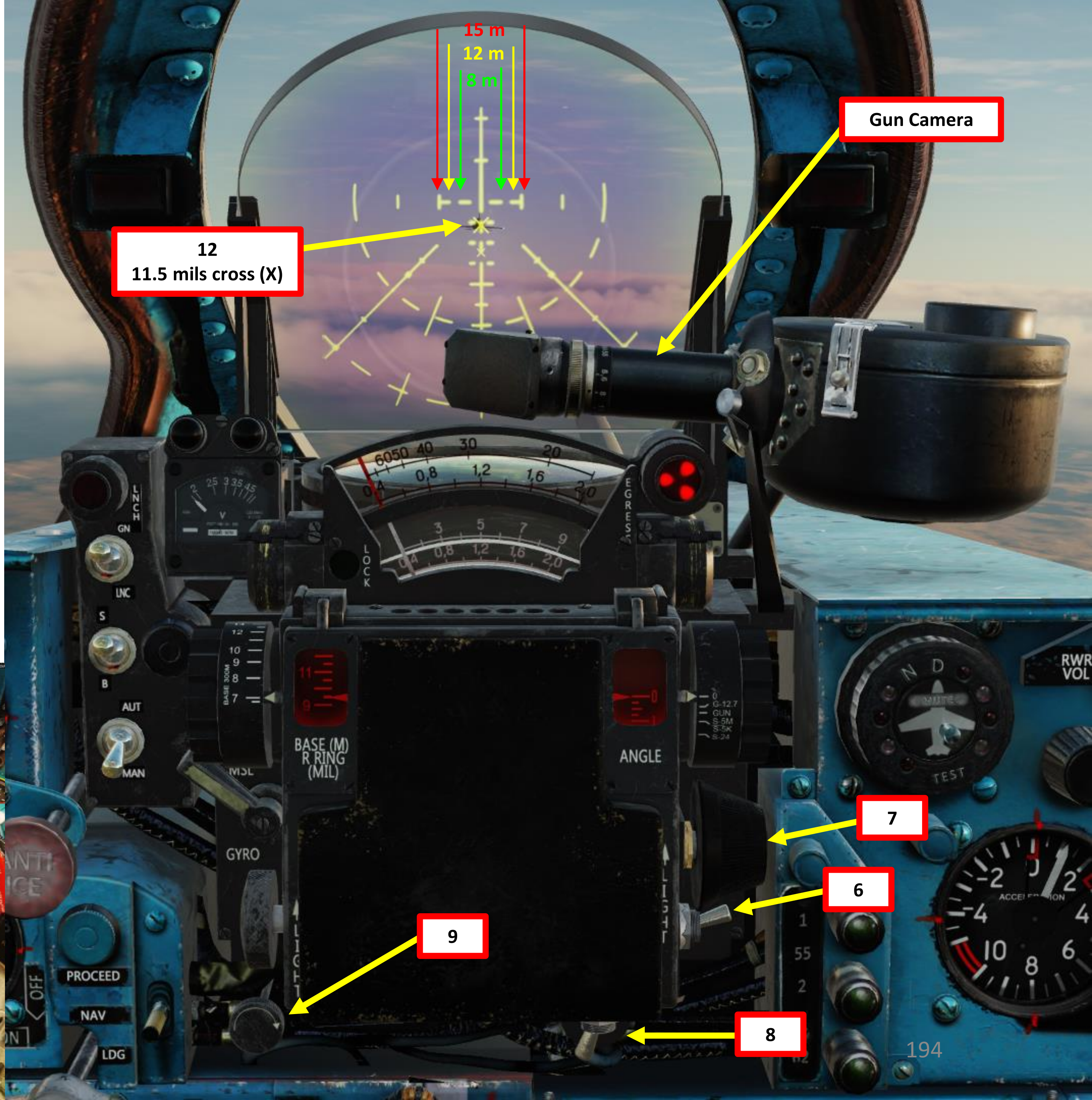




2.1 – GSh-23 23 mm Cannon (Air-to-Air)

AIMING METHOD 3: FIXED NET ONLY

6. Set Pipper Switch – ON (UP).
7. Adjust Pipper brightness as desired. In this case, we will set the pipper dimmed.
8. Set Fixed Net Switch – ON (LEFT).
9. Adjust Fixed net brightness as desired.
10. When using the fixed net only, the GN/LNC Mode, S/B Mode, AUT/MAN Mode and MSL/GYRO Mode settings are irrelevant if no pipper is used.
11. Steer aircraft to fit the target's wings between the appropriate wingspan lines on the fixed net. We will take the inner lines (in green, set for 8 m wingspan at a 400 m range).
12. Place the 11.5 mils cross (X) on the target.
13. Fire when ready using the gun trigger (Spacebar).



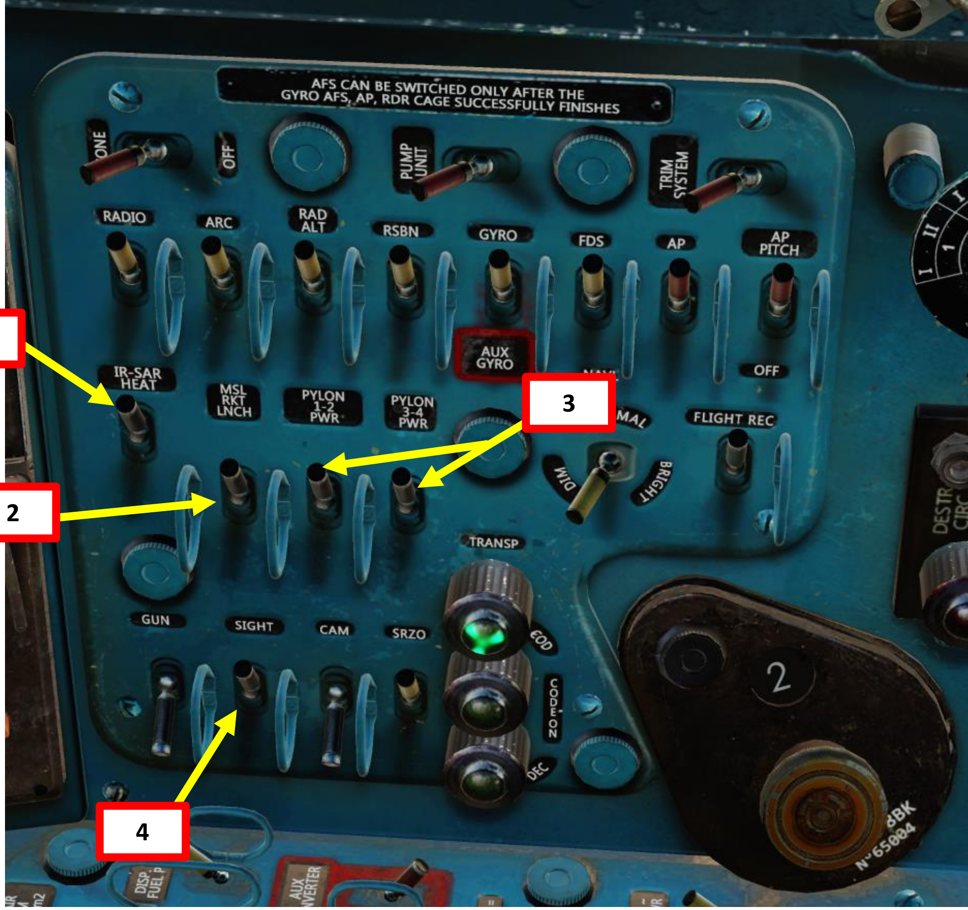
2.1 – GSh-23 23 mm Cannon (Air-to-Air)

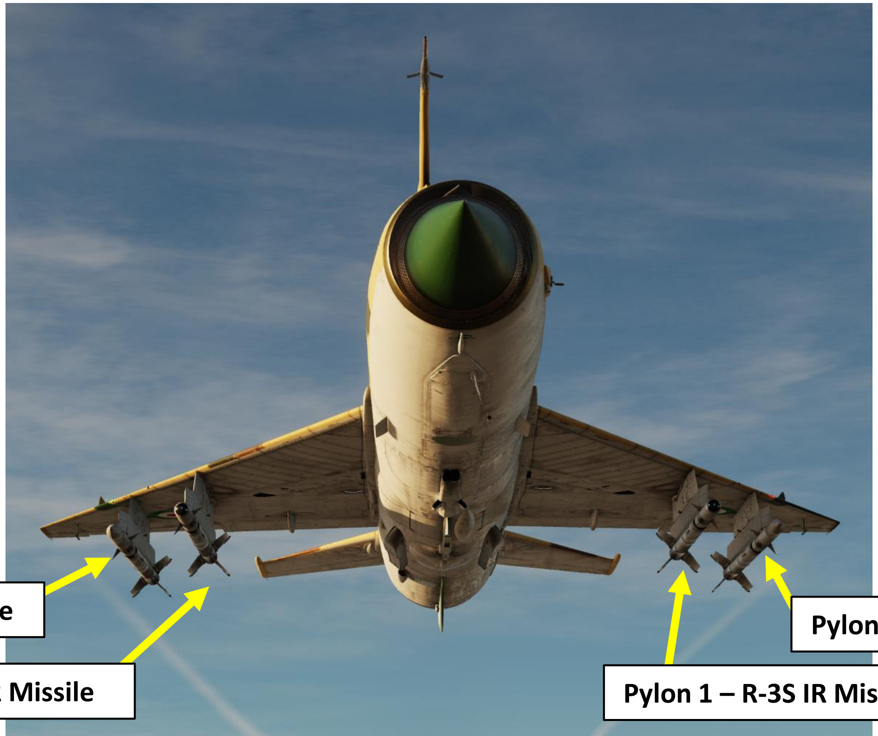
2.2 – IR (Infrared Homing) Missile R-3S "Atoll B" - Without Radar

Applicable to R-3S, R-13, R-55 and R-60 Infrared Homing Missiles.

2.2 – IR (Infrared Homing) Missile R-3S “Atoll B” - Without Radar

1. Set IR-SARH Missiles Heating Power Switch – ON (UP)
2. Set IR-SARH Missiles / Rocket Master Arm Switch – ON (UP)
3. Set relevant Pylon Power Switches – ON (UP)
    - Pylons 1-2 are the inner pylons
    - Pylons 3-4 are the outer pylons
4. Set ASP-PFD Optical Sight Power Switch – ON (UP)
5. Set Air/Ground Master Mode switch to AIR (UP).
6. Set Weapon Selector to desired pylon
    - IR-SAR 1, 2, 3 and 4 select individual pylons for a single missile launch upon firing
    - IR-SAR 3-4 selects both outer pylons for a dual missile launch upon firing
    - IR-SAR 1-2 selects both inner pylons for a dual missile launch upon firing
7. Set Air-to-Air Missile Type Selector – IR (UP).
8. Missile launch priority order is determined based on both the Weapon Selector and Missile Type selector. In our case the “Pylon 1 – IR” setting means that pressing the Weapon Release button will automatically cycle through pylons (order: 1, 2, 3 then 4) until an Infrared homing missile is detected, starting with Pylon 1.



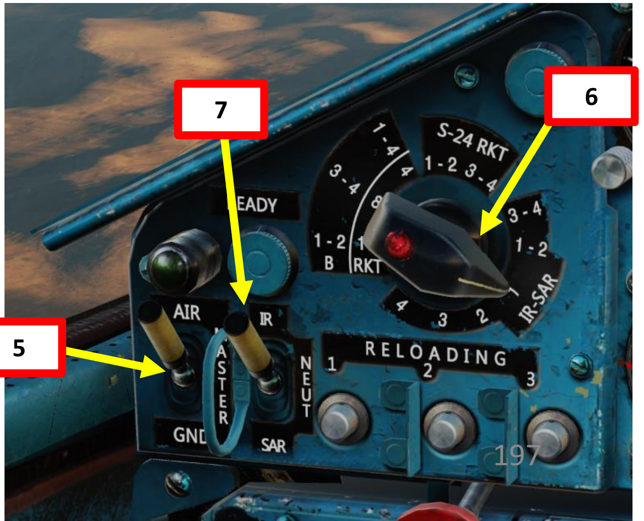


Pylon 4 – R-3R SARH Missile

Pylon 2 – R-3S IR Missile

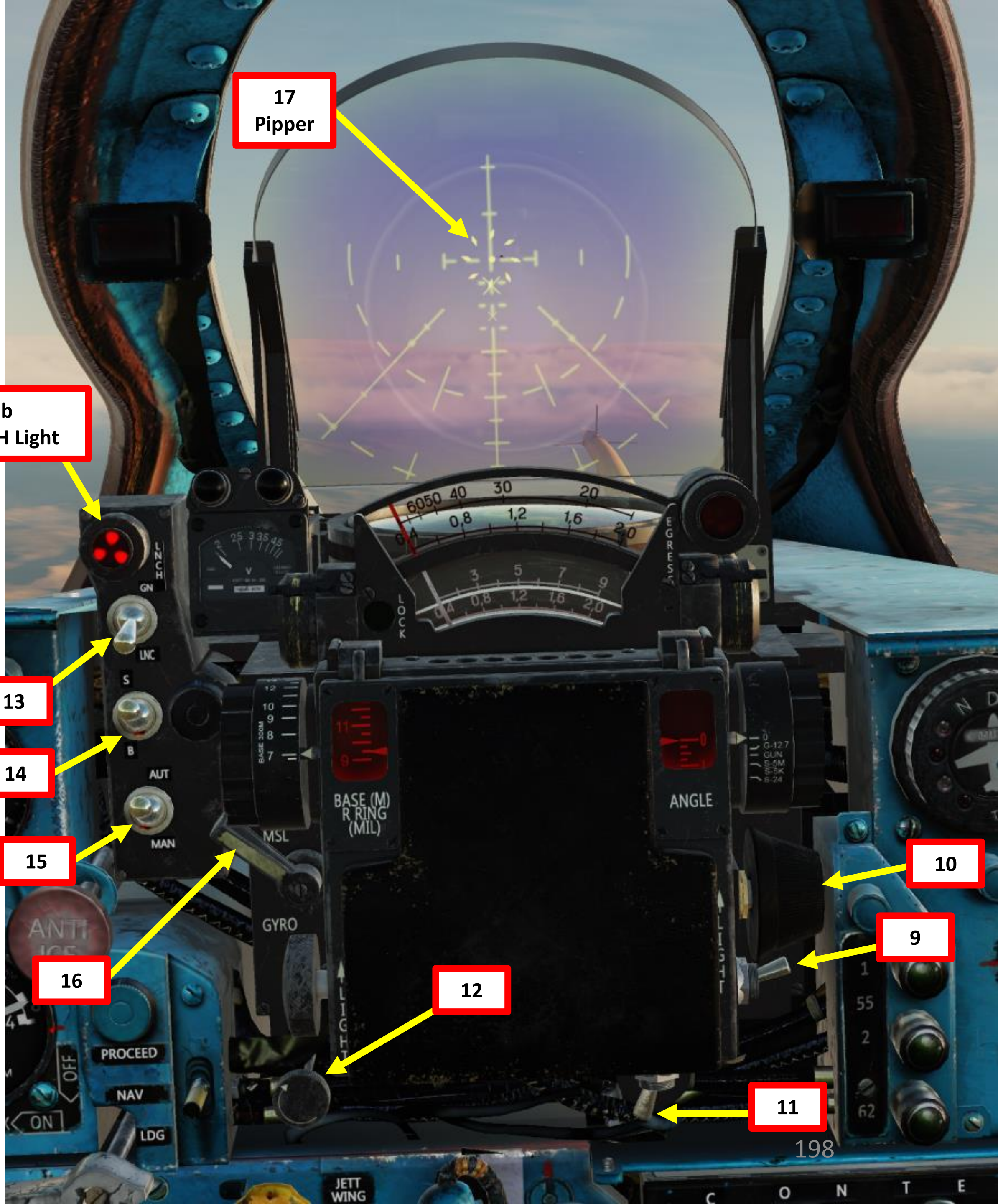
Pylon 1 – R-3S IR Missile

Pylon 3 – R-3R SARH Missile



2.2 – IR (Infrared Homing) Missile R-3S "Atoll B" - Without Radar

9. Set Pipper Switch – ON (UP).
10. Adjust Pipper brightness as desired.
11. Set Fixed Net Switch – ON (LEFT).
12. Adjust Fixed net brightness as desired.
13. Set Optical Sight GN/LNC Mode switch – LAUNCH (DOWN)
14. Set Optical Sight S/B Mode switch – SHOOT (UP)
15. Set Optical Sight AUT/MAN Mode switch – AUTO (UP)
16. Set Optical Sight MSL/GYRO Mode switch – MISSILE (UP)
17. Fly the aircraft behind the target and set it at the center of the Fixed Net or Pipper.
18. When a heat signature is detected by the missile:
    a) Missile Lock-On sound is audible
    b) LNCH light illuminates on the ASP Optical Sight
    c) If a R-60 missile is selected, the "62" (R-60 Air-to-Air IR Missile Lock) Light illuminates regardless of the pylon selected. For other IR homing missile types, the light remains extinguished.
19. Take note that the pipper reticle position remains static on the ASP Optical Sight. It can be used as a visual aid to judge the range to the target, but the pipper itself will **not** lock on the target itself.



2.2 – IR (Infrared Homing) Missile R-3S "Atoll B" - Without Radar

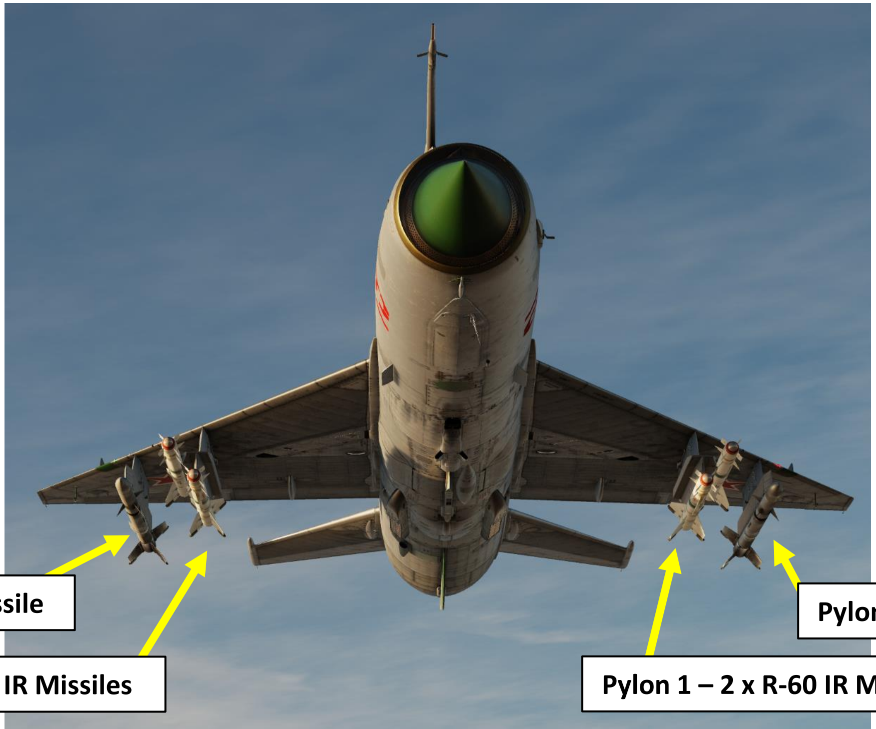
20. Flip Weapon Release Button safety and keep the Weapon Release pressed until missile launches (RALT+Spacebar).
21. The missile will track the heat signature by itself.
22. When missile is fired, the engine starter will run for about 5 seconds to ensure no engine flameout occurs due to missile smoke ingestion through the engine intake.

2.3 – IR (Infrared Homing) Missile R-60 “Aphid” - With Radar

Applicable to R-3S, R-13, R-55 and R-60 Infrared Homing Missiles.

2.3 – IR (Infrared Homing) Missile R-60 “Aphid” - With Radar

1. Set IR-SARH Missiles Heating Power Switch – ON (UP)
2. Set IR-SARH Missiles / Rocket Master Arm Switch – ON (UP)
3. Set relevant Pylon Power Switches – ON (UP)
    - Pylons 1-2 are the inner pylons
    - Pylons 3-4 are the outer pylons
4. Set ASP-PFD Optical Sight Power Switch – ON (UP)
5. Set Air/Ground Master Mode switch to AIR (UP).
6. Set Weapon Selector to desired pylon
    - IR-SAR 1, 2, 3 and 4 select individual pylons for a single missile launch upon firing
    - IR-SAR 3-4 selects both outer pylons for a dual missile launch upon firing
    - IR-SAR 1-2 selects both inner pylons for a dual missile launch upon firing
7. Set Air-to-Air Missile Type Selector – IR (UP).
8. Missile launch priority order is determined based on both the Weapon Selector and Missile Type selector. In our case the “Pylon 1 – IR” setting means that pressing the Weapon Release button will automatically cycle through pylons (order: 1, 2, 3 then 4) until an Infrared homing missile is detected, starting with Pylon 1.

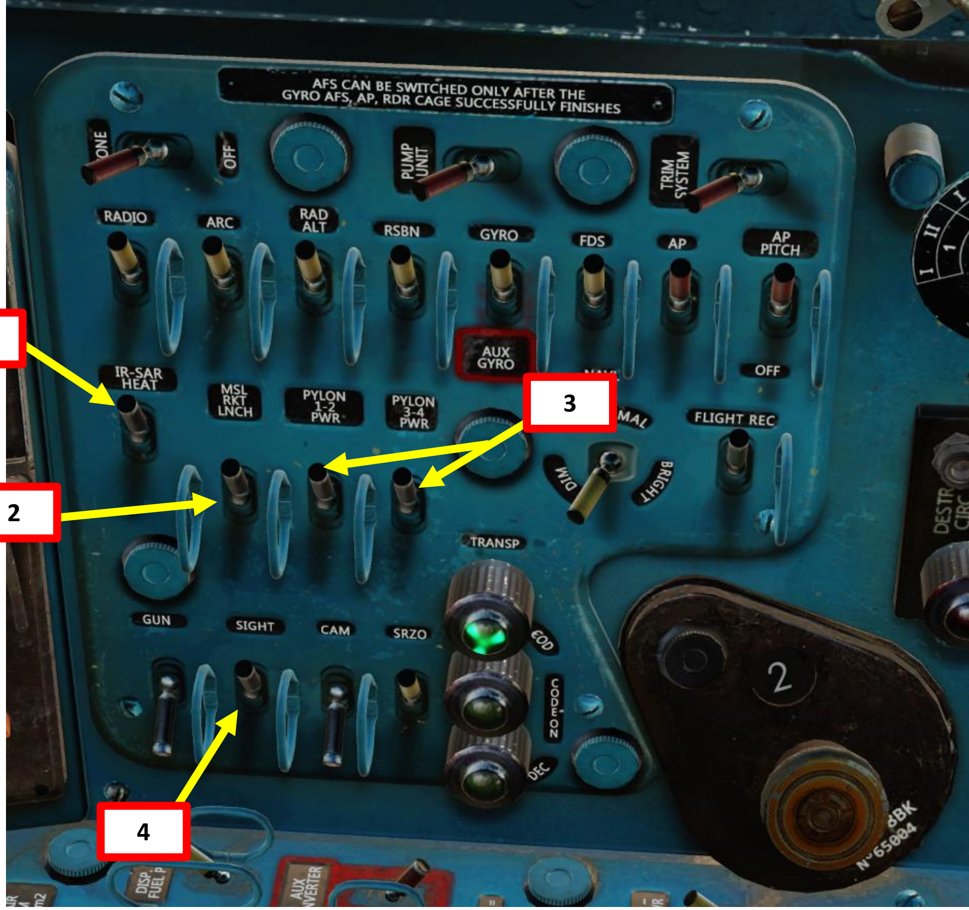


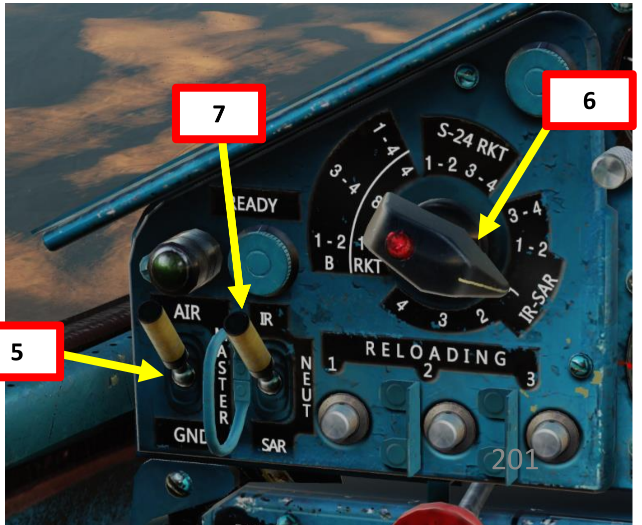
Pylon 4 – R-3R SARH Missile

Pylon 3 – R-3R SARH Missile

Pylon 2 – 2 x R-60 IR Missiles

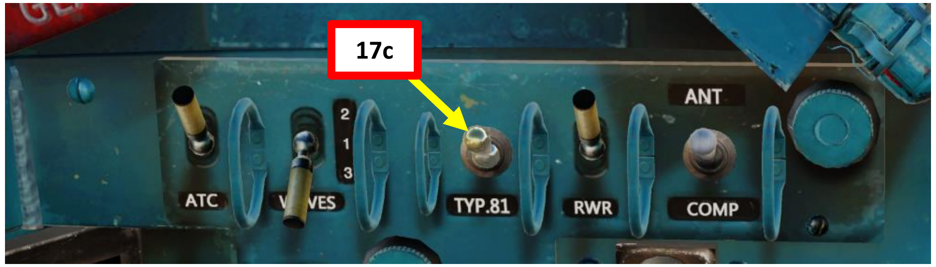
Pylon 1 – 2 x R-60 IR Missiles

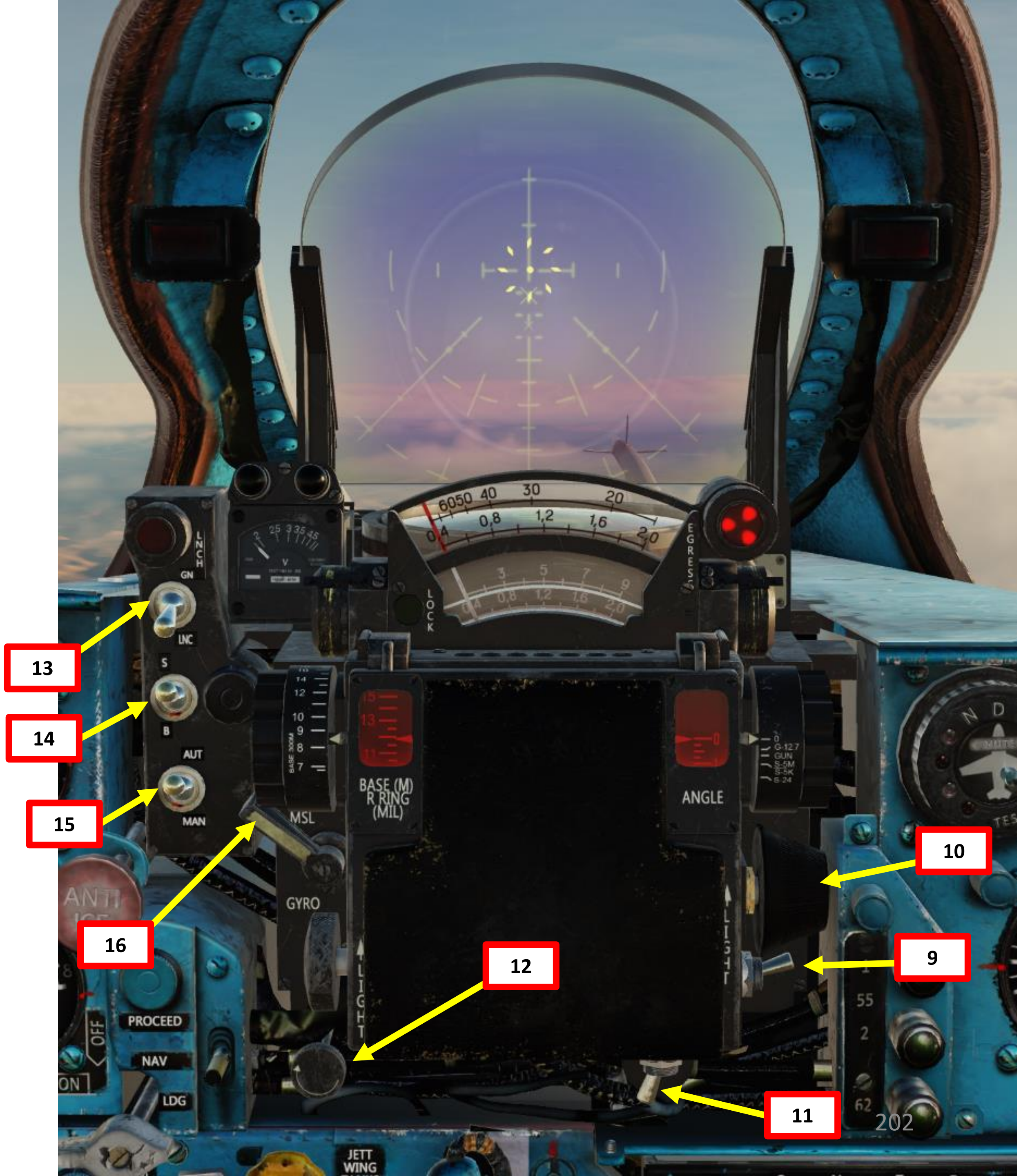




2.3 – IR (Infrared Homing) Missile R-60 "Aphid" - With Radar

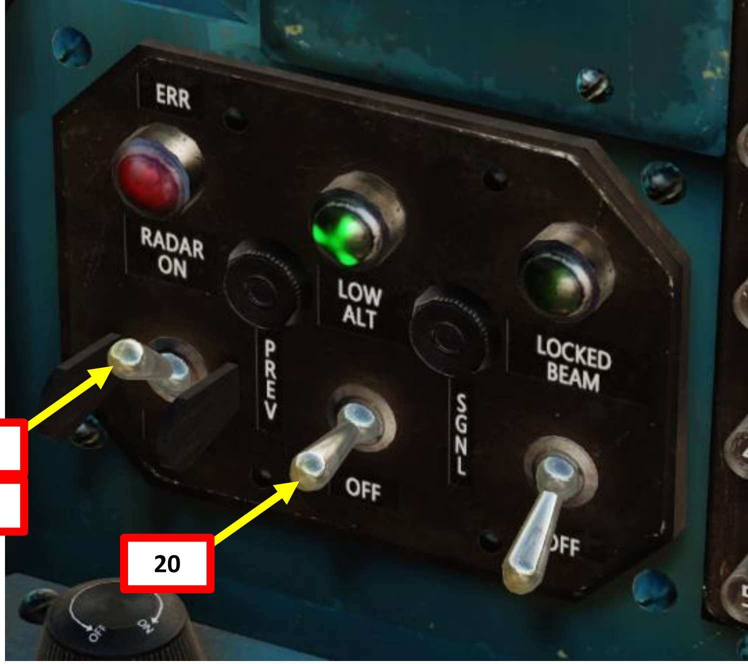
9. Set Pipper Switch – ON (UP).
10. Adjust Pipper brightness as desired.
11. Set Fixed Net Switch – ON (LEFT).
12. Adjust Fixed net brightness as desired.
13. Set Optical Sight GN/LNC Mode switch – LAUNCH (DOWN)
14. Set Optical Sight S/B Mode switch – SHOOT (UP)
15. Set Optical Sight AUT/MAN Mode switch – AUTO (UP)
16. Set Optical Sight MSL/GYRO Mode switch – MISSILE (UP)
17. Verify that IFF (Identify-Friend-or-Foe) system is powered on
    a) SRZO IFF Power Switch – ON (UP)
    b) Interrogator Code – Set as required by mission
    c) Type 81 IFF Switch – ON (UP)





2.3 – IR (Infrared Homing) Missile R-60 "Aphid" - With Radar

18. Set Radar Main Mode Selector to MIDDLE (STANDBY) to start radar warm-up. The RP-22 requires a 3 to 5 minute warm-up period before being functional. While in Standby Mode, the radar alcohol coolant lasts for 35 to 40 minutes.
19. Set Radar Main Mode Selector to UP (ON) to start scanning for targets in Search Mode.
20. Set Radar Low Altitude / Sidebeam Compensation Mode Switch – As required (see radar section).
21. When a radar contact is visible, press "IFF Interrogate" button to confirm that the target is not friendly.



18

19

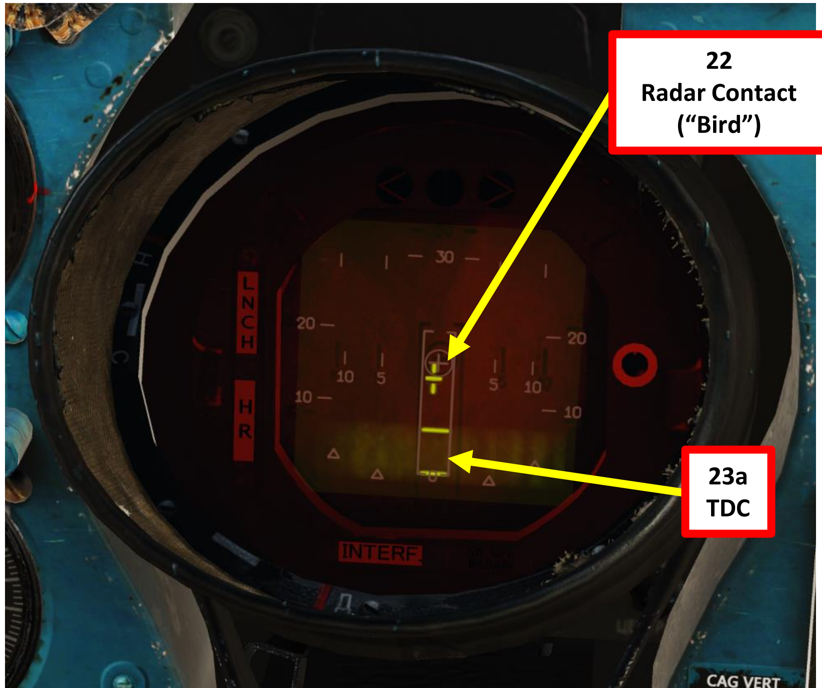
20

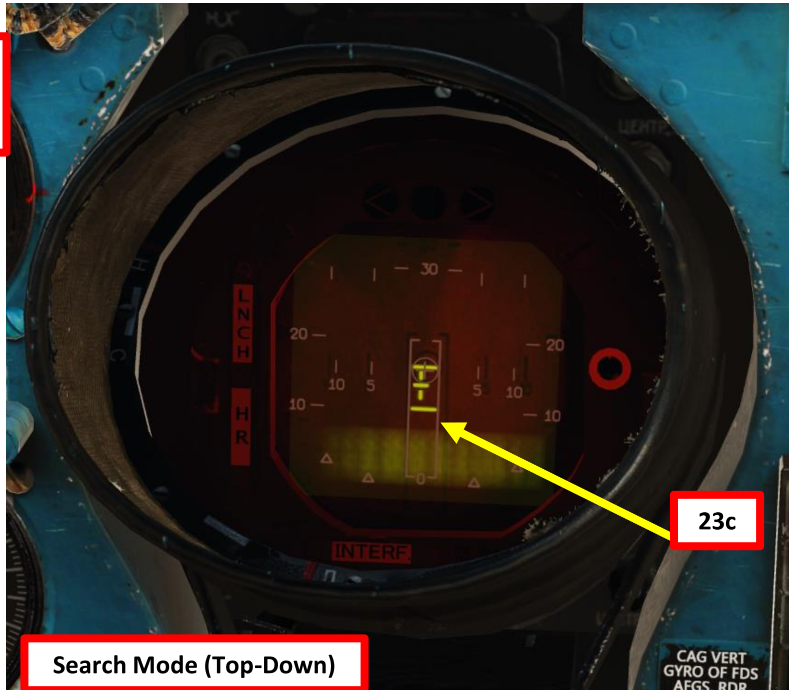
21b
No Friendly IFF Response
– : Not Friendly
= : Friendly

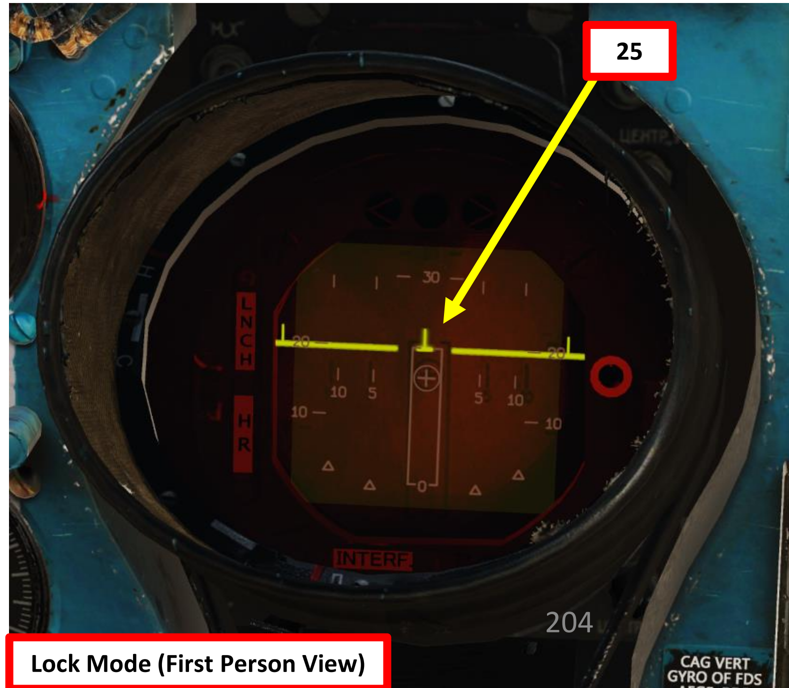
21a
IFF Interrogate Button

2.3 – IR (Infrared Homing) Missile R-60 "Aphid" - With Radar

22. Steer aircraft to align the contact ("bird") symbol with the centerline of the radar display. Make sure the radar contact is within the Azimuth Lock-On Zone (rectangle).
23. Slew the TDC (Target Designation Cue) over the radar contact using the Throttle Twist Grip. The TDC can only move up or down on the display and has no azimuth slew control.
24. When TDC gates are slewed over the radar contact, press and hold the Radar Lock-On button for 3 to 5 seconds; until the radar enters Lock Mode (Chase View).
25. When radar enters Lock Mode, the radar switches from a top-down view (Search Mode) to a first-person view (Lock Mode)

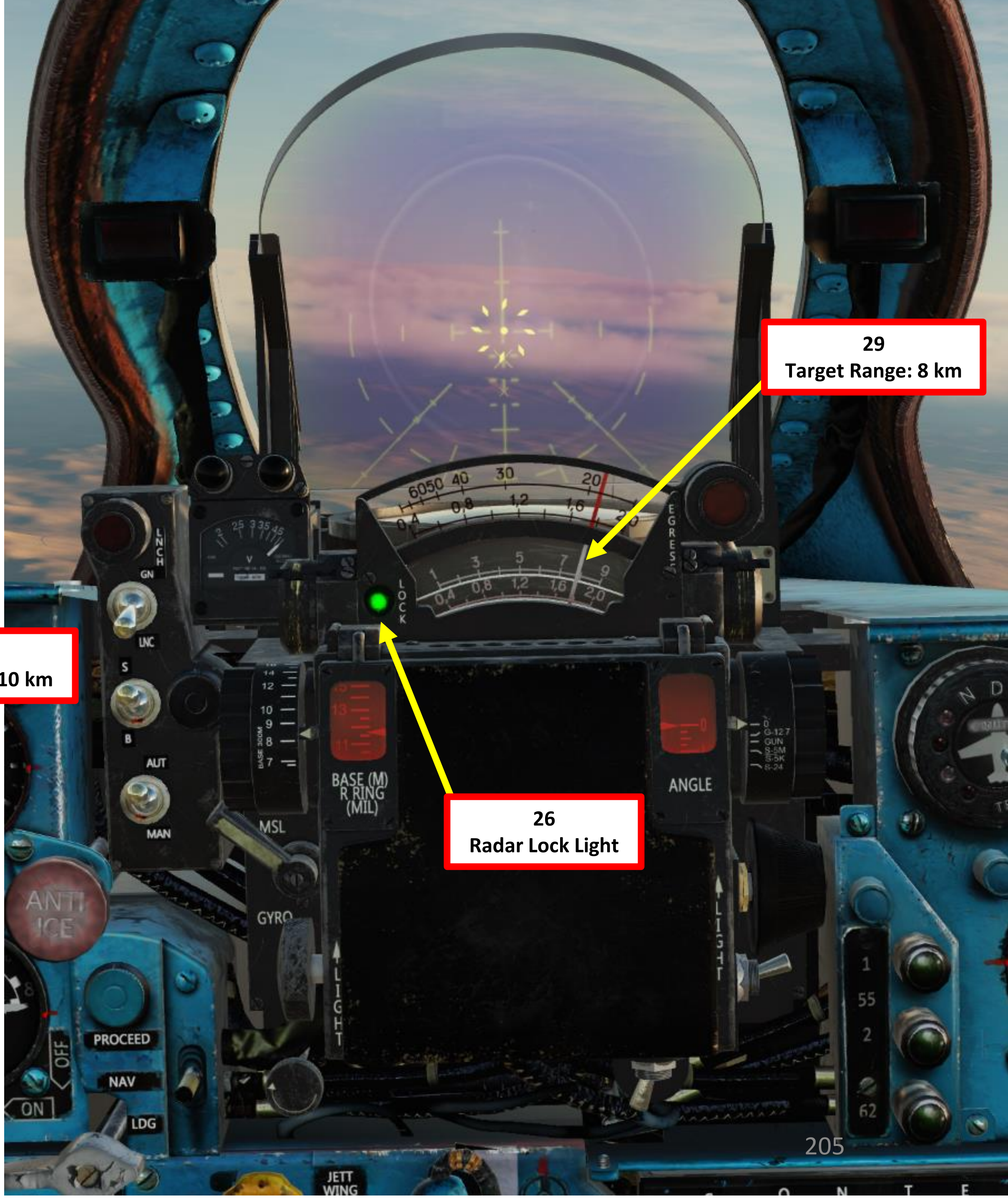






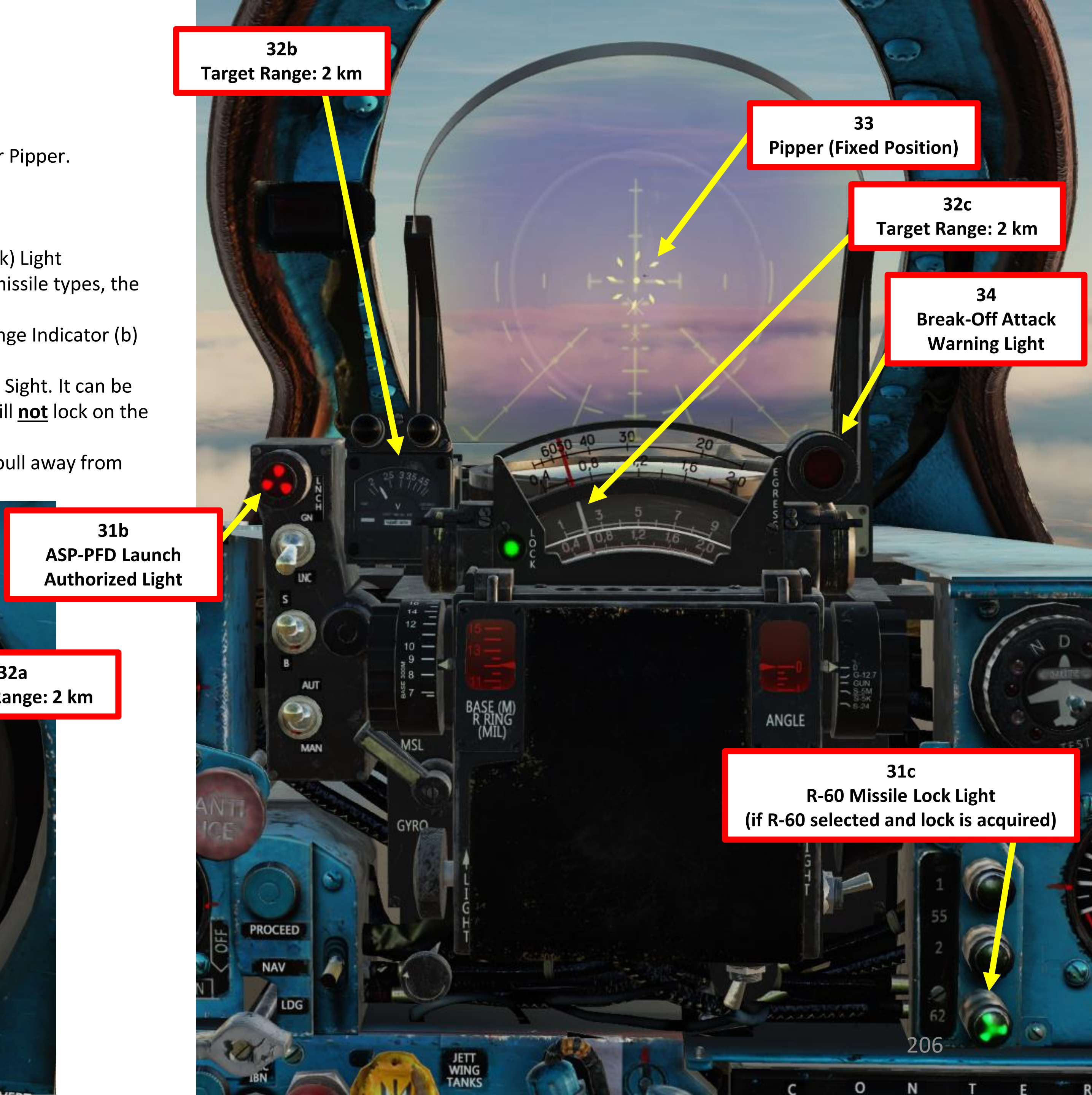
2.3 – IR (Infrared Homing) Missile R-60 "Aphid" - With Radar

26. When radar lock is performed, the LOCK light on the ASP Optical Sight will illuminate.
27. Steer aircraft to center the radar blip symbol on the radar boresight circle at the center of the display.
28. After lock, you will generally be in radar range, but not in effective missile range.
29. Use the radar display and ASP Sight scale to judge distance to target. In our case, the radar is does not provide IR missile homing guidance on the target; it is merely meant to help you steer the aircraft in the general direction of the target.



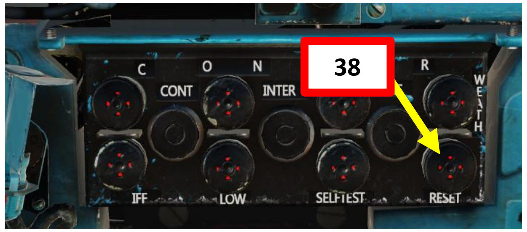
2.3 – IR (Infrared Homing) Missile R-60 "Aphid" - With Radar

30. Fly the aircraft behind the target and set it at the center of the Fixed Net or Pipper.
31. When a heat signature is detected by the missile:
    a) Missile Lock-On sound is audible
    b) LNCH light illuminates on the ASP Optical Sight
    c) If a R-60 missile is selected, the "62" (R-60 Air-to-Air IR Missile Lock) Light illuminates regardless of the pylon selected. For other IR homing missile types, the light remains extinguished.
32. The radar provides ranging information on the radar display (a), Missile Range Indicator (b) and ASP Optical Sight Range Indicator's third row (c).
33. Take note that the pipper reticle position remains static on the ASP Optical Sight. It can be used as a visual aid to judge the range to the target, but the pipper itself will **not** lock on the target itself.
34. If the Break-Off Attack Light illuminates, you risk colliding with the target; pull away from the target.



2.3 – IR (Infrared Homing) Missile R-60 "Aphid" - With Radar

35. Flip Weapon Release Button safety and keep the Weapon Release pressed until missile launches (RALT+Spacebar).
36. The missile will track the heat signature by itself.
37. When missile is fired, the engine starter will run for about 5 seconds to ensure no engine flameout occurs due to missile smoke ingestion through the engine intake.
38. To exit radar lock mode, press the Radar Reset button.

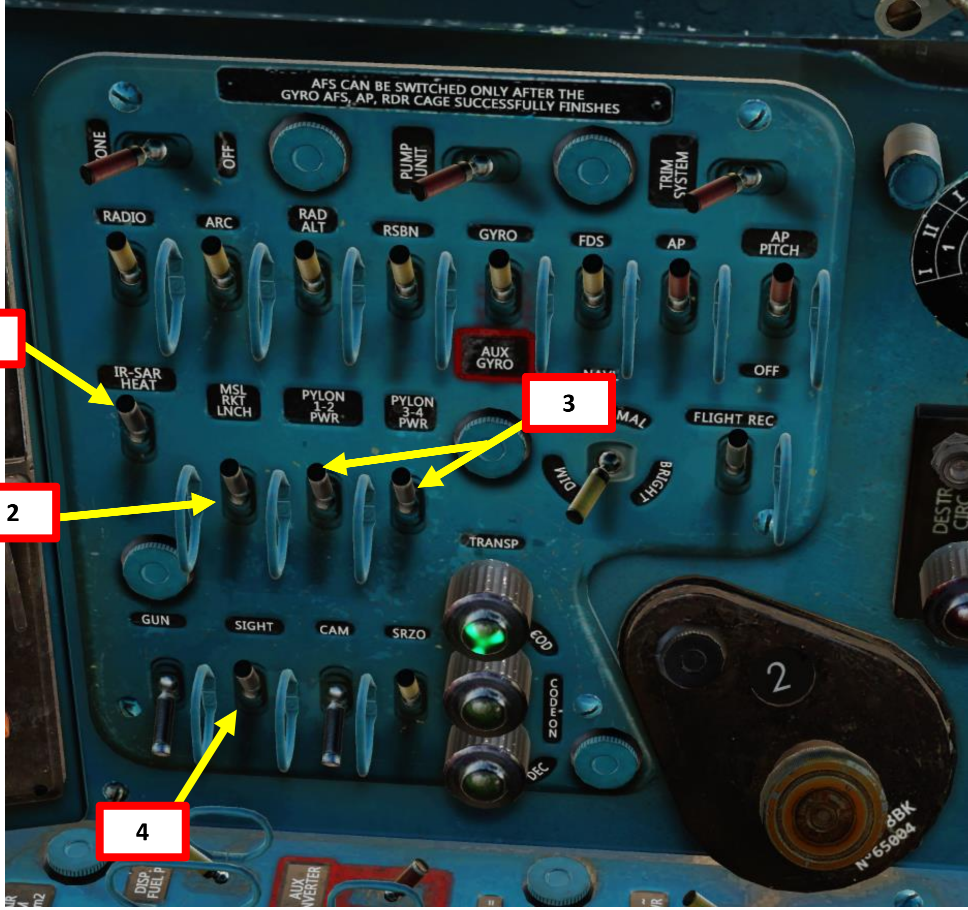


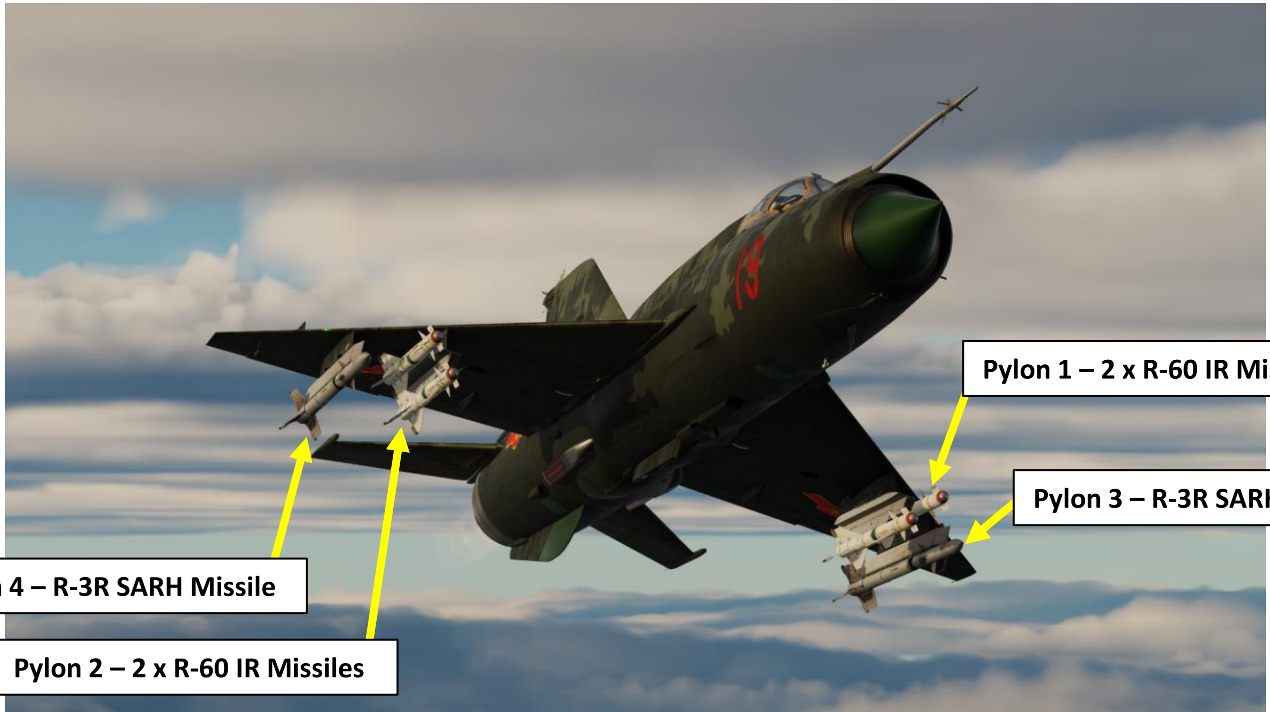
2.4 – SARH (Semi-Active Radar Homing) Missile
R-3R "Atoll C" - With Radar

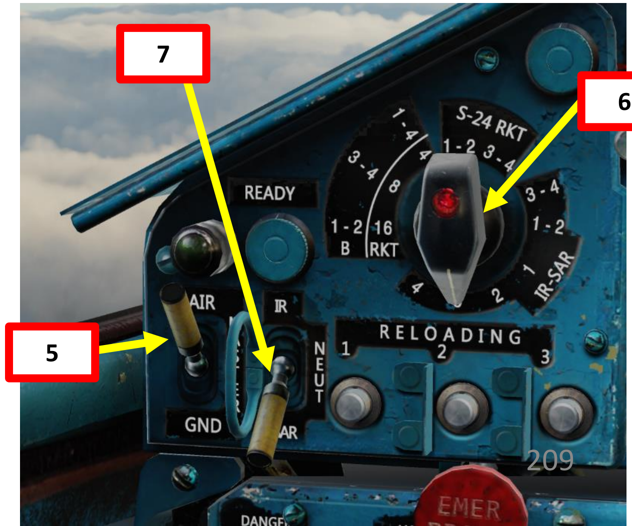
Applicable to R-3R and RS-2US Semi-Active Radar Homing Missiles.

2.4 – SARH (Semi-Active Radar Homing) Missile
R-3R "Atoll C" - With Radar

1. Set IR-SARH Missiles Heating Power Switch – ON (UP)
2. Set IR-SARH Missiles / Rocket Master Arm Switch – ON (UP)
3. Set relevant Pylon Power Switches – ON (UP)
    - Pylons 1-2 are the inner pylons
    - Pylons 3-4 are the outer pylons
4. Set ASP-PFD Optical Sight Power Switch – ON (UP)
5. Set Air/Ground Master Mode switch to AIR (UP).
6. Set Weapon Selector to desired pylon
    - IR-SAR 1, 2, 3 and 4 select individual pylons for a single missile launch upon firing
    - IR-SAR 3-4 selects both outer pylons for a dual missile launch upon firing
    - IR-SAR 1-2 selects both inner pylons for a dual missile launch upon firing
7. Set Air-to-Air Missile Type Selector – SAR (DOWN).
8. Missile launch priority order is determined based on both the Weapon Selector and Missile Type selector. In our case the "Pylon 3 – SAR" setting means that pressing the Weapon Release button will automatically cycle through pylons (order: 3, 4, 1 then 2) until a semi-active radar homing missile is detected, starting with Pylon 3.

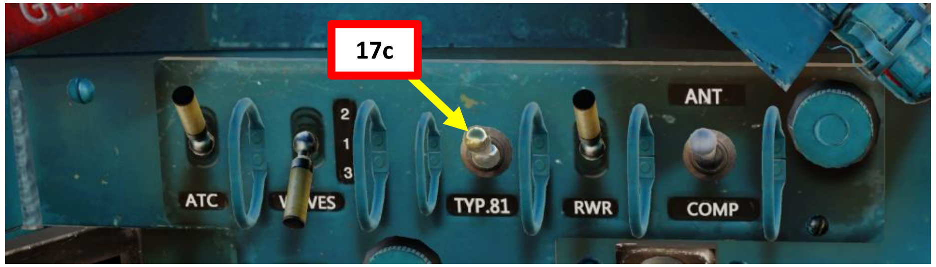


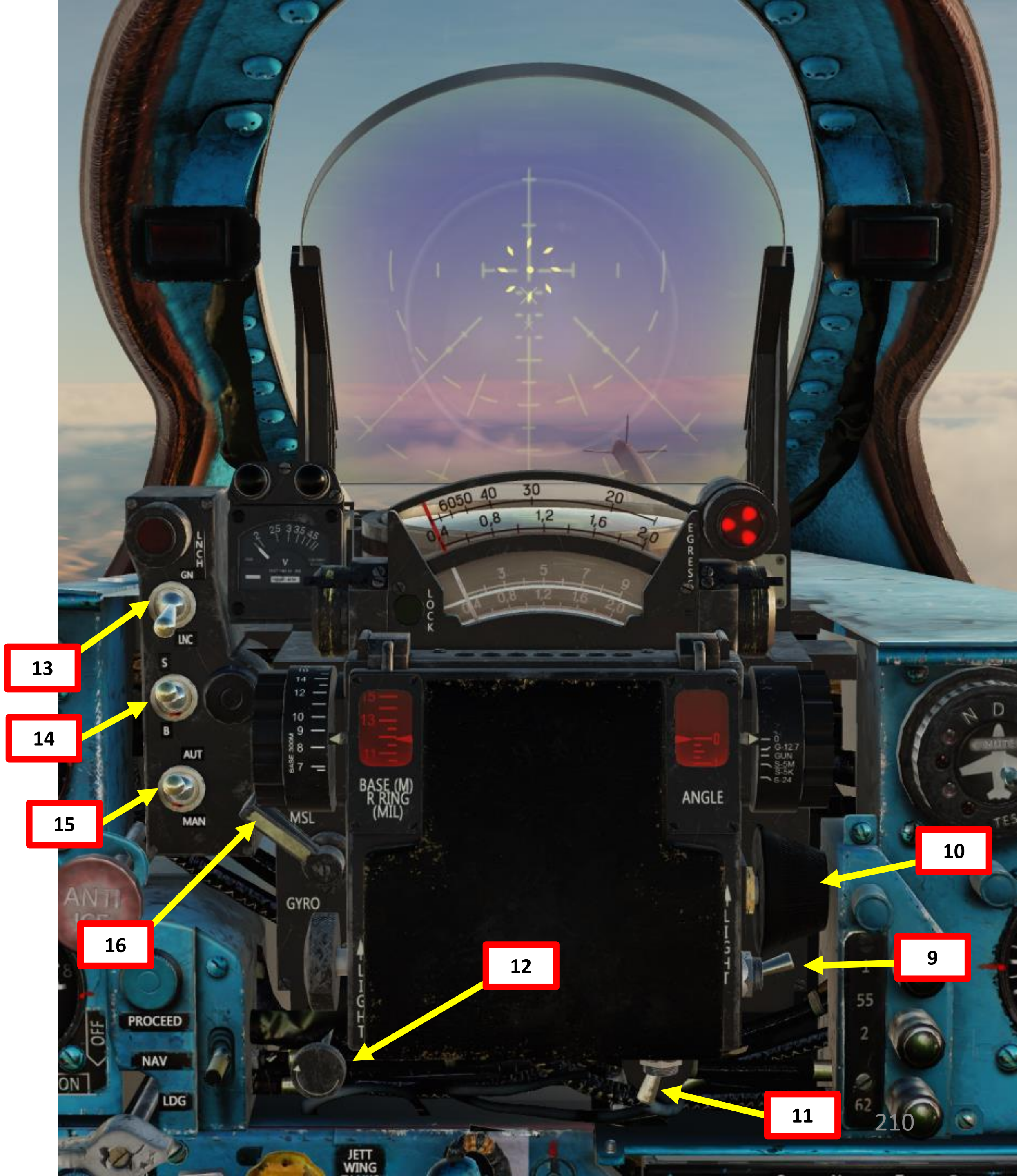




2.4 – SARH (Semi-Active Radar Homing) Missile R-3R "Atoll C" - With Radar

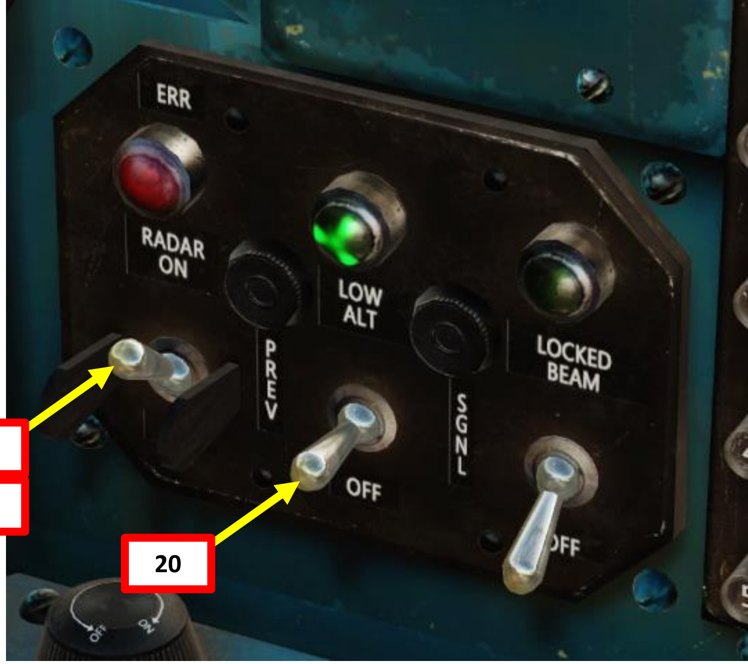
9. Set Pipper Switch – ON (UP).
10. Adjust Pipper brightness as desired.
11. Set Fixed Net Switch – ON (LEFT).
12. Adjust Fixed net brightness as desired.
13. Set Optical Sight GN/LNC Mode switch – LAUNCH (DOWN)
14. Set Optical Sight S/B Mode switch – SHOOT (UP)
15. Set Optical Sight AUT/MAN Mode switch – AUTO (UP)
16. Set Optical Sight MSL/GYRO Mode switch – MISSILE (UP)
17. Verify that IFF (Identify-Friend-or-Foe) system is powered on
    a) SRZO IFF Power Switch – ON (UP)
    b) Interrogator Code – Set as required by mission
    c) Type 81 IFF Switch – ON (UP)





2.4 – SARH (Semi-Active Radar Homing) Missile
R-3R "Atoll C" - With Radar

18. Set Radar Main Mode Selector to MIDDLE (STANDBY) to start radar warm-up. The RP-22 requires a 3 to 5 minute warm-up period before being functional. While in Standby Mode, the radar alcohol coolant lasts for 35 to 40 minutes.
19. Set Radar Main Mode Selector to UP (ON) to start scanning for targets in Search Mode.
20. Set Radar Low Altitude / Sidebeam Compensation Mode Switch – As required (see radar section).
21. When a radar contact is visible, press "IFF Interrogate" button to confirm that the target is not friendly.



