DCS GUIDE

MiG-21bis

By Chuck

LAST UPDATED: 14/09/2019

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

CONTROLS SETUP

THESE CONTROLS SHOULD BE MAPPED TO YOUR JOYSTICK AND ARE ESSENTIAL. NAMES ON LEFT COLUMN ARE WHAT YOU SHOULD LOOK FOR IN THE “ACTION” COLUMN OF THE CONTROLS SETUP MENU IN DCS. DESCRIPTION OF ACTION IS ON THE RIGHT COLUMN.

• **INTERCOMM MENU**	**ALLOWS YOU TO USE RADIO MENU WHILE FLYING**
• **AIRBRAKE SWITCH, ON/OFF**	**DEPLOYS/RETRACTS AIRBRAKES**
• **DRAG CHUTE ACTIVATE / DISCONNECT**	**DEPLOYS CHUTE / DETACHES CHUTE ONCE DEPLOYED**
• **DROP CENTER FUEL POD**	**DROPS CENTRAL FUEL DROP TANK**
• **FIRE GUN**	**FIRES GUN**
• **FLAPS IN (JOYSTICK)**	**RETRACTS FLAPS**
• **FLAPS LANDING**	**DEPLOYS FLAPS IN LANDING POSITION**
• **FLAPS TAKE-OFF**	**DEPLOYS FLAPS IN TAKEOFF POSITION**
• **GEARS UP / DOWN**	**RETRACTS/DEPLOYS LANDING GEAR**
• **SPRD DROP / OR ASO DROP CHAFF FLARES**	**DEPLOYS CHAFF AND FLARES**
• **TRIM PITCH DOWN / UP**	**TRIM ELEVATOR DOWN OR UP**

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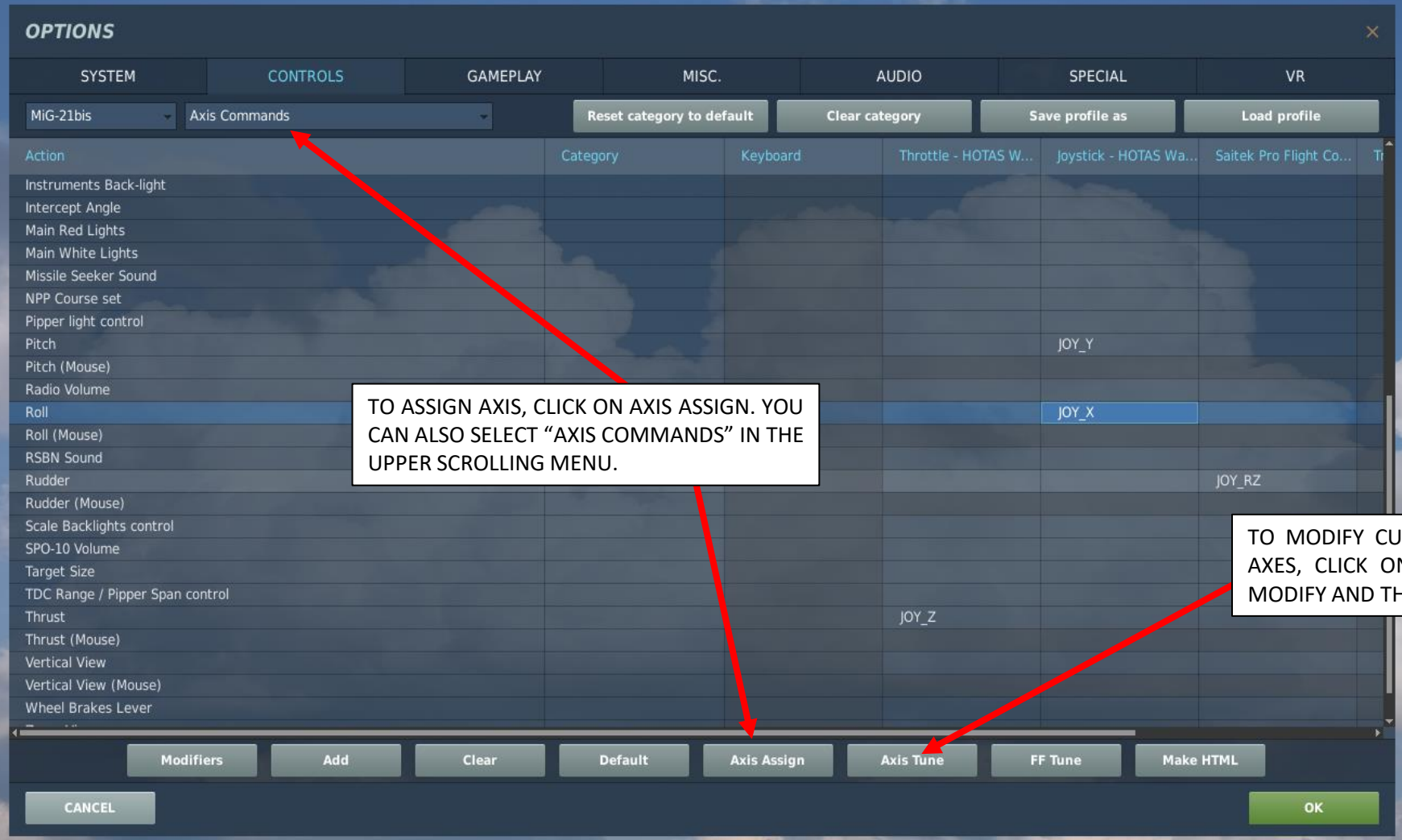
• **START ENGINE**	**ENGINE STARTER**
• **TDC RANGE / PIPPER SPAN +**	**TDC USED FOR RADAR RANGE ADJUSTMENT**
• **TDC RANGE / PIPPER SPAN -**	**TDC USED FOR RADAR RANGE ADJUSTEMENT**
• **TARGET LOCK ON**	**LOCK TARGET WITH RADAR**
• **WEAPONS RELEASE**	**USED FOR MISSILES, BOMBS AND ROCKETS**
• **WHEEL BRAKES**	**PUTS ON THE BRAKE (LIKE A CAR BRAKE)**
• **ZOOM IN SLOW**	**ALLOWS YOU TO ZOOM IN**
• **ZOOM OUT SLOW**	**ALLOWS YOU TO ZOOM OUT**


SPRD Drop / Or ASO drop Chaff Flares
TRIM NOSE DOWN
TRIM NOSE UP
TDC RANGE +
TDC RANGE -
ZOOM IN SLOW
TARGET LOCK
ZOOM OUT SLOW
WEAPONS RELEASE
GUN TRIGGER
P
Drop Ventral Fuel Tank
BRAKE LEVER (PADDLE)
Airbrake ON
Airbrake OFF
Deploy Drag Chute
Detach Drag Chute

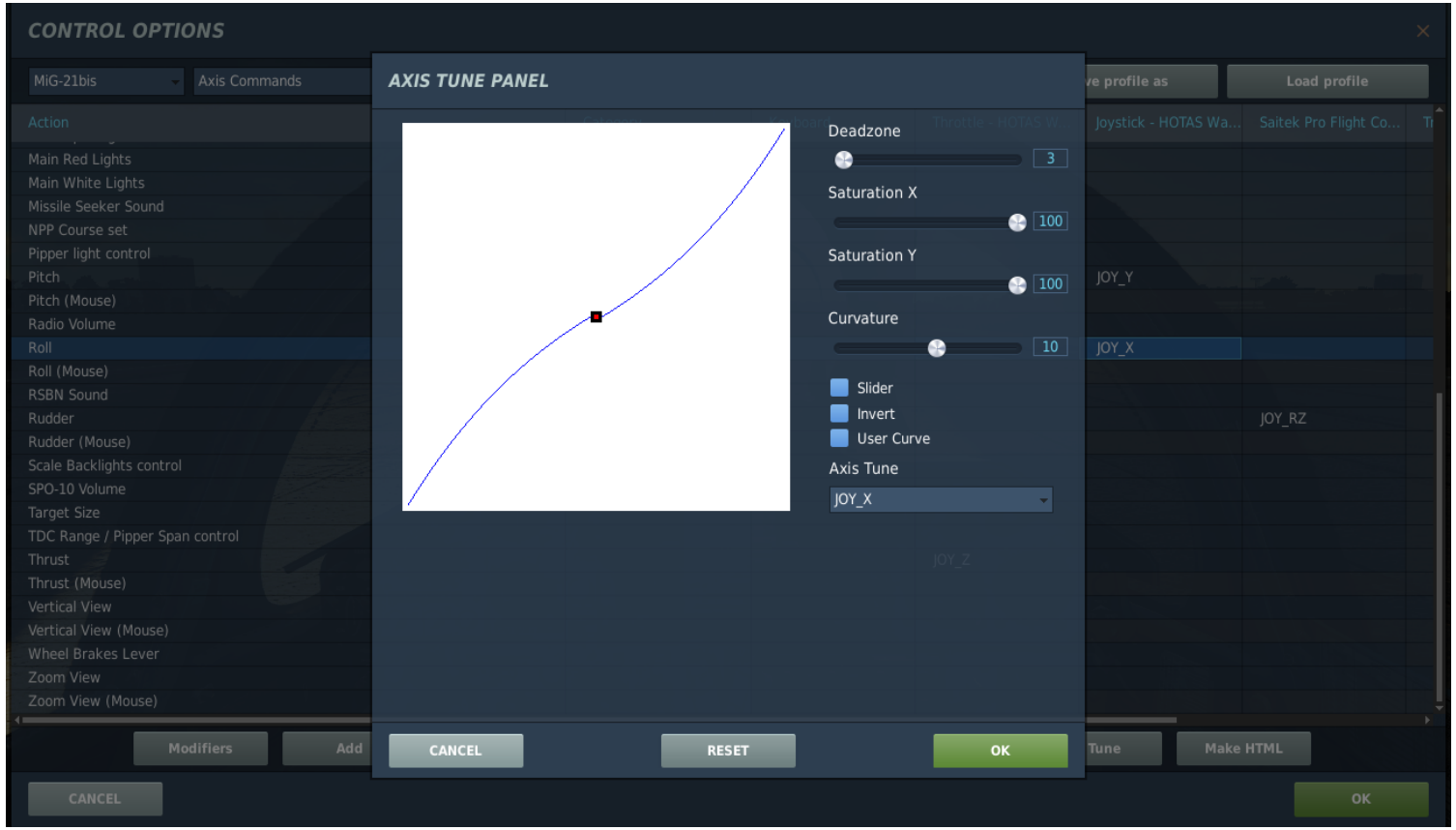
CONTROLS SETUP



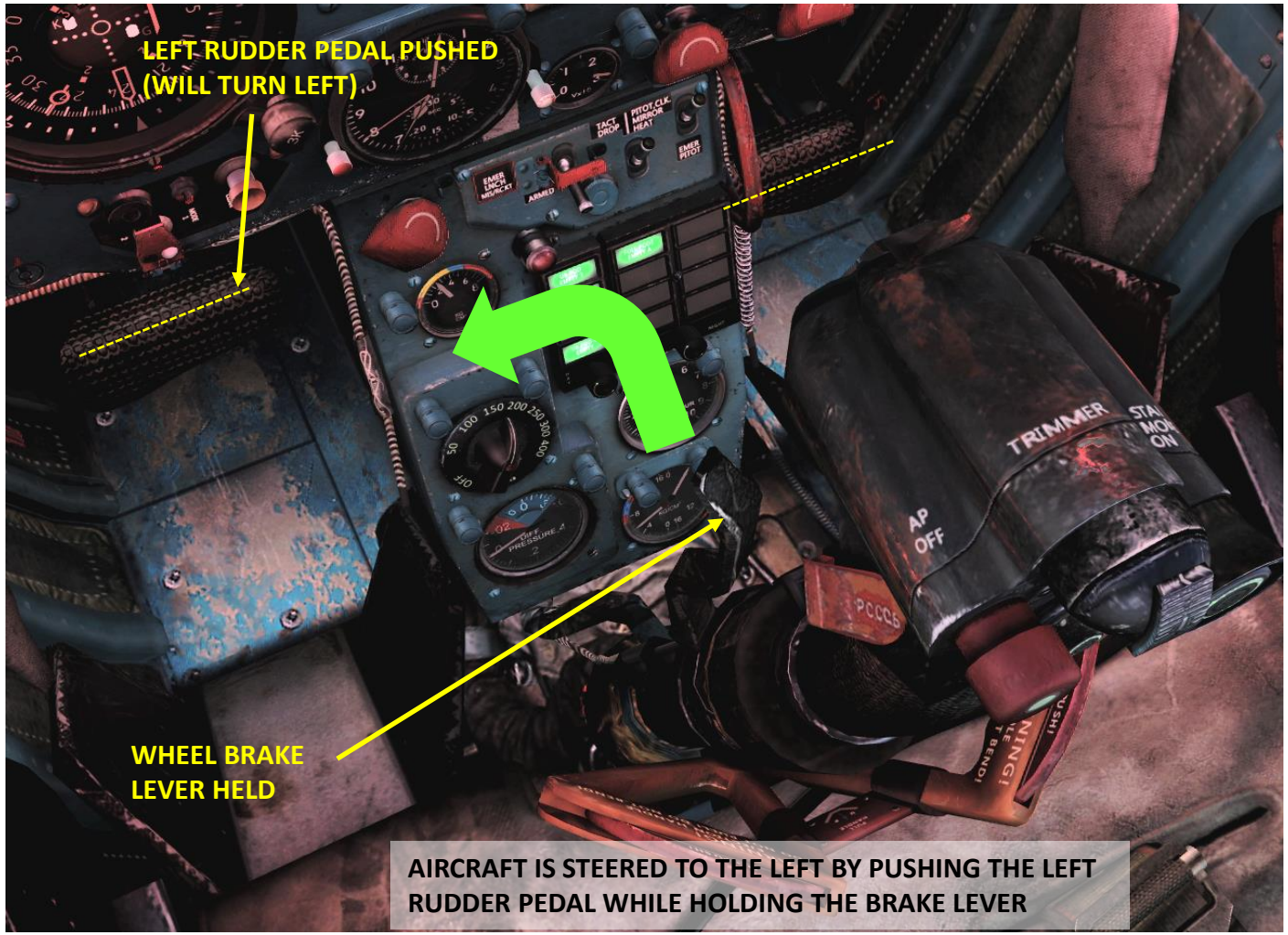
CONTROLS SETUP

BIND THE FOLLOWING AXES:

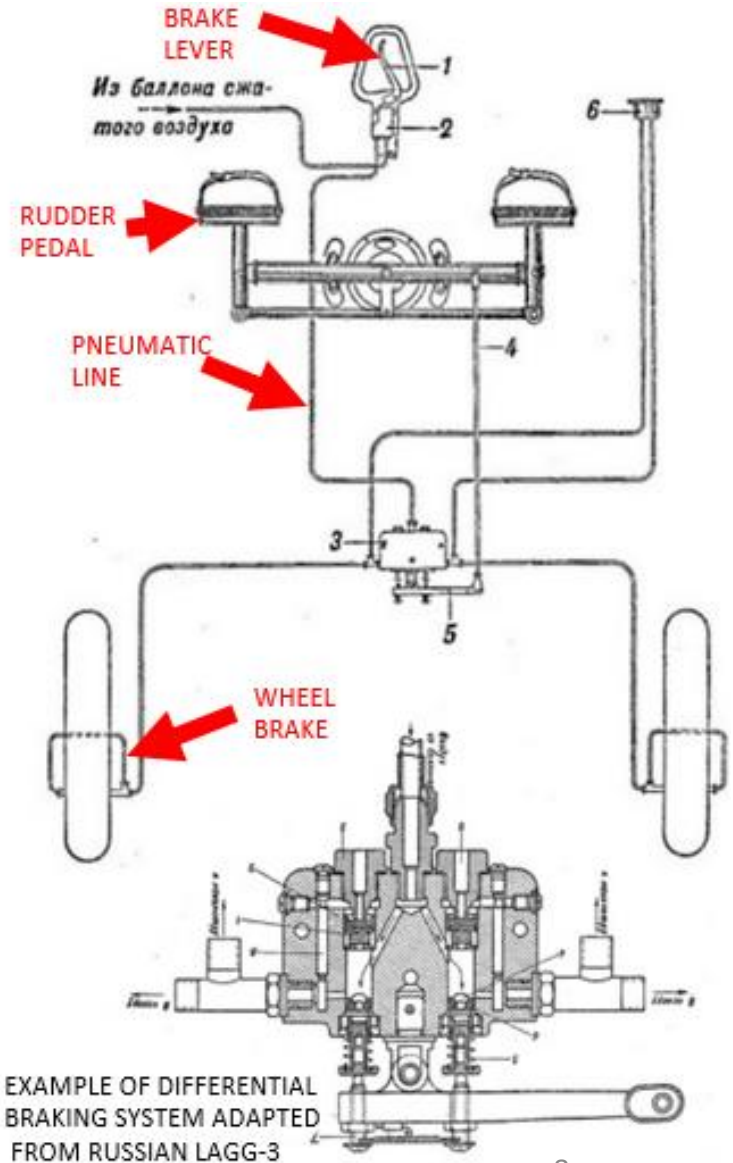
- PITCH (DEADZONE AT 3, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 20)
- ROLL (DEADZONE AT 3, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 10)
- RUDDER (DEADZONE AT 5, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 20)
- THROTTLE – CONTROLS ENGINE RPM



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

PART 2 – COCKPIT & GAUGES

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

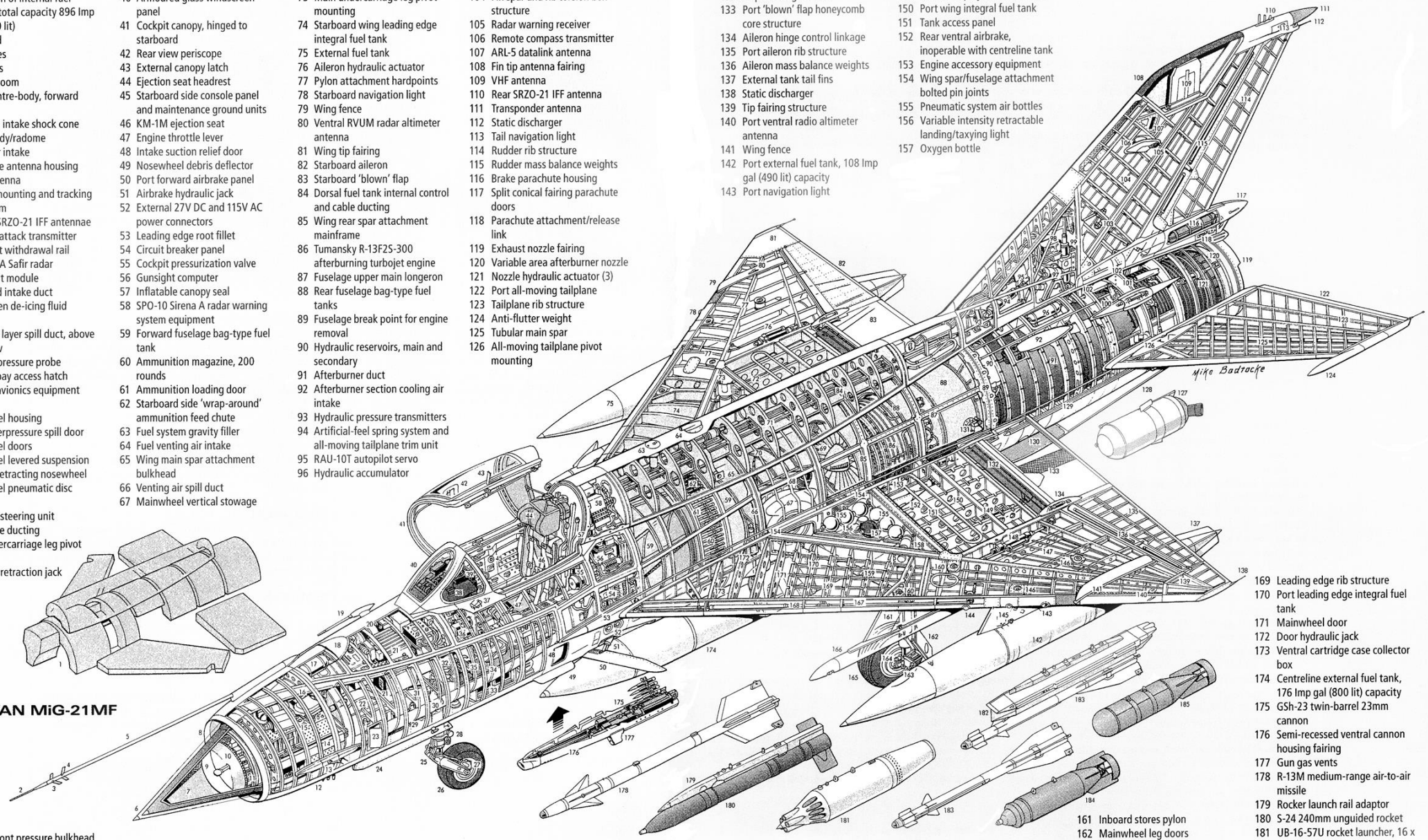
40 Armoured glass windscreen panel
41 Cockpit canopy, hinged to starboard
42 Rear view periscope
43 External canopy latch
44 Ejection seat headrest
45 Starboard side console panel and maintenance ground units
46 KM-1M ejection seat
47 Engine throttle lever
48 Intake suction relief door
49 Nosewheel debris 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



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

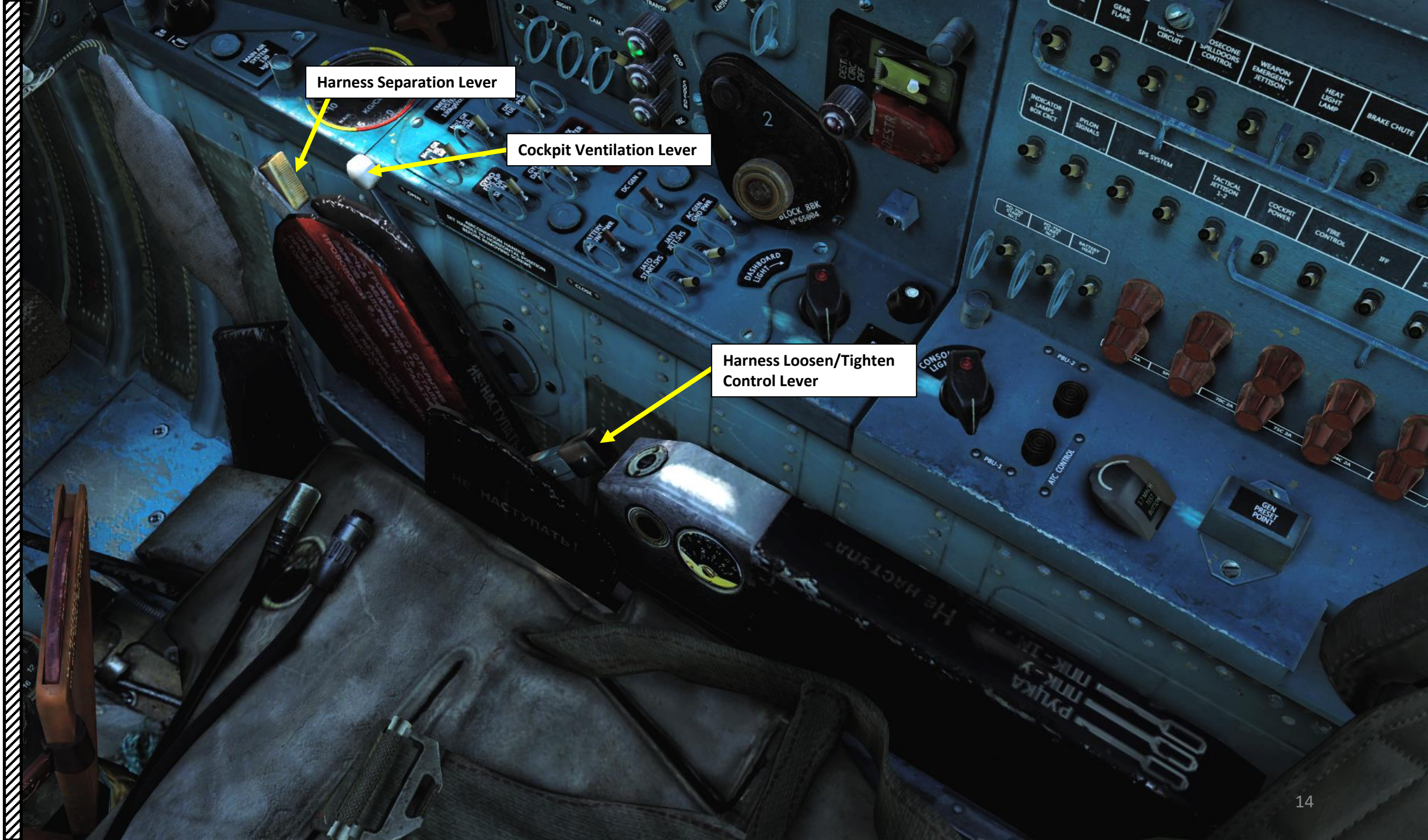
158 Main undercarriage leg pivot mounting
159 Hydraulic retraction jack/lock strut
160 Inboard pylon attachment hardpoints

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

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

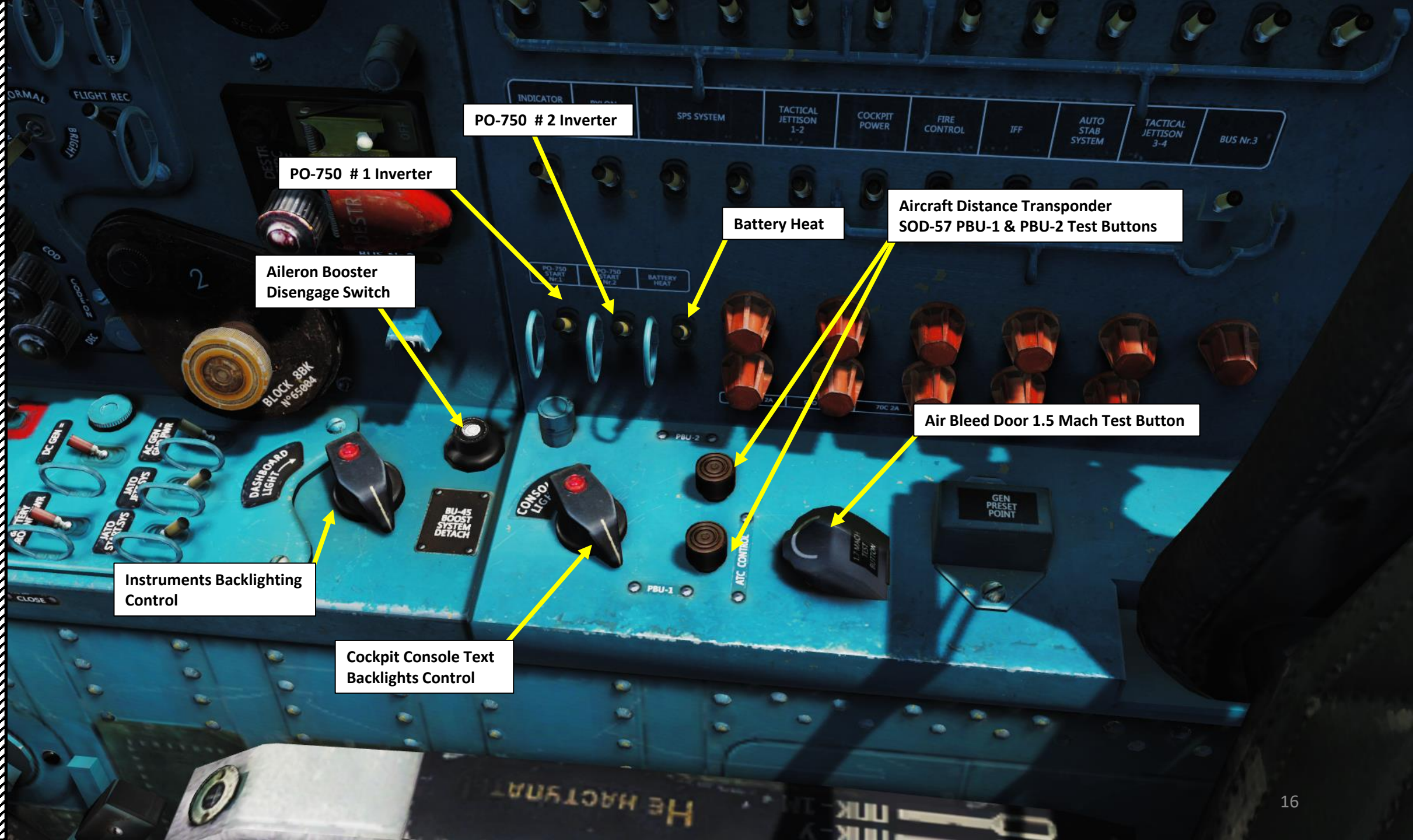
SYSTEM	DESCRIPTION
AGD/GIRO	ATTITUDE INDICATOR / ARTIFICIAL HORIZON
ARC (ARK)	AUTOMATIC RADIO COMPASS
ARU	HORIZONTAL TAIL MOVEMENT CONTROL SYSTEM
ASP	OPTICAL AIMING DEVICE (GUNSIGHT)
ILS	INSTRUMENTAL LANDING SYSTEM
IR	INFRARED
KPP (AGD/GIRO)	ARTIFICIAL HORIZON (AGD/GIRO)
KSI/FDS	COURSE AND GROUND NAVIGATION RADIO STATION INDICATOR
NPP (KSI/FDS)	COURSE AND GROUND NAVIGATION RADIO STATION INDICATOR (KSI OR FDS)
PO-750	DC TO AC CONVERTER
PRMG	RUSSIAN EQUIVALENT OF INSTRUMENTAL LANDING SYSTEM (ILS)
RP-22	RADAR
RSBN	TACTICAL RADIO NAVIGATION SYSTEM
SARPP	“BLACK BOX” (FLIGHT RECORDER)
SAU	AUTOPILOT
SOD	TRANSPONDER
SPO	RADAR WARNING RECEIVER (RWR)
SPS	FLAPS BOUNDARY LAYER BLOWING CONTROL SYSTEM
SRZO	IDENTIFICATION FRIEND/FOE SYSTEM (IFF)
SPRD (RATO)	ROCKET BOOSTERS USED FOR TAKEOFF
SUA	DANGEROUS ANGLE OF ATTACK (AOA) WARNING LIGHTS
TDC	TARGET DESIGNATION CUE (ON RADAR SCREEN)
UUA	ANGLE OF ATTACK INDICATOR

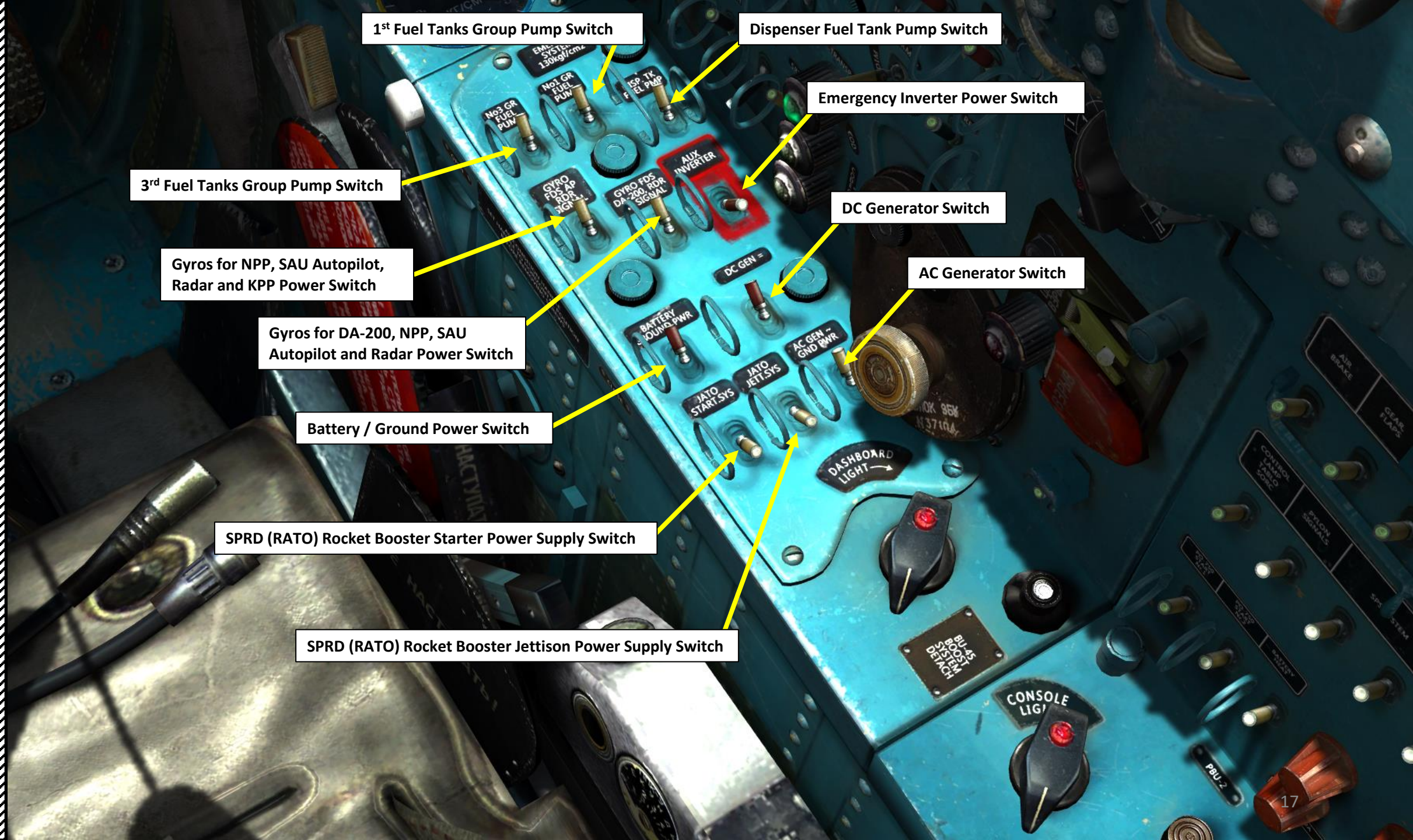
PART 2 – COCKPIT & GAUGES

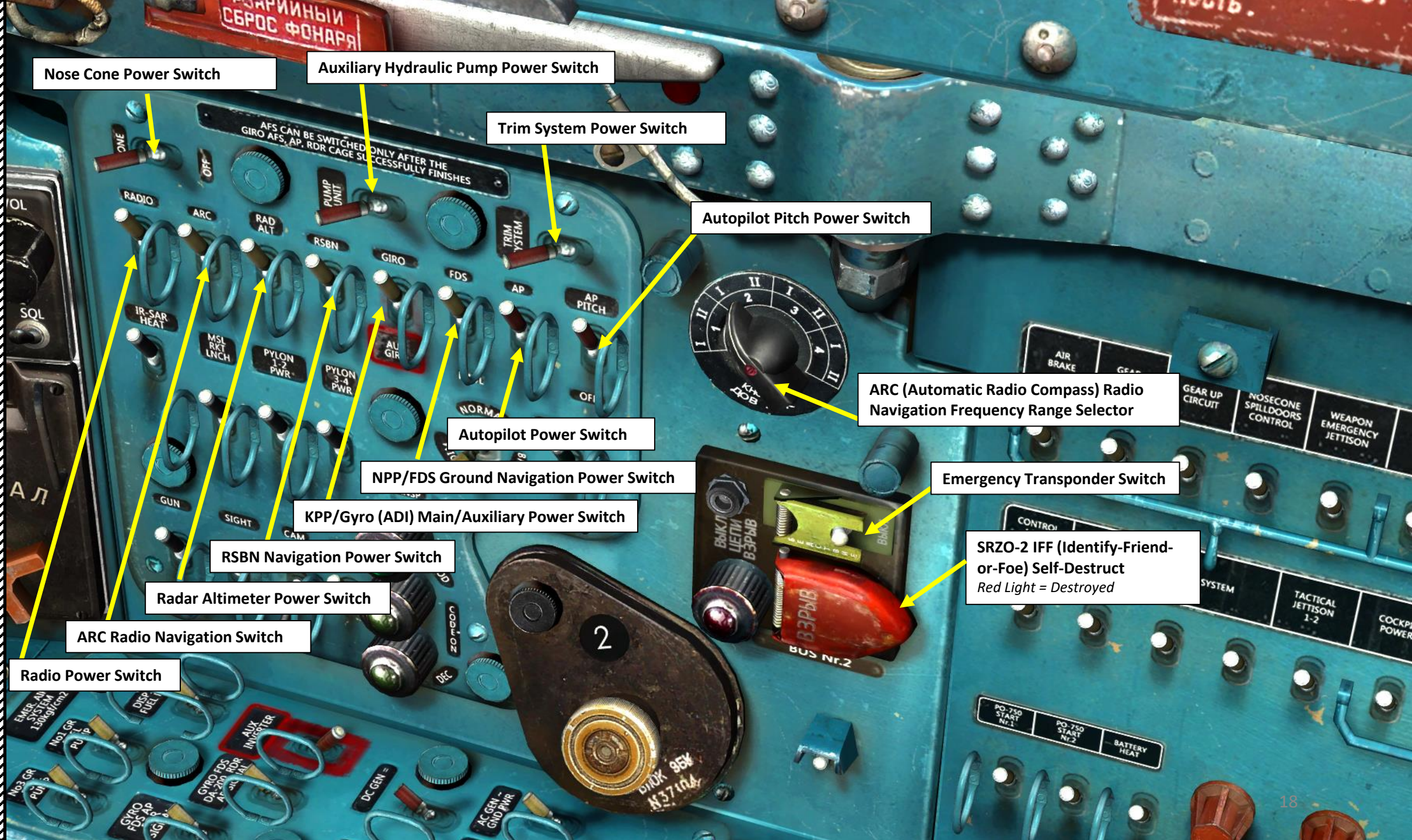

Harness Separation Lever
Cockpit Ventilation Lever
Harness Loosen/Tighten Control Lever