18

19

20

21b
No Friendly IFF Response
– : Not Friendly
= : Friendly

21a
IFF Interrogate Button

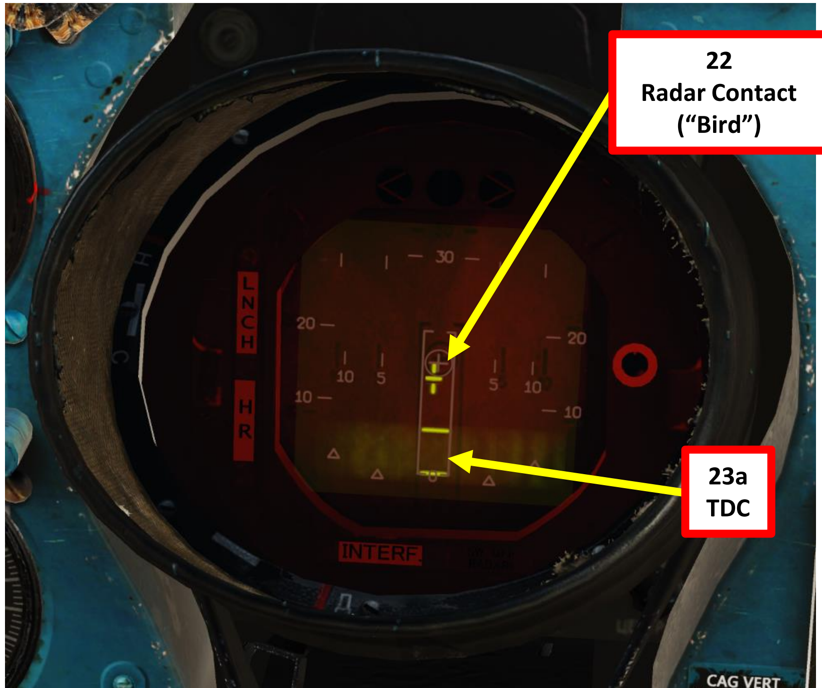
2.4 – SARH (Semi-Active Radar Homing) Missile R-3R "Atoll C" - With Radar

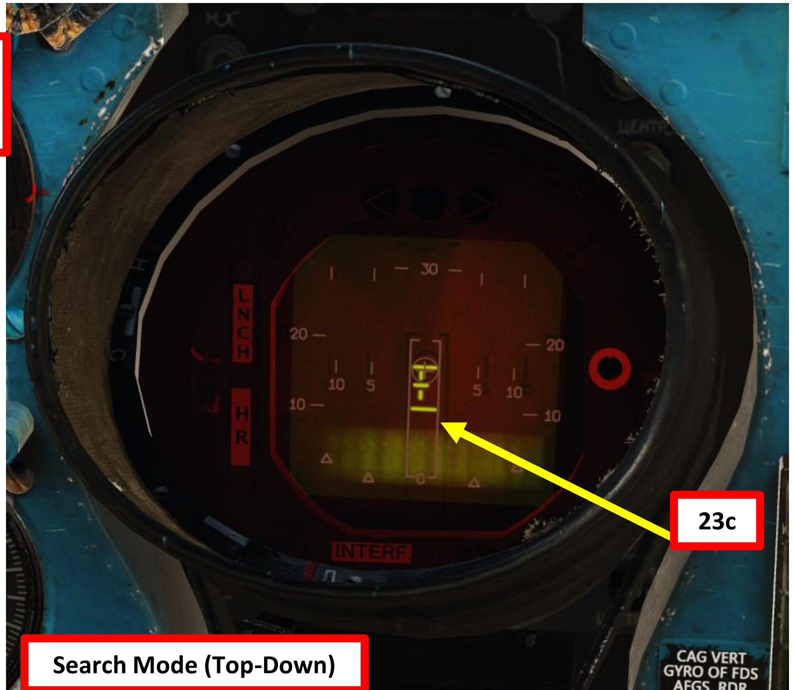
22. Steer aircraft to align the contact ("bird") symbol with the centerline of the radar display. Make sure the radar contact is within the Azimuth Lock-On Zone (rectangle).
23. Slew the TDC (Target Designation Cue) over the radar contact using the Throttle Twist Grip. The TDC can only move up or down on the display and has no azimuth slew control.
24. When TDC gates are slewed over the radar contact, press and hold the Radar Lock-On button for 3 to 5 seconds; until the radar enters Lock Mode (Chase View).
25. When radar enters Lock Mode, the radar switches from a top-down view (Search Mode) to a first-person view (Lock Mode)

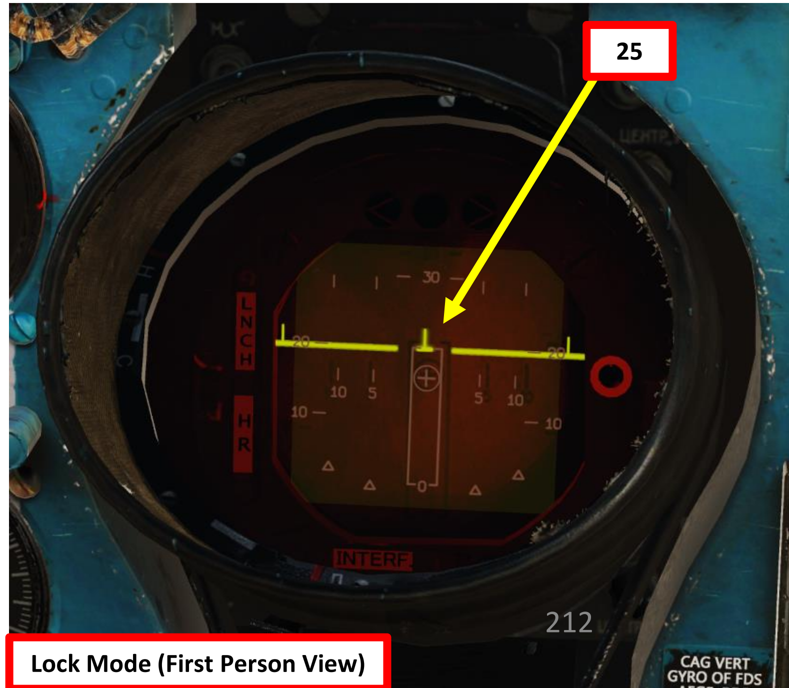
Throttle Twist Grip

- *Changes ASP Optical Sight Range & Radar TDC Slew Control*

23b

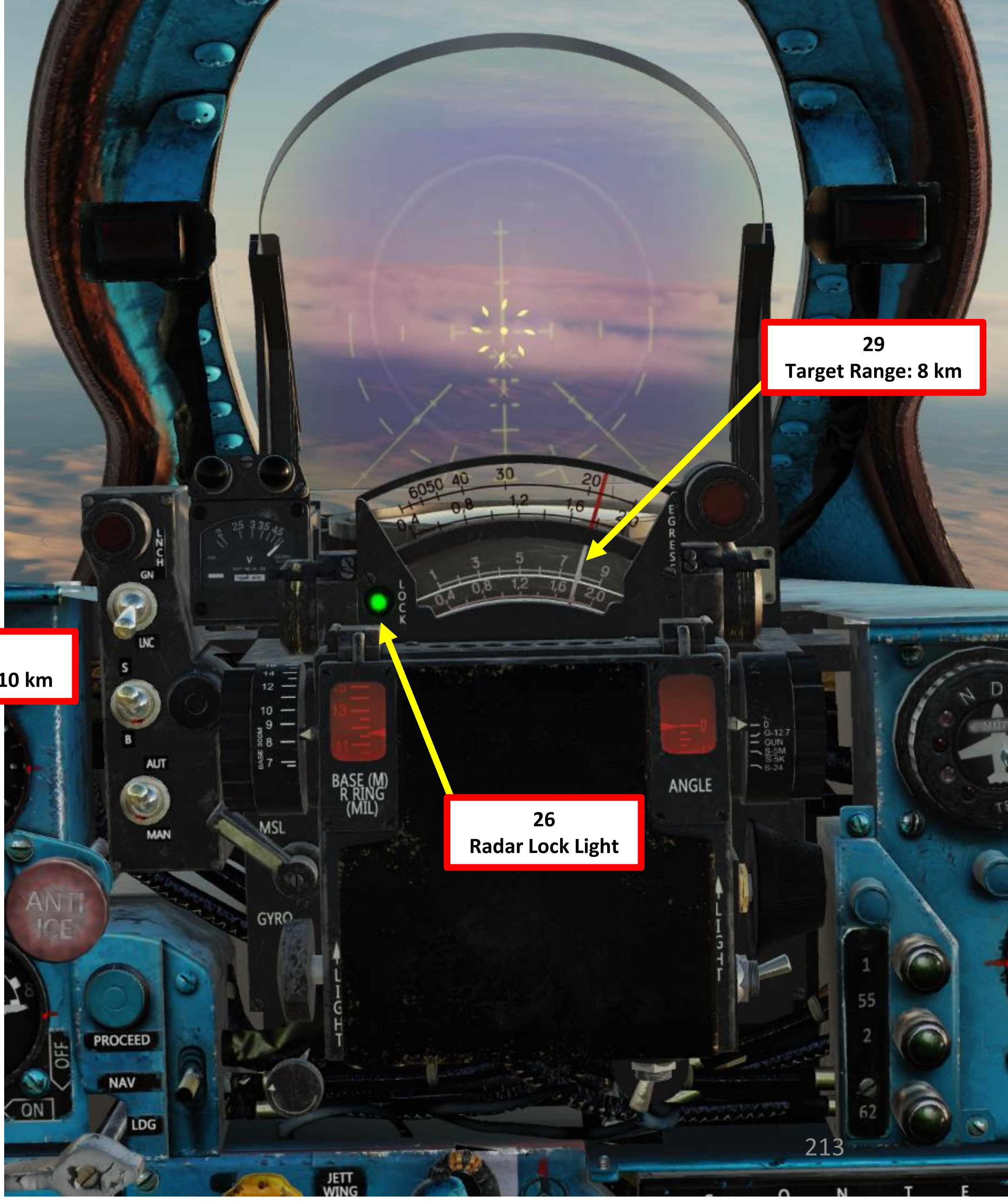






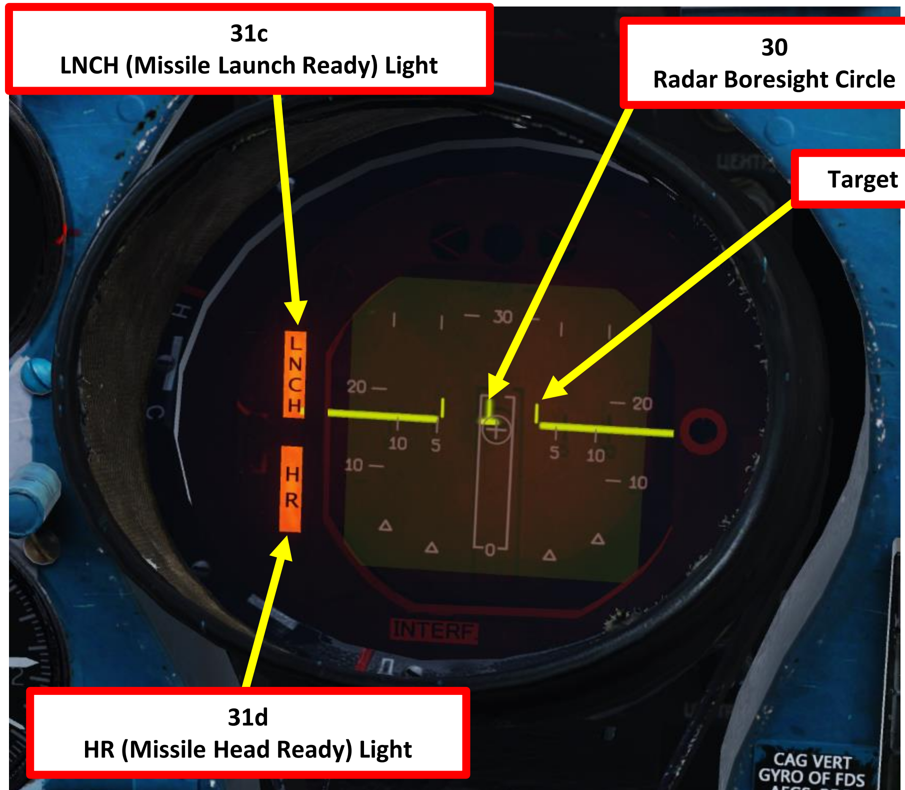
2.4 – SARH (Semi-Active Radar Homing) Missile R-3R “Atoll C” - With Radar

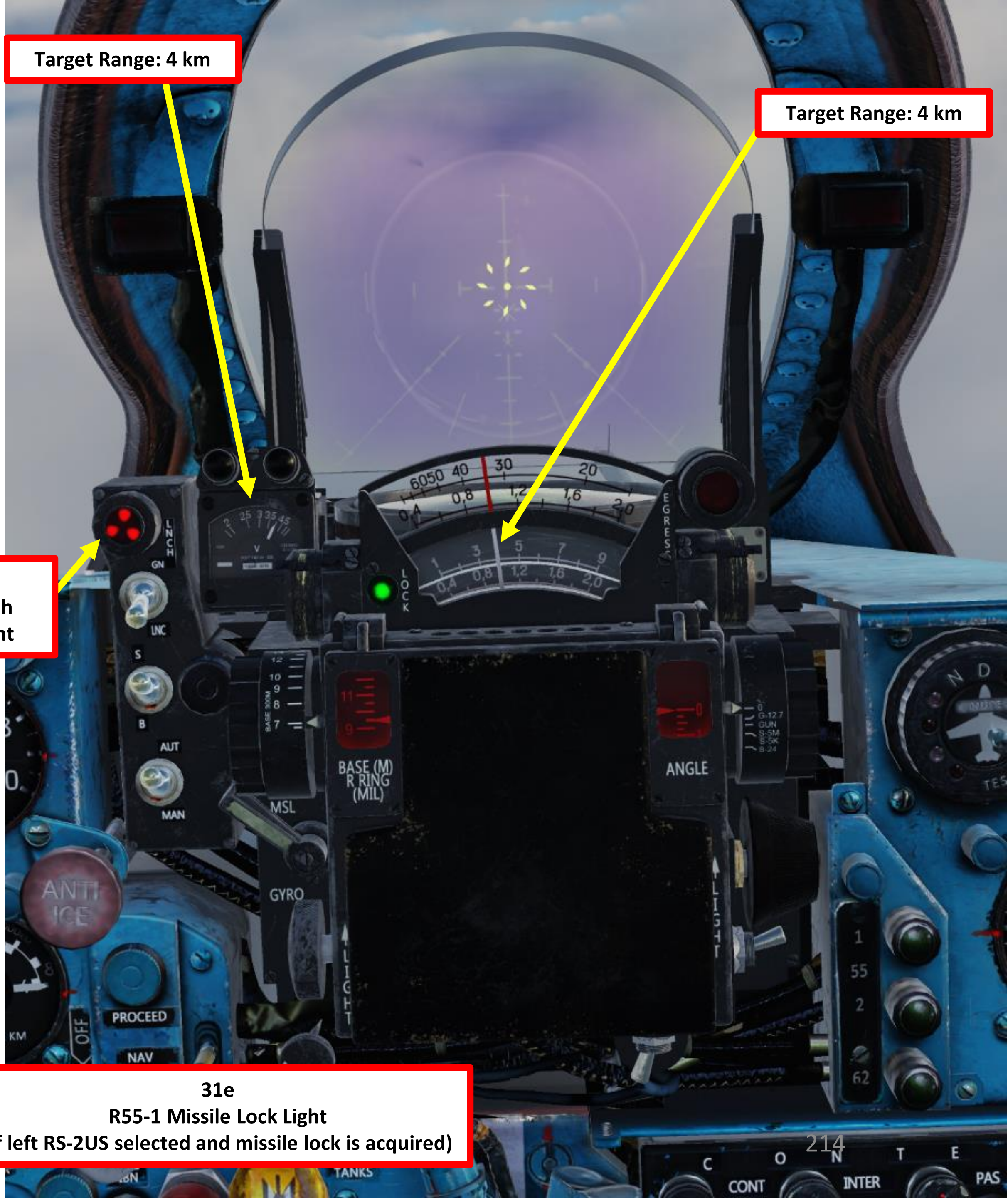
26. When radar lock is performed, the LOCK light on the ASP Optical Sight will illuminate.
27. Steer aircraft to center the radar blip symbol on the radar boresight circle at the center of the display.
28. After lock, you will generally be in radar range, but not in effective missile range.
29. Use the radar display and ASP Sight scale to judge distance to target. Keep in mind that even if you have a radar lock, you may not have a missile firing solution yet.



2.4 – SARH (Semi-Active Radar Homing) Missile
R-3R "Atoll C" - With Radar

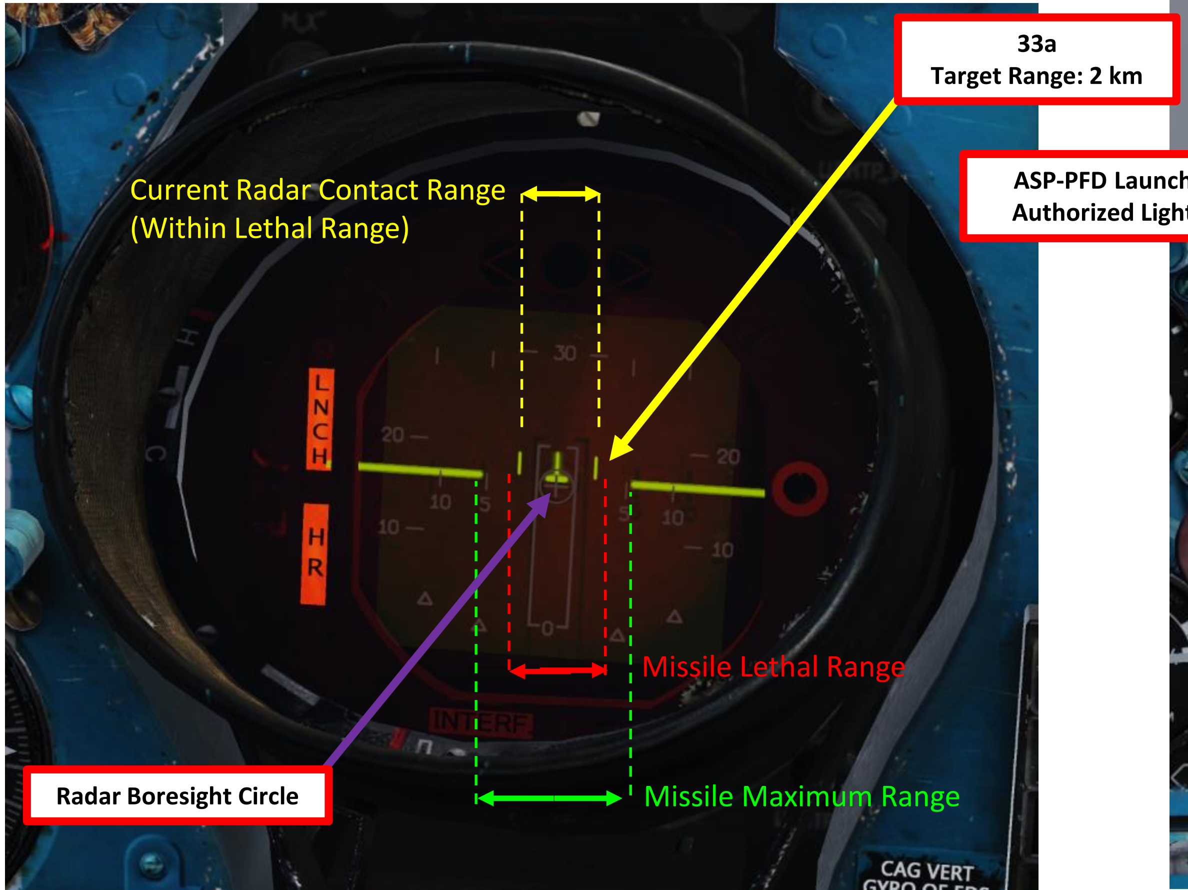
30. Keep the radar blip symbol centered on the boresight circle at all times to maintain radar lock.
31. When the radar locked target is detected by the missile:
    a) Missile Lock-On sound is audible
    b) LNCH light illuminates on the ASP Optical Sight
    c) LNCH (Launch Authorized) light illuminates on the radar display
    d) HR (Missile Head Ready) light illuminates on the radar display
    e) If a R-S-2US missile is selected, the "55 - 1" or "55 - 2" (RS-2US Air-to-Air Missile Lock) Light illuminates based on whether left pylon (55 - 1) or right pylon (55 – 2) is selected. For other semi-active radar homing (SARH) missile types, the lights remain extinguished.
32. Keep in mind that even if the missile is locked with the LNCH and HR cues, it does not guarantee a kill at maximum range. Make sure to get within effective (lethal) missile range.

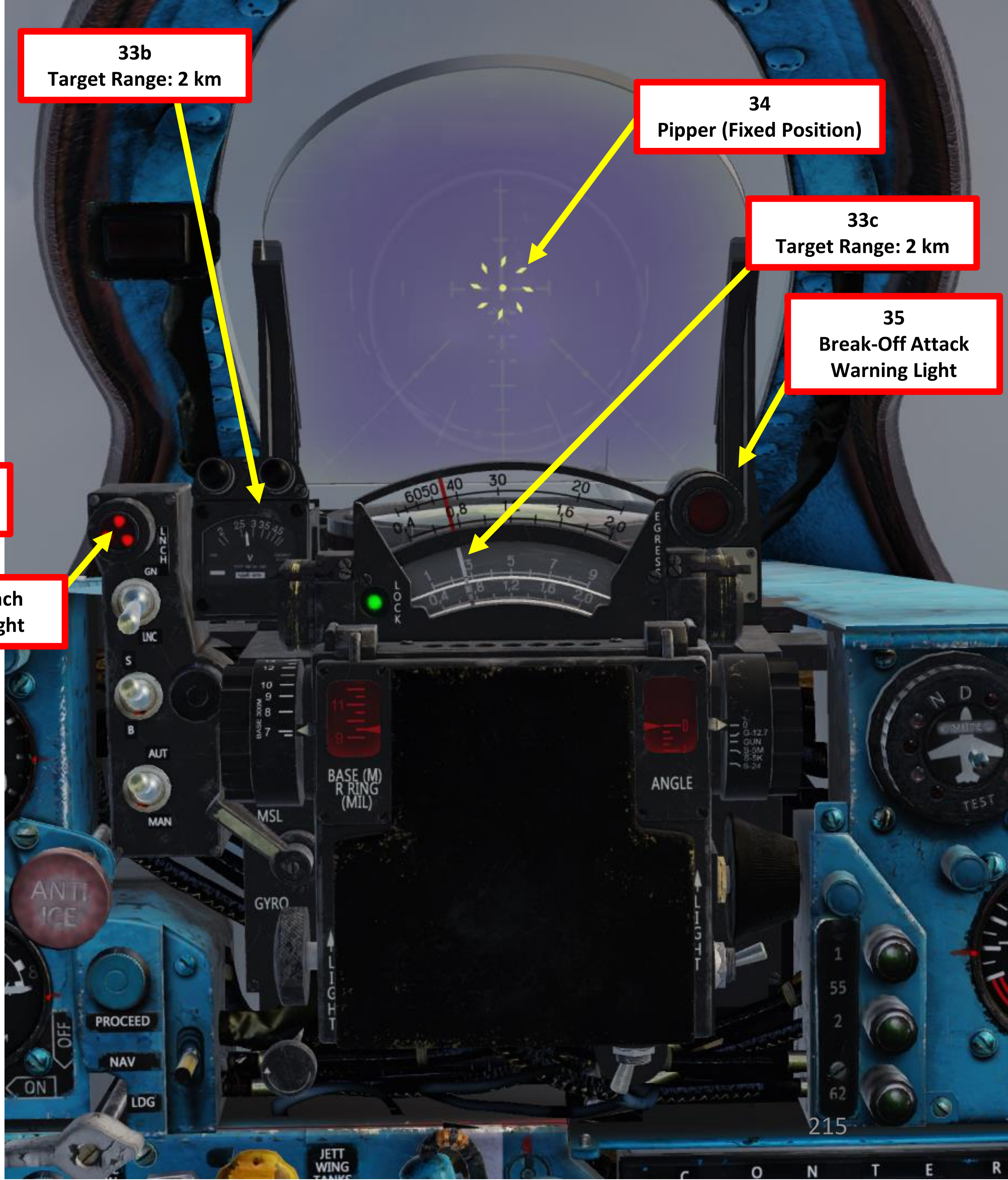




2.4 – SARH (Semi-Active Radar Homing) Missile R-3R "Atoll C" - With Radar

33. The radar provides ranging information on the radar display (a), Missile Range Indicator (b) and ASP Optical Sight Range Indicator's third row (c).
34. Take note that the pipper reticle position remains static on the ASP Optical Sight. It can be used as a visual aid to judge the range to the target, but the pipper itself will **not** lock on the target itself.
35. If the Break-Off Attack Light illuminates, you risk colliding with the target; pull away from the target.
36. Fly the aircraft until the missile is within "lethal" range (about 2-3 km). Make sure to maintain the radar blip symbol centered on the radar boresight circle to maintain radar lock.





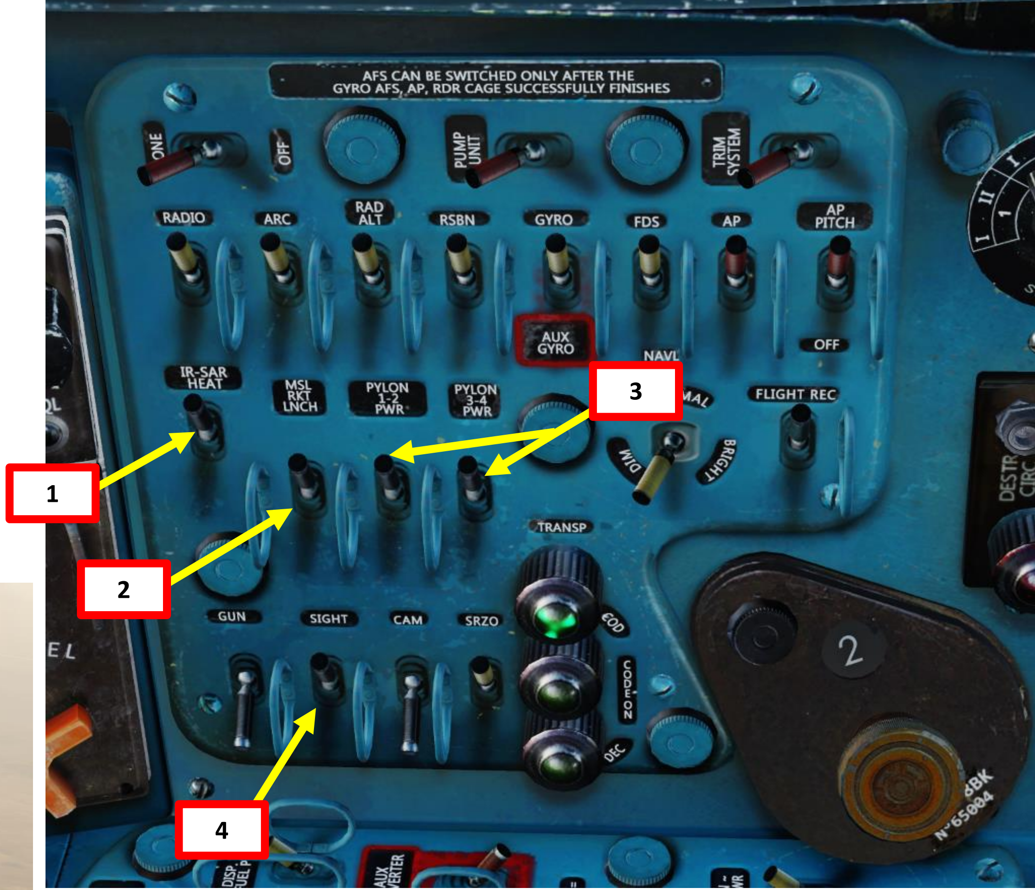
2.4 – SARH (Semi-Active Radar Homing) Missile
R-3R "Atoll C" - With Radar

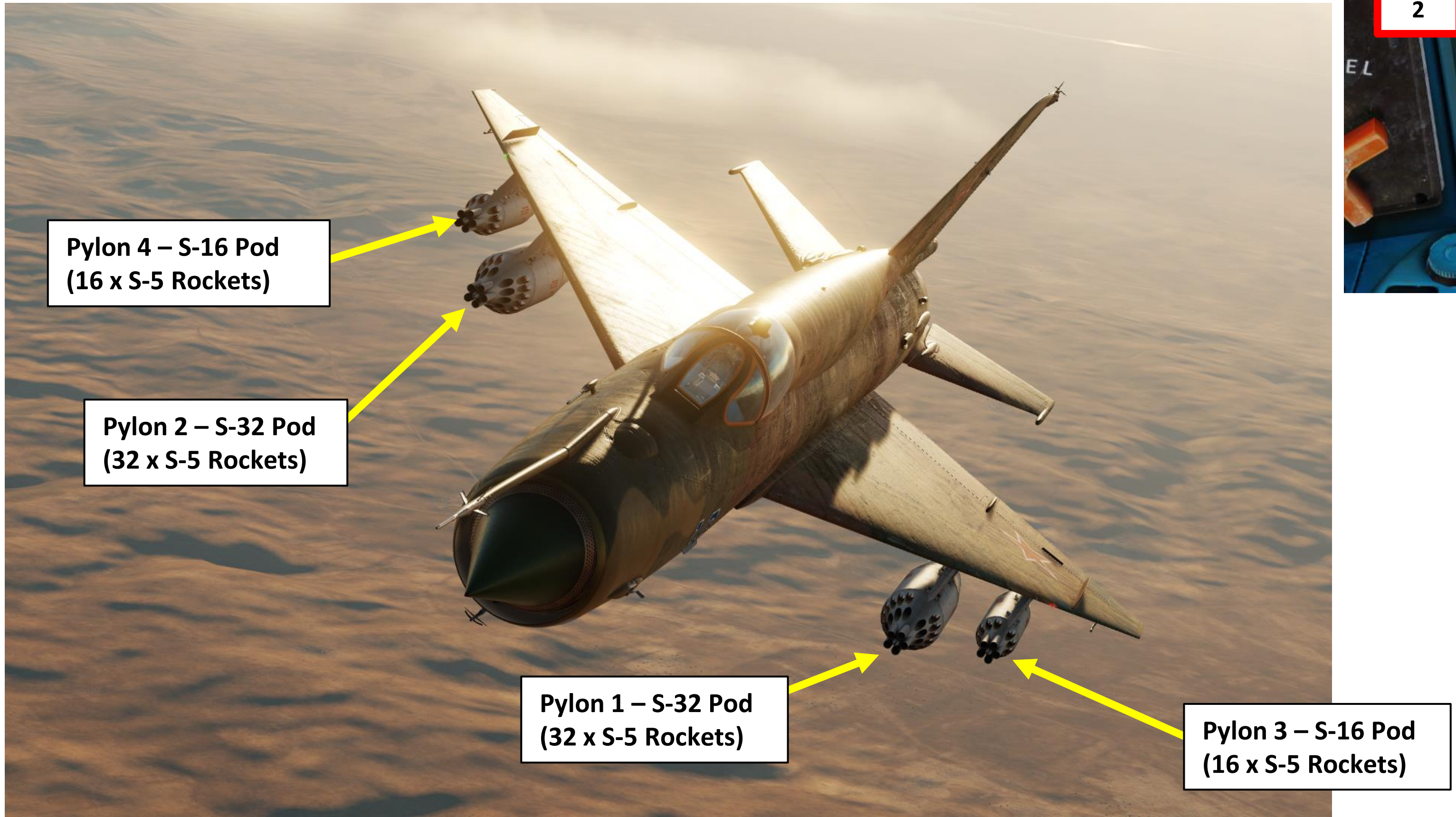
37. Flip Weapon Release Button safety and keep the Weapon Release pressed until missile launches (RALT+Spacebar).
38. The missile will track the target locked by your radar. Maintain radar lock until missile impact, otherwise the missile will break lock and go "dumb".
39. When missile is fired, the engine starter will run for about 5 seconds to ensure no engine flameout occurs due to missile smoke ingestion through the engine intake.
40. To exit radar lock mode, press the Radar Reset button.

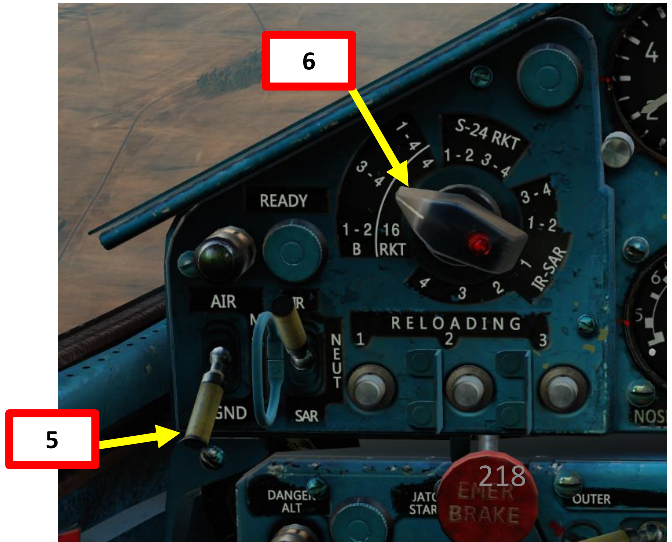
3.1 – S-16/S-32 (S-5) Rockets

3.1 – S-16/S-32 (S-5) Rockets

1. Set IR-SARH Missiles /Rocket Heating Power Switch – ON (UP)
2. Set IR-SARH Missiles / Rocket Master Arm Switch – ON (UP)
3. Set relevant Pylon Power Switches – ON (UP)
    - Pylons 1-2 are the inner pylons
    - Pylons 3-4 are the outer pylons
4. Set ASP-PFD Optical Sight Power Switch – ON (UP)
5. Set Air/Ground Master Mode switch to GROUND (DOWN).
6. Set Weapon Selector to desired pylon
    - RKT 4 selects rocket pods for a salvo of 4 rockets upon firing
    - RKT 8 selects rocket pods for a salvo of 8 rockets upon firing
    - RKT 16 selects rocket pods for a salvo of 16 rockets upon firing

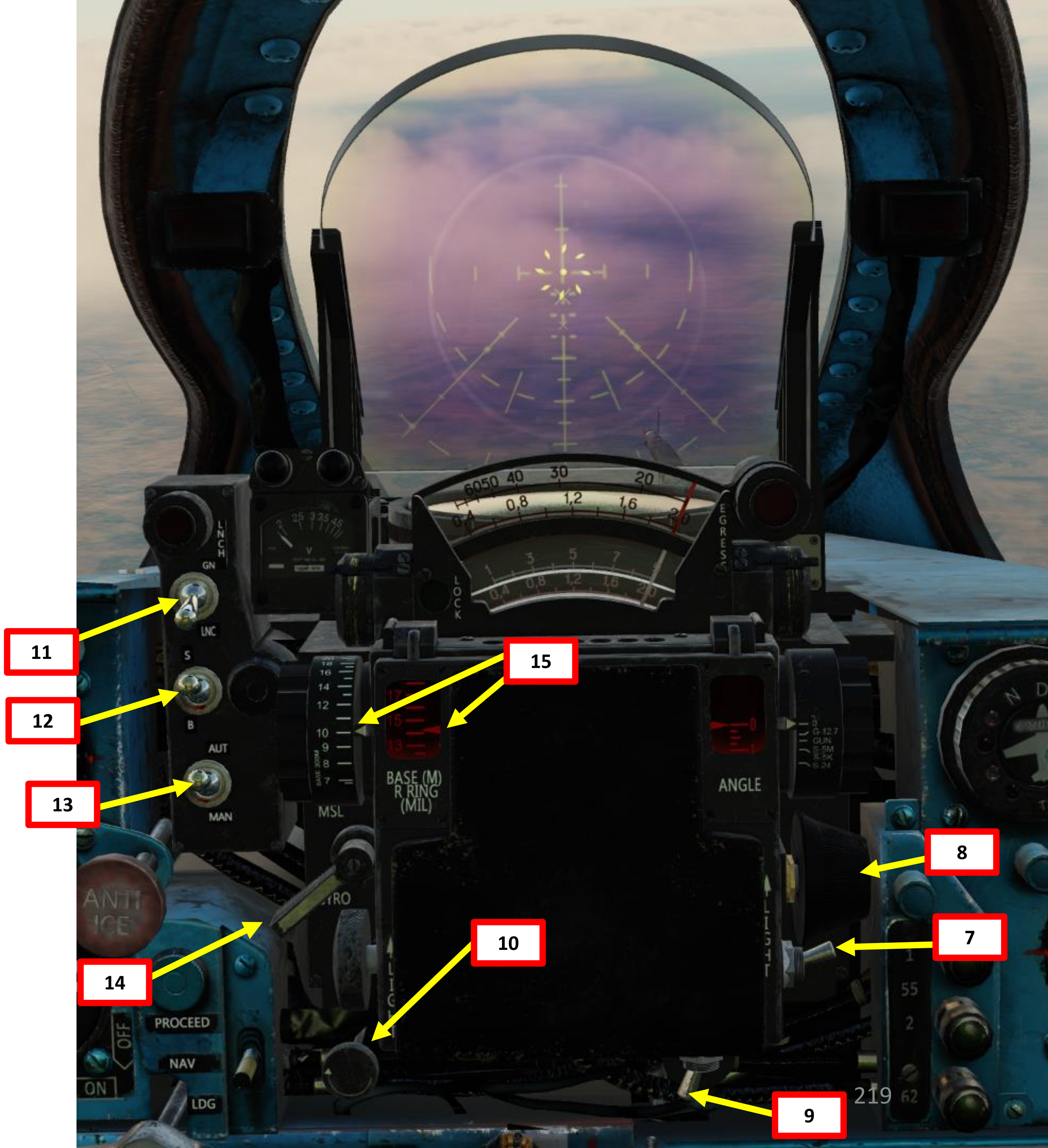






3.1 – S-16/S-32 (S-5) Rockets

7. Set Pipper Switch – ON (UP).
8. Adjust Pipper brightness as desired.
9. Set Fixed Net Switch – ON (LEFT).
10. Adjust Fixed net brightness as desired.
11. Set Optical Sight GN/LNC Mode switch – LAUNCH (DOWN)
12. Set Optical Sight S/B Mode switch – SHOOT (UP)
13. Set Optical Sight AUT/MAN Mode switch – AUTO (UP)
14. Set Optical Sight MSL/GYRO Mode switch – GYRO (DOWN)
15. Rotate Target Wingspan Setting Control Knob to enter the target's size/wingspan. Pipper size will adjust accordingly.

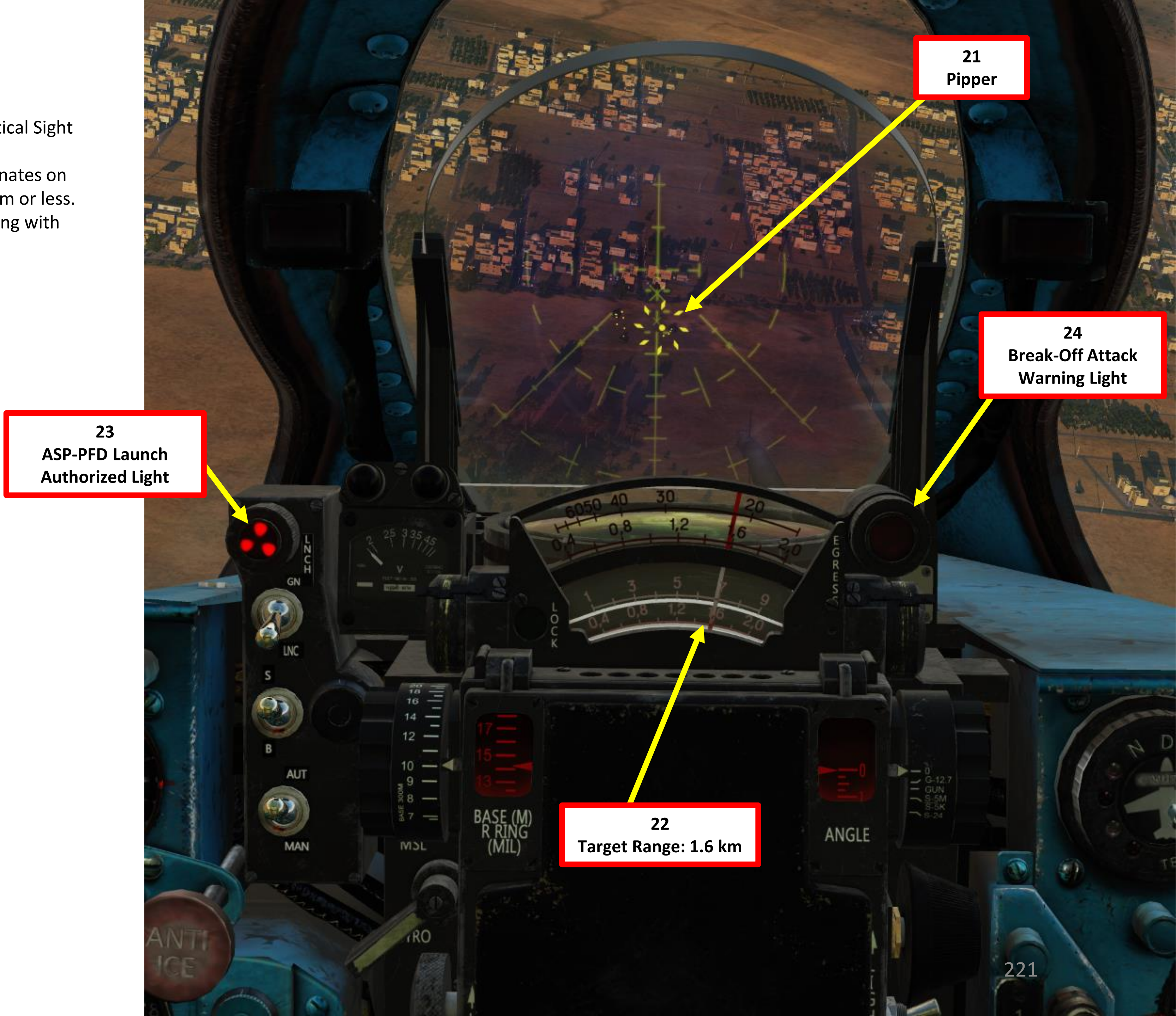


3.1 – S-16/S-32 (S-5) Rockets

16. Set Radar Main Mode Selector to MIDDLE (STANDBY) to start radar warm-up. The RP-22 requires a 3 to 5 minute warm-up period before being functional. While in Standby Mode, the radar alcohol coolant lasts for 35 to 40 minutes.
17. Set Radar Main Mode Selector to UP (ON).
18. Set Fixed/Locked Beam Mode Selector Switch – ON (UP)
19. The radar will now emit a fixed beam to provide ranging information to the ASP Optical Sight during the diving attack.
20. Spot the target, then perform a 30-45 degree dive at 600-900 km/h. Avoid pulling negative Gs during the dive.

3.1 – S-16/S-32 (S-5) Rockets

21. During the dive, place the pipper over the target.
22. The radar provides ranging information on the ASP Optical Sight Range Indicator’s fourth row.
23. When you are within firing range, the LNCH light illuminates on the ASP Optical Sight. Firing range should be within 2 km or less.
24. If the Break-Off Attack Light illuminates, you risk colliding with the target; pull away from the target.



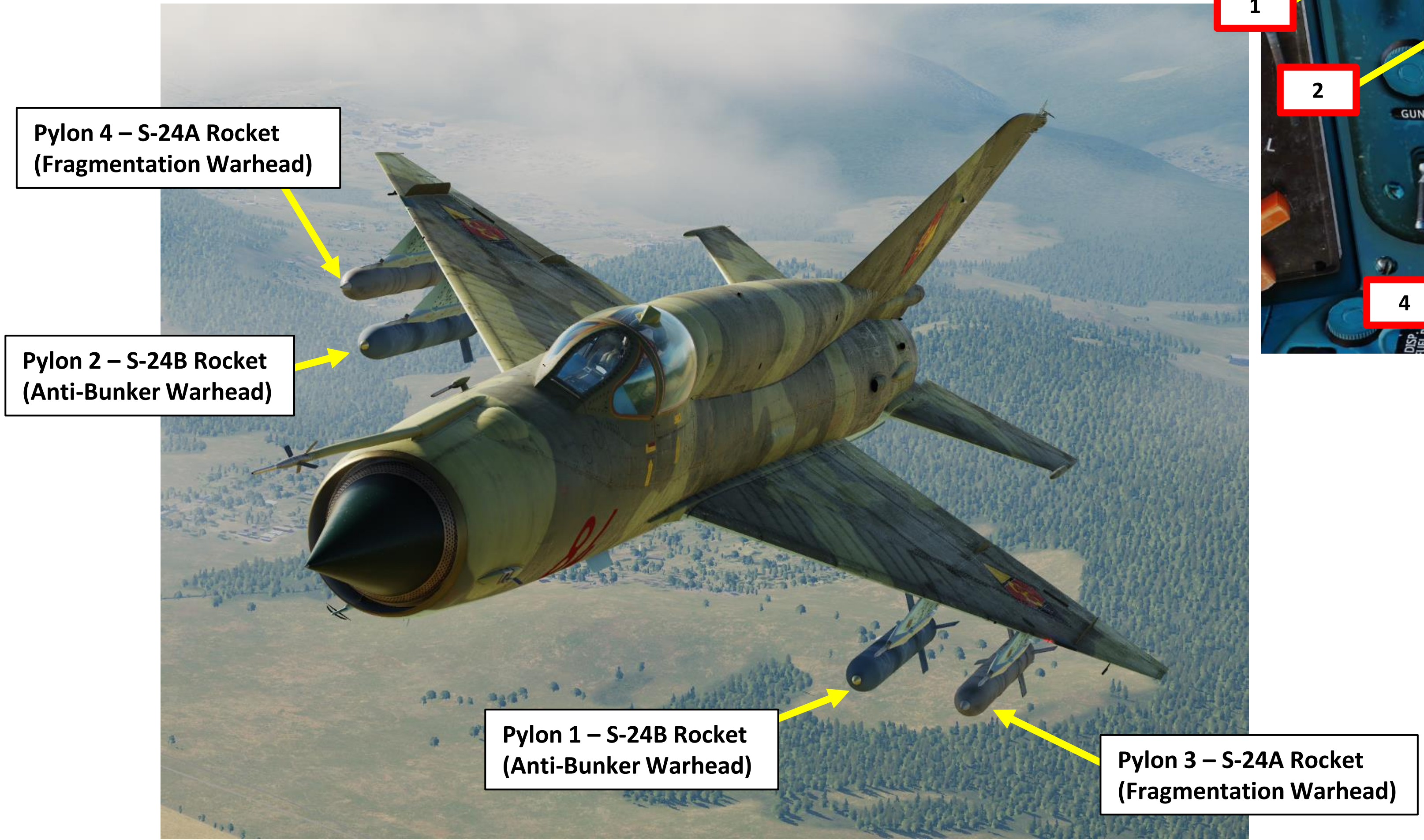
3.1 – S-16/S-32 (S-5) Rockets

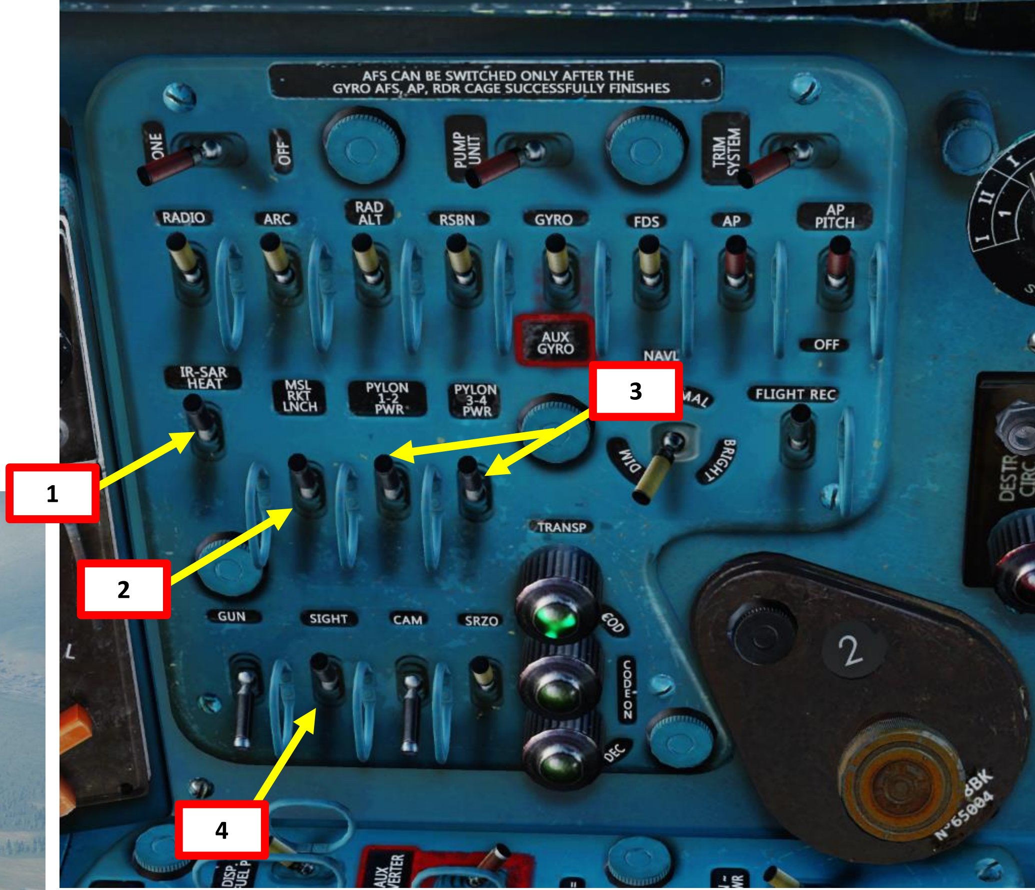
25. Flip Weapon Release Button safety and keep the Weapon Release pressed until rockets are fired (RALT+Spacebar).
26. When rockets are fired, the engine starter will run for about 5 seconds to ensure no engine flameout occurs due to missile smoke ingestion through the engine intake.
27. Pull away from the target. Ensure that you do not pull more than 5 Gs since weapon racks may be ripped off at higher G loads.

3.2 – S-24A/B Rockets

3.2 – S-24A/B Rockets

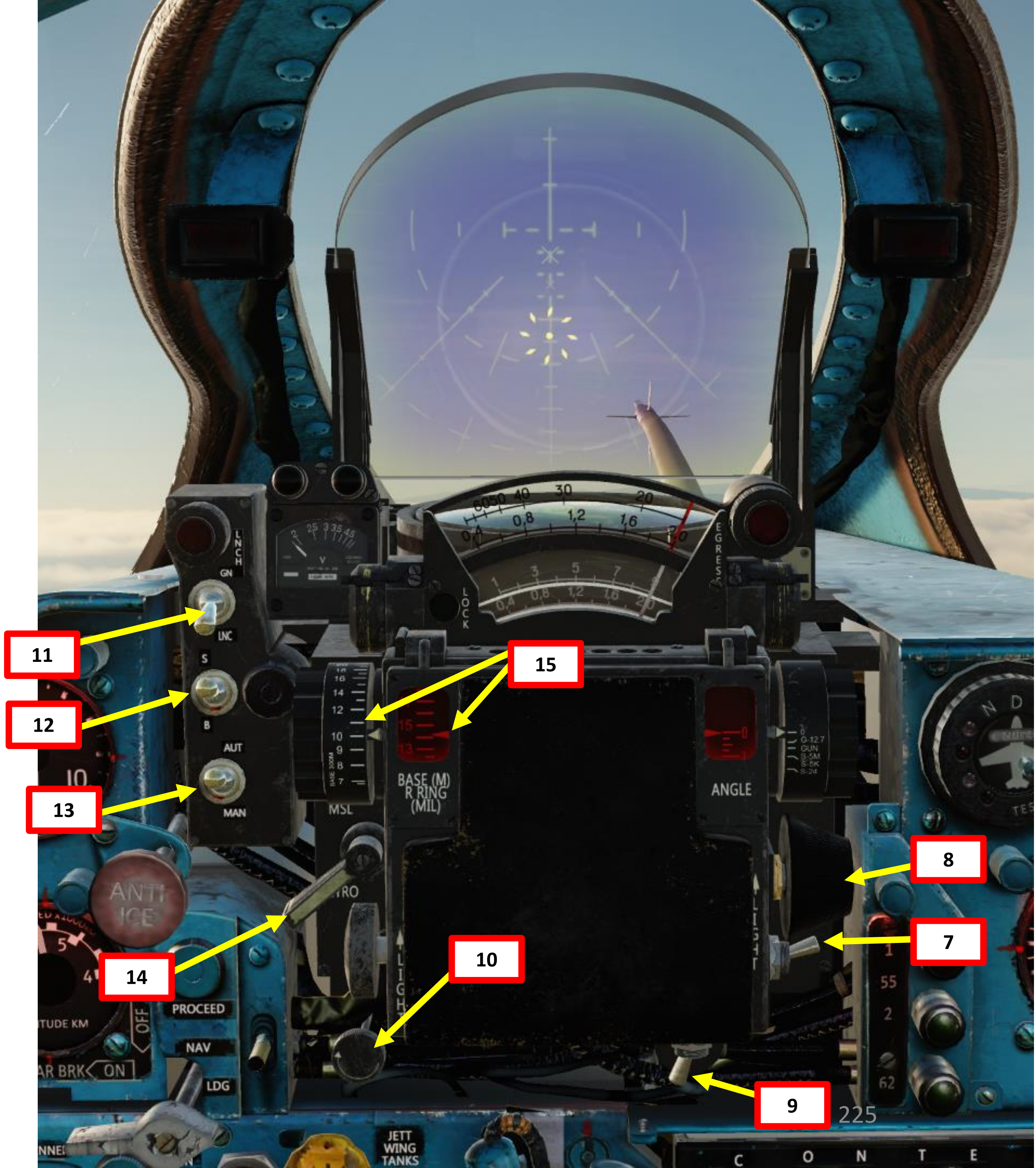
1. Set IR-SARH Missiles /Rocket Heating Power Switch – ON (UP)
2. Set IR-SARH Missiles / Rocket Master Arm Switch – ON (UP)
3. Set relevant Pylon Power Switches – ON (UP)
    - Pylons 1-2 are the inner pylons
    - Pylons 3-4 are the outer pylons
4. Set ASP-PFD Optical Sight Power Switch – ON (UP)
5. Set Air/Ground Master Mode switch to GROUND (DOWN).
6. Set Weapon Selector to desired pylon
    - S-24 RKT 3-4 selects both outer rocket pods on pylons 3 and 4. Rockets are fired in pairs.
    - S-24 RKT 1-2 selects both inner rocket pods on pylons 1 and 2. Rockets are fired in pairs.





3.2 – S-24A/B Rockets

7. Set Pipper Switch – ON (UP).
8. Adjust Pipper brightness as desired.
9. Set Fixed Net Switch – ON (LEFT).
10. Adjust Fixed net brightness as desired.
11. Set Optical Sight GN/LNC Mode switch – LAUNCH (DOWN)
12. Set Optical Sight S/B Mode switch – SHOOT (UP)
13. Set Optical Sight AUT/MAN Mode switch – AUTO (UP)
14. Set Optical Sight MSL/GYRO Mode switch – GYRO (DOWN)
15. Rotate Target Wingspan Setting Control Knob to enter the target's size/wingspan. Pipper size will adjust accordingly.

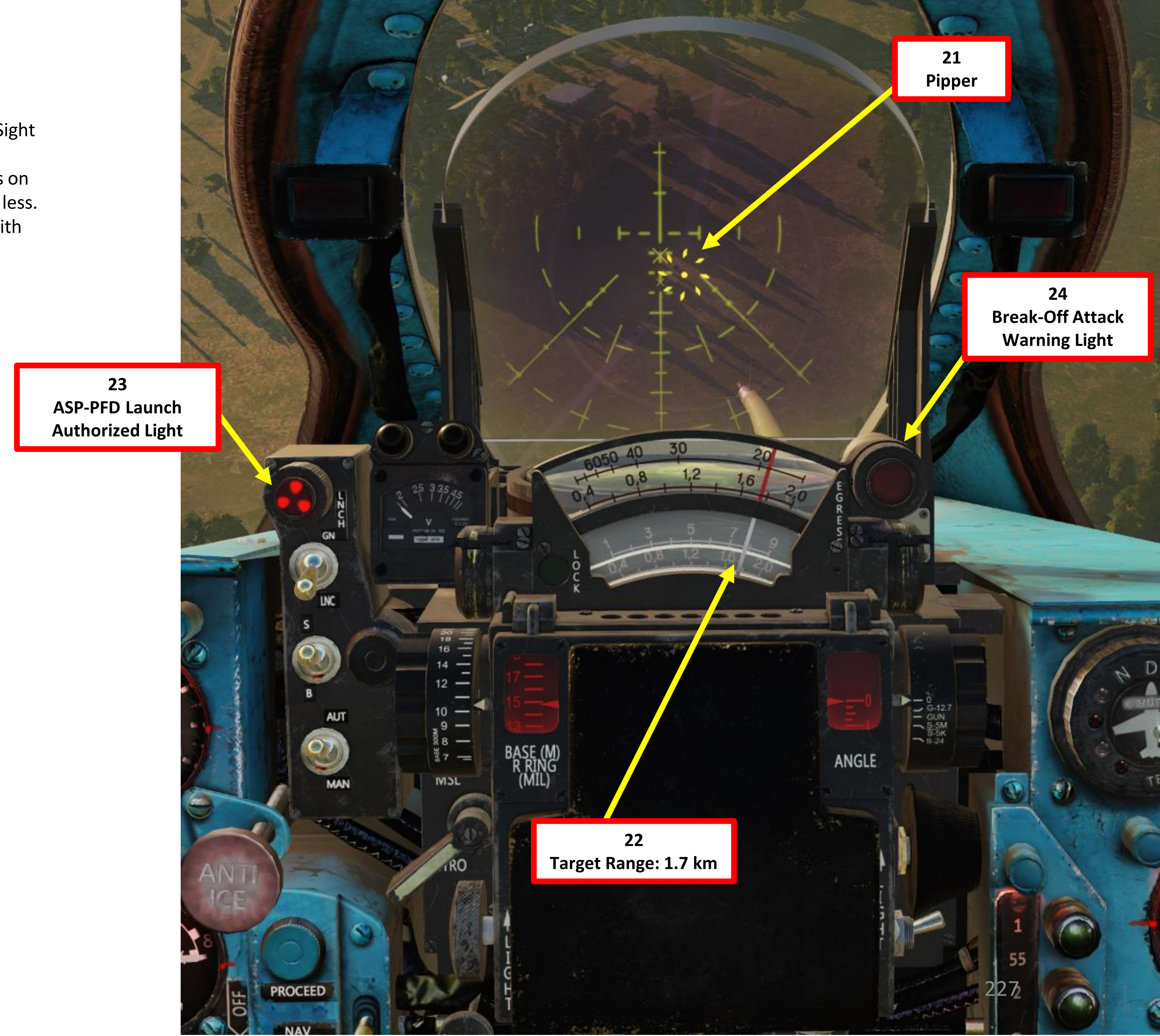


3.2 – S-24A/B Rockets

16. Set Radar Main Mode Selector to MIDDLE (STANDBY) to start radar warm-up. The RP-22 requires a 3 to 5 minute warm-up period before being functional. While in Standby Mode, the radar alcohol coolant lasts for 35 to 40 minutes.
17. Set Radar Main Mode Selector to UP (ON).
18. Set Fixed/Locked Beam Mode Selector Switch – ON (UP)
19. The radar will now emit a fixed beam to provide ranging information to the ASP Optical Sight during the diving attack.
20. Spot the target, then perform a 30-45 degree dive at 600-900 km/h. Avoid pulling negative Gs during the dive.

3.2 – S-24A/B Rockets

21. During the dive, place the pipper over the target.
22. The radar provides ranging information on the ASP Optical Sight Range Indicator’s fourth row.
23. When you are within firing range, the LNCH light illuminates on the ASP Optical Sight. Firing range should be within 2 km or less.
24. If the Break-Off Attack Light illuminates, you risk colliding with the target; pull away from the target.



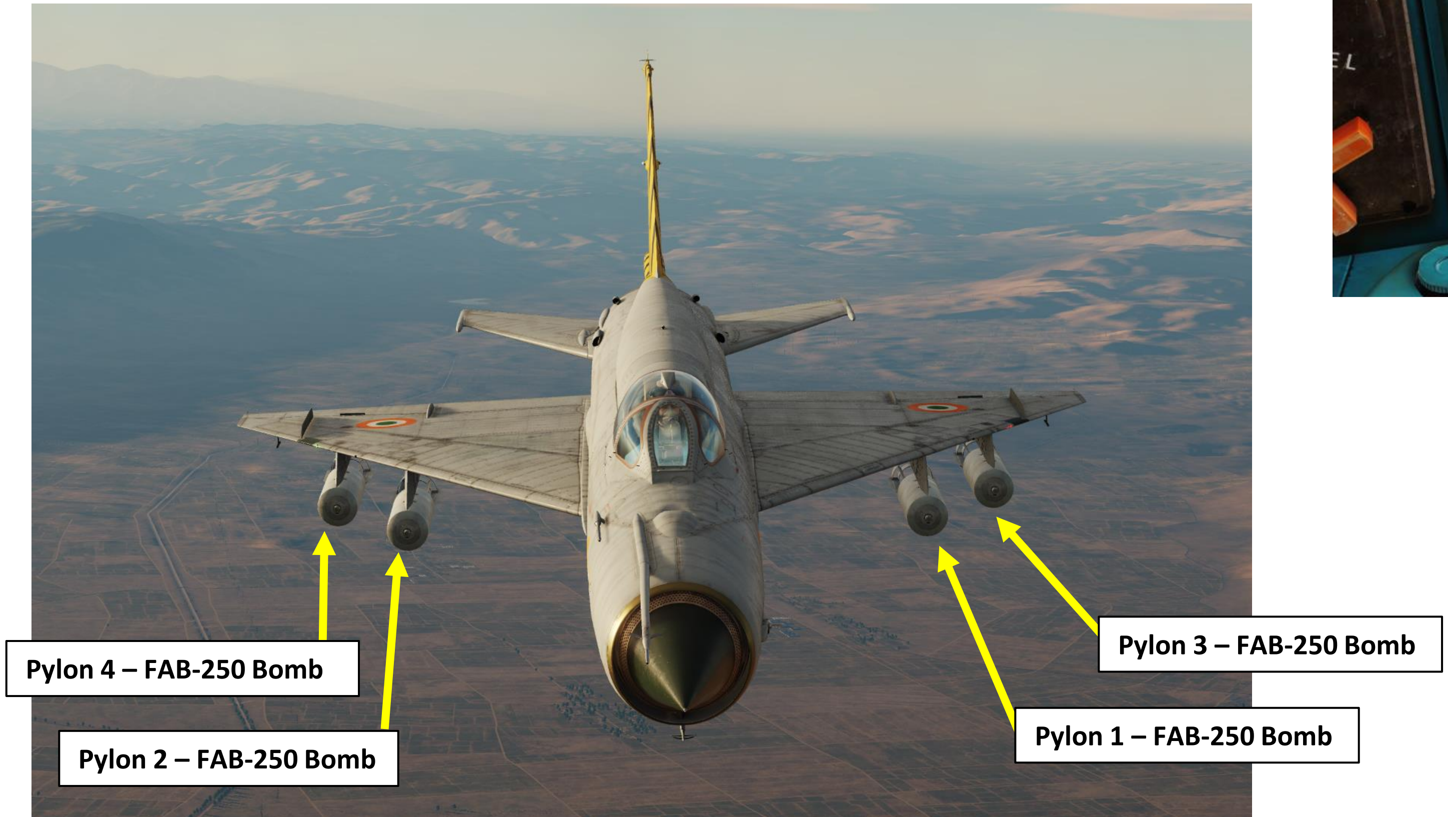
3.2 – S-24A/B Rockets

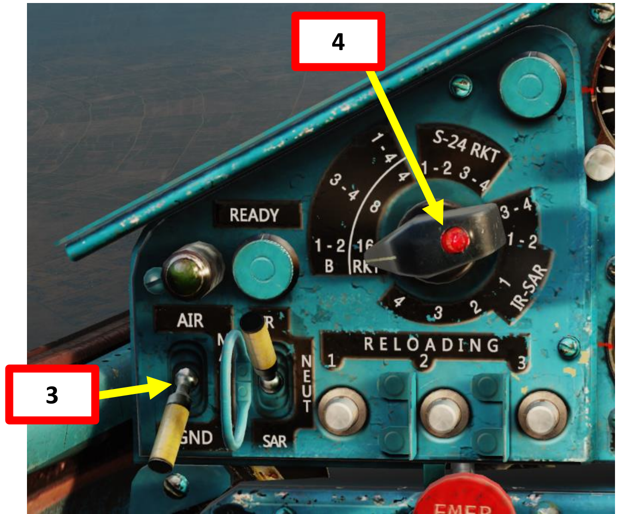
25. Flip Weapon Release Button safety and keep the Weapon Release pressed until rockets are fired (RALT+Spacebar).
26. When rockets are fired, the engine starter will run for about 5 seconds to ensure no engine flameout occurs due to missile smoke ingestion through the engine intake.
27. Pull away from the target. Ensure that you do not pull more than 5 Gs since weapon racks may be ripped off at higher G loads.