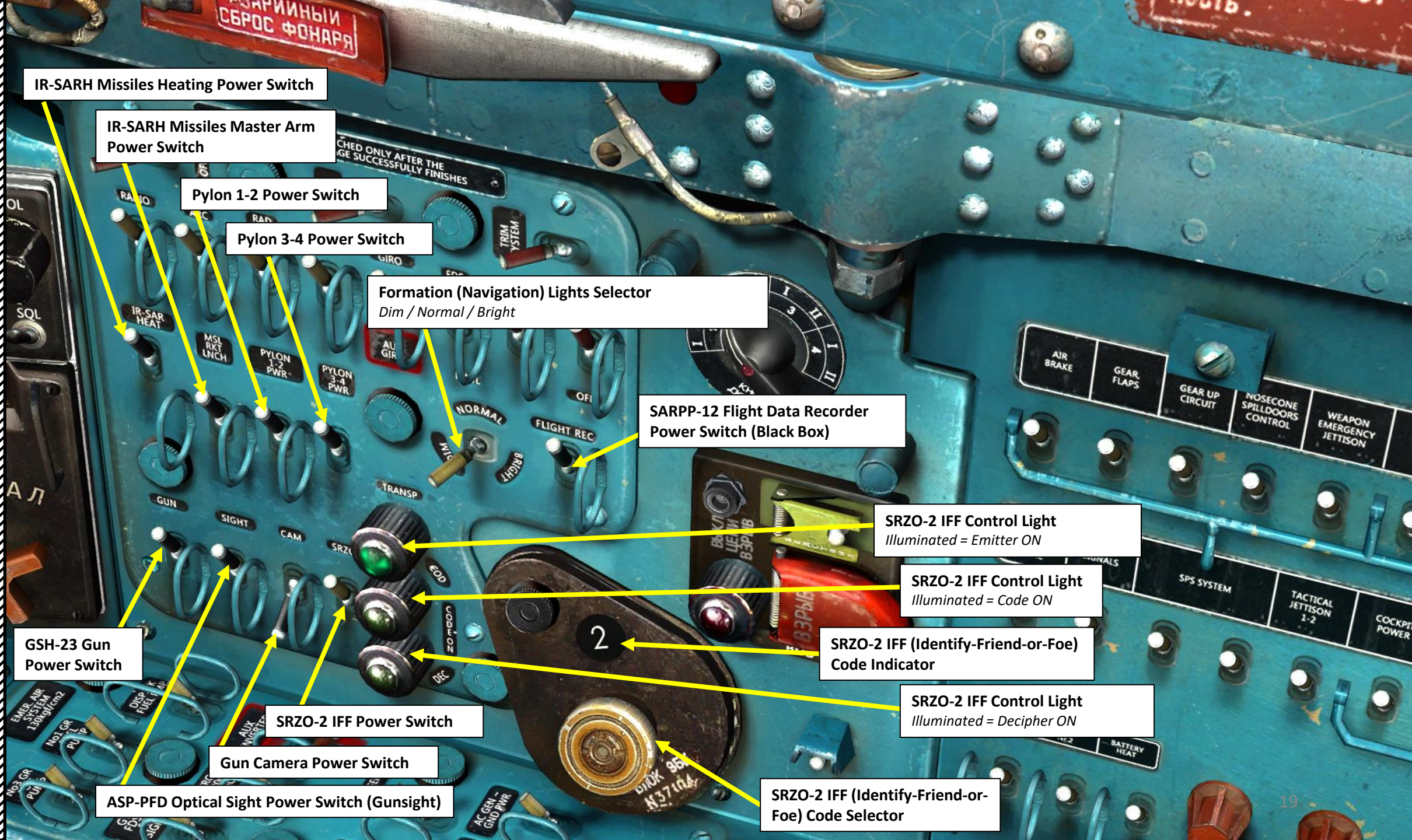
PART 2 – COCKPIT & GAUGES

PART 2 – COCKPIT & GAUGES

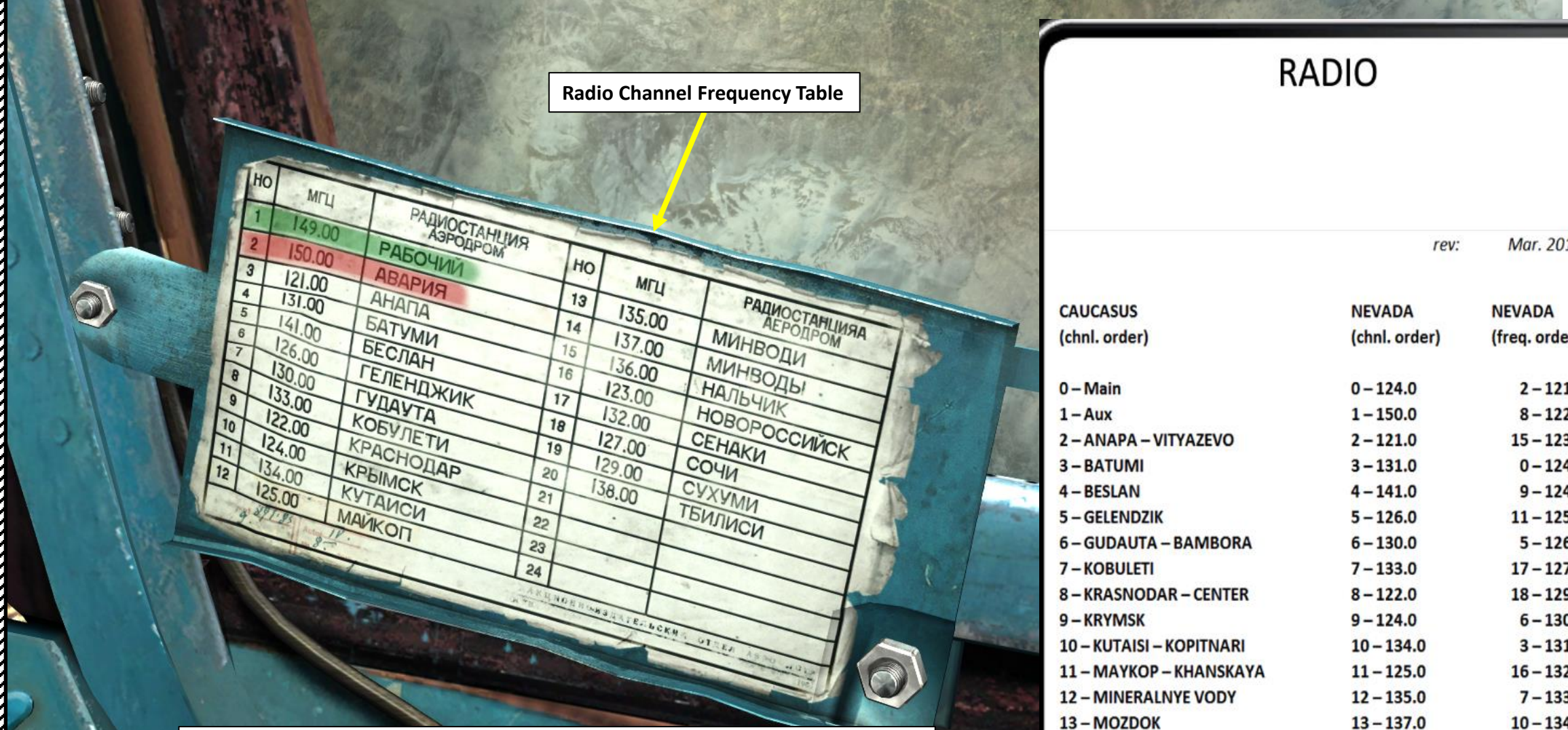



1st Fuel Tanks Group Pump Switch
Dispenser Fuel Tank Pump Switch
Emergency Inverter Power Switch
3rd Fuel Tanks Group Pump Switch
DC Generator Switch
Gyros for NPP, SAU Autopilot, Radar and KPP Power Switch
AC Generator Switch
Gyros for DA-200, NPP, SAU Autopilot and Radar Power Switch
Battery / Ground Power Switch
SPRD (RATO) Rocket Booster Starter Power Supply Switch
SPRD (RATO) Rocket Booster Jettison Power Supply Switch
AUX INVERTER
DC GEN
JATO START.SYS
JATO JETT.SYS
DASHBOARD LIGHT


Nose Cone Power Switch
Auxiliary Hydraulic Pump Power Switch
Trim System Power Switch
Autopilot Pitch Power Switch
ARC (Automatic Radio Compass) Radio Navigation Frequency Range Selector
Autopilot Power Switch
NPP/FDS Ground Navigation Power Switch
Emergency Transponder Switch
KPP/Gyro (ADI) Main/Auxiliary Power Switch
SRZO-2 IFF (Identify-Friend-or-Foe) Self-Destruct
Red Light = Destroyed
RSBN Navigation Power Switch
Radar Altimeter Power Switch
ARC Radio Navigation Switch
Radio Power Switch
AFS CAN BE SWITCHED ONLY AFTER THE GIRO AFS, AP, RDR CAGE SUCCESSFULLY FINISHES
RADIO
ARC
RAD ALT
PUMP UNIT
TRIM SYSTEM
RSBN
GIRO
FDS
AP
AP PITCH
IR-SAR HEAT
MSL RKT LNCH
PYLON 1-2 PWR
PYLON 3-4 PWR
GUN
SIGHT
CAM
GEAR UP CIRCUIT
NOSECONE SPILLDOORS CONTROL
WEAPON EMERGENCY JETTISON
TACTICAL JETTISON 1-2
PO-750 START Nr.1
PO-750 START Nr.2
BATTERY HEAT


IR-SARH Missiles Heating Power Switch
IR-SARH Missiles Master Arm Power Switch
Pylon 1-2 Power Switch
Pylon 3-4 Power Switch
Formation (Navigation) Lights Selector
Dim / Normal / Bright
SARPP-12 Flight Data Recorder Power Switch (Black Box)
SRZO-2 IFF Control Light
Illuminated = Emitter ON
SRZO-2 IFF Control Light
Illuminated = Code ON
SRZO-2 IFF (Identify-Friend-or-Foe) Code Indicator
SRZO-2 IFF Control Light
Illuminated = Decipher ON
GSH-23 Gun Power Switch
SRZO-2 IFF Power Switch
Gun Camera Power Switch
ASP-PFD Optical Sight Power Switch (Gunsight)
SRZO-2 IFF (Identify-Friend-or-Foe) Code Selector

Radio Channel Frequency Table



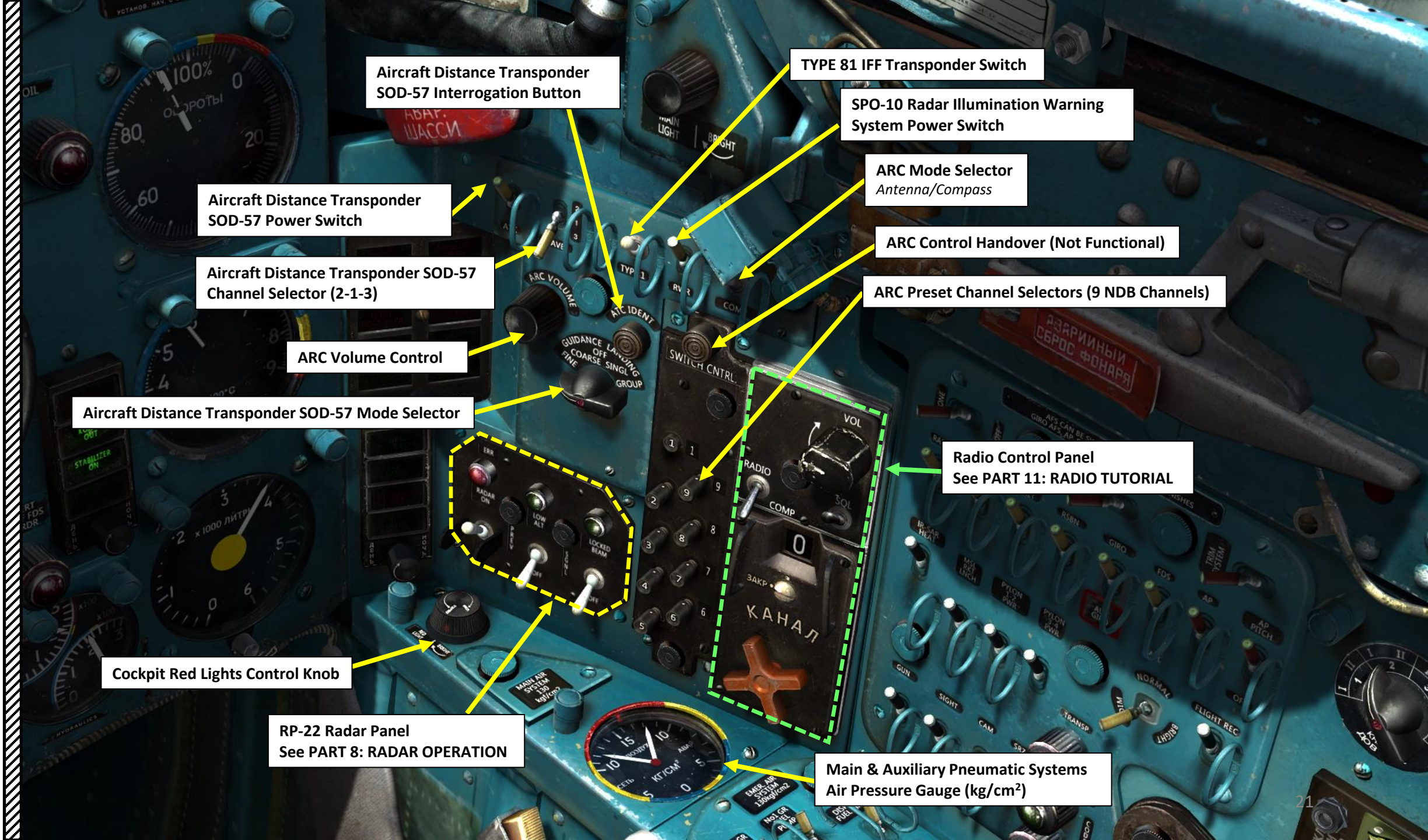
Can't read Cyrillic? Neither can I! You can see the list of radio channels for different airfields using your kneeboard (RCTRL+UP) and cycle through the pages to find this one by using RCTRL+LEFT or RCTRL+RIGHT.

Or even better: you can go to part 11 (radio tutorial) and print a nice list.

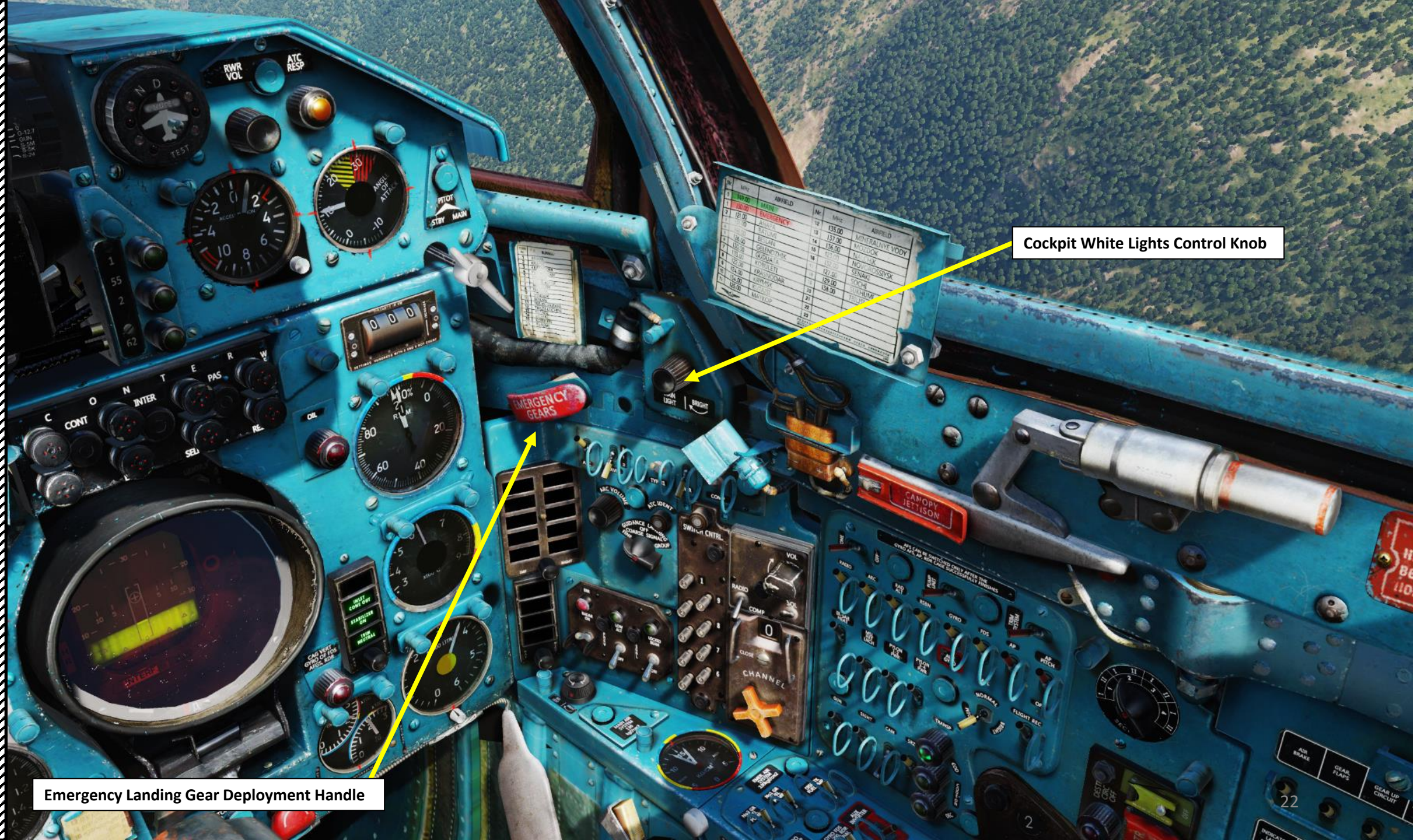
RADIO

rev: Mar. 2017

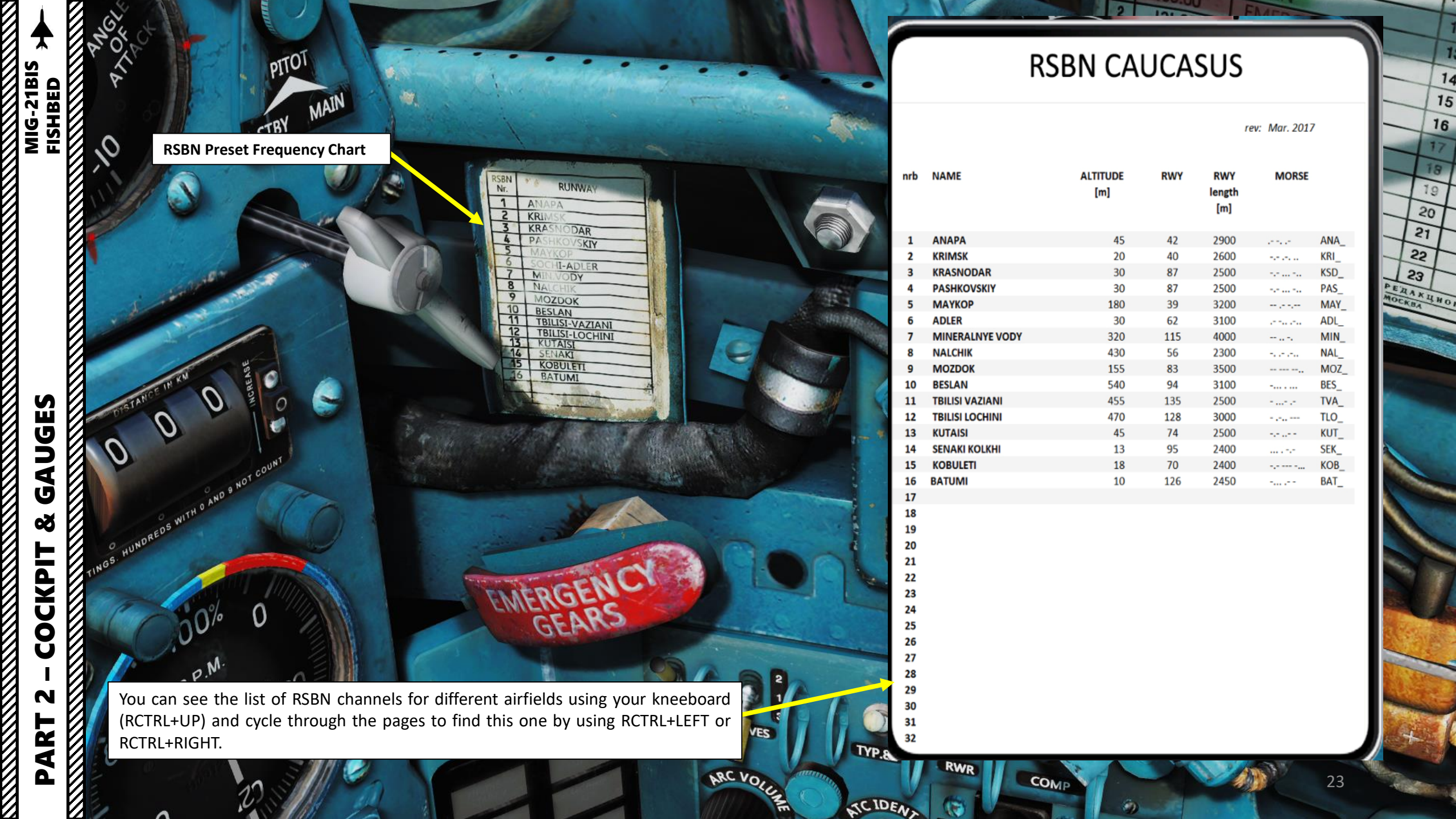
CAUCASUS (chnl. order)	NEVADA (chnl. order)	NEVADA (freq. order)
0 – Main	0 – 124.0	2 – 121.0
1 – Aux	1 – 150.0	8 – 122.0
2 – ANAPA – VITYAZEVO	2 – 121.0	15 – 123.0
3 – BATUMI	3 – 131.0	0 – 124.0
4 – BESLAN	4 – 141.0	9 – 124.0
5 – GELENDZIK	5 – 126.0	11 – 125.0
6 – GUDAUTA – BAMBORA	6 – 130.0	5 – 126.0
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


Aircraft Distance Transponder SOD-57 Interrogation Button
TYPE 81 IFF Transponder Switch
SPO-10 Radar Illumination Warning System Power Switch
ARC Mode Selector
Antenna/Compass
Aircraft Distance Transponder SOD-57 Power Switch
ARC Control Handover (Not Functional)
Aircraft Distance Transponder SOD-57 Channel Selector (2-1-3)
ARC Preset Channel Selectors (9 NDB Channels)
ARC Volume Control
Aircraft Distance Transponder SOD-57 Mode Selector
Radio Control Panel
See PART 11: RADIO TUTORIAL
Cockpit Red Lights Control Knob
RP-22 Radar Panel
See PART 8: RADAR OPERATION
Main & Auxiliary Pneumatic Systems
Air Pressure Gauge (kg/cm²)

PART 2 – COCKPIT & GAUGES



RSBN Preset Frequency Chart



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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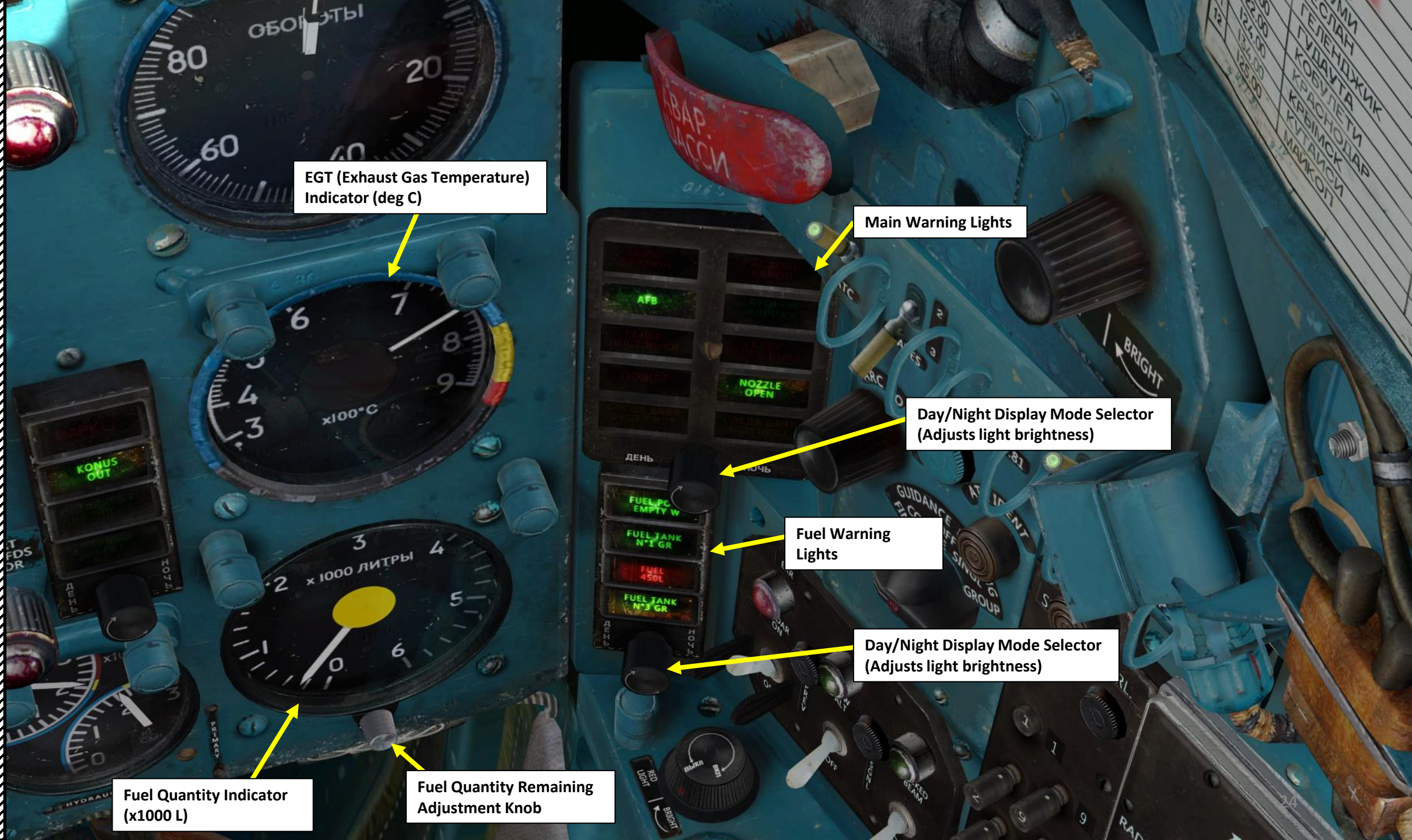
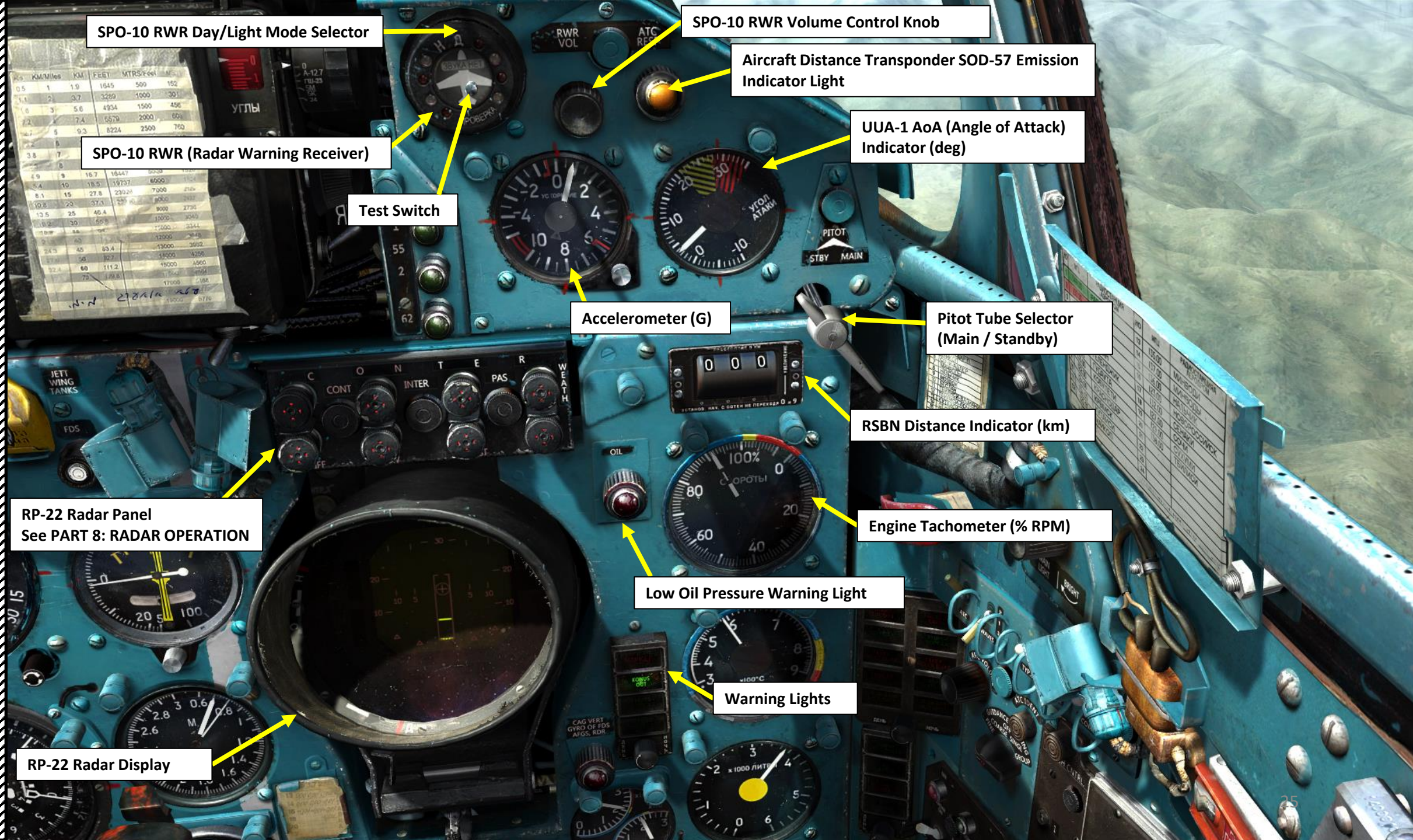
32						

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.

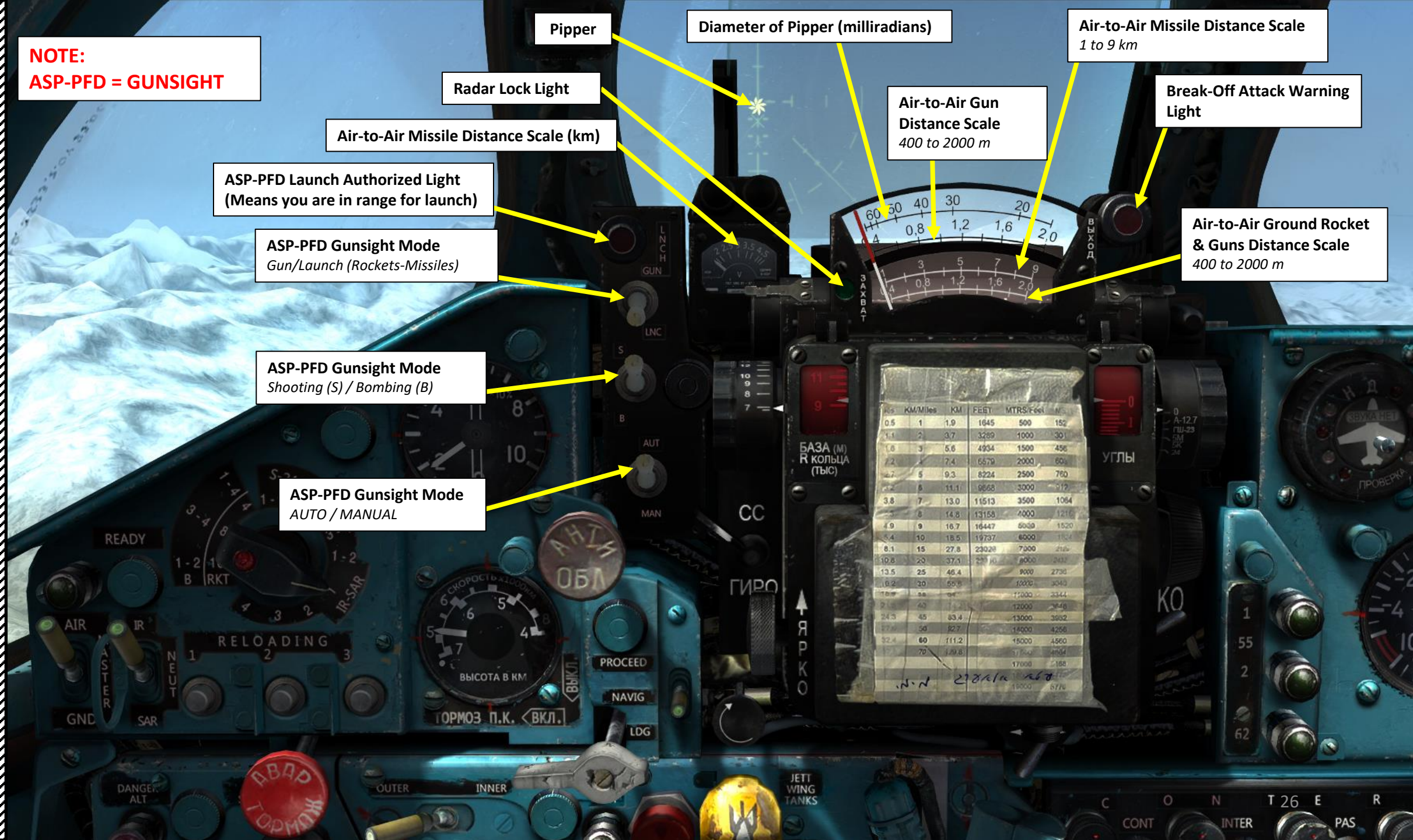
PART 2 – COCKPIT & GAUGES




SPO-10 RWR Day/Light Mode Selector
SPO-10 RWR Volume Control Knob
Aircraft Distance Transponder SOD-57 Emission Indicator Light
SPO-10 RWR (Radar Warning Receiver)
UUA-1 AoA (Angle of Attack) Indicator (deg)
Test Switch
Accelerometer (G)
Pitot Tube Selector (Main / Standby)
RSBN Distance Indicator (km)
RP-22 Radar Panel
See PART 8: RADAR OPERATION
Engine Tachometer (% RPM)
Low Oil Pressure Warning Light
Warning Lights
RP-22 Radar Display

PART 2 – COCKPIT & GAUGES

NOTE:
ASP-PFD = GUNSIGHT



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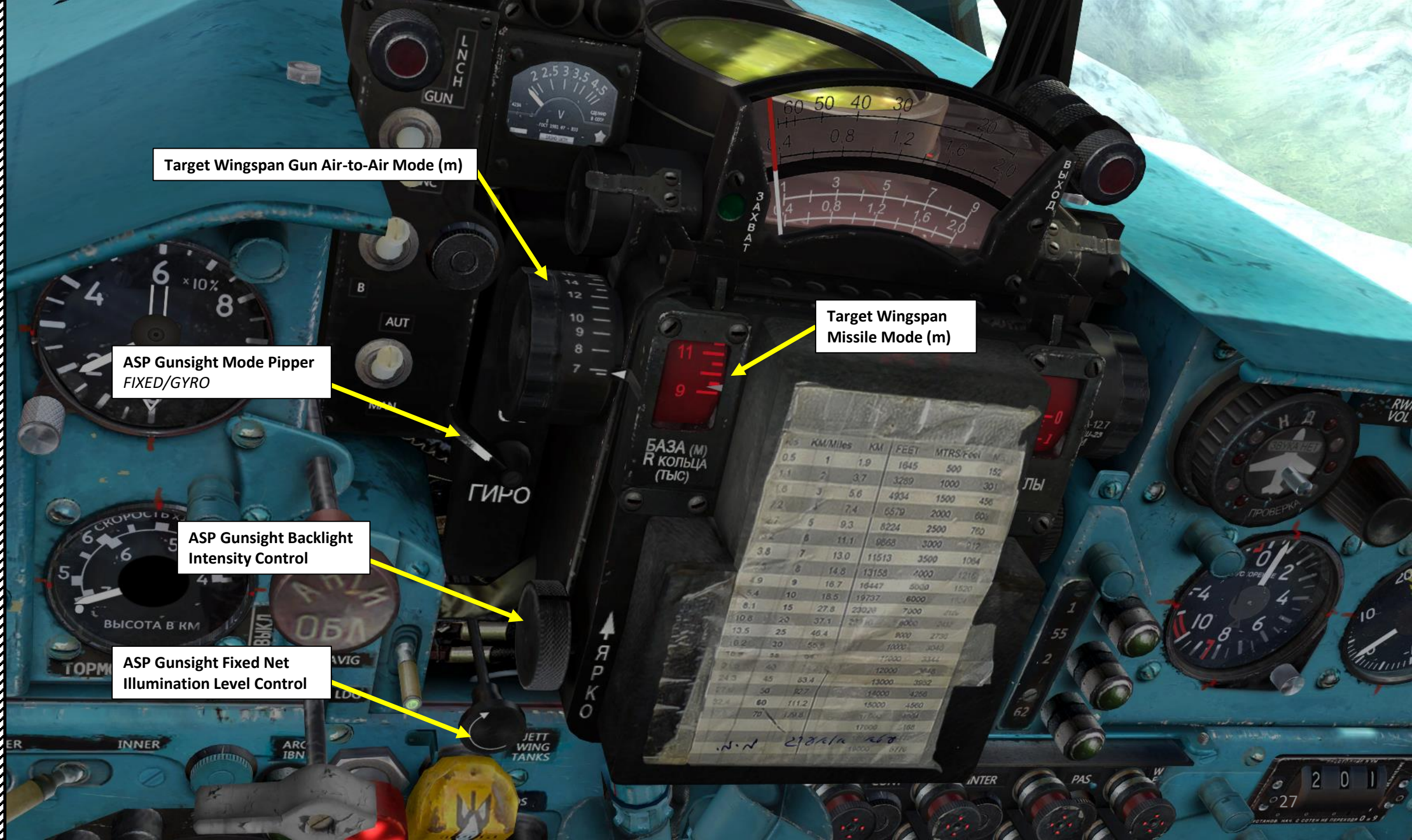
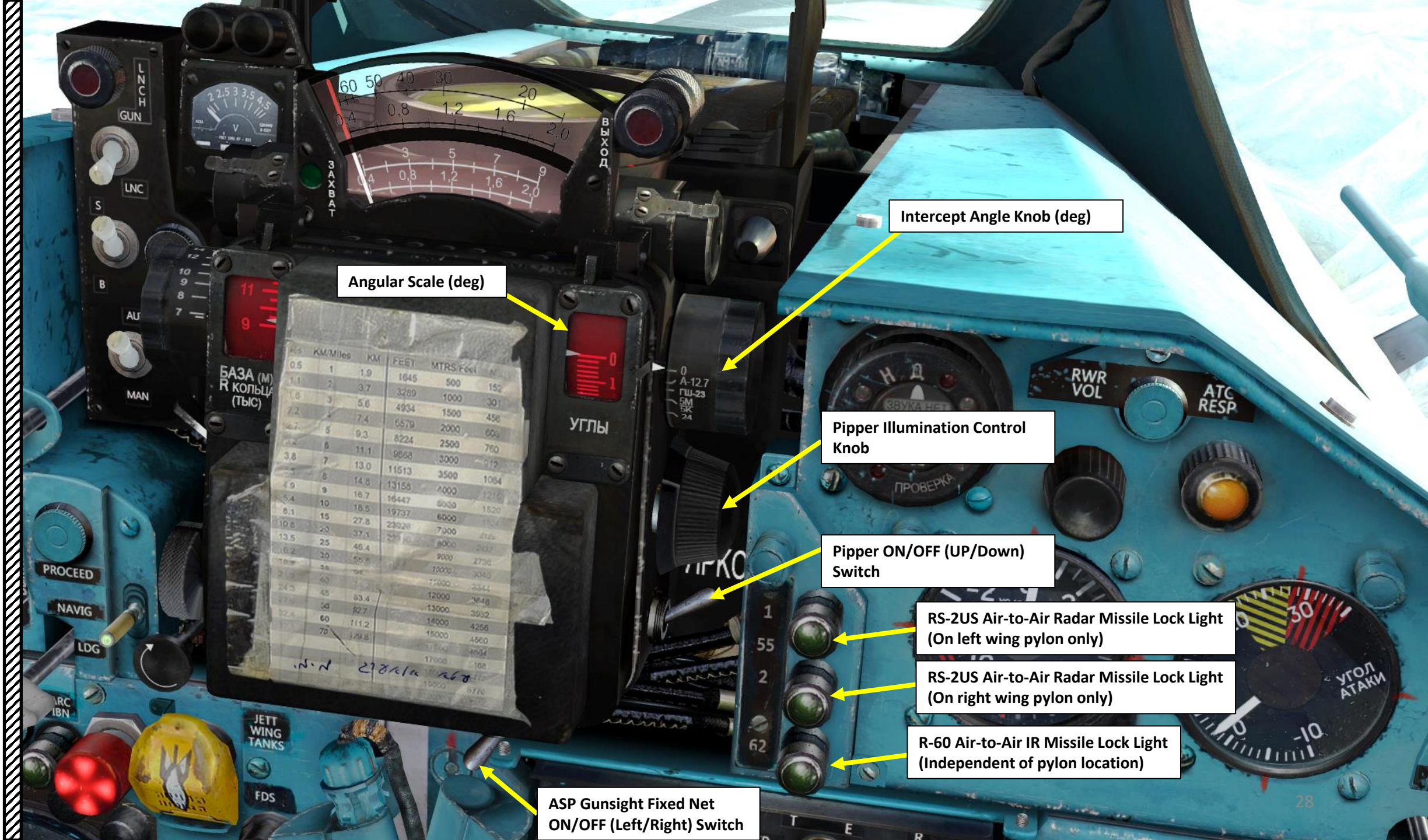
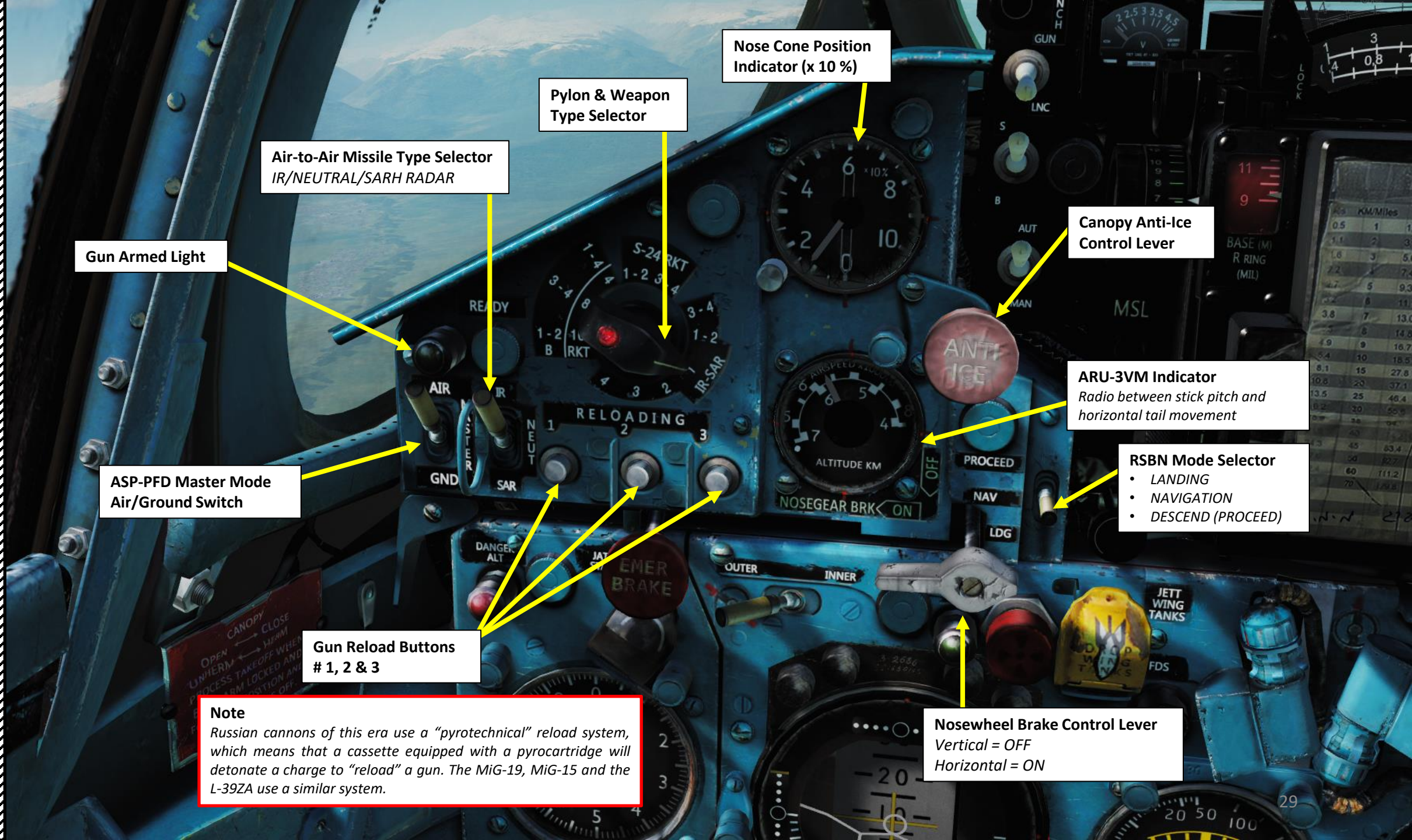


PART 2 – COCKPIT & GAUGES




Nose Cone Position Indicator (x 10 %)
Pylon & Weapon Type Selector
Air-to-Air Missile Type Selector
IR/NEUTRAL/SARH RADAR
Gun Armed Light
Canopy Anti-Ice Control Lever
ARU-3VM Indicator
Radio between stick pitch and horizontal tail movement
RSBN Mode Selector
LANDING
NAVIGATION
DESCEND (PROCEED)
ASP-PFD Master Mode Air/Ground Switch
Gun Reload Buttons # 1, 2 & 3
Nosewheel Brake Control Lever
Vertical = OFF
Horizontal = ON
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.
RELOADING
ALTITUDE KM
NOSEGEAR BRK
PROCEED
NAV
LDG
ANTI ICE
EMER BRAKE
JETT WING TANKS
OUTER
INNER
AIR
GND
SAR
IR-SAR
MSL

ARU-3VM Indicator

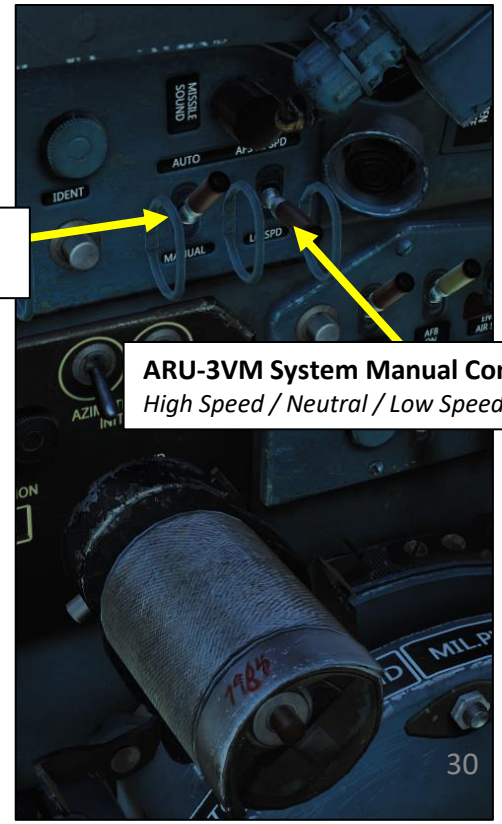
The ARU is a device that controls the ratio between stick pitch and horizontal tail movement. The ARU-3VM gauge shows the current position of the ARU arm transpositioned to a speed-altitude scale.

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.

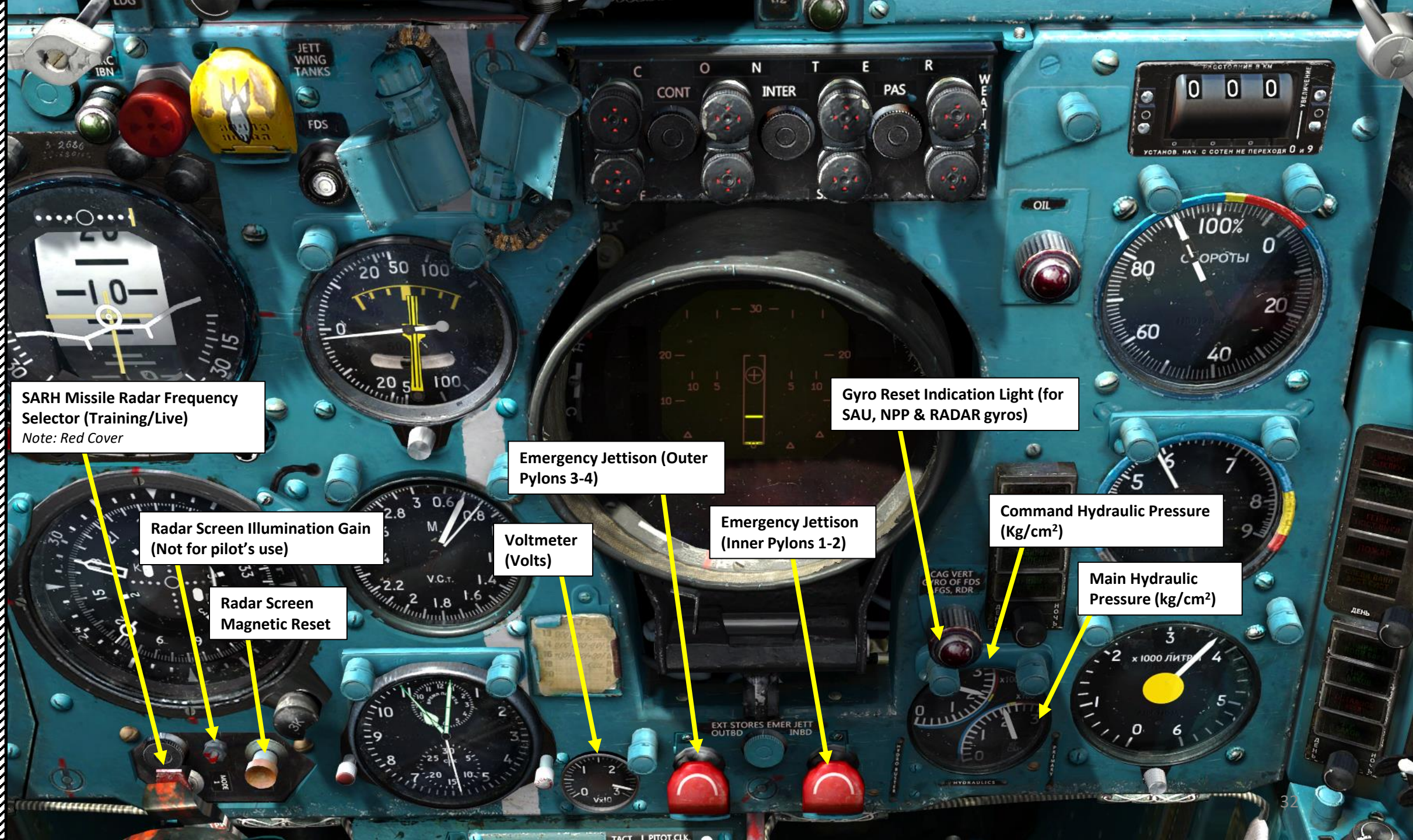
For example, if IAS is 600 km/h, the pilot should move the needle to index 6 at the outer scale, abort the mission and perform an emergency landing.

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).

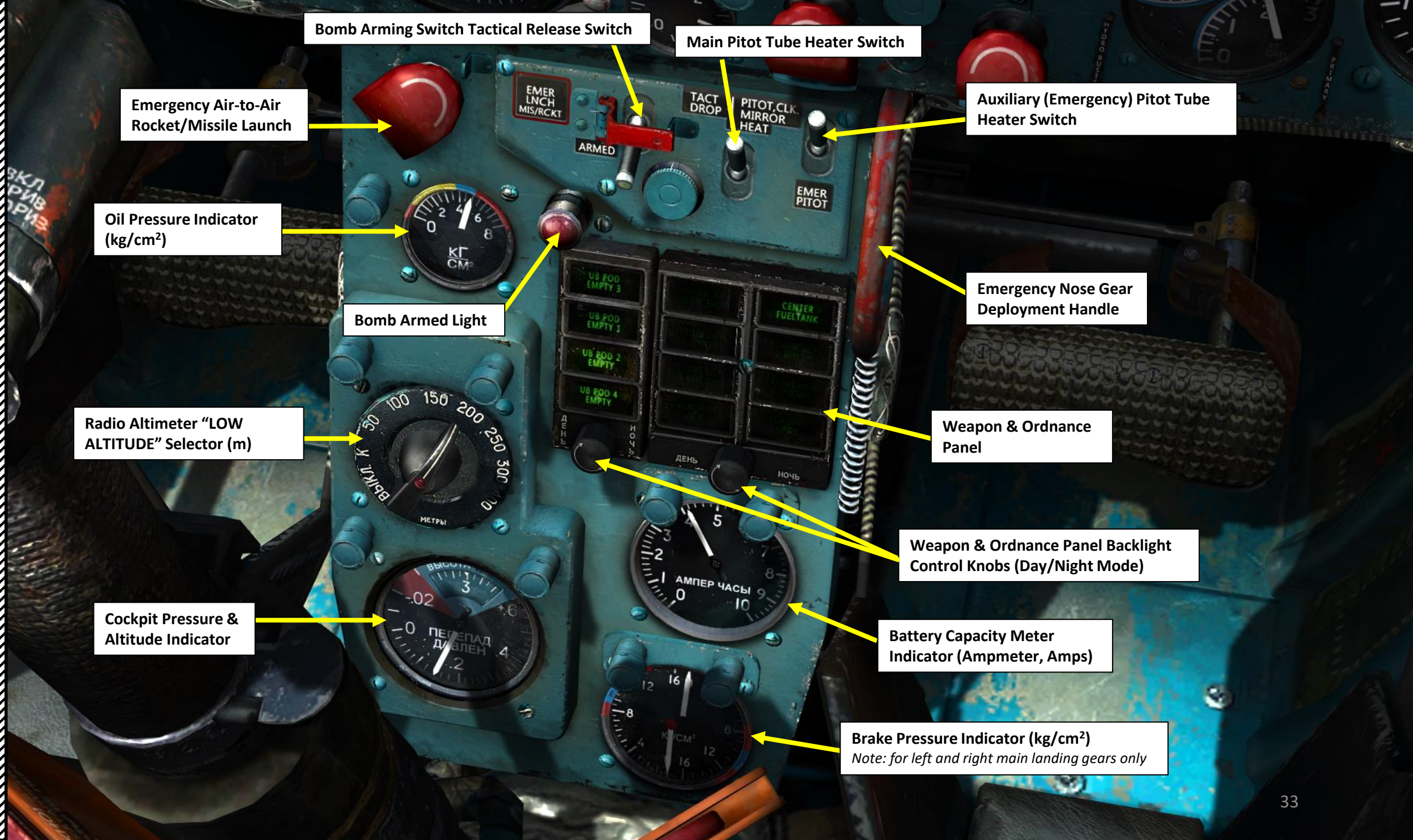


PART 2 – COCKPIT & GAUGES

PART 2 – COCKPIT & GAUGES



PART 2 – COCKPIT & GAUGES



Bomb Arming Switch Tactical Release Switch

Main Pitot Tube Heater Switch

Emergency Air-to-Air Rocket/Missile Launch

Auxiliary (Emergency) Pitot Tube Heater Switch

Oil Pressure Indicator (kg/cm²)

Bomb Armed Light

Emergency Nose Gear Deployment Handle

Radio Altimeter "LOW ALTITUDE" Selector (m)

Weapon & Ordnance Panel

Weapon & Ordnance Panel Backlight Control Knobs (Day/Night Mode)

Cockpit Pressure & Altitude Indicator

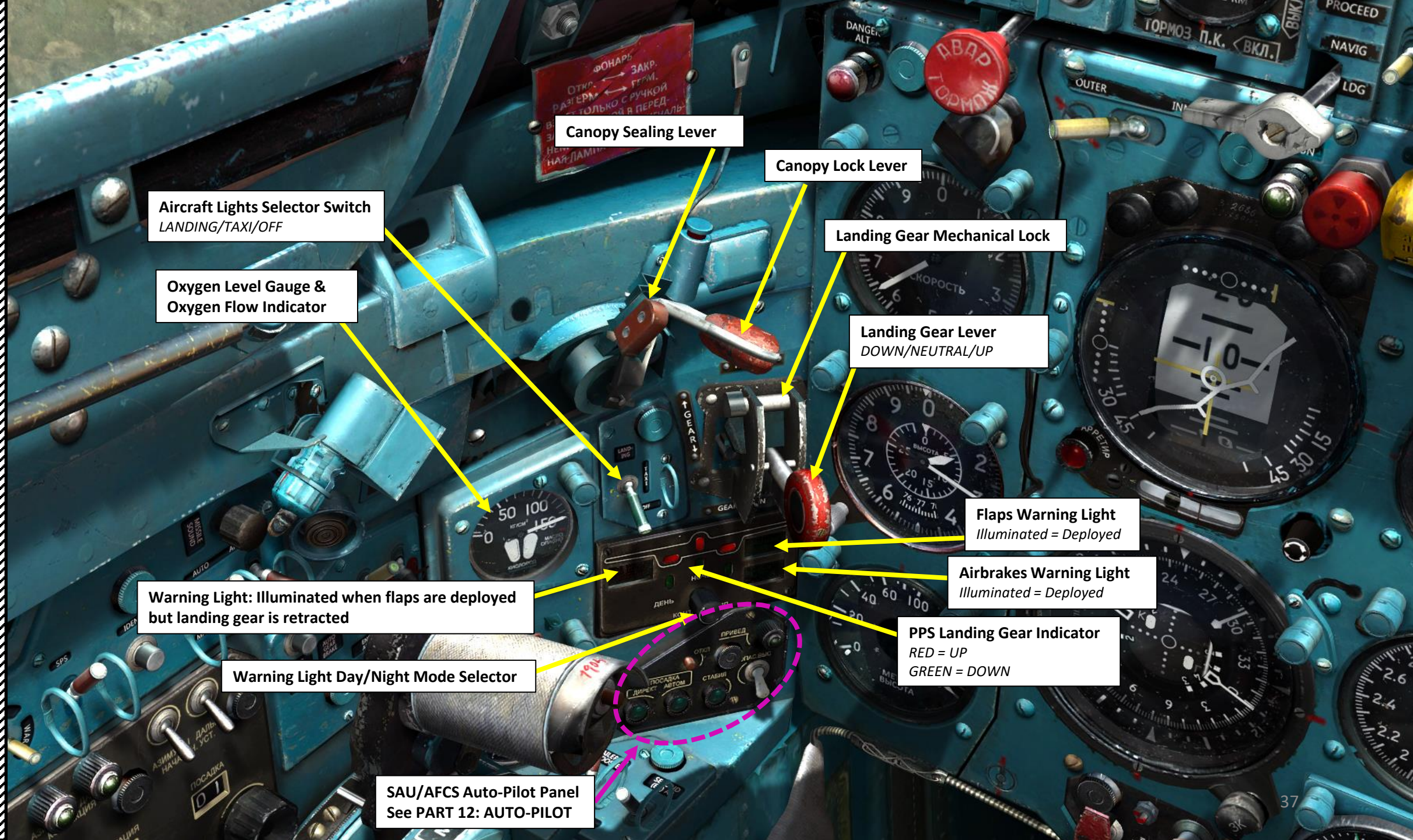
Battery Capacity Meter Indicator (Ampmeter, Amps)

Brake Pressure Indicator (kg/cm²)
Note: for left and right main landing gears only

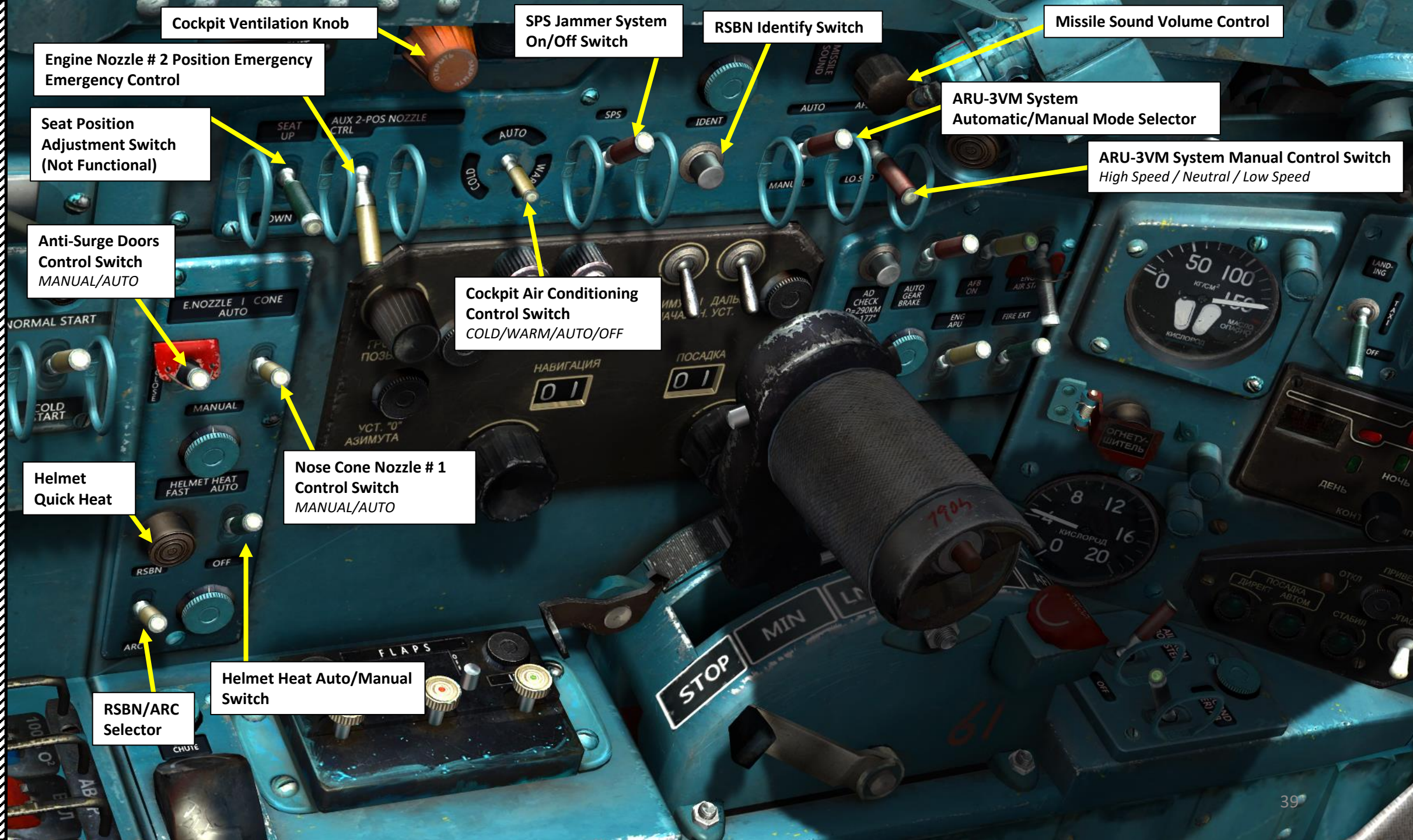

НЕ НАСТУПАТЬ!
STOP
MIN
MIL PWR
AIRSPEED
EMERGENCY GEARS
DASHBOARD LIGHT

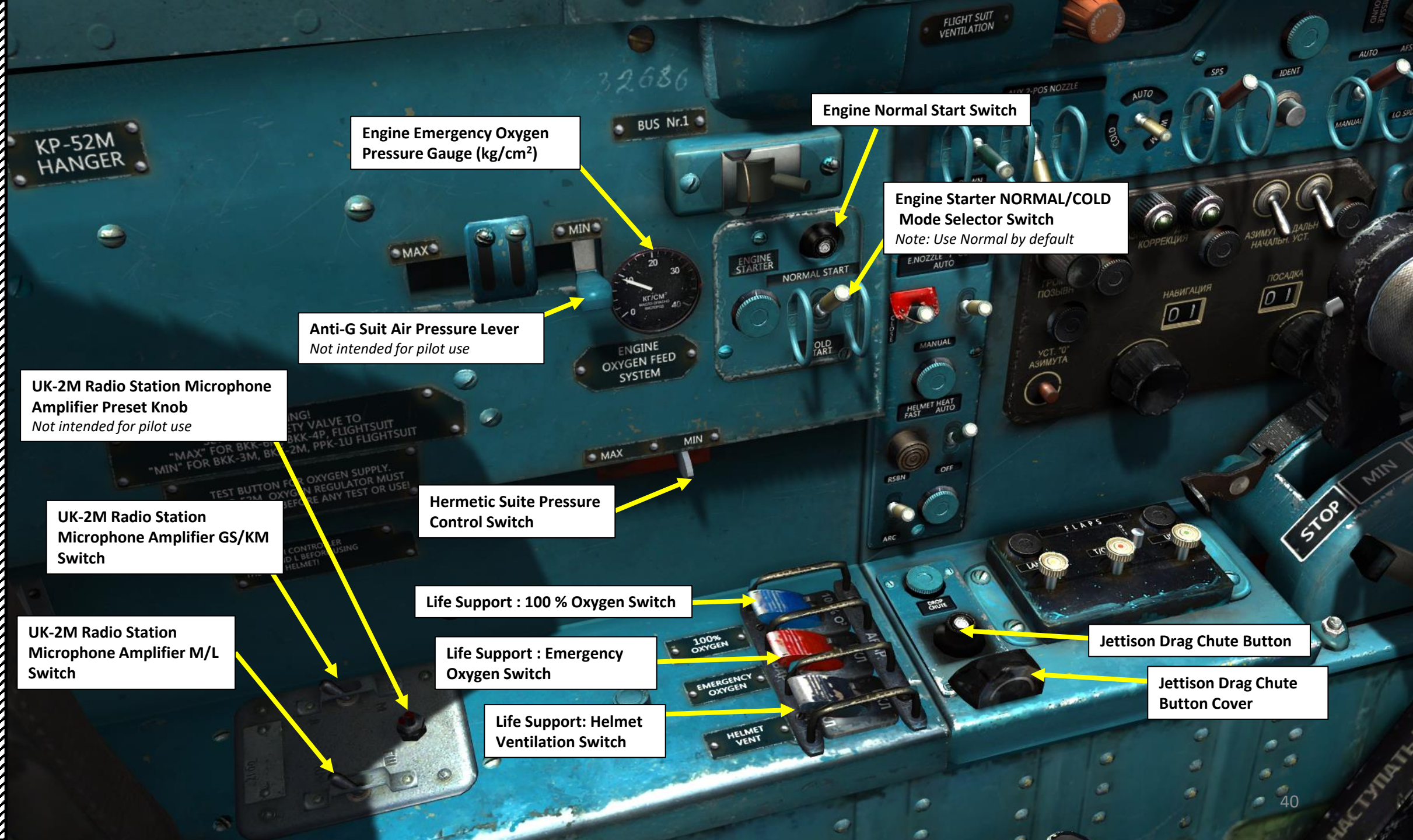

RELOADING
READY
EMER BRAKE
GYRO
MSL
JETT WING TANKS
CONT
INTER
PAS


ARC (Automatic Radio Compass)
Sector & Preset Channel Chart
ARC SEC
CH
MAP GRID
WARNING!
LIST NEED TO BE CHECK
BEFORE TAKEOFF
MISSILE SOUND
AUTO
IDENT
SPS
MANUAL
LO SPD
AIR STA
AFB ON
FIRE EXT


Canopy Sealing Lever
Canopy Lock Lever
Aircraft Lights Selector Switch
LANDING/TAXI/OFF
Landing Gear Mechanical Lock
Oxygen Level Gauge &
Oxygen Flow Indicator
Landing Gear Lever
DOWN/NEUTRAL/UP
Flaps Warning Light
Illuminated = Deployed
Airbrakes Warning Light
Illuminated = Deployed
PPS Landing Gear Indicator
RED = UP
GREEN = DOWN
Warning Light: Illuminated when flaps are deployed
but landing gear is retracted
Warning Light Day/Night Mode Selector
SAU/AFCS Auto-Pilot Panel
See PART 12: AUTO-PILOT


FLIGHT SUIT VENTILATION
APU (Auxiliary Power Unit) Switch
RSBN Self-Test Switch
Drag Chute Deploy Button
Auto Gear Brake ON/OFF Switch
Afterburner Power Switch
RSBN/PRMG Control Panel
See PART 13: RADIO NAVIGATION & PRECISION LANDING
In-Air Engine Relight Switch (Engine Air Restart)
Fire Extinguisher Power Switch
Fire Extinguisher Switch & Cover Switch
Oxygen Pressure Indicator (kg/cm²)
Aileron Booster Switch
Second-Stage Emergency Afterburner Switch
Flaps Reset Button
Throttle Twist Grip: Changes ASP Gunsight Range & Radar TDC Slew Control
Throttle Mechanical Lock
Intercomm Switch (Microphone)
Countermeasure Switch (under red cover)
Hold to release flares & chaff
Flaps Landing Switch
Flaps Takeoff Switch
Flaps Up Switch
Throttle Movement Friction Lever (Lock)
E.NOZZLE I CONE AUTO
MANUAL
HELMET HEAT FAST AUTO
RSBN
OFF
ARC
DROP CHUTE
FLAPS
НАВИГАЦИЯ
ПОСАДКА
УСТ. "0" АЗИМУТА
SPS
IDENT
AUTO
AUTO GEAR BRAKE
FIRE EXT
ENG APU
AFB ON
AD CHECK
КИСЛОРОД


Cockpit Ventilation Knob
SPS Jammer System On/Off Switch
RSBN Identify Switch
Missile Sound Volume Control
Engine Nozzle # 2 Position Emergency Emergency Control
ARU-3VM System Automatic/Manual Mode Selector
Seat Position Adjustment Switch (Not Functional)
ARU-3VM System Manual Control Switch
High Speed / Neutral / Low Speed
Anti-Surge Doors Control Switch
MANUAL/AUTO
Cockpit Air Conditioning Control Switch
COLD/WARM/AUTO/OFF
Nose Cone Nozzle # 1 Control Switch
MANUAL/AUTO
Helmet Quick Heat
Helmet Heat Auto/Manual Switch
RSBN/ARC Selector



Engine Emergency Oxygen Pressure Gauge (kg/cm²)

Engine Normal Start Switch

Engine Starter NORMAL/COLD Mode Selector Switch
Note: Use Normal by default

Anti-G Suit Air Pressure Lever
Not intended for pilot use

UK-2M Radio Station Microphone Amplifier Preset Knob
Not intended for pilot use

Hermetic Suite Pressure Control Switch

UK-2M Radio Station Microphone Amplifier GS/KM Switch

Life Support : 100 % Oxygen Switch

UK-2M Radio Station Microphone Amplifier M/L Switch

Life Support : Emergency Oxygen Switch

Life Support: Helmet Ventilation Switch

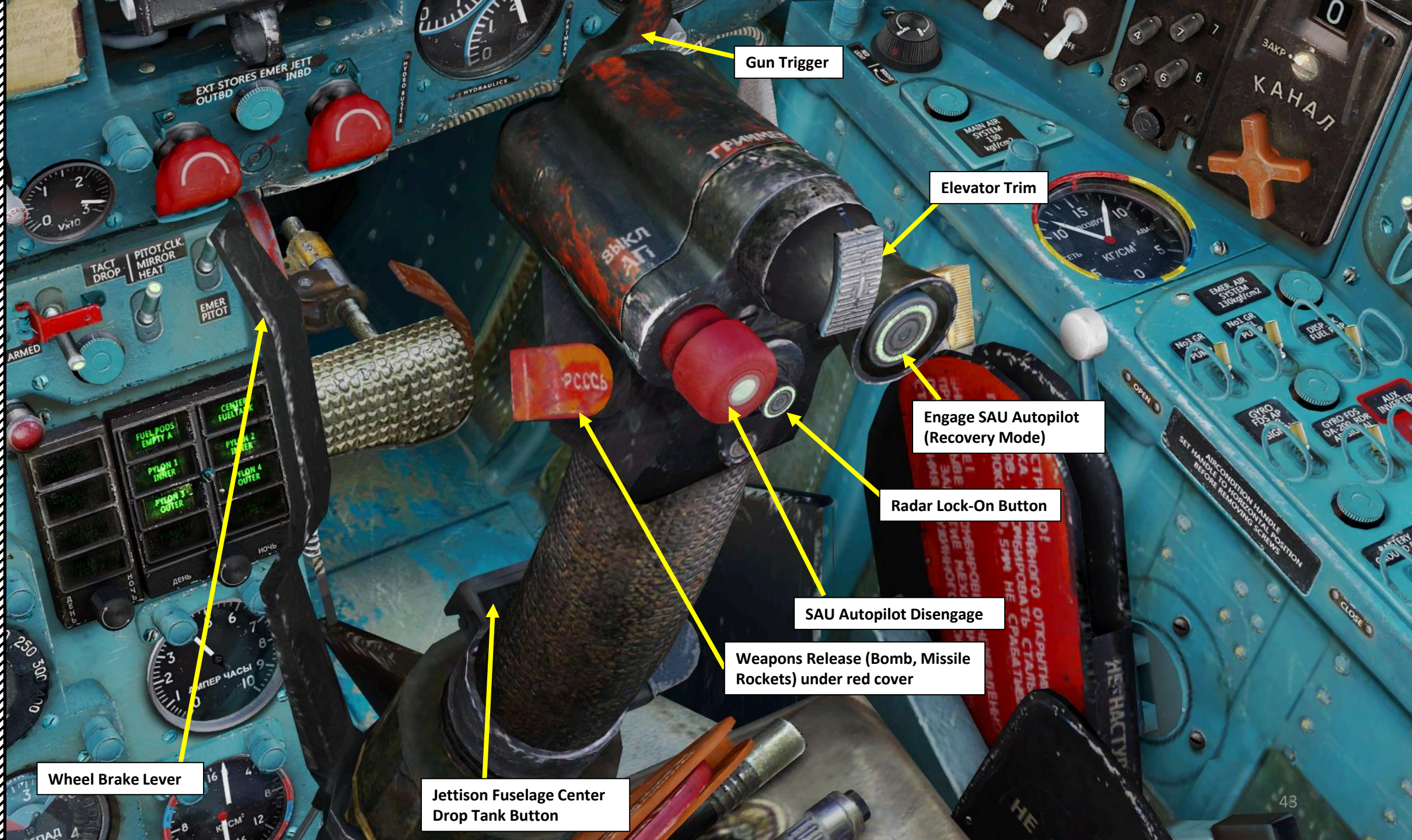
Jettison Drag Chute Button

Jettison Drag Chute Button Cover


KP-52M
HANGER
STOP
MIN
UHD
MILMAX


100% OXYGEN
EMERGENCY OXYGEN
HELMET VENT
DROP CHUTE
Ejection Seat Emergency Oxygen

PART 2 – COCKPIT & GAUGES



PART 2 – COCKPIT & GAUGES

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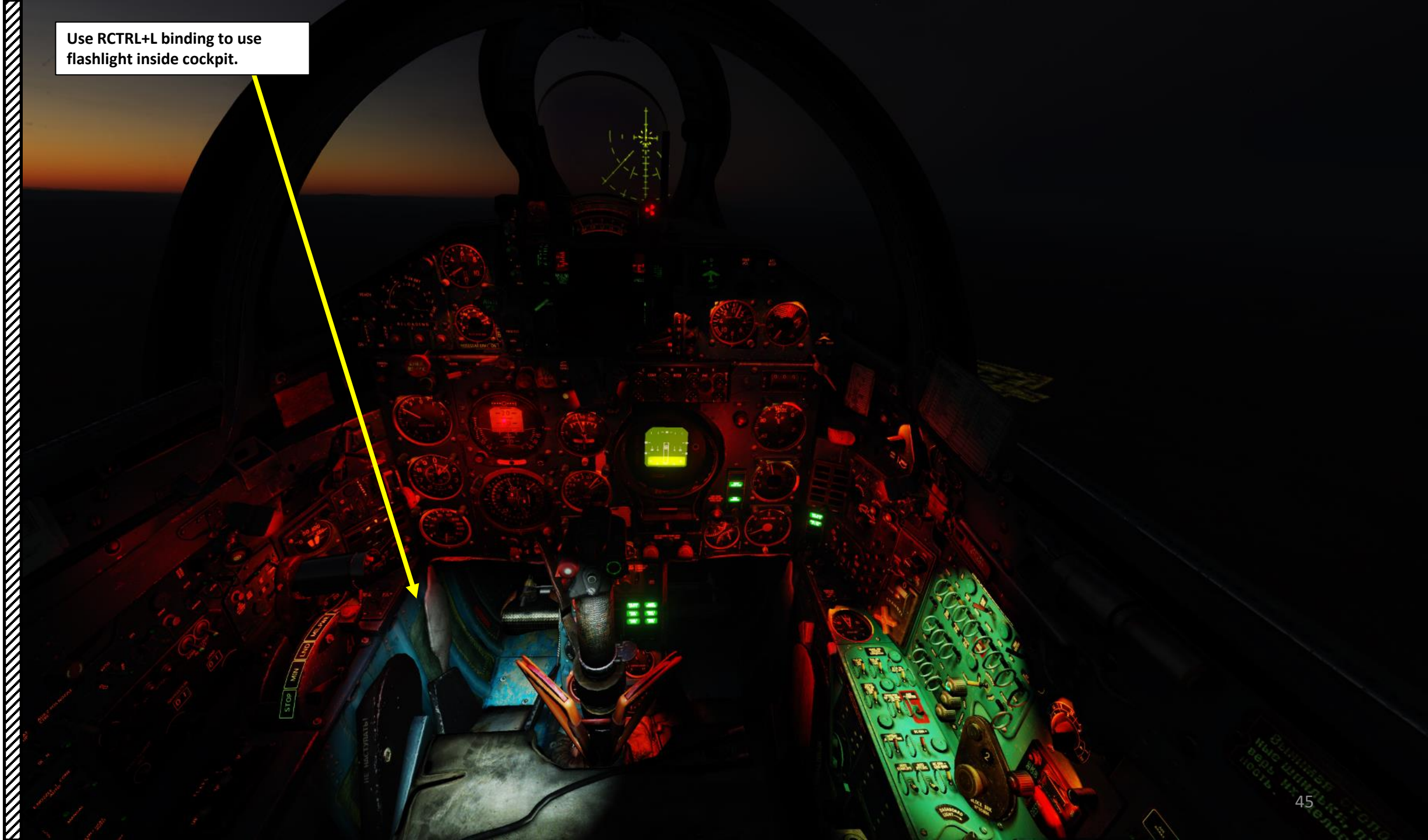
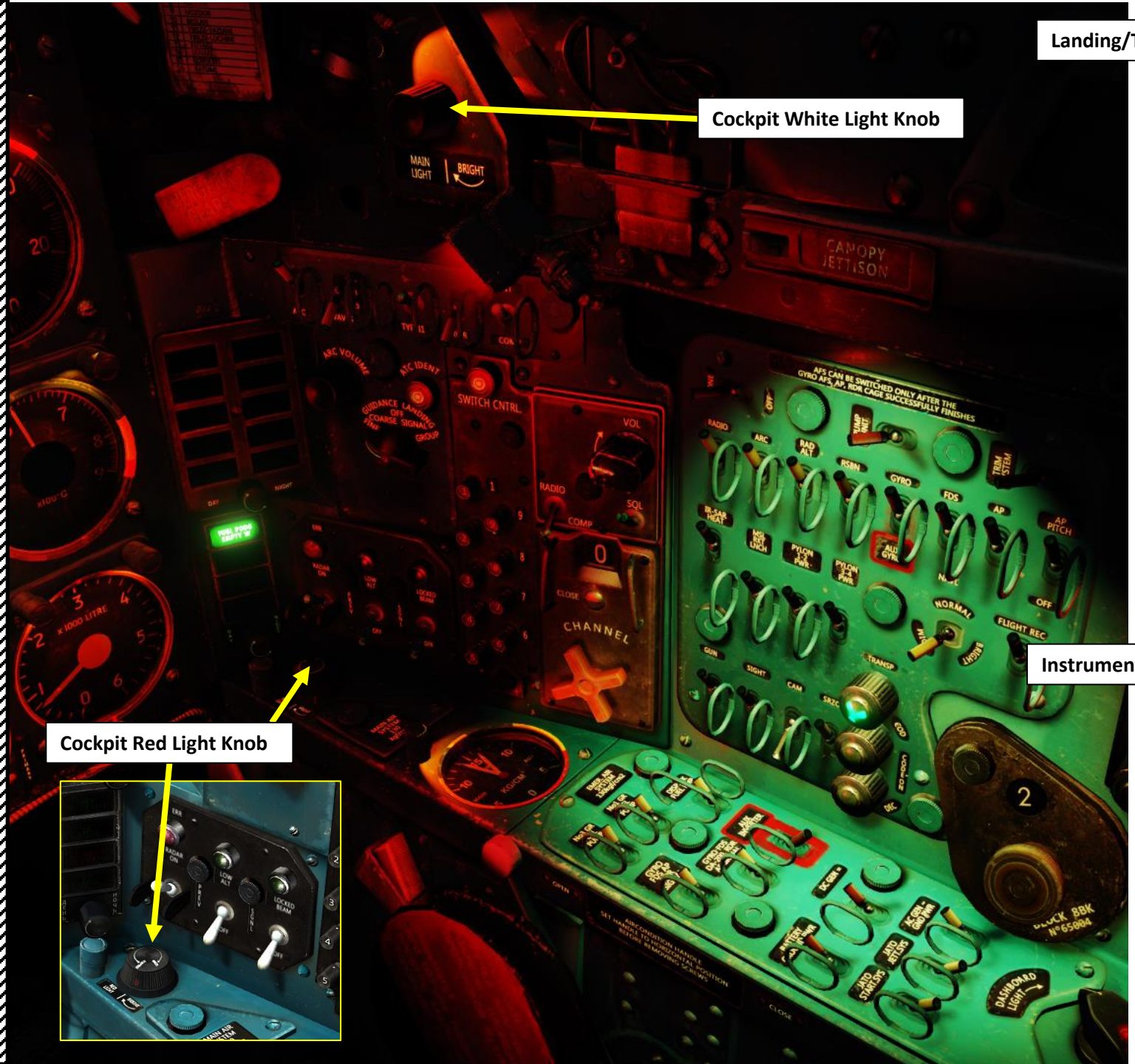
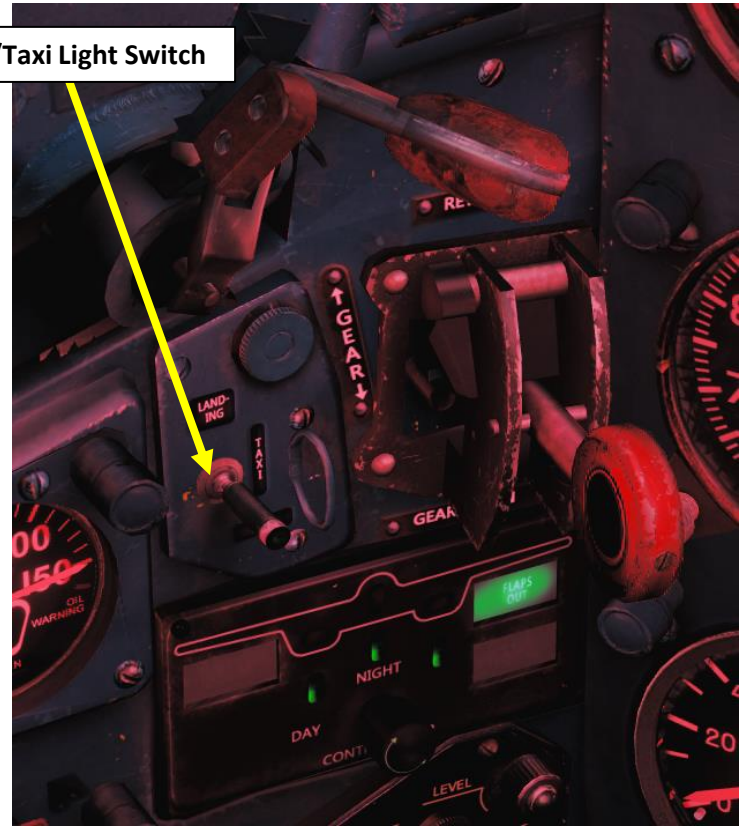
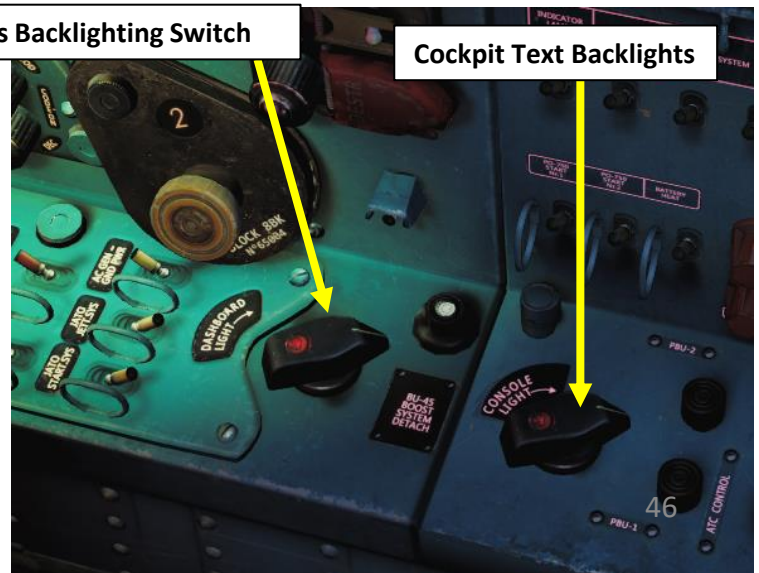
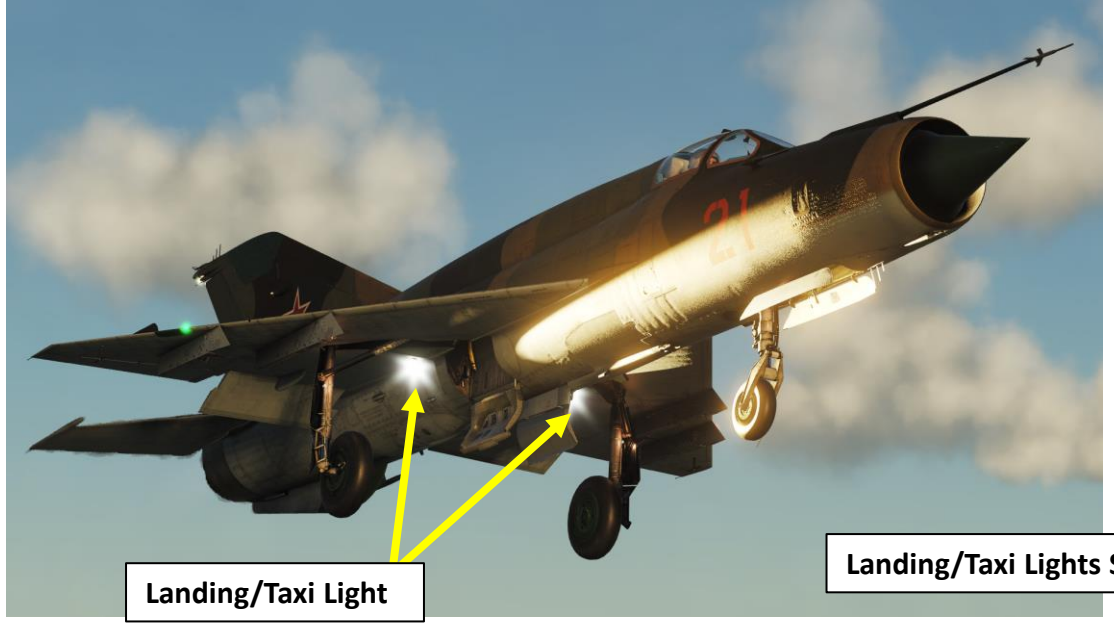