3.3 – FAB-250 Bombs

3.3 – FAB-250 Bombs

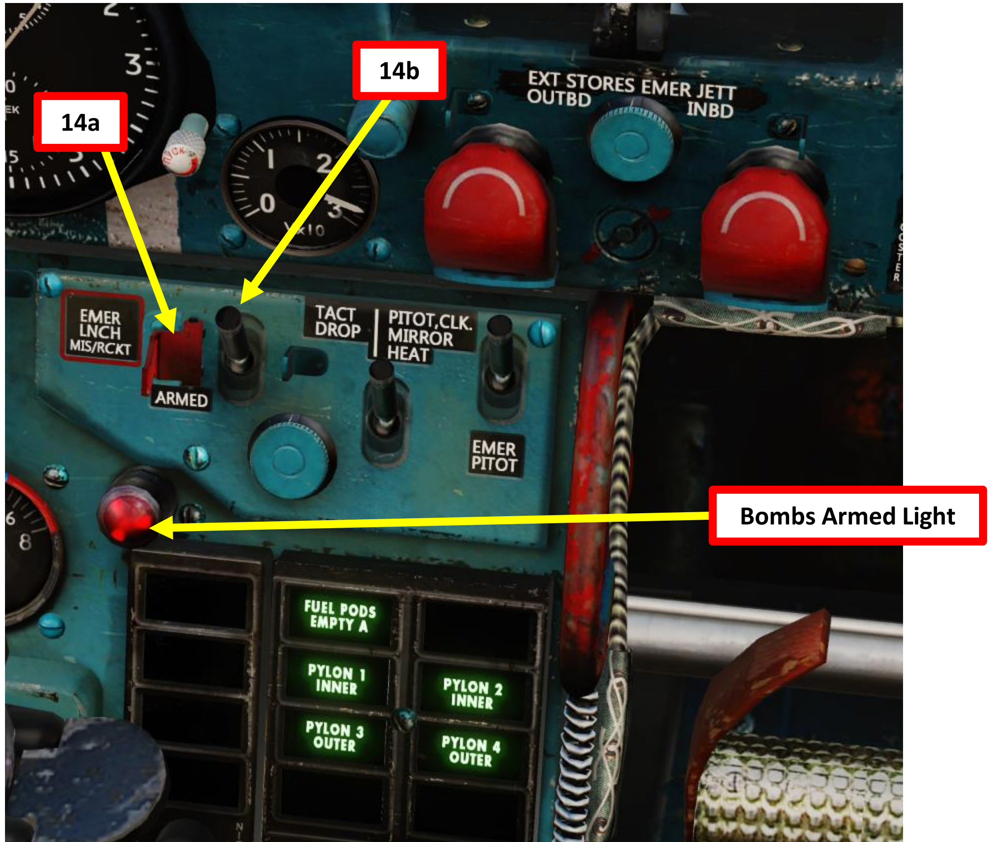
1. Set relevant Pylon Power Switches – ON (UP)
   - Pylons 1-2 are the inner pylons
   - Pylons 3-4 are the outer pylons
2. Set ASP-PFD Optical Sight Power Switch – ON (UP)
3. Set Air/Ground Master Mode switch to GROUND (DOWN).
4. Set Weapon Selector to desired pylon
   - B 3-4 selects both outer bombs on pylons 3 and 4. Bombs are released in pairs.
   - B 1-2 selects both inner bombs on pylons 1 and 2. Bombs are released in pairs.
   - B 1-4 selects both inner and outer pylons (1, 2, 3 and 4). All bombs are released at once.

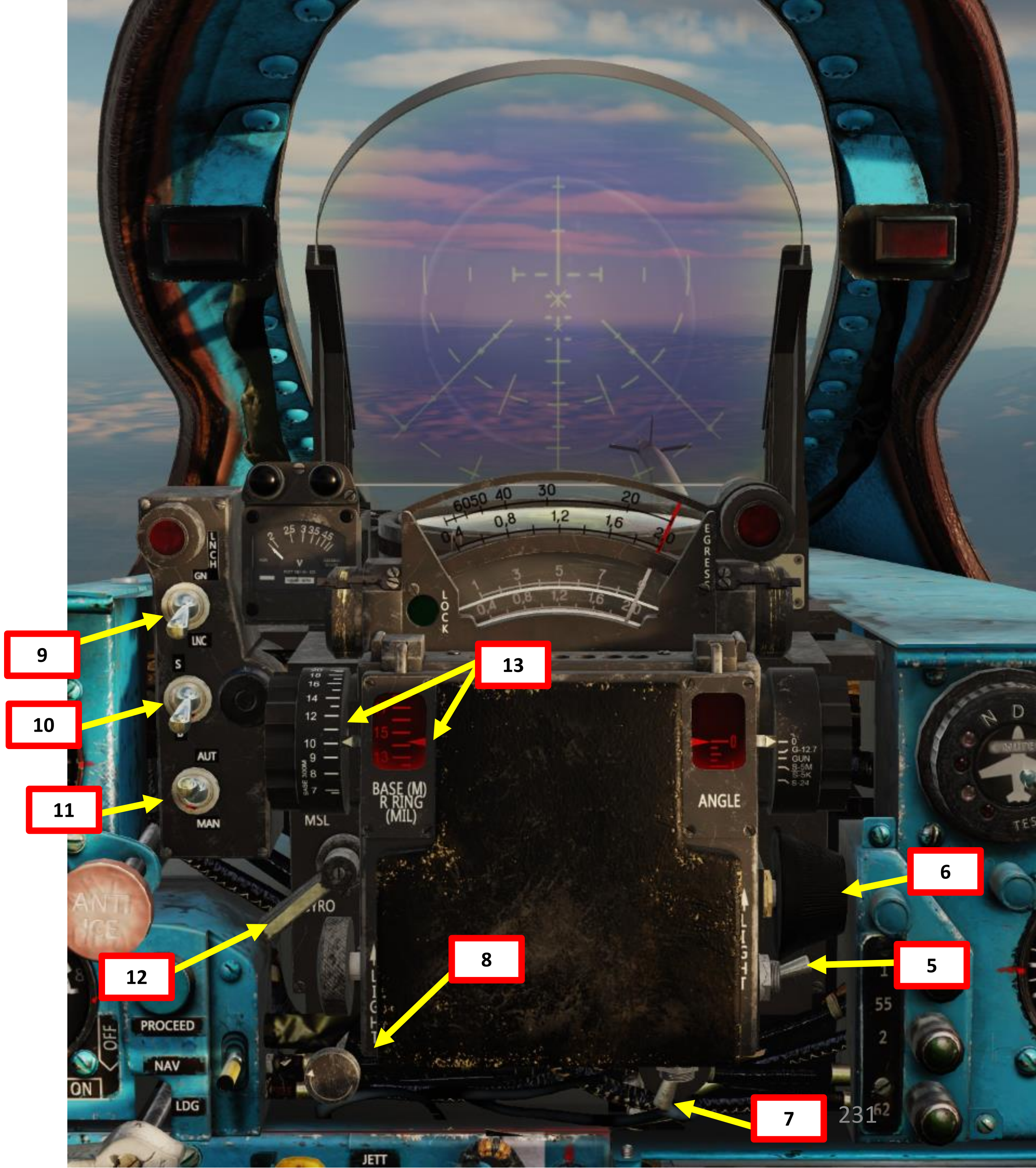




3.3 – FAB-250 Bombs

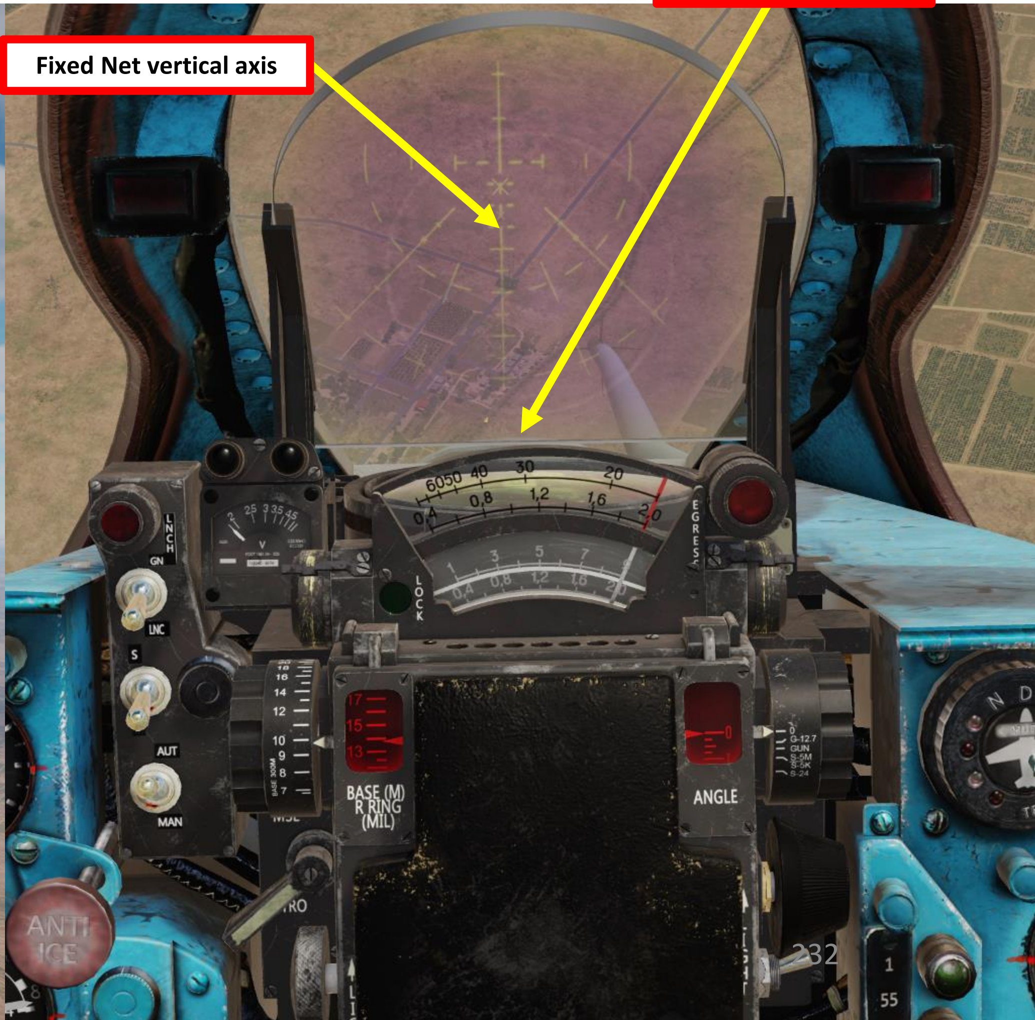
5. Set Pipper Switch – ON (UP).
6. Adjust Pipper brightness as desired.
7. Set Fixed Net Switch – ON (LEFT).
8. Adjust Fixed net brightness as desired.
9. Set Optical Sight GN/LNC Mode switch – LAUNCH (DOWN)
10. Set Optical Sight S/B Mode switch – BOMBING (DOWN)
11. Set Optical Sight AUT/MAN Mode switch – AUTO (UP)
12. Set Optical Sight MSL/GYRO Mode switch – GYRO (DOWN)
13. Rotate Target Wingspan Setting Control Knob to enter the target's size/wingspan. Pipper size will adjust accordingly.
14. Flip the red safety lever, then set the Bomb Arming (Tactical Release) Switch – ON (UP)





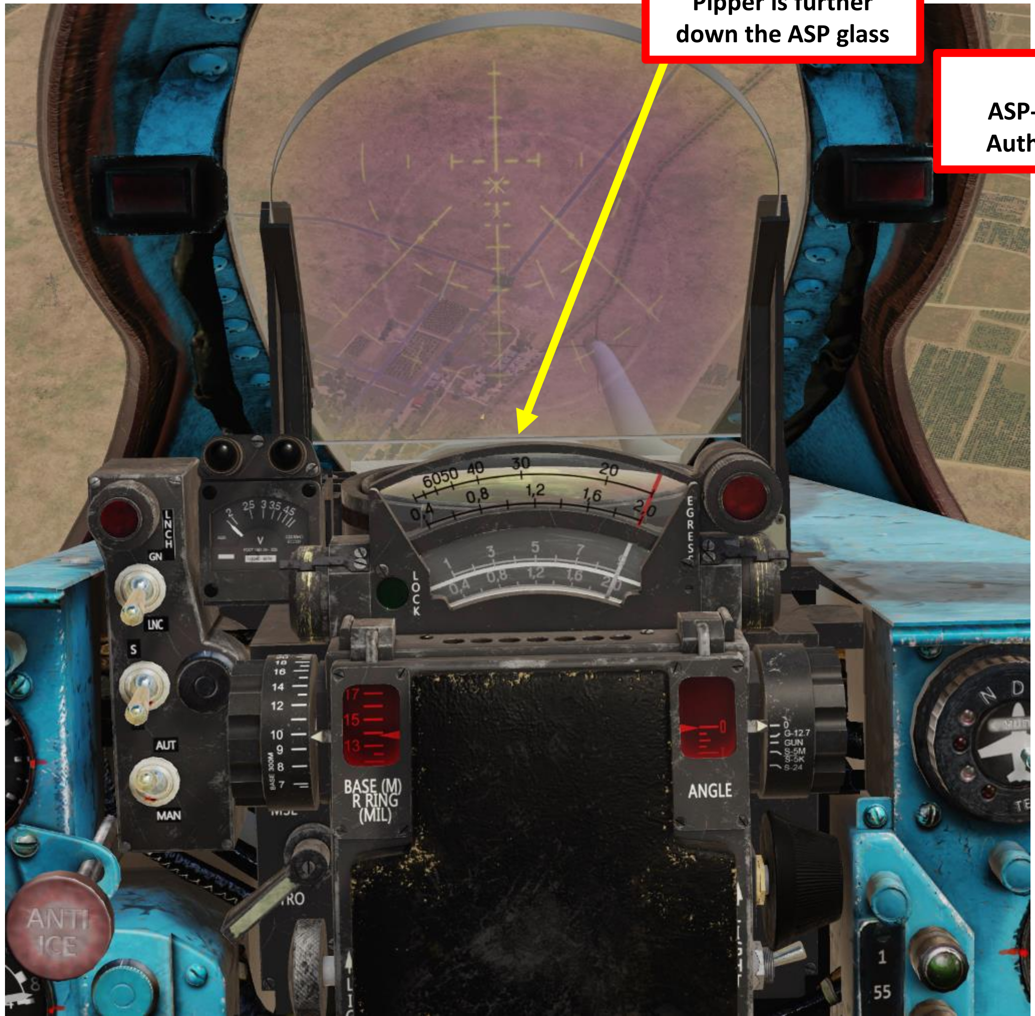
3.3 – FAB-250 Bombs

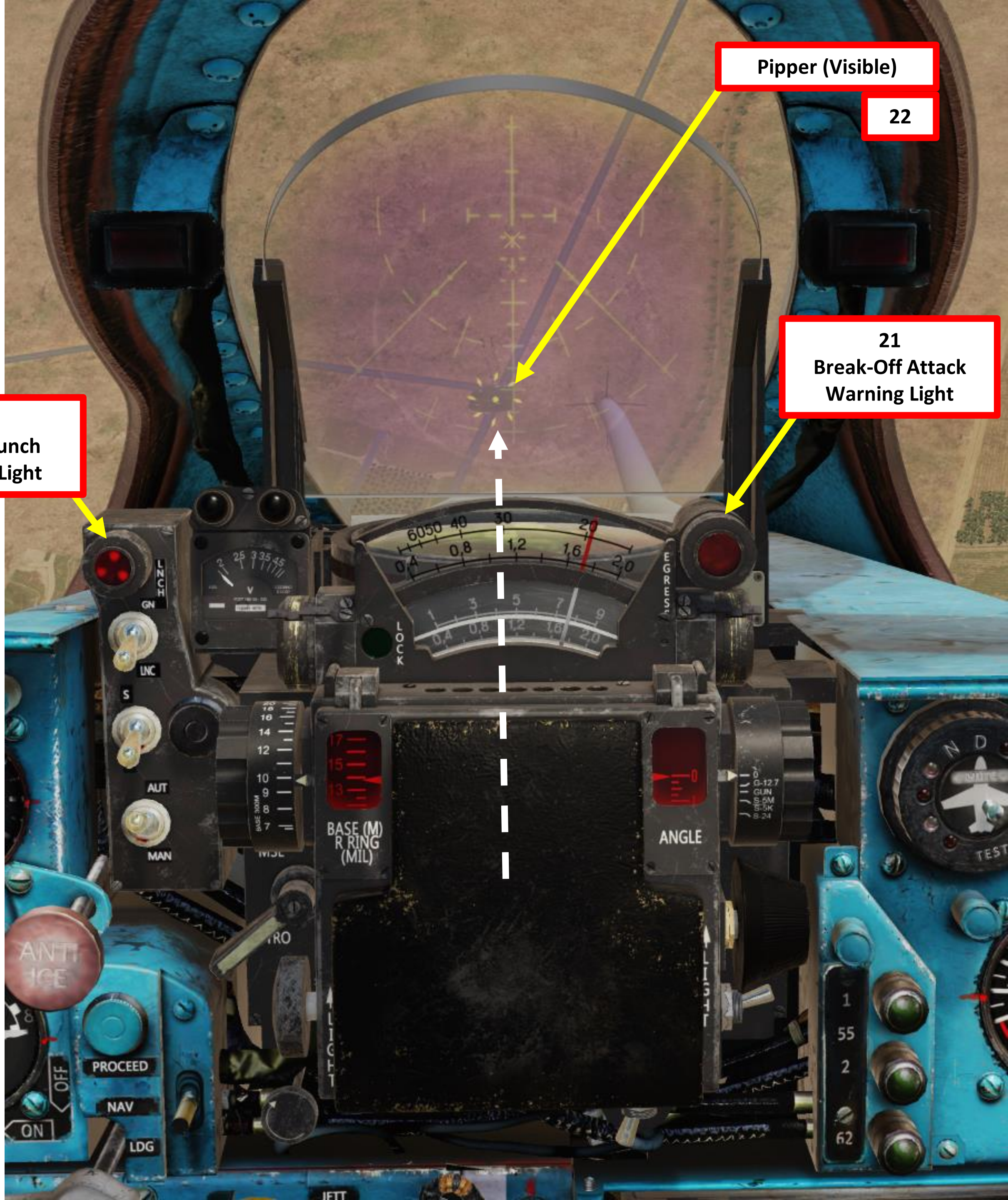
15. Climb to at least 4000 m over the target. Be very careful not to exceed 5 Gs; exceeding this limit could rip the bombs apart from their racks.
16. Throttle back to IDLE, then perform a 30-40 deg dive on the target. Do not dive steeper than 40 degrees since the aircraft acceleration could force you to pull excessive amount of Gs during the pull up phase.
17. During the initial phase of the dive, the pipper should not be visible yet since it is automatically set to an intercept angle greater than 6.5 deg (beyond the ASP optical sight glass).
18. During the dive, line up the target horizontally with the center of the fixed net and avoid inducing side slip with the rudder pedals.



3.3 – FAB-250 Bombs

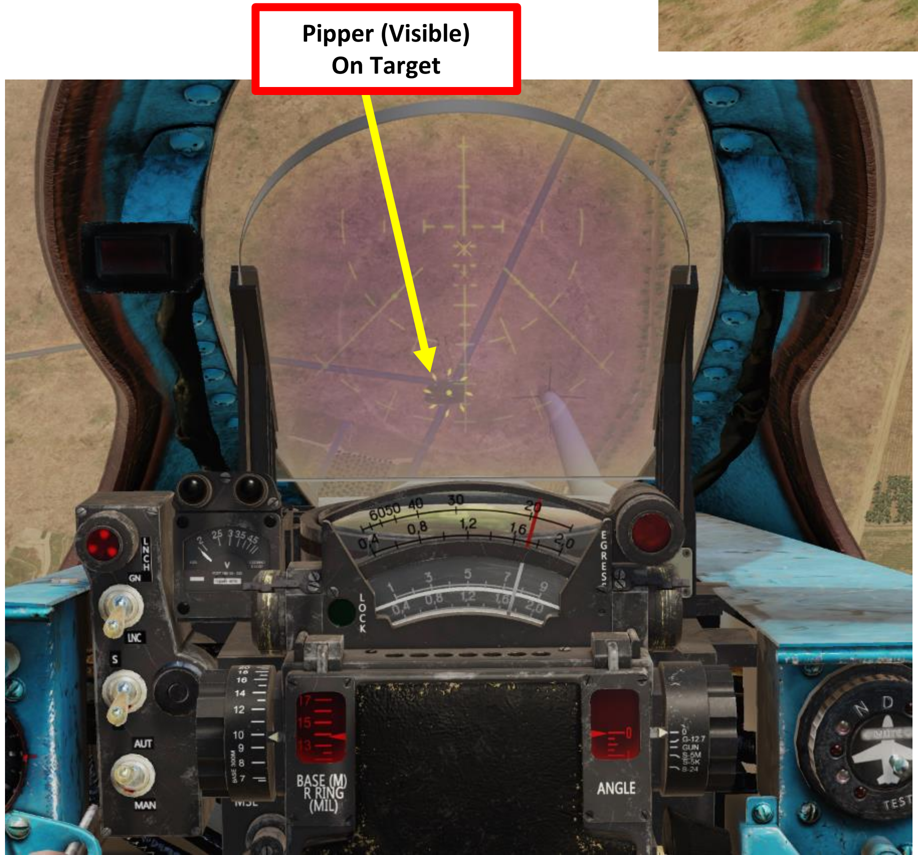
19. As you get closer to the target, the pipper will gradually appear from the bottom of the ASP Optical Sight and rise towards the computed impact point. A dive that is too shallow may leave the pipper outside the ASP Sight glass.
20. When you are within bombing range, the LNCH light illuminates on the ASP Optical Sight.
21. If the Break-Off Attack Light illuminates, you risk colliding with the target; pull away from the target.
22. When the LNCH light illuminates and the pipper is settled on the target, you can now release your bombs.





3.3 – FAB-250 Bombs

23. Flip Weapon Release Button safety and keep the Weapon Release pressed until bombs are dropped (RALT+Spacebar).
24. Pull away from the blast radius. Make sure to avoid pulling more than 5 Gs.

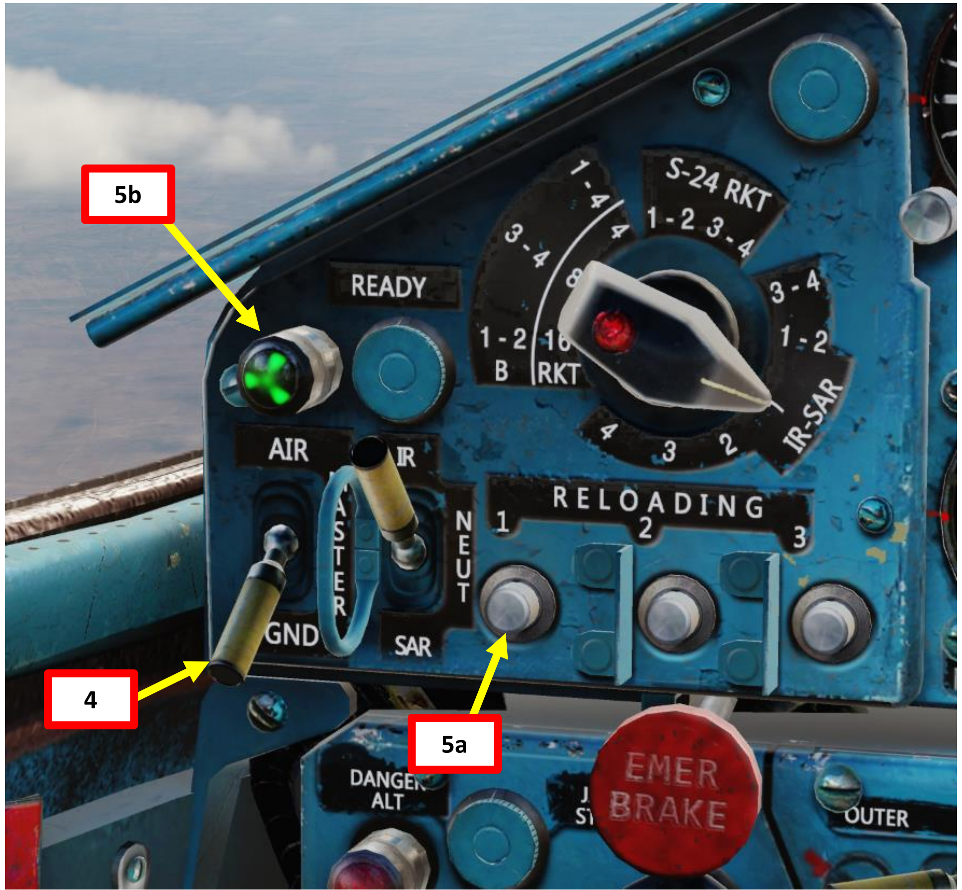


3.4 – GSh-23 23 mm Cannon (Air-to-Ground)

23 mm GSh-23 Gryazev-Shipunov Cannon
(250 rounds, 4 seconds of firing time)

3.4 – GSh-23 23 mm Cannon (Air-to-Ground)

1. Set GSH-23 Gun Power Switch – ON (UP)
2. Set ASP-PFD Optical Sight Power Switch – ON (UP)
3. (Optional) Set Gun Camera Power Switch – ON (UP).
4. Set Air/Ground Master Mode switch to GROUND (DOWN).
5. Press and hold CANNON RELOAD button for at least 2 seconds to arm cannon. Confirm that cannon is armed with the green arming light.



Note
Russian cannons of this era use a “pyrotechnical” reload system, which means that a cassette equipped with a pyrocartridge will detonate a charge to “reload” a gun. The MiG-21bis, MiG-15, MiG-19 and the L-39ZA use a similar system.

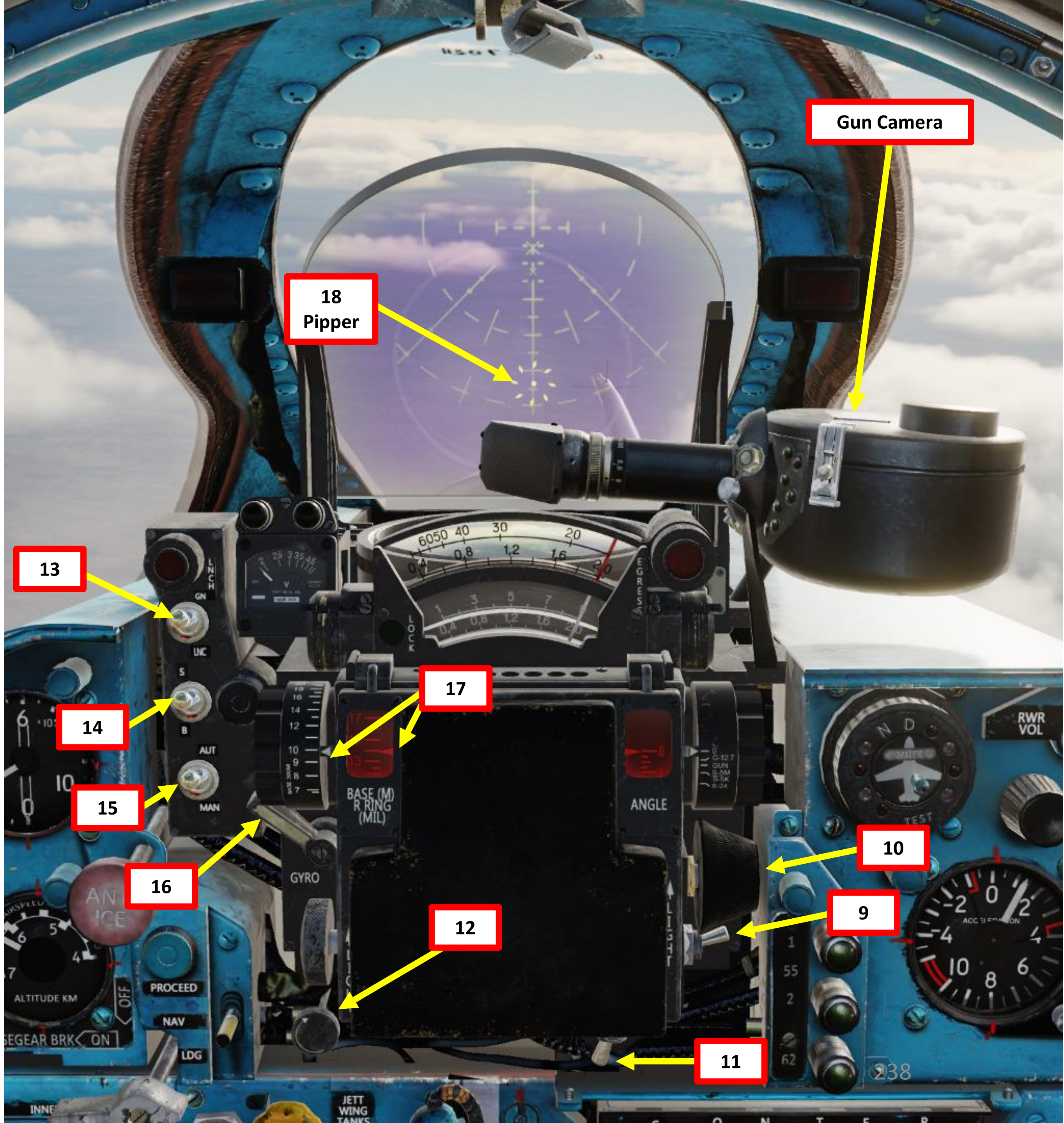
3.4 – GSh-23 23 mm Cannon (Air-to-Ground)

6. Set Radar Main Mode Selector to MIDDLE (STANDBY) to start radar warm-up. The RP-22 requires a 3 to 5 minute warm-up period before being functional. While in Standby Mode, the radar alcohol coolant lasts for 35 to 40 minutes.
7. Set Radar Main Mode Selector to UP (ON).
8. Set Fixed/Locked Beam Mode Selector Switch – ON (UP)

3.4 – GSh-23 23 mm Cannon (Air-to-Ground)

AIMING METHOD: AUTO + MSL + RADAR RANGING

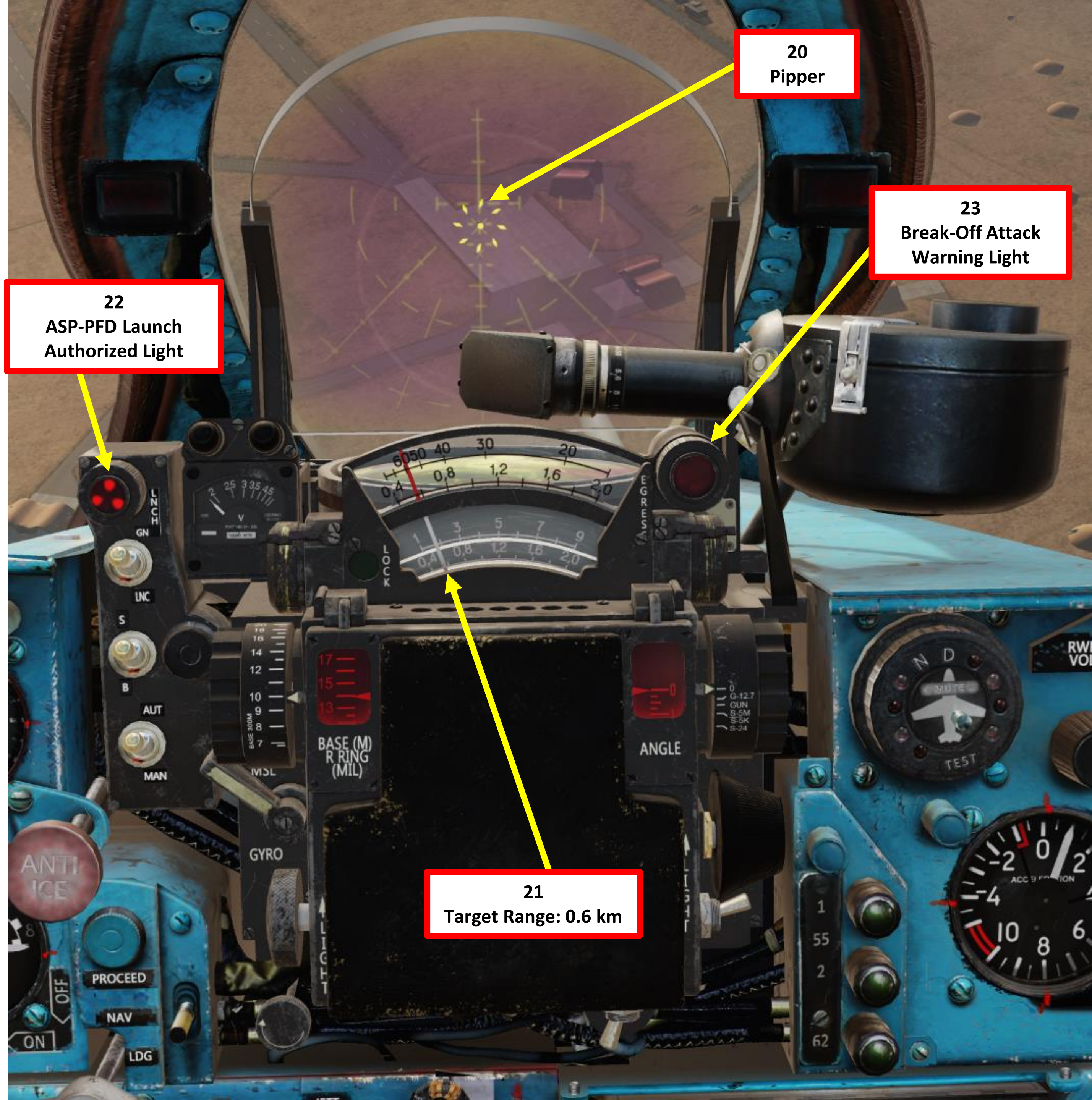
9. Set Pipper Switch – ON (UP).
10. Adjust Pipper brightness as desired.
11. Set Fixed Net Switch – ON (LEFT).
12. Adjust Fixed net brightness as desired. In this case, we will set the fixed net dimmed.
13. Set Optical Sight GN/LNC Mode switch – GUN (UP)
14. Set Optical Sight S/B Mode switch – SHOOT (UP)
15. Set Optical Sight AUT/MAN Mode switch – AUTO (UP)
16. Set Optical Sight MSL/GYRO Mode switch – MSL (UP)
17. Rotate Target Wingspan Setting Control Knob to enter the target's size. Pipper size will adjust accordingly.
18. In Auto Mode, Intercept Angle value setting is automatically selected for you.
19. Dive on the target and start your attack.



3.4 – GSh-23 23 mm Cannon (Air-to-Ground)

AIMING METHOD: AUTO + MSL + RADAR RANGING

20. During the dive, place the pipper over the target.
21. The radar provides ranging information on the ASP Optical Sight Range Indicator's fourth row.
22. When you are within firing range, the LNCH light illuminates on the ASP Optical Sight. Firing range should be within 600 m or less.
23. If the Break-Off Attack Light illuminates, you risk colliding with the target; pull away from the target.
24. Fire when ready using the gun trigger.



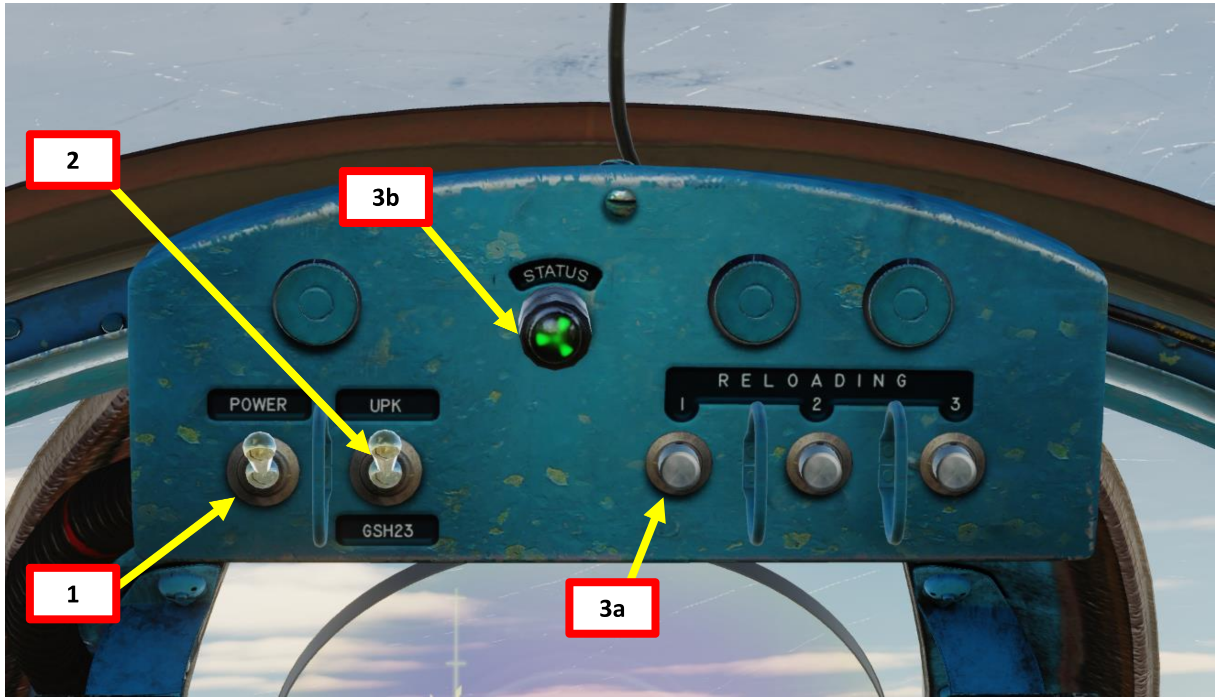
3.4 – GSh-23 23 mm Cannon (Air-to-Ground)

Take note that the 23 mm cannon has only about 4 seconds of fire. Make sure to use short bursts and conserve ammunition if possible. The cannon should only be used against soft targets like infantry or lightly armored vehicles.

3.5 – UPK-23-250 Gun Pods (Air-to-Ground)

3.5 – UPK-23-250 Gun Pods (Air-to-Ground)

1. Set UPK-23-250 Gunpod Power Switch – ON (UP)
2. Set UPK/GSH23 Weapon Selector Switch – UPK (UP)
3. On the UPK Control Panel, press and hold CANNON RELOAD button for at least 2 seconds to arm cannon. Confirm that cannon is armed with the green arming light.
4. Set ASP-PFD Optical Sight Power Switch – ON (UP)
5. (Optional) Set Gun Camera Power Switch – ON (UP).
6. Set Air/Ground Master Mode switch to GROUND (DOWN).



Note
Russian cannons of this era use a “pyrotechnical” reload system, which means that a cassette equipped with a pyrocartridge will detonate a charge to “reload” a gun. The MiG-21bis, MiG-15, MiG-19 and the L-39ZA use a similar system.

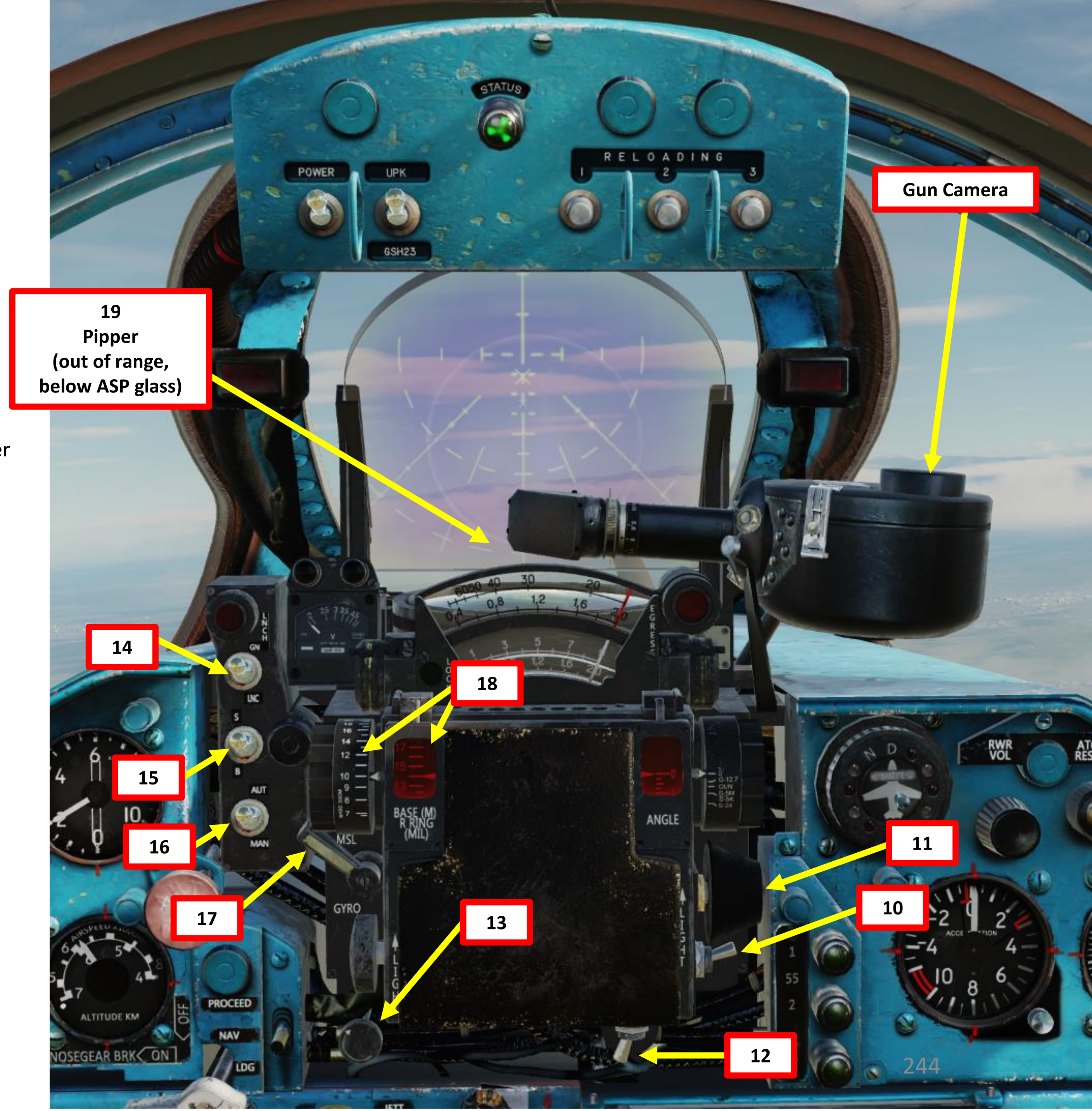
3.5 – UPK-23-250 Gun Pods (Air-to-Ground)

7. Set Radar Main Mode Selector to MIDDLE (STANDBY) to start radar warm-up. The RP-22 requires a 3 to 5 minute warm-up period before being functional. While in Standby Mode, the radar alcohol coolant lasts for 35 to 40 minutes.
8. Set Radar Main Mode Selector to UP (ON).
9. Set Fixed/Locked Beam Mode Selector Switch – ON (UP)

3.5 – UPK-23-250 Gun Pods (Air-to-Ground)

AIMING METHOD: AUTO + MSL + RADAR RANGING

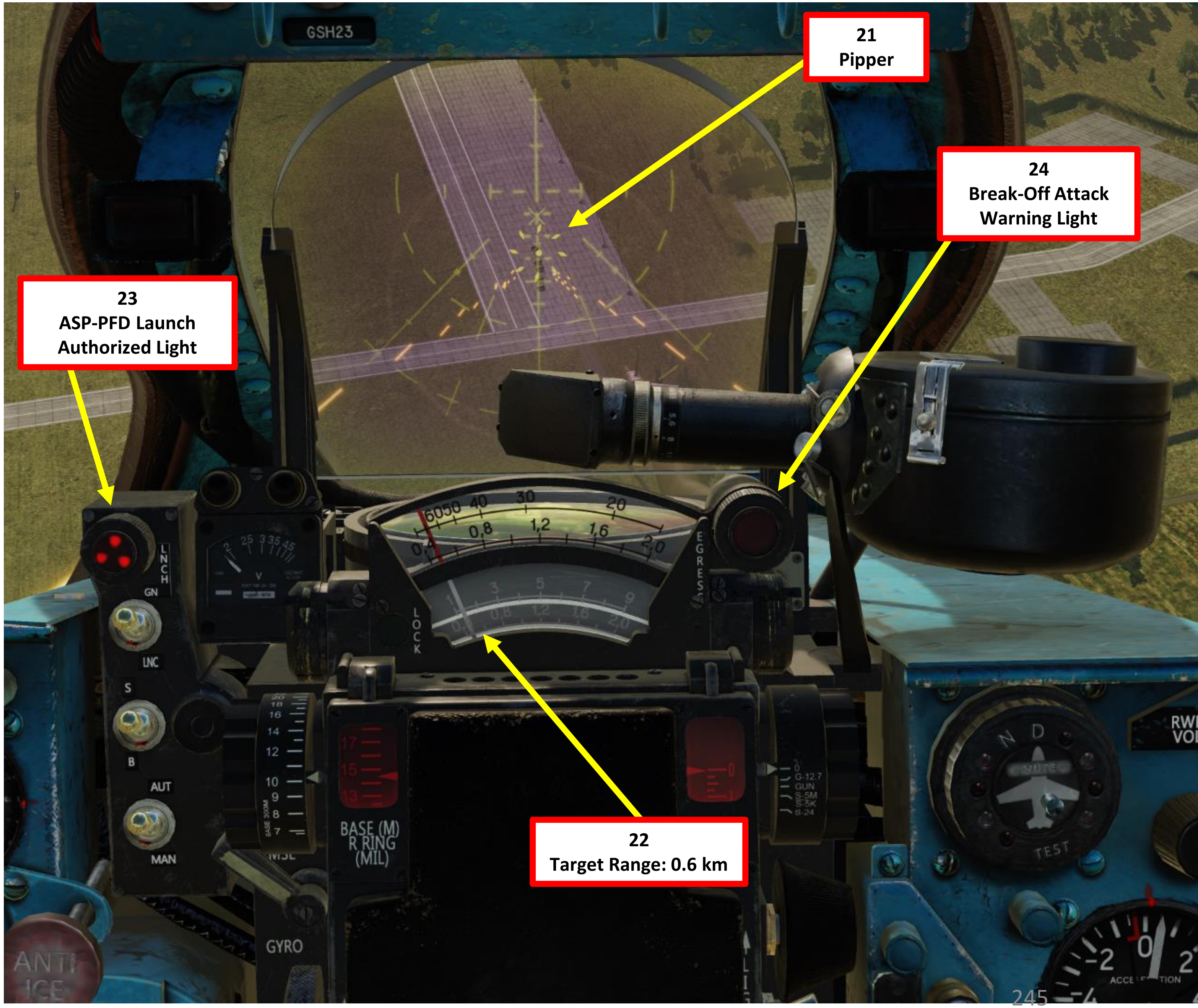
10. Set Pipper Switch – ON (UP).
11. Adjust Pipper brightness as desired.
12. Set Fixed Net Switch – ON (LEFT).
13. Adjust Fixed net brightness as desired. In this case, we will set the fixed net dimmed.
14. Set Optical Sight GN/LNC Mode switch – GUN (UP)
15. Set Optical Sight S/B Mode switch – SHOOT (UP)
16. Set Optical Sight AUT/MAN Mode switch – AUTO (UP)
17. Set Optical Sight MSL/GYRO Mode switch – MSL (UP)
18. Rotate Target Wingspan Setting Control Knob to enter the target's size. Pipper size will adjust accordingly.
19. In Auto Mode, Intercept Angle value setting is automatically selected for you. Before entering the dive, the pipper may be hidden below the ASP glass.
20. Dive on the target and start your attack.



3.5 – UPK-23-250 Gun Pods (Air-to-Ground)

AIMING METHOD: AUTO + MSL + RADAR RANGING

21. During the dive, place the pipper over the target.
22. The radar provides ranging information on the ASP Optical Sight Range Indicator's fourth row.
23. When you are within firing range, the LNCH light illuminates on the ASP Optical Sight. Firing range should be within 600 m or less.
24. If the Break-Off Attack Light illuminates, you risk colliding with the target; pull away from the target.
25. Fire when ready using the gun trigger.



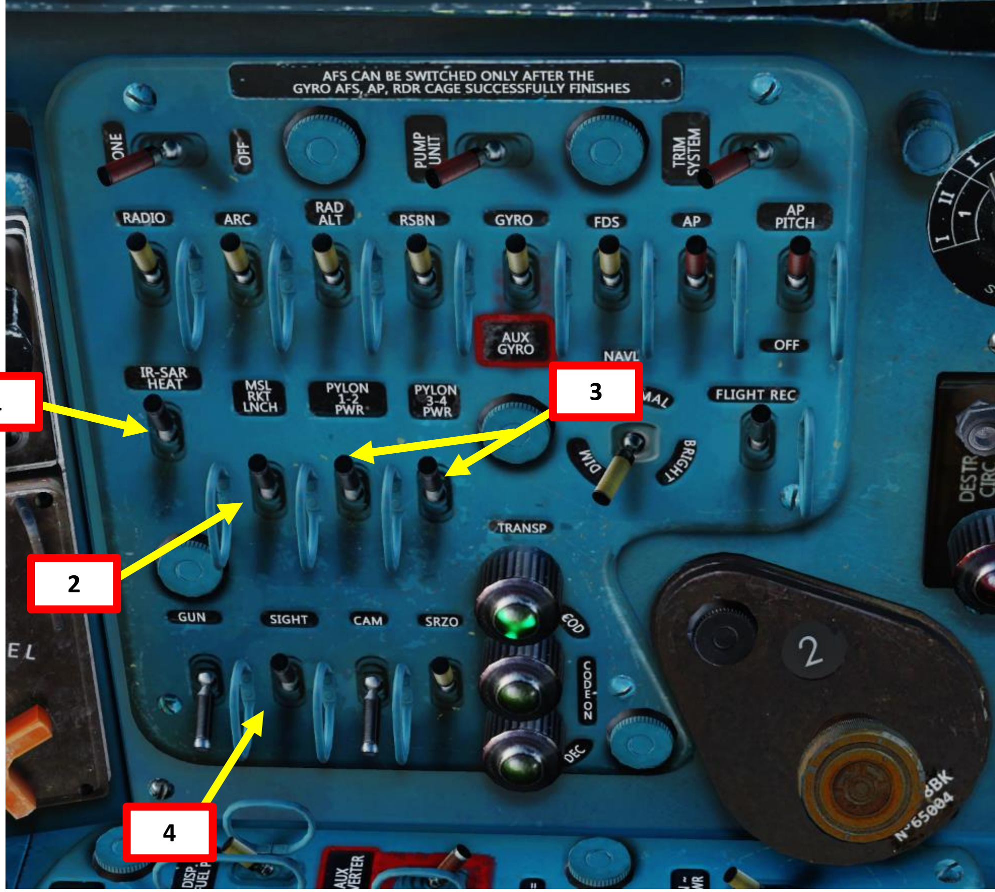
3.5 – UPK-23-250 Gun Pods (Air-to-Ground)

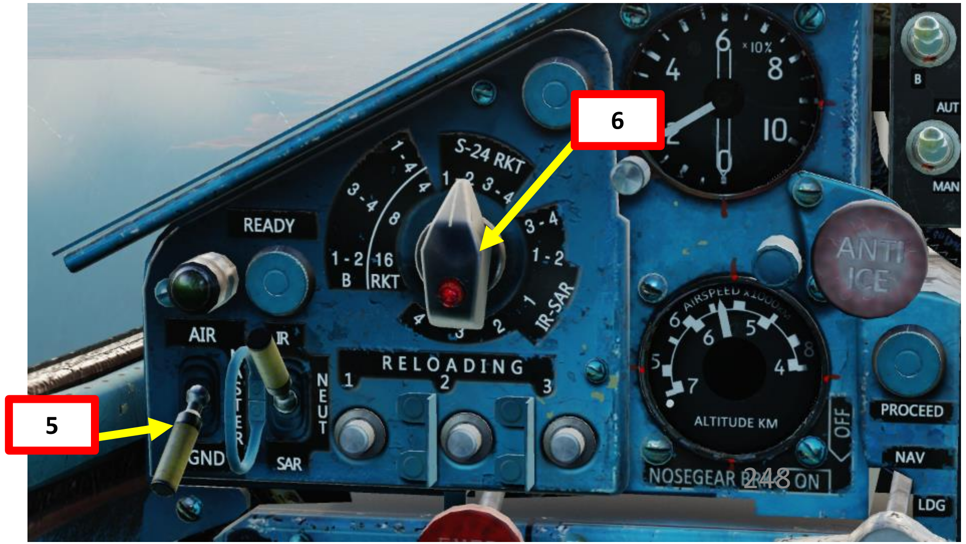
Make sure to use short bursts and conserve ammunition if possible. The gun pods should only be used against soft targets like infantry or lightly armored vehicles.

3.6 – KH-66 Grom (Radar Beam Riding Missile)

3.6 – KH-66 Grom (Radar Beam Riding Missile)

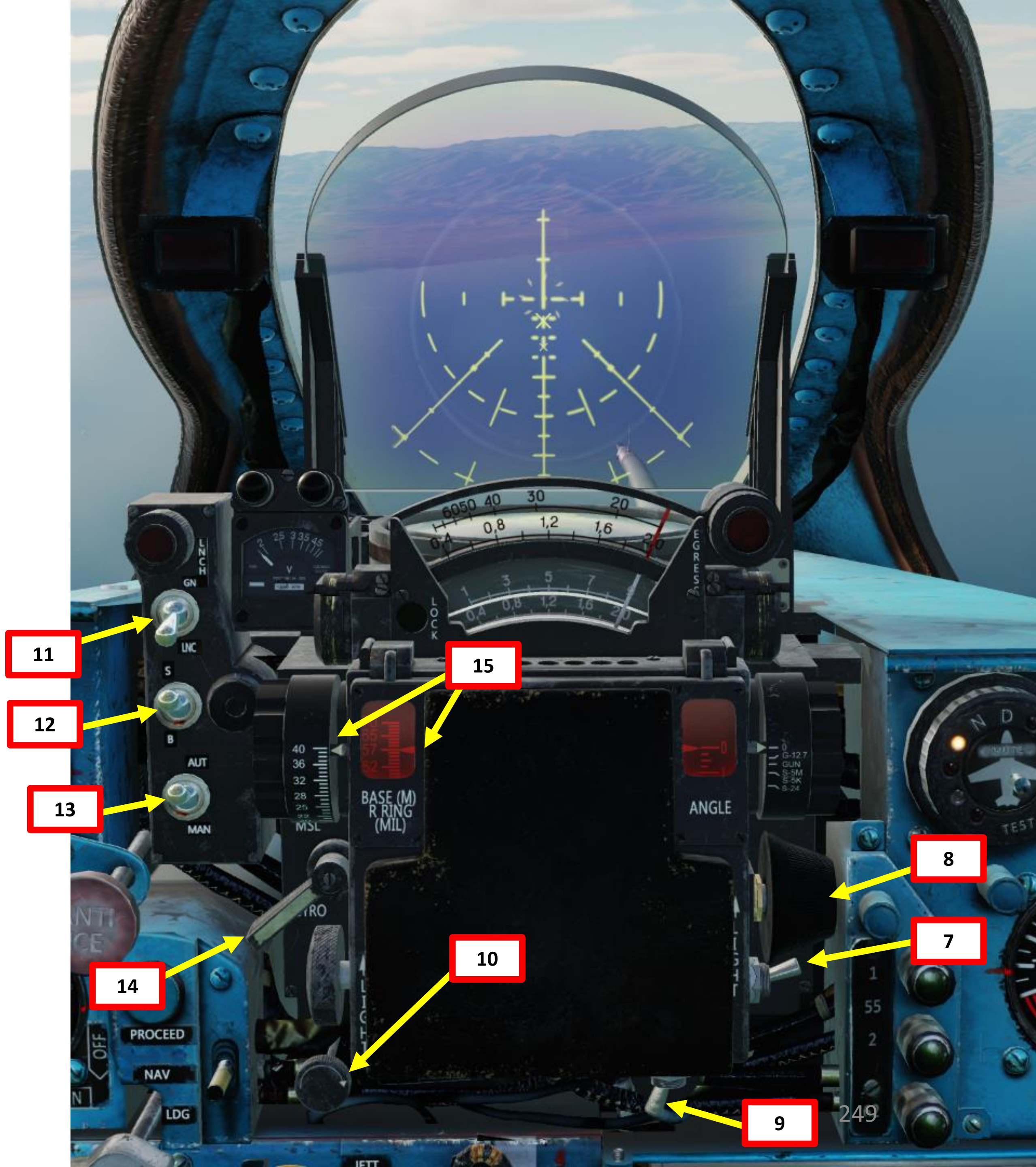
1. Set IR-SARH Missiles /Rocket Heating Power Switch – ON (UP)
2. Set IR-SARH Missiles / Rocket Master Arm Switch – ON (UP)
3. Set relevant Pylon Power Switches – ON (UP)
   - Pylons 1-2 are the inner pylons
   - Pylons 3-4 are the outer pylons
4. Set ASP-PFD Optical Sight Power Switch – ON (UP)
5. Set Air/Ground Master Mode switch to GROUND (DOWN).
6. Set Weapon Selector to desired pylon
   - S-24 RKT 1-2 selects one of the Grom missiles on inner pylons 1 and 2. Missiles are fired individually.





3.6 – KH-66 Grom (Radar Beam Riding Missile)

7. Set Pipper Switch – ON (UP).
8. Adjust Pipper brightness as desired. Since we will use the Fixed Net as a reference to aim the missile, I suggest you dim the pipper to avoid cluttering the optical sight.
9. Set Fixed Net Switch – ON (LEFT).
10. Adjust Fixed net brightness as desired.
11. Set Optical Sight GN/LNC Mode switch – LAUNCH (DOWN)
12. Set Optical Sight S/B Mode switch – SHOOT (UP)
13. Set Optical Sight AUT/MAN Mode switch – AUTO (UP)
14. Set Optical Sight MSL/GYRO Mode switch – GYRO (DOWN)
15. Rotate Target Wingspan Setting Control Knob to enter the target's size/wingspan. Pipper size will adjust accordingly.

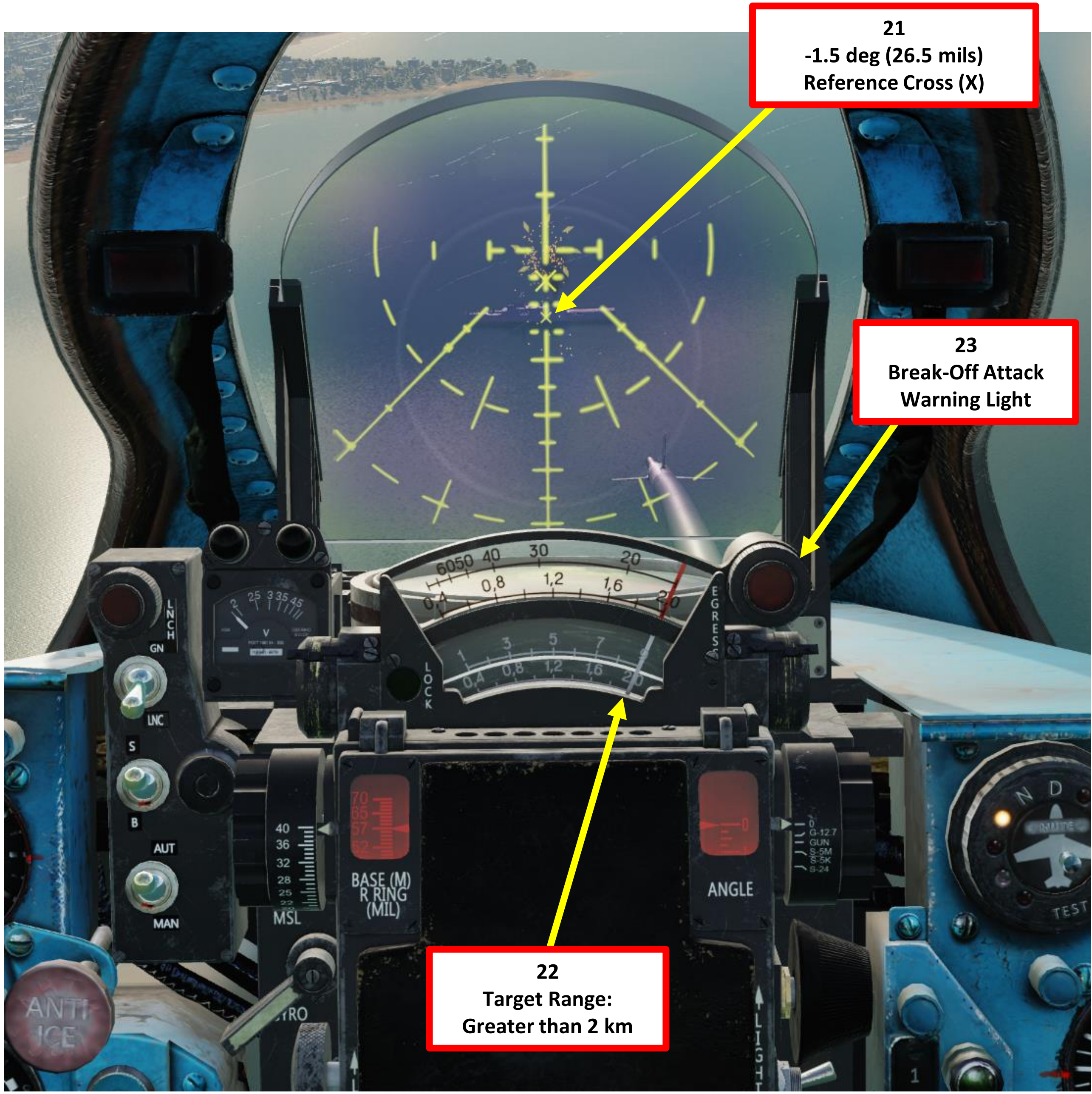


3.6 – KH-66 Grom (Radar Beam Riding Missile)

16. Set Radar Main Mode Selector to MIDDLE (STANDBY) to start radar warm-up. The RP-22 requires a 3 to 5 minute warm-up period before being functional. While in Standby Mode, the radar alcohol coolant lasts for 35 to 40 minutes.
17. Set Radar Main Mode Selector to UP (ON).
18. Set Fixed/Locked Beam Mode Selector Switch – ON (UP)
19. The radar will now emit a fixed beam to guide the missile during the attack.
20. Spot the target, then perform a shallow dive on the target (between 10-30 deg) at 600-900 km/h. Avoid pulling negative Gs during the dive.

3.6 – KH-66 Grom (Radar Beam Riding Missile)

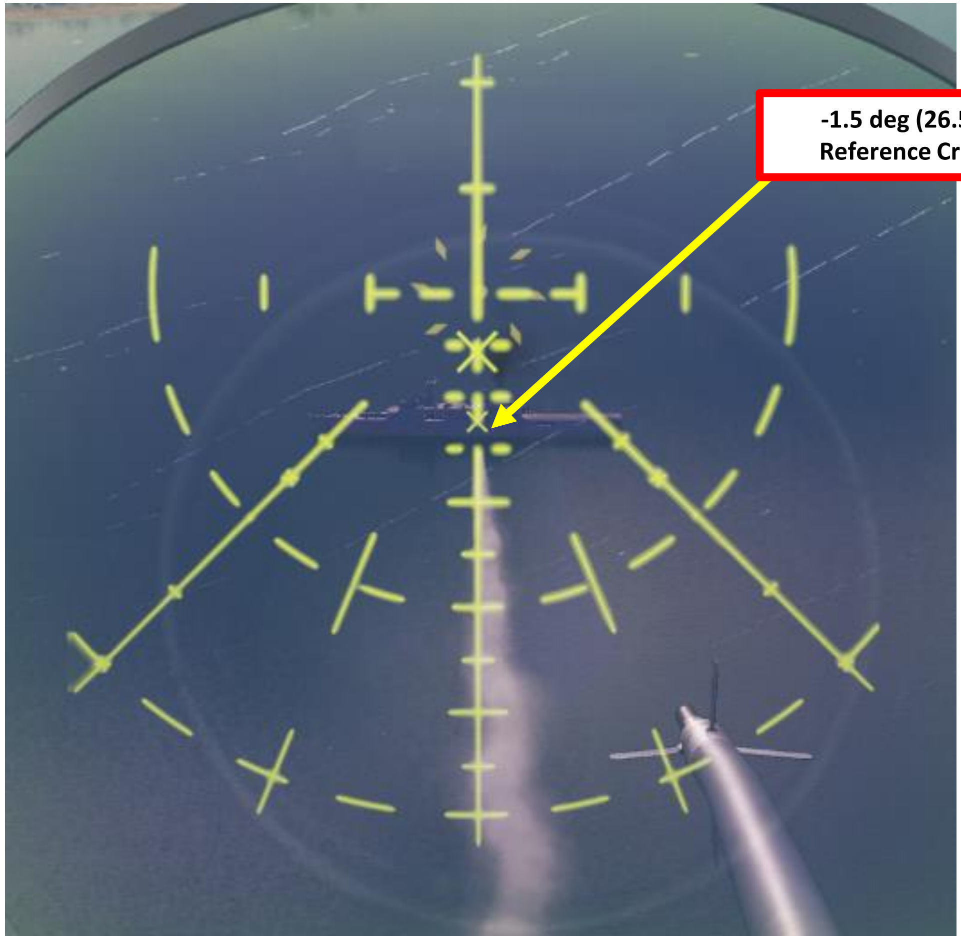
21. During the attack, place the bottom-most cross (-1.5 deg, or 26.5 mils reference cross) over the target. This is where your radar beam is pointing.
22. The radar can provide ranging information on the ASP Optical Sight Range Indicator’s fourth row, but in practice you should launch the missile before reaching the “2 km range” mark.
23. If the Break-Off Attack Light illuminates, you risk colliding with the target; pull away from the target.
24. When ready, flip Weapon Release Button safety and keep the Weapon Release pressed until the missile is fired (RALT+Spacebar).
25. When missile is fired, the engine starter will run for about 5 seconds to ensure no engine flameout occurs due to missile smoke ingestion through the engine intake. Expect an asymmetric wing load once the missile is launched, which has to be compensated with aileron input.