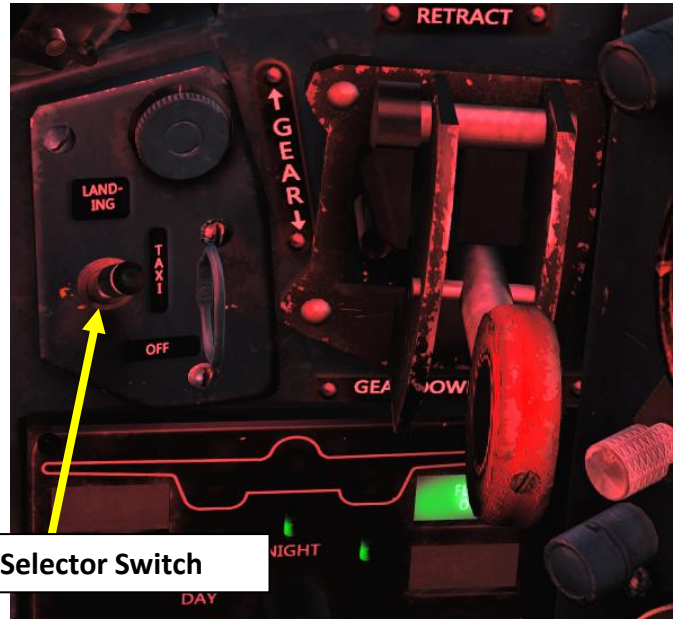
PART 2 – COCKPIT & GAUGES

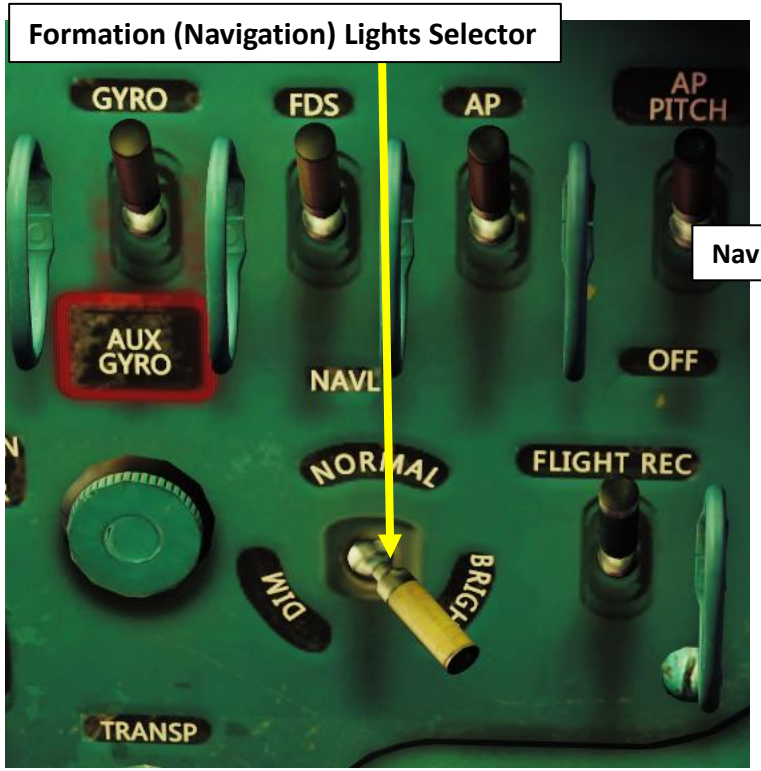







Landing/Taxi Light


RETRACT
GEAR
LAND-ING
TAXI
OFF
Landing/Taxi Lights Selector Switch
NIGHT
DAY

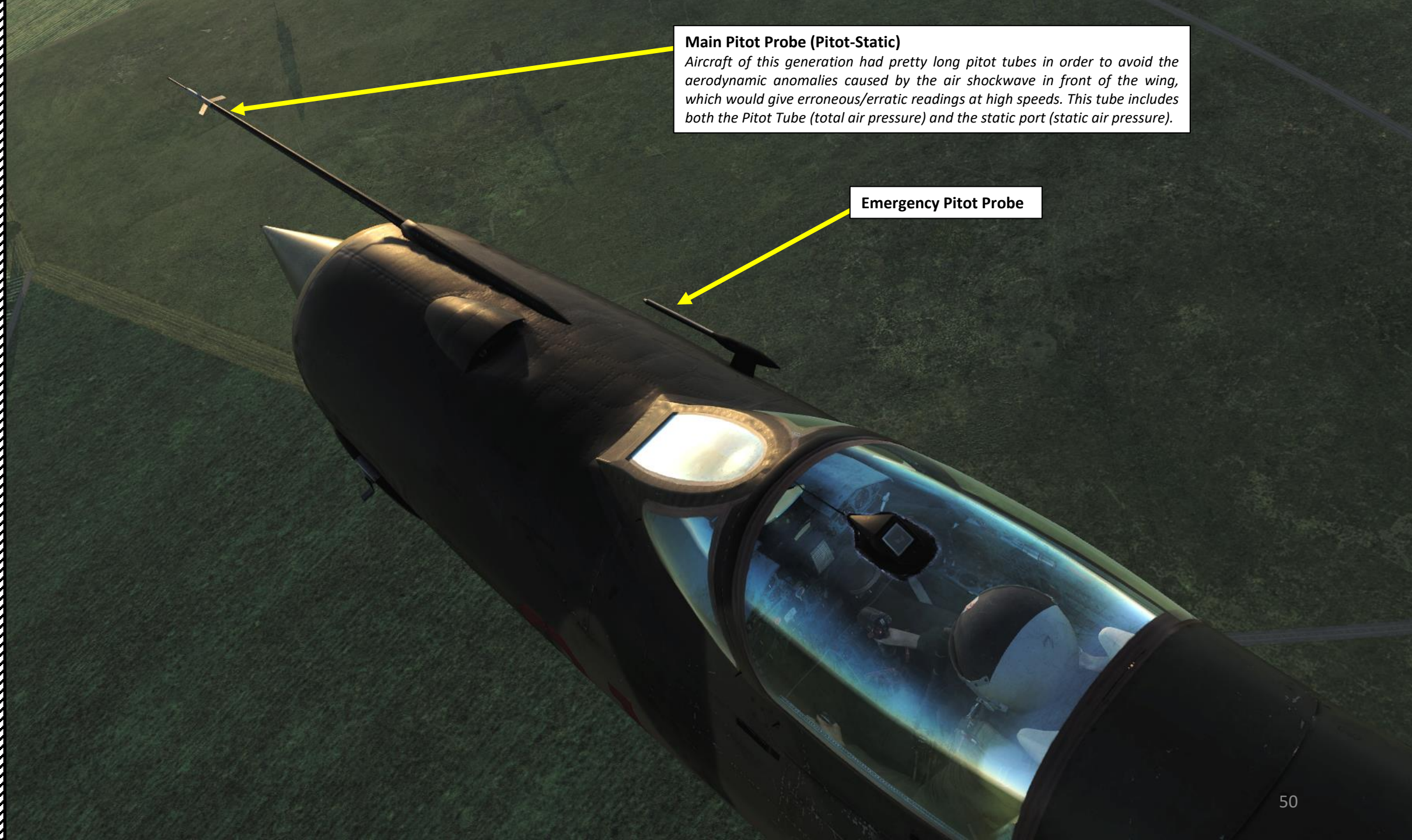

Formation (Navigation) Lights Selector
GYRO
FDS
AP
AP PITCH
AUX GYRO
NAVL
OFF
NORMAL
FLIGHT REC
DIM
BRIGHT
TRANSP


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

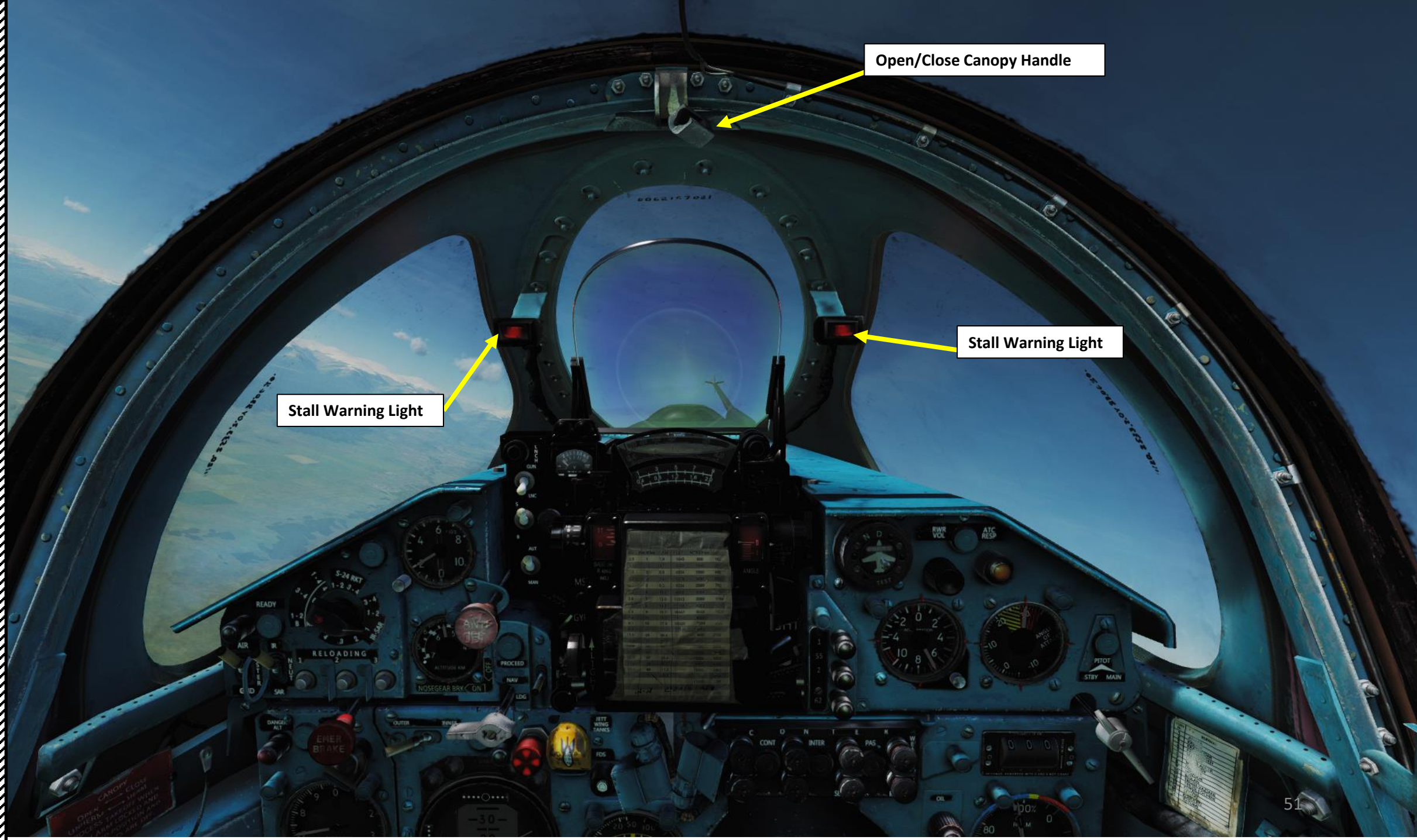
PART 2 – COCKPIT & GAUGES


Airbrakes


Airbrakes
Ventral Fin
Improves aircraft stability at high angles of attack

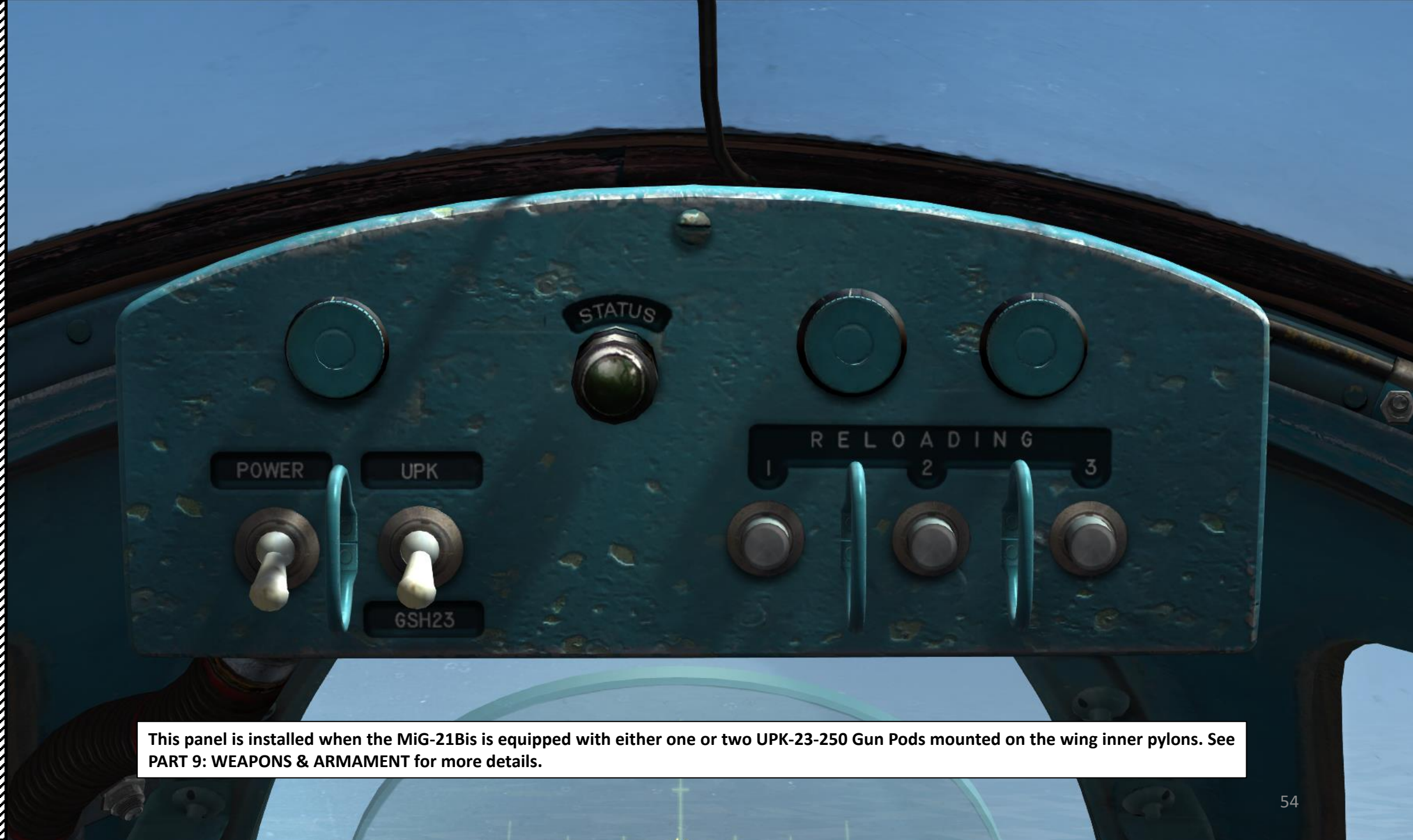

Main Pitot Probe (Pitot-Static)
Aircraft of this generation had pretty long pitot tubes in order to avoid the aerodynamic anomalies caused by the air shockwave in front of the wing, which would give erroneous/erratic readings at high speeds. This tube includes both the Pitot Tube (total air pressure)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

PART 2 – COCKPIT & GAUGES



PART 2 – COCKPIT & GAUGES

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. See PART 9: WEAPONS & ARMAMENT for more details.



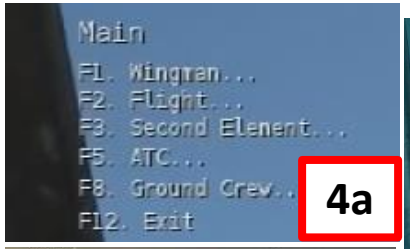
This panel is installed when the MiG-21Bis is equipped with either one or two UPK-23-250 Gun Pods mounted on the wing inner pylons. See PART 9: WEAPONS & ARMAMENT for more details.

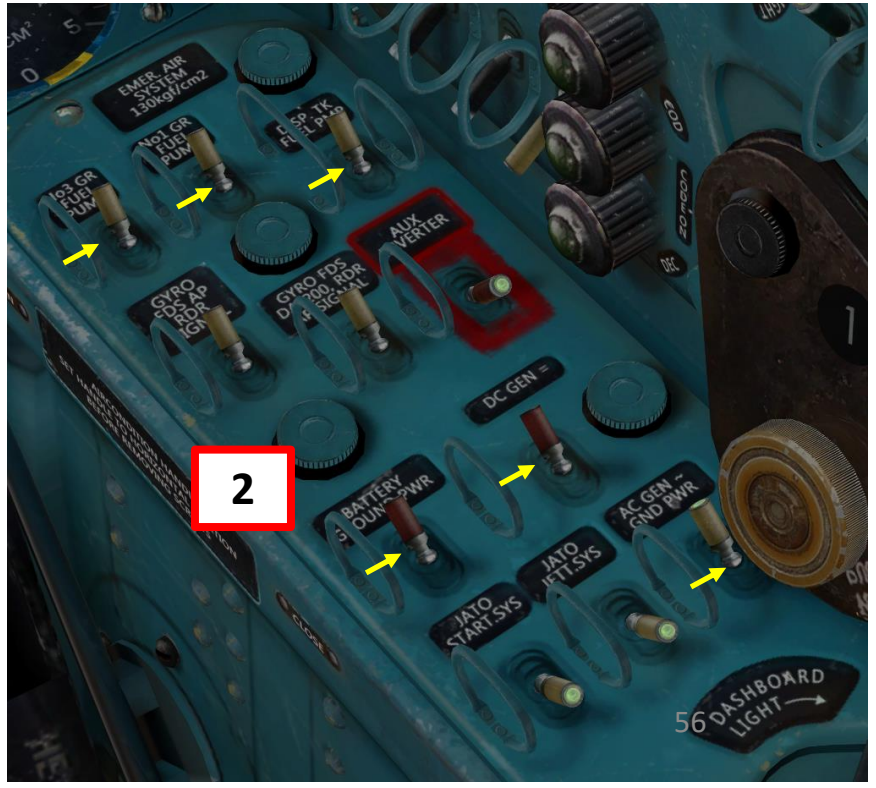
This panel is installed when the MiG-21Bis is equipped with a SPS-141-100 Countermeasure Pod with a jammer mounted on the central fuselage pylon. In theory, it should drop flares and chaff automatically when a missile is launched at you. It was historically used for SEAD (Suppression of Enemy Air Defense)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

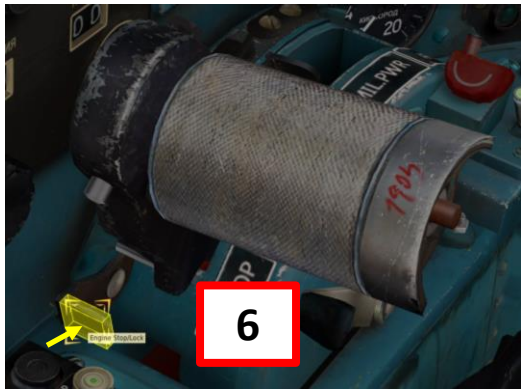
Note: Since the jammer currently does not work as intended in DCS' the SPS-141 Active & Passive Countermeasure Pod tutorial will be skipped.

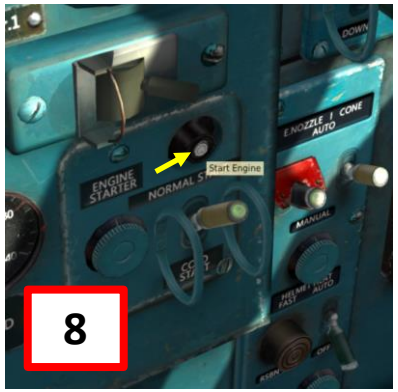
PART 3 – START-UP PROCEDURE

1. PO-750 Inverters # 1 & 2 and Battery Heat ON (UP)
2. Battery, DC Generator ON, AC Generator Ground Power ON, Fuel Pump Switch # 1, 2 & 3 **ON (FWD)**
3. Turn on radio and set frequency to airfield tower frequency (Check briefing or mission editor to find which channel to use).
4. Call ground crew for External Power
   a) Press "\" (Intercomm switch) and "F8" to select ground crew
   b) Select "Ground Electric Power" by pressing "F2"
   c) Select "**ON**" by pressing "F1" to turn on ground power
5. Fire Extinguisher & APU **ON (UP)**
6. Click on Engine Lock lever (on throttle)
7. Move throttle to **MIN** position
8. Click and hold engine starter switch for 4 seconds.
9. Move throttle to **IDLE** (half an inch forward) and wait for RPM to reach a minimum of 35 %. Process may take up to 45 seconds.



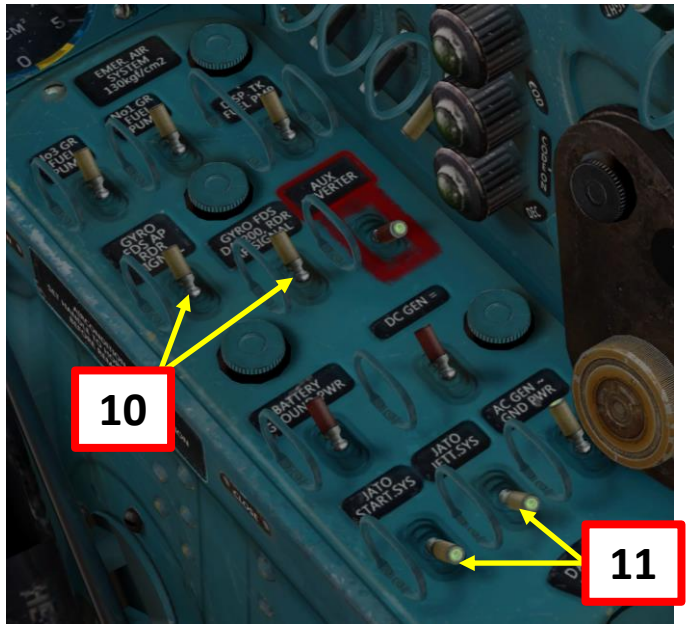


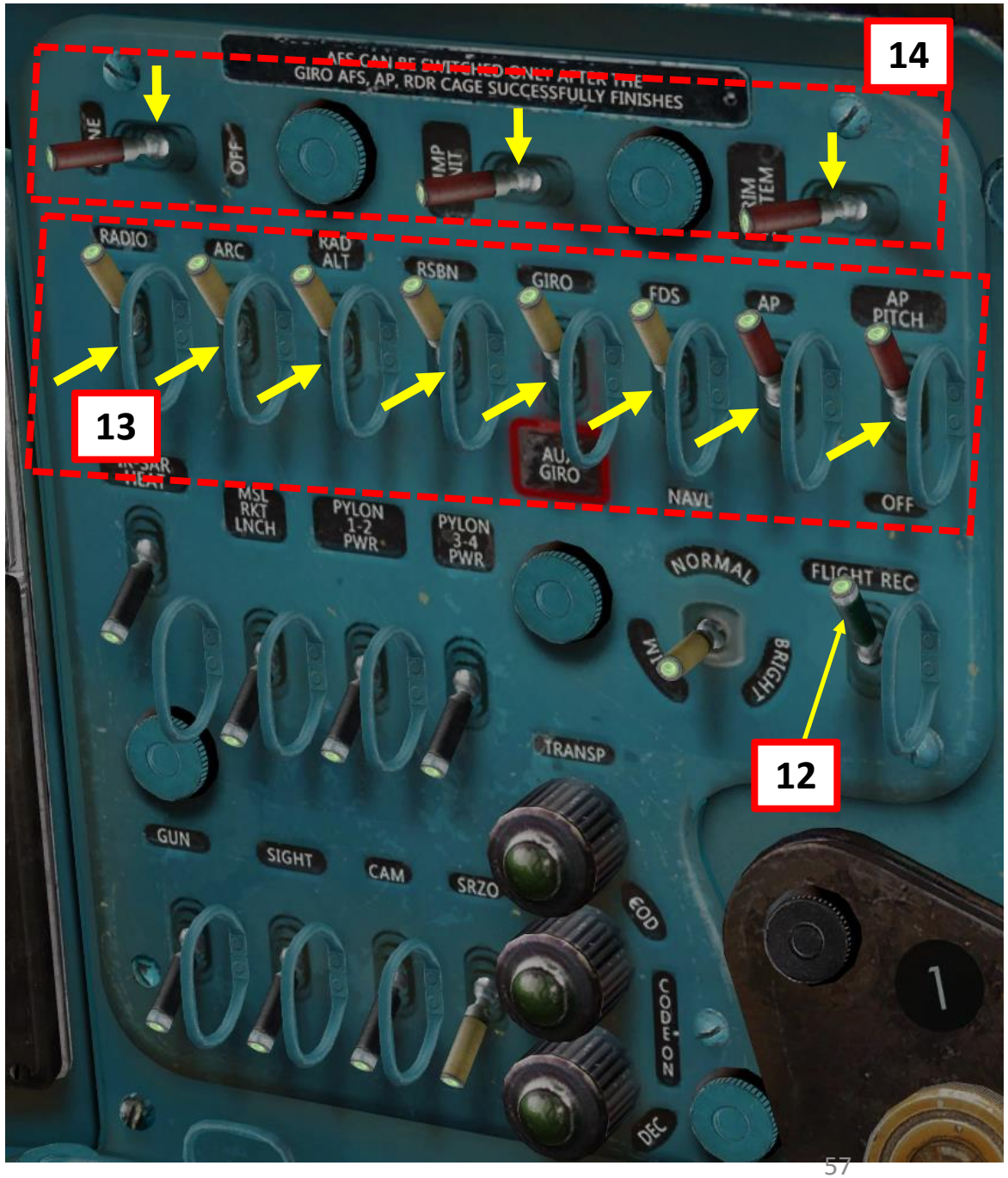




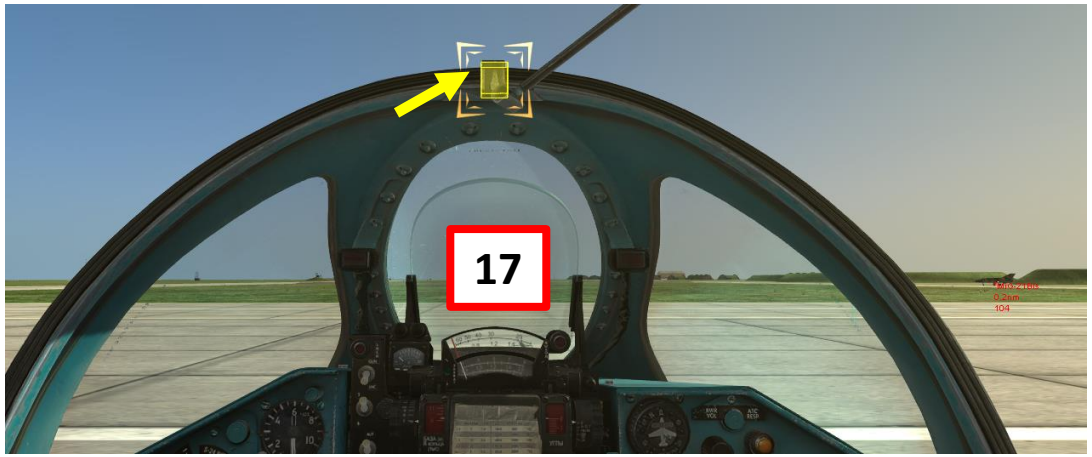
PART 3 – START-UP PROCEDURE

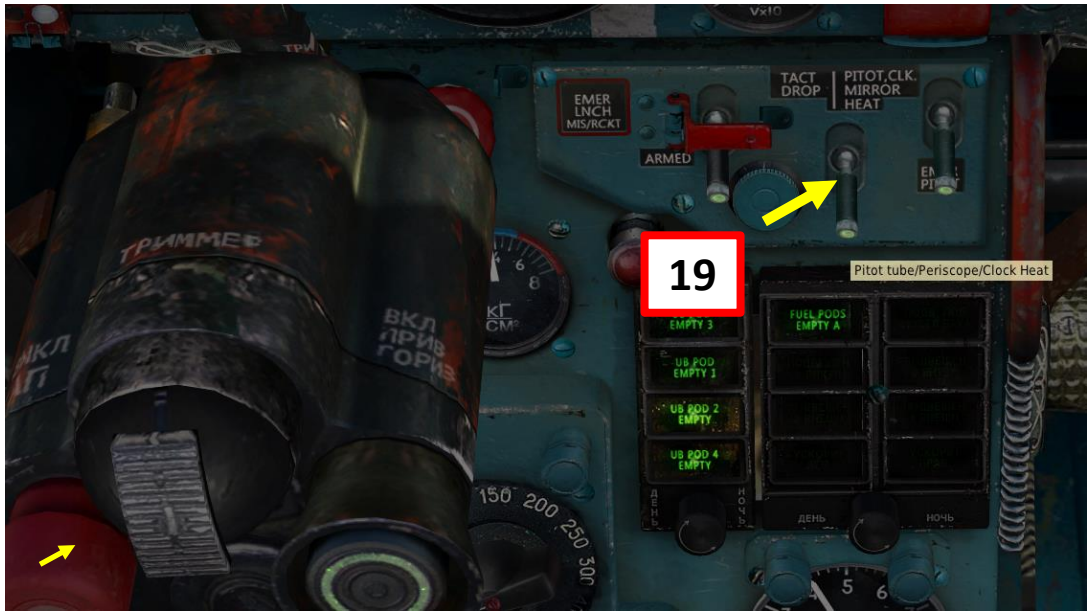
10. GYRO switch for instrument sets # 1 & # 2 **ON (FWD).**
11. If flares and chaff ASO pod is mounted (and it should be since it is the standard equipment for any combat mission), set JATO (SPRD) Start & Jettison system switches **"ON" (FWD)**
12. Optional - Flight recorder switch **"ON" (UP)**
13. ARK Radio Compass, Radio Altimeter, RSBN (Navigation System), GIRO (KPP = ADI = Attitude Indicator), FDS (NPP = HSI = Horizontal Situation Indicator), AP (SAU = Auto-pilot), AP Pitch (Auto-pilot pitch) **ON (UP)**
14. Trim System, Auxiliary Hydraulic Pump and Nosecone switch **ON (FWD)**
15. Flaps on TAKEOFF position
16. Hold FDS Adjust (NPP = HSI) switch until HSI stops moving (magnetic compass is aligned).

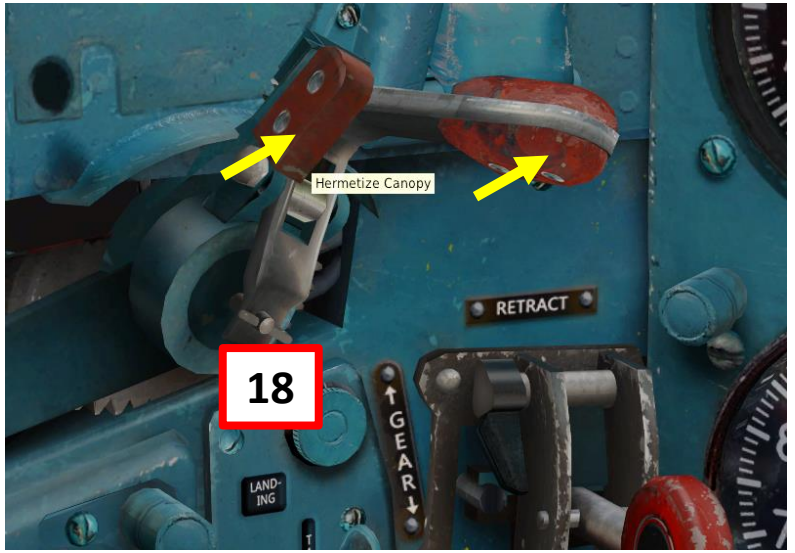




17. Close canopy by clicking on canopy switch
18. Lock and seal cockpit (2 levers)
19. Pitot Heat ON (UP)
20. IR-SARH Missiles Heat ON (UP) - use if IR or Radar-guided missiles are equipped
21. Pylon 1-2 Power, Pylon 3-4 Power, ASP Gunsight Power, SRZO IFF **ON (UP)**







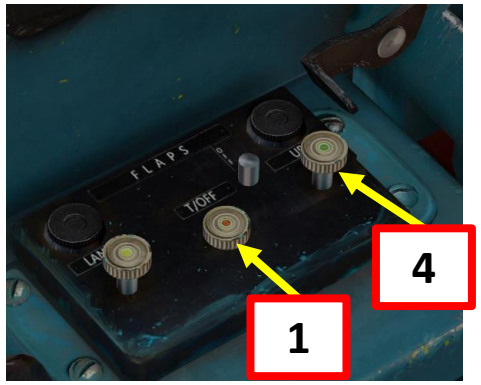
PART 4 – COMBAT TAKEOFF

TAKEOFF PROCEDURE

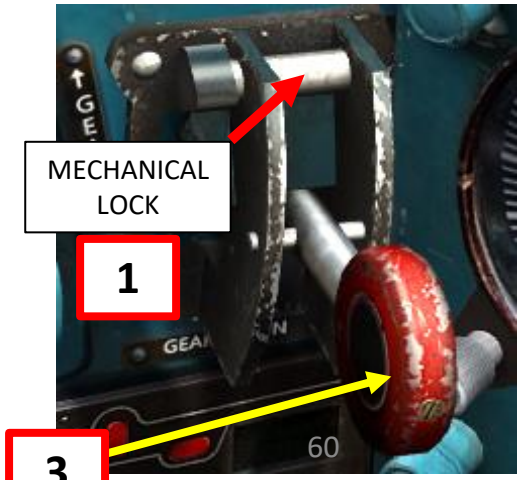
NOTE: A combat takeoff or scramble had to be done very quickly since the MiG-21bis was used as an interceptor. The whole start-up procedure and takeoff had to be performed in **ONE MINUTE** or less. With a bit of practice, you can do it too.

1. Set nosewheel brake OFF (vertical) to line up on the runway by using brakes and rudder. Once in position, click on landing gear mechanical lock, set flaps to TAKEOFF position (25 deg). Straighten the plane nosewheel and set nosewheel brake ON (horizontal).
2. Hold brakes and throttle up to full afterburner (100 %). Release brakes and rotate (nose up 10 deg on UUA) at 250-300 km/h IAS.
3. Raise landing gear (note: the lever has 3 positions: DOWN/NEUTRAL/UP). Initial climb at 360-380 km/h IAS. Once gear is raised, set to neutral position.
4. At 100 m above ground level, set flaps in UP position and keep a 15 deg climb (use UUA as reference).
5. Keep a minimum altitude of 600 m above ground (check radar altimeter) and maintain a minimum speed of 600 km/h IAS. Throttle back to set afterburner OFF.