3.6 – KH-66 Grom (Radar Beam Riding Missile)

26. Keep the bottom Reference Cross over the target to guide the missile until impact. The missile “rides” (tracks) the radar beam, which follows the longitudinal weapon axis (-1.5 deg, marked as the bottom-most “X” on the ASP Fixed Net). Use of rudder is not recommended since it will steer the missile off target when rudder pedal is applied.

Note: The way the radar beam riding is simulated for the RP-22 radar is not exactly as per real life; the way it is simulated in DCS is a gameplay concession to allow the use of the KH-66 GROM.



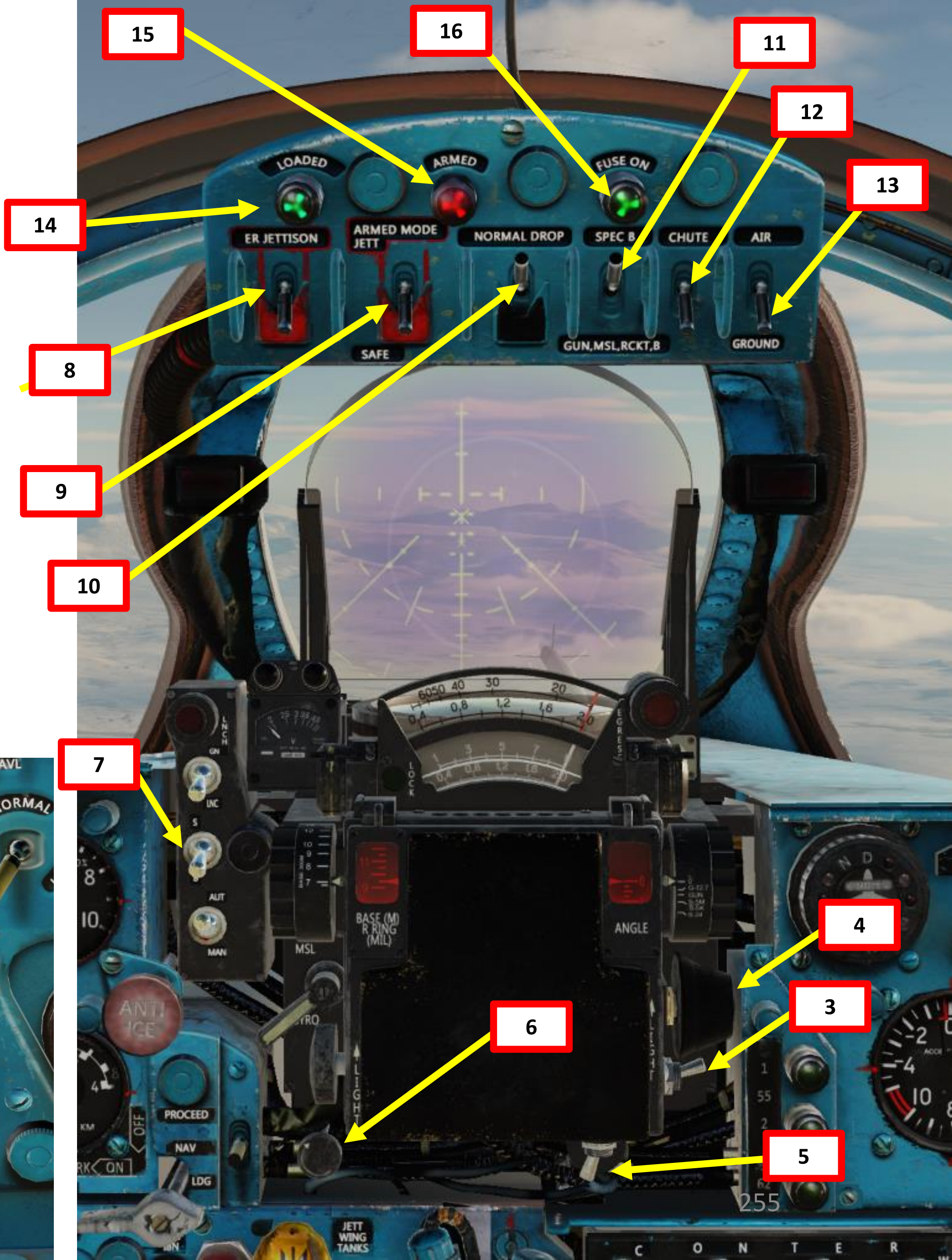
3.6 – KH-66 Grom (Radar Beam Riding Missile)

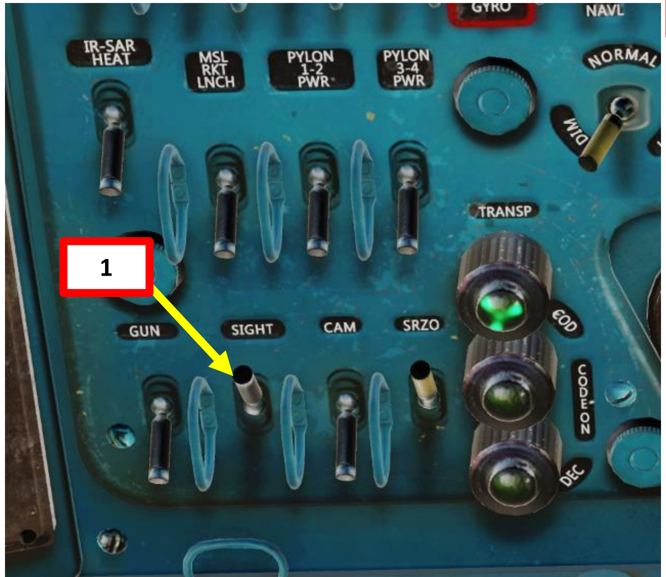
27. Performing attacks with the Grom against armed ships is very dangerous since you have to remain lined up on the ship itself, making your aircraft very vulnerable to anti-air defences. Launching a second missile shortly after the first one is good practice in case the first one gets destroyed on its way to the ship.
28. If the missile flies for more than 30 seconds, it will self-destruct. You have to judge when to launch the missile from far enough to be safe and close enough to not have the missile self-destruct.

3.7 – RN-24 Tactical Nuclear Bomb

3.7 – RN-24 Tactical Nuclear Bomb

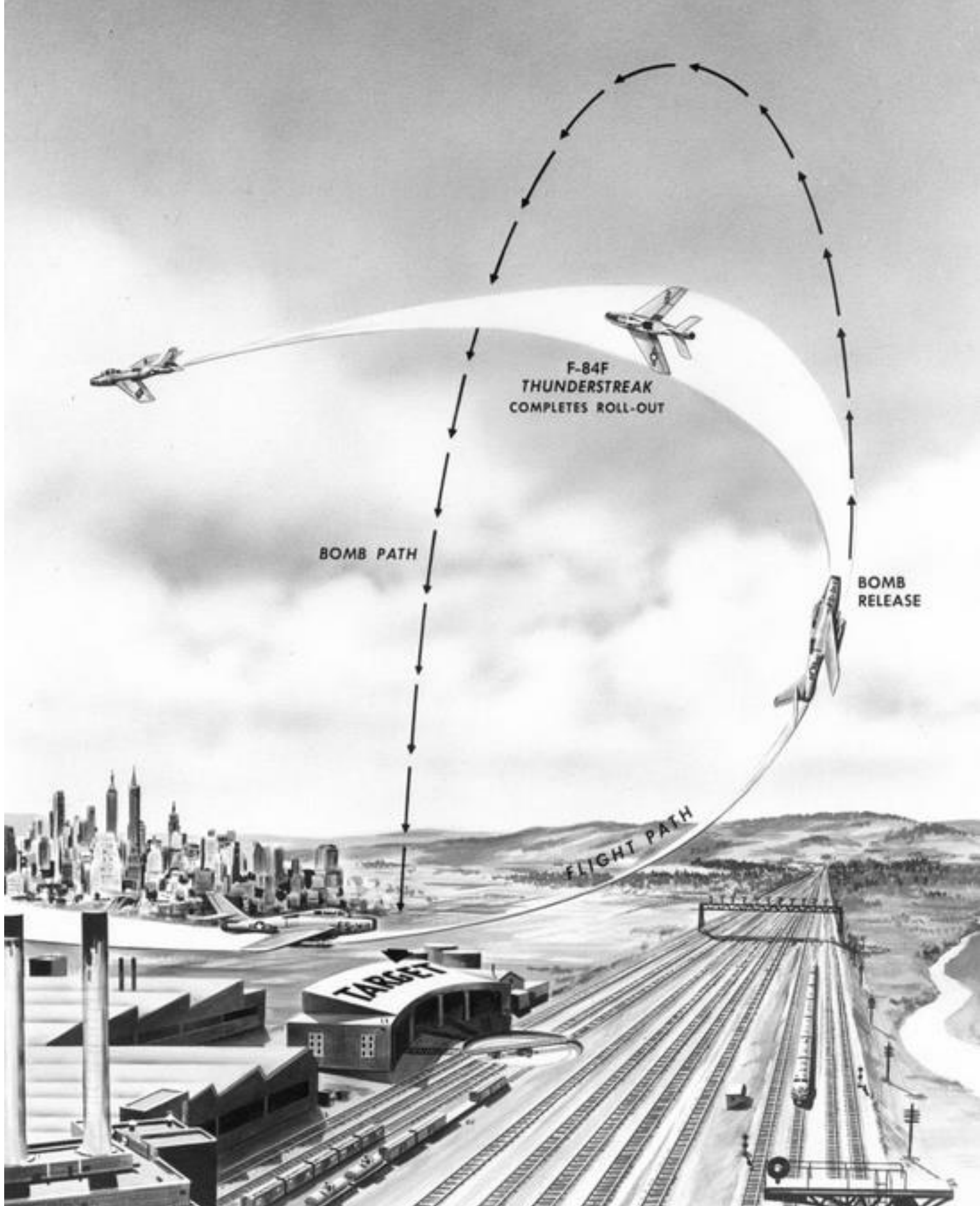
1. Set ASP-PFD Optical Sight Power Switch – ON (UP)
2. Set Air/Ground Master Mode switch to GROUND (DOWN).
3. Set Pipper Switch – ON (UP).
4. Adjust Pipper brightness as desired.
5. Set Fixed Net Switch – ON (LEFT).
6. Adjust Fixed net brightness as desired.
7. Set Optical Sight S/B Mode switch – BOMBING (DOWN)
8. Set Emergency Jettison Switch – OFF (DOWN)
9. Set Emergency Jettison Arming Switch – OFF (DOWN)
10. Set Normal Drop (Tactical Jettison) Switch – ON/ARMED (UP)
11. Set Weapon Selector Switch – SPEC B / Nuclear Bomb (UP)
12. Set Braking Chute Switch – OFF (DOWN)
13. Set Nuke Air/Ground Detonation Switch – GROUND DETONATION (DOWN)
14. Confirm that Nuke Loaded Light is illuminated
15. Confirm that Nuke Armed Light is illuminated
16. Confirm that Nuke Fuse ON Light is illuminated
17. You may now unleash nuclear winter.





3.7 – RN-24 Tactical Nuclear Bomb

18. For nuclear strikes, an “over-the-shoulder” attack profile is recommended. Do keep in mind that it may very well be a one-way-trip.
    - With full afterburner, stay close to the ground to avoid radar detection.
    - When you reach target, pull up in a constant 4 G loop. Exceeding 5 Gs may rip the bomb apart from the rack.
    - When you reach 45 deg, you may drop the nuclear bomb and immediately pull away from the target.
19. When ready, flip Weapon Release Button safety and keep the Weapon Release pressed until the nuclear bomb is dropped (RALT+Spacebar).



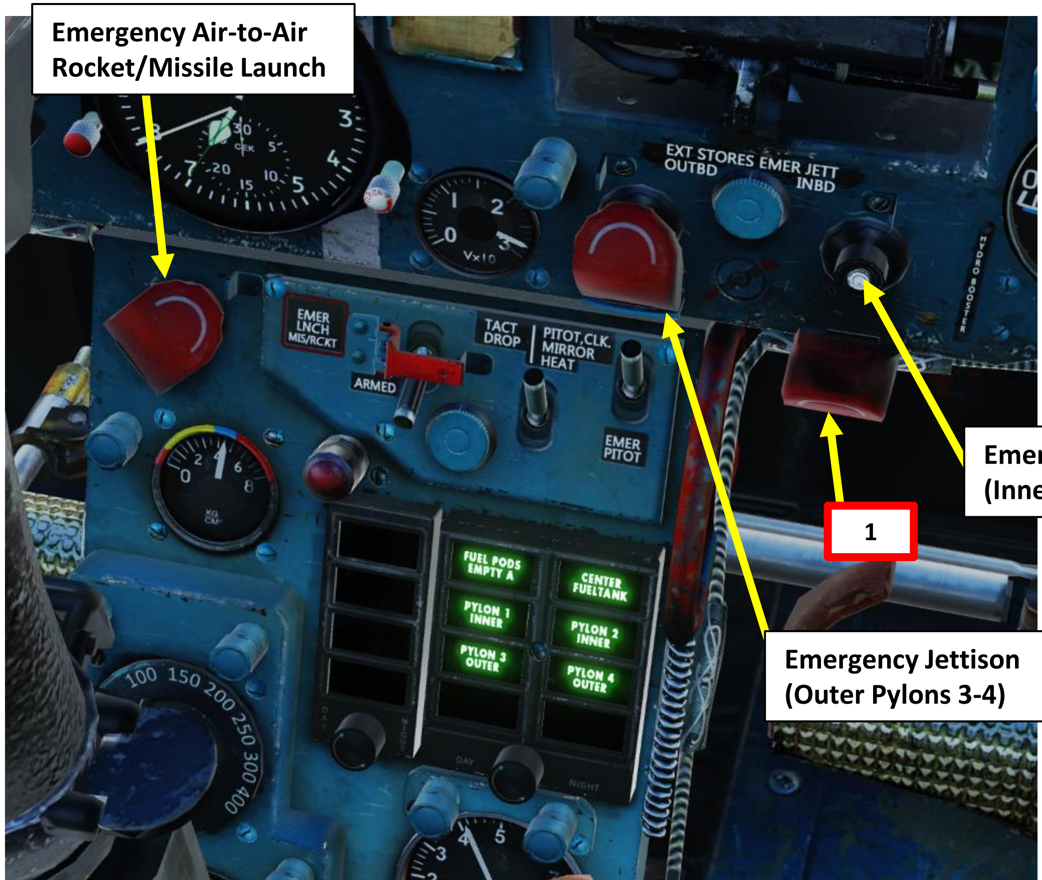
3.7 – RN-24 Tactical Nuclear Bomb

4 – Ordnance Jettison

In order to jettison weapons, there are three switches you can use:

- The Emergency Jettison switch for Inner Pylons (1-2)
- The Emergency Jettison switch for Outer Pylons (3-4)
- The Emergency Air-to-Air Rocket/Missile Launch switch

Keep in mind that they have a safety cover that needs to be flipped before pressing the button.



Countermeasures Introduction

Countermeasures are very simple to use in the MiG-21. You have three countermeasure types at your disposal: flares, chaff and an ECM (Electronic Countermeasure) jammer. 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 or 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.

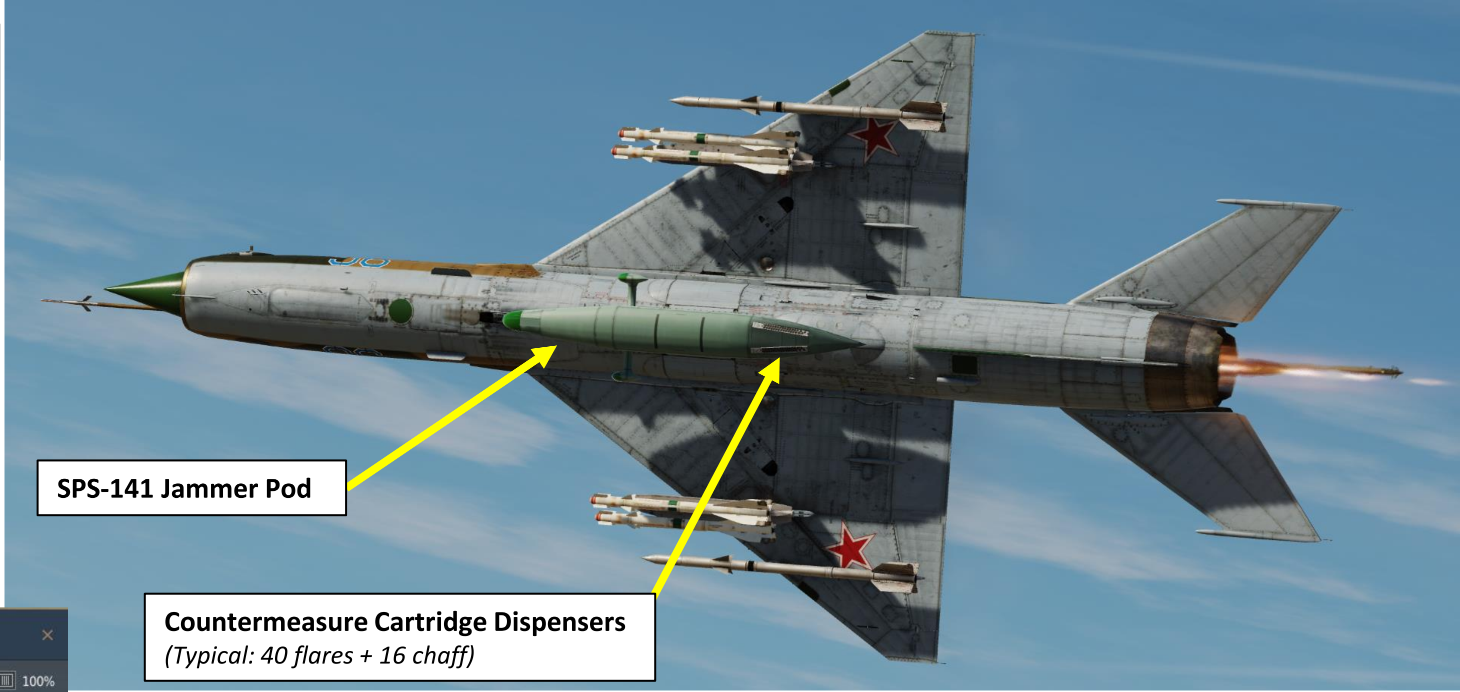
Countermeasures Introduction

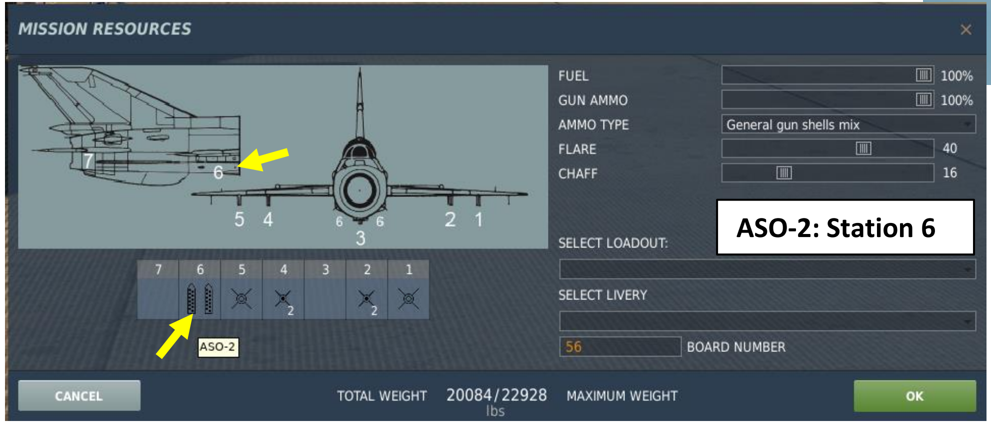
The MiG-21 can be equipped with two countermeasure systems that are mutually exclusive:

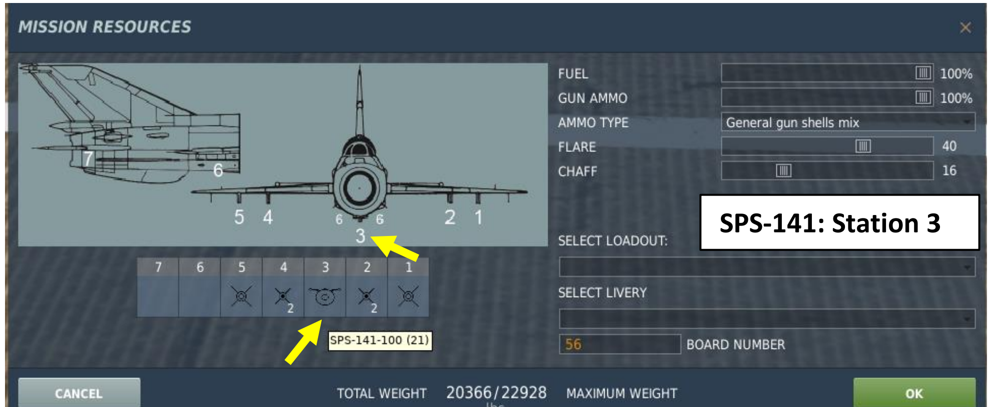
- The **ASO-2 Countermeasure Dispensers**, which contains chaff and flares
- The **SPS-141-100 ECM pod** that will act as both a chaff/flare dispenser and a radar jammer.

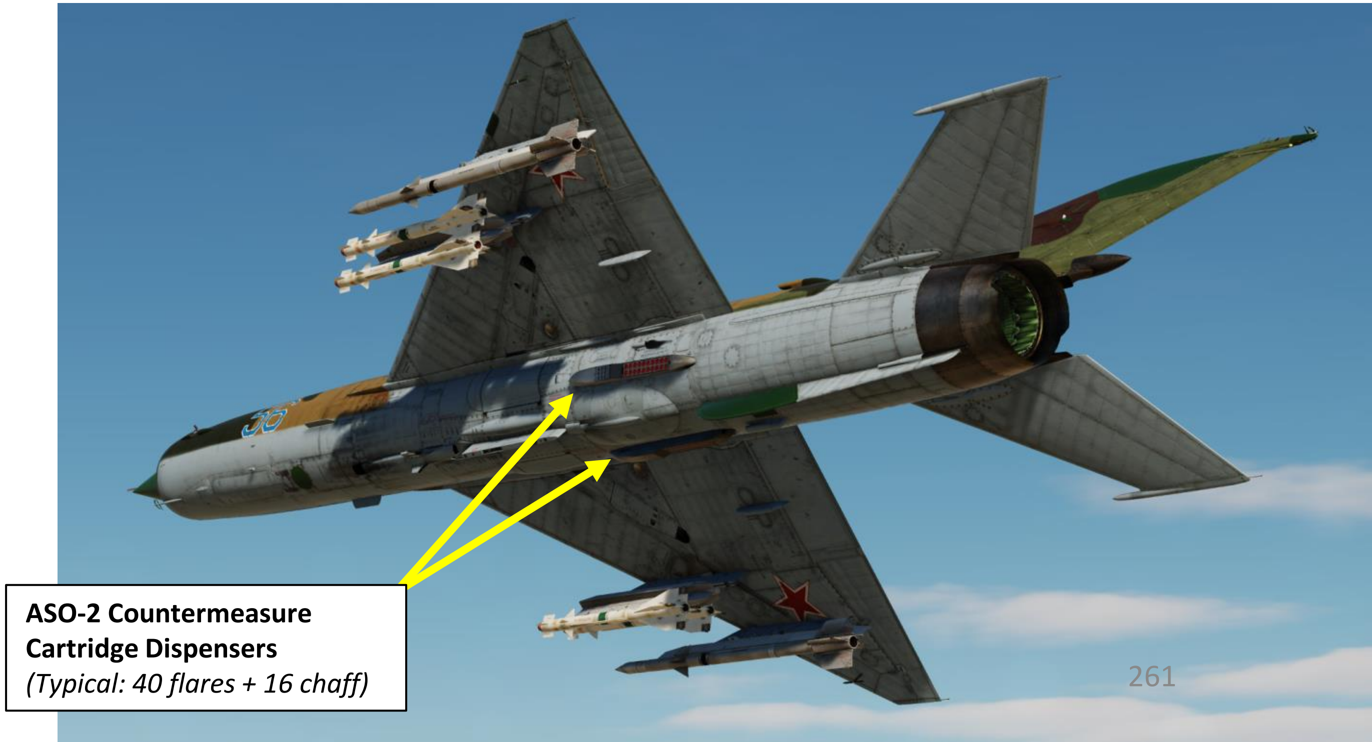
Both these systems need to be installed by the ground crew.

Keep in mind that you need to equip these dispensers/pods if you want to use them and that they cannot be jettisoned. If you forget to equip these pods, your only way to defend yourself will be to dive at treetop level and dodge those SAM sites and missiles.





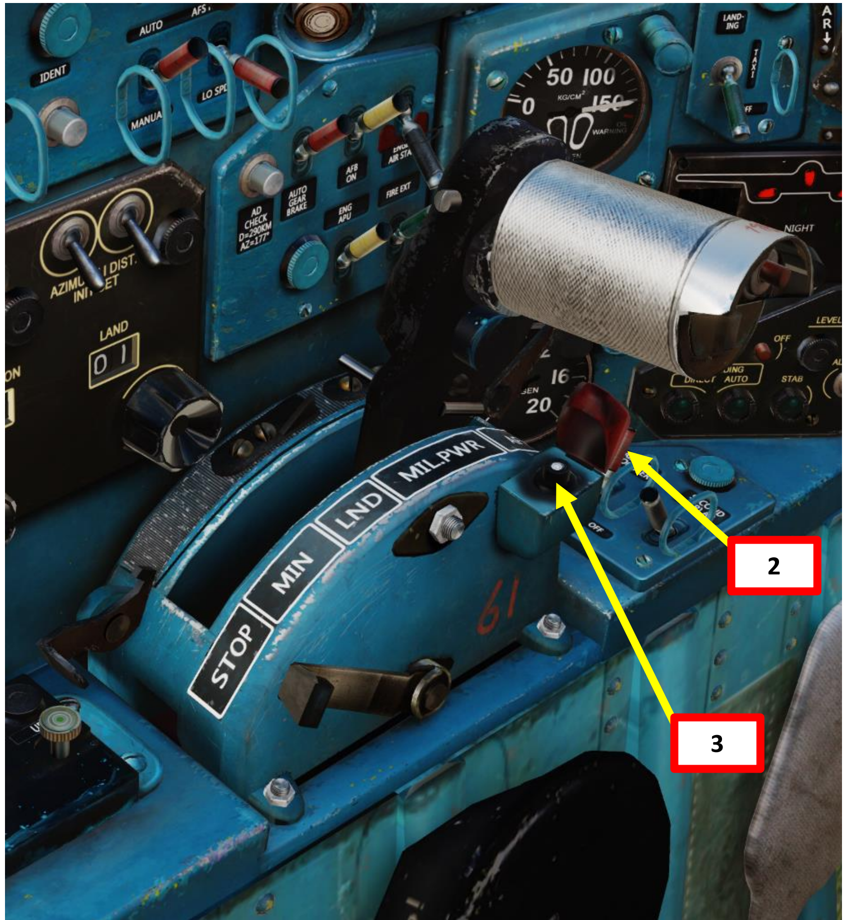


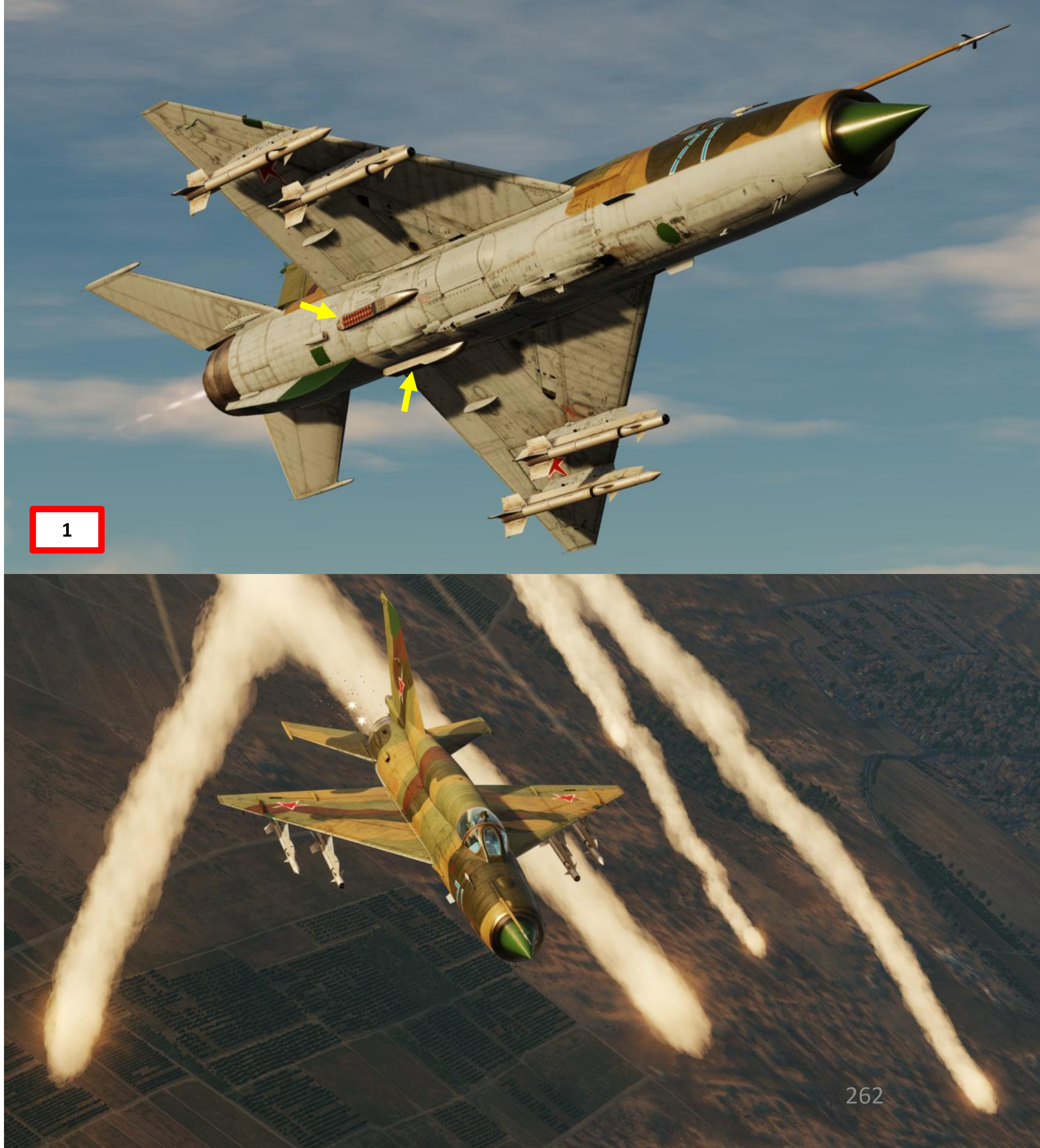


Countermeasures
Chaff & Flares Tutorial (ASO-2 Dispensers)

To deploy countermeasures using the ASO-2 Dispensers:

1. When on the ground, have the ground crew install the ASO-2 Dispenser pods on station 6.
2. Flip the ASO Chaff/Flare Button safety
3. Hold ASO Drop Chaff/Flare Button to drop a pair of flares and chaff (LCTRL+SPACE)

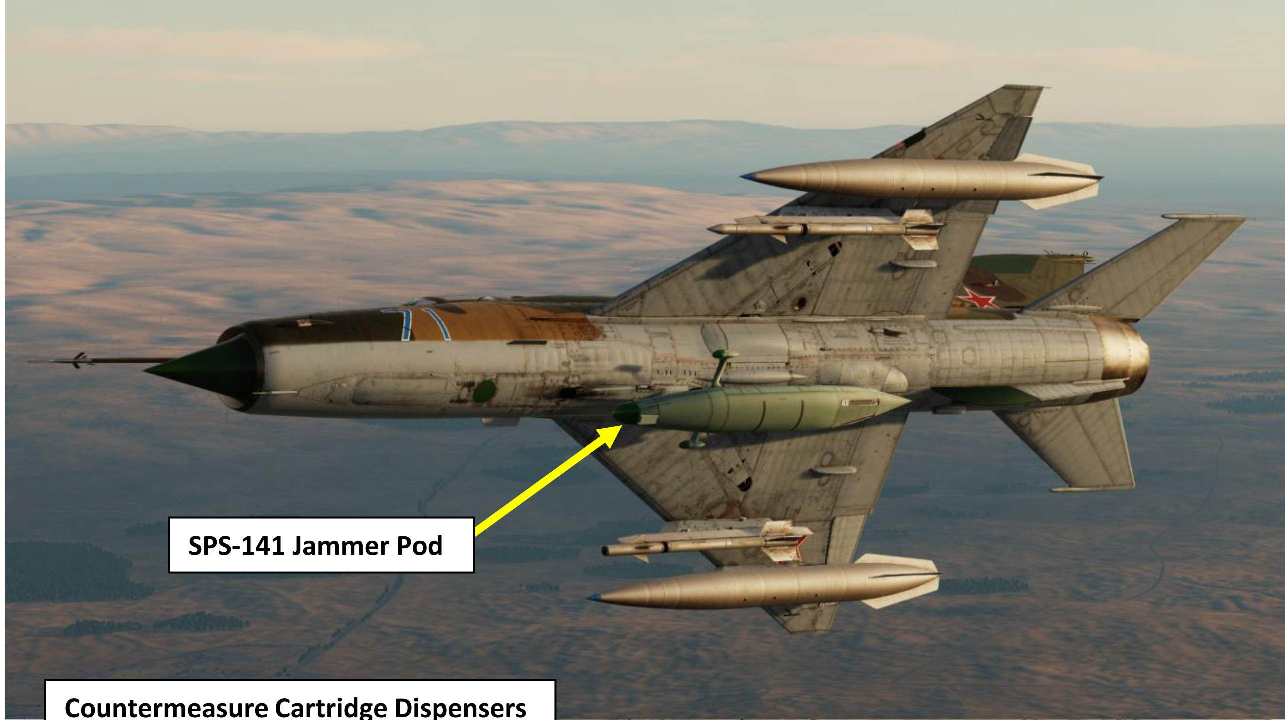


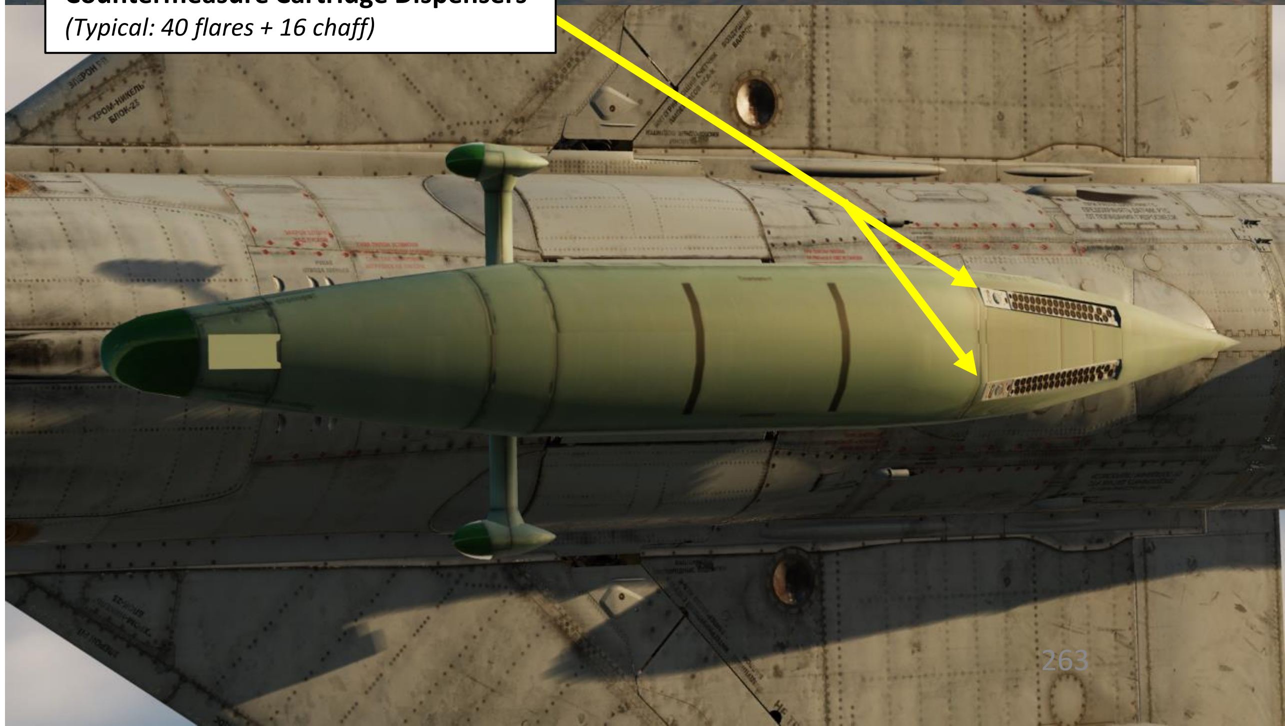


Countermeasures
SPS-141-100 Countermeasure Pod

The SPS-141-100 Jammer & Countermeasure pod can be used as an alternative to the ASO-2 dispensers. However, keep in mind that it has to be installed on the central ventral pylon, which usually is loaded with a fuel tank.

When the SPS-141 pod is installed, a special Control Panel is installed in the cockpit as well.

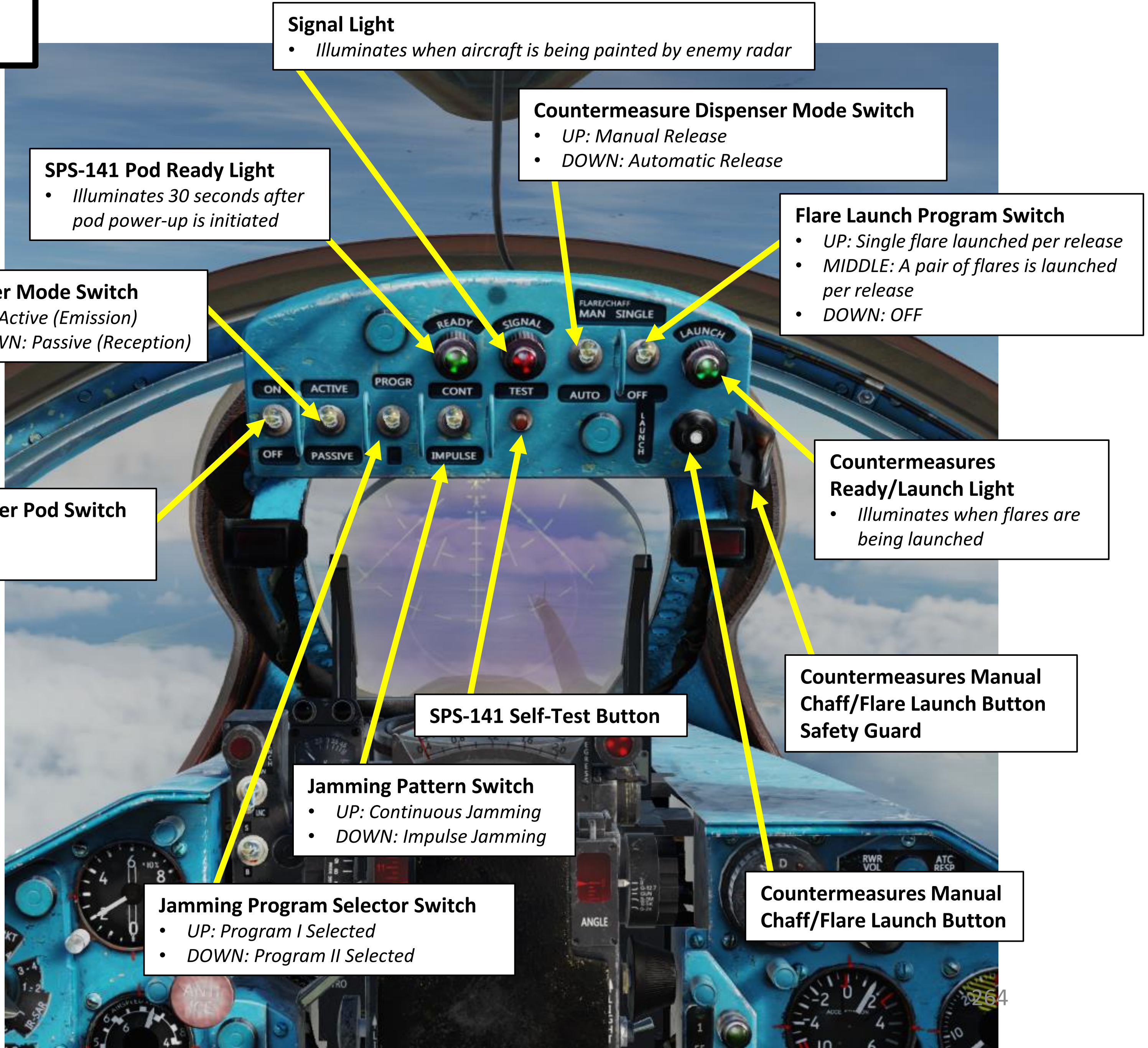




Countermeasures
SPS-141-100 Countermeasure Pod

Here is a breakdown of the different functions of the SPS-141 pod:

- Jamming radar signals (ECM, Electronic Countermeasures)
- Dispense Chaff & Flare countermeasure, either via a preset program or via manual release.



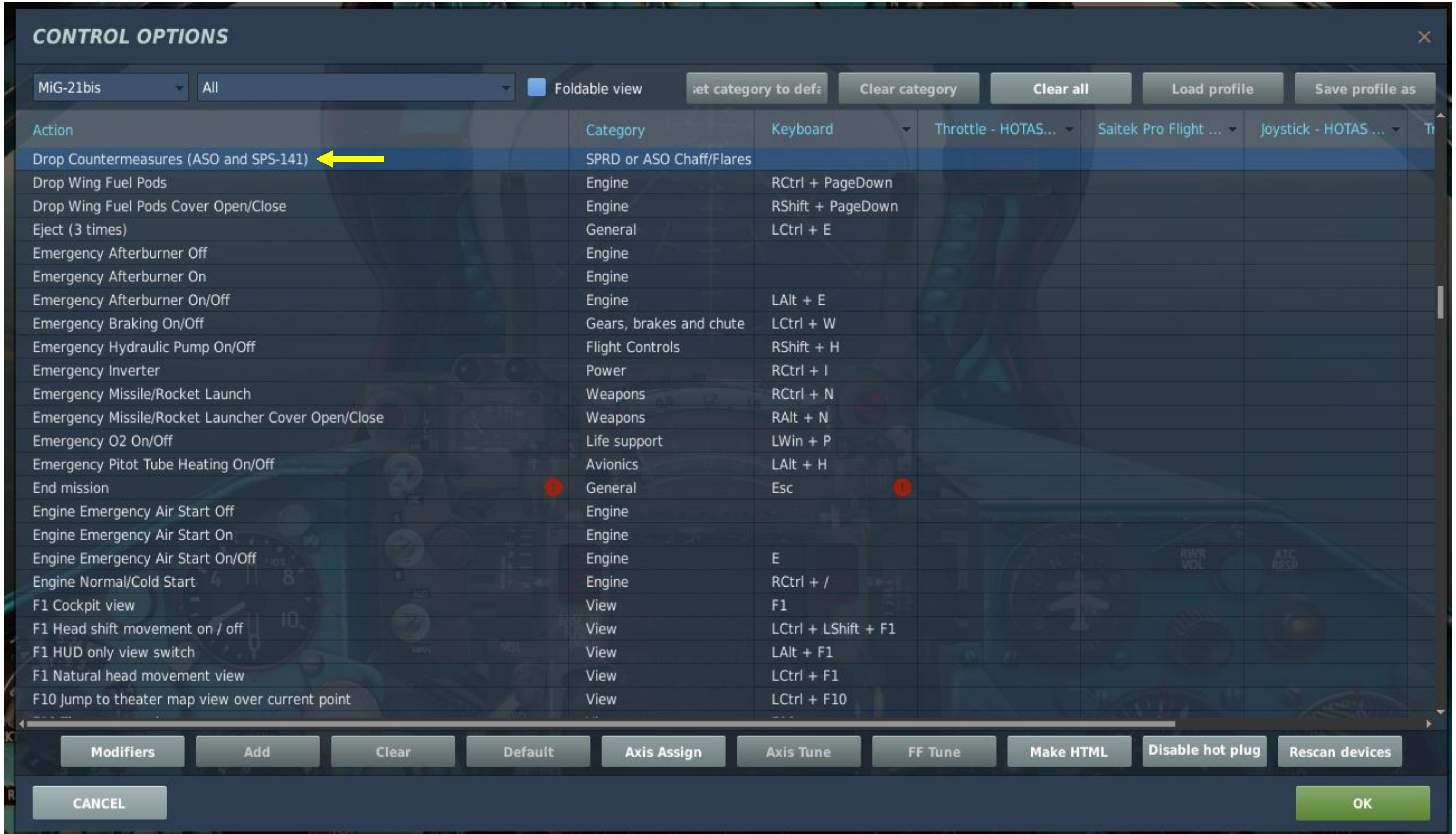
Countermeasures
Chaff & Flares Tutorial (SPS-141 Pod)

To deploy countermeasures using the SPS-141 Pod Dispensers:

1. When on the ground, have the ground crew install the SPS-141 Pod on station 3.
2. Set the SPS-141 Pod Power Switch – ON (UP).
3. SPS-141 Power-Up sequence takes about 30 seconds. When SPS-141 pod is ready to be used, the READY light illuminates.
4. Set the Countermeasure Dispenser Mode Switch – MANUAL (UP)
5. Set Flare Launch Program Switch – As Desired (UP or MIDDLE position)
   - UP: A single flare is launched per countermeasure release, alternating between left and right dispenser after each release
   - MIDDLE: A pair of flares is launched per countermeasure release.
6. Flip the Countermeasures Manual Chaff/Flare Launch Button safety guard
7. Press Countermeasures Manual Chaff/Flare Launch Button to release flares and chaff as per selected Countermeasure Program selected in step 5.
8. When countermeasure release is in progress, the READY/LAUNCH Light illuminates.

Countermeasures
Chaff & Flares Tutorial (SPS-141 Pod)

Take note that since the ASO-2 and SPS-141 Pod have two different buttons within the cockpit, the developer has made an artificial binding available to deploy countermeasures regardless of whether the ASO-2 dispensers or the SPS-141 Pod is installed. This binding is called "Drop Countermeasures (ASO and SPS-141)".

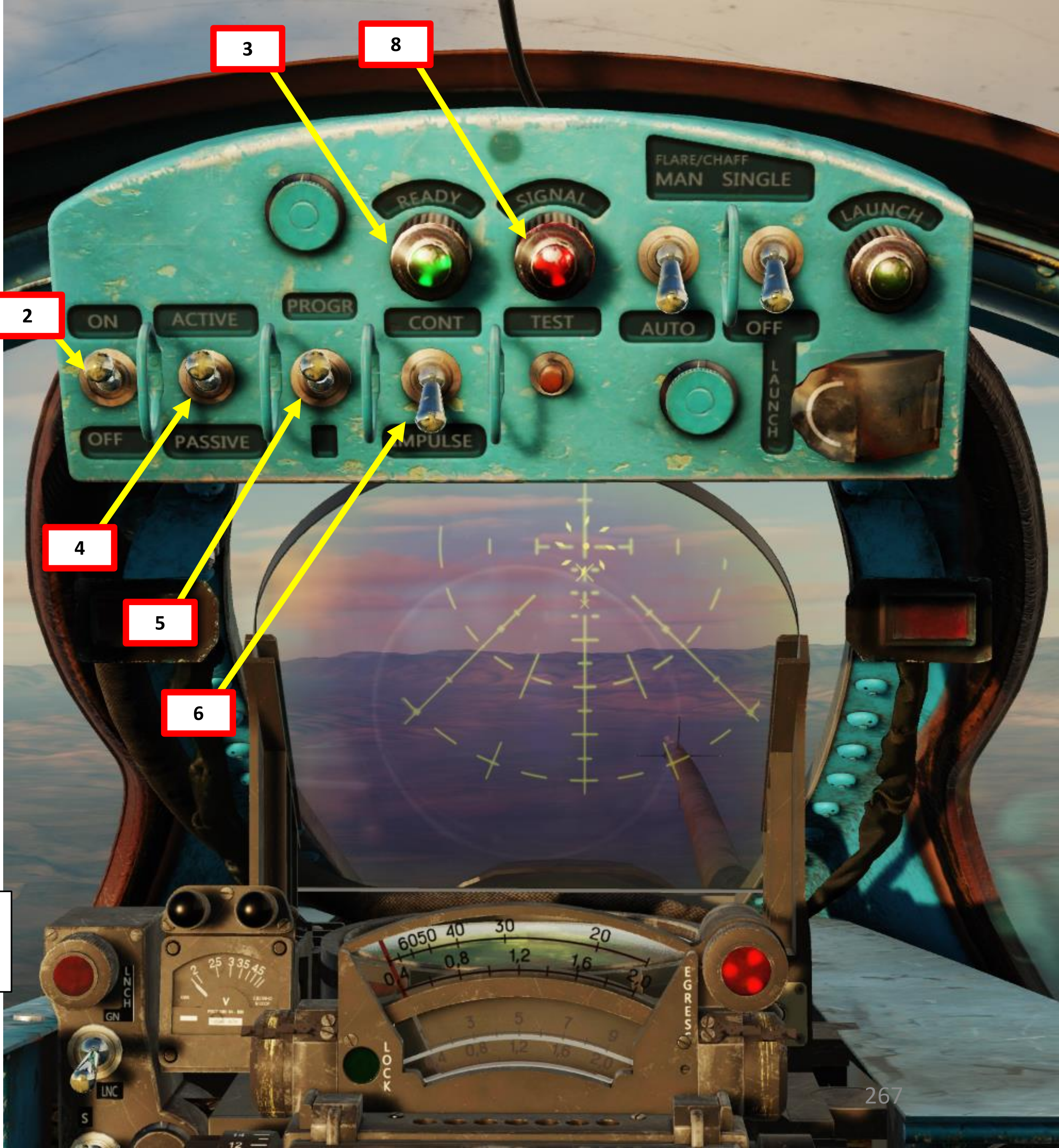


Countermeasures
Electronic Jammer (ECM) Tutorial (SPS-141 Pod)

To deploy countermeasures using the SPS-141 Pod Dispensers:

1. When on the ground, have the ground crew install the SPS-141 Pod on station 3.
2. Set the SPS-141 Pod Power Switch – ON (UP).
3. SPS-141 Power-Up sequence takes about 30 seconds. When SPS-141 pod is ready to be used, the READY light illuminates.
4. Set the Jammer Mode Switch – As Required
   - UP: Active / Emission Mode, which is used to drown lock-on radars (not search radars) with noise signals
   - DOWN: Passive / Reception Mode, which is used to observe/record radar emitters for reconnaissance purposes (not very useful for DCS).
     - If Passive/Reception Mode is used, don't forget to set the SPO-10 Radar Warning Receiver (RWR) Power Switch – ON (UP).
5. Set Jamming Program Selector Switch – As Required
   - UP: Program I
   - DOWN: Program II
6. Set Jamming Pattern Switch – As Required
   - UP: Continuous Jamming
   - DOWN: Impulse Jamming
7. Based on what Mode/Program/Pattern is selected, the Jammer pod will perform its task. It is unknown how much of this is simulated, therefore a good way to operate the SPS-141 pod is:
   - Jammer Mode - Active/Emission
   - Jamming Program - I or II
   - Jamming Pattern - Continuous for continuous jamming, Impulse for jamming in short pulses
8. Signal Light illuminates when radar jammer is transmitting/operating.

SPO-10 Radar Illumination Warning (Radar Warning Receiver, RWR) System Power Switch
- *UP: ON / DOWN: OFF*



Countermeasures
Electronic Jammer (ECM) Tutorial (SPS-141 Pod)

To deploy countermeasures using the SPS-141 Pod Dispensers:

In Active/Emission Mode:

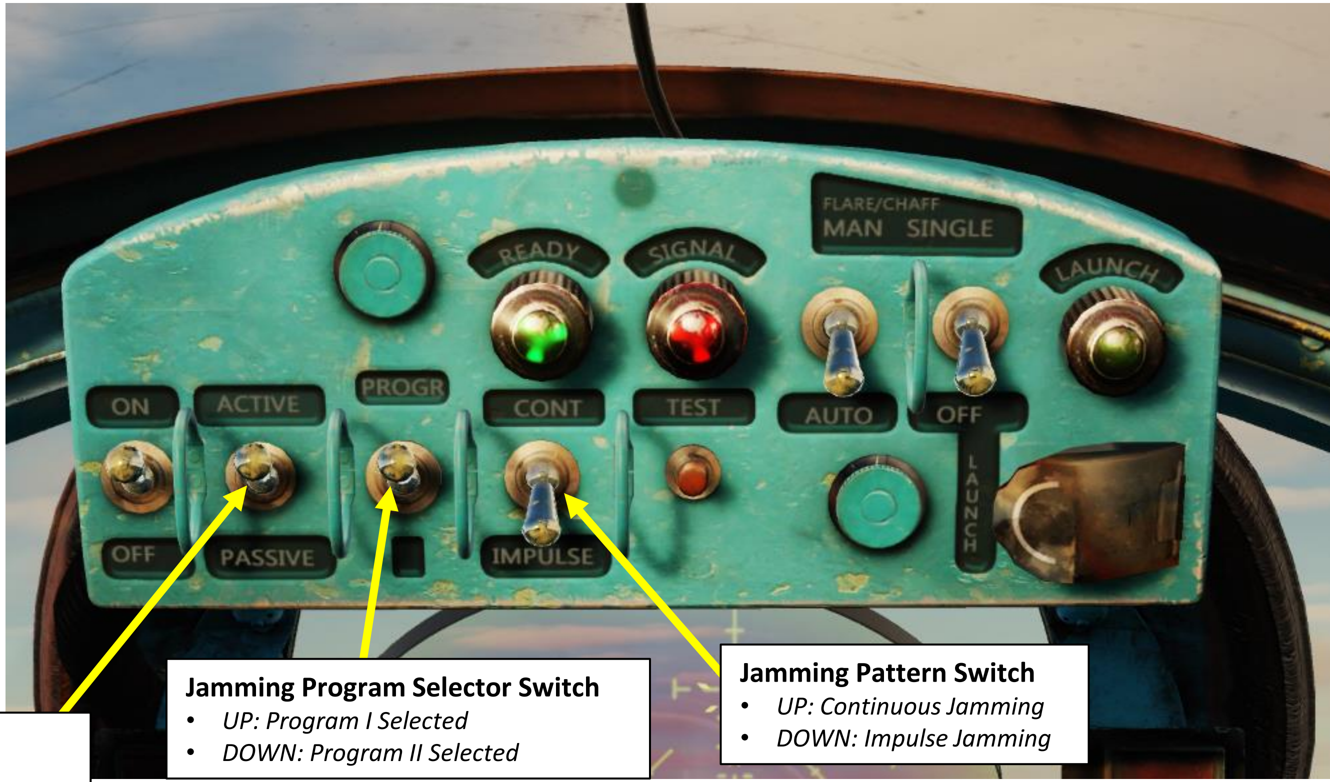
Pulse – Program I:
- Jamming of missile head homing system, fighter aircraft's fire control radars, ground fire control radars from SAM (Surface-to-Air Missile) and AAA (Anti-Aircraft Artillery) systems (false distance and angle signals).

Pulse – Program II:
- Same as Program I. Jamming of missile head homing system, fighter aircraft's fire control radars, ground fire control radars from SAM and AAA systems (false distance and angle signals).

****

Continuous – Program I:
- Jamming of missile head homing system, fighter aircraft's fire control radars, ground fire control radars from SAM's and AAA systems (target's false speed signal).

Continuous – Program II:
- Used for defending a group of aircraft (at least two aircraft) with SPS. "Doppler noise" and "blink noise" are transmitted simultaneously from both aircrafts flying in the formation.



Jammer Mode Switch
- *UP: Active (Emission)*
- *DOWN: Passive (Reception)*

Jamming Program Selector Switch
- *UP: Program I Selected*
- *DOWN: Program II Selected*

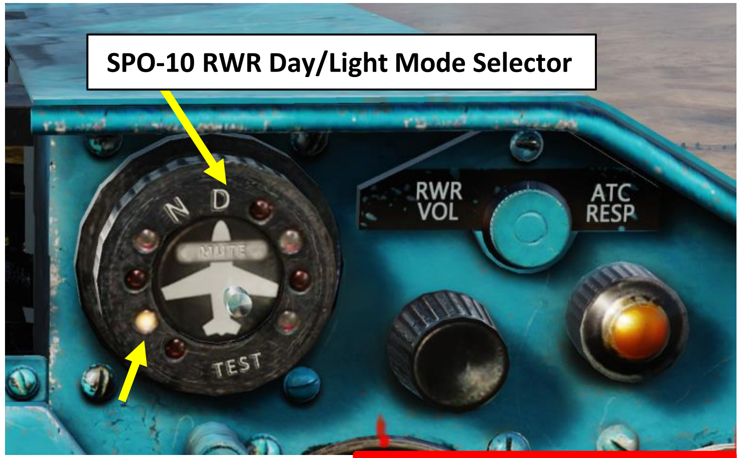
Jamming Pattern Switch
- *UP: Continuous Jamming*
- *DOWN: Impulse Jamming*

SPO-10 RWR (Radar Warning Receiver)

RWR operation requires the **RWR (Radar Warning Receiver) Power Switch to be ON (UP)**.

Day or Night setting is available by clicking on the D and N to switch the RWR filter. RWR Volume is controlled with the SPO-10 Volume knob.

SPO-10 RWR Day/Light Mode Selector



RWR – Day Mode (during day)

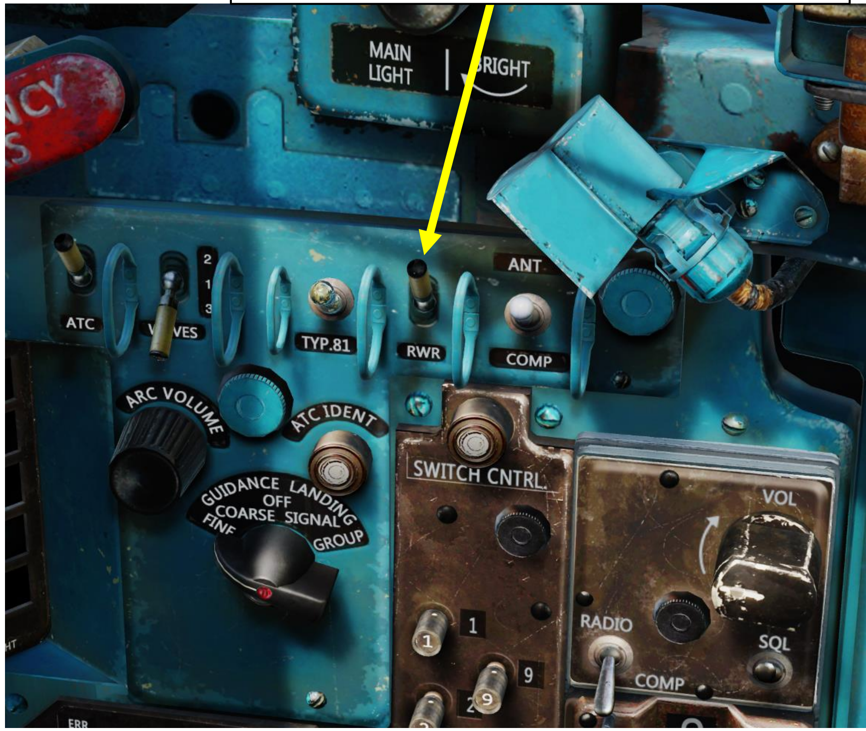
SPO-10 RWR Volume Control Knob

RWR – Night Mode (during day)

RWR – Day Mode (during night)

RWR – Night Mode (during night)

SPO-10 Radar Illumination Warning (Radar Warning Receiver, RWR) System Power Switch
- *UP: ON / DOWN: OFF*



SPO-10 RWR (Radar Warning Receiver)

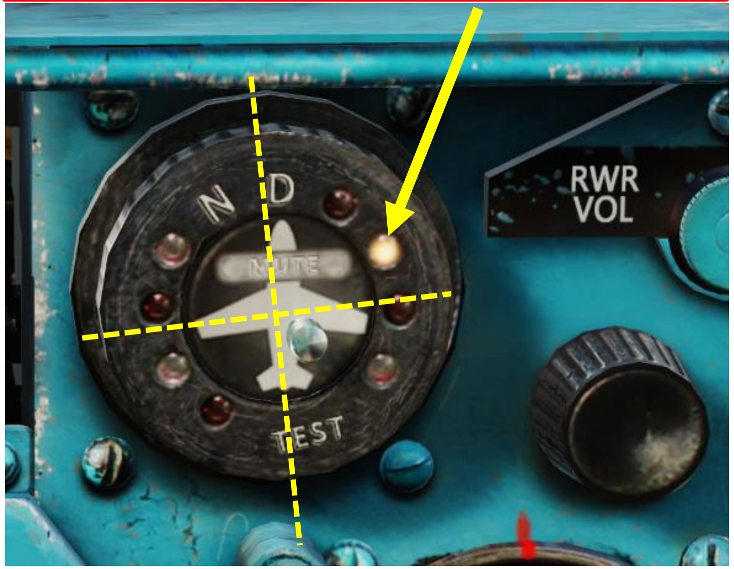
Here is a great youtube tutorial on the RWR made by XXJOHNXX: https://www.youtube.com/watch?v=P4MF1u3e23A

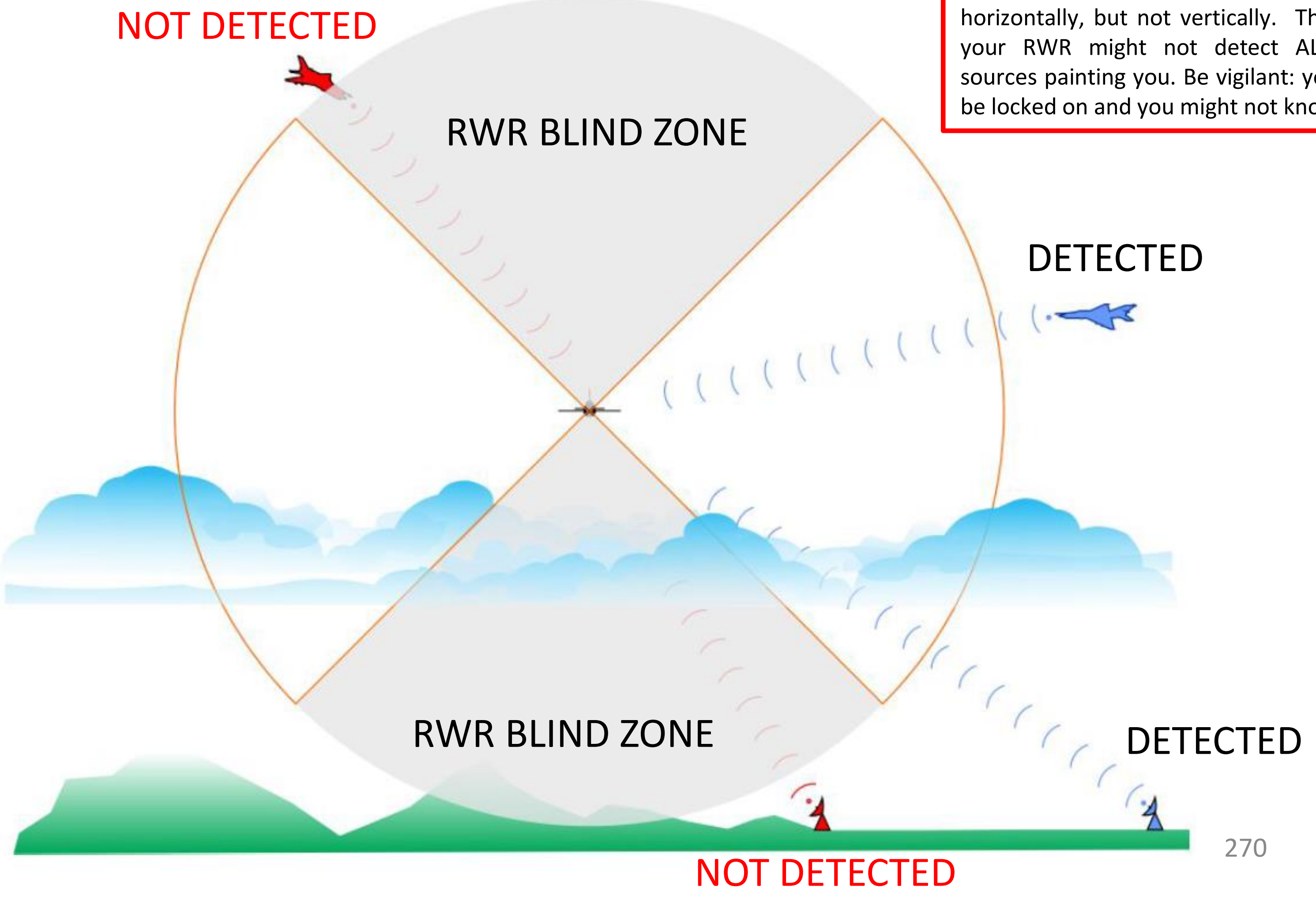
The RWR is fairly simple. There are four lights: one for each 90 deg quadrant surrounding the aircraft. The RWR is a top-down view. For example, a light that flashes on the top right means that a contact between your 12 o'clock and your 3 o'clock is "painting" you with radar. The RWR has blinking lights 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.

Your RWR might see 360 deg around you horizontally, but not vertically. Therefore, your RWR might not detect ALL radar sources painting you. Be vigilant: you could be locked on and you might not know it!

Blinking Light & Tone: you are detected
Continuous Light & Fast Tone: you are being locked by radar



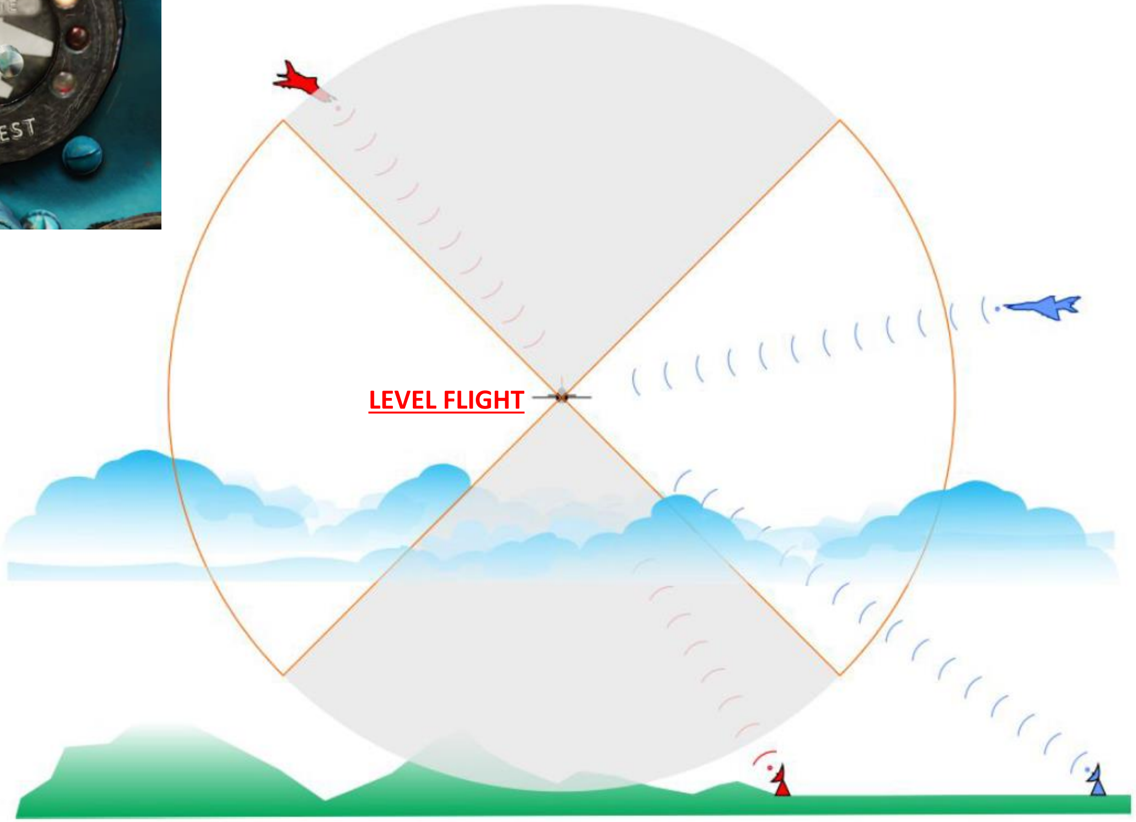


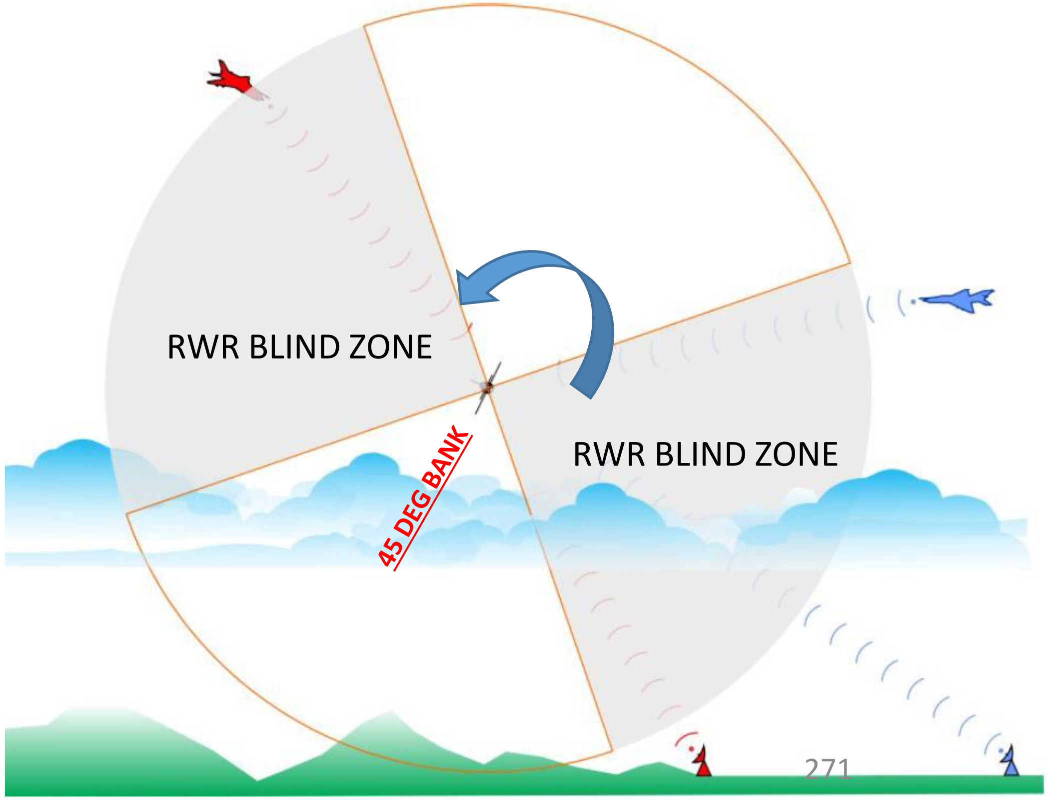
SPO-10 RWR (Radar Warning Receiver)

- In order to allow the RWR to cover your blind spots, it is recommended to roll left and right at 45 deg angles.
- The RWR tells you where the enemy radar waves come from, but in the horizontal plane only: it doesn't tell you the contact's altitude. Is he above you or below you?
- Make sure to have all your sectors covered: checking one direction only can put you in trouble. Be vigilant, and always try to figure out what your RWR is trying to tell you.
- **Example**: RWR top right light is blinking. Someone is in front of you, to your right . Is he above or below? Roll your aircraft to the right by 45 deg. If the blinking light disappears, it means that the contact is now in your blind spot. Think of it this way: if you roll to check below you to your right, no blinking means he's not where you just looked. Therefore, he must be where you didn't look: above you. Test it out: you'll figure it out soon enough.

EXAMPLE: Contact spotted between your 12 o'clock and your 3 o'clock.

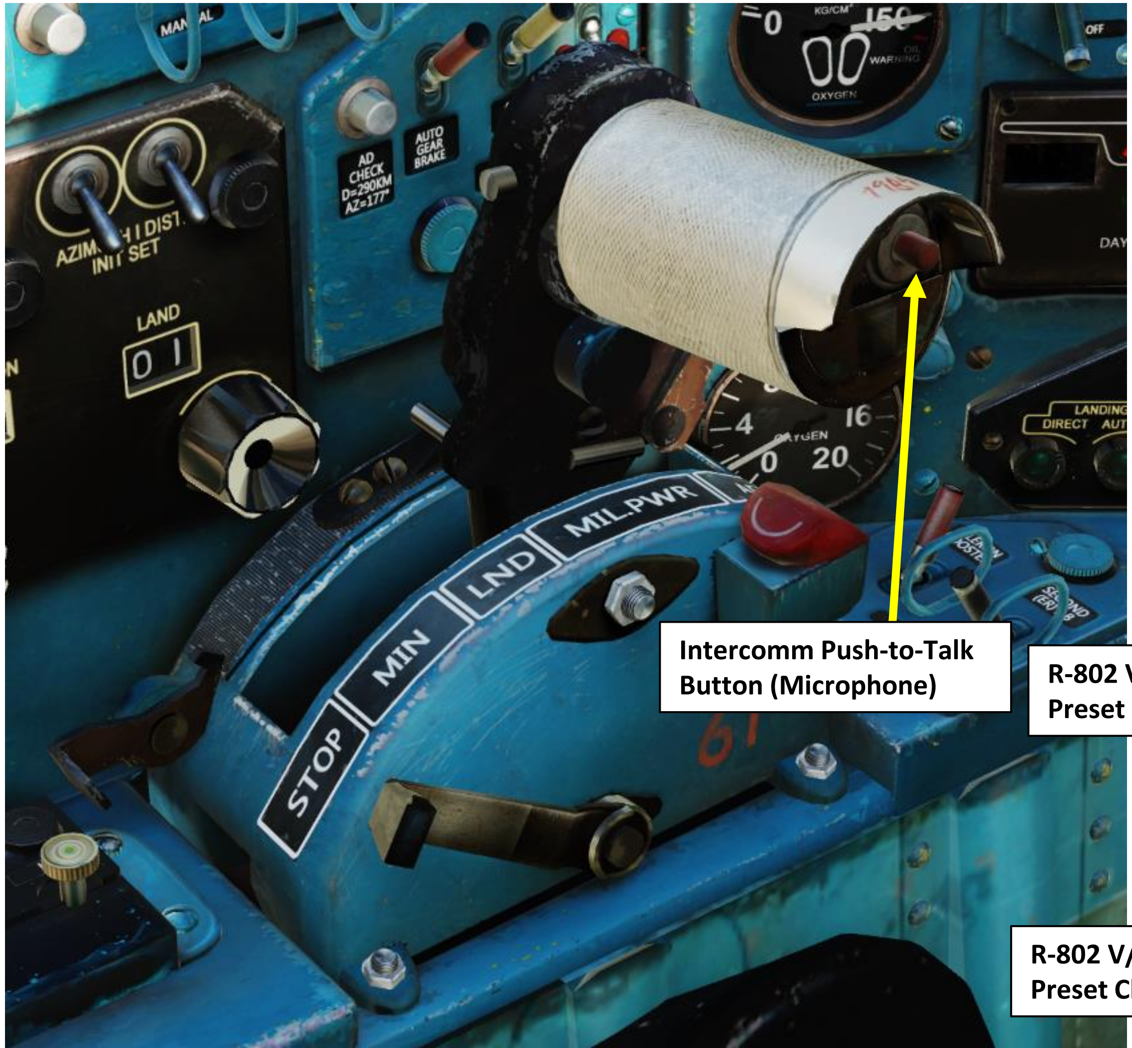
This guy is painted by 4 radars, and he doesn't know it… he's in big, big trouble.

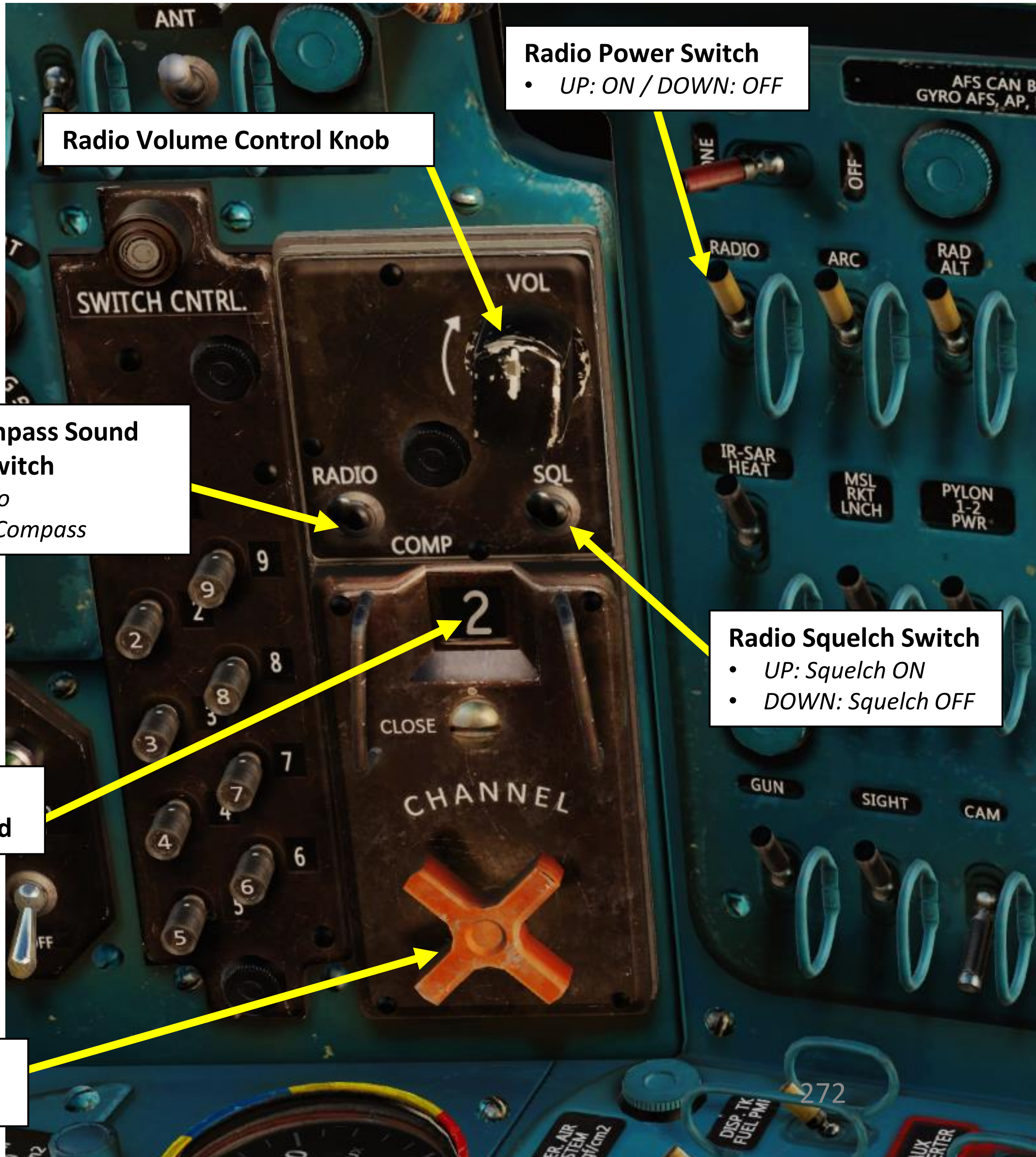




R-802G V/UHF Radio Introduction

The MiG-21bis simulated in DCS uses the R-802G V/UHF radio. This radio has 20 preset channels, which can only be set via the Mission Editor.





R-802G V/UHF Radio Preset Channel Frequencies

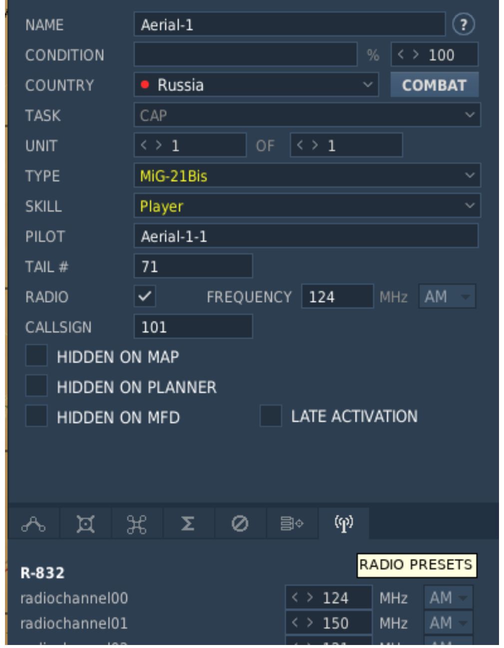
Here is an overview of the frequencies associated with each preset channel when flying in the Caucasus map. Take note that there is a placard in the cockpit that lists all different frequencies for each airfield.

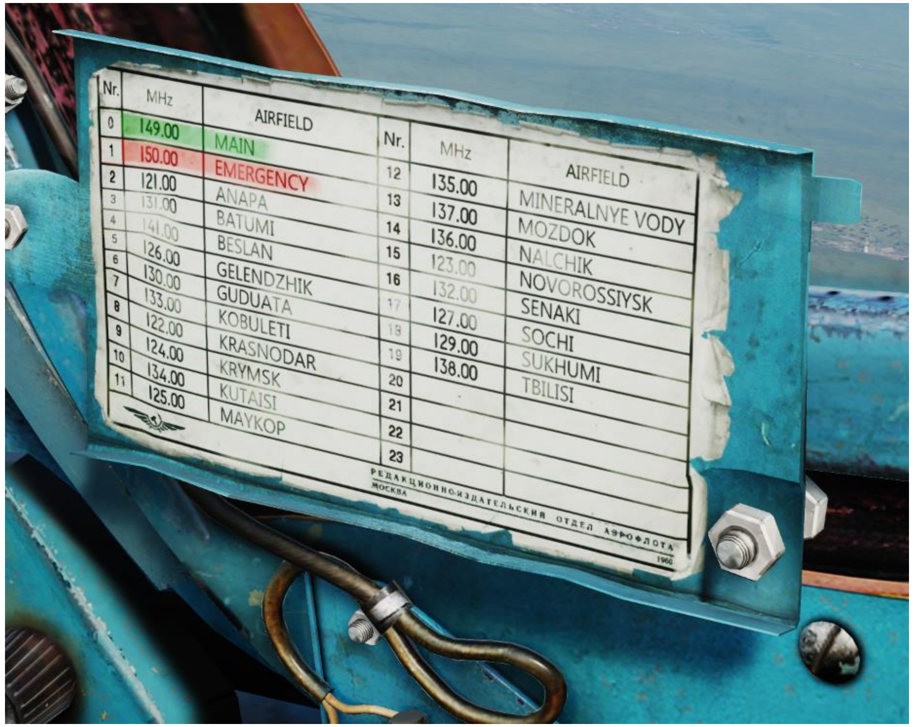
Channel 0 is the Main Channel, used for primary communications. By default, its frequency is set to 124.00 MHz.

- The default Main Channel frequency used to be 149.00 Mhz before, but it has been changed to 124.00 MHz since. It is up to the Mission Maker to make the frequencies match what is written on the placard. Check the kneeboard to see what the actual frequency of the Main Channel really is.

Channel 1 is the Emergency/Auxiliary Channel, used for emergency communications. By default, its frequency is set to 150.00 MHz.

Channels 2 to 19 are reserved for **airfield towers**.





Channel Frequencies (Caucasus)

RADIO	FREQ (Mhz)	AIRPORT / RUNWAY HDG
0	149.00	MAIN CHANNEL (CUSTOM)
1	150.00	AUX (CUSTOM)
2	121.00	ANAPA-VITYAZEVO / 42
3	131.00	BATUMI / 126
4	141.00	BESLAN / 94
5	126.00	GELENDZIK
6	130.00	GUDAUTA-BOMBORA
7	133.00	KOBULETI / 70
8	122.00	KRASNODAR-CENTER / 87 KRASNODAR-PASHKOVSKIY / 47
9	124.00	KRYMSK / 40
10	134.00	KUTAISI-KOPITNARI / 74
11	125.00	MAYKOP-KHANSKAYA / 39
12	135.00	MINERANYE VODY / 115
13	137.00	MOZDOK / 83
14	136.00	NALCHIK / 56
15	123.00	NOVOROSSIYSK
16	132.00	SENAKI-KOLKHI / 95
17	127.00	SOCHI-ADLER / 62
18	129.00	SUKHUMI-BABUSHARA
19	138.00	TBILISI-LOCHINI / 128 TBILISI-VAZIANI / 135

R-802G V/UHF Radio Preset Channel Frequencies

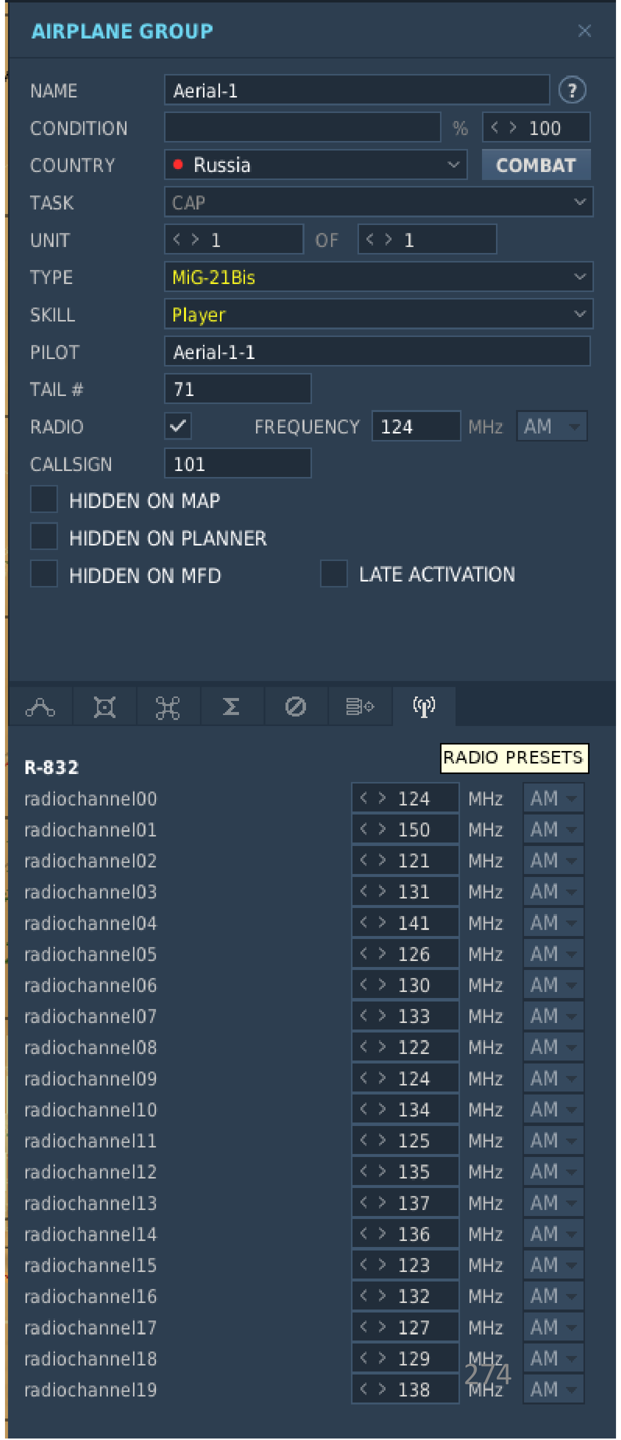
If you are not sure what frequency is associated with what channel, you can open the kneeboard and cycle through pages with until you see the RADIO page.

Open your kneeboard using “RCTRL+UP” and cycle through the pages using “RCTRL+LEFT” or “RCTRL+RIGHT”.

RADIO

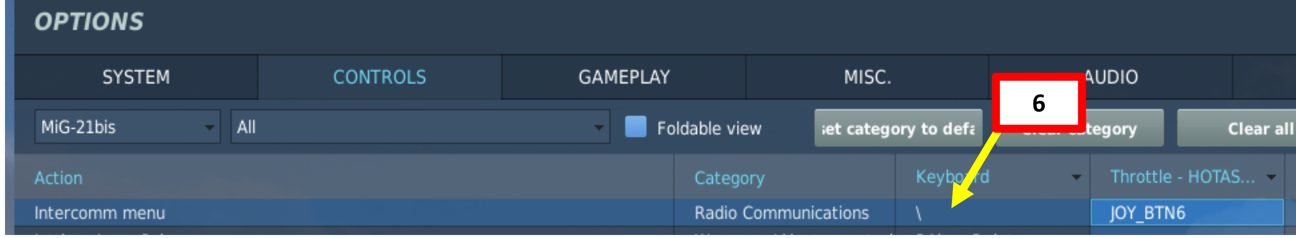
rev: Mar. 2017

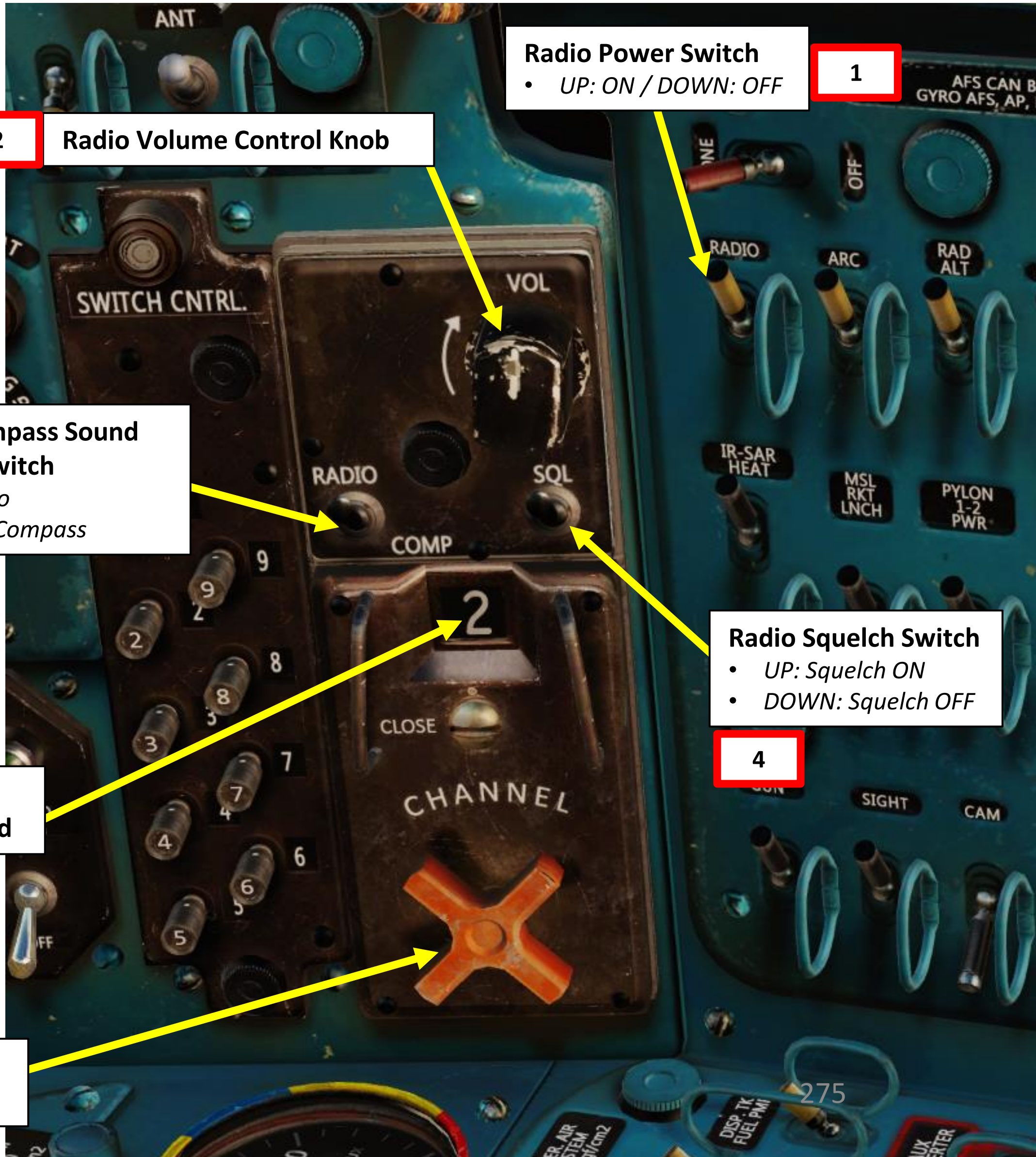
CAUCASUS (chnl. order)	NEVADA (chnl. order)	NEVADA (freq. order)
0 – Main	0 – 124.0	2 – 121.0
1 – Aux	1 – 150.0	8 – 122.0
2 – ANAPA – VITYAZEVO	2 – 121.0	15 – 123.0
3 – BATUMI	3 – 131.0	0 – 124.0
4 – BESLAN	4 – 141.0	9 – 124.0
5 – GELENDZIK	5 – 126.0	11 – 125.0
6 – GUDAUTA – BAMBORA	6 – 130.0	5 – 126.0
7 – KOBULETI	7 – 133.0	17 – 127.0
8 – KRASNODAR – CENTER	8 – 122.0	18 – 129.0
9 – KRYMSK	9 – 124.0	6 – 130.0
10 – KUTAISI – KOPITNARI	10 – 134.0	3 – 131.0
11 – MAYKOP – KHANSKAYA	11 – 125.0	16 – 132.0
12 – MINERALNYE VODY	12 – 135.0	7 – 133.0
13 – MOZDOK	13 – 137.0	10 – 134.0
14 – NALCHIK	14 – 136.0	12 – 135.0
15 – NOVOROSSIYSK	15 – 123.0	14 – 136.0
16 – SENAKI – KOLKHI	16 – 132.0	13 – 137.0
17 – SOCHI – ADLER	17 – 127.0	19 – 138.0
18 – SUKHUMI – BABUSHARA	18 – 129.0	4 – 141.0
19 – TBILISI – LOCHINI	19 – 138.0	1 – 150.0

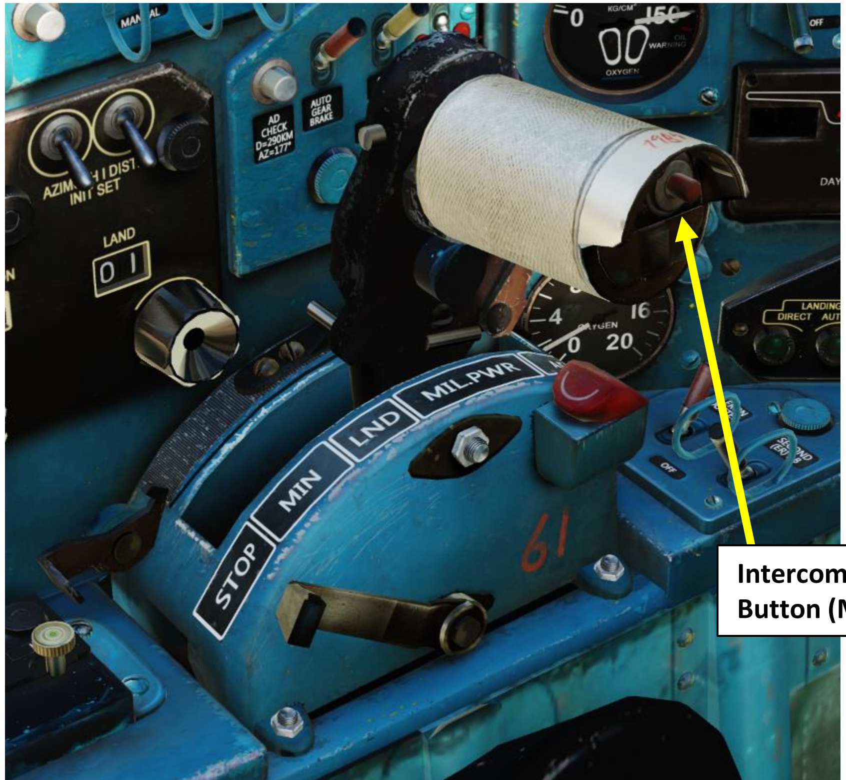


R-802G V/UHF Radio Tutorial

1. Set Radio Power Switch – ON (UP)
2. Set Radio Volume Control Knob – As Desired
3. Set Radio/Compass Sound Selector Switch – Radio (UP)
4. Set Radio Squelch Switch – ON (UP). This will filter noise and improve radio reception signal clarity. If you are tracking a distant radio station and need to increase the reception range, set Squelch Switch to OFF (DOWN). You will have better range but a much noisier signal.
5. Set Preset Channel Selector. Consult kneeboard (RCTRL+UP to show kneeboard, RCTRL+LEFT or RCTRL+RIGHT to cycle pages) to know what frequency is associated with each channel.
6. Transmit on radio channel by using the Intercomm Push-to-Talk Microphone Button ("\" binding).







PART 13 – SAU AUTOPILOT

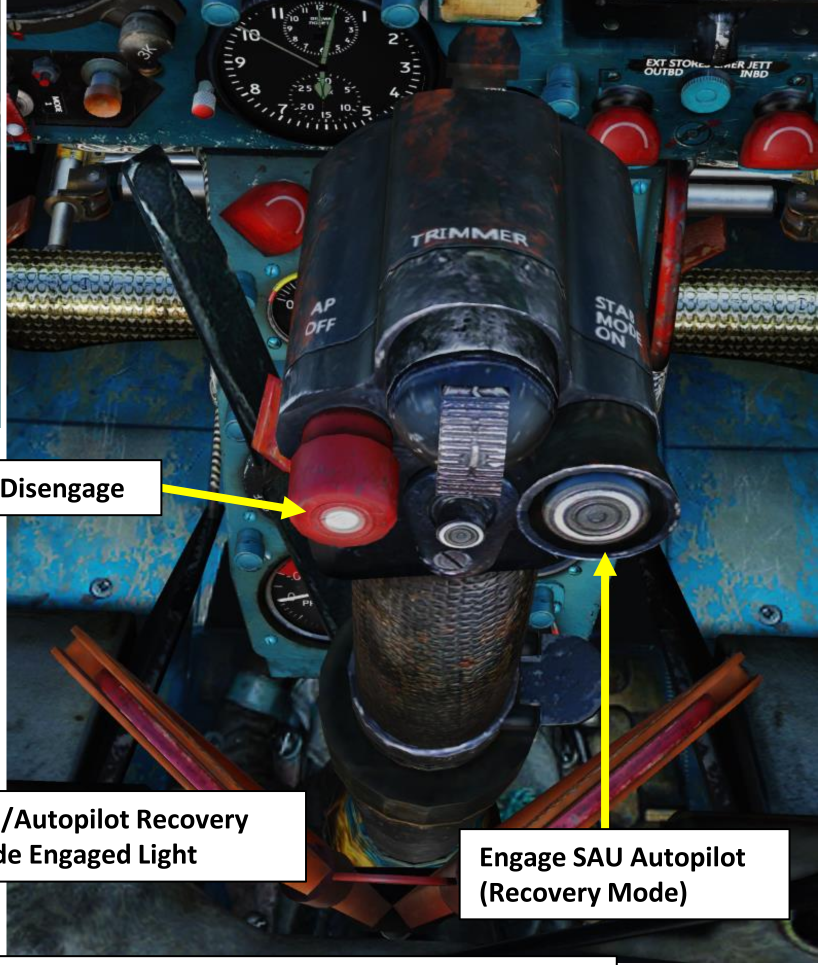
SAU-23ESN Autopilot Overview

You will hear people refer to the auto-pilot in the MiG-21 as either the SAU, the AFCS (Automatic Flight Control System) or the AP (Auto-pilot). There are 5 autopilot modes:

- Stabilization Mode
- Recovery Mode
- Low Altitude Recovery Mode
- Directional Landing Mode
- Automatic Landing Mode

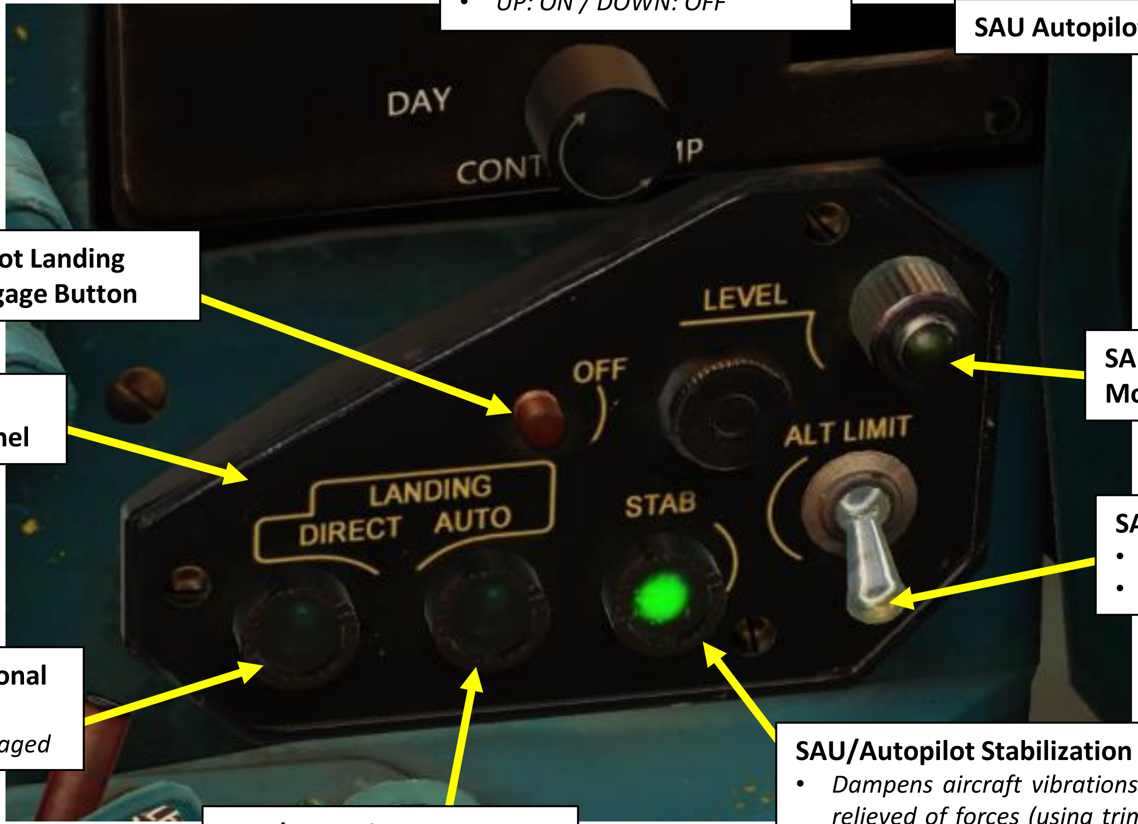
Autopilot Power Switch
- *UP: ON / DOWN: OFF*

Autopilot Pitch Power Switch
- *UP: ON / DOWN: OFF*



SAU Autopilot Disengage

Engage SAU Autopilot (Recovery Mode)



SAU/Autopilot Landing Mode Disengage Button

SAU/AFCS (Automatic Flight Controls System) Autopilot Panel

SAU/Autopilot Recovery Mode Engaged Light

SAU/Autopilot Low Altitude Limit Mode Switch
- *UP: engages Low Altitude SAU recovery mode*
- *DOWN: disengages Low Altitude SAU recovery mode*

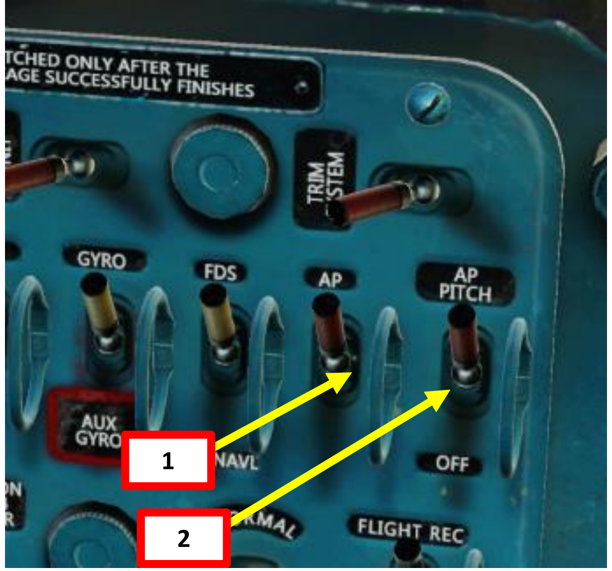
SAU/Autopilot Directional Landing Mode Button
- *Illuminated when engaged*

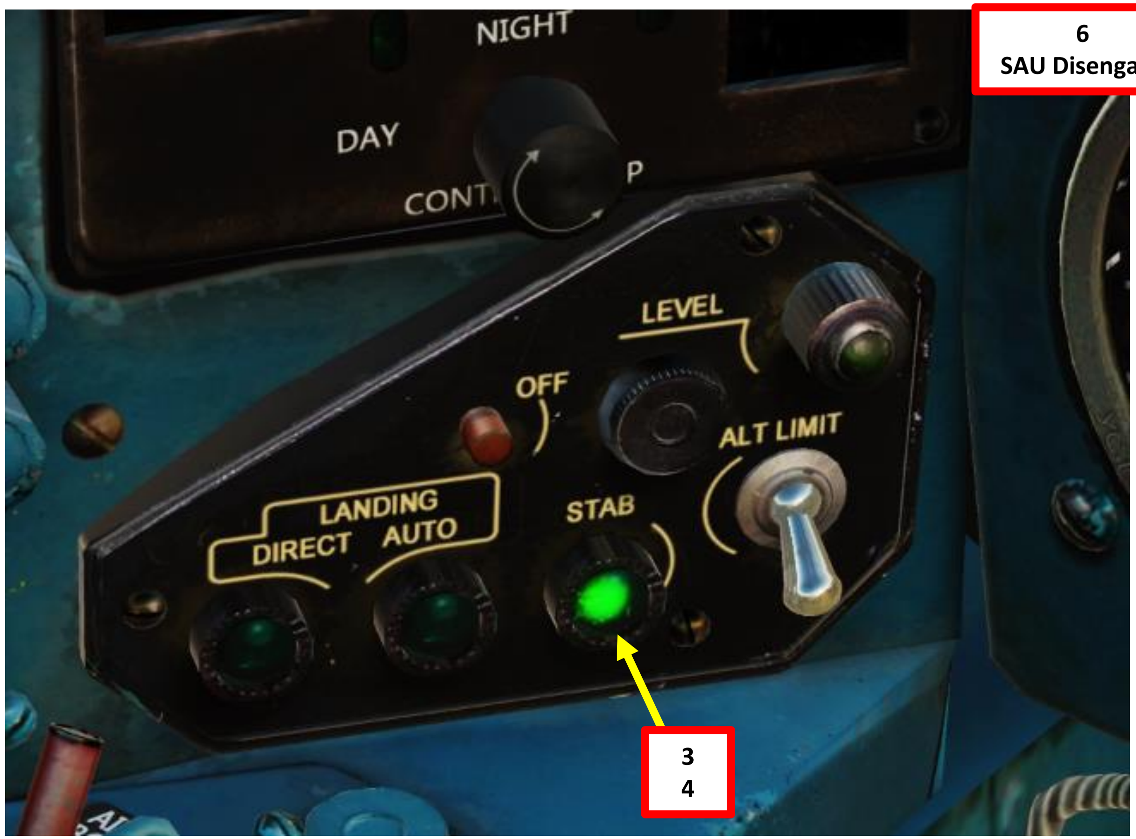
SAU/Autopilot Automatic Landing Mode Button
- *Illuminated when engaged*

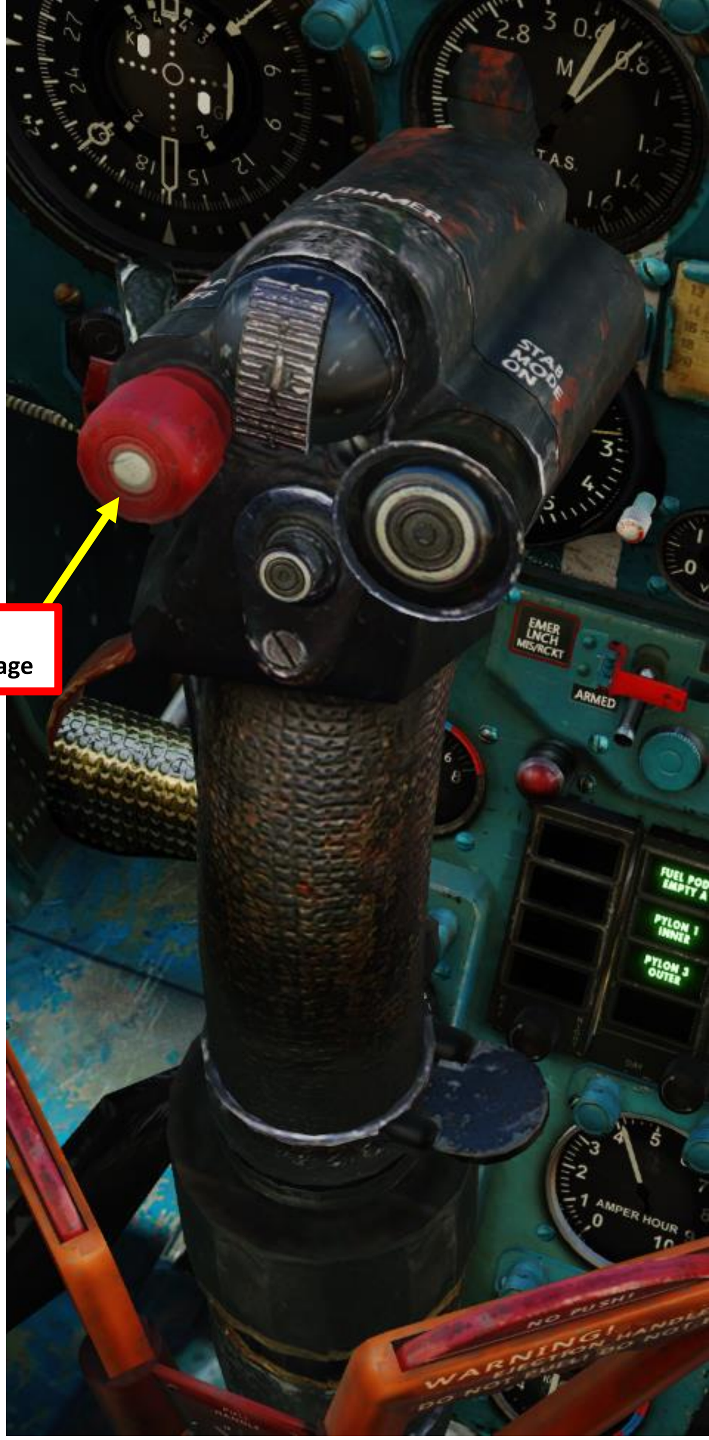
SAU/Autopilot Stabilization Mode Button
- *Dampens aircraft vibrations and stabilizes current aircraft position if stick is relieved of forces (using trimmer) and not held. This is done by filtering stick inputs. Additionally, the SAU will try to stabilize your heading and pitch (if your bank is small, lesser than ~10 deg) or your bank and pitch (if your current bank is > ~10 deg).*
- *Illuminated when engaged*

SAU-23ESN Autopilot Stabilization Mode

1. Set Autopilot Power Switch – ON (UP)
2. Set Autopilot Pitch Power Switch – ON (UP)
3. Press the "SAU/Autopilot Stabilization Mode" Button to engage Stabilization mode.
4. The "STAB" Light illuminates as the mode is engaged.
5. Stabilization mode dampens aircraft vibrations and stabilizes current aircraft position if stick is relieved of forces (using trimmer) and not held. This is done by filtering stick inputs. Additionally, the SAU will try to stabilize your heading and pitch (if your bank is small, lesser than 10 deg) or your bank and pitch (if your current bank is greater than 10 deg).
   - Very important: Stabilization Mode should be **disengaged prior to takeoff**.
6. To disengage Stabilization Mode, press the "SAU Disengage" button on the stick ("LALT+LCTRL+A" binding).

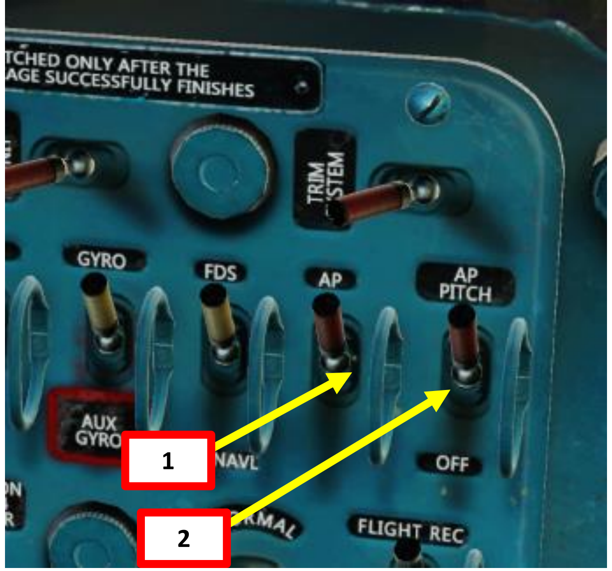


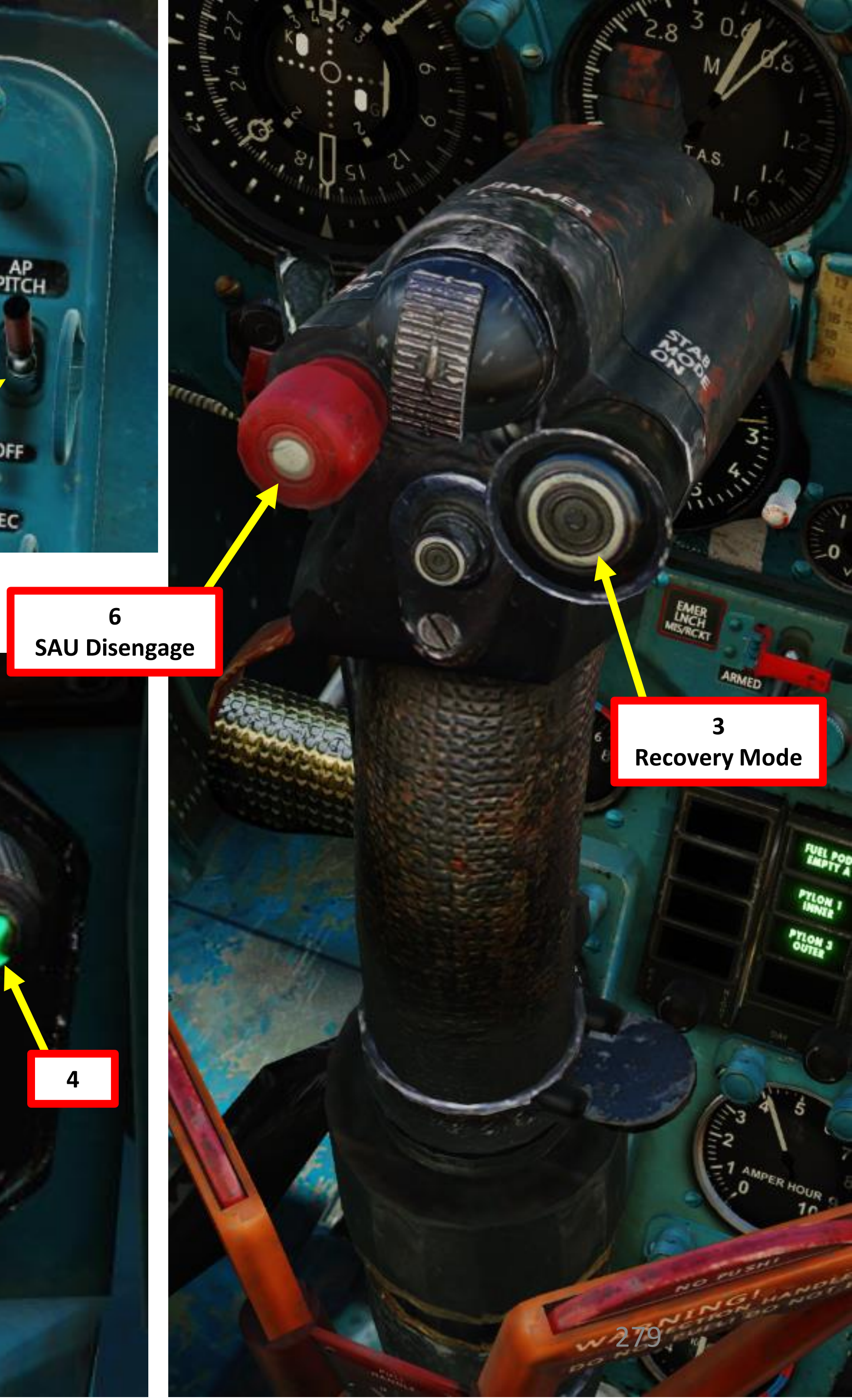




SAU-23ESN Autopilot Recovery Mode

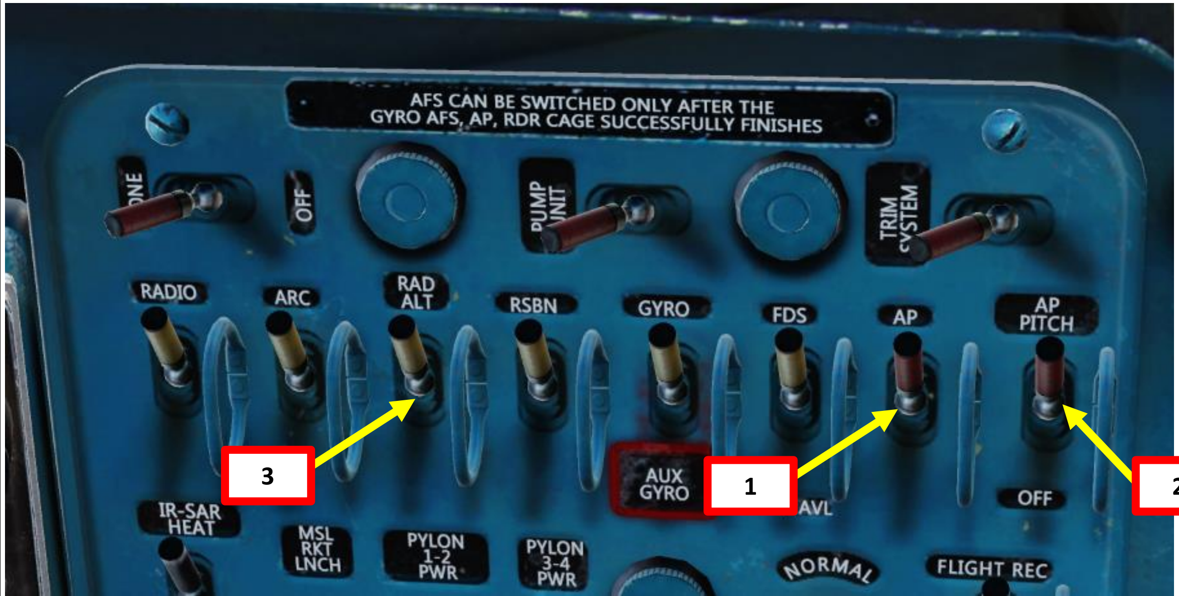
1. Set Autopilot Power Switch – ON (UP)
2. Set Autopilot Pitch Power Switch – ON (UP)
3. Verify that adequate engine power is set to maintain airspeed above 500 km/h, then press the "SAU Recovery" button on the stick ("A" binding) to engage Recovery Mode.
4. The "SAU/Autopilot Recovery Mode Engaged" Light illuminates as the mode is engaged.
5. Recovery mode will try to recover the aircraft from any attitude to level flight. Note that recovery is not always possible. This isn't meant to be used as an "altitude hold" mode, but more as a "hands free" mode to keep the aircraft flyable while you perform certain tasks in cockpit.
6. To disengage Recovery Mode, press the "SAU Disengage" button on the stick ("LALT+LCTRL+A" binding).

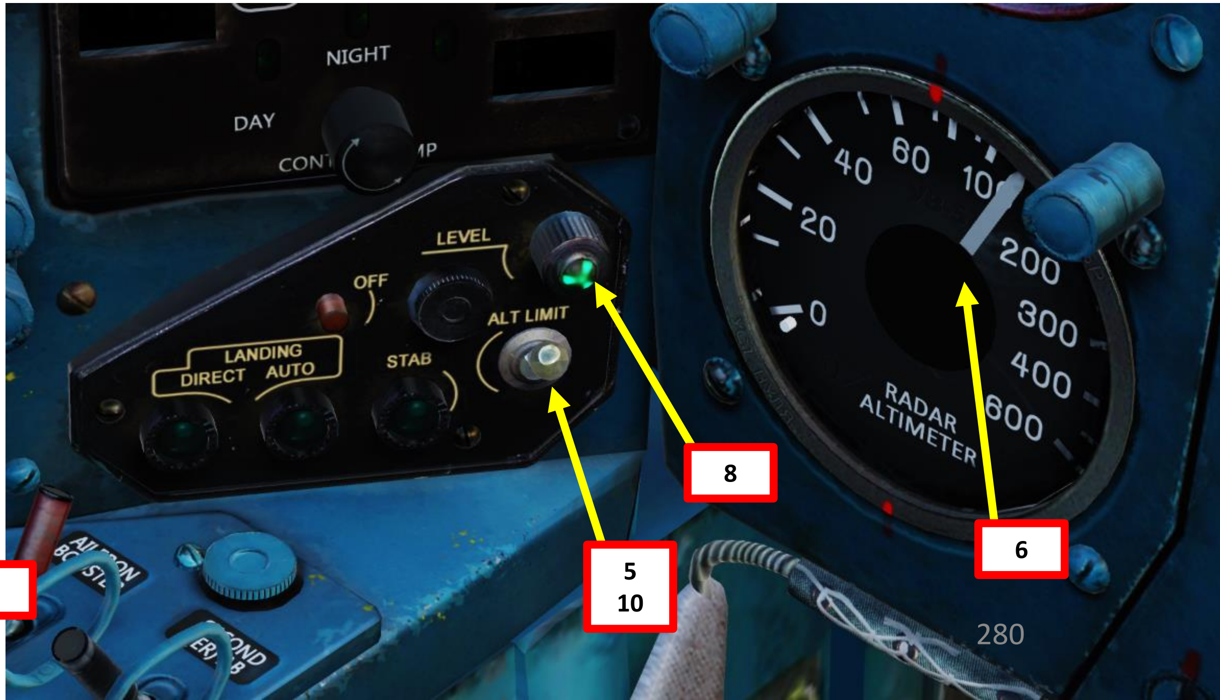




SAU-23ESN Autopilot
Low Altitude Recovery Mode

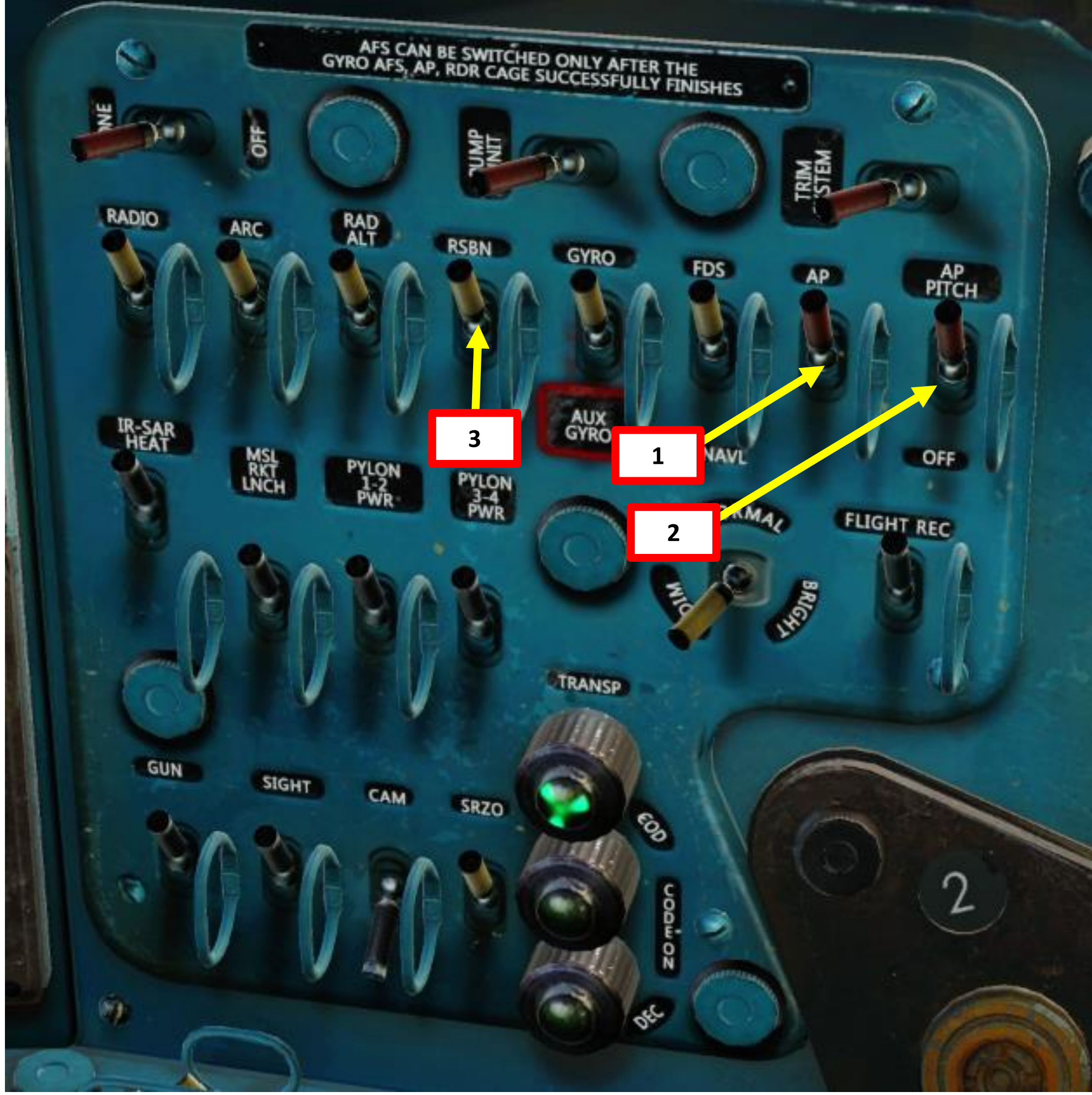
1. Set Autopilot Power Switch – ON (UP)
2. Set Autopilot Pitch Power Switch – ON (UP)
3. Set Radar Altimeter Power Switch – ON (UP)
4. Select LOW ALTITUDE setting (in meters) to use as a reference. We will set 150 meters.
5. Verify that adequate engine power is set to maintain airspeed above 500 km/h, then set SAU/Autopilot Low Altitude Limit Mode Switch – ON (UP)
6. When aircraft flies at or below the LOW ALTITUDE reference selected, an aural warning tone is triggered and the DANGER ALT light illuminates.
7. When aircraft is below the LOW ALTITUDE reference and the landing gear is retracted, the Low Altitude Recovery Mode automatically engages.
   - The system will not operate correctly if the aircraft bank or pitch angle is more than +/- 20 deg since it will affect the radar altimeter readings.
8. The “SAU/Autopilot Recovery Mode Engaged” Light illuminates as the mode is engaged.
9. Low Altitude Recovery mode will try to recover the aircraft from any attitude to level flight. Note that the aircraft will keep pitching up until altitude is above the Reference LOW ALTITUDE setting. This setting is useful in conditions where you need to fly low to avoid SAM sites or in low visibility conditions at low altitudes.
10. To disengage Low Altitude Recovery Mode, set SAU/Autopilot Low Altitude Limit Mode Switch – OFF (DOWN).