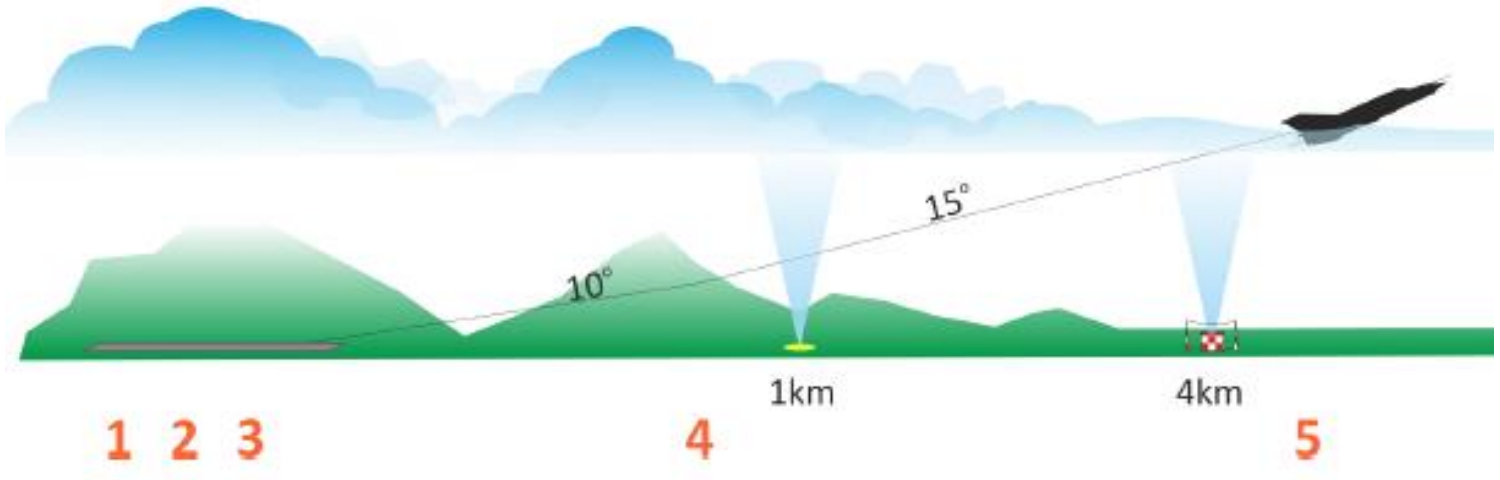
UUA (AOA)



FLAPS



LANDING GEAR LEVER

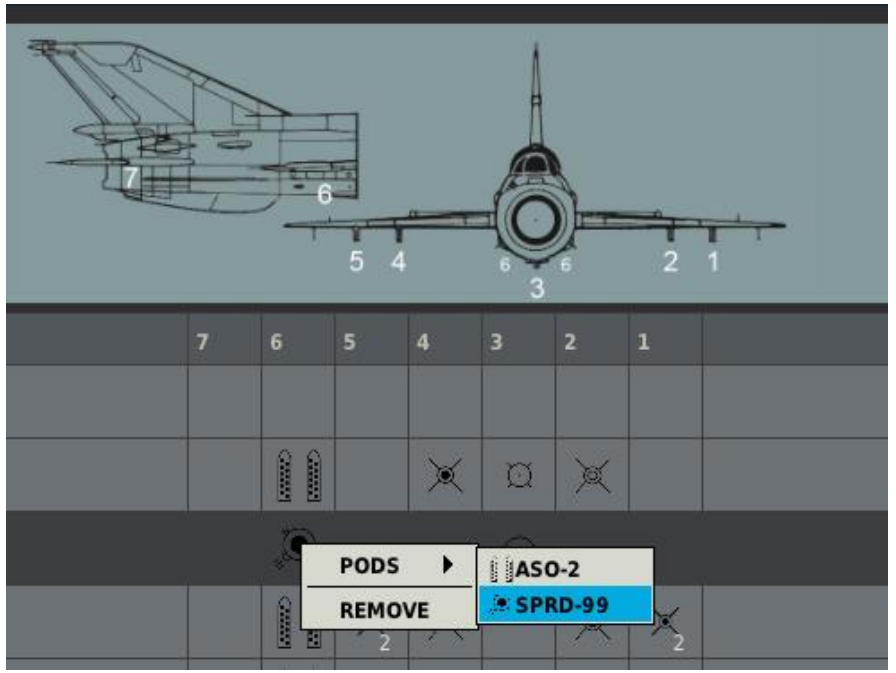


TAKEOFF PROCEDURE

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

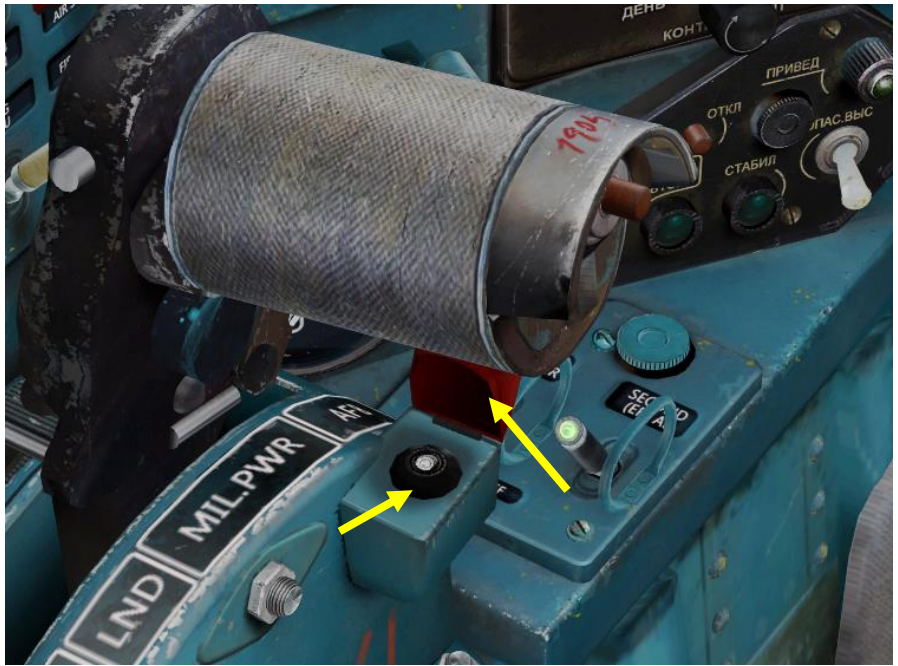
SPRD ROCKET-ASSISTED TAKEOFF (RATO) TUTORIAL

1. Equip SPRD-99 rockets on pylon 6 (this is usually where you have your ASO-2 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 afterburners).
4. When you reach 120-150 km/h, the rockets will ignite automatically and give you a significant thrust increase during 7 seconds.



SPRD ROCKET-ASSISTED TAKEOFF (RATO) TUTORIAL

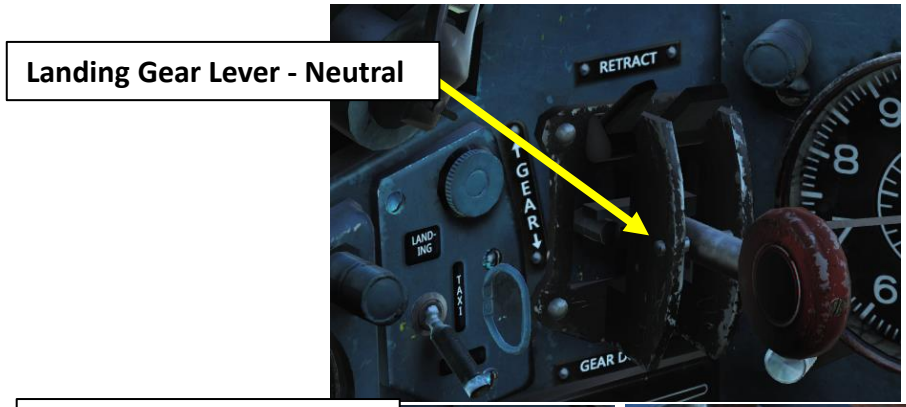
5. When you are up, you can jettison the rockets by flipping up the red countermeasure switch cover and hold the countermeasure switch during 1 second.
6. Raise landing gear and flaps as seen previously in normal takeoff procedure.
7. You may now buy a pair of new underwear.

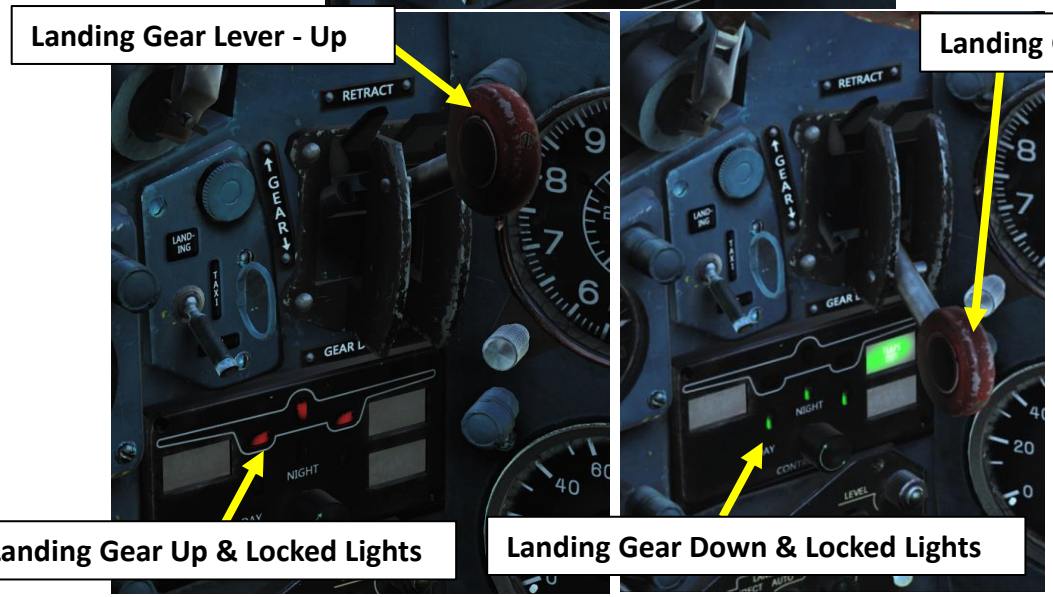


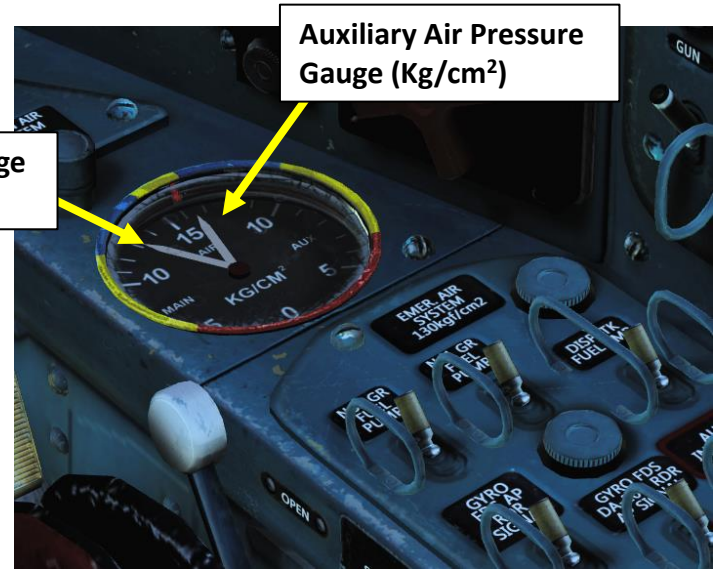
IMPORTANT POINT ABOUT THE PNEUMATIC SYSTEM

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.





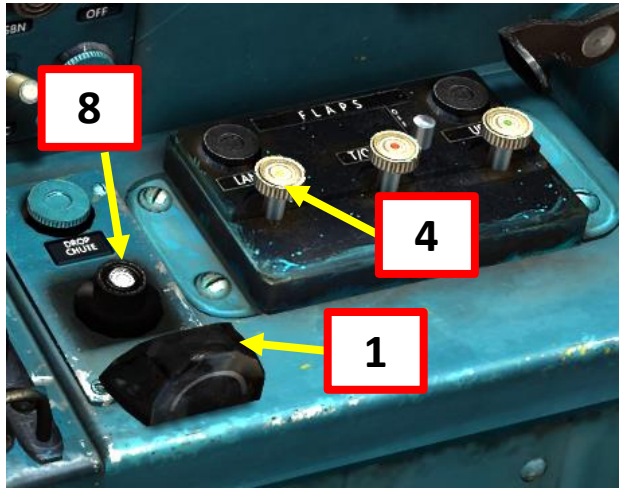


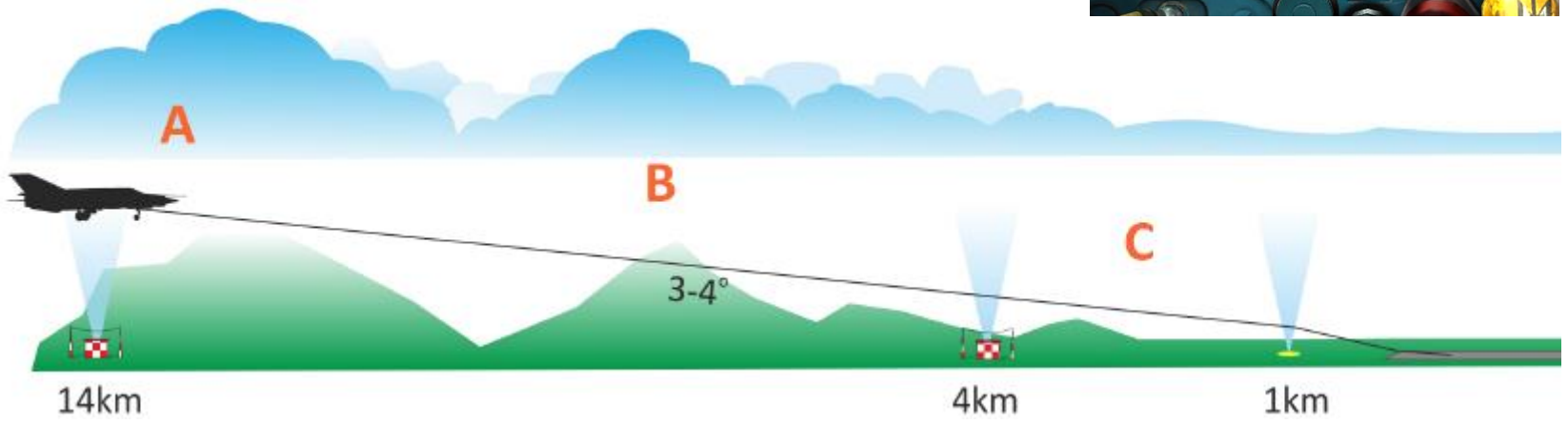
PART 5 – LANDING

LANDING PROCEDURE

NOTE: Landing in the MiG-21bis is NOT like landing a regular plane. The delta wing configuration means the aircraft can be very fast, but generates less lift at low speeds. Rather than come in slow and glide to the ground, you have to come in very fast (400 km/h!!!) and shallow and "gently" touch the ground. Coming in slow and steep is a recipe for disaster.

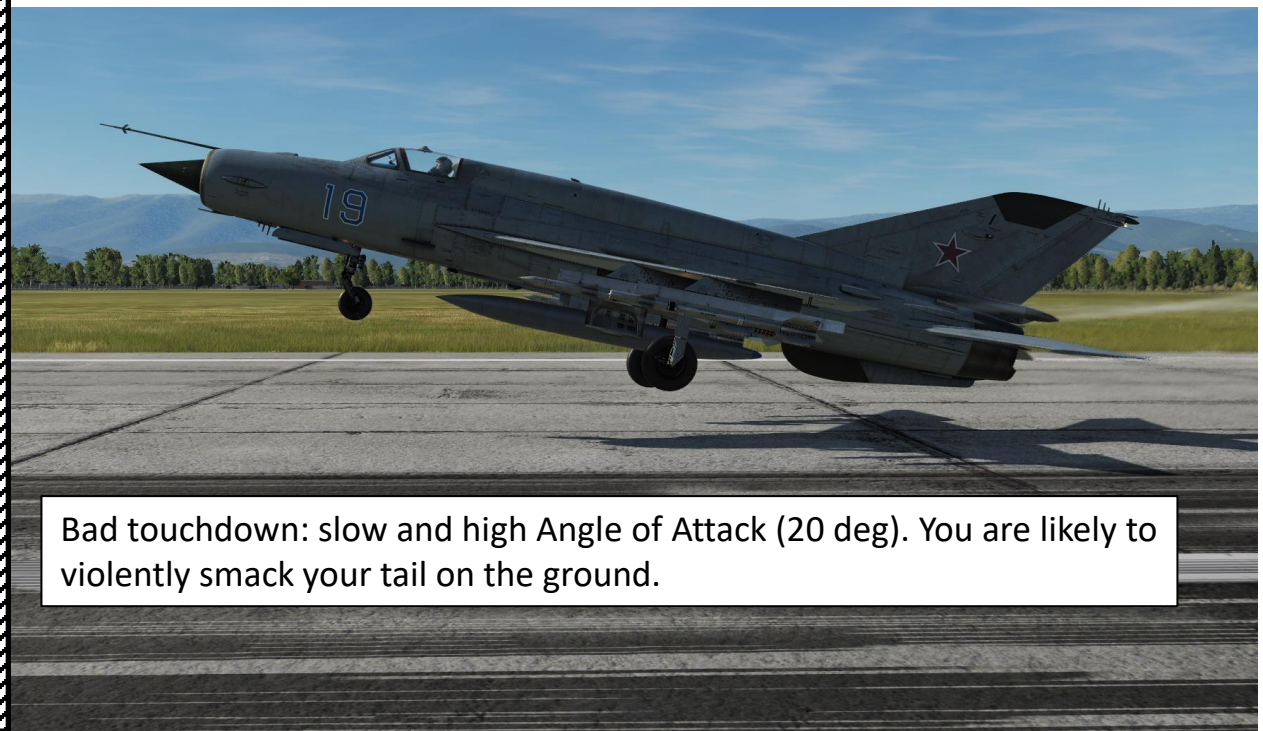
1. Flip safety cover for drag chute jettison switch UP.
2. Set Nosewheel Brake Control Switch to ON (Horizontal position). This will maximize your braking capability for landing if you have a short runway.
3. Deploy landing gear at 1000 m AGL at 500 km/h IAS. Initial descent @ 7 m/s (check variometer). Remember that landing gear has 3 positions: UP/NEUTRAL/DOWN.
4. At 300 m AGL and 380 km/h AGL, deploy flaps in LANDING position (45 deg).
5. Maintain speed between 380 and 340 km/h IAS. Adjust throttle to remain faster than 340 km/h. Maintain 5 deg AoA (Angle of Attack) on the UUA. NOTE: Do NOT use airbrakes.
6. Reach runway at 350 km/h IAS at a vertical speed of 2 m/s (check variometer).
7. Touchdown at 330 km/h or less, set throttle to idle once wheels have touched the ground, deploy drag chute and start tapping your brakes.
8. When you are slow enough, jettison drag chute and set nosewheel brake OFF (vertical) to taxi down the runway.



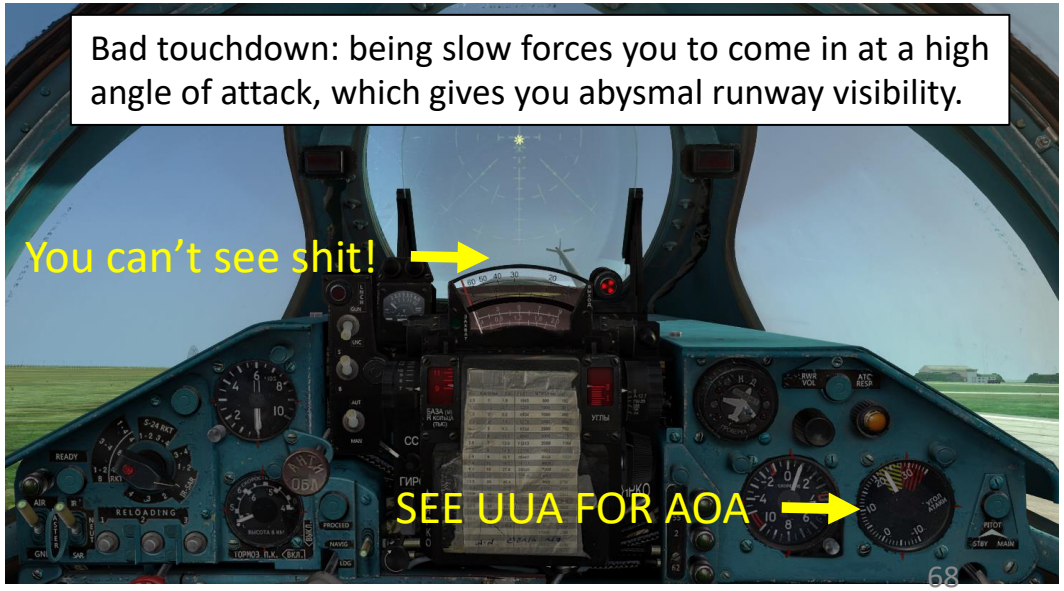


Good touchdown: fast and low Angle of Attack (0-5 deg) – very gentle contact with the ground

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



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

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21

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 LIMITATIONS

1. The RPM gauge (in %) has two needles: needle # 1 is for the low pressure compressor speed (N1) and needle # 2 is for the high pressure compressor speed (N2). Power settings always refer to needle # 1 as a thrust reference indication.
   - MAX RPM (#1) = 103.5 %
   - MAX RPM (#2) = 107.5 %
2. The EGT (Exhaust Gas Temperature) gauge can help you see if your engine is too hot.
   - MAX TEMPERATURE (NO AFTERBURNER) = 780 deg C
   - MAX TEMPERATURE (WITH AFTERBURNER) = 850 deg C

ENGINE FLAMEOUT – RELIGHT PROCEDURE

NOTE: 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.

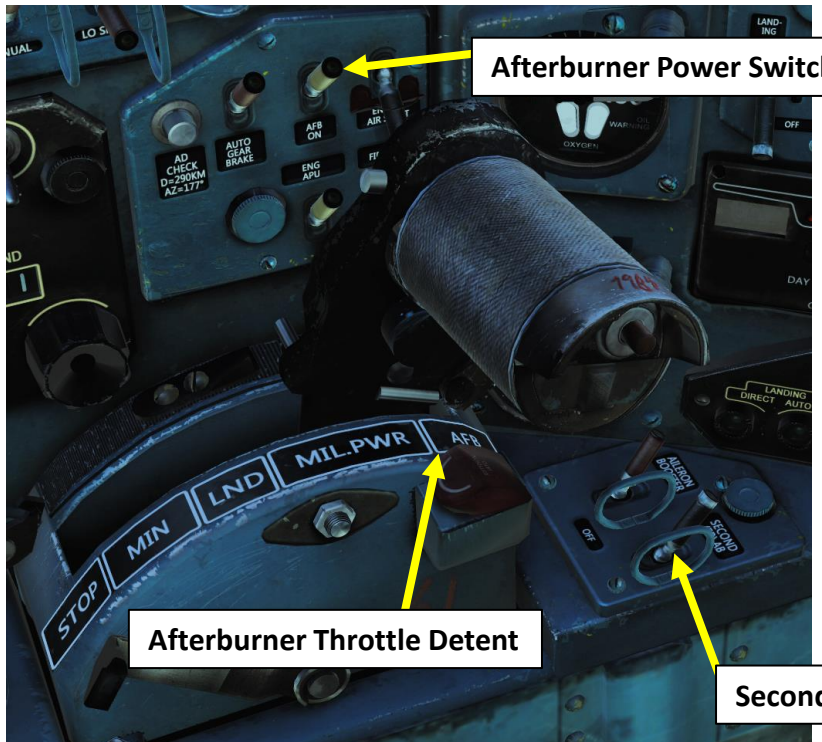
1. Throttle fully back (SHUT-OFF/MIN)
2. Point your nose down and gain some airspeed ASAP.
   a) If your altitude is 8,000 m or higher, speed up to 550 km/h IAS MINIMUM
   b) If your altitude is below 8,000 m, speed up to 450 km/h IAS MINIMUM
3. Turn ON the AIR RELIGHT switch and make sure engine is spooling back up.
4. Once RPM is over 60-70 %, smoothly throttle back up and make sure the engine is running correctly.
5. 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.

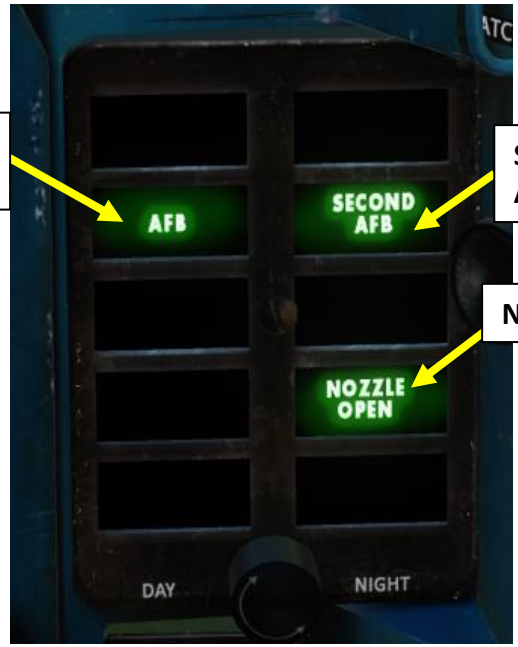
AFTERBURNERS

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 afterburners", 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 afterburners are 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.**





COMPRESSOR SURGE – WHEN THE NEED FOR SPEED GETS YOU IN TROUBLE

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.

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

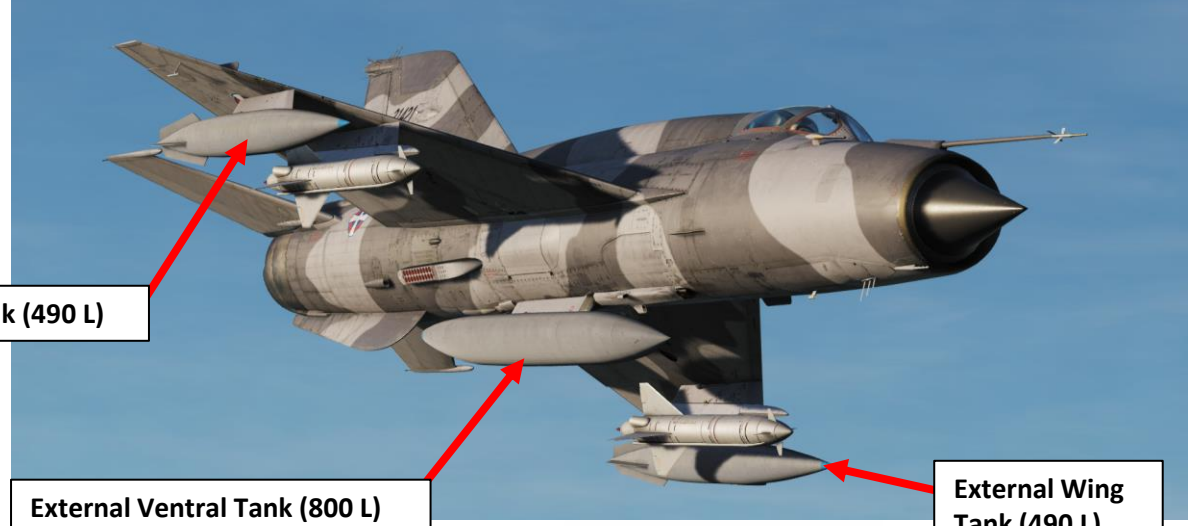
Now, what do you do?

1. Set ANTI-SURGE SHUTTERS control switch to MANUAL (DOWN).
2. Turn off afterburner ASAP
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.

FUEL MANAGEMENT

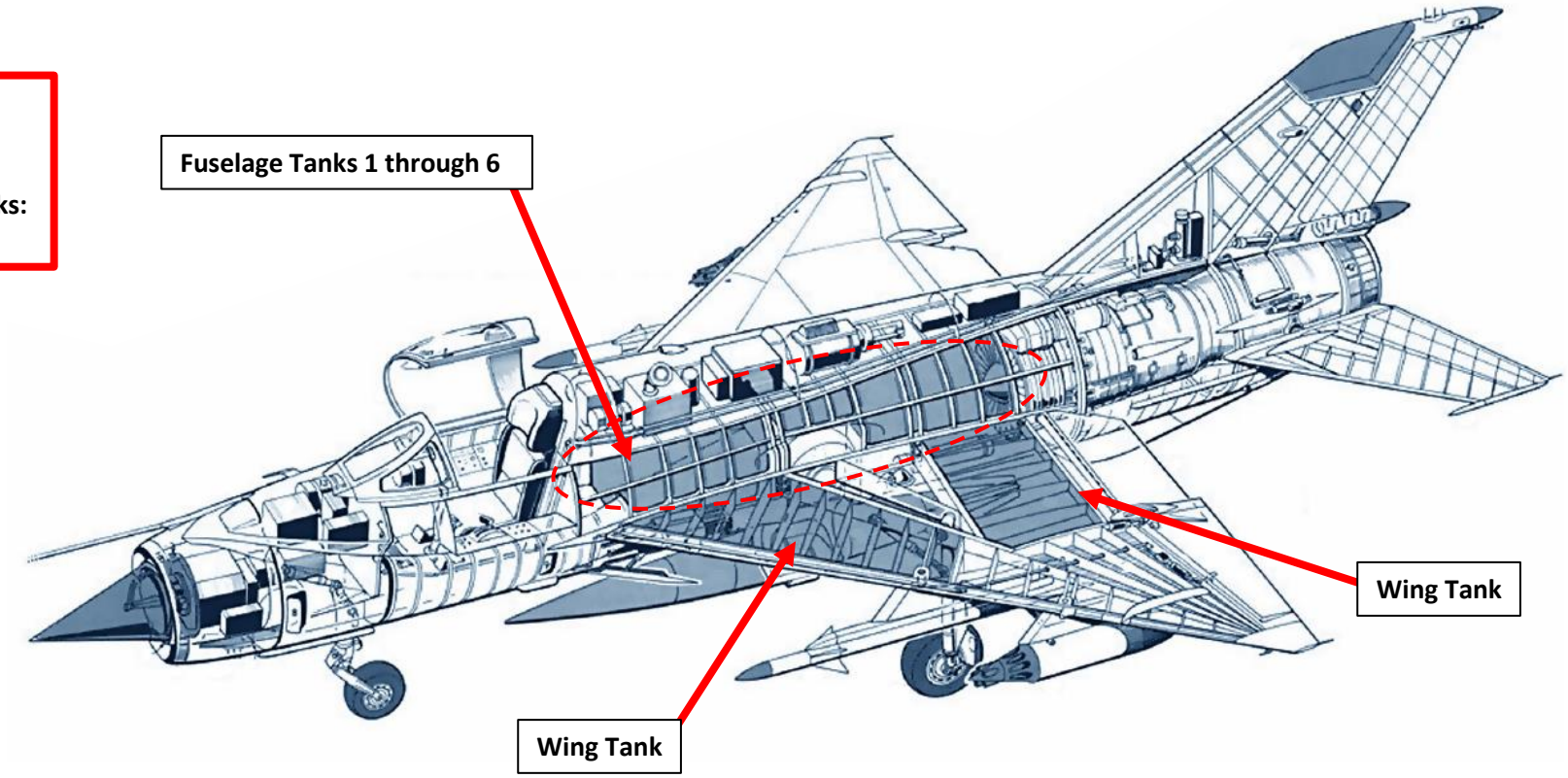
The MiG-21 fuel system is composed of:

- 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



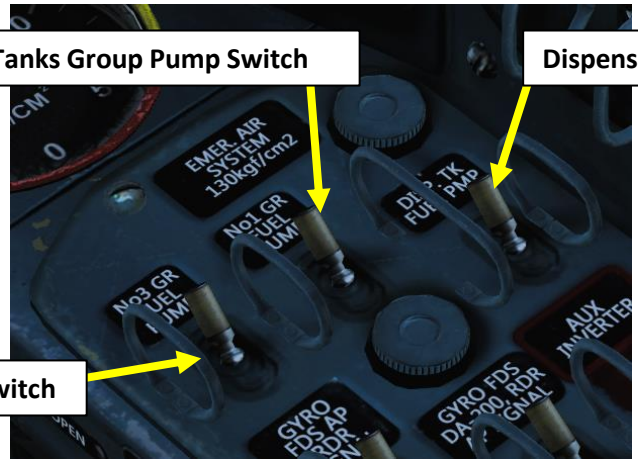
Total Internal Fuel Capacity:
2840 Liters (5027 lbs / 2280 kg)

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

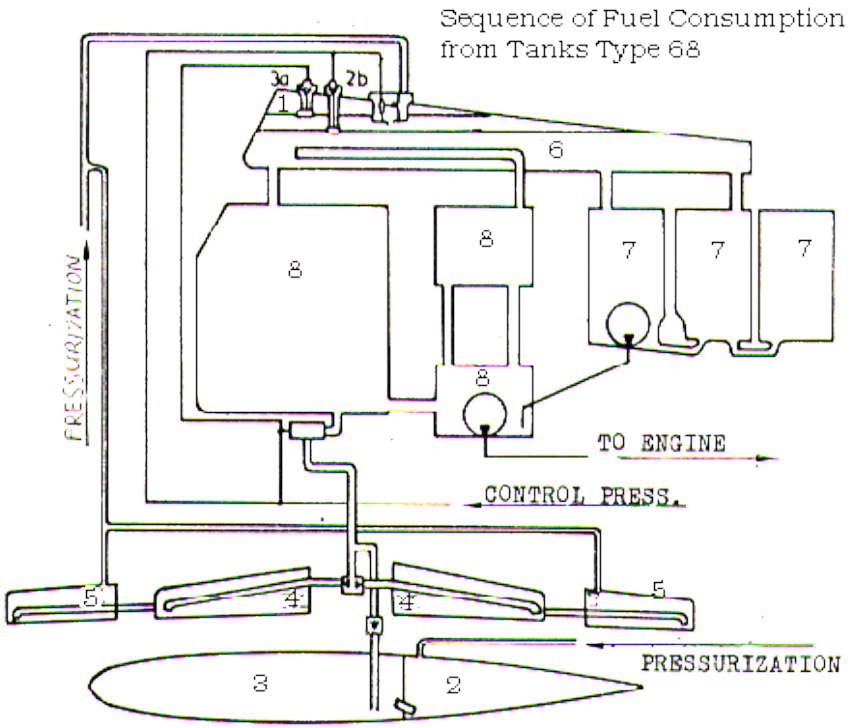


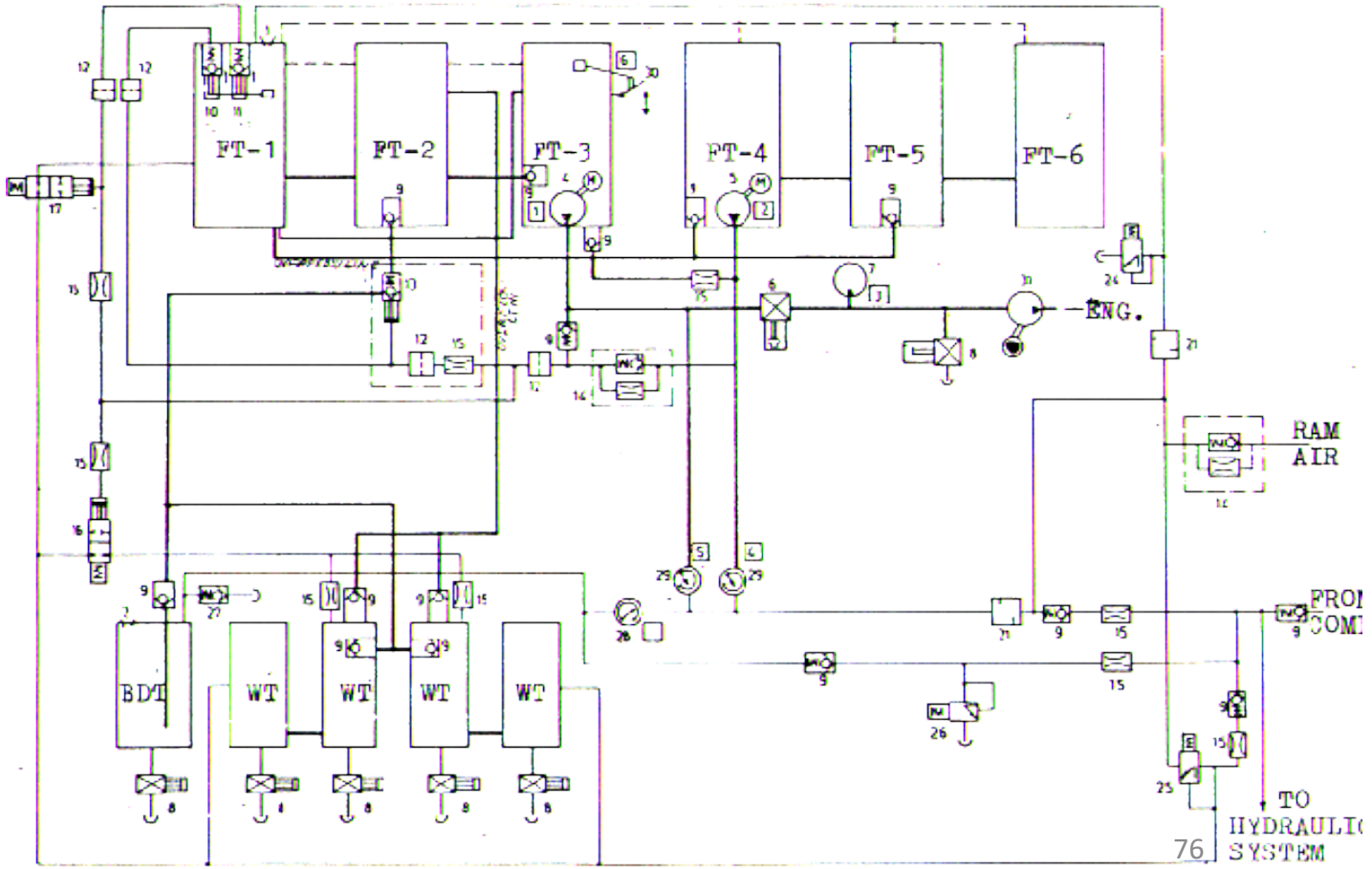
FUEL MANAGEMENT

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

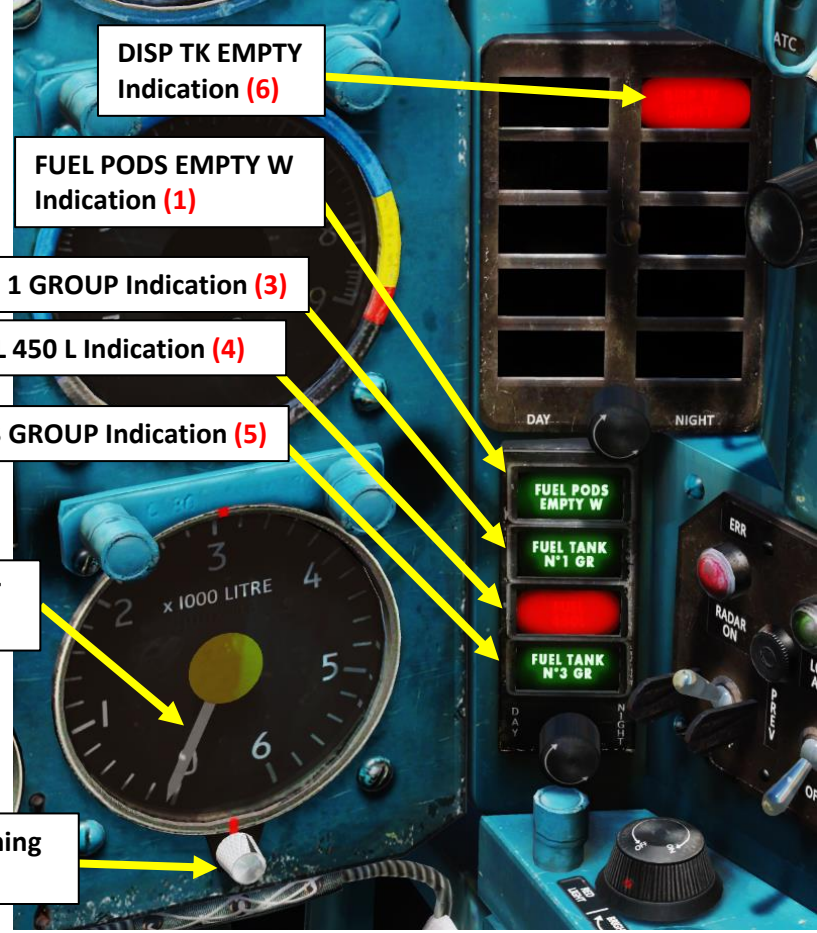




FUEL MANAGEMENT

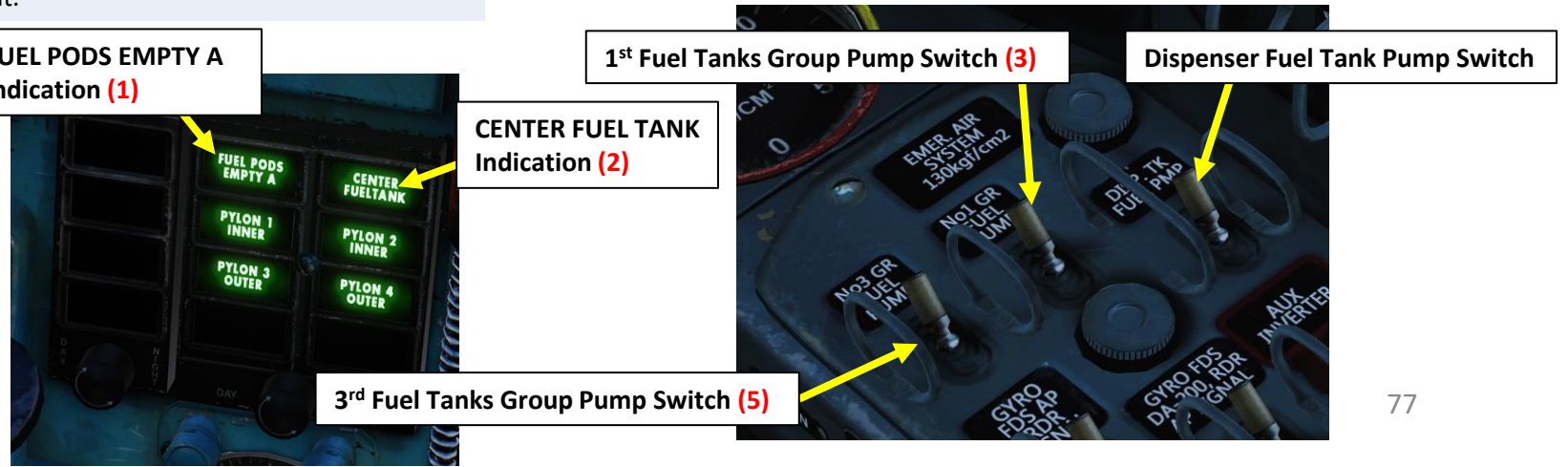
When coming in to land with a fuel remainder of less than 200 L, switch on the 1st Fuel Tank Group Pump circuit breaker in order to transfer fuel that may happen to remain in the first tank group into the service (dispenser) tank. Then, this circuit breaker shall be switched off only after landing. The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

Message & Light Color	Meaning
FUEL PODS EMPTY W or A **(1)**	If plane has fuselage tank, remaining fuel state is 3200-3000 L. If plane does not have external ventral tank, remaining fuel state is 2700-2500 L.
CENTER FUEL TANK **(2)**	If plane had ventral (central external) tank, remaining fuel state is 2700-2500 L. If plane does not have ventral tank, remaining fuel state is 2700 L.
FUEL TANK NO 1 GROUP **(3)**	First fuel tank group is empty; turn off 1st Fuel Tanks 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.



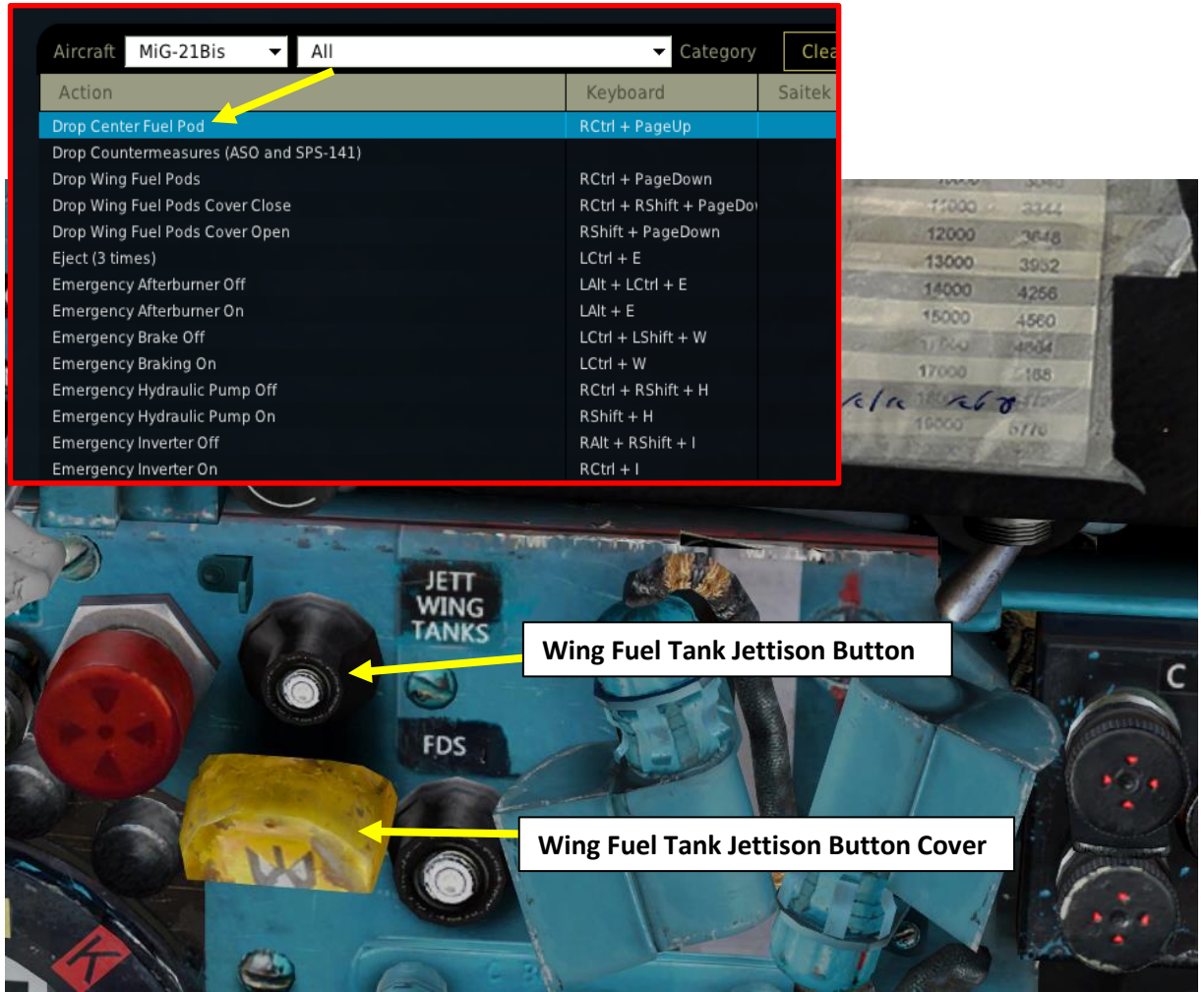
Note:

*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 for the ventral fuel tank jettison switch: the switch is in front of the stick and very hard to access.



GENERAL RULES

- Flaps should be used on takeoff and landing, but should NEVER be used to turn tighter.
- Airbrakes can be used to turn tighter, but should NEVER be used during landing.
- 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.

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.

- 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**

SIGNAL/CAUTION LIGHT ANALYSIS (TAKEN FROM THE 476TH VFG FLIGHT CREW CHECKLIST PAGES 24-25-26, SEE PART 15: OTHER RESOURCES)

LEFT CONSOLE

LIGHT	CONDITION	CORRECTIVE ACTION
GEAR DOWN	Flaps lowered, gear up	Lower landing gear if required.
FLAPS OUT	Flaps Deployed	Retract as needed
AIRBRAKE OUT	Speedbrakes Deployed	Close as needed

LOWER CENTER CONSOLE

LIGHT	CONDITION	CORRECTIVE ACTION
UB POD EMPTY 3	Pod Empty	N/A
UB POD EMPTY 1	Pod Empty	N/A
UB POD 2 EMPTY	Pod Empty	N/A
UB POD 4 EMPTY	Pod Empty	N/A
FUEL PODS EMPTY A	Wing external tanks empty	Jettison tank if entering combat
PYLON 1 INNER	Pylon Empty	N/A
PYLON 3 OUTER	Pylon Empty	N/A
JATO RIGHT	JATO ON ACFT	Jettison after takeoff (light off)
CENTER FUELTANK	Centerline external fuel tank empty	Jettison tank if entering combat
PYLON 2 INNER	Pylon Empty	N/A
PYLON 4 OUTER	Pylon Empty	N/A
JATO LEFT	JATO ON ACFT	Jettison after takeoff (light off)

UPPER CENTER CONSOLE

LIGHT	CONDITION	CORRECTIVE ACTION
MARKER	Will blink & beep marker Morse code for 3 seconds	No Action
KONUS OUT	Cone operational	Should only be on when landing gear is extended
STABILIZER ON	Indicates ARU system set-up for low speed tail movements	If ON and under 450kh/h IAS ARU system inop.
TRIM NEUTRAL	Trim in neutral (takeoff) position	No Action

LOWER RIGHT CONSOLE

LIGHT	CONDITION	CORRECTIVE ACTION
FUEL PODS EMPTY W	external wing fuel tanks empty	Jettison tank if entering combat
FUEL TANK N`1 GR	Fuel tank group empty	Turn off 1st fuel group pump 700 – 1000 L fuel remaining
FUEL 450L	Minimum Fuel	Land as soon as possible 450-550 L fuel remaining
FUEL TANK N31 GR	Fuel tank group empty	Land as soon as possible 250 – 350 L fuel remaining

UPPER RIGHT CONSOLE

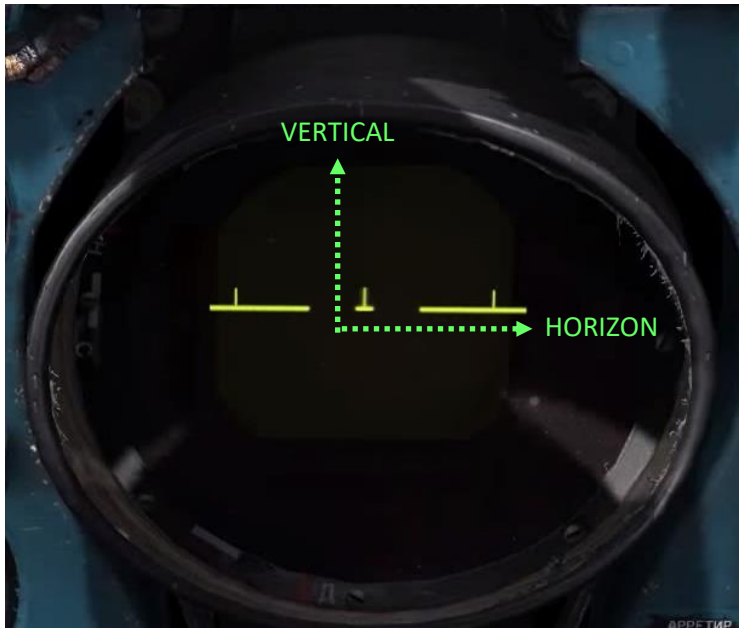
LIGHT	CONDITION	CORRECTIVE ACTION
ENGINE START	Engine is starting	Observe Engine Instruments
AFB	Afterburner Engaged	No Action
DC GEN	DC Generator failure	Follow DC Gen Failure Emergency Procedure
FIRE	Engine compartment fire	Follow Engine Fire Emergency Procedure
Booster Pressure	Buster Hydraulic pressure low	Follow Failure of Booster Hydraulic System with Engine Running Emergency Procedure
DISP TK EMPTY	Low fuel pressure or only 80 liters remaining.	Land as soon as possible
SECOND AFB	Emergency afterburner engaged	Dissengage emergency afterburner when not needed.
AC GEN	AC Generator failure	Turn off AC generator
NOZZLE OPEN	Throttle in reheat position	N/A
HYDRAULIC PRESSURE	Main Hydraulic Pressure low	Follow Booster Hydraulic System with Engine Running Emergency Procedure

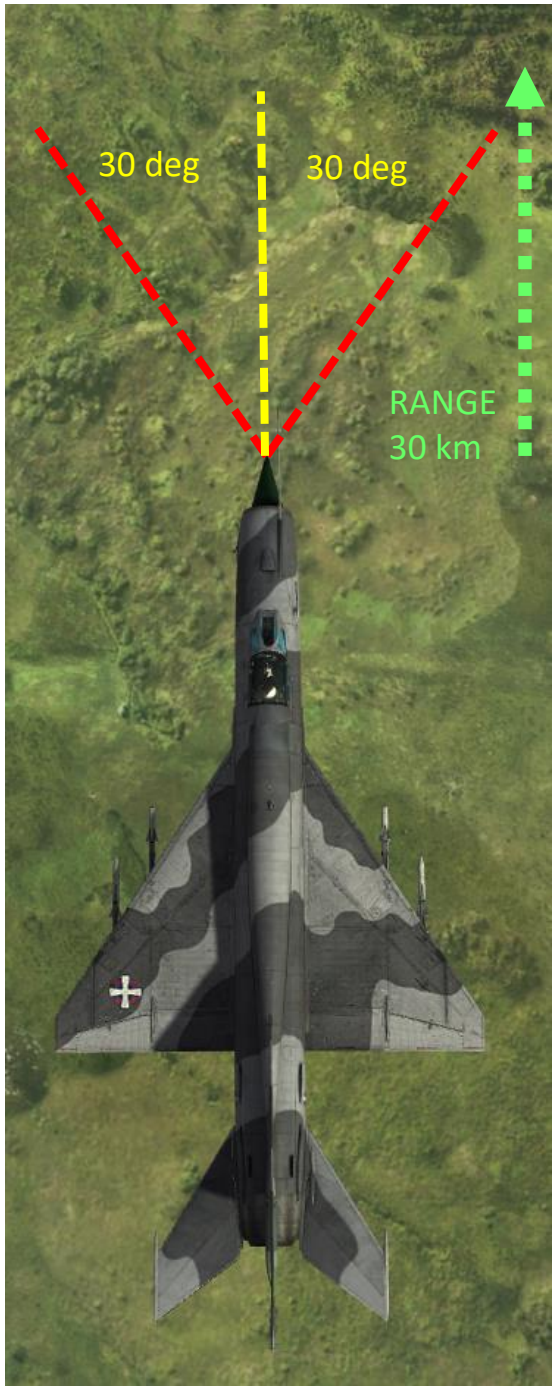
RP-22 RADAR INTRODUCTION

- The RP-22SM “SAPFIR” (Sapphire) radar was introduced in 1968 with the MiG-21SM.

RADAR SCAN MODE
(TOP DOWN VIEW)

RADAR LOCK MODE
(CHASE VIEW)





RP-22 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.

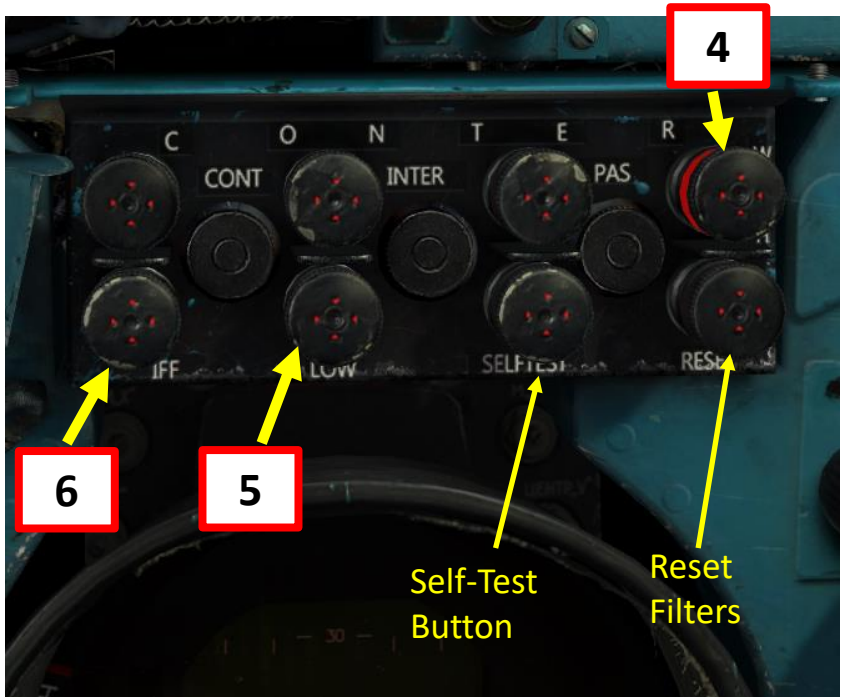
- But why? Isn't that limitation very restrictive, especially since most western aircraft can operate their radar all flight long? Yes, maybe, but there is a reason behind this design. Russian engineers had to work with very constraining limitations: low budget, tight schedule. At that time, the RP-22 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!).

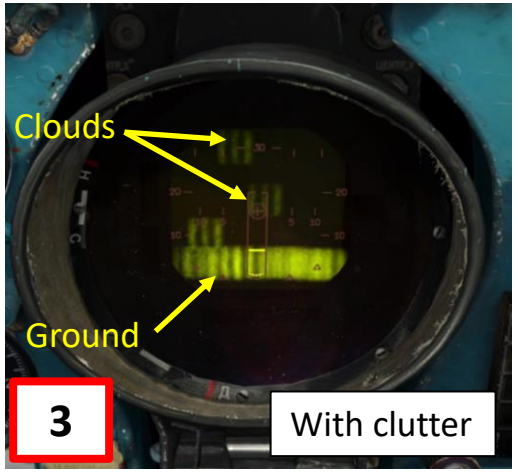
- This design is practical in the sense that the USSR used interception tactics based on the GCI (Ground-Controlled Interception) model: flights of interceptors would be scrambled and directed to targets by ground controllers, like the British were during the Battle of Britain with the Dowding System. 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.

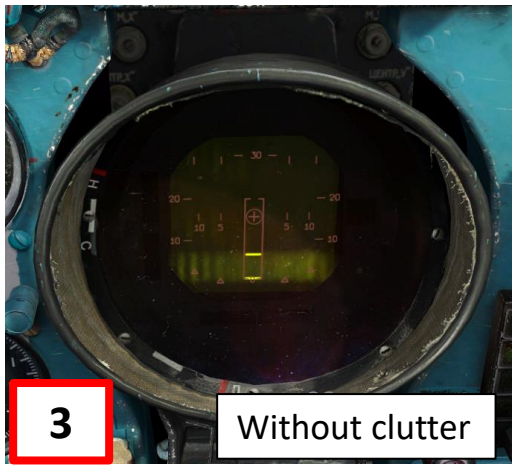
RP-22 RADAR – HOW TO SCAN

1. After takeoff, set radar to STANDBY mode using the Master switch (middle position) on the radar master control panel. Wait for 5 minutes for the radar to warm up. IN STDBY mode, alcohol coolant lasts for 2.5 hours (150 minutes).
2. Set radar to ON using the Master switch (UP position) when you are in the vicinity of target. In this mode, alcohol coolant lasts for 45 minutes.
3. To remove ground clutter reflections from radar, set the LOW ALT switch to the middle position.
4. To remove cloud reflections from radar, use the cloud filter switch on the filter panel.
5. Optional: To scan for "low speed differential" targets (bombers or helicopters), use the LOW filter.
6. Set the IFF filter to identify friendlies in the area. Dashes are for enemy or unidentified contacts. Equal signs are for friendly contacts.
7. In SCAN mode, radar has a top down view. Contact spotting is easier if you fly UNDER them.
8. Unlike modern radar, the RP-22 has a fixed orientation. You don't have to touch anything: you just need to steer the aircraft towards spotted contacts.

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



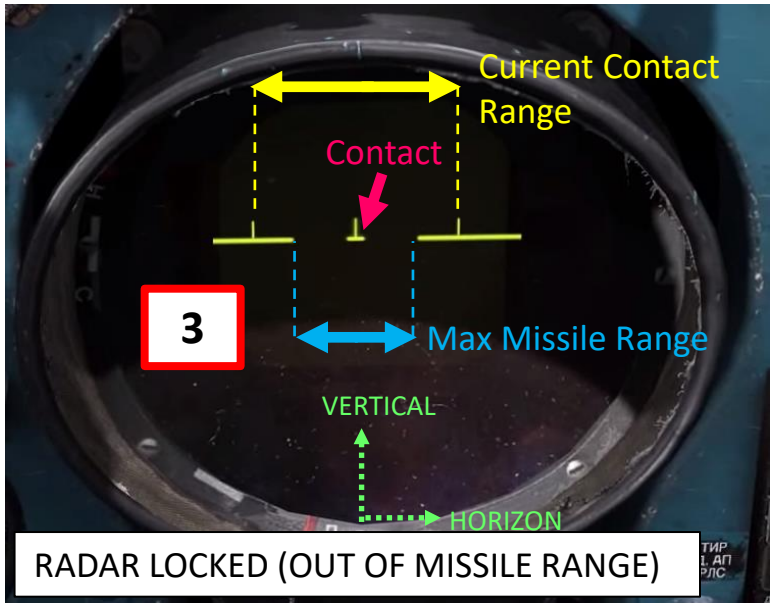


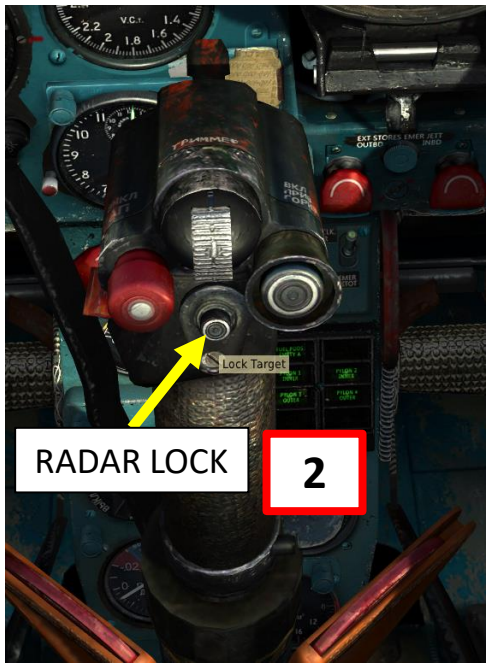


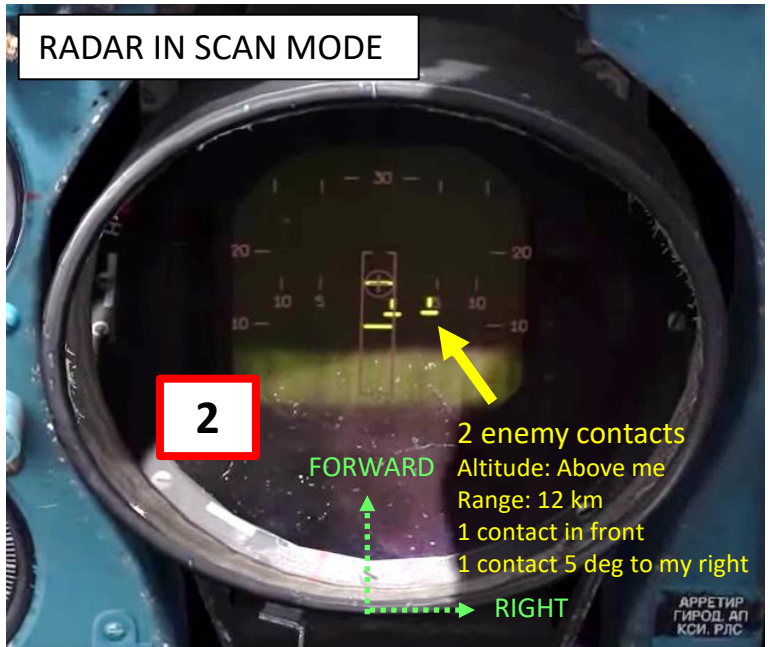
RP-22 RADAR – HOW TO LOCK

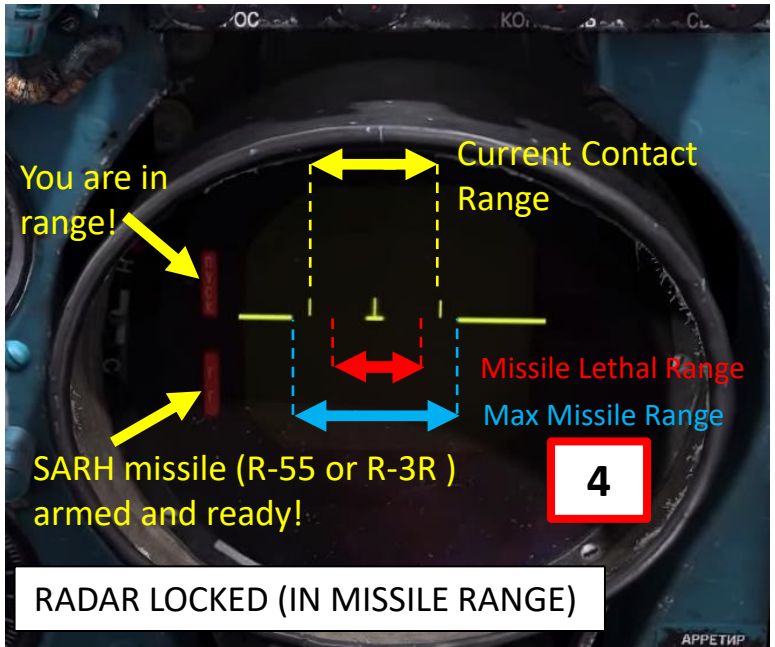
1. When a contact is spotted, you will most likely be flying under it.
2. To lock radar contact, slew TDC over contact and hold the RADAR LOCK button on your stick for 2 to 3 seconds. If the target is more than 5 degrees to your left or right, steer the aircraft towards it.
3. After lock, you will generally be in radar range, but not in effective missile range.
4. 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.
5. 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.

- Radar locking is **useful** for SARH (Semi-Active Radar Homing) missiles like the **R-55 or the R-3R**, which require constant radar lock to track a target. It is also used for Beam Riding missiles like the **KH-66** GROM.
- Radar lock is **useless** for **IR** (infrared) missiles like the **R-3S, R-13 and R-60**, who track targets on their own.







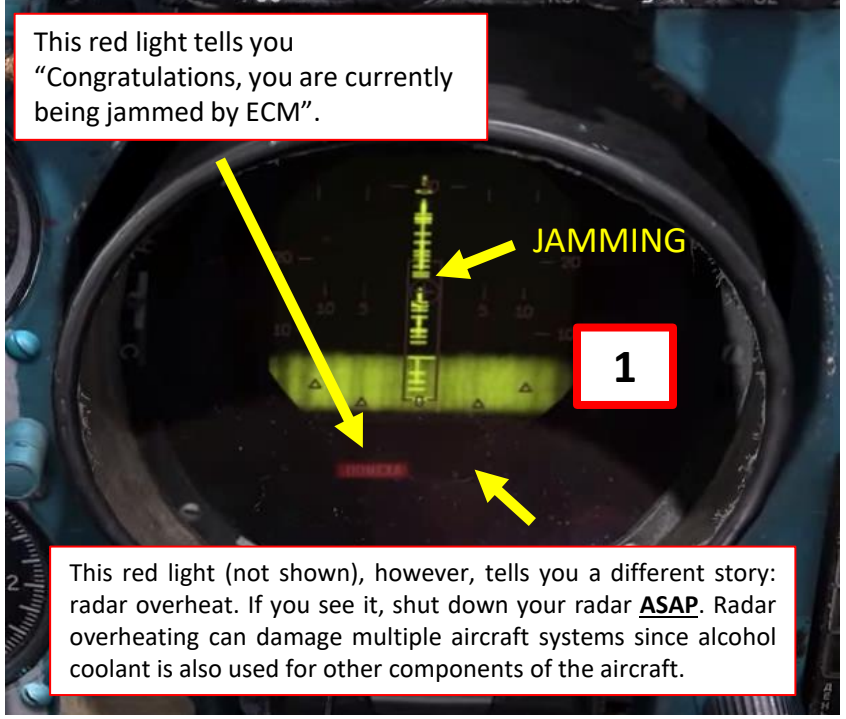


RP-22 RADAR – HOW TO DEAL WITH RADAR JAMMING

- 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-15C, 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.

- **CONTINUOUS** 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.
- **PASSIVE** 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.
- **INTERMITTENT** will switch back and forth between CONTINUOUS and PASSIVE filters. **Highly recommended**.

- **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.**
- 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.



AIR-TO-AIR MISSILES

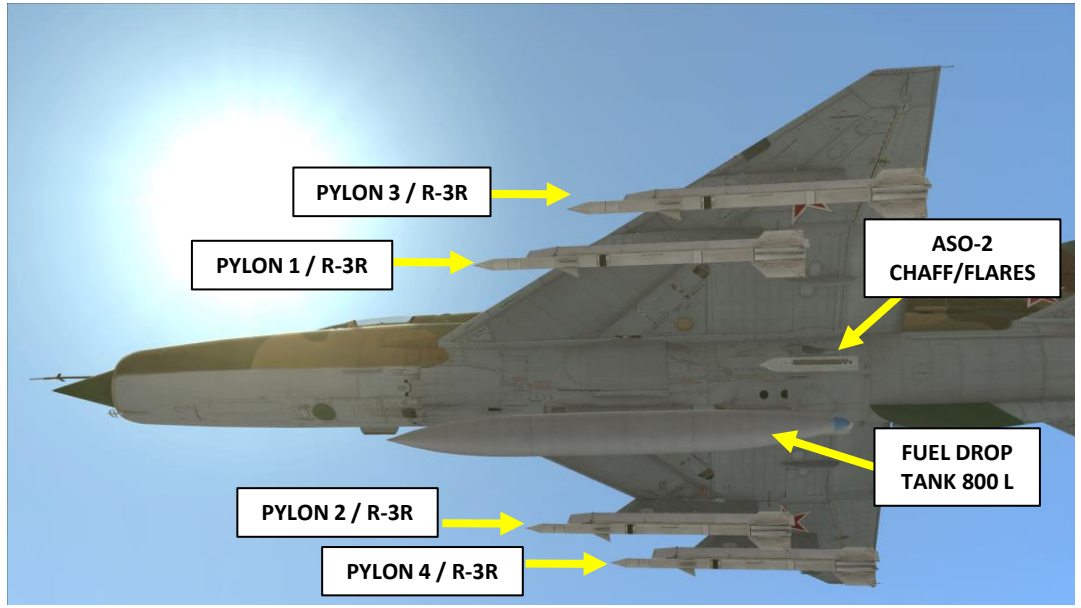
NAME	RANGE MAX/EFFECTIVE	DESCRIPTION	GOOD AGAINST
RS-2US ALKALI	5 / 3 km	Semi-Active Radar, 1957, Rear Aspect	Bombers (unreliable)
R-3S ATOLL	7 / 2 km	Infrared Seeker, 1962, Rear Aspect, Similar to AIM-9B (GAR-8) SIDEWINDER	Fighters (unreliable)
R-3R ATOLL	8 / 3 km	Semi-Active Radar, 1966, All Aspect	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

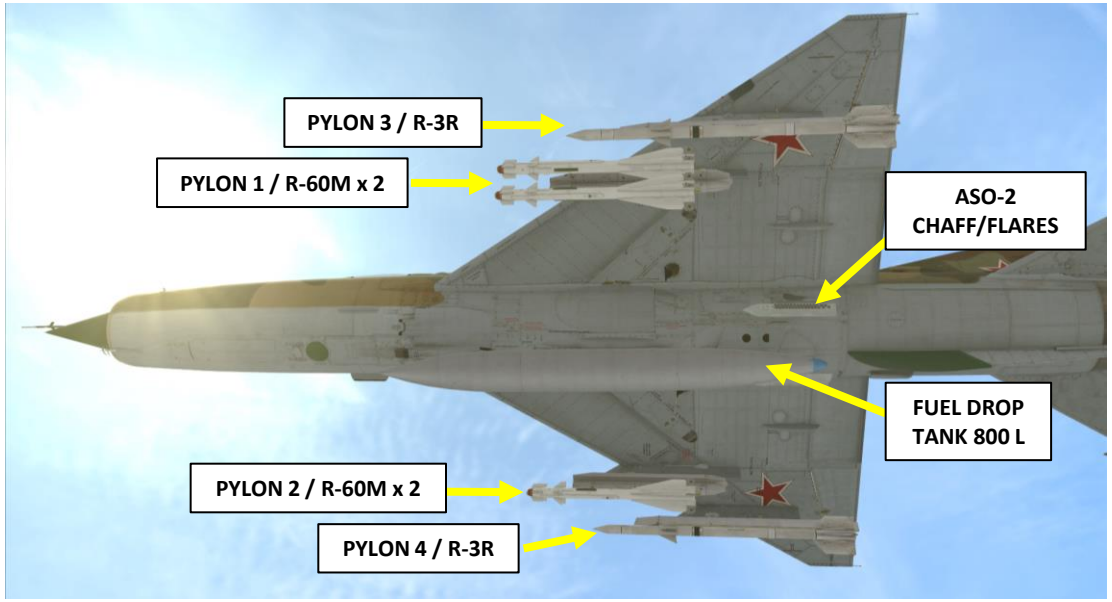
MISSILE TERMINOLOGY

GUIDANCE/HOMING MODE	IN ENGLISH, PLEASE?
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	**IN ENGLISH, PLEASE?**
REAR ASPECT	Target can only be tracked from the rear.
ALL ASPECT	Target can be tracked in all directions.

TYPICAL LOADOUT FOR AIR INTERCEPTION

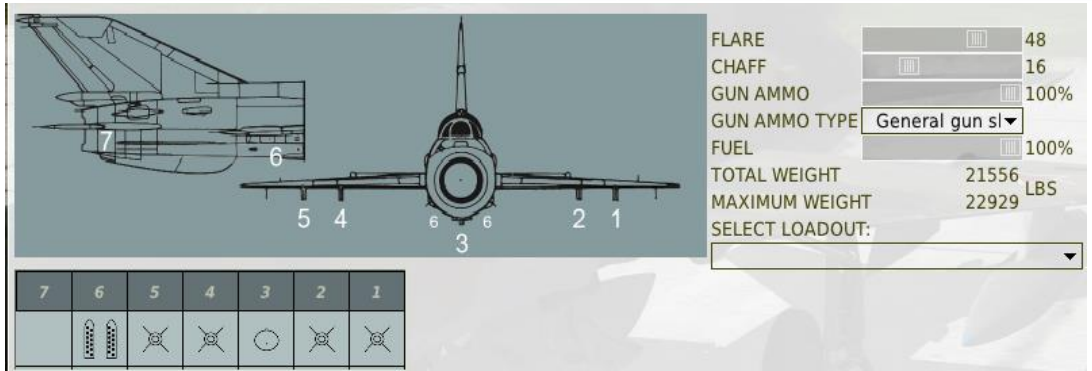
Trick to remember pylon position: Repeat out loud “3-1-2-4” many times quickly. You now remember pylon numbers from left to right. ☺





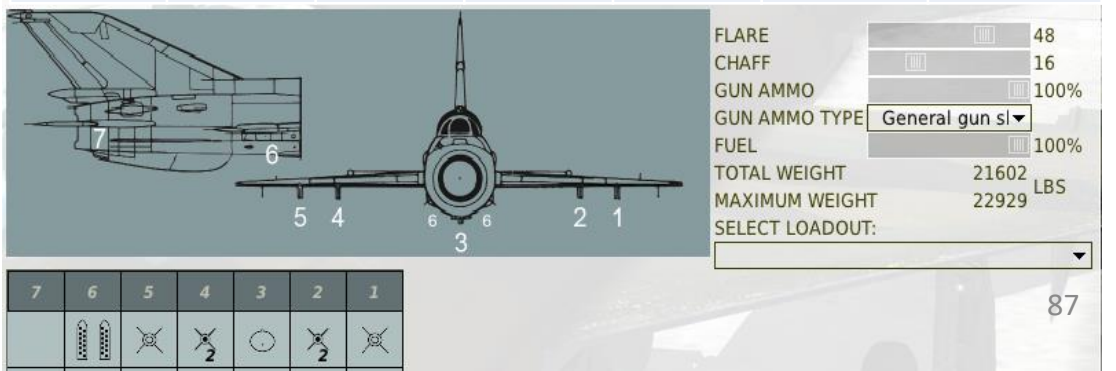
LOADOUT 1 – FIGHTER INTERCEPT

VENTRAL	PYLON 3	PYLON 1	PYLON 2	PYLON 4	FUSELAGE	INTERNAL
MENU: 6	MENU: 1	MENU: 2	MENU: 4	MENU: 5	MENU: 3	N/A
ASO-2	**R-3R**	**R-3R**	**R-3R**	**R-3R**	**800 L FUEL TANK**	**GSh-23 GUN**
48 FLARES 16 CHAFF	SARH Missile	SARH Missile	SARH Missile	SARH Missile	Drop tank 800 L	250 CANNON ROUNDS



LOADOUT 2 – BOMBER/A-10 INTERCEPT

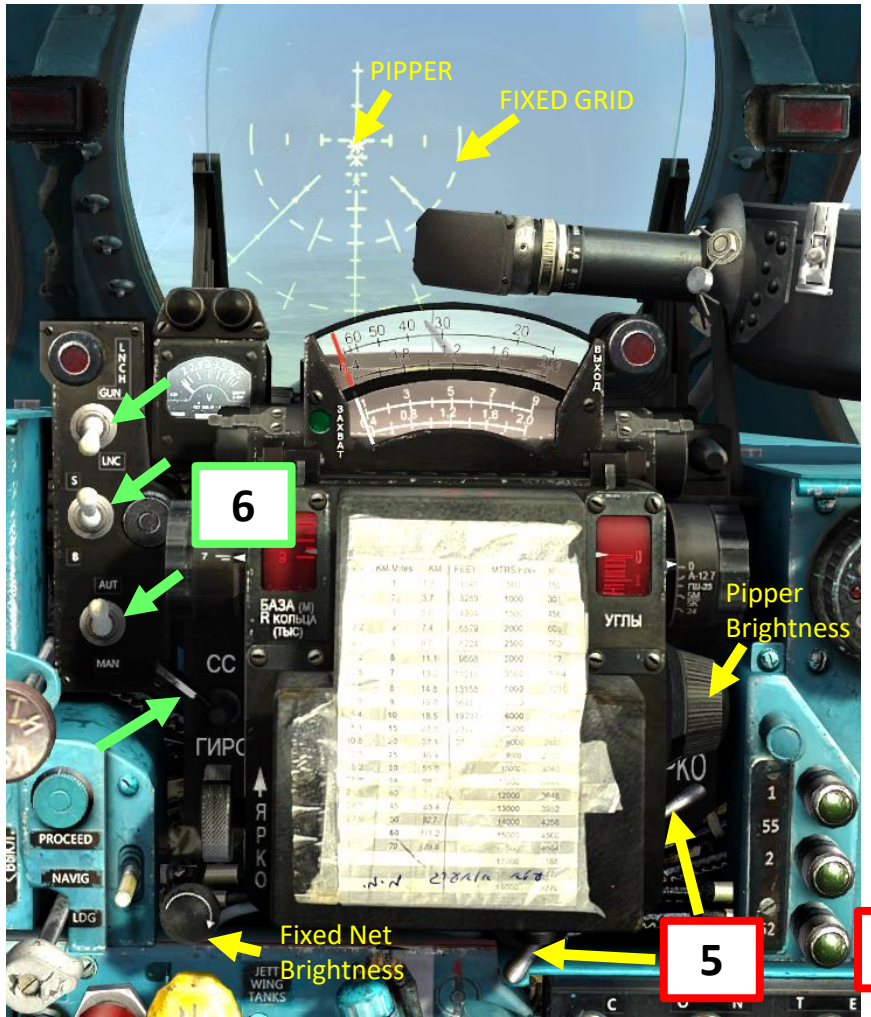
VENTRAL	PYLON 3	PYLON 1	PYLON 2	PYLON 4	FUSELAGE	INTERNAL
MENU: 6	MENU: 1	MENU: 2	MENU: 4	MENU: 5	MENU: 3	N/A
ASO-2	**R-3R**	**R-60M X 2**	**R-60M X 2**	**R-3R**	**800 L FUEL TANK**	**GSh-23 GUN**
48 FLARES 16 CHAFF	SARH Missile	IR A2A Missile	IR A2A Missile	SARH Missile	Drop tank 800 L	250 CANNON ROUNDS

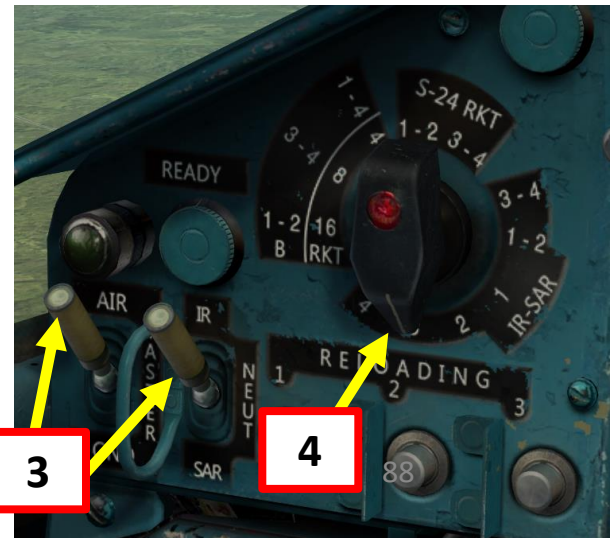


IR (INFRARED) MISSILE TUTORIAL

APPLICABLE TO R-3S, R-13, R-55 AND R-60 MISSILES

1) Turn ON (UP) weapon system switches (in black) on armament panel.
2) Warm up radar (5 minutes, do that on the ground) by using the radar mode switch to STANDBY (middle position). Then, set radar mode to ON (UP position) and LOW ALT switch to middle position.
3) Set Air/Ground Mode switch to AIR and Missile Mode switch to IR (UP).
4) Select appropriate missile pylon (example: R-60M IR missile on outer left pylon, select pylon 3). NOTE: 1-2 and 3-4 fire 2 missiles in quick succession.
5) Turn ON ASP gunsight pipper and fixed net.
6) Set ASP gunsight to LNC (launch = DOWN), S (shooting mode = UP), AUT (automatic = UP) and CC (ASP MISSILE Mode).
7) Find target on radar (see radar tutorial of in previous section), slew your TDC on it and lock it with the RADAR LOCK button on your stick to get its position. NOTE: You do not aim with your radar.
8) Target range should be updated on both your ASP gunsight (see next page for details) and radar "CHASE" mode screen.
9) Line up pipper on target until it automatically tracks the target. You should hear a lock tone and see a green light based on IR missile type.
10) Launch missile holding "WEAPONS RELEASE" button when you are in lethal missile range.
11) You do not need to maintain radar lock: the missile will track the target on its own. Fire and forget!