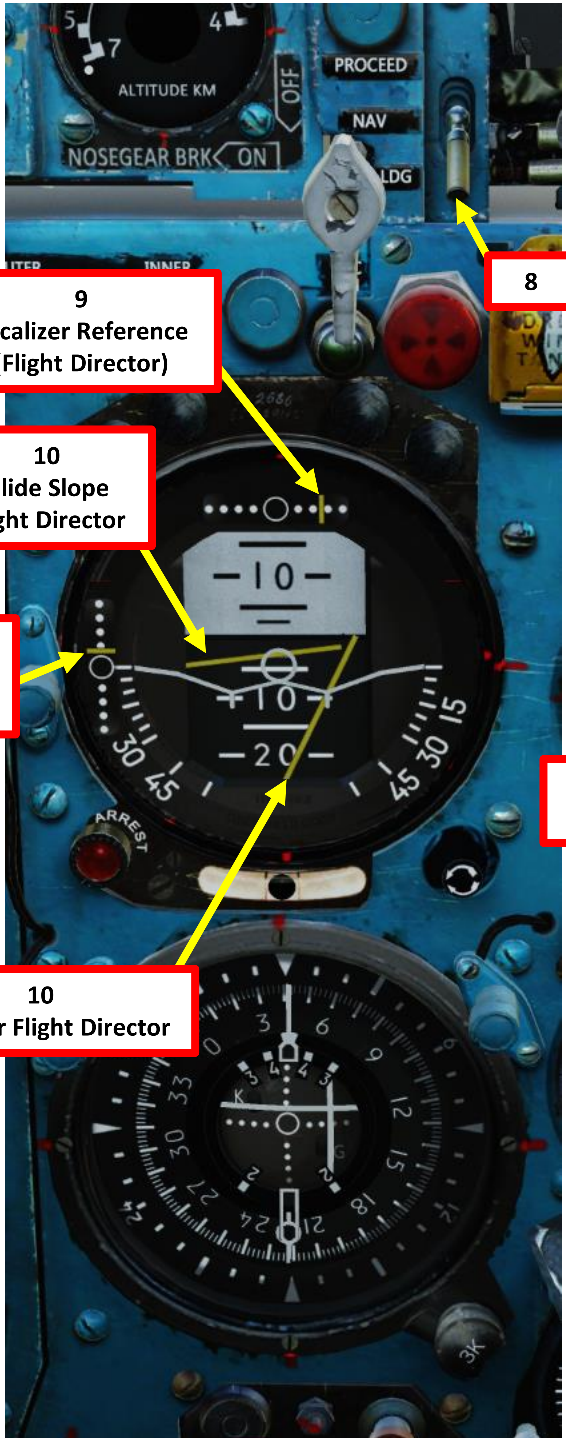
SAU-23ESN Autopilot Directional Landing Mode

1. Set Autopilot Power Switch – ON (UP)
2. Set Autopilot Pitch Power Switch – ON (UP)
3. Set RSBN Power Switch – ON (UP)
4. Set RSBN (Navigation) Channel – As required for desired airfield (i.e. RSBN Channel 2 for Krymsk)
5. Set PRMG (Landing) Channel – As required for desired airfield (i.e. PRMG Channel 2 for Krymsk)
6. Confirm that both RSBN and PRMG Signal lights illuminate; this means that the station signals are received.
7. Set RSBN/ARC Selector Switch – RSBN (UP). This will determines if NPP Course System needle points towards the selected RSBN or ARC station.



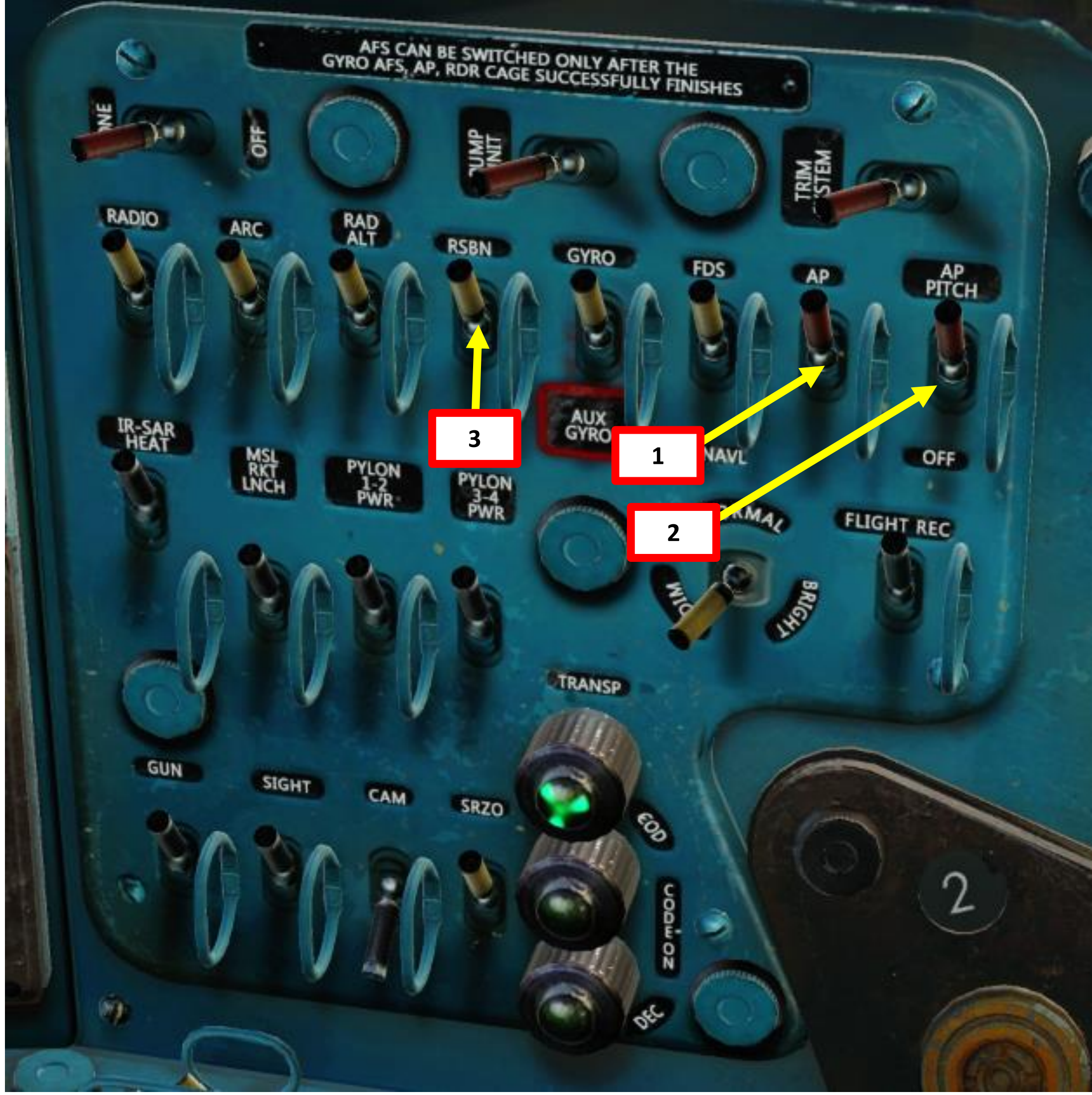
SAU-23ESN Autopilot Directional Landing Mode

8. When you are 20 km from the RSBN/PRMG station, set RSBN Mode Selector Switch – LANDING (DOWN)
9. Steer aircraft to capture localizer and glide slope
10. Press SAU/Autopilot Directional Landing Mode Button to engage Directional mode (DIRECT light illuminates when engaged). Steering cue bars for localizer (lateral axis) and glide slope (vertical axis) will appear on the KPP (Attitude Director Indicator). In this mode, **the autopilot does not control flight control surfaces and merely acts as a guidance system to help you fly the aircraft on the correct approach path. You can consider this mode as a "flight director"**.
11. To disengage Direct Landing Mode, press the "SAU Disengage" button on the stick ("LALT+LCTRL+A" binding).



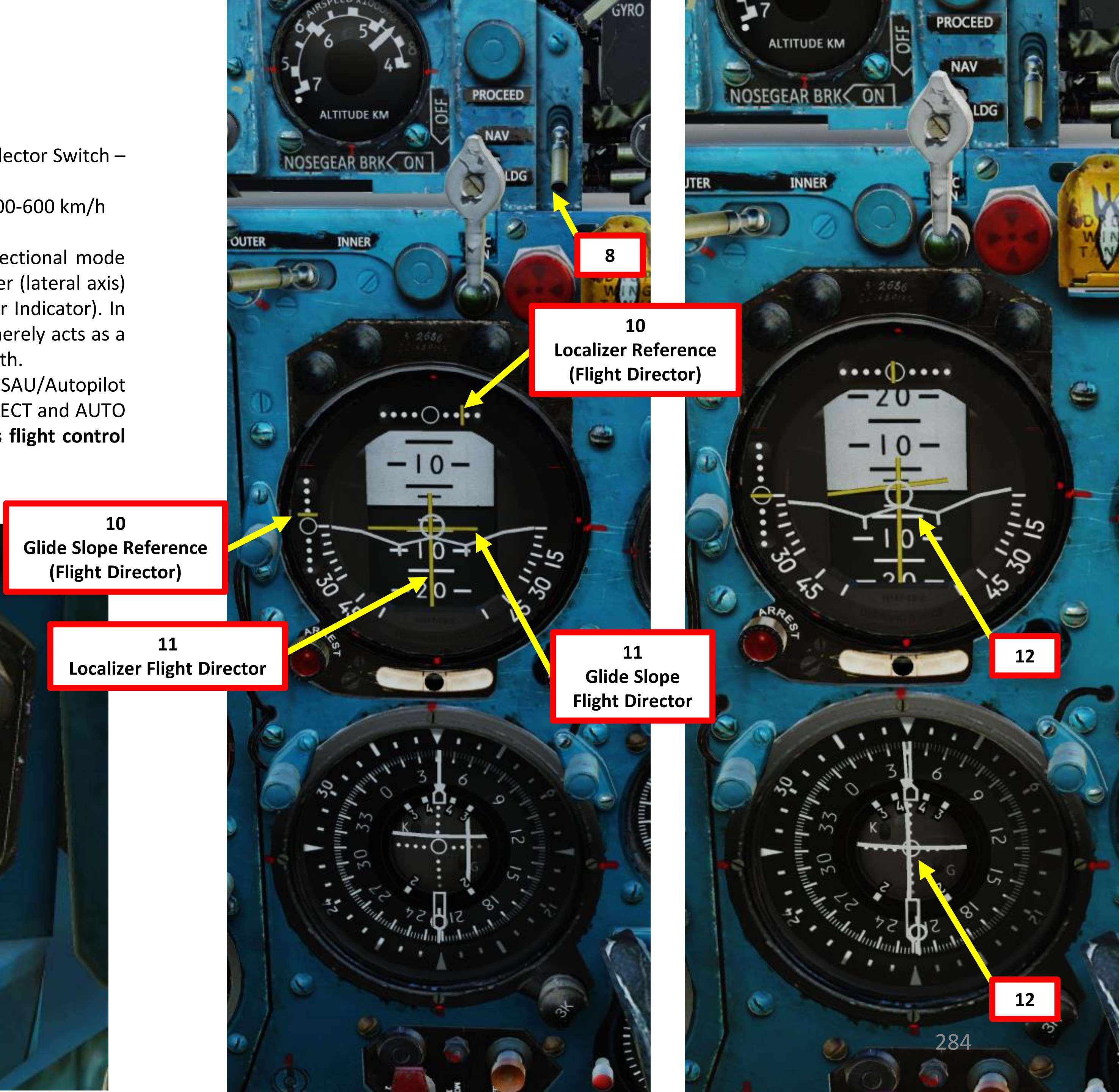
SAU-23ESN Autopilot Automatic Landing Mode

1. Set Autopilot Power Switch – ON (UP)
2. Set Autopilot Pitch Power Switch – ON (UP)
3. Set RSBN Power Switch – ON (UP)
4. Set RSBN (Navigation) Channel – As required for desired airfield (i.e. RSBN Channel 2 for Krymsk)
5. Set PRMG (Landing) Channel – As required for desired airfield (i.e. PRMG Channel 2 for Krymsk)
6. Confirm that both RSBN and PRMG Signal lights illuminate; this means that the station signals are received.
7. Set RSBN/ARC Selector Switch – RSBN (UP). This will determines if NPP Course System needle points towards the selected RSBN or ARC station.



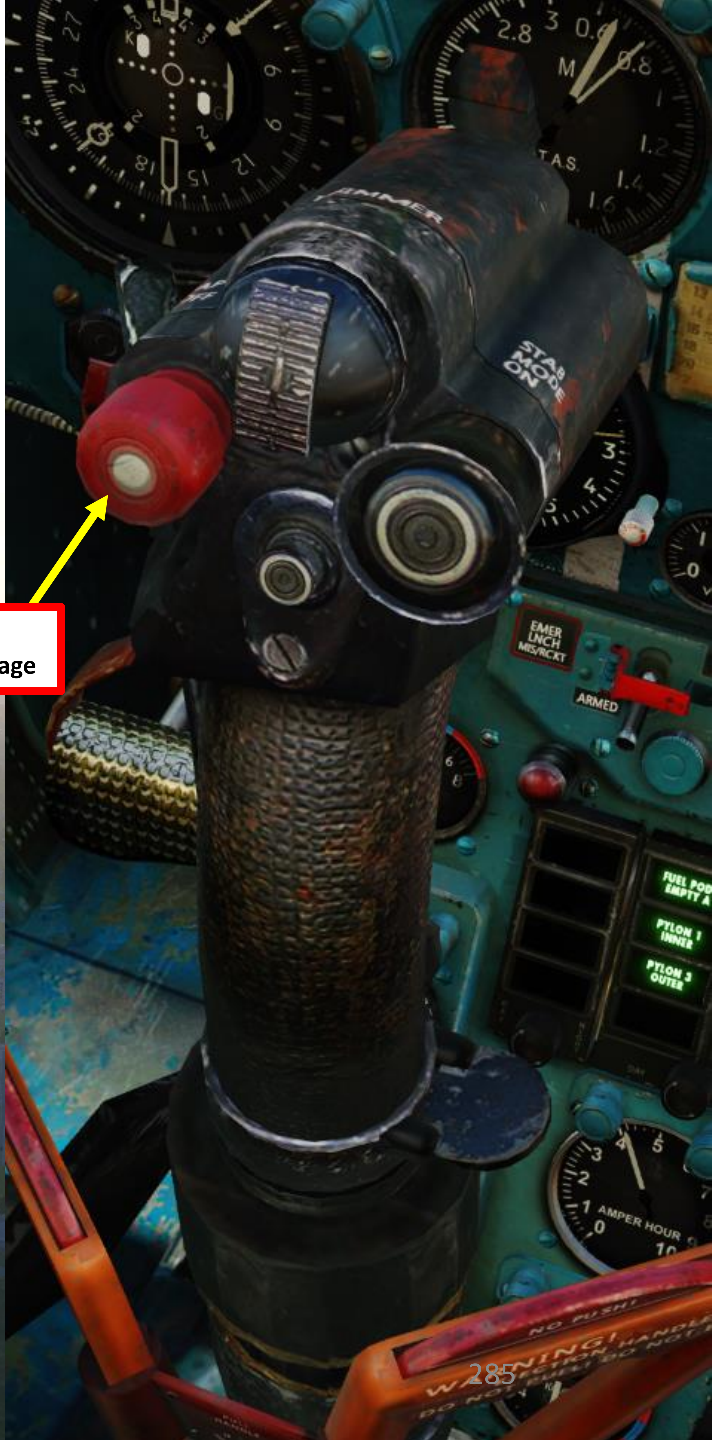
SAU-23ESN Autopilot Automatic Landing Mode

8. When you are 20 km from the RSBN/PRMG station, set RSBN Mode Selector Switch – LANDING (DOWN)
9. Verify that adequate engine power is set to maintain airspeed above 500-600 km/h
10. Steer aircraft to capture localizer and glide slope
11. Press SAU/Autopilot Directional Landing Mode Button to engage Directional mode (DIRECT light illuminates when engaged). Steering cue bars for localizer (lateral axis) and glide slope (vertical axis) will appear on the KPP (Attitude Director Indicator). In this mode, the autopilot does not control flight control surfaces and merely acts as a guidance system to help you fly the aircraft on the correct approach path.
12. When aircraft has captured the localizer and glide slope, press SAU/Autopilot Automatic Landing Mode Button to engage Automatic mode (both DIRECT and AUTO lights illuminate when engaged). In this mode, the **autopilot controls flight control surfaces and steers the aircraft on the correct approach path**.



SAU-23ESN Autopilot Automatic Landing Mode

13. Make sure to maintain throttle between 85 and 90 % N1; try to maintain airspeed above 500 km/h.
14. The Automatic Landing mode is used to perform the approach to the airport, but not to land the aircraft. This has to be done by you.
15. To disengage Automatic Landing Mode, press the "SAU Disengage" button on the stick ("LALT+LCTRL+A" binding).



SECTION SUMMARY

1 – Navigation Aids Introduction
1.1 - ARC, RSBN & PRMG

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.
- ILS (Instrument Landing System) allows an aircraft find their way to an airstrip (provided it is equipped with a VOR or NDB) despite bad visibility conditions.

- The ARC (Automated Radio Compass) is the russian equivalent of an ADF (automatic direction finder), which can help you track NDB stations.
- The RSBN (Short Range Radio Navigation System) is the russian equivalent of a VOR system.

- ARC stations are similar to NDBs and have a max range of approximately 120 km.
- RSBN stations are similar to VOR stations and have a max range of approximately 200 km.
- ARC and RSBN stations are complementary: you can use both of them to help you navigate. Simply put, you can use many different types of "lighthouses" (beacons and stations) to navigate through the sky.

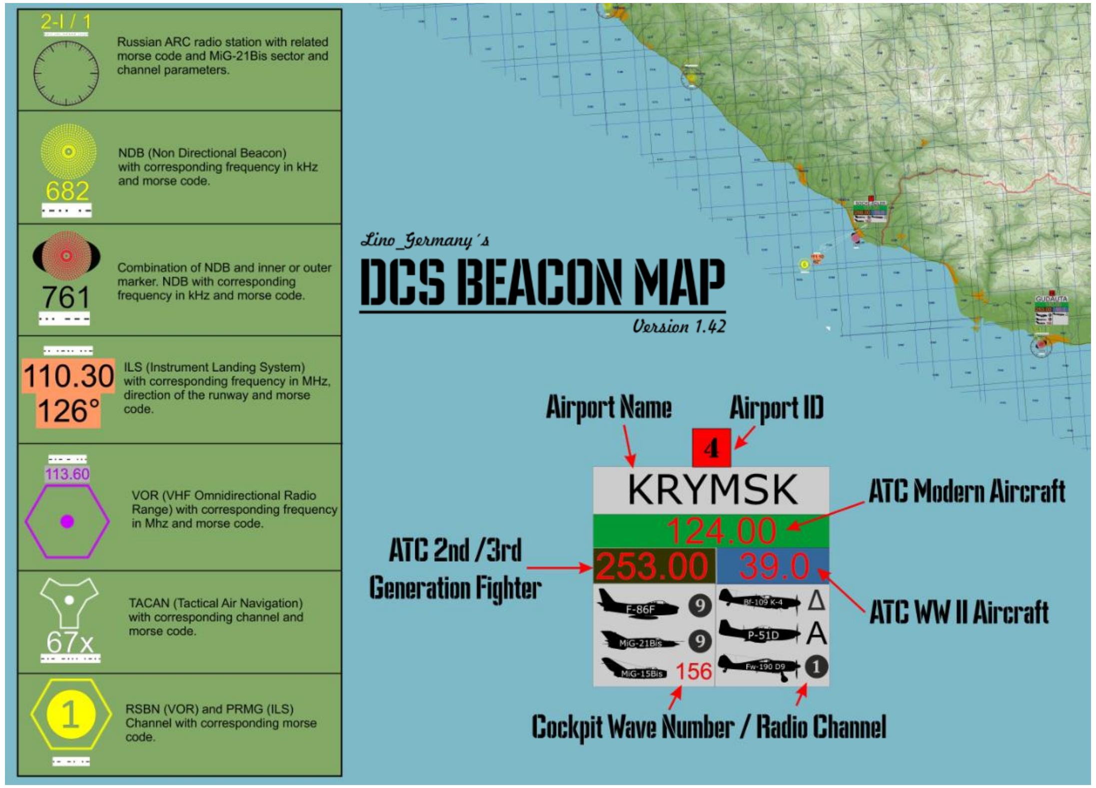
- The PRMG is the russian equivalent of a ILS (Instrument Landing System). It uses RSBN beacons to guide you to the airstrip when you need to land in bad weather or low visibility conditions like night missions.

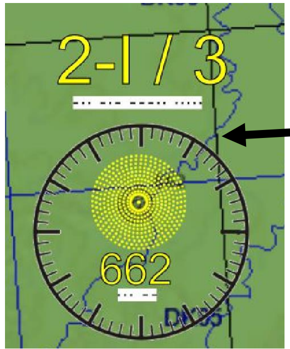
ARC (NDB) RANGE IN FUNCTION OF MINIMUM ALTITUDE						
Distance from station (km)	20	40	60	80	100	120
Minimum altitude (m)	350	700	1050	1400	1750	2100

RSBN (VOR) RANGE IN FUNCTION OF MINIMUM ALTITUDE						
Distance from station (km)	20	40	60	80	100	120
Minimum altitude (m)	350	700	1050	1400	1750	2100

1 – Navigation Aids Introduction
1.2 - Navigation Aid Database

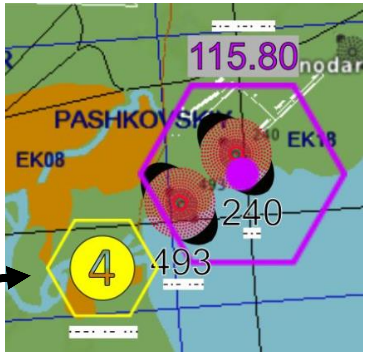
Lino_Germany created a **wonderful** HD map containing all ARC stations and RSBN stations scattered throughout the map. Use this to know the RSBN or ARC channels you need to use.
LINK: https://drive.google.com/open?id=0B-uSpZROuEd3LVRDS3hyaElkUEk





ARC Station (NDB)

RSBN Station (VOR)



RADIO	RSBN	AIRPORT / RUNWAY HDG	RSBN MORSE CODE
0		MAIN CHANNEL	.- -. .-
1		AUX	-... .- -
2	1	ANAPA-VITYAZEVO / 42	-... . ...
3	16	BATUMI / 126	
4	10	BESLAN / 94	
5		GELENDZIK	-.- --- -...
6		GUDAUTA-BOMBORA	-.- ... -..
7	15	KOBULETI / 70	.-- .- ...
8	3	KRASNODAR-CENTER / 87	-.- ... -..
	4	KRASNODAR-PASHKOVSKIY / 47	.-- .- ...
9	2	KRYMSK / 40	-.- .-. ..
10	13	KUTAISI-KOPITNARI / 74	-.- ..- -
11	5	MAYKOP-KHANSKAYA / 39	-- .- -.--
12	7	MINERANYE VODY / 115	-- .. -.
13	9	MOZDOK / 83	-- ---- --..
14	8	NALCHIK / 56	-. .- .-..
15		NOVOROSSIYSK	
16	14	SENAKI-KOLKHI / 95	... . -.-
17	6	SOCHI-ADLER / 62	.- -.. .-..
18		SUKHUMI-BABUSHARA	
19	12	TBILISI-LOCHINI / 128	- .-.. ---
	11	TBILISI-VAZIANI / 135	- ...- .-

1 – Navigation Aids Introduction
1.2 - Navigation Aid Database

You can access navigation aid data from the kneeboard:
- Use RCTRL+UP to toggle kneeboard
- Use RCTRL+LEFT or RCTRL+RIGHT to cycle through kneeboard pages

RSBN CAUCASUS

rev: Mar. 2017

nrb	NAME	ALTITUDE [m]	RWY	RWY length [m]	MORSE	
1	ANAPA	45	42	2900	.- -. .-	ANA_
2	KRIMSK	20	40	2600	-.- .-. ..	KRI_
3	KRASNODAR	30	87	2500	-.- ... -..	KSD_
4	PASHKOVSKIY	30	87	2500	-.- ... -..	PAS_
5	MAYKOP	180	39	3200	-- .- -.--	MAY_
6	ADLER	30	62	3100	.- -.. .-..	ADL_
7	MINERALNYE VODY	320	115	4000	-- .. -.	MIN_
8	NALCHIK	430	56	2300	-. .- .-..	NAL_
9	MOZDOK	155	83	3500	-- --- --..	MOZ_
10	BESLAN	540	94	3100	-...	BES_
11	TBILISI VAZIANI	455	135	2500	- ...- .-	TVA_
12	TBILISI LOCHINI	470	128	3000	- .-.. ---	TLO_
13	KUTAISI	45	74	2500	-.- ..- -	KUT_
14	SENAKI KOLKHI	13	95	2400	... . -.-	SEK_
15	KOBULETI	18	70	2400	-.- --- -...	KOB_
16	BATUMI	10	126	2450	-... .- -	BAT_
17						
18						
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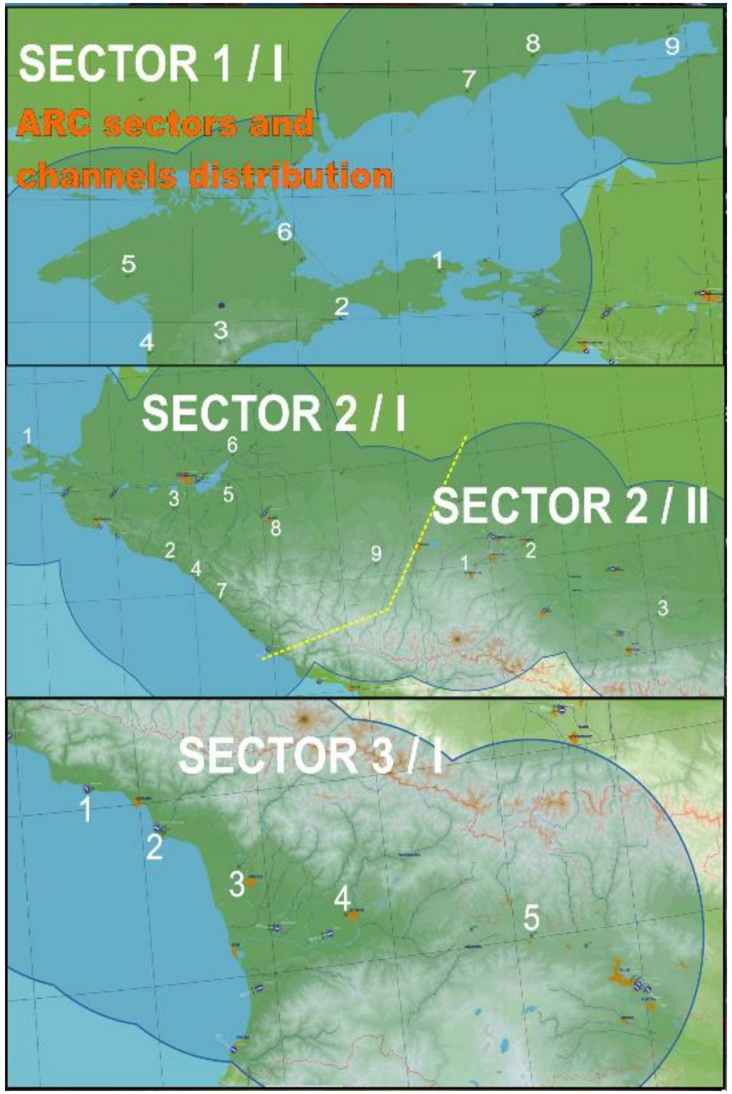
32						



RSBN PERSIAN GULF

rev: May 2020

nrb	NAME	ALTITUDE [m]	RWY	RWY length [m]	MORSE	
1	Al Dhafra L	16	128 L	3700	.- -.. .-..	ADL_
2	Al Dhafra R	16	128 R	3700	.- -.. .-.	ADR_
3	Al Maktoum Intl	38	122	4500	.- -- ..	AMI_
4	Al Minhab	55	090	4000	.- -- -.	AMN_
5	Dubai Intl L	5	122 L	4000	-.. .. .-..	DIL_
6	Dubai Intl R	5	122 R	4000	-.. .. .-.	DIR_
7	Sharjah Intl	30	122	3500	... .	SHI_
8	Khasab	22	014	2500	-.- ... -...	GLR_
9	Fujairah Intl	32	113	3000	..-. .--- ..	FJI_
10	Sirri	4	127	2700	... .. .-.	SIR_
11	Abu Musa	5	084	2500	.- -- .-	AMA_
12	Tunb	13	028	2000	- -. -...	TNB_
13	Bandar Lengeh	23	082	2500	-... .-.. --.	BLG_
14	Qeshm	5	050	4200	--.- ... --	QSM_
15	Havadarya	9	080	3000	....- -..	HVD_
16	Bandar Abbas Intl L	5	030 L	3400	-... .- .. .-..	BAIL_
17	Bandar Abbas Intl R	5	030 R	3600	-... .- .. .-.	BAIR_
18	Lar	803	090	3000	.-.. .- .-.	LAR_
19	Liwa	125	132	3600	.-.. .. .--	LIW_
20	Al Ain Intl	253	008	3900	.- .- ..	AAI_
21	Ras Al Khaimah	27	165	3800	.-. .- -.-	RAK_
22	Lavan Island	28	112	2700	.-.. .- ..	LAI_
23	Kish Intl L	40	096 L	3600	-.- .. .-..	KIL_
24	Kish Intl R	40	096 R	3600	-.- .. .-.	KIR_
25	Shiraz Intl L	1490	117 L	4300	... .. .-..	SIL_
26	Shiraz Intl R	1490	117 R	4300	... .. .-.	SIR_
27	Jiroft	815	128	3000	... .. .-.	JIR_
28	Kerman	1756	158	3800	-.- . .-.	KER_

ARK DATA — Sector 1 I — channels 1 - 9

1	-.. ---	DO_
2	... .. .-.	SIR_
3	.- -... --	ABM_
4	.-.. . -.	LEN_
5	-... -. -..	BND_
6	--- .. ... .-..	OISL_

1 – Navigation Aids Introduction
1.2 - Navigation Aid Database

You can access navigation aid data from the kneeboard:

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- Use RCTRL+LEFT or RCTRL+RIGHT to cycle through kneeboard pages

ARC SYRIA

	TURKEY ARK DATA	Sector 1 II	channels 1 - 4		
1	Hatay			.... - -.--	HTY_
2	CA69			-.-. .- -.... ----.	CA69_
3	Kahramanmaras			-.- -- --	KMM_
4	Adana Sakirpasa			.- -.. -.	ADN_
	SYRIA ARK DATA	Sector 2 I	channels 1 - 9		
1	Mezzeh			-- . --..	MEZ_
2	Damascus L			.- -... -..	ABD_
3	Damascus R			-.. .- .-..	DAL_
4	Kariatain			-.- - -.	KTN_
5	Palmyra Outer			.--. .-.. .-.	PLR_
6	Palmyra Inner			.--. .- .-..	PAL_
7	Bassel Al. Assad			.-.. - -.-	LTK_
8	Aleppo Inner			.- .-.. .	ALE_
9	Aleppo Outer			-- . .-.	MER_
	ISRAEL ARK DATA	Sector 2 II	channel 1		
1	Ramat David			.-. -- -..	RMD_
	LEBANON ARK DATA	Sector 2 II	channels 2 - 3		
2	Beirut-Rafic Hariri			-... --- -..	BOD_
3	Rene Mouawad			.-. .-	RA_

RSBN SYRIA

nrb	NAME	ALTITUDE [m]	RWY	RWY length [m]	MORSE	
1	Megiddo	55	93	2000	-- --. -..	MGD_
2	Ramat David L	34	11	2400	.-. -.. .-..	RDL_
3	Ramat David C	36	09	2400	.-. -.. -.-.	RDC_
4	Ramat David R	40	15	2400	.-. -.. .-.	RDR_
5	Haifa	6	16	1100	....-.	HIF_
6	King Hussein Air College	672	13	3000	-.- .... .-	KHA_
7	H4	693	103	2500	.... -....- ....-	H-4_
8	Tha'lah	738	58	3000	- .... .-	THA_
9	Rosh Pina	270	152	1000	.-. ... .--.	RSP_
10	Kiryat Shmona	100	03	1150	-.-	KSH_
11	Khalkhalah	724	76	3000	-.- .-.. -.-	KLK_
12	Marj Ruhayyil	659	64	3000	-- .-.	MRH_
13	Damascus L	612	05	3600	-.. -- .-..	DML_
14	Damascus R	612	23 R	3600	-.. -- .-.	DMR_
15	Mezzeh	720	060	2700	-- --..	MZH_
16	Al-Dumayr	630	66	3000	.- -.. .-.	ADR_
17	An Nasiriyah	834	45	2700	.- -. -.--	ANY_
18	Sayqual	698	61	2450	... -.-- --.-	SYQ_
19	Rayak	908	04	2900	.-. -.-- -.-	RYK_
20	Beirut-Rafic Hariri L	12	03	2200	-... .-. .-..	BRL_
21	Beirut-Rafic Hariri C	12	16	3000	-... .-. -.-.	BRC_
22	Beirut-Rafic Hariri R	12	17	2400	-... .-. .-.	BRR_
23	Wujah Al Hajar	198	02	1500	.-- .-	WAH_
24	Rene Mouawad	5	06	2800	.-. -- -..	RMD_
25	Al Qusayr	527	28	2900	.- --.- .-.	AQR_
26	Shayrat	809	112	3000	... -.-- -	SYT_
27	Tiyas	553	90	3000	- .. -.--	TIY_
28	Palmyra	393	85	2900	.--. .-.. .-.	PLR_
29	Hama	300	280	2600	.... .- --	HAM_
30	Bassel Al-Assad	28	17 R	2800	-... .- .-	BAA_
31	Abu al-Duhur	250	274	2800	.- .- -..	AAD_
32	Tabqa	325	273	2800	- -... --.-	TBQ_
33	Jirah	353	101	3000	.--- .-.	JRH_
34	Kuweires	366	101	2400	-.- .-- .-.	KWR_
35	Aleppo	382	09	2900	.- .--. .--.	APP_
36	Hatay	77	04	3000	.... - -.--	HTY_
37	Minakh	492	102	1400	-- -. -.-	MNK_
38	Gaziantep	686	106	2860	--. --.. -	GZT_
39	Incirlik	58	05	3000	.. -.-. .-.	ICR_
40	Adana Sakirpasa	17	05	2800	.- ... .--.	ASP_

1 – Navigation Aids Introduction
1.2 - Navigation Aid Database

You can access navigation aid data from the kneeboard:
- Use RCTRL+UP to toggle kneeboard
- Use RCTRL+LEFT or RCTRL+RIGHT to cycle through kneeboard pages

RSBN NEVADA

rev: Mar. 2017

nrb	NAME	ALTITUDE [m]	RWY	RWY length [m]	MORSE	
1	MINA	2342			-- ...- .-	MVA_
2	COALDALE	1463			--- .- .-..	OAL_
3	TONOPAH	1629			- .--.	TPH_
4	WILLSON CREEK	2778			.. .-.. -.-.	ILC_
5	MILLFORD	1690			-- .-.. ..-.	MLF_
6	BISHOP	1254			-...	BIH_
7	TONOPAH TRAINING RANGE	1689	337	3600	- --.- --.-	TQQ_
8	GROOM LAKE 336R	1361	156--L	3600	--. .-.. .-.	GLR_
9	GROOM LAKE 336L	1361	156	3600	--. .-.. .-..	GLL_
10	ST. GEORGE	875			..- - ..	UTI_
11	CEDAR CITY	1665			-.-. -.. -.-.	CDC_
12	BRYCE CANYON	2711			-... -.-. .	BCE_
13	BEATTY	890			-... - -.--	BTY_
14	CREECH 092	953	92	2700	-.-. .-. .	CRE_
15	CREECH 145	953	145	1600	-.-. .-. -.-.	CRC_
16	INDIAN SPRINGS	953			.. -. ...	INS_
17	NORTH LAS VEGAS	681	123	1161	.... .-- --.	HWG
18	NELLIS 220 L	562	220	3000	-. . .-..	NEL_
19	NELLIS 220 R	564	220	3000	-. . .-.	NER_
20	GOFFS	1225			--. ..-. ...	GFS_
21	McCARRAN INT. 269 L	639	89	3000	-- .. .-..	MIL_
22	McCARRAN INT. 269 R	639	89	3000	-- .. .-.	MIR_
23	McCARRAN INT. 024 L	657	24	3000	-- -.-. .-..	MCL_
24	McCARRAN INT. 024 R	658	24	3000	-- -.-. .-.	MCR_
25	MORMON MESA	641			-- -- --	MMM_
26	BOULDER CITY	1084			-... .-.. -..	BLD_
27	KINGMAN	1039			.. --. --	IGM_
28	PEACH SPRINGS	1449			.--. --. ...	PGS_
29	GRAND CANYON	2024			--. -.-. -.	GCN_
30	DAGGETT	538			-.. .- --.	DAG_
31	HECTOR	565			.... . -.-.	HEC_
32	NEEDLES	198			. . -..	EED_

RSBN NORMANDY

rev: May 2017

nrb	NAME	ALTITUDE [m]	RWY	RWY length [m]	MORSE	
1	CHAILEY	41	55	1800	-.-. .... .-	CHA_
2	FORD	9	37	1500	..-. --- .-.	FOR_
3	TANGMERE	15	110	1600	- .- -.	TAN_
4	FUNTINGTON	50	72	1800	..-. ..- -.	FUN_
5	NEEDS OAR POINT	9	49	1800	-. --- .--.	NOP_
6	CARPIQUET	57	123	1600	-.-. .- .-.	CAR_
7	BENY-SUR-MER	61	172	1300	-... ... --	BSM_
8	SAINTE-CROIX-SUR-MER	49	90	1400	... -.-. ... --	SCSM_
9	LANTHEUL	53	60	1300	.-.. .- -.	LAN_
10	RUCQUEVILLE	59	90	1400	.-. ..- -.-.	RUC_
11	BAZENVILLE	61	53	1700	-... .- --..	BAZ_
12	SOMMERVIEU	57	86	1400	... --- --	SOM_
13	LONGUES-SUR-MER	69	121	1300	.-.. ... --	LSM_
14	LIGNEROLLES	123	110	1500	.-.. .. --.	LIG_
15	LE MOLAY	32	41	1400	.-.. . --	LEM_
16	CHIPPELLE	38	60	1500	-.-.	CHI_
17	DEUX JUMEAUX	38	105	1500	-.. . .---	DEJ_
18	SAINT PIERRE DU MONT	31	92	1500	... .--. -.. --	SPDM_
19	CHRICQUEVILLE-EN-BESSEIN	25	173	1500	-.-. . -...	CEB_
20	CARDONVILLE	31	154	1500	-.-. .- -..	CAD_
21	BRUCHEVILLE	14	66	1500	-... .-. ..-	BRU_
22	MEAUTIS	25	80	1400	-- . .-	MEA_
23	LESSAY	20	304	1800	.-..	LES_
24	CRETTEVILLE	29	310	1500	-.-. .-. .	CRE_
25	BEUZEVILLE	35	229	1400	-... . ..-	BEU_
26	PICAUVILLE	22	290	1400	.--. .. -.-.	PIC_
27	BINIVILLE	32	320	1000	-... .. -.	BIN_
28	AZEVILLE	23	70	1100	.- --.. .	AZE_
29	MAUPERTUS	134	101	1500	-- .- ..-	MAU_
30	EVREUX	129	164	1600	. ...- .-.	EVR_
31						
32						

RSBN CHANNEL

nrb	NAME	ALTITUDE [m]	RWY	RWY length [m]	MORSE	
1	MANSTON	55	102	2700	-- .- -.	MAN_
2	HIGH HALDEN	37	31	1300	....-..	HHL_
3	DETLING	195	45	1000	-.. . -	DET_
4						
5						
6	MERVILLE CALONNE	21	38	2900	-- -.-. .-	MCA_
7	ABBEVILLE DRUCAT	61	90	1500	.- -.. ..-	ADU_

	ARK DATA		Sector 1 I	channels 1 - 9		
1	Lympne airfield	UK			.-.. -.-- .-	LYA_
2						
3						
4						
5	Dunkirk airfield	FRN			-.. -.- .-	DKA_
6	Saint Omer Long. airfield	FRN			... --- .-..	SOL_

2 – Magnetic Deviation

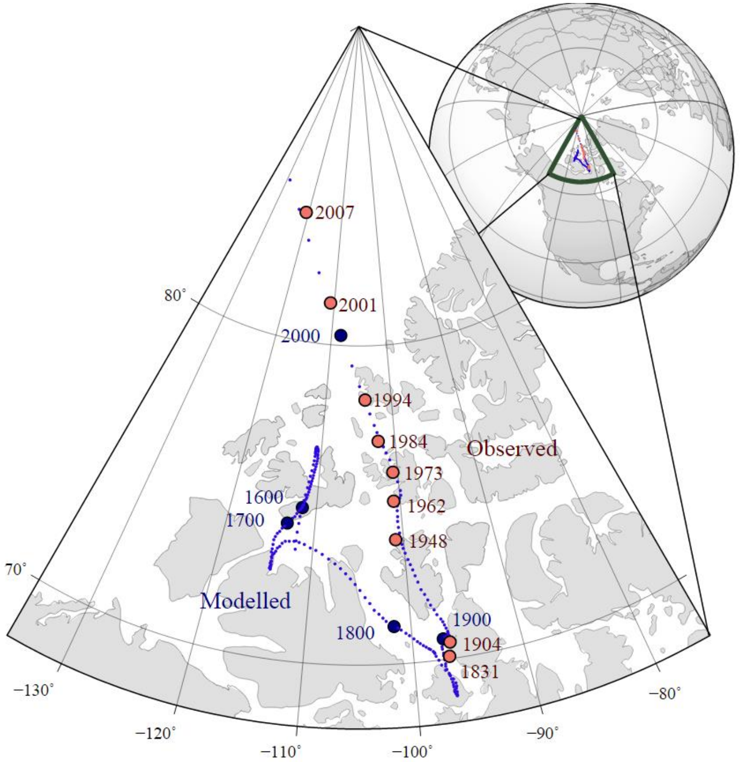
The direction in which a compass needle points is known as magnetic north. In general, this is not exactly the direction of the North Magnetic Pole (or of any other consistent location). Instead, the compass aligns itself to the local geomagnetic field, which varies in a complex manner over the Earth's surface, as well as over time. The local angular difference between magnetic north and true north is called the magnetic declination. Most **map coordinate** systems are based on **true north**, and magnetic declination is often shown on map legends so that the direction of true north can be determined from north as indicated by a compass. This is the reason why in DCS, the course to a runway needs to be "adjusted" to take into account this magnetic declination of the magnetic North pole (which is actually modelled in the sim, which is pretty neat).

True Heading = Magnetic Heading + Magnetic Deviation

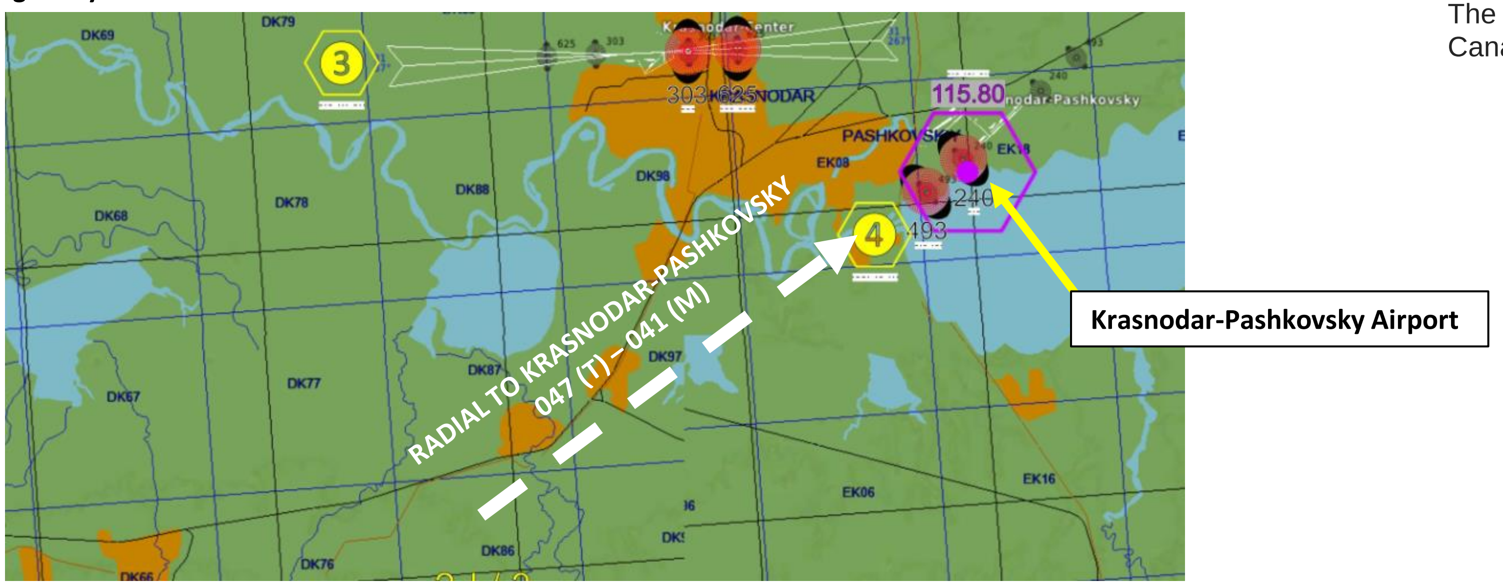
As an example, if the runway heading that you read on the F10 map in Krasnodar-Pashkovsky is 047 (True Heading), then the input to your magnetic compass course should be 047 subtracted with the Magnetic Deviation (+6 degrees), or 041. You would need to enter a course of 041 (M) on the NPP Course Indicator.

Magnetic Declination:

- **+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**
- **+5.2 deg for Syria**



The movement of Earth's north magnetic pole across the Canadian arctic, 1831–2007.

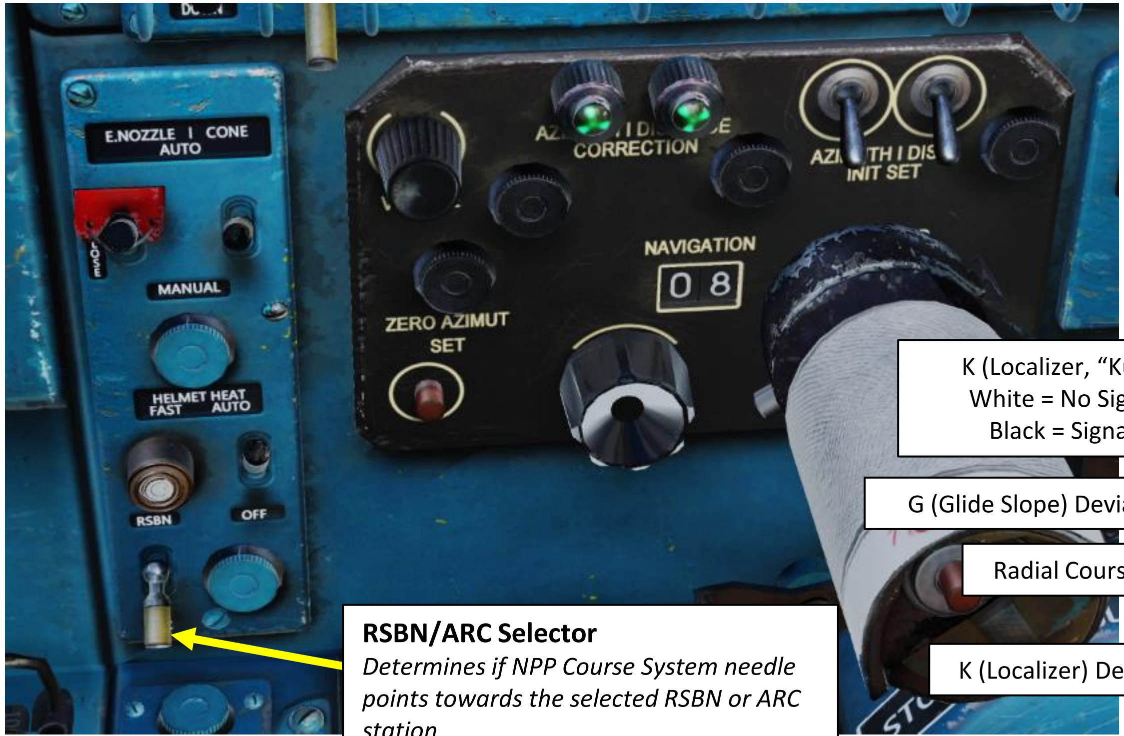


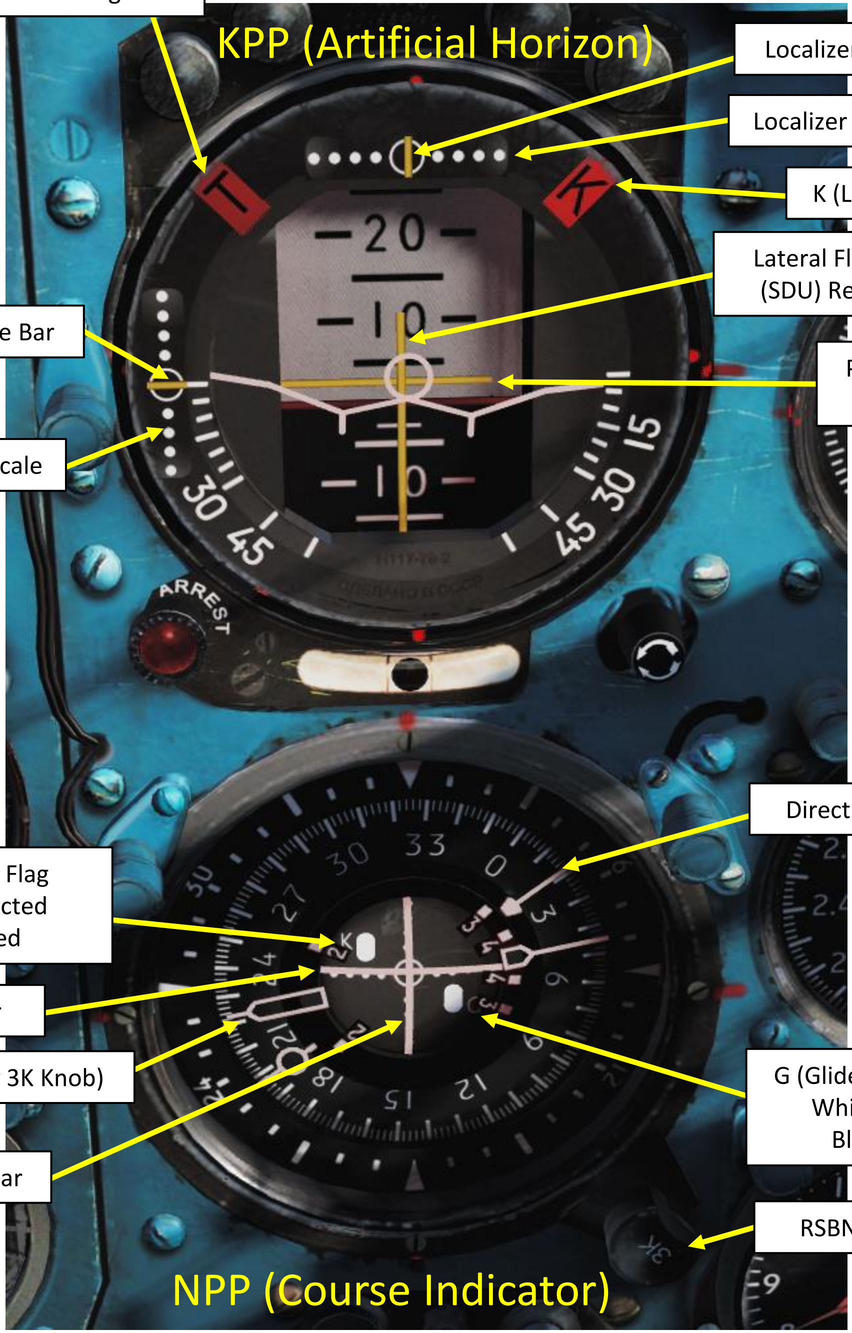
3 – KPP (Artificial Horizon) & NPP (Course Indicator) Overview

The KPP is the Artificial Horizon.

The NPP is the Course Indicator, which is similar to a western Horizontal Situation Indicator (HSI).

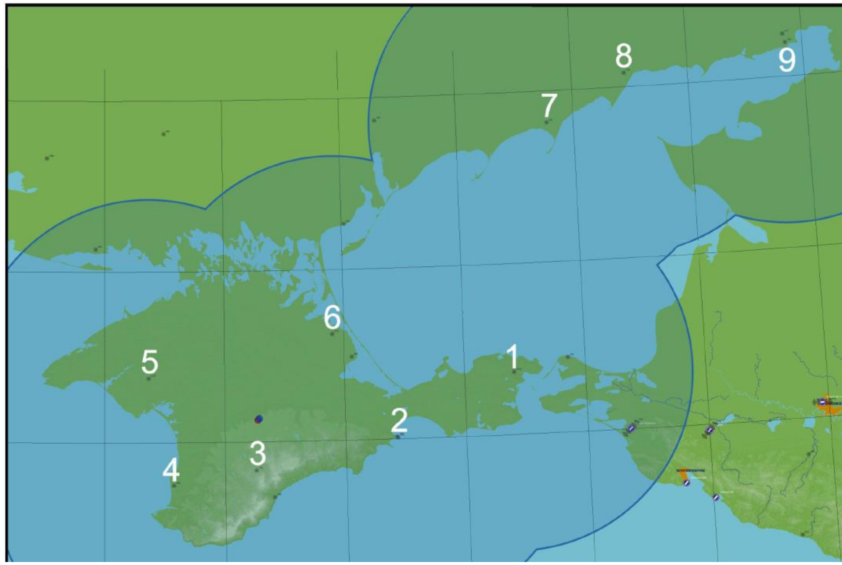
The Course Indicator System can track either a RSBN station or a ARC station, which is controlled with the RSBN/ARC Selector.

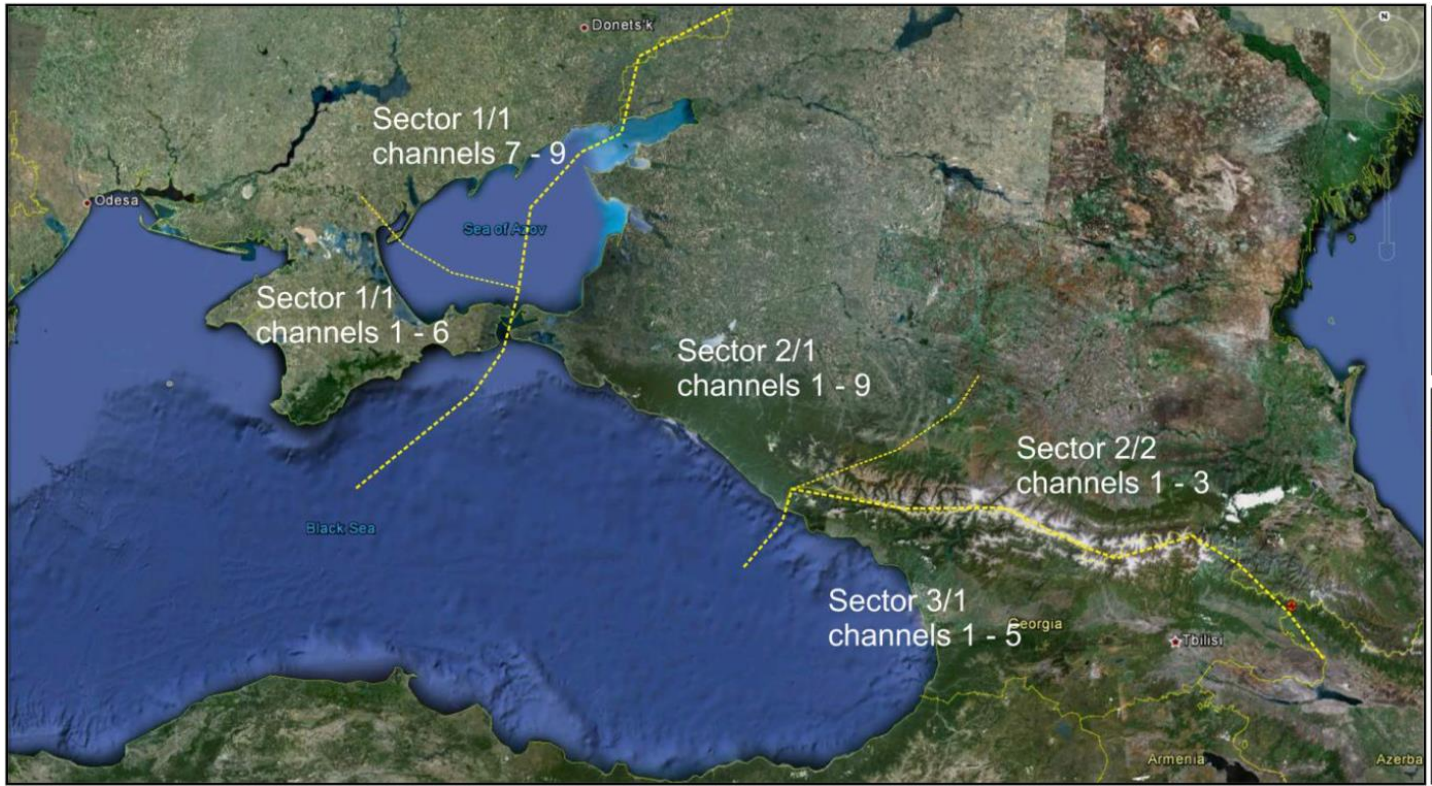


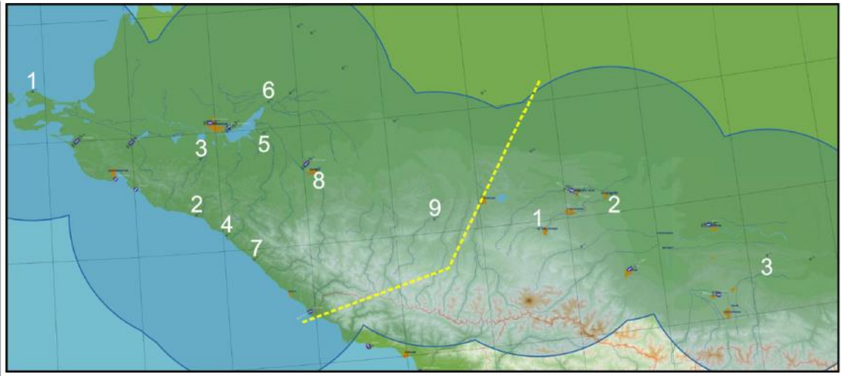


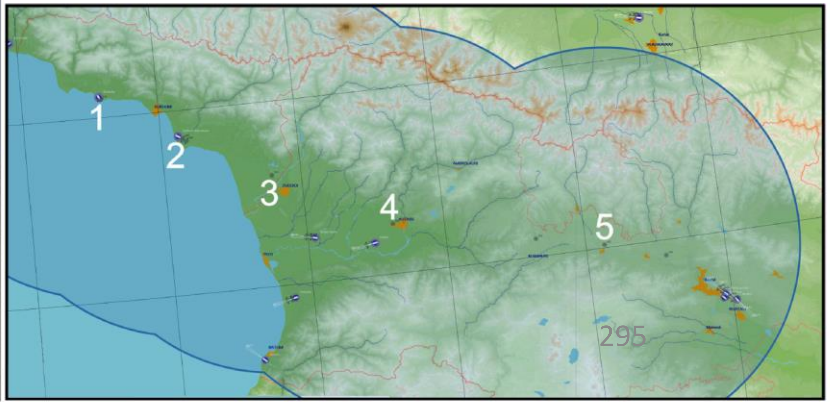
4 – ARC-10 (Automatic Radio Compass) Navigation
4.1 - Overview

- ARC stations (NDB) cover 4 sectors divided in 2 subsectors each (noted in roman numerals I and II).
- Each subsector has a varying number of NDB stations placed throughout the map.
- Why make it so complicated? Because these airspaces are controlled by different authorities. In a 2000 scenario, sectors 1-I and 1-II belong to Crimea and Ukraine. Sectors 2-I and 2-II belong to the Russian Federation, sectors 3-I belongs to Georgia. Sectors 3-II, 4-I and 4-II are not used.
- You are guided to ARC stations by your **NPP Course Indicator**.
- ARC signals give you a direction to the station, but no distance information.
- To pick up ARC signals, make sure you are flying at an altitude of at least 2,500 m.

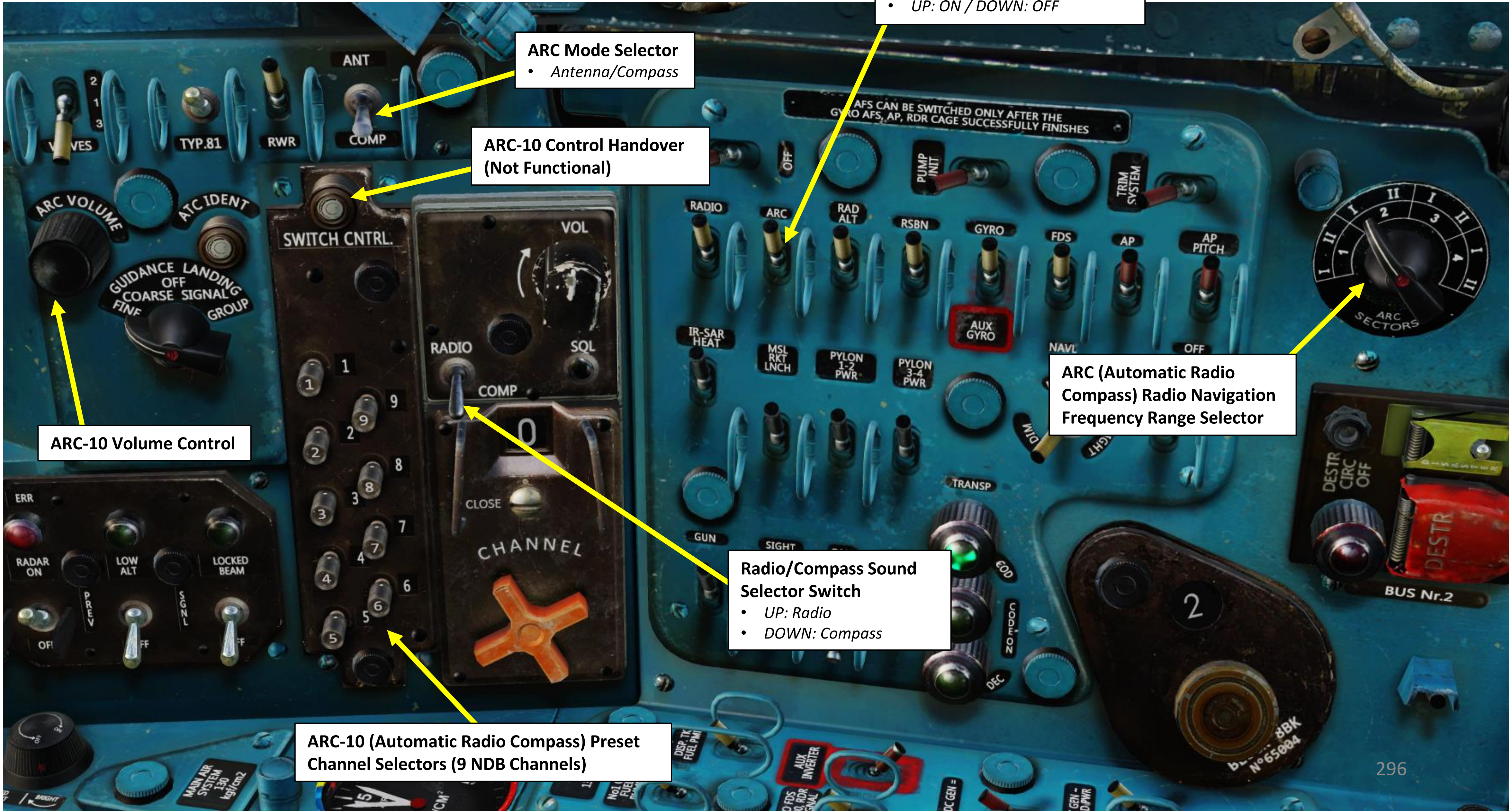






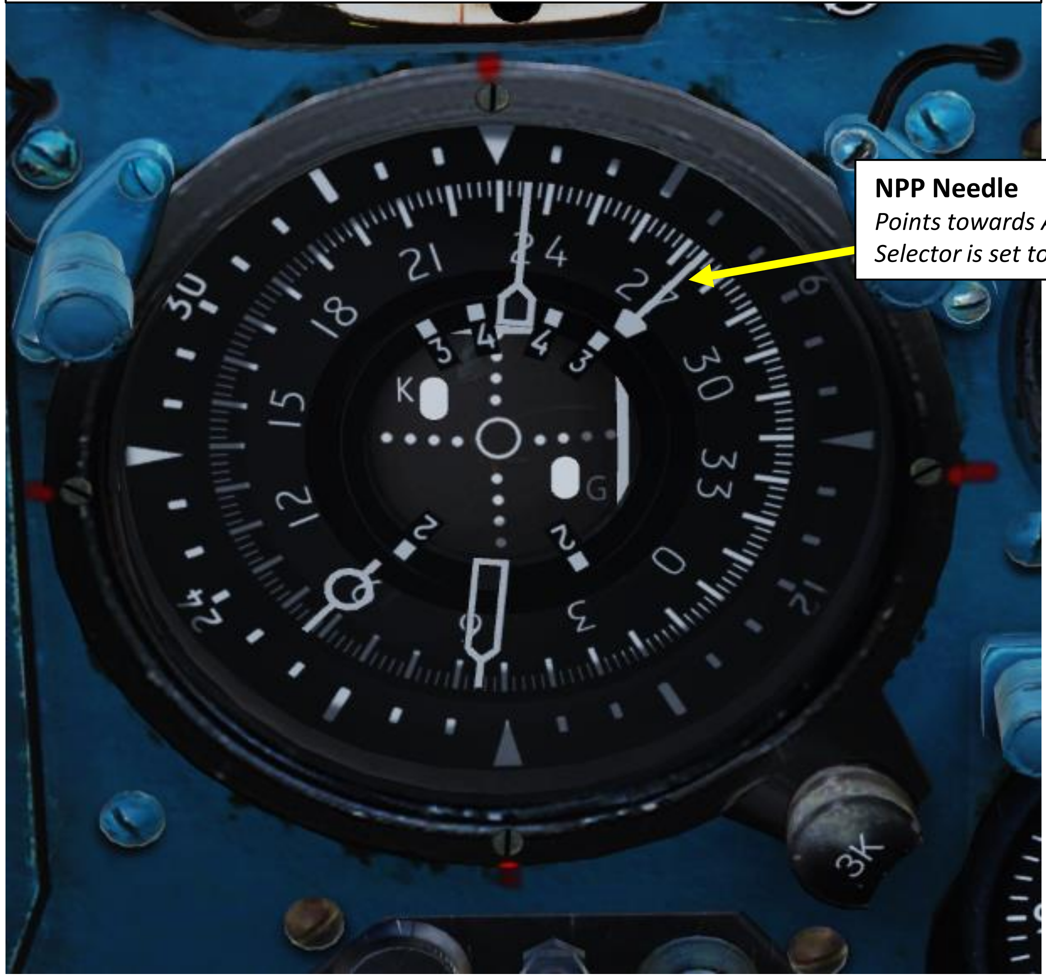


4 – ARC-10 (Automatic Radio Compass) Navigation
4.1 - Overview



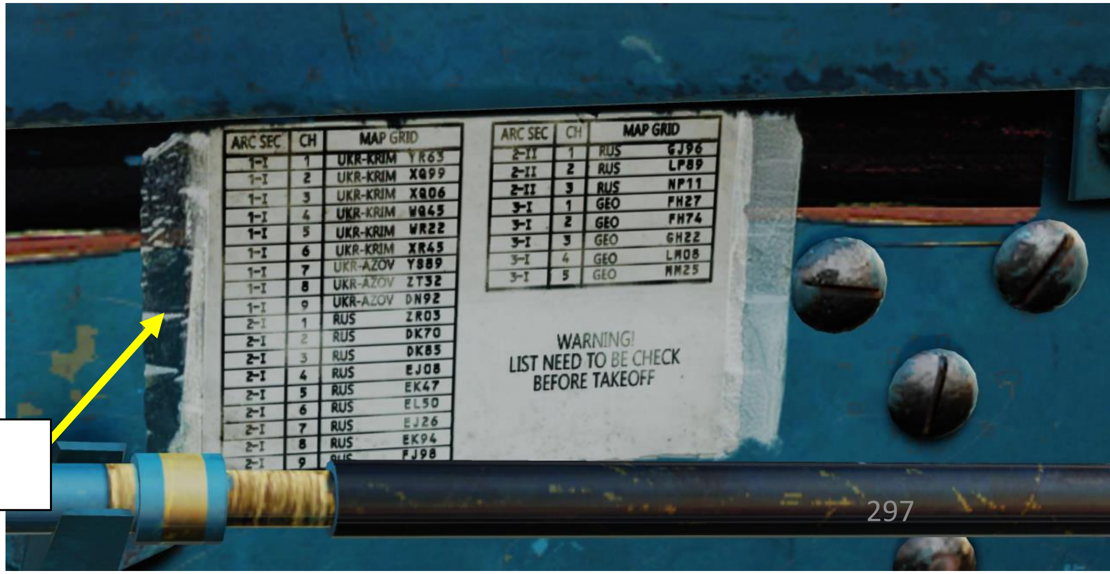
4 – ARC-10 (Automatic Radio Compass) Navigation
4.1 - Overview

NPP (Course Indicator System)



NPP Needle
Points towards ARC if RSBN/ARC Selector is set to ARC (DOWN)

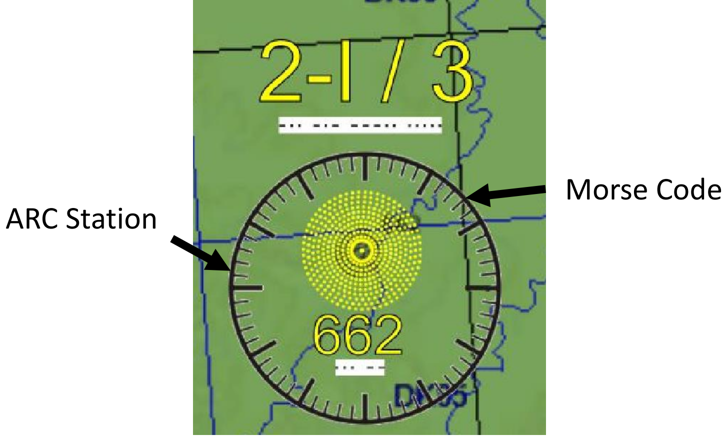
RSBN/ARC Selector
Determines if NPP Course System needle points towards the selected RSBN or ARC station
- *UP: RSBN*
- *DOWN: ARC*

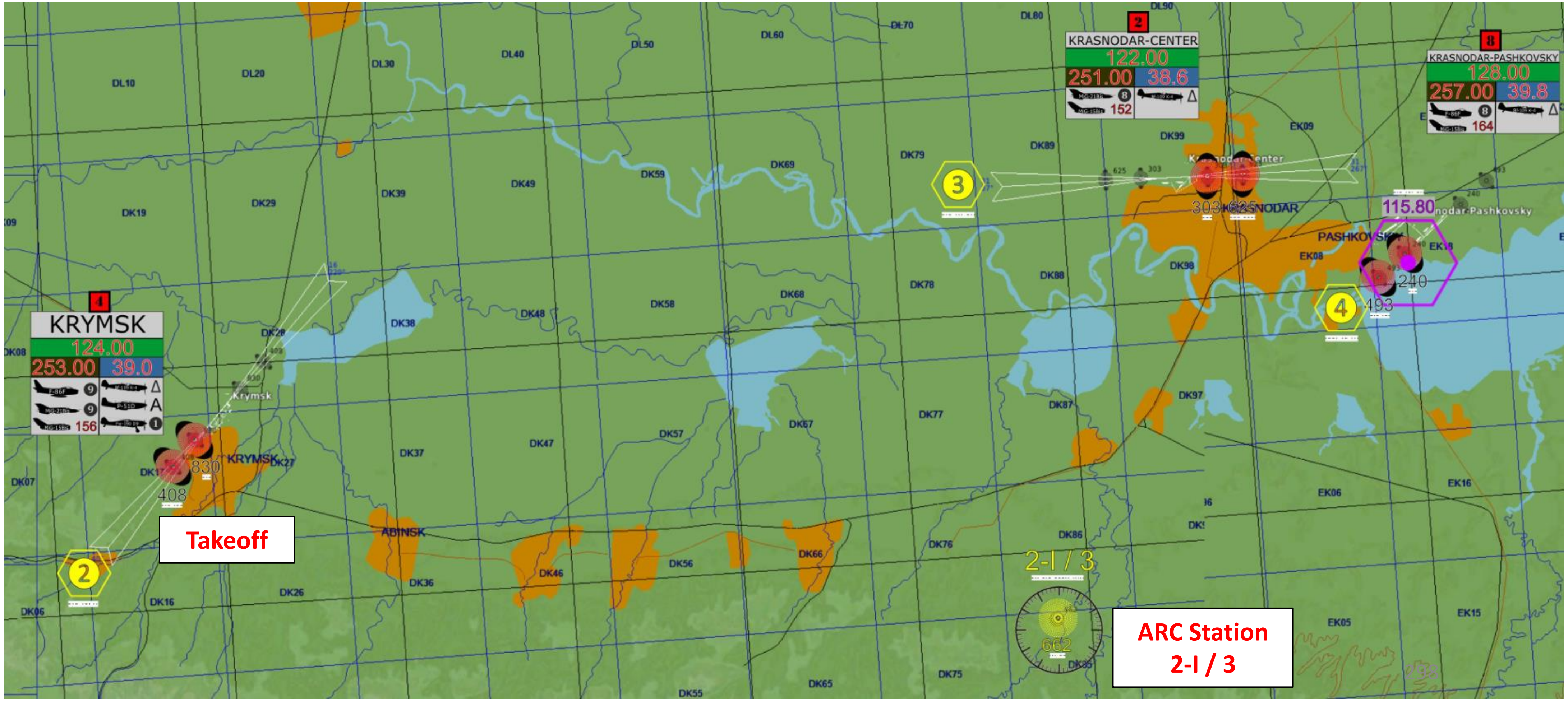


ARC-10 (Automatic Radio Compass) Sector & Preset Channel Chart

4 – ARC-10 (Automatic Radio Compass) Navigation
4.2 - Tutorial

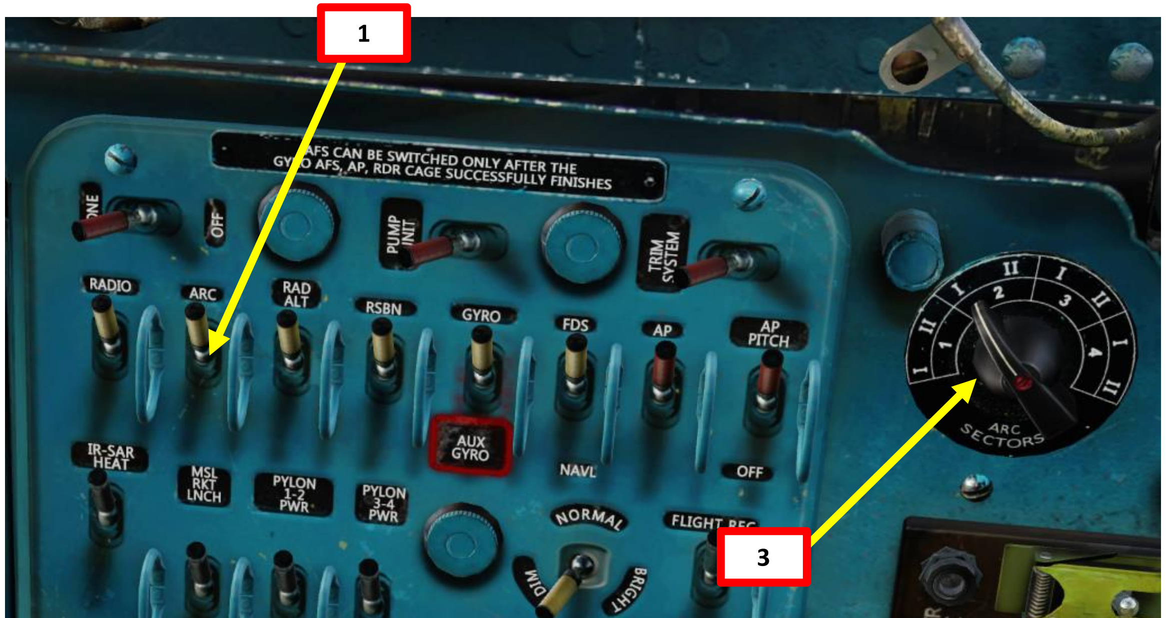
In this example, we will takeoff from Krymsk and use the ARC-10 radio compass to navigate to ARC NDB station 2-I / 3 (obtained through Lino_Germany's HD map).

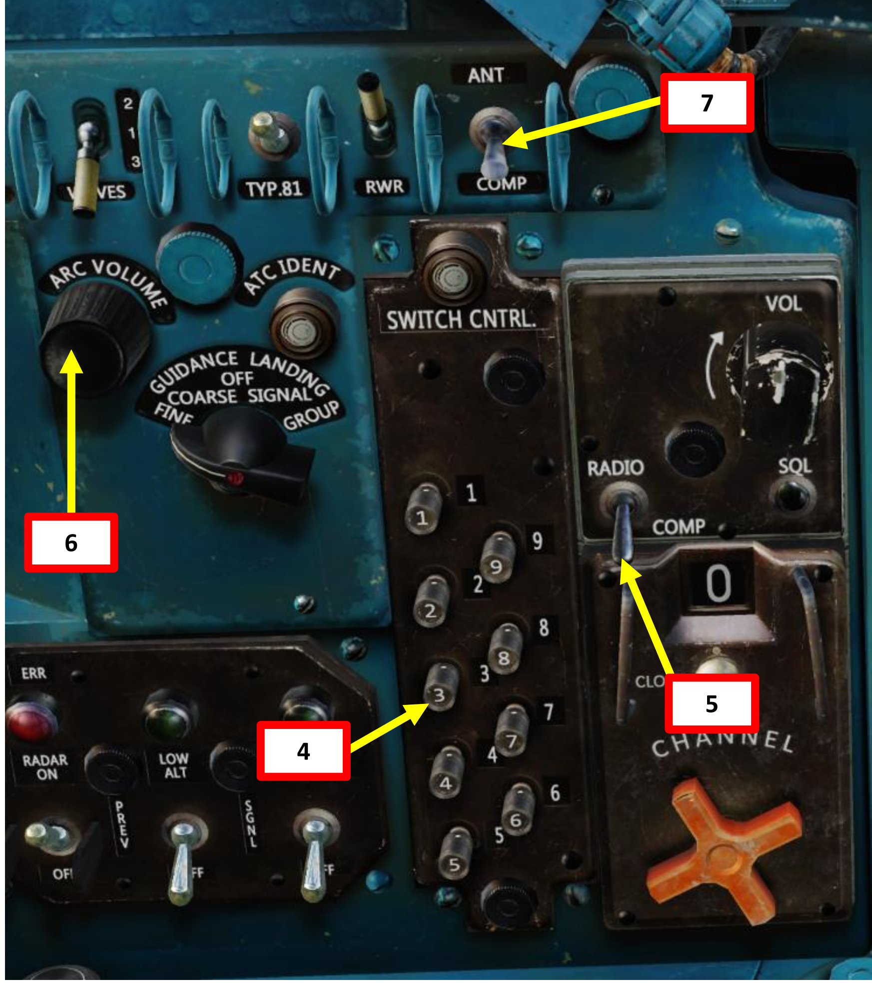


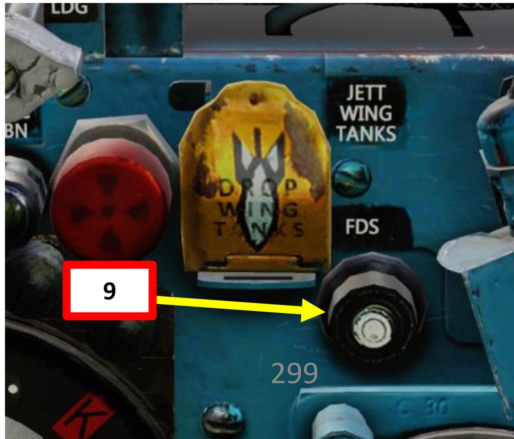


4 – ARC-10 (Automatic Radio Compass) Navigation
4.2 - Tutorial

1. Turn on ARC Radio Navigation Power switch – ON (UP).
2. Our ARC NDB is in sector 2-I / 3. On Lino_Germany's map, you can also see the morse code we should expect to hear.
3. Select ARC channel 2-I on the ARC Frequency Range Selector.
4. Select ARC sub-channel # 3 on the radio panel
5. Select Radio/Compass Sound Selector – COMPASS (DOWN). This will allow you to hear the station morse code.
6. Adjust ARC-10 Volume – As desired
7. Set ARC Mode Switch – COMPASS (DOWN)
8. Set RSBN/ARC Selector switch – ARC (DOWN). The NPP Course System needle will then point towards the selected ARC station.
9. Hold FDS switch for 3-4 seconds to align NPP Course Indicator with magnetic compass.

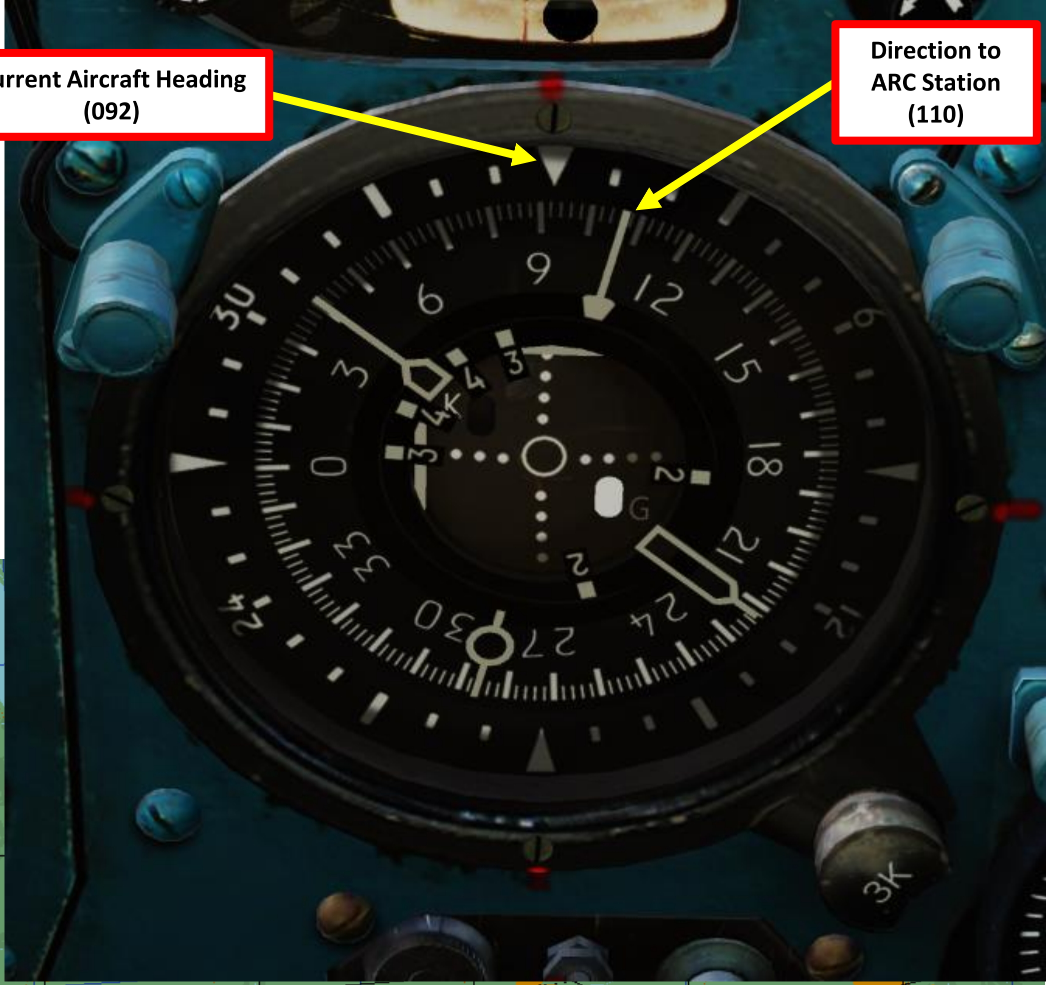


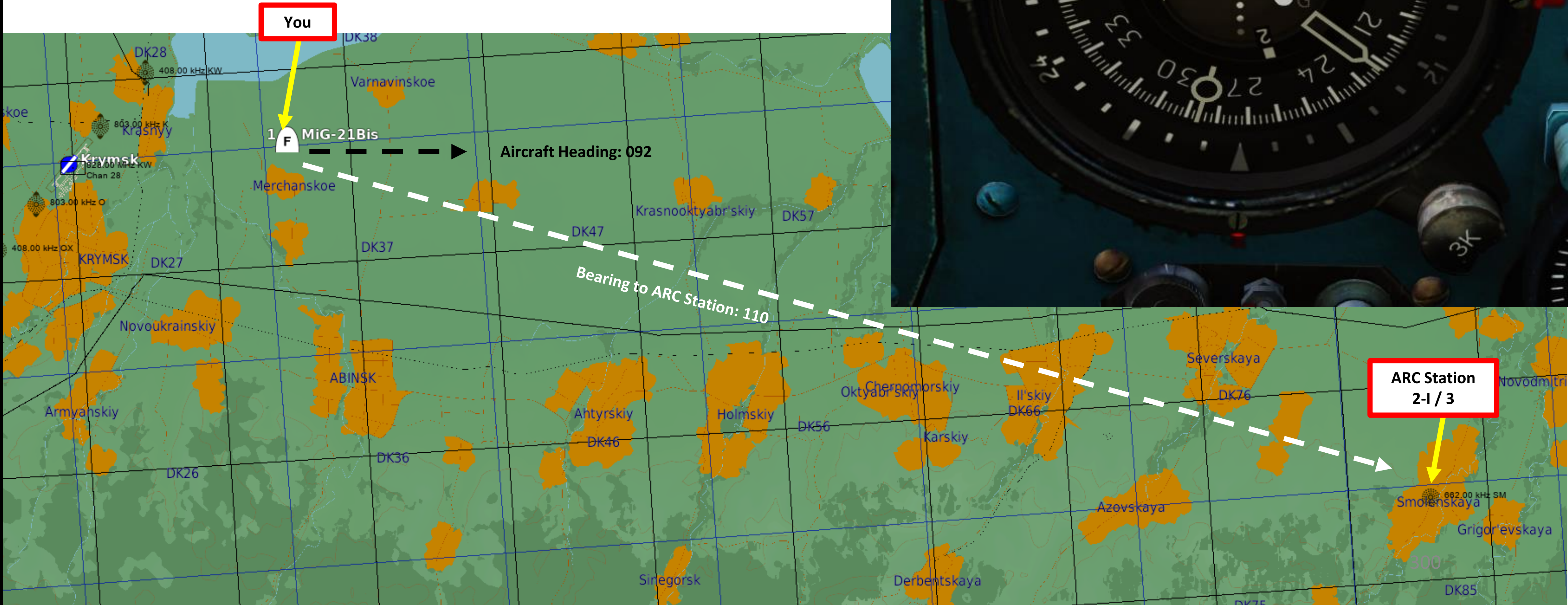




4 – ARC-10 (Automatic Radio Compass) Navigation
4.2 - Tutorial

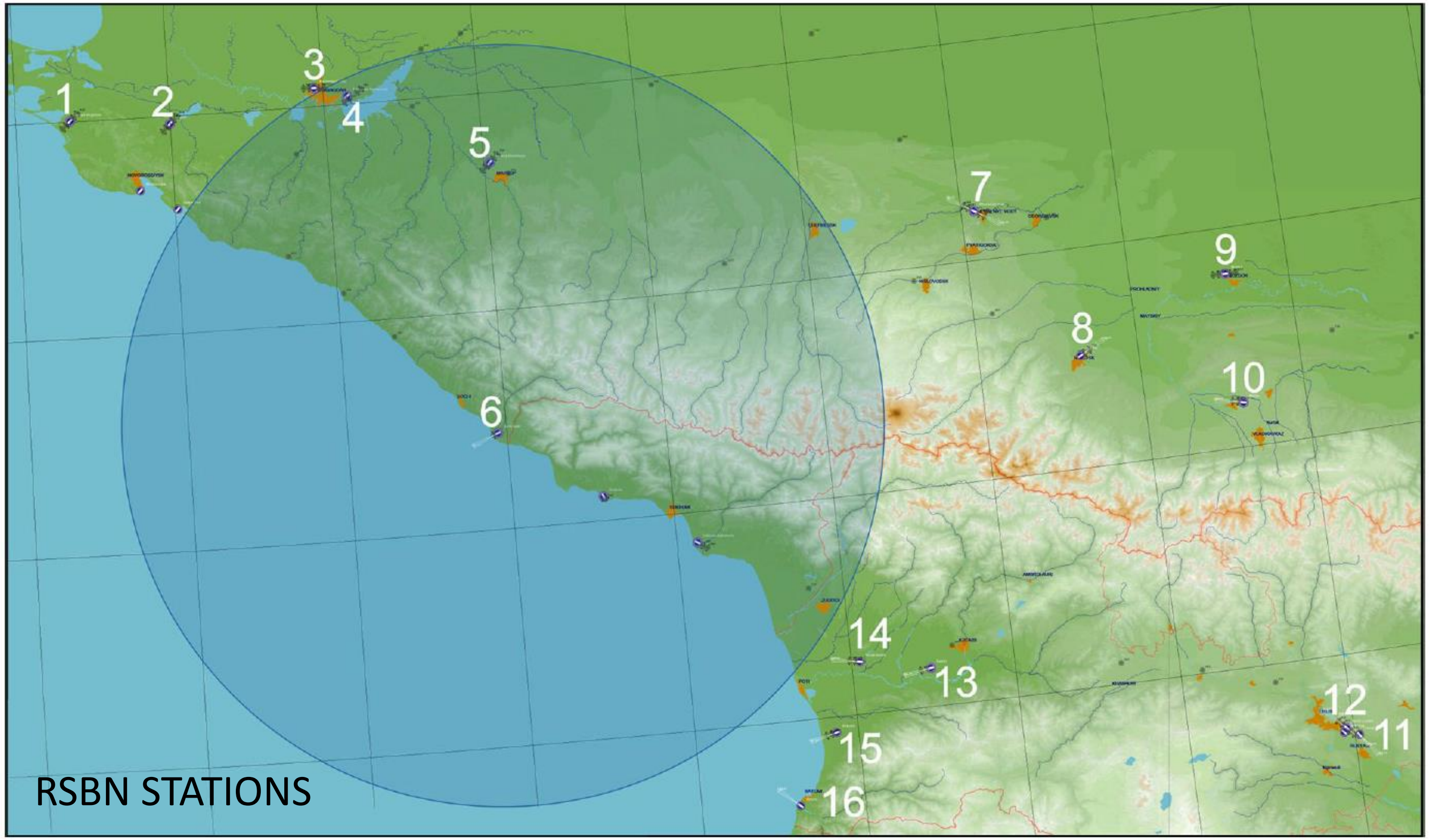
10. The NPP Course Indicator compass will start moving once you pick up a signal with a morse code auditive signal. Fly to align the pointy end of the needle (the one with the white circle) with the upper white triangle. Once aligned, you are on course.
11. You have no way of judging the distance to the beacon. Once you fly over it, the white circle needle will suddenly start turning fast. This means you are passing over the ARC NDB station.





5 – RSBN (VOR) Navigation
5.1 - Overview

- RSBN VOR stations are generally set next to airstrips to guide air traffic towards airfields, unlike NDBs which can be placed anywhere… sort of. In simple terms, you could compare NDBs to waypoints on an “air highway” and VOR stations to the exits of this “air highway”.
- You are guided to RSBN stations by both your **NPP** (Course Indicator System / Radio-Compass), which works like a Horizontal Situation Indicator, and your **KPP** (Artificial Horizon), which works like an ADI (Attitude Director Indicator) augmented with an ILS (Instrument Landing System).
- RSBN signals give you a bearing and distance information to the station.
- RSBN signals are used for PRMG (ILS) precision landings in bad weather or low visibility conditions.
- To pick up RSBN signals, make sure you are flying at an altitude of at least 2,500 m.



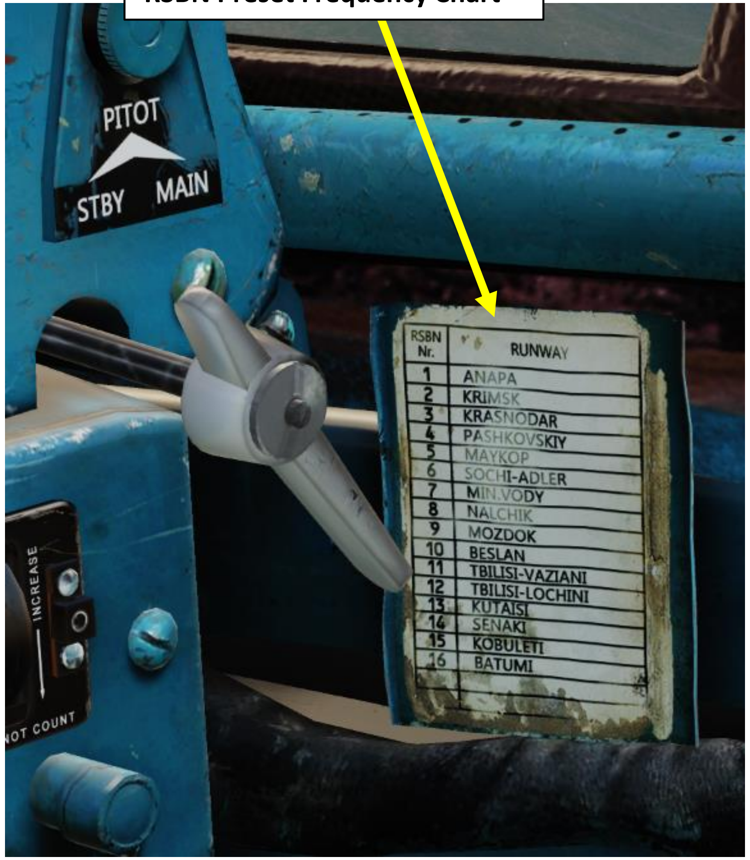
NPP (Course Indicator System)

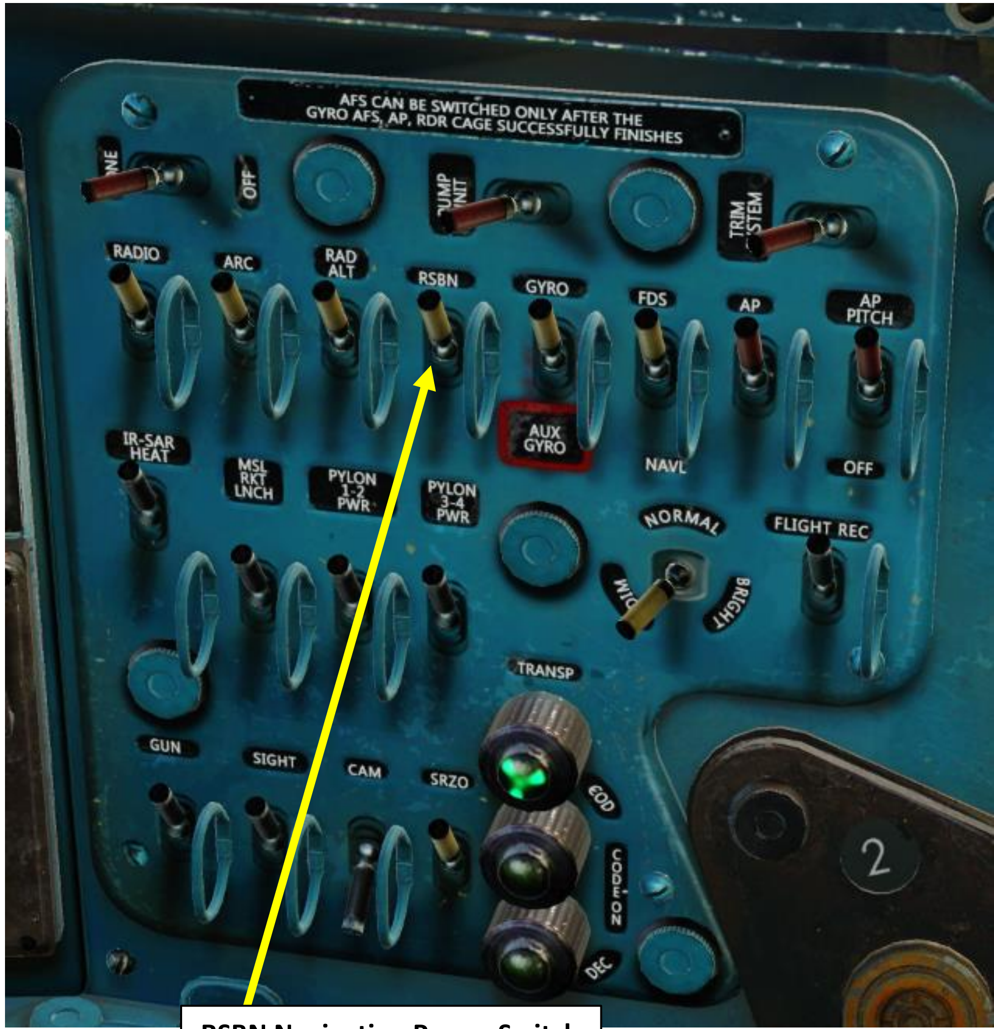
KPP (Artificial Horizon)

5 – RSBN (VOR) Navigation
5.1 - Overview

RSBN Distance Indicator (km)

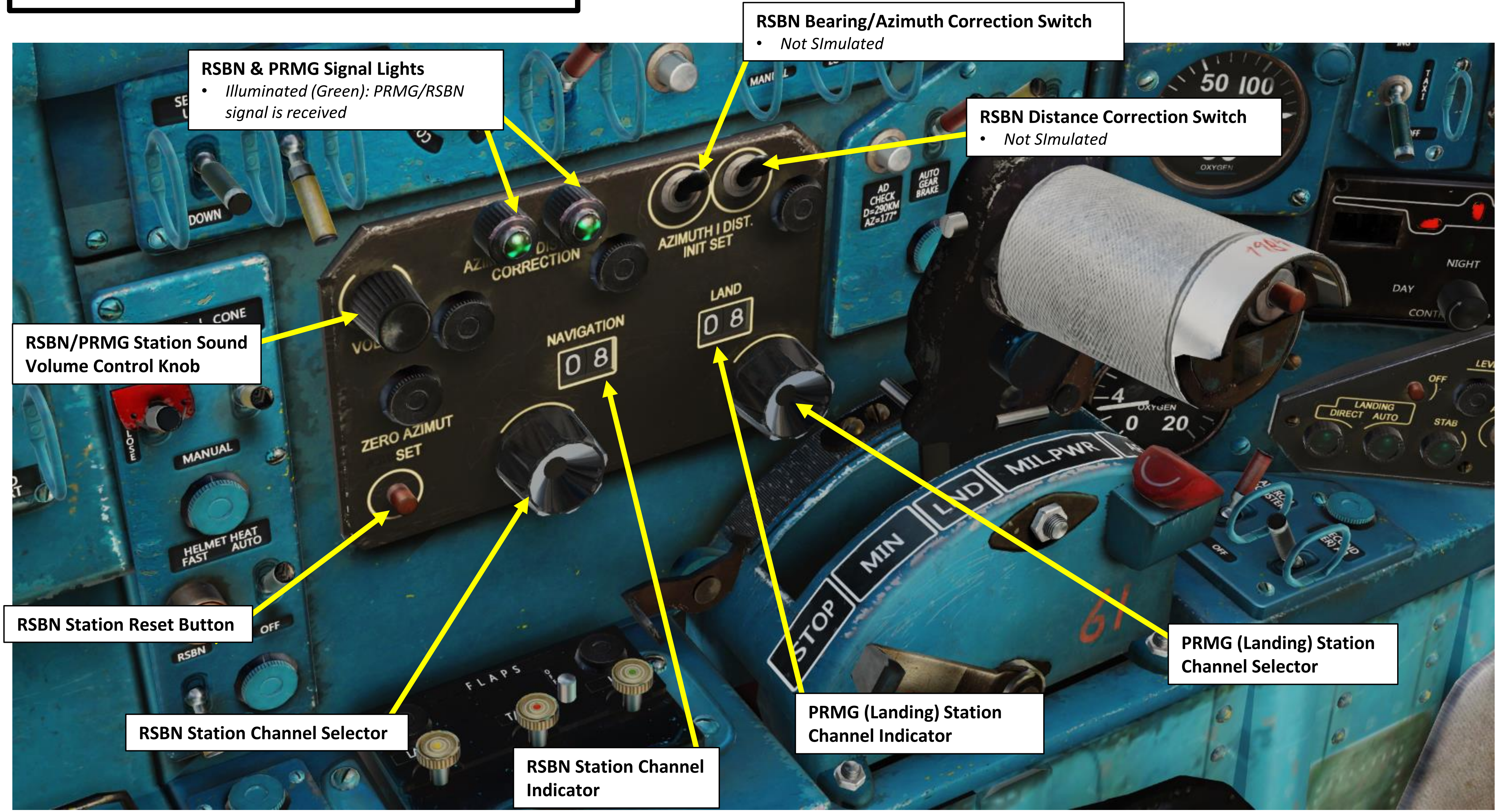
RSBN Preset Frequency Chart





RSBN Navigation Power Switch
- *UP: ON / DOWN: OFF*

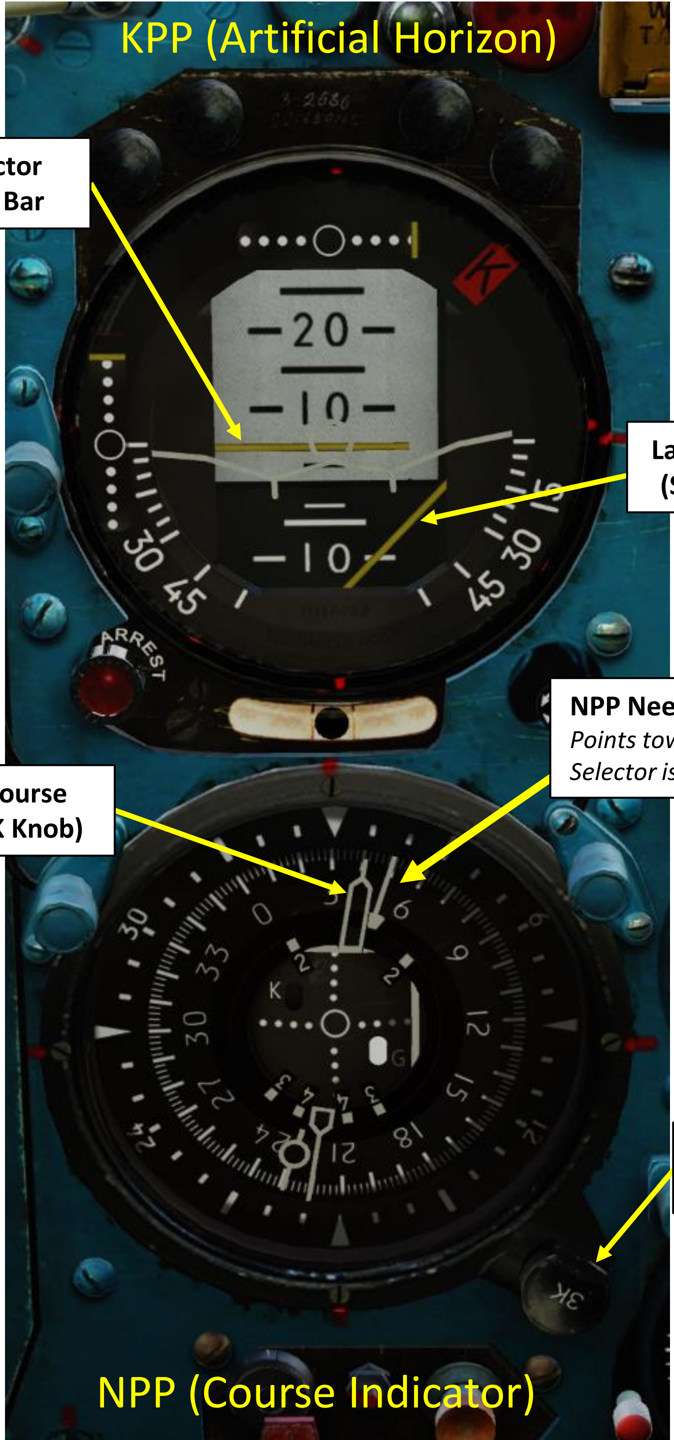
5 – RSBN (VOR) Navigation
5.1 - Overview



5 – RSBN (VOR) Navigation
5.1 - Overview

RSBN Mode Selector
- *UP: Descend (Proceed) Mode*
- *MIDDLE: Navigation Mode*
- *DOWN: Landing Mode*

RSBN/ARC Selector
Determines if NPP Course System needle points towards the selected RSBN or ARC station
- *UP: RSBN*
- *DOWN: ARC*



Pitch Flight Director (SDU) Reference Bar

Lateral Flight Director (SDU) Reference Bar

NPP Needle
Points towards RSBN if RSBN/ARC Selector is set to RSBN UP)

Radial Course (set by 3K Knob)

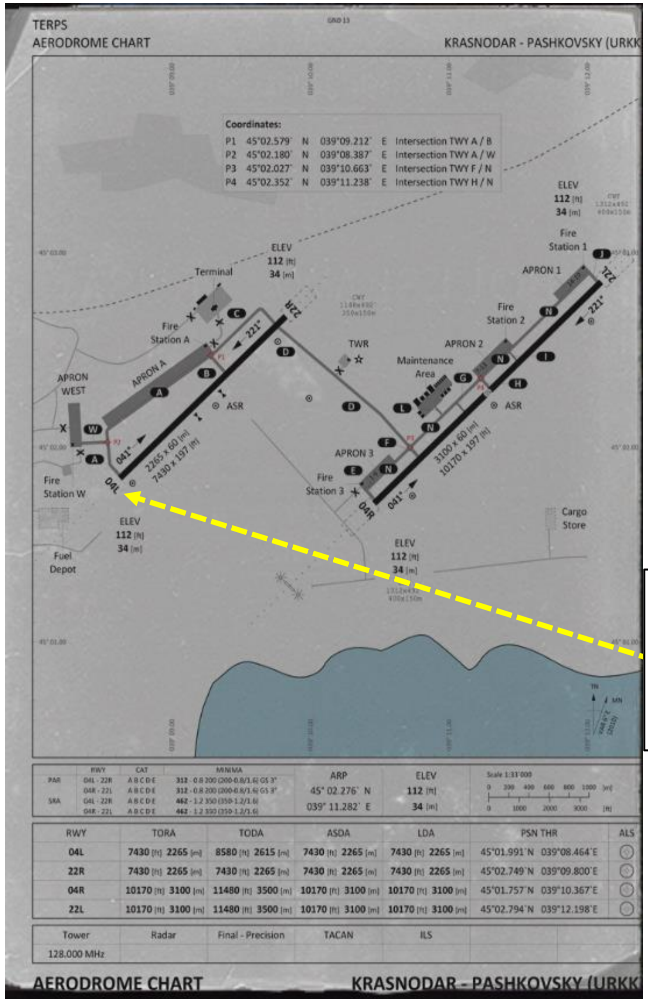
RSBN 3K Course Selector Knob

5 – RSBN (VOR) Navigation
5.2 - RSBN in Navigation Mode

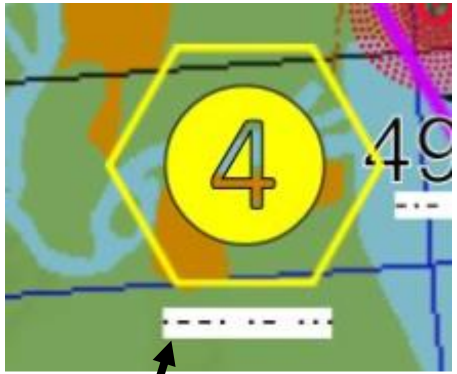
Check out XXJohnXX's excellent tutorial on RSBN navigation:
https://www.youtube.com/watch?v=K4av0wGnPs0

In real life, there are designated air corridors that pilots need to take in order to get to certain airfields. This is what we call a "radial" (think of it like an aerial highway). "Intercepting a radial" is just a fancy way of saying that you fly towards an air corridor to sort of "jump on the highway" towards your airfield. Don't worry, we'll take a simple case. To find the radial to Krasnodar-Pashkovsky, you can check the orientation of the runway in either the RSBN table given previously or by using your kneeboard to find the right page. In our case, the heading of the runway is 047 (True Heading) or 041 (Magnetic Heading). 041 is the radial we will need to intercept.

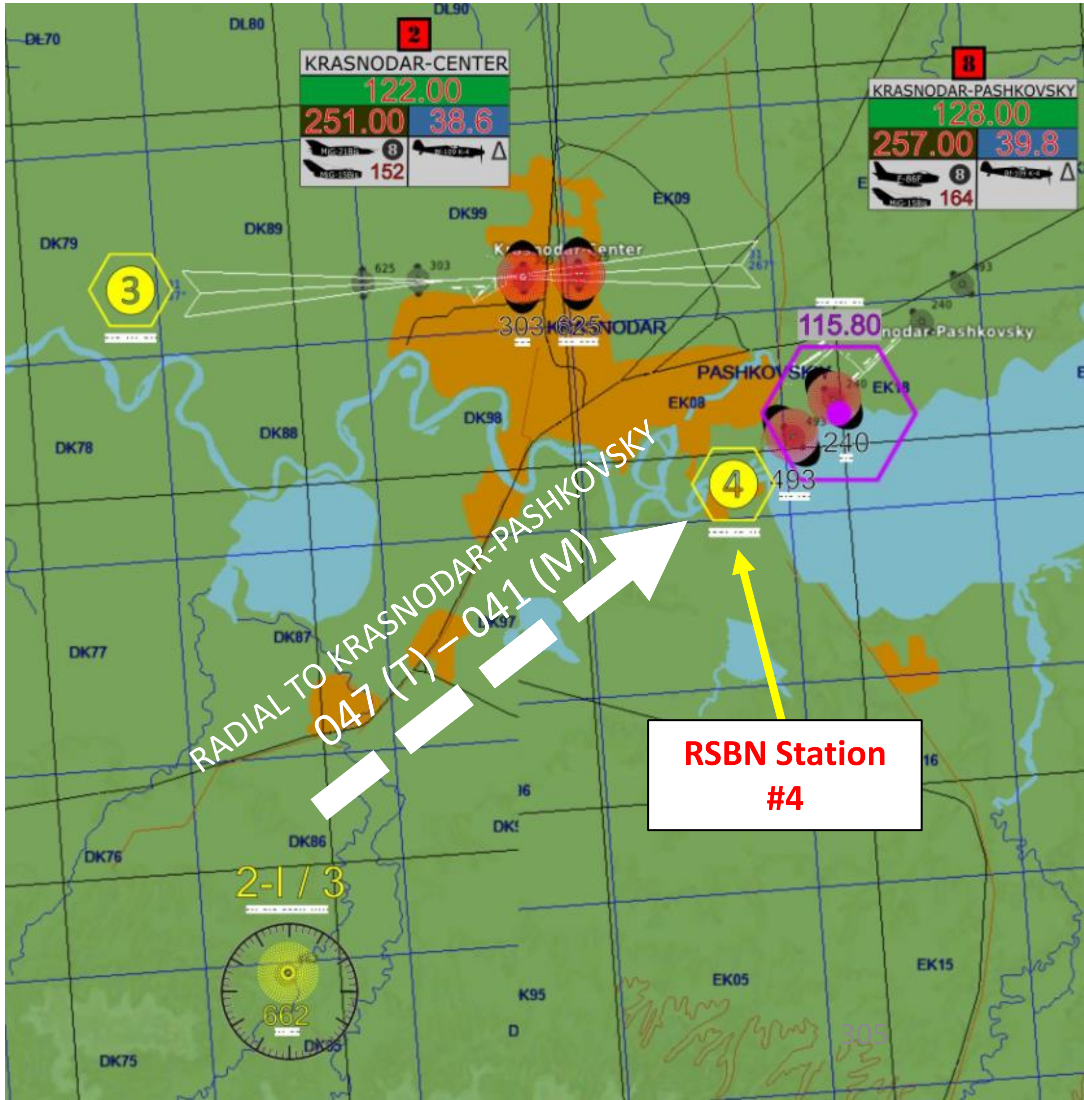
In this example, we will use the RSBN system to intercept the 041 radial next page.



RUNWAY HEADING: 047 (T) – 041 (M)
Kneeboard Commands:
Toggle Kneeboard: RCTRL+UP
Cycle Pages: RCTRL+RIGHT / RCTRL+LEFT

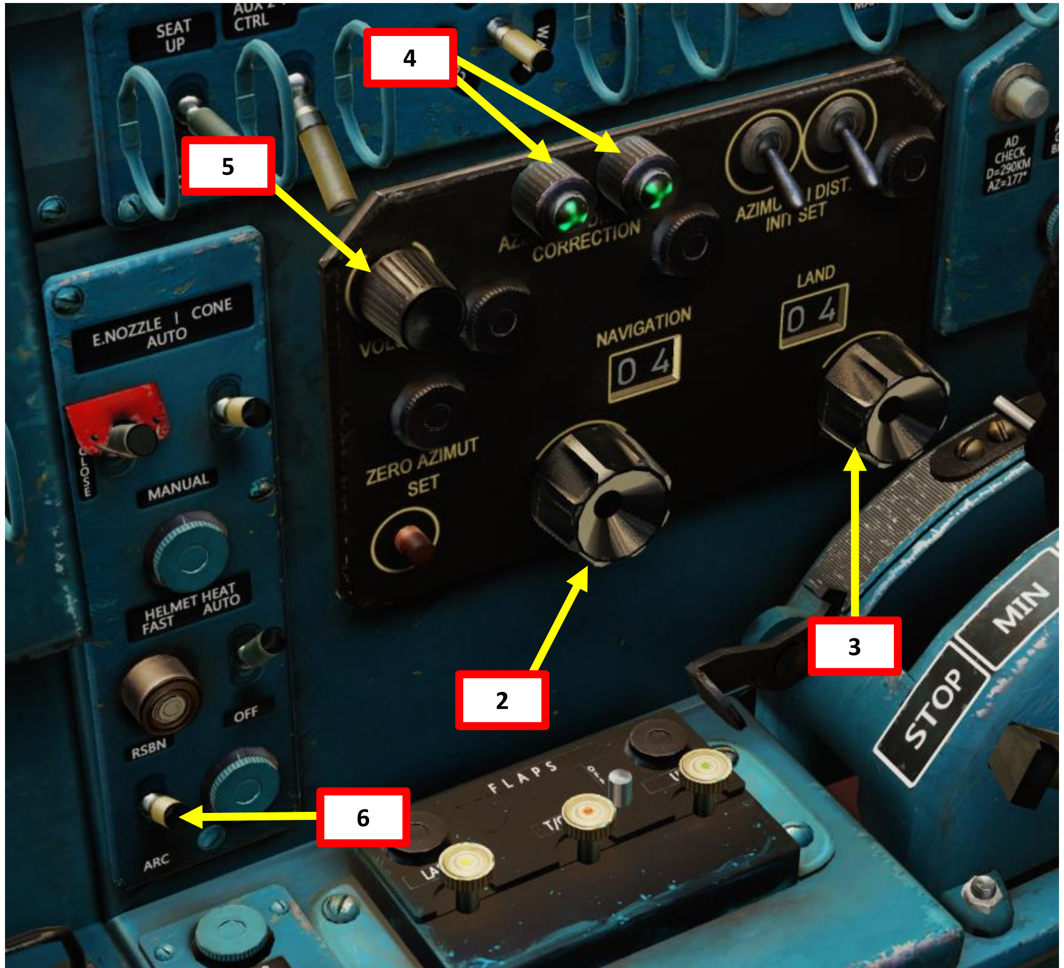


Morse Code



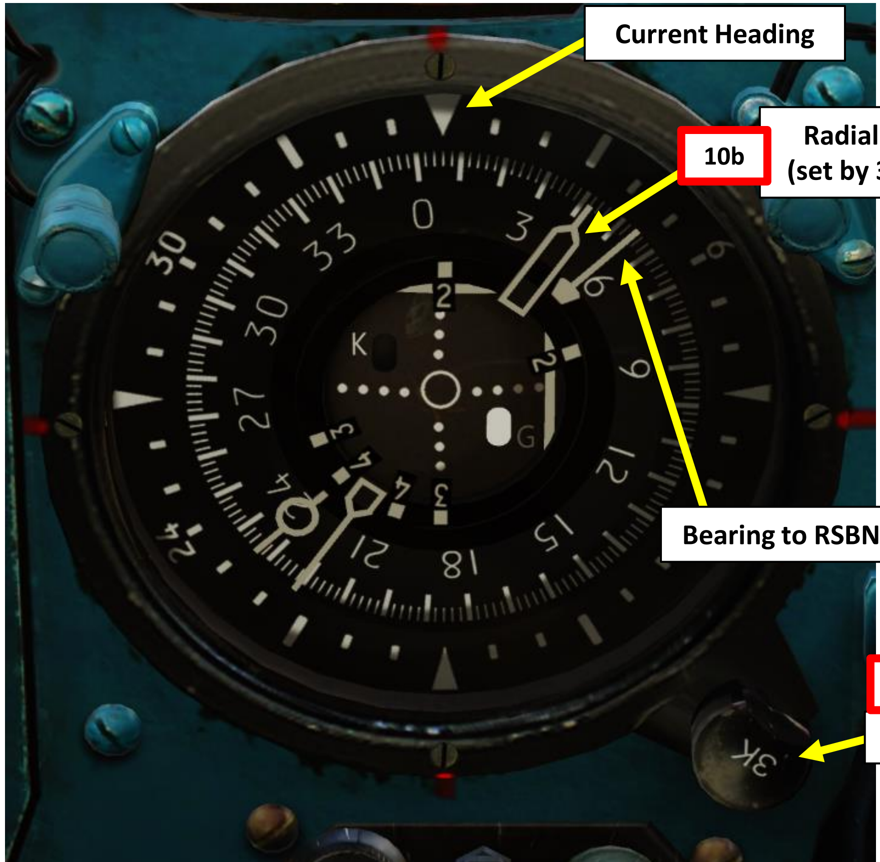
5 – RSBN (VOR) Navigation
5.2 - RSBN in Navigation Mode

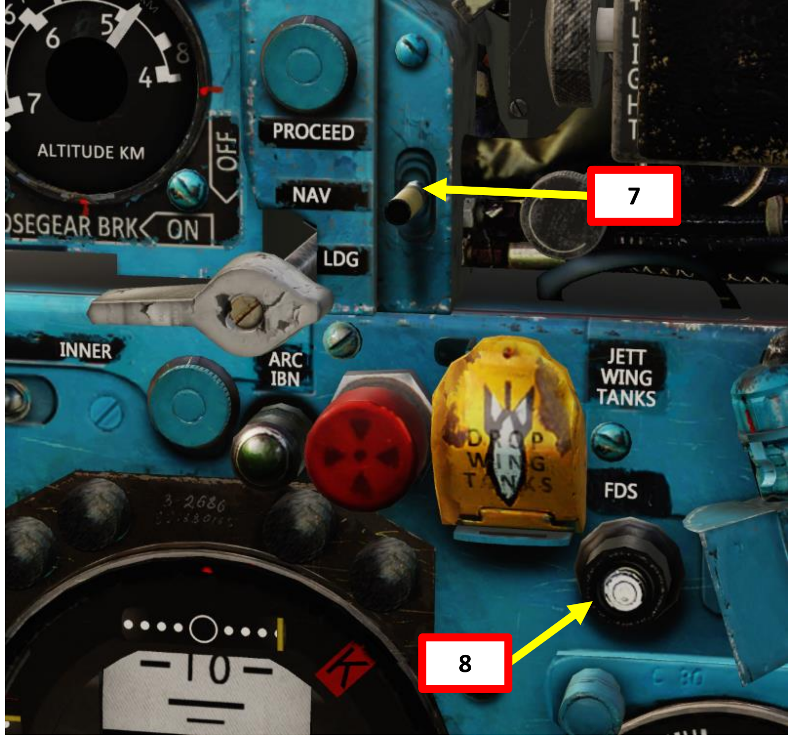
1. Set RSBN Power Switch – ON (UP)
2. Set RSBN (Navigation) Channel – As required for desired station (i.e. RSBN Channel 4 for Krasnodar-Pashkovsky)
3. If using the PRMG for a Precision Approach, set PRMG (Landing) Channel – As required for desired airfield (i.e. PRMG Channel 4 for Krasnodar-Pashkovsky). In this particular case, we will not be using PRMG.
4. Confirm that both Signal lights illuminate; this means that the station signals are received.
5. Adjust RSBN Volume – As desired
6. Set RSBN/ARC Selector Switch – RSBN (UP). This will determines if NPP Course System needle points towards the selected RSBN or ARC station.



5 – RSBN (VOR) Navigation
5.2 - RSBN in Navigation Mode

7. Set RSBN Mode Switch – Navigation (MIDDLE)
8. Hold FDS switch for 3-4 seconds to align NPP Course Indicator with magnetic compass.
9. Check the RSBN distance indicator: we currently are 35 km away from the beacon.
10. Rotate the 3-K knob with mousewheel to set the largest/longest end of the thick needle to 041, since this is the radial we intend to follow to the airfield. When both needles are aligned, you are surfing on the radial. It is YOUR job to know if you're going in the right direction (TO the RSBN or AWAY FROM the RSBN) as there is no TO/FROM indicator. Use common sense.

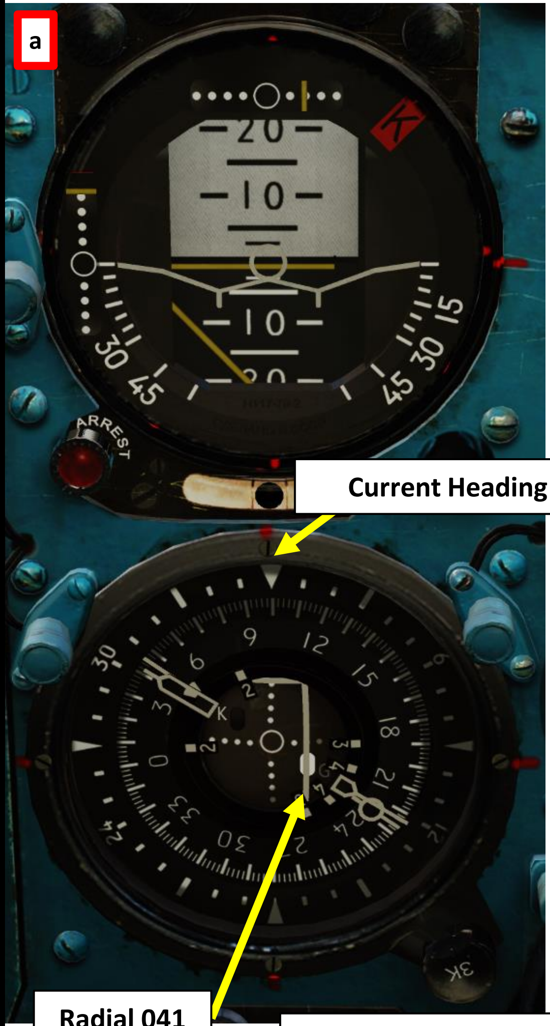


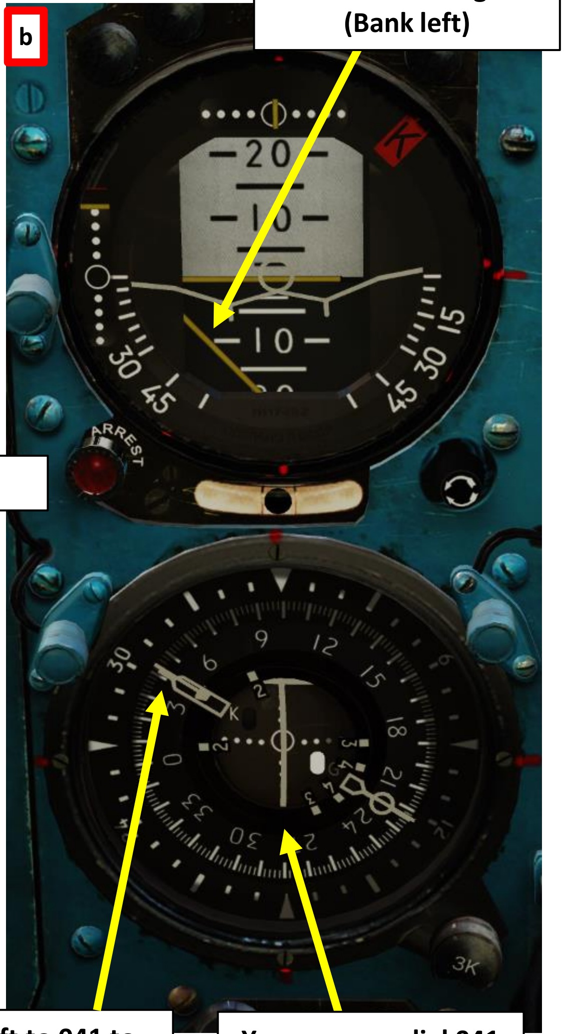


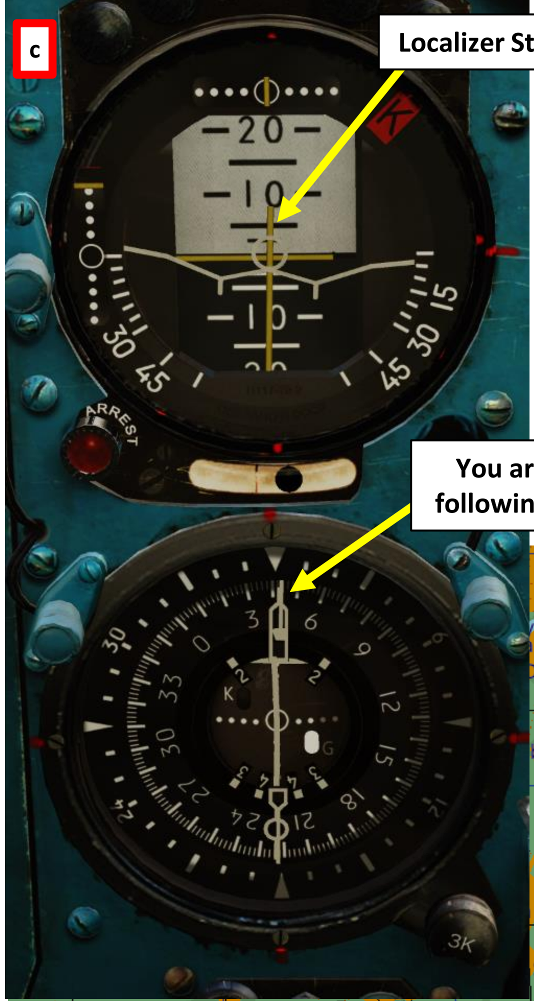
Distance from the ground station (km)	30	60	90	120	150	200
Minimum altitude (m)	530	1050	1570	2100	2620	3500

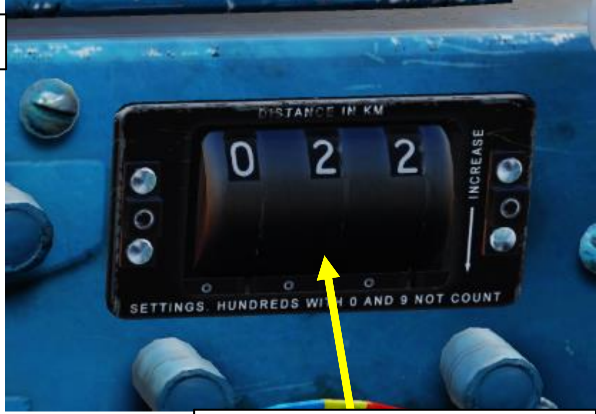
5 – RSBN (VOR) Navigation
5.2 - RSBN in Navigation Mode

11. Intercept radial 041 by using the NPP Course Indicator and KPP Artificial Horizon.









5 – RSBN (VOR) Navigation
5.2 - RSBN in Navigation Mode

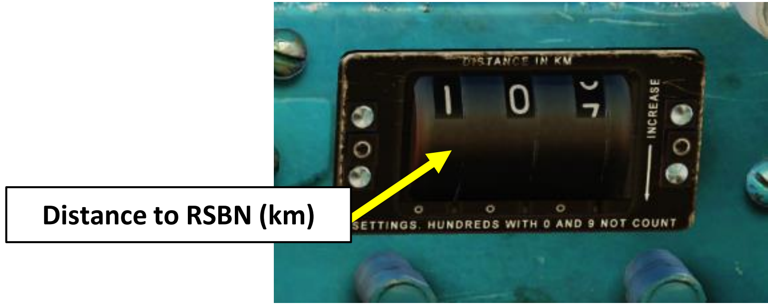
12. Once you have intercepted radial 041, steer towards the RSBN station.