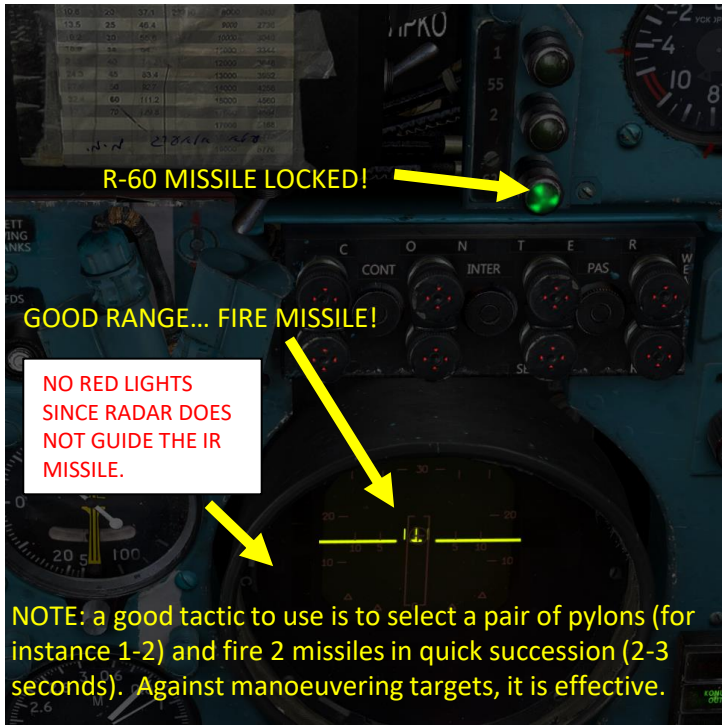
IR (INFRARED) MISSILE TUTORIAL

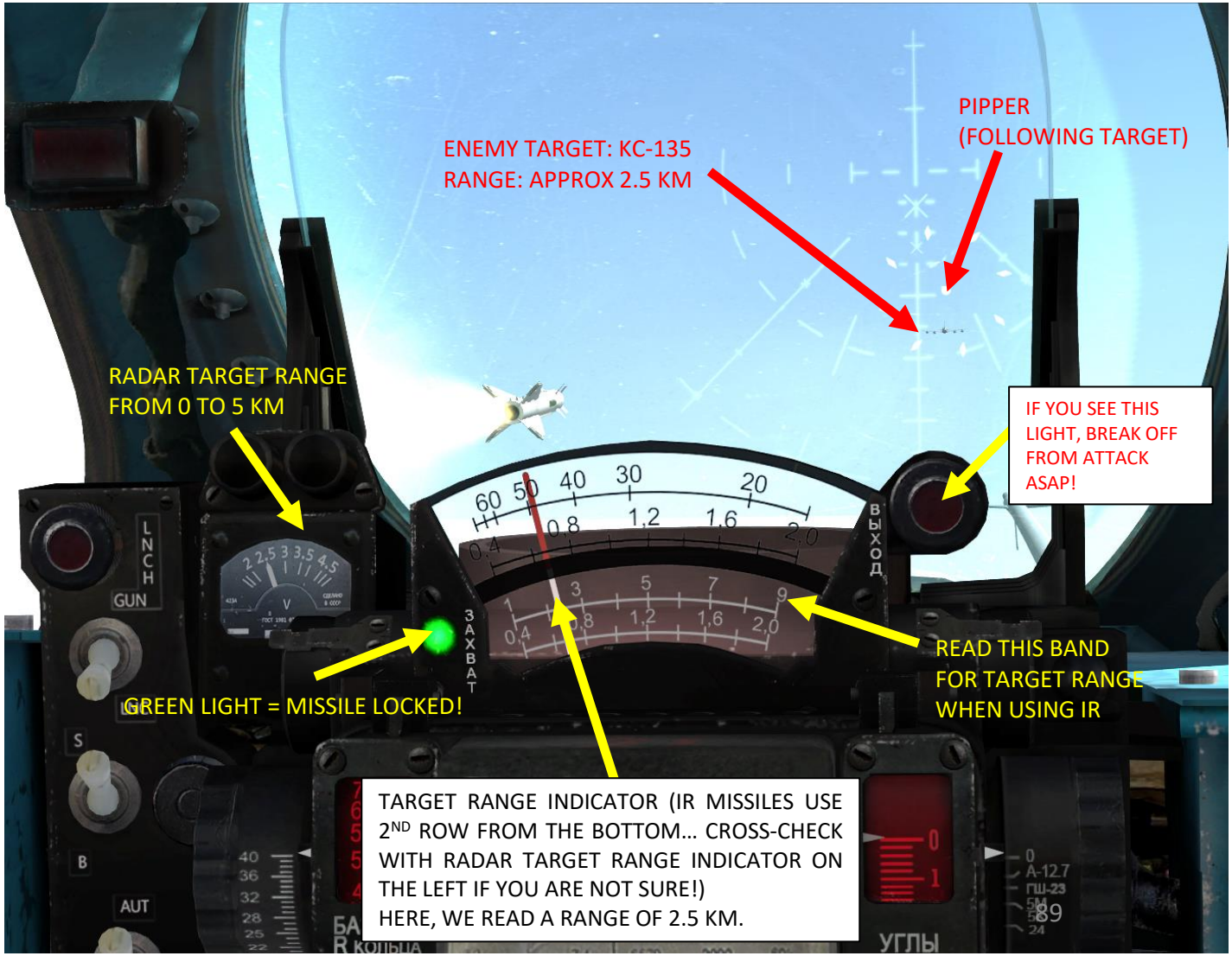
APPLICABLE TO R-3S, R-13, R-55 AND R-60 MISSILES

SUMMARY:

A) Power up your weapon systems on the ground (steps 1 through 6): you will win valuable time.
B) Find target via radar or Ground Control instructions.
C) Select appropriate missile and release modes.
D) Estimate target range and altitude by slewing your TDC on target and lock target with radar. (facultative)
E) Launch missile when your pipper is tracking the target and you hear a tone. Radar can be used to judge the adequate range for release.

It is important to understand that **IR missiles do not require radar**. Steps 7 and 8 could be skipped altogether provided that you know where your target is. With IR missiles, radar is only used to know where to point your nose so your missile can seek "heat" signatures. The only thing that matters when you aim an IR missile is that your pipper tracks the target and you hear the tone. On the other hand, it is useful to use radar locks to approximate the target's range. Shooting an IR missile is useless if you are too far away.

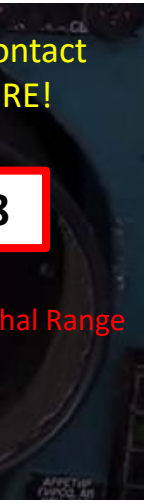


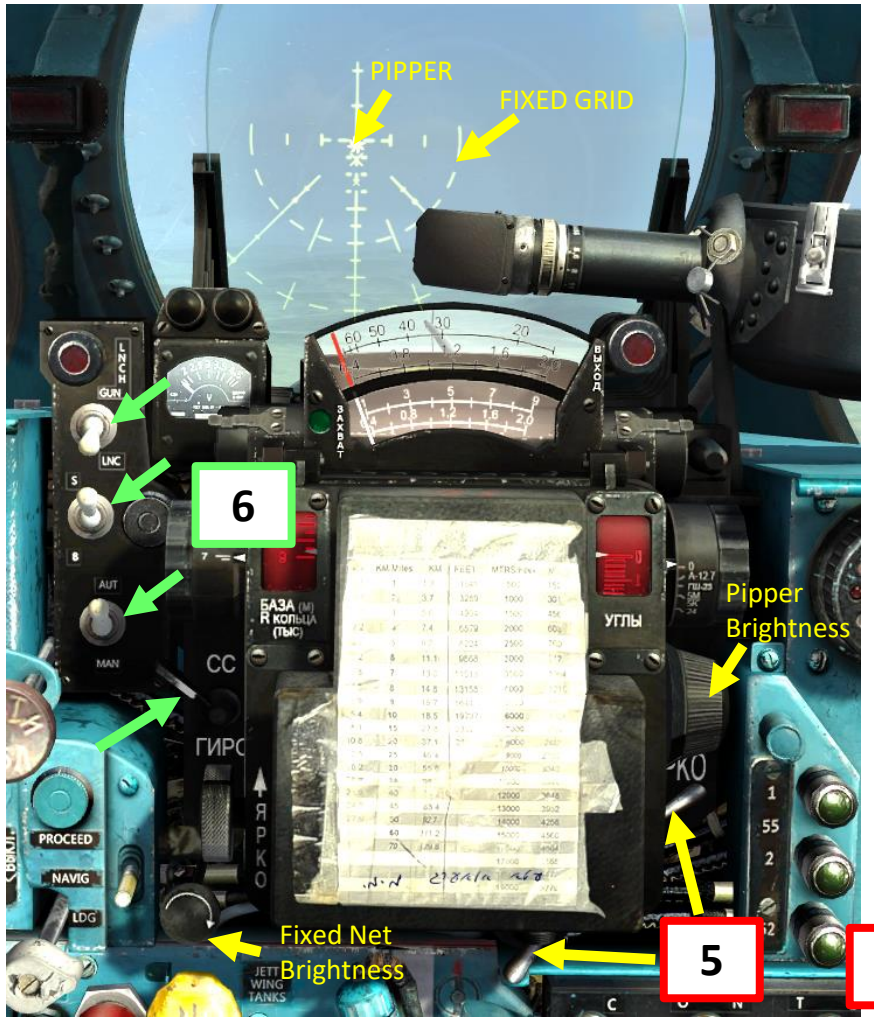


SARH (SEMI-ACTIVE RADAR HOMING) MISSILE TUTORIAL

APPLICABLE TO R-3R, AND RS-2US MISSILES

1) Turn ON (UP) weapon system switches (in black) on armament panel.
2) Warm up radar (5 minutes, do that on the ground) by using the radar mode switch to STANDBY (middle position). Then, set radar mode to ON (UP position) and LOW ALT switch to middle position.
3) Set Air/Ground Mode switch to AIR and Missile Mode switch to SAR (DOWN).
4) Select appropriate missile pylon (example: R-3R SARH missile on inner left pylon, select pylon 1). NOTE: 1-2 and 3-4 fire 2 missiles in quick succession.
5) Turn ON ASP gunsight pipper and fixed net.
6) Set ASP gunsight to LNC (launch = DOWN), S (shooting mode = UP), AUT (automatic = UP) and CC (ASP MISSILE mode).
7) Find target on radar (see radar tutorial of in previous section), slew your TDC on it and lock it with the RADAR LOCK button on your stick.
8) Target range should be updated on both your ASP gunsight (see next page for details) and radar "CHASE" mode screen.
9) Launch missile holding "WEAPONS RELEASE" button when you are in lethal missile range.
10) Maintain radar lock by following your target until missile impact.



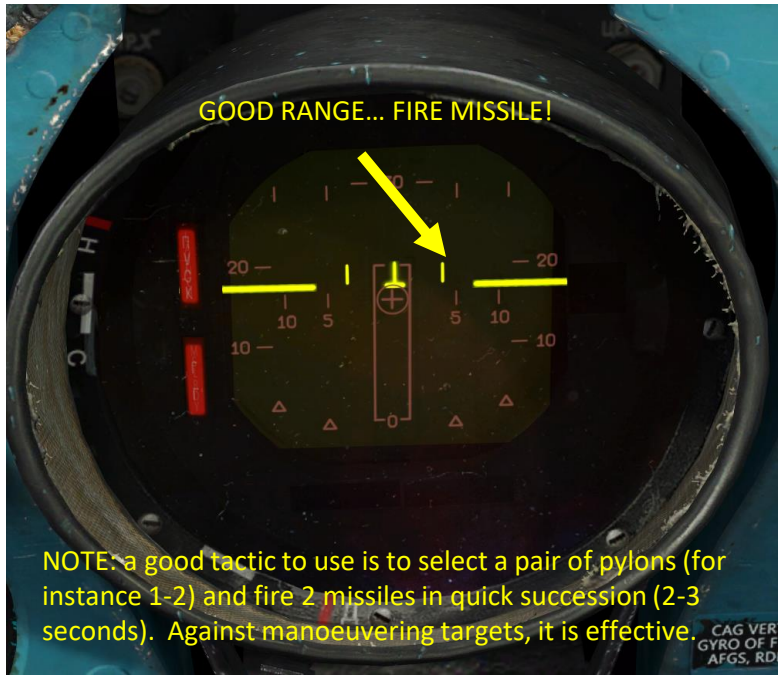


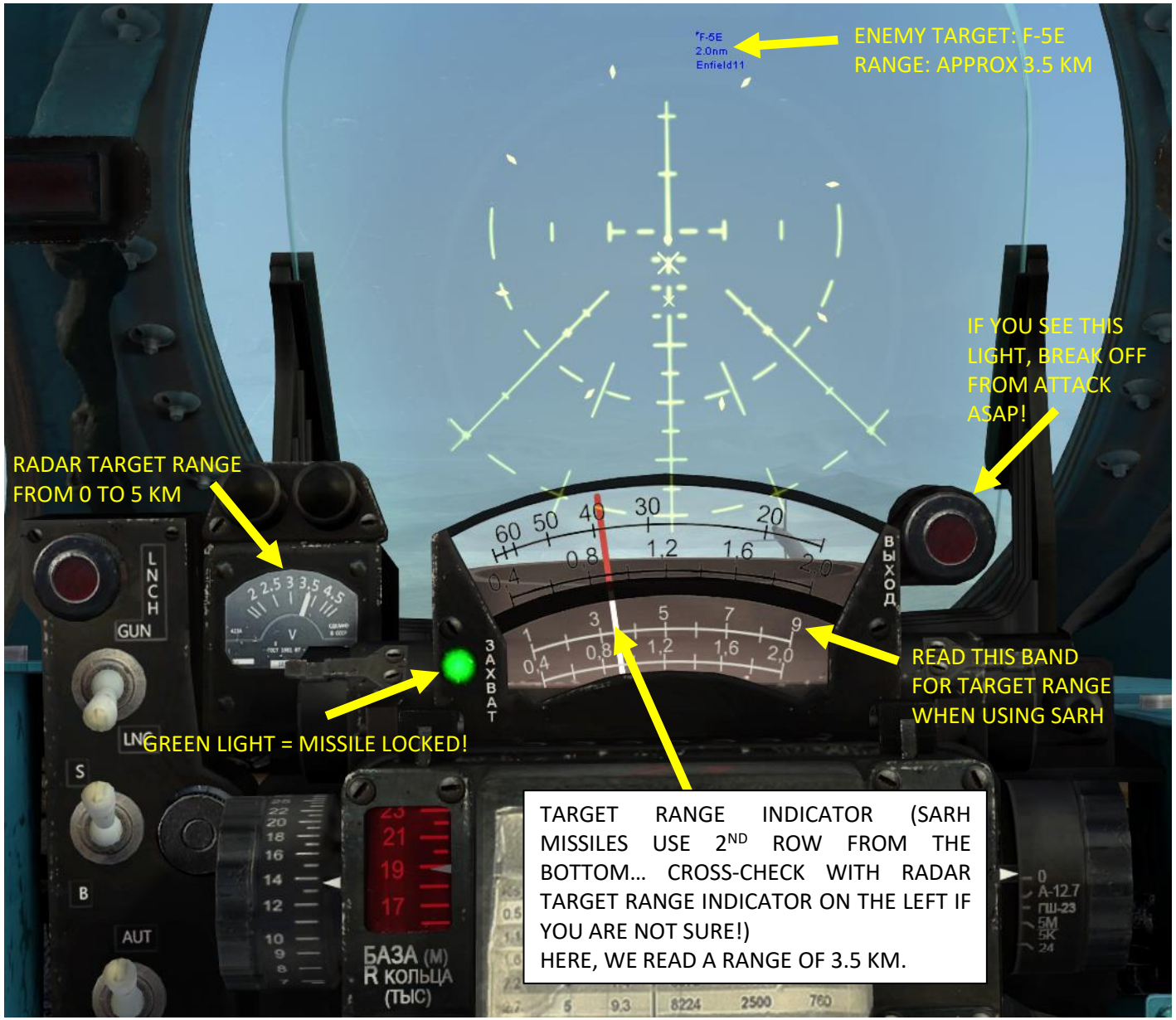
SARH (SEMI-ACTIVE RADAR HOMING) MISSILE TUTORIAL

APPLICABLE TO R-3R, AND RS-2US MISSILES

SUMMARY:

A) Power up your weapon systems on the ground (steps 1 through 6): you will win valuable time.
B) Find target via radar or Ground Control instructions.
C) Select appropriate missile and release modes.
D) Estimate target range, slew your TDC on target and lock target with radar.
E) Launch missile when you are in lethal range.





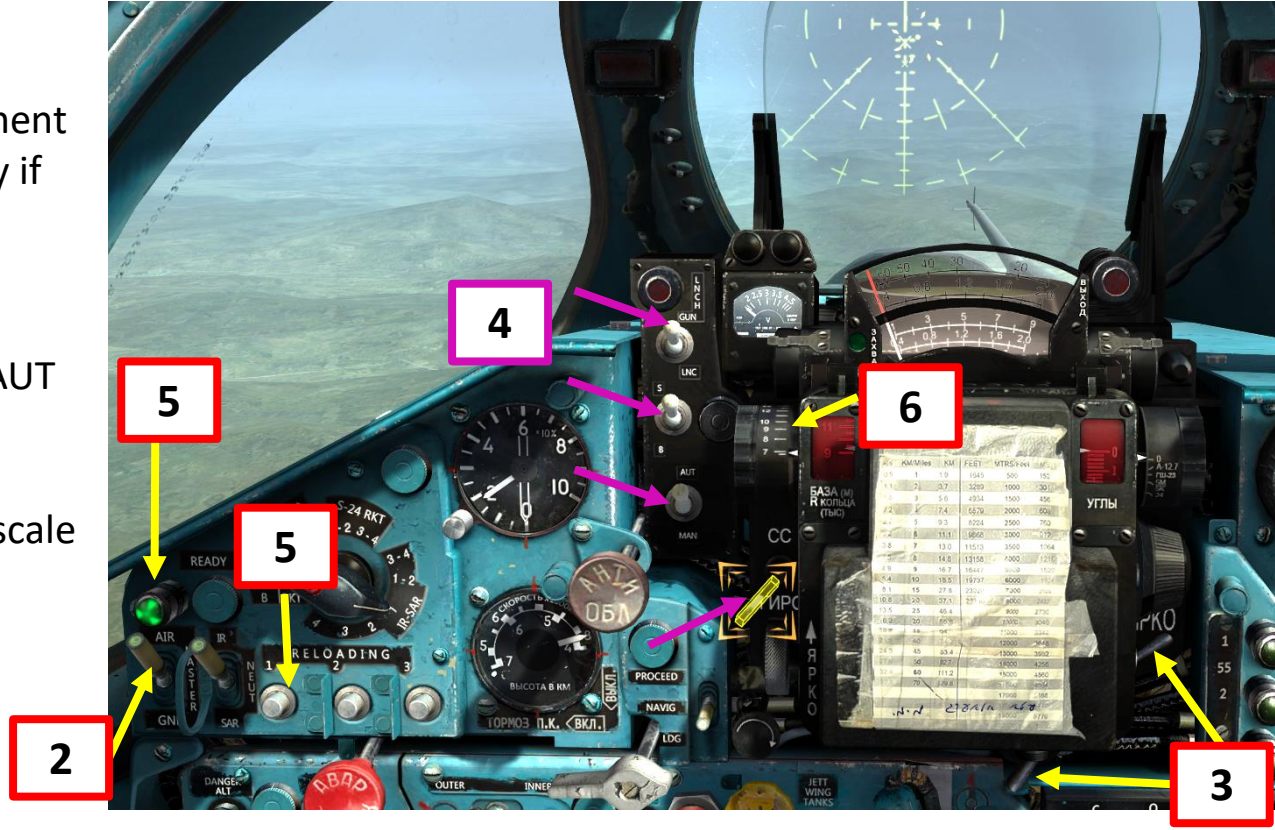
AIR-TO-GROUND MISSILE			
NAME	RANGE MAX/EFFECTIVE	DESCRIPTION	GOOD AGAINST
KH-66 GROM	10 / 10 km	Radar Beam Riding, 1968, Rear Aspect, can be used on both air and ground targets.	Ground Targets Ships Bombers

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	N/A
RN-24 /28	Tactical nuke, detonates on impact, no drag parachute.	Clusters of targets

EXTERNAL GUNPOD & ROCKETS		
NAME	DESCRIPTION	GOOD AGAINST
UPK-23-250	23 mm 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

GSh-23 GUN TUTORIAL

1) Turn ON (UP) weapon system switches (in black) on armament panel. (Note: Pylons have to be powered as well, especially if you want to use gunpods)
2) Set Air/Ground Mode switch to AIR.
3) Turn ON ASP gunsight pipper and fixed net.
4) Set ASP gunsight to GUN (GUN = UP), S (gun mode = UP), AUT (automatic = UP) and ASP mode (GYRO = DOWN).
5) Click on “RELOAD” switch. Gun arming light should be lit.
6) Enter target wingspan if you know it. Use white scale; red scale window is for missiles.
7) Fire when ready using the gun trigger.



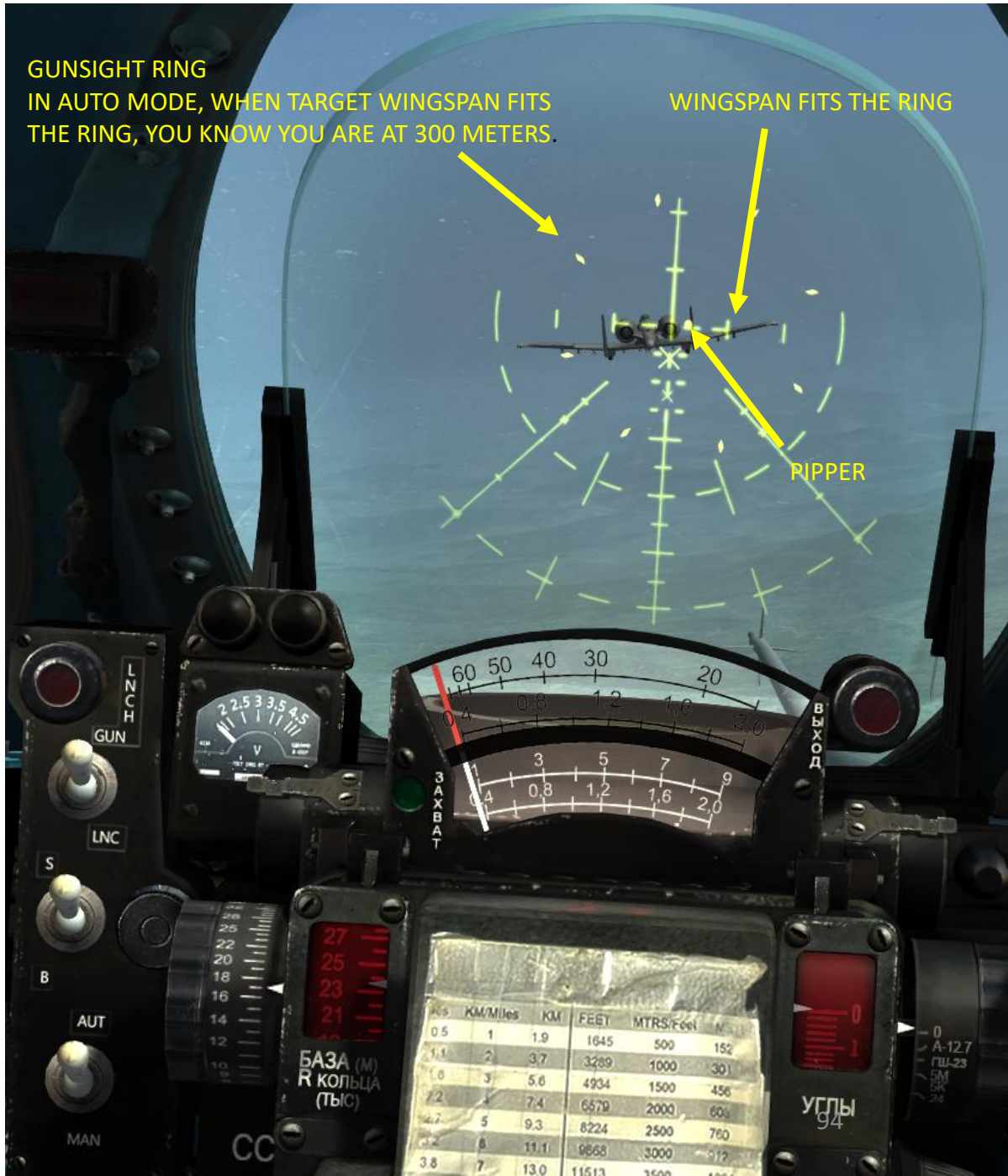
GSh-23 GUN TUTORIAL

TIPS:

- You have about 4 seconds of fire. Use short bursts.
- Cannon round velocity is very low: fire at point blank range if you want to avoid too much cannon round drop.

ARMING UPK-23-250 GUN PODS

1. UPK power switch ON (UP)
2. Gun Selector set to UPK (UP)
3. Press RELOAD switch. Status light should turn green!
4. Fire when ready using gun trigger.
5. To switch back to internal gun, set Gun Selector to GSH23 (DOWN).



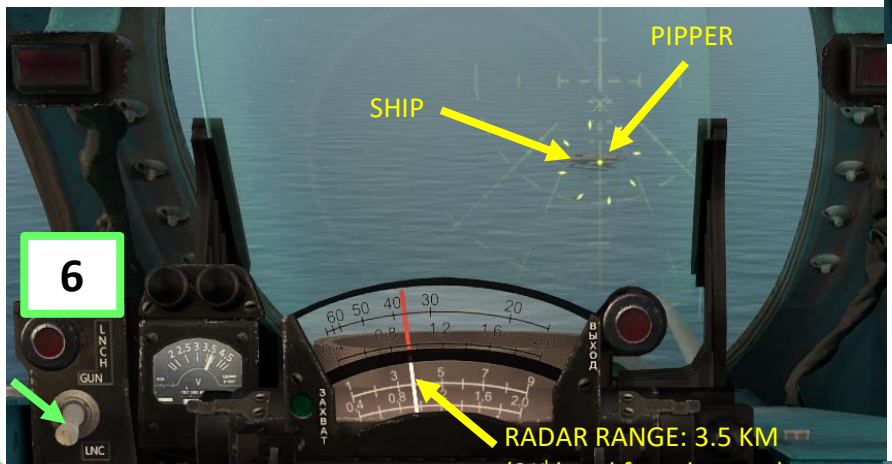
KH-66 GROM (RADAR BEAM RIDING) MISSILE TUTORIAL

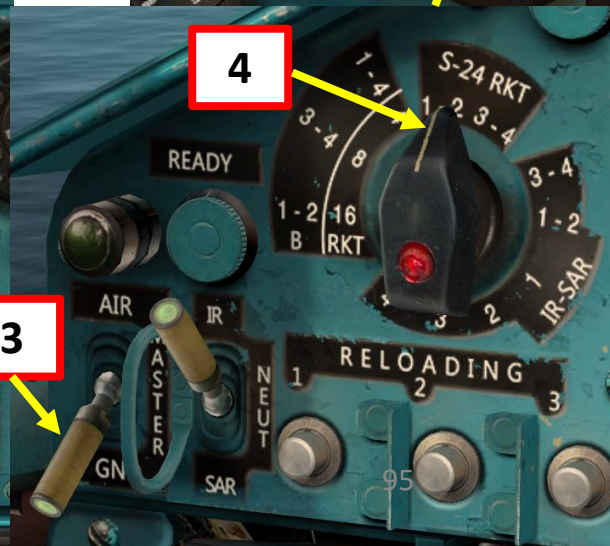
1) Turn ON (UP) weapon system switches (in black) on armament panel.
2) Warm up radar (5 minutes, do that on the ground) by using the radar mode switch to STANDBY (middle position). Then, set radar mode to ON (UP position), LOW ALT switch to middle position and LOCKED BEAM switch ON (UP).
3) Set Air/Ground Mode switch to GROUND.
4) Select appropriate missile pylons (example: KH-66 missiles on inner left and right pylons, select S-24 RKT pylons 1-2). NOTE: Select SR-24 RKT pylons for KH-66 GROM, not the IR-SAR pylons.
5) Turn ON ASP gunsight pipper and fixed net.
6) Set ASP gunsight to LNC (launch = DOWN), S (shooting mode = UP), AUT (automatic = UP) and GYRO (ASP GYRO mode = DOWN).
7) Set target wingspan (size) to 40 m (for ships).

8) **A)** Point pipper on target and lock target with the RADAR LOCK button. Reticle will remain fixed on target. Weapons Release when ready.

B) Alternative: Point pipper on target but don't use the RADAR LOCK button. Weapons Release and move your nose so the pipper remains on target. Missile will follow your pipper: make sure you track your target. Useful for slow moving targets (or bombers!).

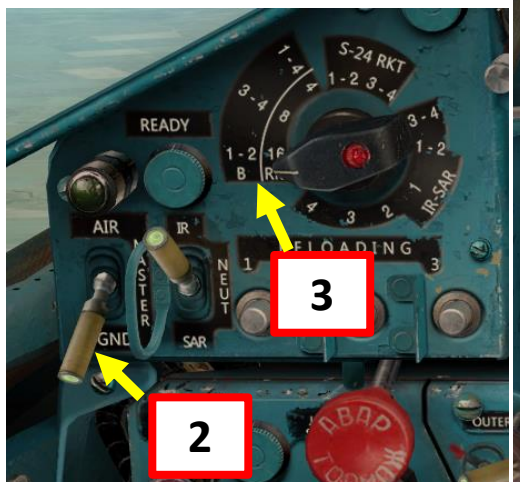
9) Once GROM is launched, your aircraft will start rolling (the KH-66 is an anti-ship missile: it's very heavy). GROM missiles are inaccurate, but sure pack a punch.

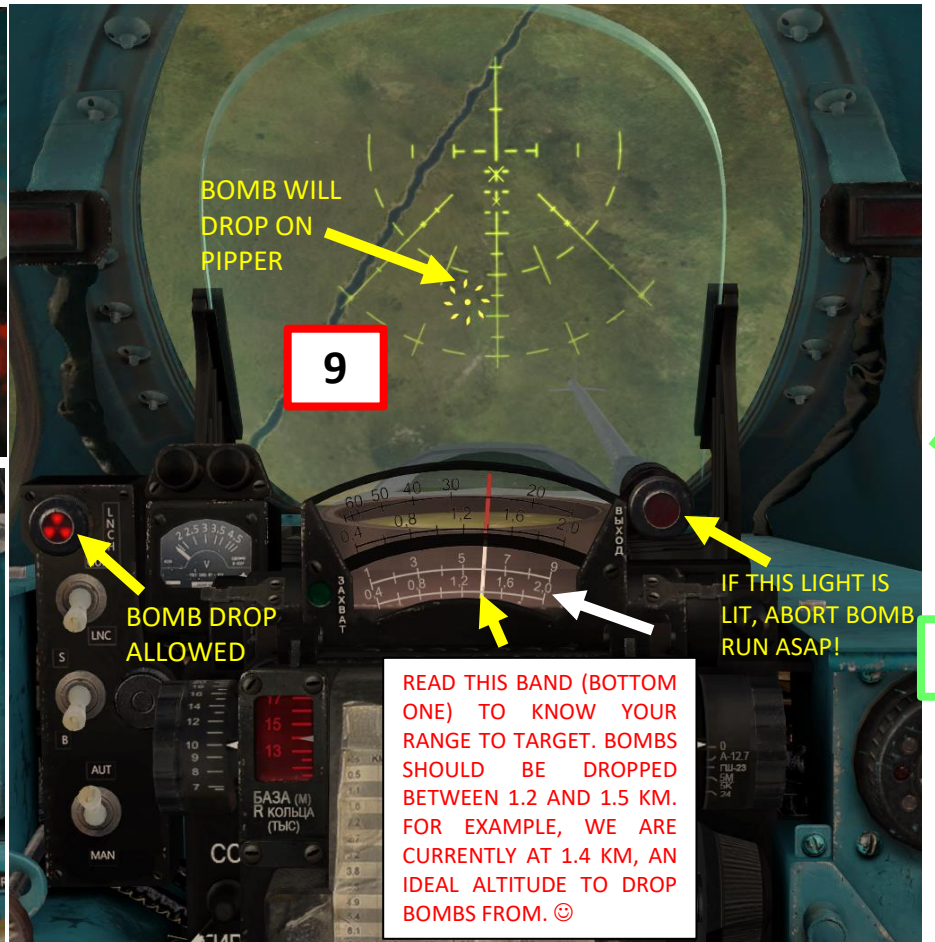


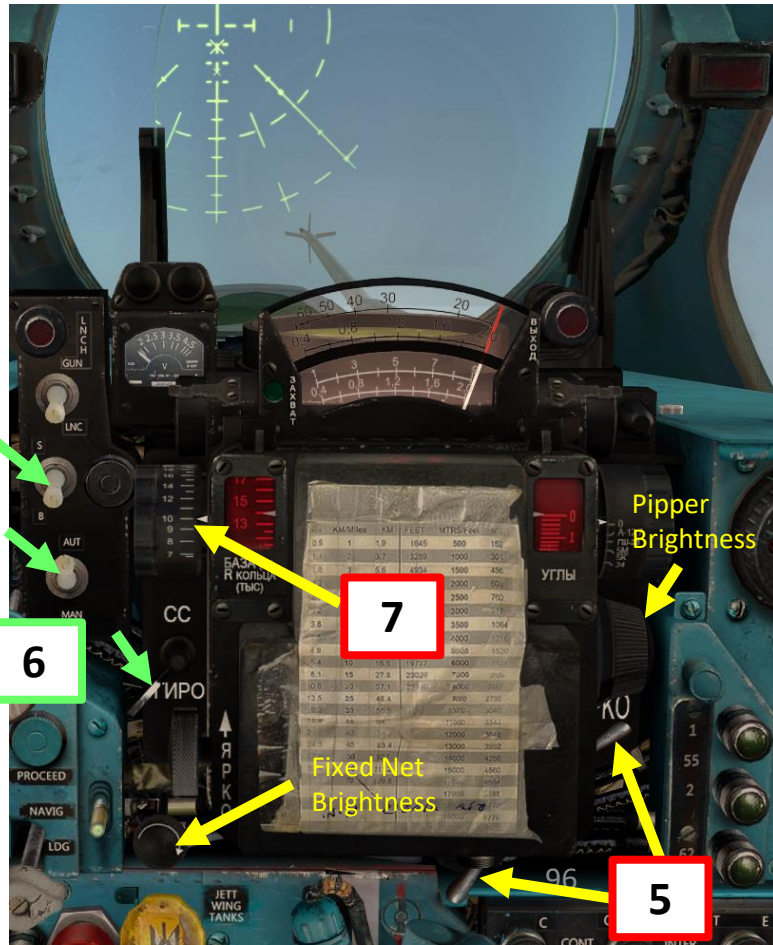


BOMBING TUTORIAL

1) Turn ON (UP) weapon system switches (in black) on armament panel.
2) Set Air/Ground Mode switch to GROUND.
3) Select appropriate missile pylons (example: FAB-250 bombs on inner left and right pylons, select B pylons 1-2).
4) Flip TACTICAL ARM switch cover and turn switch UP.
5) Turn ON ASP gunsight pipper and fixed net.
6) Set ASP gunsight to B (bombing mode = DOWN), AUT (automatic = UP) and GYRO (ASP GYRO mode = DOWN).
7) Set target wingspan (size) to 10 m.
8) Cut throttle (IDLE) and enter a 30 deg dive from 3,000 m minimum.
9) Put pipper on target and monitor bottom range band: drop bombs from 1,500 m or higher by holding the WEAPONS RELEASE button. You will have a visual cue when the LAUNCH ALLOWED light is lit up.
10) Pull up and avoid pulling more than 4-5 G or your other bombs will detach themselves.

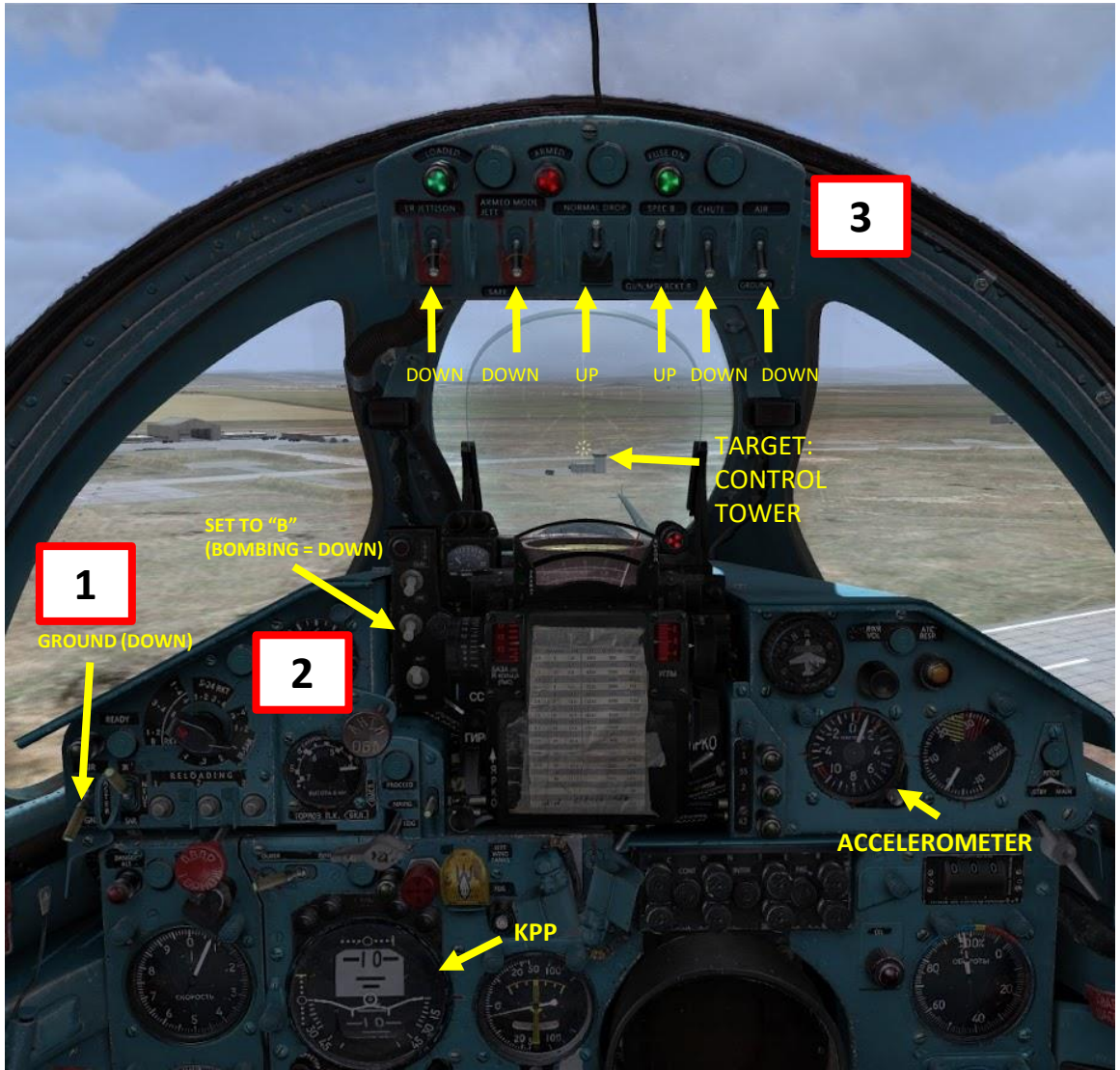


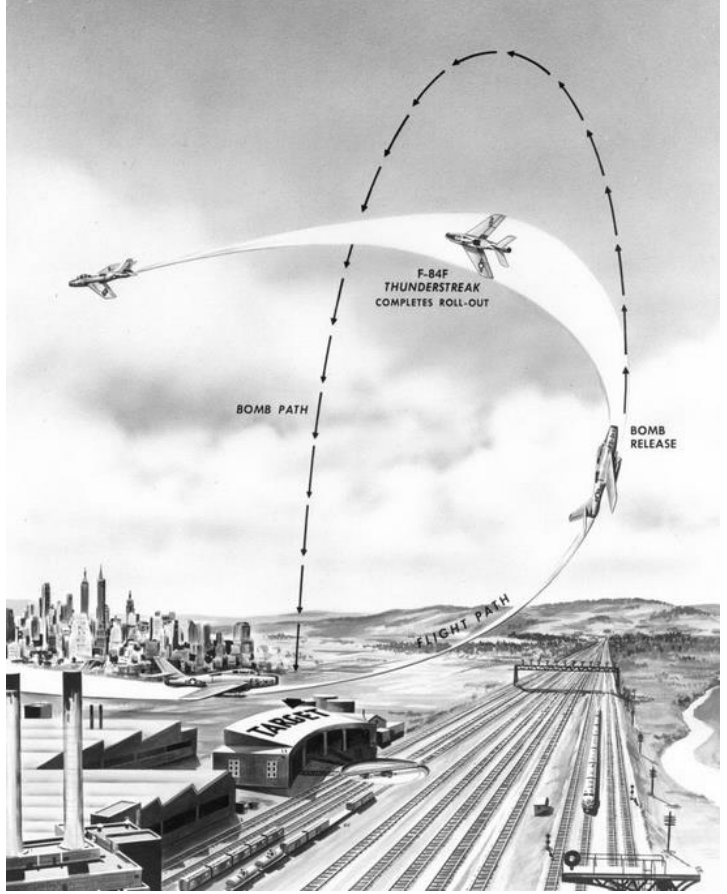


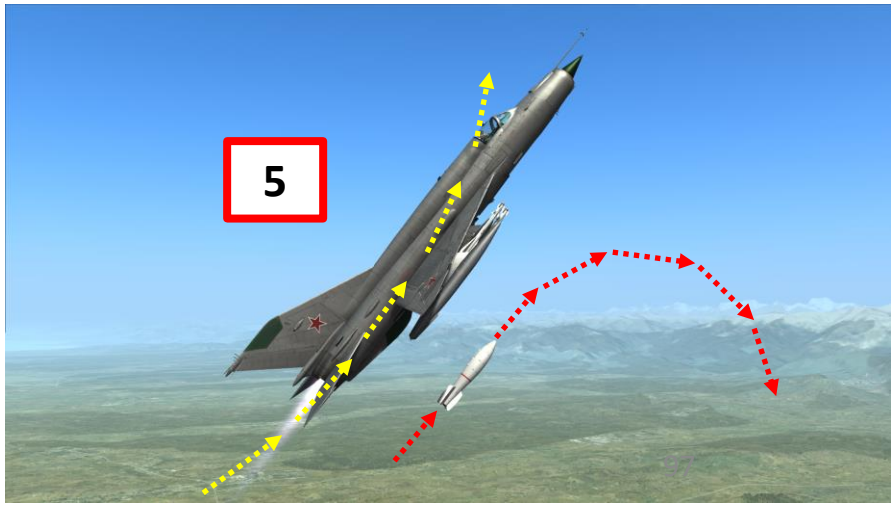


RN-24 / RN-28 NUCLEAR BOMB ("OVER THE SHOULDER" BOMBING)

1) Set Air/Ground Mode switch to GROUND.
2) Set ASP gunsight to B (bombing mode = DOWN).
3) Set Nuclear Armament Panel switches as shown.
4) With full afterburner, stay close to the ground to avoid radar detection. When you reach target, pull up in a constant 4 G loop.
5) Hit WEAPONS RELEASE when you reach 45 deg on the KPP.