5 – RSBN (VOR) Navigation
5.2 - RSBN in Navigation Mode

5 – RSBN (VOR) Navigation
5.3 - RSBN in Cloud Penetration / Descent Mode

Cloud Penetration (Descent) is a simple mode allowing the aircraft to safely descend over obstacles during approach to the selected airbase for landing. The Mode Selector has to be set to the “PROCEED” (up) position. This mode is turned on when the airplane is approaching the selected RSBN station for landing, before it reaches either the PRMG radio beams coverage range, or the pilot obtains visual contact with the runway. It is usually used during night missions or in IFR conditions. If this mode is selected, the horizontal directional needle will point to the calculated descent speed, which needs to be held in order to reach the desired descent altitude at a given distance from the runway.

It operates regardless of the speed of the aircraft, enabling the pilot to fly the aircraft along a safe descent path. This mode allows an initial descent at a maximum distance of 120 km from the runway. 20 km away from the runway, the altitude should be 600 m above the station, allowing the pilot to either acquire visual contact with the runway and continue a visual approach for landing, or to enter the PRMG approach. Note that this mode does not take into account the direction of the runway automatically. The pilot needs to select the proper radial along which he wants to perform the descent. If the pilot chooses a radial using the 3K knob, he needs to intercept it using the localizer (*kurs*) needle, while at the same time descending using the glide path (*glisada*) needle.



5 – RSBN (VOR) Navigation
5.3 - RSBN in Cloud Penetration / Descent Mode

1. Set RSBN system and NPP Course Indicator as required, as shown in the previous RSBN tutorial. Engage CLOUD PENETRATION (labeled "Descend/Proceed") mode whenever you need it. At 120 km or further from the RSBN station, you altitude should be 10000 m.
2. Descent starting point is at 120 km from the RSBN station. Recommended airspeed during descent is 600 km/h.
3. Keep the GLIDE director needle near the center of the aircraft silhouette on the KPP (Artificial Horizon). If you are flying on a certain radial, keep the LOCALIZER director and needles around the center.
4. 20 km from the RSBN, altitude is 600 m and the descent program ends. At this point, you can engage the RSBN LANDING mode or you can proceed with a visual approach. If you continue with CLOUD PENETRATION mode, the needles will instruct you to maintain 600 m.
5. Area of constant altitude of 600 m within 20 km around RSBN station.

RSBN Mode Selector
- *UP: Descend (Proceed) Mode*
- *MIDDLE: Navigation Mode*
- *DOWN: Landing Mode*

Distance to RSBN (km)

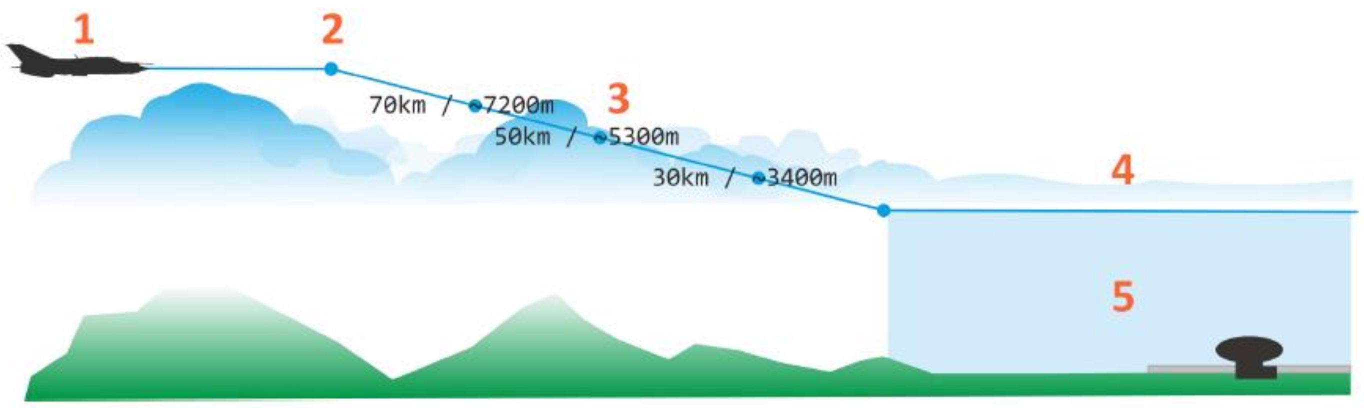


Image 9.9: Guidance program for CLOUD PENETRATION mode

5 – RSBN (VOR) Navigation
5.3 - RSBN in Cloud Penetration / Descent Mode

1. Aircraft is below the descent path. Either fly horizontally until you intercept the descent path, or climb to intercept. Once you intercept the glide path, continue your descent.
2. Aircraft is above descent path. Increase descent rate to intercept descent path. Don't descend too fast or you will overshoot the glide path.

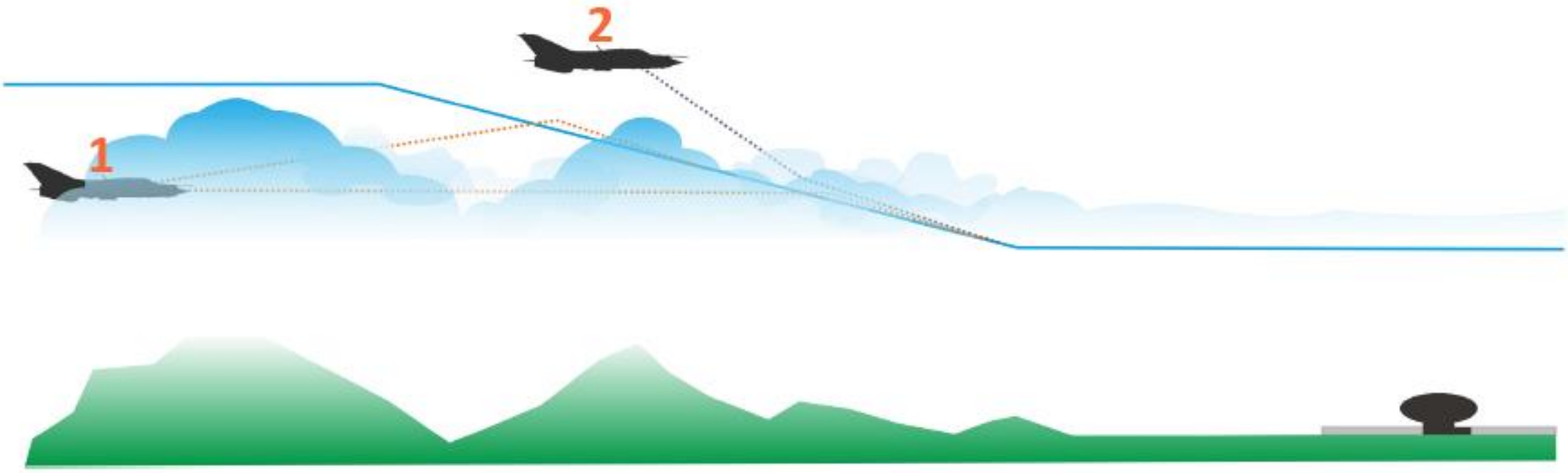
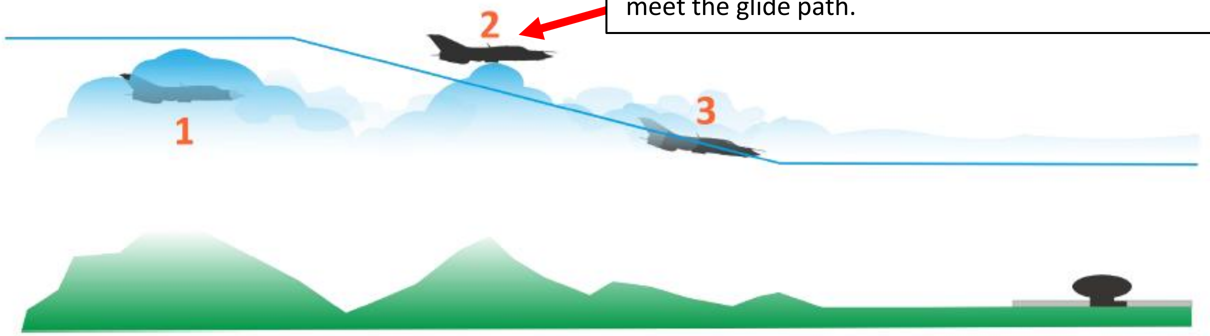


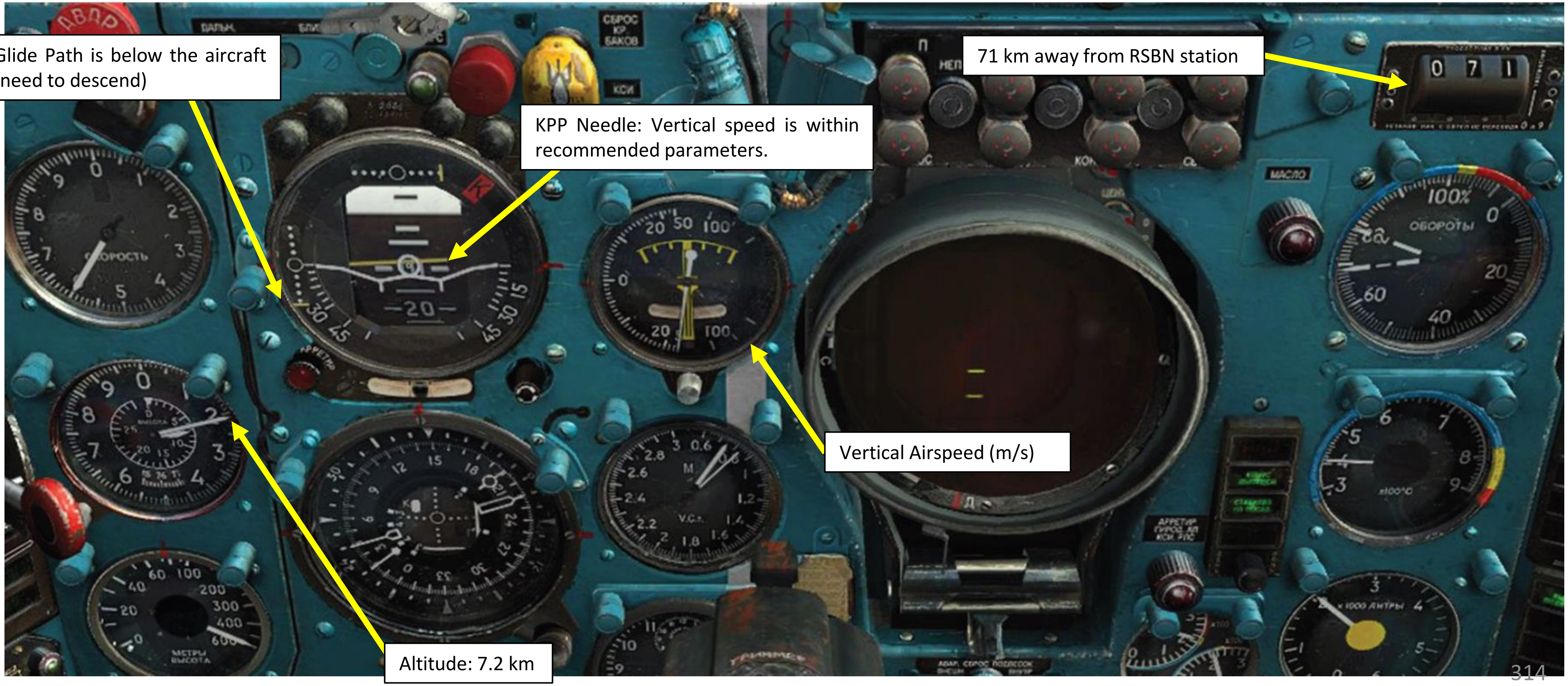
Image 9.10: Intercepting penetration glide

5 – RSBN (VOR) Navigation
5.3 - RSBN in Cloud Penetration / Descent Mode

1. Aircraft is below glide path – needles indicating path are above “horizon” on KPP Artificial Horizon and NPP Course Indicator.
2. Aircraft is above glide path – needles indicating path are below “horizon” on KPP Artificial Horizon and NPP Course Indicator.

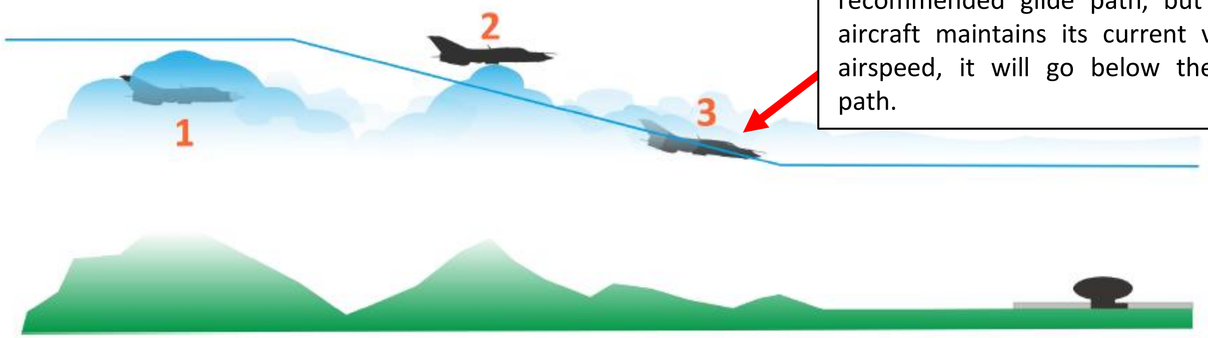
Current Situation: Aircraft is above glide path, but if the aircraft maintains its current vertical airspeed, it will meet the glide path.



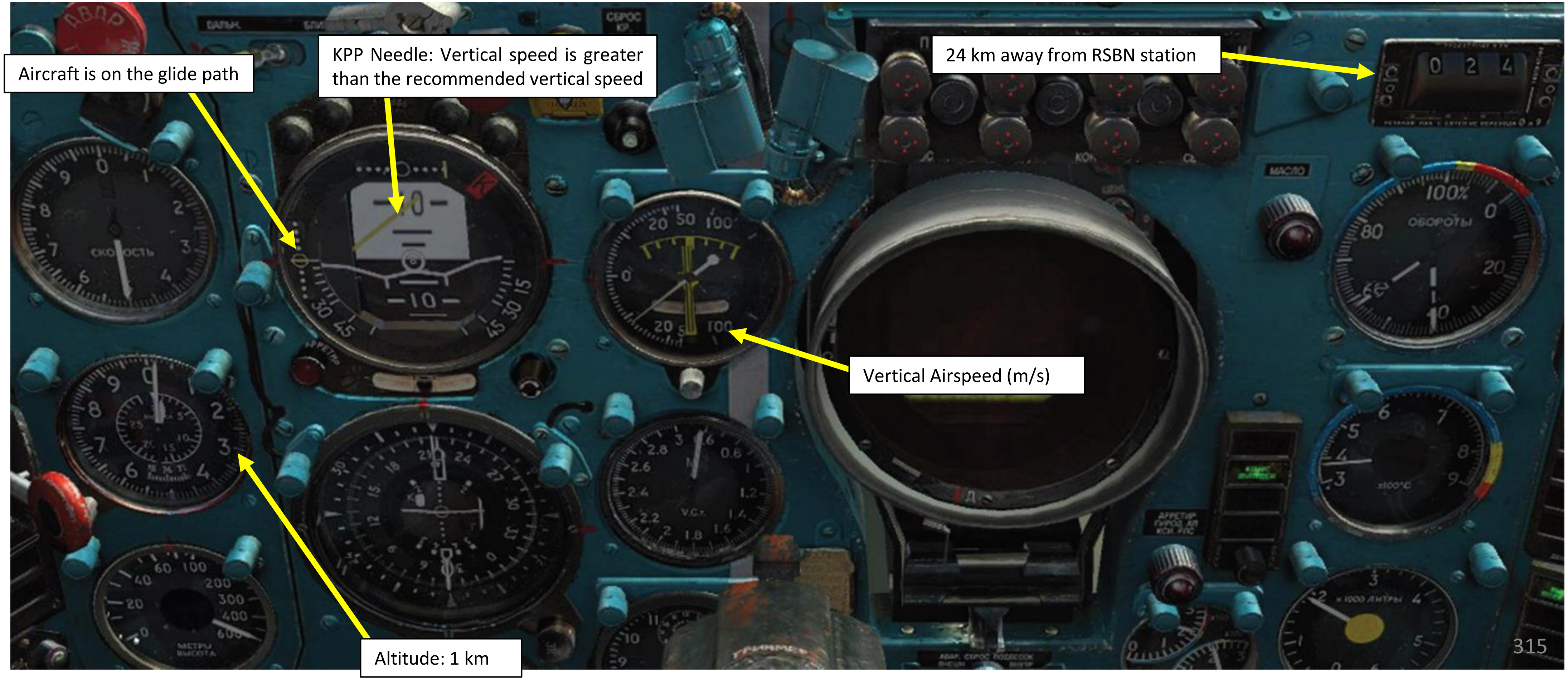


5 – RSBN (VOR) Navigation
5.3 - RSBN in Cloud Penetration / Descent Mode

3. Aircraft is on glide path, needles are on “horizon”.



Current Situation: Aircraft is on the recommended glide path, but if the aircraft maintains its current vertical airspeed, it will go below the glide path.



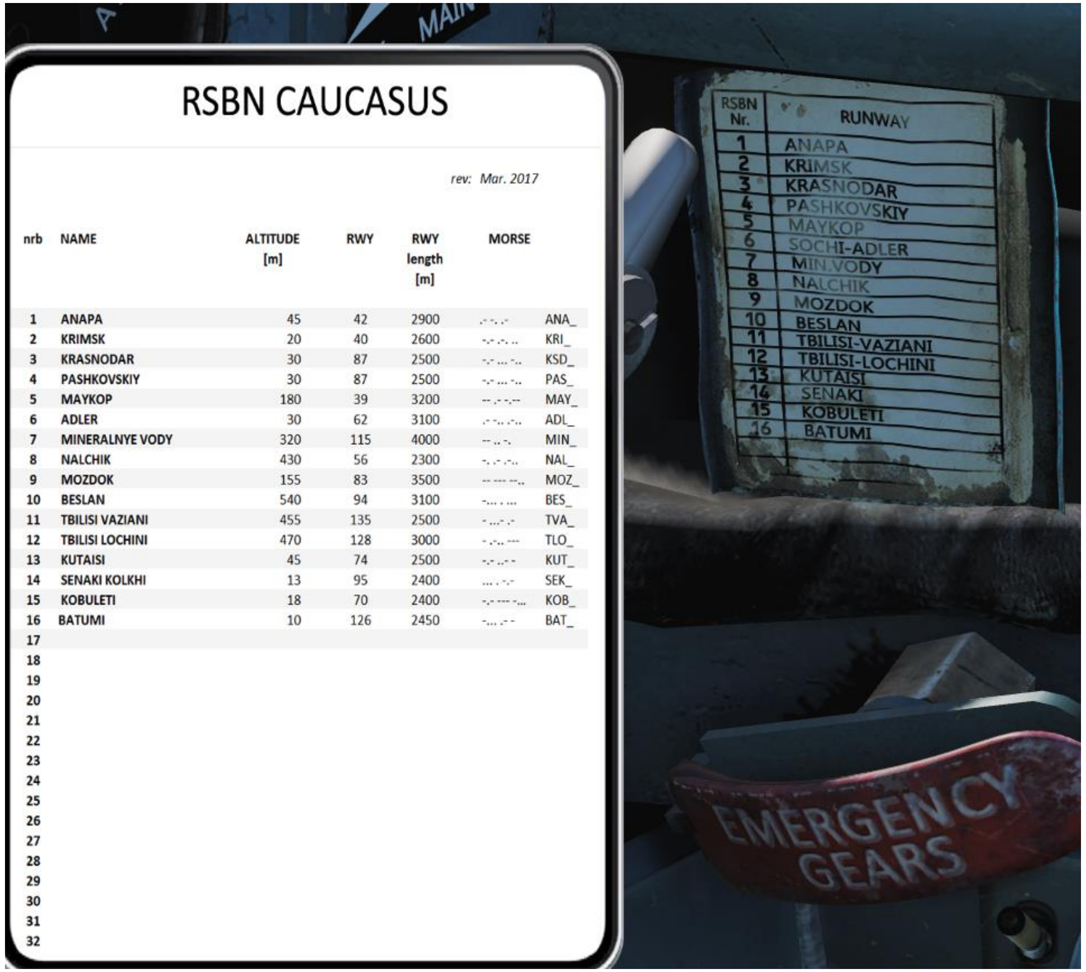
6 – PRMG Tutorial (Precision/Instrument Approach Landing)

The PRMG landing is basically an ILS landing but with russian systems.

An important distinction needs to be made between RSBN (VOR) and PRMG (ILS) stations: RSBN stations are used by civilian air traffic while PRMG stations are generally used by the Russian military only. Both systems are independent from one another. Furthermore, PRMG systems are only available for use if the Airfield Tower allows you to use it.

As in real life, PRMG systems are set for certain runways only, not for every single one. Tower Controllers in DCS will allow you to use certain runways in certain conditions only (bad weather and great winds for instance). As an example, PRMG systems will not be available if you have no head winds. However, PRMG station will be available if you have a strong headwind (5+ m/s) or low visibility, which will trigger the runway 090 in Krasnodar-Center to become the “active” (available) runway. If a PRMG beacon cannot be detected (even if you entered the right PRMG channel) in one of your missions, maybe the runway is not “active” since weather conditions do not require you to use a PRMG system.

For the Krasnodar-Center PRMG, we will use RSBN and PRMG stations 3 and 3. You can consult these frequencies on your kneeboard (RCTRL+UP) or in the cockpit.



nrb	NAME	ALTITUDE [m]	RWY	RWY length [m]	MORSE	
1	ANAPA	45	42	2900	.- -. .-	ANA_
2	KRIMSK	20	40	2600	-.- .-. ..	KRI_
3	KRASNODAR	30	87	2500	-.- ... -..	KSD_
4	PASHKOVSKIY	30	87	2500	-.- ... -..	PAS_
5	MAYKOP	180	39	3200	-- .- -.--	MAY_
6	ADLER	30	62	3100	.- -.. .-..	ADL_
7	MINERALNYE VODY	320	115	4000	-- .. -.	MIN_
8	NALCHIK	430	56	2300	-. .- .-..	NAL_
9	MOZDOK	155	83	3500	-- --- -..	MOZ_
10	BESLAN	540	94	3100	-...	BES_
11	TBILISI VAZIANI	455	135	2500	- ...- .-	TVA_
12	TBILISI LOCHINI	470	128	3000	- .-.. ---	TLO_
13	KUTAISI	45	74	2500	-.- ..- -	KUT_
14	SENAKI KOLKHI	13	95	2400	... . -.-	SEK_
15	KOBULETI	18	70	2400	-.- --- -...	KOB_
16	BATUMI	10	126	2450	-... .- -	BAT_
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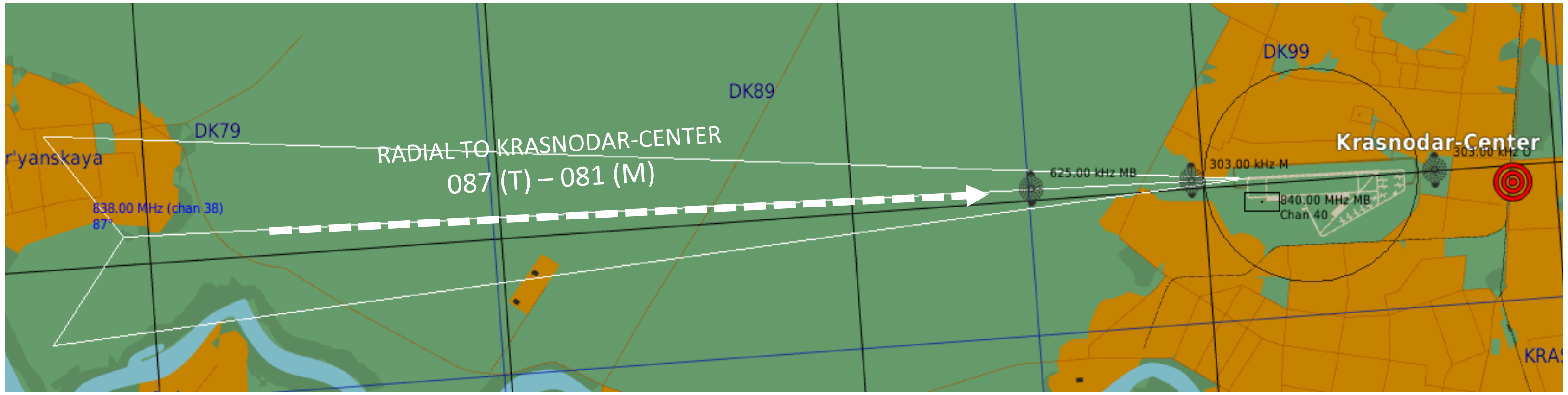
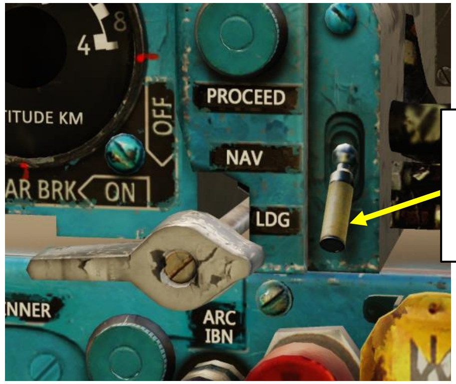


6 – PRMG Tutorial (Precision/Instrument Approach Landing)

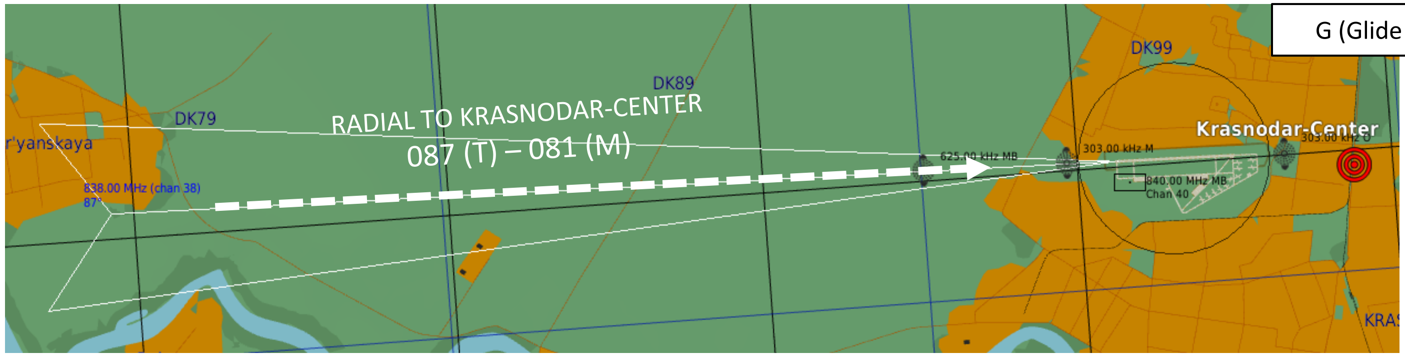
The Instrument Landing System (Rus. PRMG – ПРМГ – *Посадочная радиомаячная группа*) mode is used at a maximum range of 25 km from the selected PRMG station and in the direction of approach for landing. In this mode, the range (distance) indicator displays current distance to the PRMG station. The NPP needle continues to show the direction to the selected RSBN station which can be on the same airfield as the selected PRMG station.

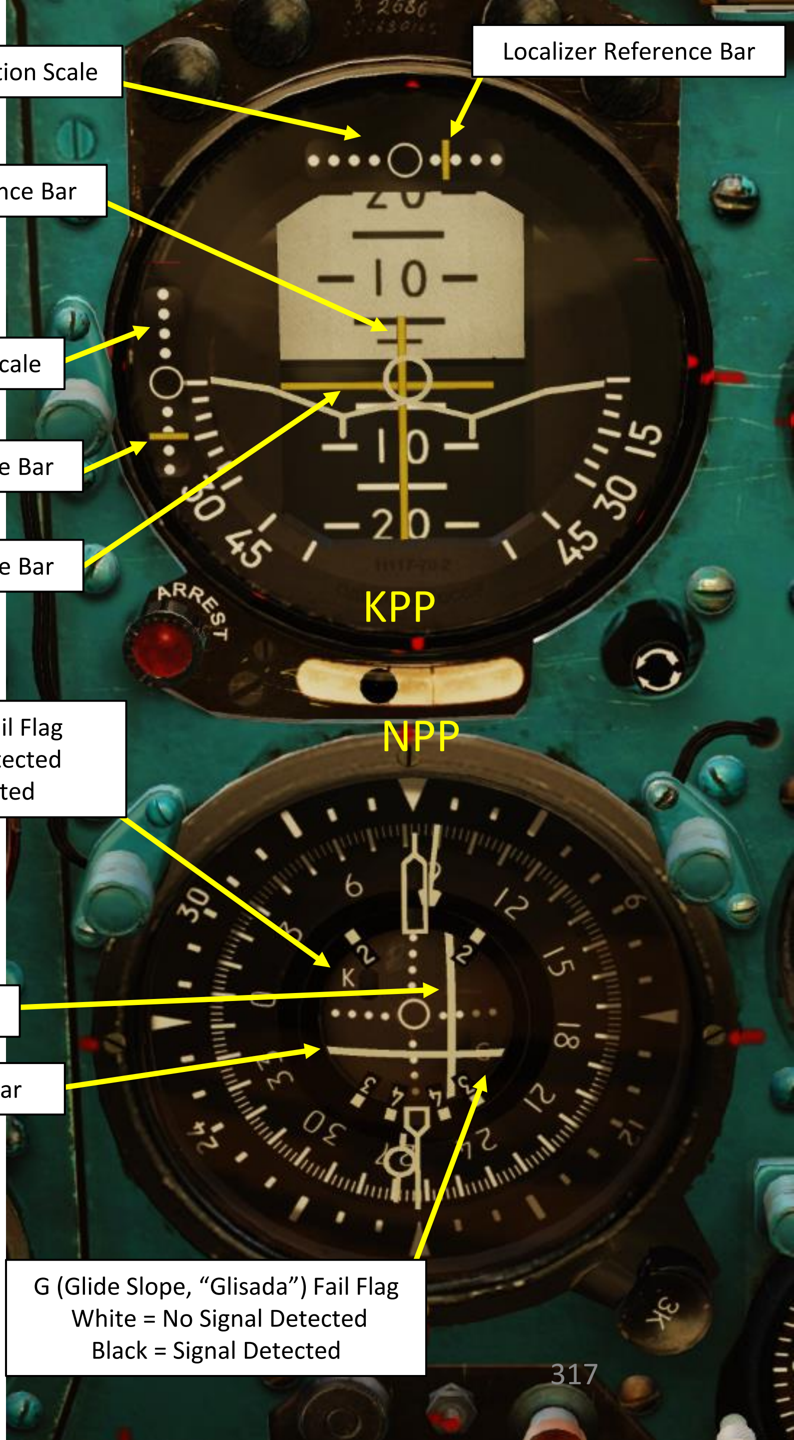
The NPP Course Indicator and KPP Artificial Horizon's localizer and glide path needles show the aircraft position in relation to the programmed approach flight path (deviation from the approach course and altitude). The Localizer and glide path blinkers are white if the PRMG signals are not acquired (airplane is outside the PRMG signal zones). When the aircraft is receiving PRMG signals, the localizer/glide path ("K"– course, "Г"– glide path) flashers will turn black.

It is advised to set up your approach using the **RSBN NAVIGATION** mode before using the RSBN LANDING mode since the Navigation mode has a much greater range.



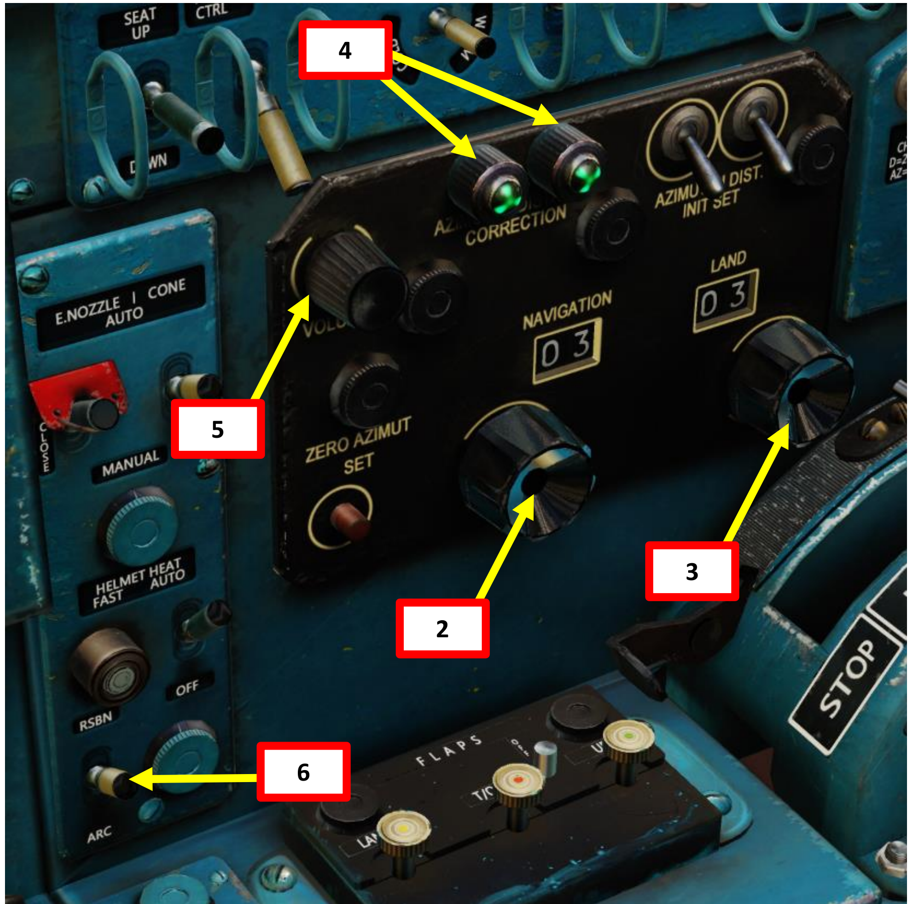
RSBN Mode Selector
- *UP: Descend (Proceed) Mode*
- *MIDDLE: Navigation Mode*
- *DOWN: Landing Mode*





6 – PRMG Tutorial
(Precision/Instrument Approach Landing)

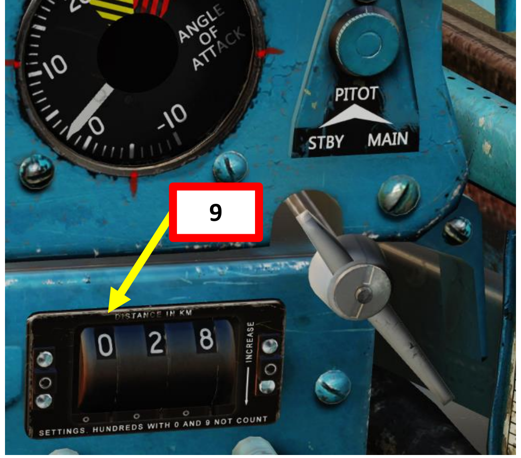
1. Set RSBN Power Switch – ON (UP)
2. Set RSBN (Navigation) Channel – As required for desired airfield (i.e. RSBN Channel 3 for Krasnodar-Center)
3. Set PRMG (Landing) Channel – As required for desired airfield (i.e. PRMG Channel 3 for Krasnodar-Center)
4. Confirm that both RSBN and PRMG Signal lights illuminate; this means that the station signals are received.
5. Adjust RSBN/PRMG Volume – As desired
6. Set RSBN/ARC Selector Switch – RSBN (UP). This will determines if NPP Course System needle points towards the selected RSBN or ARC station.

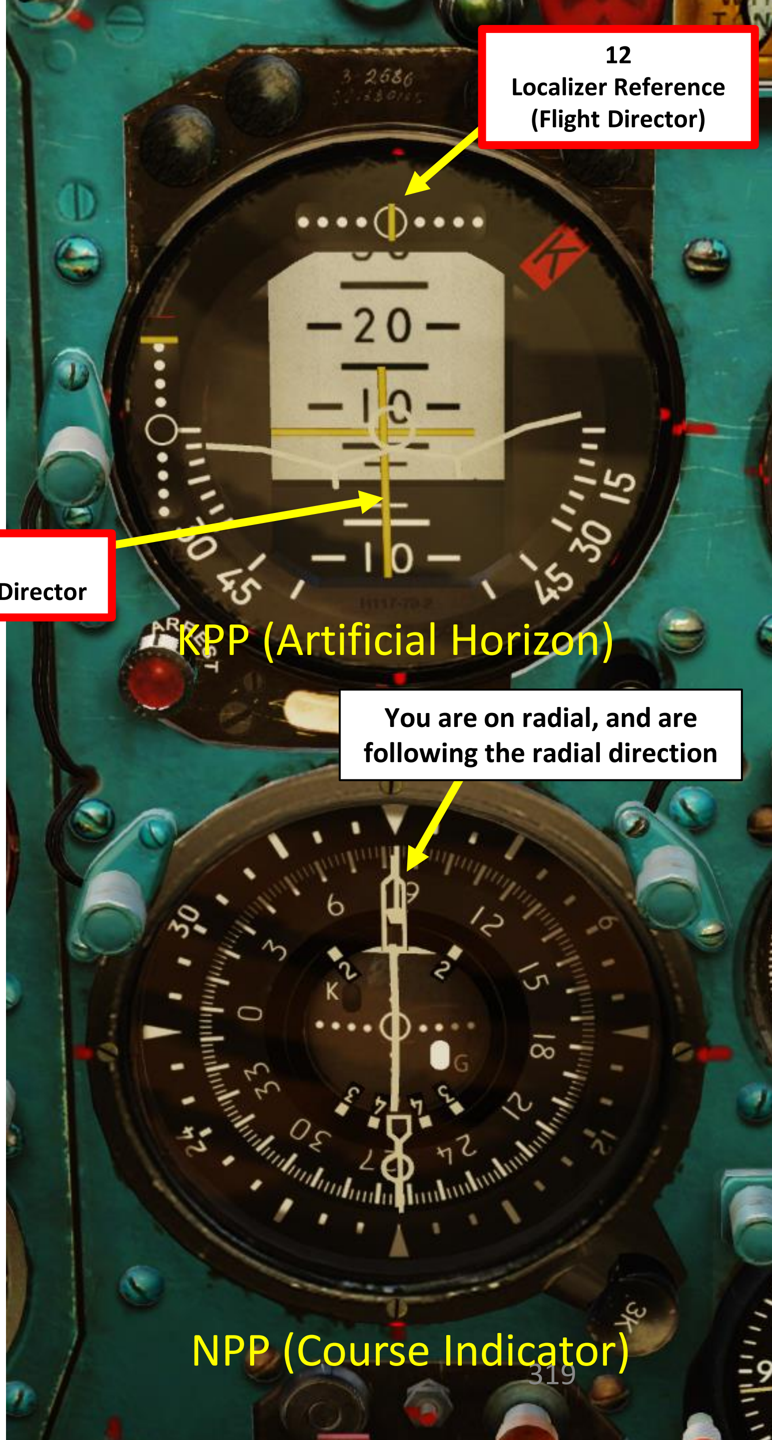


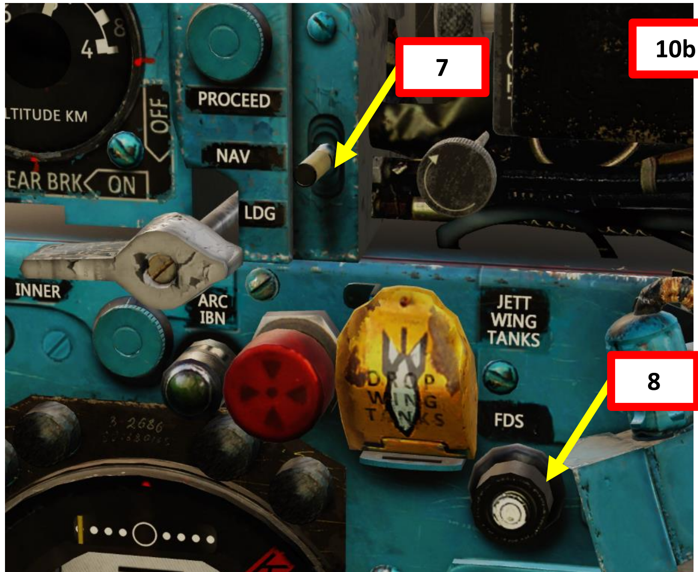
6 – PRMG Tutorial
(Precision/Instrument Approach Landing)

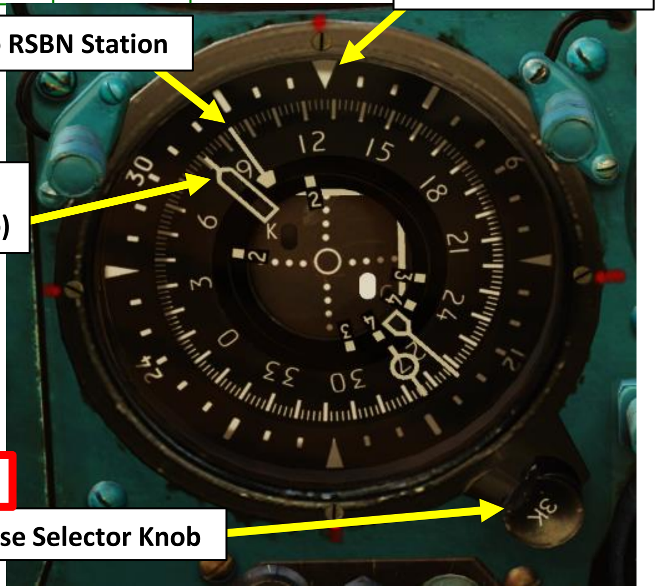
7. Set RSBN Mode Switch – Navigation (MIDDLE)
8. Hold FDS switch for 3-4 seconds to align NPP Course Indicator with magnetic compass.
9. Check the RSBN distance indicator: we currently are 28 km away from the beacon.
10. Rotate the 3-K knob with mousewheel to set the largest/longest end of the thick needle to 081, since this is the radial we intend to follow to the airfield. When both needles are aligned, you are surfing on the radial. It is YOUR job to know if you're going in the right direction (TO the RSBN or AWAY FROM the RSBN) as there is no TO/FROM indicator. Use common sense.
11. Verify that adequate engine power is set to maintain airspeed above 500-600 km/h
12. Steer aircraft to capture localizer and follow selected radial.

Distance from the ground station (km)	30	60	90	120	150	200
Minimum altitude (m)	530	1050	1570	2100	2620	3500



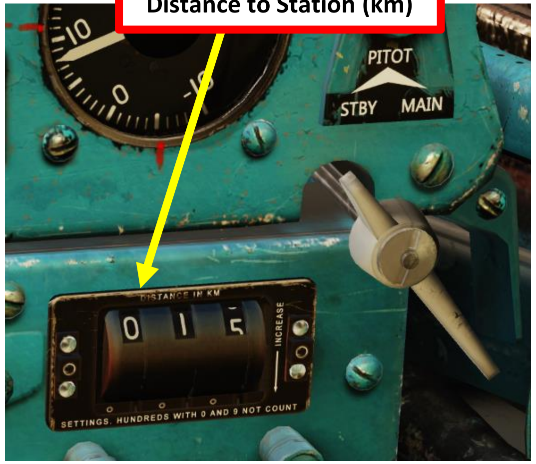


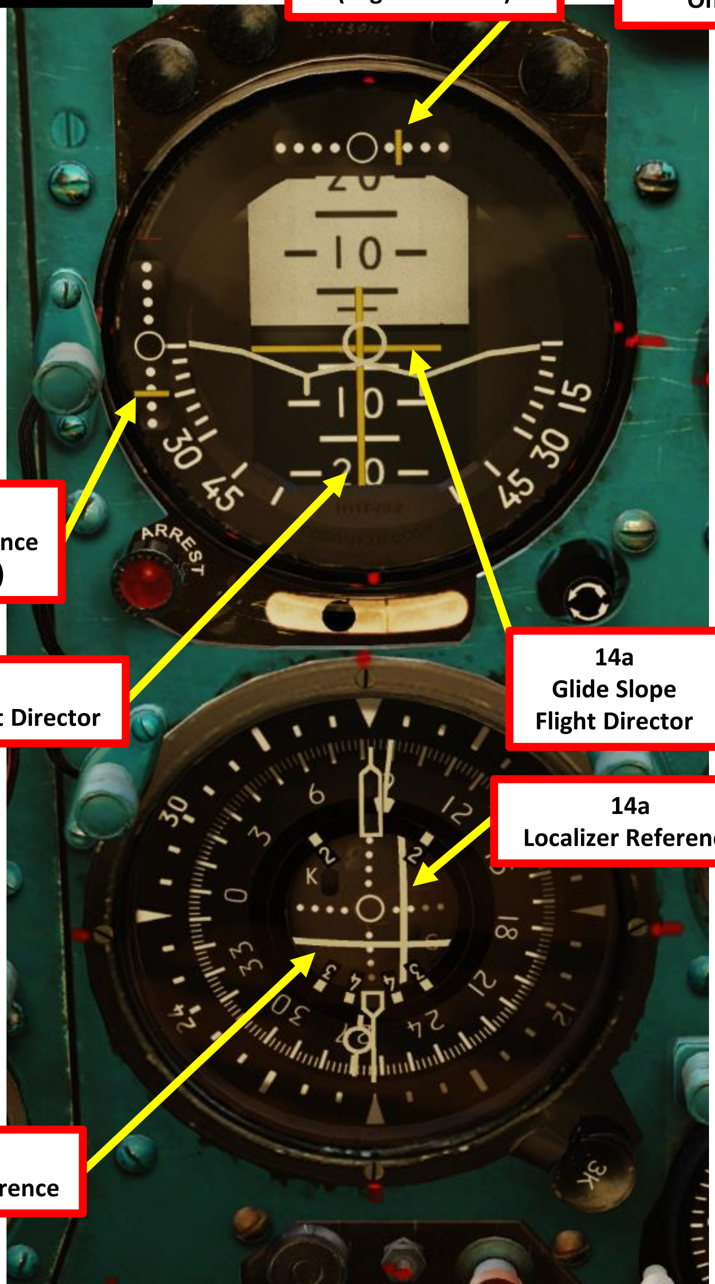


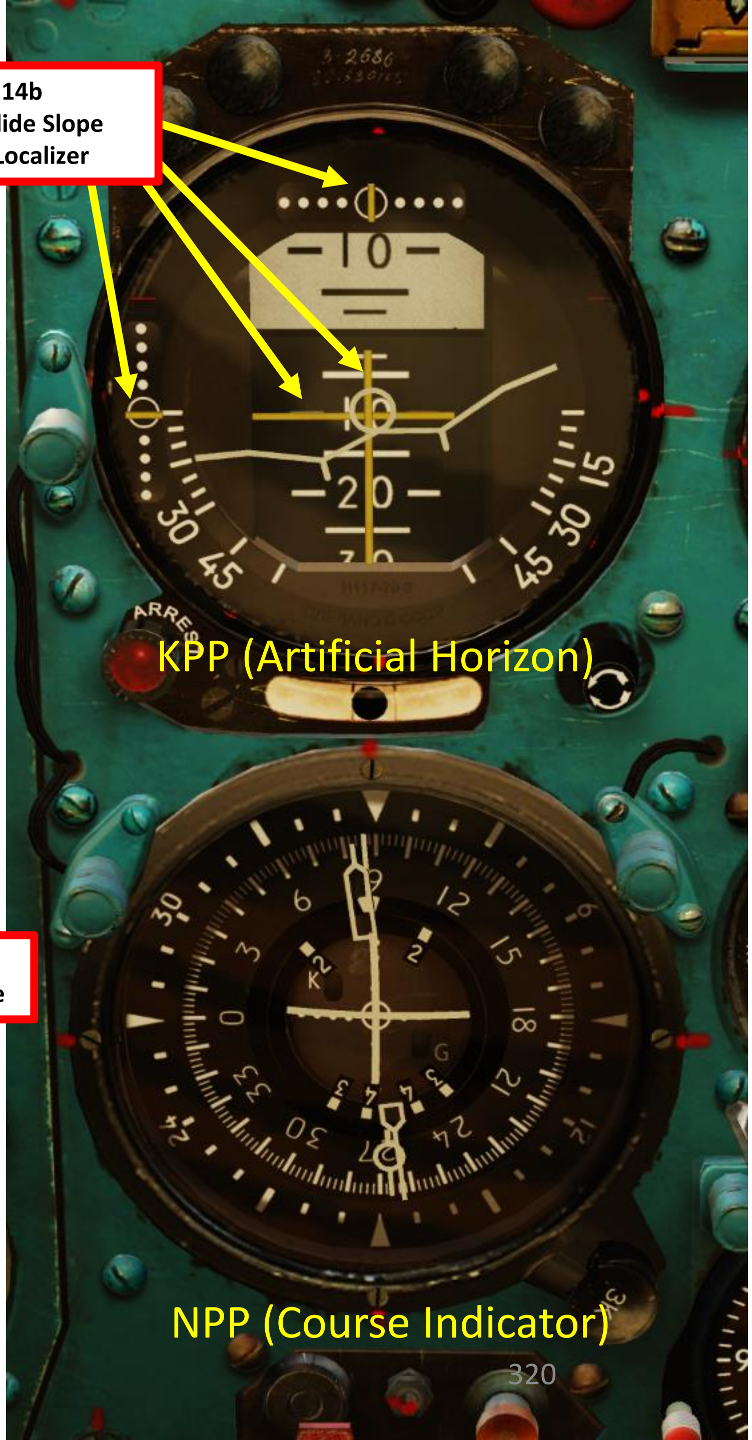


6 – PRMG Tutorial (Precision/Instrument Approach Landing)

13. When you are 20 km from the RSBN/PRMG station and following the radial to the runway, set RSBN Mode Selector Switch – LANDING (DOWN). Both localizer and glide slope flight director steering cues are now visible on the KPP Artificial Horizon.
    - If a red "T" and "K" are on your KPP, this means that you are not receiving a signal (beacon is more than 45 deg left or right from you).
14. Steer aircraft to capture localizer and glide slope.

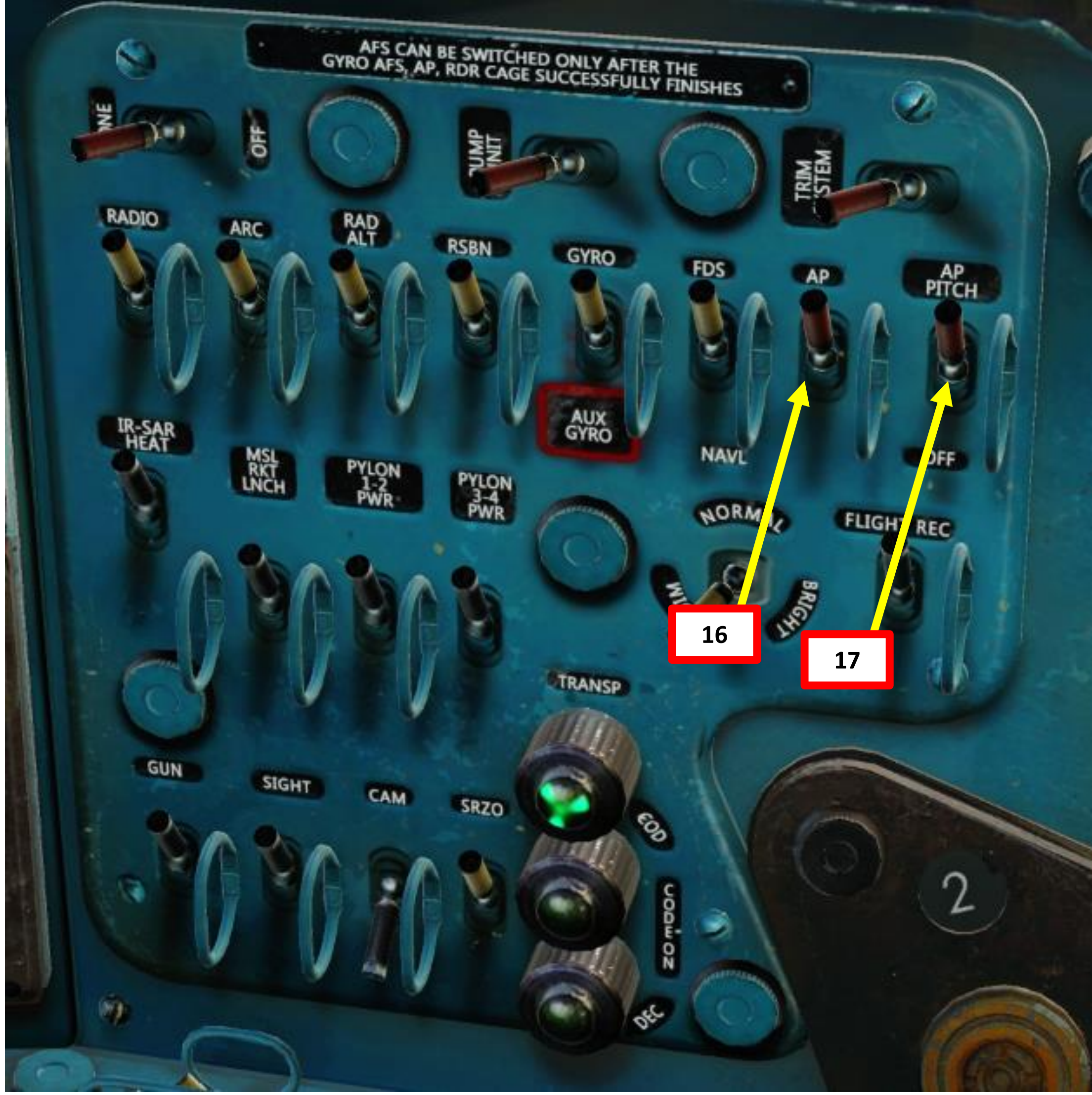


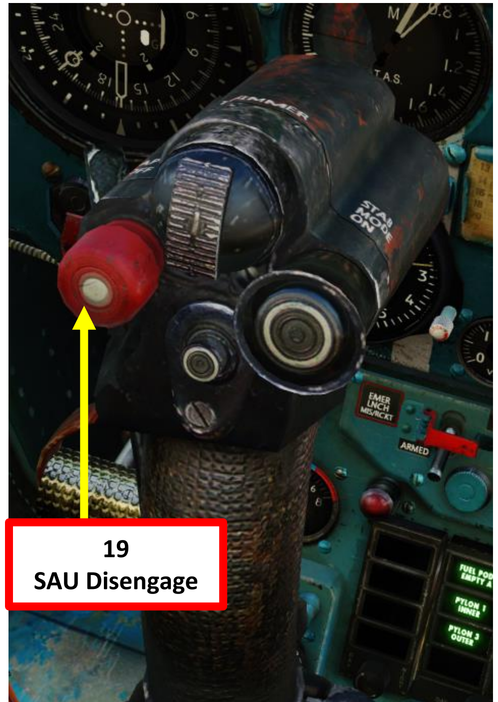




6 – PRMG Tutorial (Precision/Instrument Approach Landing)

15. (Optional) When you have successfully captured the glide slope and localizer, you can use the SAU Autopilot Automatic Landing Mode to fly the aircraft for you through the approach if desired.
16. (Optional) Set Autopilot Power Switch – ON (UP)
17. (Optional) Set Autopilot Pitch Power Switch – ON (UP)
18. (Optional) When aircraft has captured the localizer and glide slope, press SAU/Autopilot Automatic Landing Mode Button to engage Automatic mode (both DIRECT and AUTO lights illuminate when engaged). In this mode, the **autopilot controls flight control surfaces and steers the aircraft on the correct approach path**.
    - Make sure you are already on the correct flight path before engaging the autopilot; being above glide slope could cause the aircraft to perform violent negative G manoeuvers, causing engine flameout… while being below glide slope could cause the aircraft to pitch up and stall the aircraft.
    - Maintain throttle between 85-90 % N1 and maintain airspeed above 500 km/h.
19. (Optional) When you have the runway in sight, disengage Automatic Landing Mode. Press the "SAU Disengage" button on the stick ("LALT+LCTRL+A" binding).
    - The Automatic Landing Autopilot is meant to fly you through the approach, not land the aircraft for you.





6 – PRMG Tutorial (Precision/Instrument Approach Landing)

20. Set Landing/Taxi Light Switch – Landing (UP)
21. Set Navigation Lights Selector – BRIGHT (As Required)
22. Set Nosewheel Brake Control Lever – ON (Horizontal). This will maximize your braking capability for landing if you have a short runway.
23. Set power to 80-85 % N1 RPM. Throttle should be within the LND (Landing) zone.
24. Deploy landing gear at 1000 m AGL at 500 km/h.
25. Perform descent with a descent rate between 5 and 10 m/s (check variometer). Speed can be allowed to drop below 500 km/h but not below 400 km/h.
26. When reaching 600 m AGL and airspeed is below 500 km/h, set Flaps – Takeoff Position (25 deg). Confirm that FLAPS OUT light illuminates.
27. Maintain a descent rate of about 6 m/s and allow a further speed decrease to 380 km/h. Adjust airspeed with throttle, do not use Airbrakes.
28. If the airfield is equipped with an Outer and an Inner Marker beacon, the MARKER light will illuminate and marker signal sound (a short series of « beeps ») will be audible as you overfly these markers. For russian airfields:
    - The outer marker is typically set 4 km from the runway threshold
    - The inner marker is typically set 1 km from the runway threshold
29. When reaching the Outer Marker (4 km from the runway threshold) and maintaining 300 m AGL altitude and 380 km/h airspeed, set Flaps – Landing Position (45 deg).
30. Place the visible part of the aircraft's nose just below the runway threshold. If the runway is not visible, reduce angle of attack (AoA) and increase airspeed with throttle. Avoid using afterburner.
31. Adjust throttle to maintain N1 RPM between 83 % and 87 %.
32. When you are 1 km from the runway, you should be flying at the following parameters:
    - Altitude: 80 m AGL
    - Descent rate: 5 m/s
    - Airspeed: decreasing to 340 km/h (do not fly any slower than this).
33. You should be over the runway's touchdown point at 2 m altitude AGL. Decrease power and gently touch the runway by making small stick inputs. At this point, the aircraft will still have some lift reserve; increasing pitch could make you bounce.
    - Note: It is better to touch the runway gently at a higher speed than to hit the runway harder at a slower speed.
34. When the aircraft main wheels touch the ground, throttle back to IDLE and keep the nose up at about 5 deg pitch on the KPP (Artificial Horizon). Let the aircraft slow down by itself.

6 – PRMG Tutorial
(Precision/Instrument Approach Landing)

THE MERCILESS WORLD OF MULTIPLAYER (YIKES!)

Let’s face it: if you want to fly the MiG-21 in a multiplayer environment, you are a complete badass. Or completely insane, whatever floats your boat. F-15s have AMRAAM missiles and radars that can spot you before your RWR even senses anything. Most of your systems are somehow “primitive” when compared to what is used on modern jets. This is why even if I could write a long, exhaustive guide on the tactics used during the Vietnam War against Thunderchiefs, Phantoms, Crusaders and the likes… they would not be of much use against opponents that will not fight you on even terms, with weapons and systems that are generations ahead from yours. The MiG-21 pilot’s mind must be sharp and creative.

Predrag and Nenad Pavlovic wrote an interesting document on how to fly the MiG-21 to its strengths. It is called “Making the Best of the MiG-21”. I recommend you check it out, it’s a very interesting read!
https://drive.google.com/open?id=0B-uSpZROuEd3SlphQlItbWJLRm8&authuser=0

THE MERCILESS WORLD OF MULTIPLAYER (YIKES!)

Some pilots have some success in the MiG-21 in multiplayer in a modern setting, but they are few and far between. My main tip is to NOT fly alone. Get a wingman!

In modern scenarios, experienced DCS MiG-21 pilots recommend to fly in the mountain areas and to use them as a way to deny modern jets of their radar range and insane missile range. Flying on a flat landscape is the best way to be shot down by an AIM-120. Mountains offer concealment where you can use surprise to your advantage. The MiG-21 with afterburner is faster than the Su-27 and the F-15 (without their afterburners). Use that to your advantage.

Using your radar makes you very visible. Most people will be able to see you without you being able to see them. However, you can use it to your advantage. If you use your radar for a few seconds, wait for someone to paint you with their radar, turn off your radar and hit the deck… your RWR will give a direction of where the enemy radar's signature came from. Basically, you bait the enemy by using your radar.

<u>Note: If anyone has viable MiG-21 tactics online, feel free to share them with me. I will upload the guide with more information for all you MiG-21 heroes.</u>

GCI: Ground-Controlled Interception

The USSR used interception tactics based on the GCI (Ground-Controlled Interception) model: flights of interceptors would be scrambled and directed to targets by ground controllers, like the British were during the Battle of Britain with the Dowding System. By turning on their radars in the vicinity of targets only, interceptors could minimize their detectability (since your radar radiation "warns" the enemy RWR when it is scanning) and use surprise to their advantage. This strategy proved to be rather effective during the Vietnam war.

If you are having a hard time finding targets, do like the real MiG pilots did: use AWACS (or radar stations you can communicate with) to give you bearings towards targets. Request BOGEY DOPE.

The AWACS will often give you a BRA (Bearing, Range, Altitude) callout relative to your position if it is at a range of 50 nautical miles or less.

- Example: "117, 1, BRA, 265 for 130, at 11000, flanking.".
    - In this case, 117 is your 3-digit designation number. BRA means "Bearing Range Altitude". The alternative to BRA is BULLSEYE.
    - 265 for 130 means the target is at a heading of 265 in relationship to you at 130 km.
    - At 11,000 means an altitude of 11 km (11000 m).
    - "Flanking" refers to the target's aspect (where is it going in relationship to you?). A "flanking" bandit is showing his side to you, a "hot" bandit is heading straight to you and a "cold" bandit is flying away from you.

If the target's range is more than 50 nm, the AWACS will give you a bullseye callout. This callout is not much different from a BRA callout: the locations are simply given in relationship to a reference point in space other than yourself. This is what people call a "bullseye" in pilot lingo.

Here is a quick n' dirty tutorial about BULLSEYE by JEDILINKS from the 104th Phoenix Virtual Fighter Bomber Squadron: https://www.youtube.com/watch?v=vgcXcfeGb2M

OTHER INTERESTING RESOURCES AND USEFUL STUFF

476TH VFG MIG-21BIS FLIGHT CREW CHECKLIST
https://drive.google.com/open?id=0B-uSpZROuEd3S1I1cG9XbHZPaWM&authuser=0

XXJOHNXX YOUTUBE CHANNEL – MIG-21 TUTORIALS
https://www.youtube.com/playlist?list=PLs4yzB9MM2SwJTc8yho5o2H0K-RA5OA9G

BUNYAP'S YOUTUBE CHANNEL – TEST FLIGHT SERIES
https://www.youtube.com/watch?v=6y8Vv0D7Vjk&list=PLoiMNu5jyFzQejy-Q3ajLezINgNyXrxSt

LINO_GERMANY'S NAVIGATION MAP
http://www.digitalcombatsimulator.com/en/files/588673/

MONTYPYTHON76'S MIG-21 COCKPIT LAYOUT CHART
http://www.digitalcombatsimulator.com/en/files/1026153/

CLASHES: AIR COMBAT OVER NORTH VIETNAM 1965-1972
A great book written by Marshall L. Michel III, which also includes tactics used by MiG-21 pilots during the Vietnam war. It's a fascinating read. Highly recommended.

MIKOYAN MIG-21 (FAMOUS RUSSIAN AIRCRAFT)
Another book on the MiG-21 written by Yefim Gordon. It's a real encyclopedia, but it is a very rare book (which is outrageously expensive for some reason).

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

PREDRAG AND NENAD PAVLOVIC'S "MAKING THE BEST OF THE MIG-21".
https://drive.google.com/open?id=0B-uSpZROuEd3SlphQlItbWJLRm8&authuser=0

THANK YOU TO ALL MY PATRONS

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