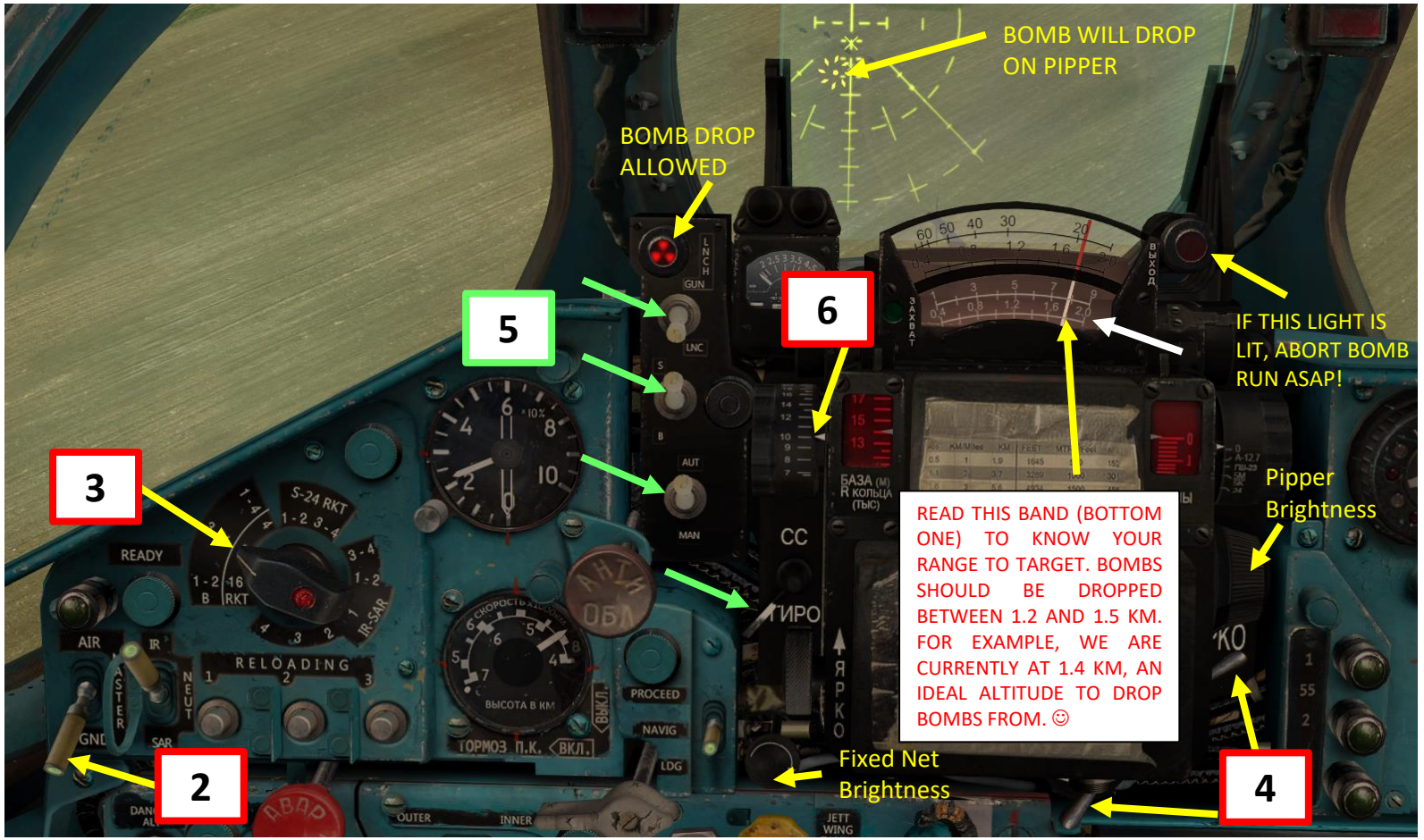


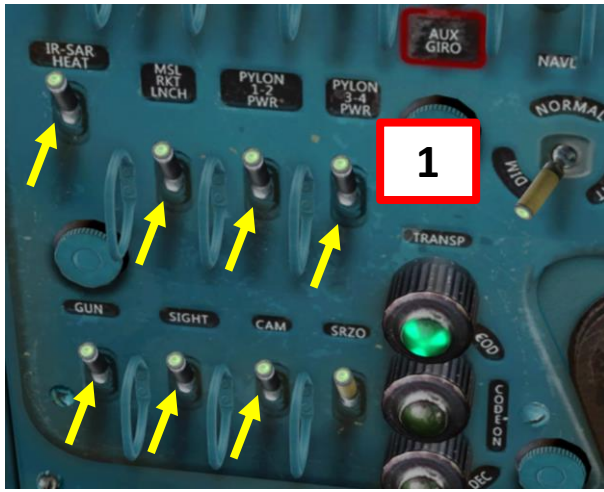




S-16/S-32 ROCKET PODS

1) Turn ON (UP) weapon system switches (in black) on armament panel.
2) Set Air/Ground Mode switch to GROUND.
3) Select desired rocket salvo quantity (example: we choose “8” on the inner scale, which means that each time we press the weapons release button we sent a volley of 8 rockets coming from ALL pods).
4) Turn ON ASP gunsight pipper and fixed net.
5) Set ASP gunsight to LNC (Missile & Rocket = DOWN), S (shooting mode = UP), AUT (automatic = UP) and GYRO (ASP GYRO mode = DOWN).
6) Set target wingspan (size) to 10 m.
7) Cut throttle (IDLE) and enter a 30 deg dive from 3,000 m minimum.
8) Put pipper on target and monitor bottom range band: fire from 1,700 m by holding the WEAPONS RELEASE button. You will have a visual cue when the LAUNCH ALLOWED light is lit up.

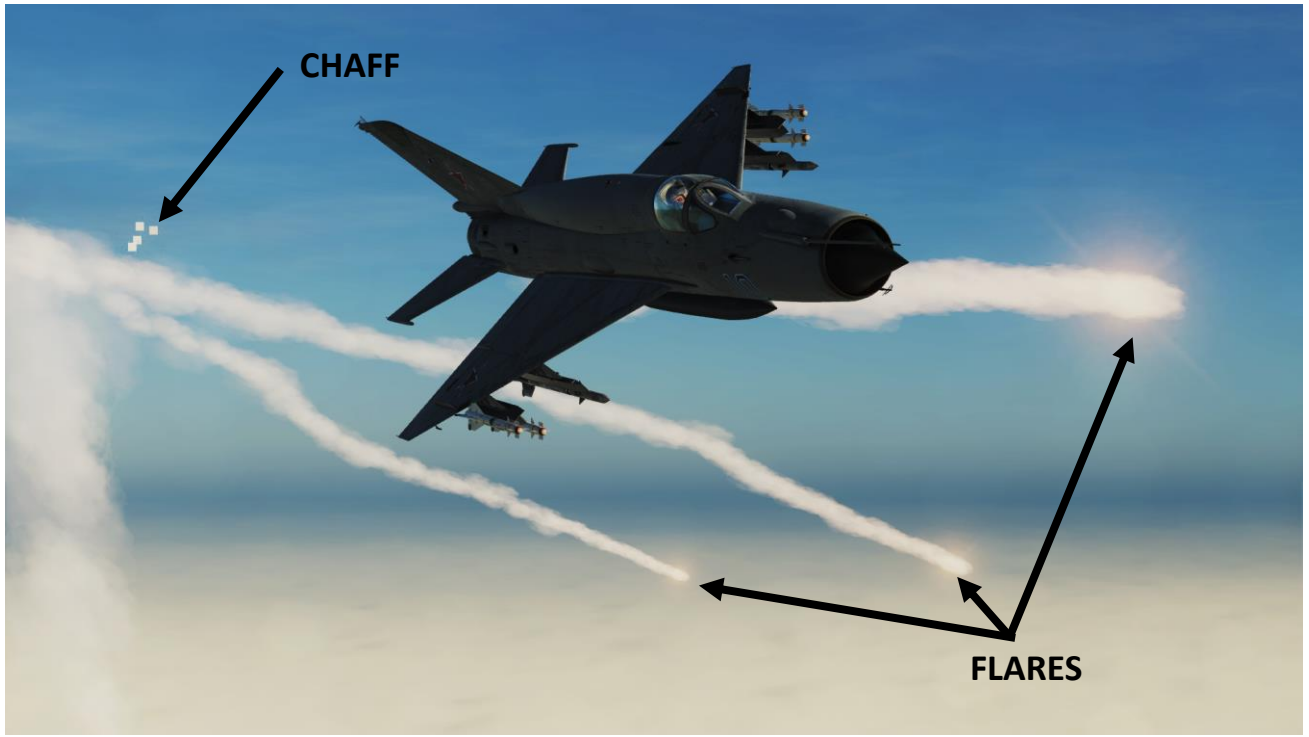


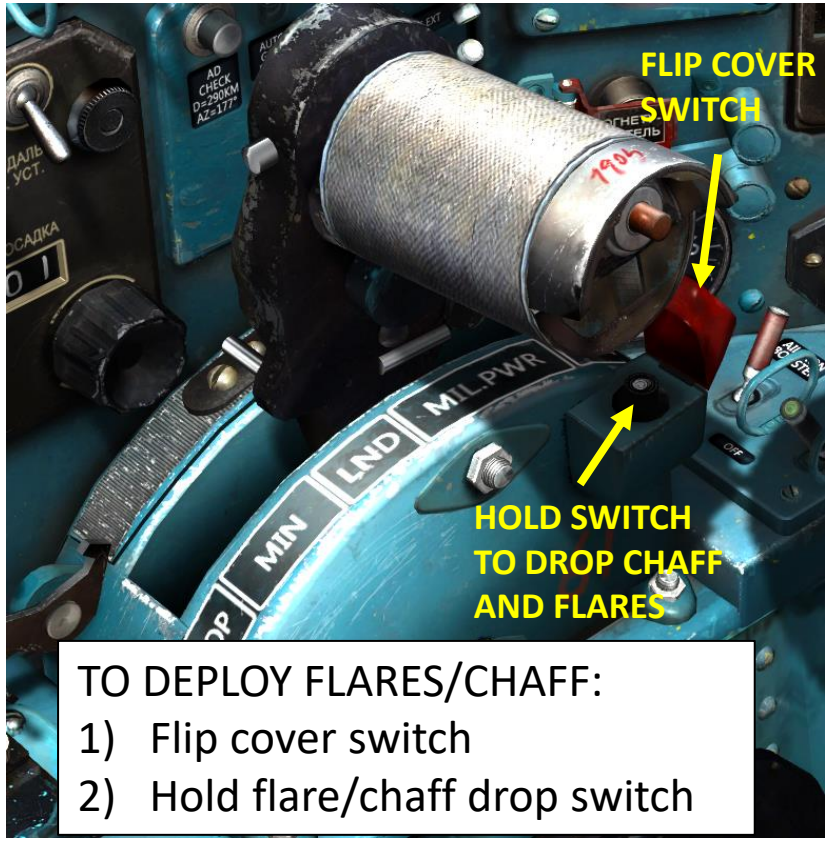


COUNTERMEASURES & MISCELLANEOUS EXTERNAL EQUIPMENT

NOTE: FLARES/CHAFF ARE AVAILABLE FROM EXTERNAL PODS ONLY. DON'T FORGET TO EQUIP THEM.

NAME	DESCRIPTION
ASO-2	Standard chaff/flare dispenser pod. MUST-HAVE.
SPS-141	Combined ECM (Electronic Countermeasures) and chaff/flare dispenser pod. Currently not working as of version 1.2.16.
SPRD-99 RATO rockets	Booster rockets for takeoff. If you equip this, you will not be able to take flares with you. Not practical for intercept missions.





TO DEPLOY FLARES/CHAFF:

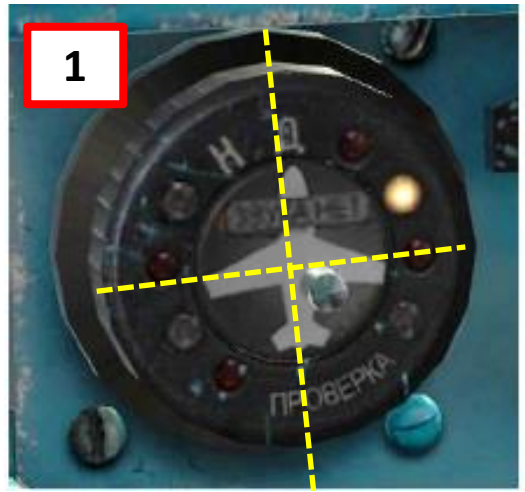
1) Flip cover switch
2) Hold flare/chaff drop switch

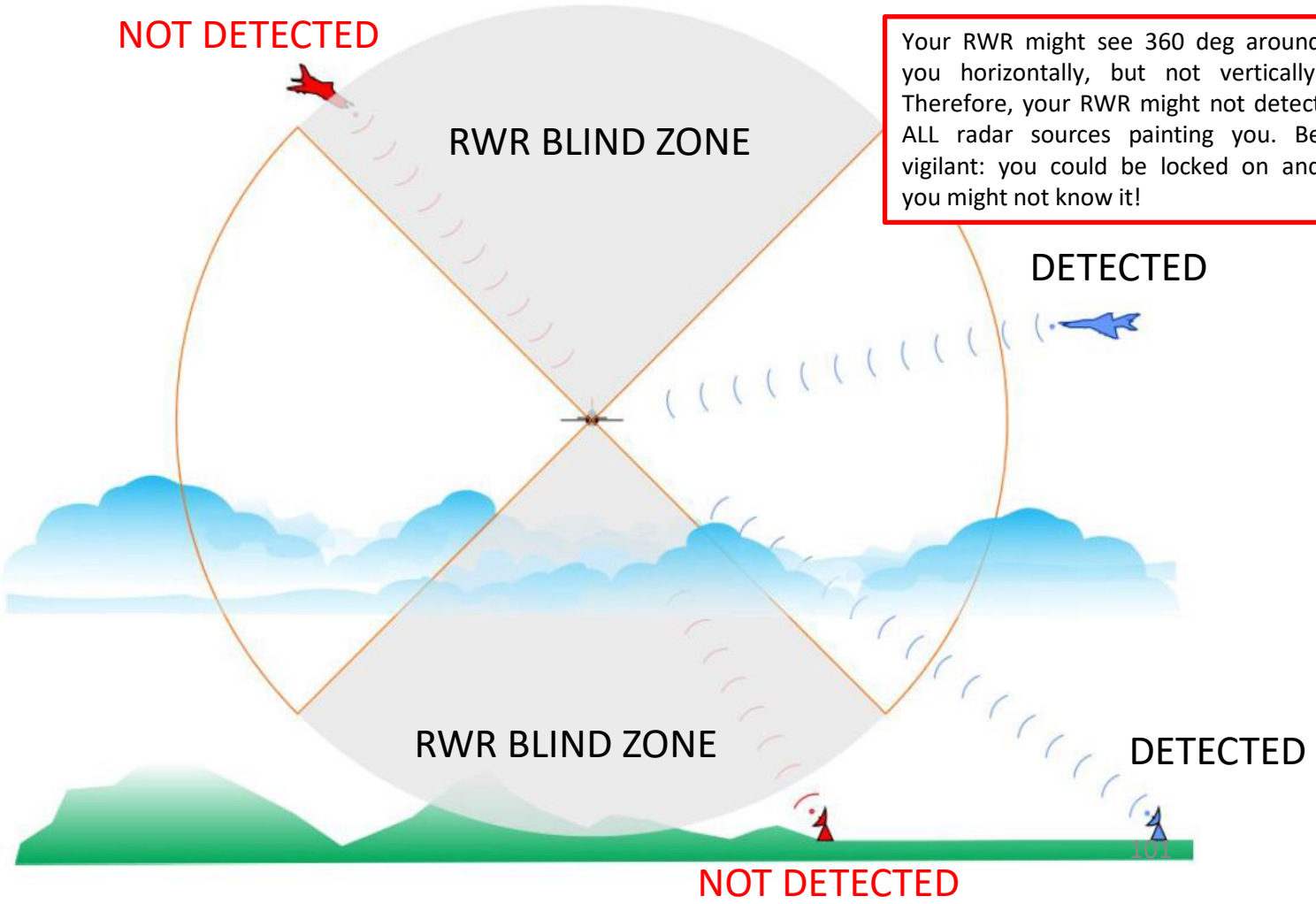
SPO-10 RWR (RADAR WARNING RECEIVER)

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 (1) 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.

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

- 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 (2) = you are being locked by radar. Immediate action needs to be taken. You may need to change your underwear.



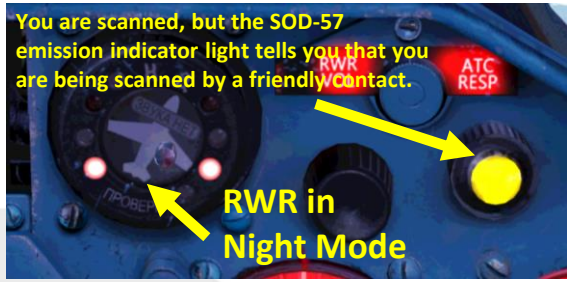


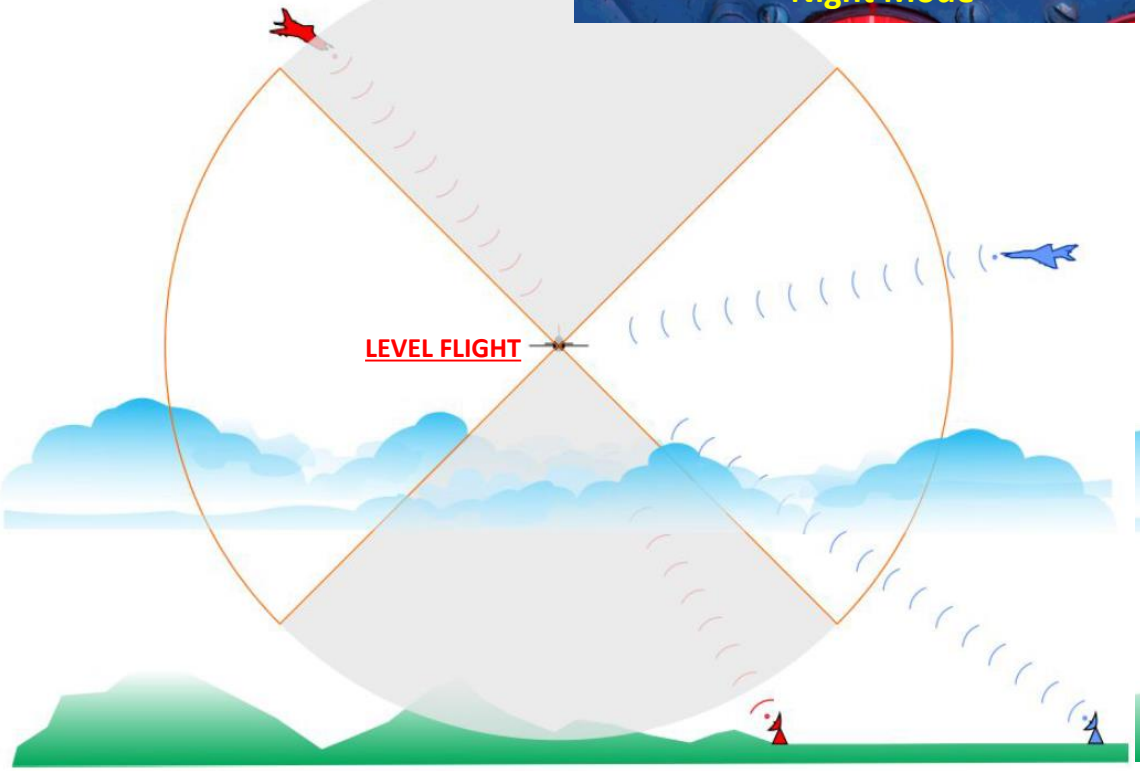
Your RWR might see 360 deg around you horizontally, but not vertically. Therefore, your RWR might not detect ALL radar sources painting you. Be vigilant: you could be locked on and you might not know it!

SPO-10 RWR (RADAR WARNING RECEIVER)

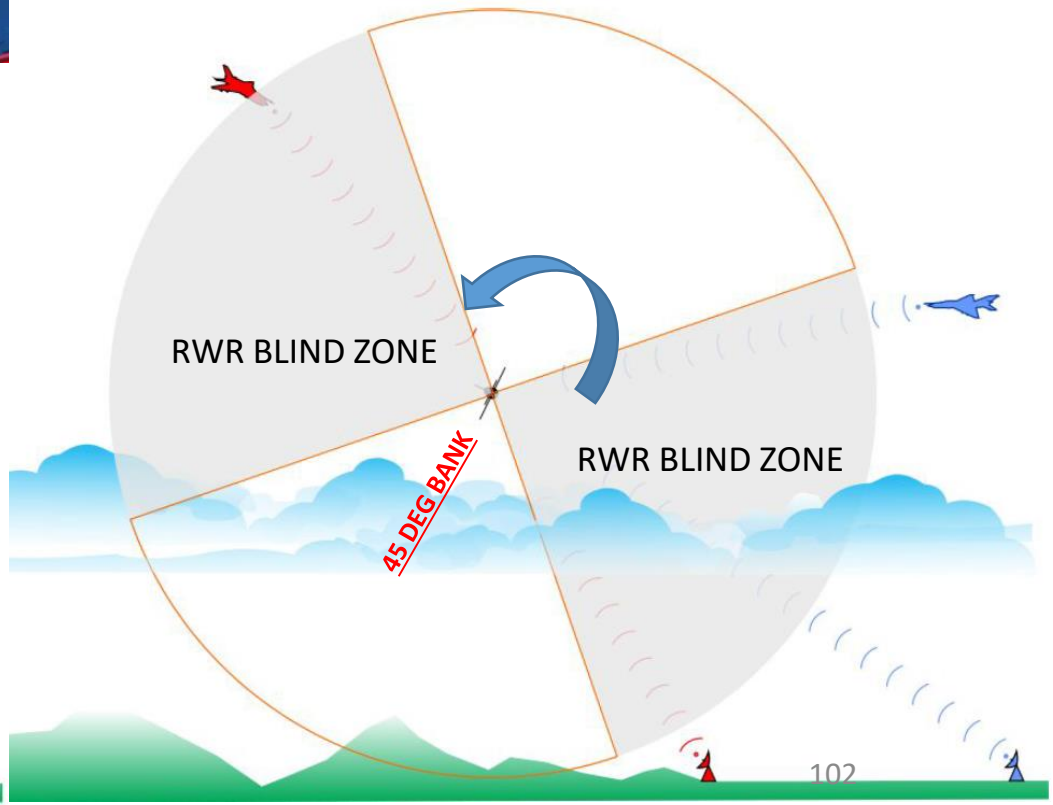
- In order to allow the RWR to cover your blind spots, it is recommended to roll left and right at 45 deg angles.
- The RWR tells you where the enemy radar waves come from, but in the horizontal plane only: it doesn't tell you the contact's altitude. Is he above you or below you?
- Make sure to have 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.





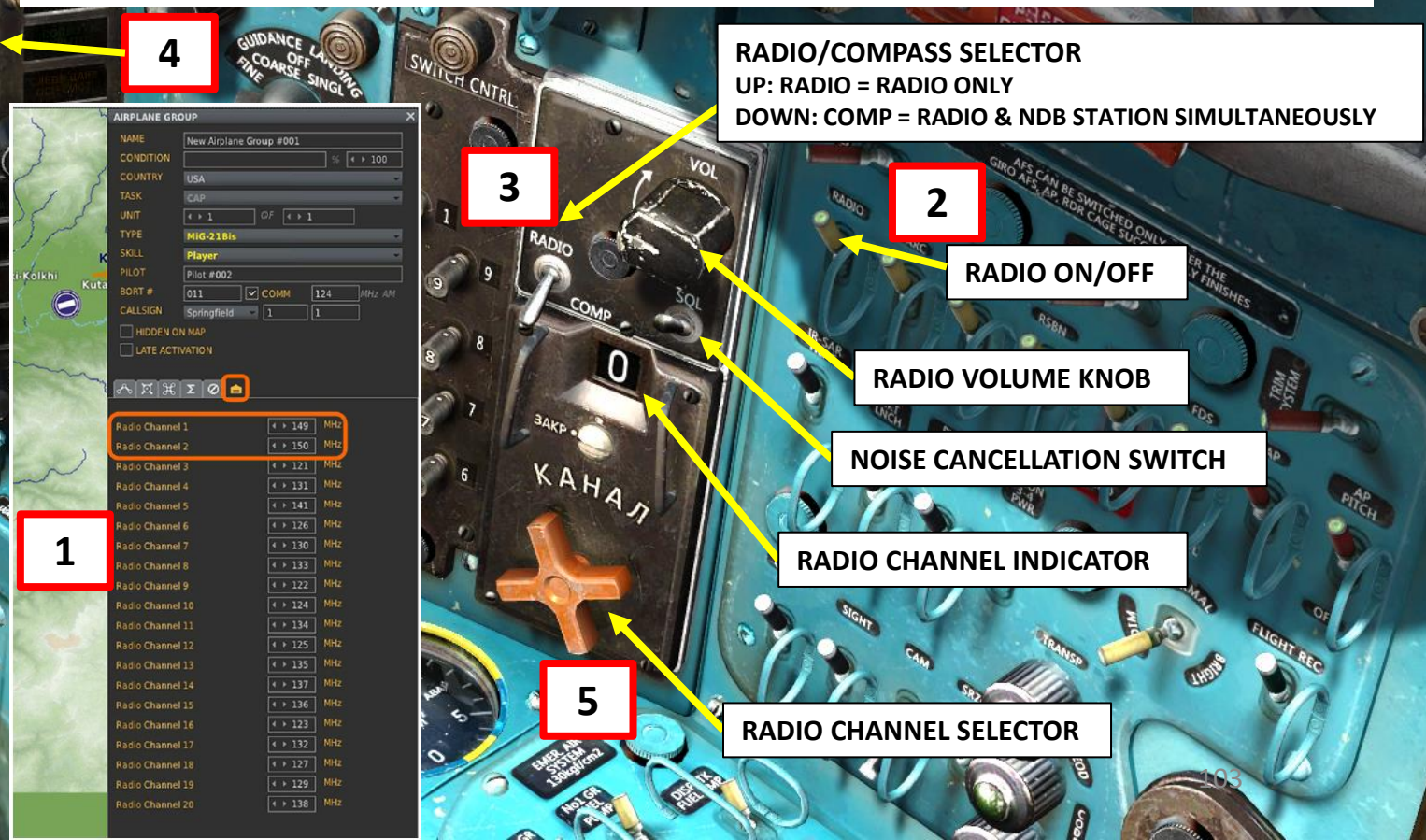
This guy is painted by 4 radars, and he doesn't know it… he's in big, big trouble.



RADIO	FREQ	AIRPORT / RUNWAY HDG
0	149	MAIN CHANNEL (CUSTOM)
1	150	AUX (CUSTOM)
2	121	ANAPA-VITYAZEVO / 42
3	131	BATUMI / 126
4	141	BESLAN / 94
5	126	GELENDZIK
6	130	GUDAUTA-BOMBORA
7	133	KOBULETI / 70
8	122	KRASNODAR-CENTER / 87
		KRASNODAR-PASHKOVSKIY / 47
9	124	KRYMSK / 40
10	134	KUTAISI-KOPITNARI / 74
11	125	MAYKOP-KHANSKAYA / 39
12	135	MINERANYE VODY / 115
13	137	MOZDOK / 83
14	136	NALCHIK / 56
15	123	NOVOROSSIYSK
16	132	SENAKI-KOLKHI / 95
17	127	SOCHI-ADLER / 62
18	129	SUKHUMI-BABUSHARA
19	138	TBILISI-LOCHINI / 128
		TBILISI-VAZIANI / 135

TO USE RADIO:

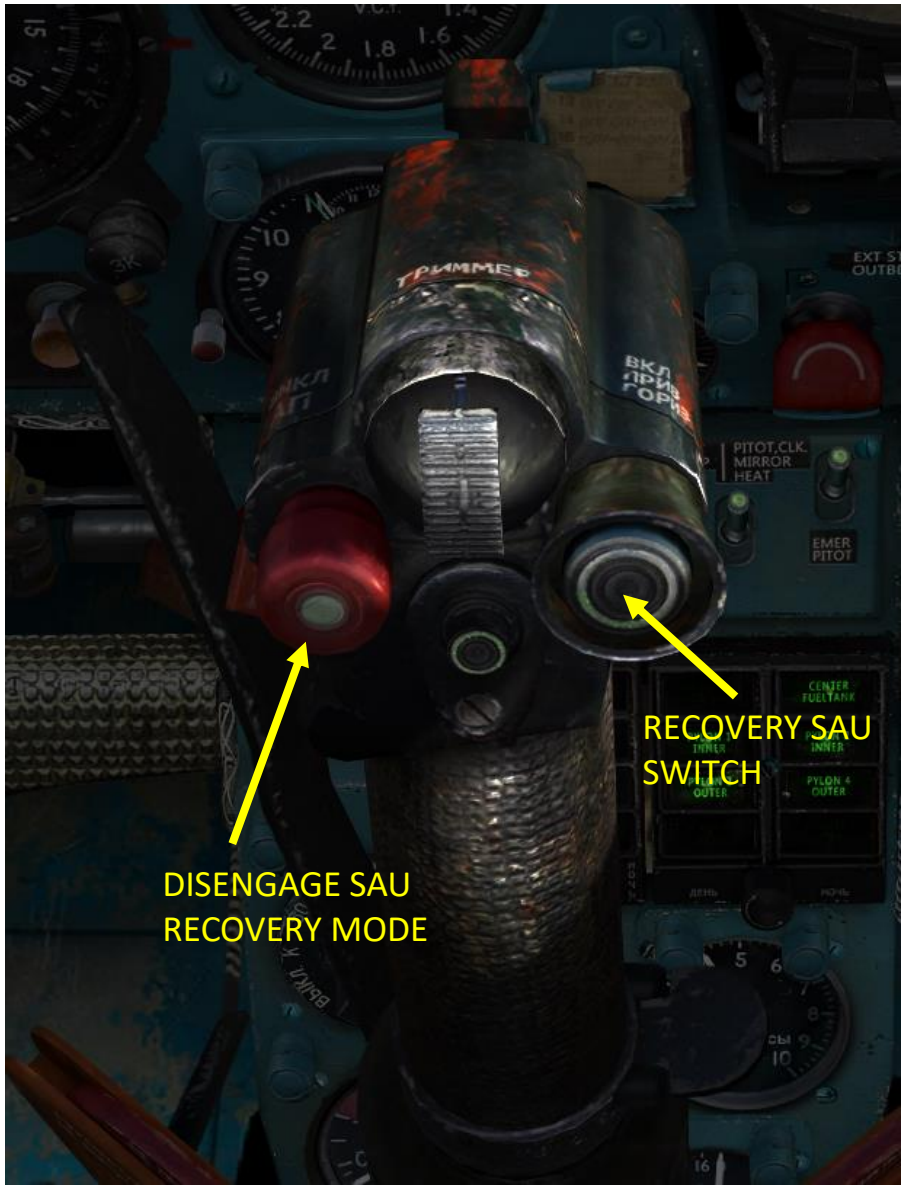
1. In the mission editor, you can manually set each channel to a certain frequency. Preferably channels 2 to 19 (or 3 to 20 in the mission editor) are reserved to control towers. You don't need to touch them. I recommend you set channels 0 (main) and 1 (aux) (designated as channels 1 and 2 in mission editor) to AWACS, other aircraft or ground units.
2. Turn ON radio switch.
3. Turn radio/compass selector switch to RADIO (UP).
4. Find what preset channel you want to use by consulting the channel table.
5. Select desired radio channel using the selector switch.
6. Use microphone switch (on throttle) to communicate on set frequency.



UNDERSTANDING AUTOPILOT

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 4 autopilot modes: Automatic, Directional, Stabilization and Recovery.

- Automatic is used for PRMG approaches. SAU takes over all controls except throttle & flaps. Make sure you are over 70 % throttle or you will crash. Disengage AUTO mode before you touchdown: it will not land the aircraft for you. AUTO mode explained in PART 13.
- Directional is used for PRMG approaches. SAU shows visual cues for proper approach.
- Stabilization is used to dampen vibrations and stabilize aircraft.
- Recovery is used in flight for level flight. SAU takes over all controls except throttle & flaps. Basically, you hit “SAU recovery” when you need to fly straight and level to operate cockpit switches, check kneepad, check maps… It is quite useful. Just don’t forget to disengage SAU recovery once you are done. Make sure you are over 70 % throttle or you will stall.



UNDERSTANDING 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.

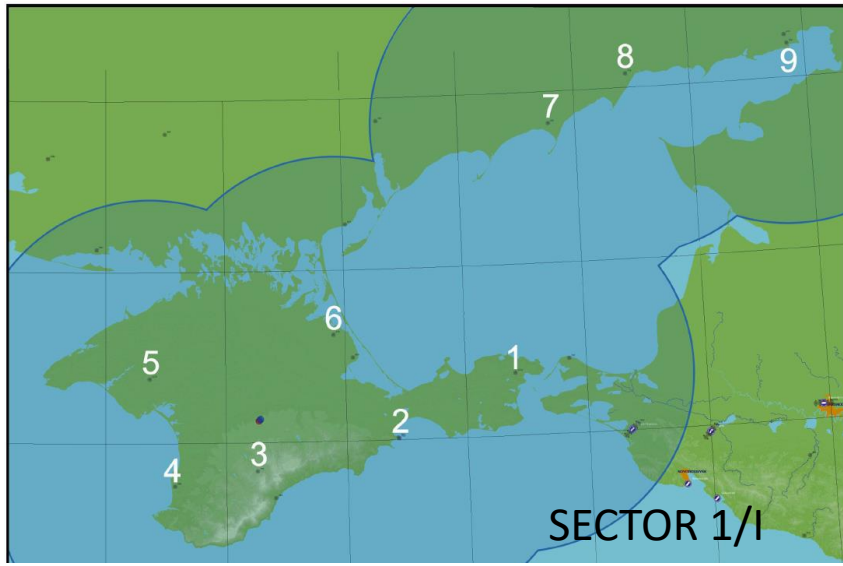
- The PRMG is the russian equivalent of a ILS (Instrument Landing System). It uses RSBN beacons to guide you to the airstrip when you need to land in bad weather or low visibility conditions like night missions.

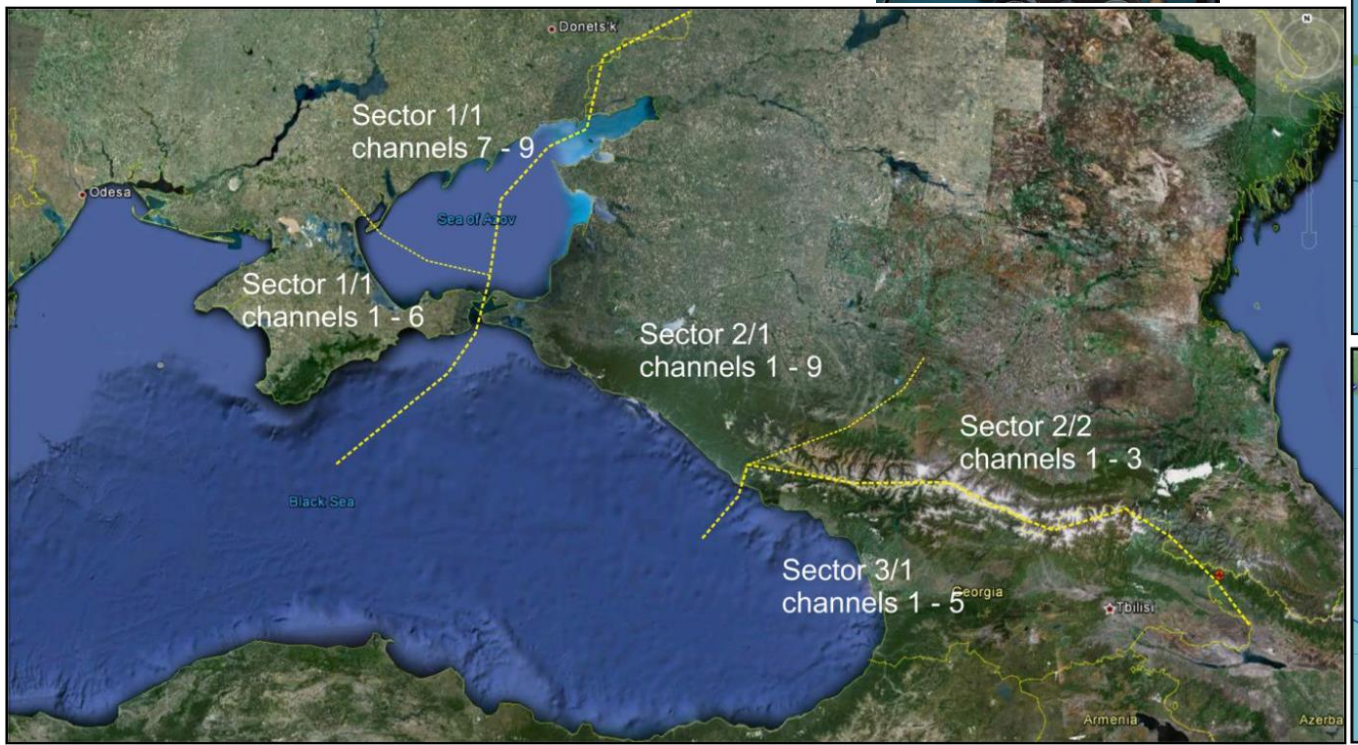
ARC (NDB) RANGE IN FUNCTION OF MINIMUM ALTITUDE						
Distance from station (km)	20	40	60	80	100	120
Minimum altitude (m)	350	700	1050	1400	1750	2100

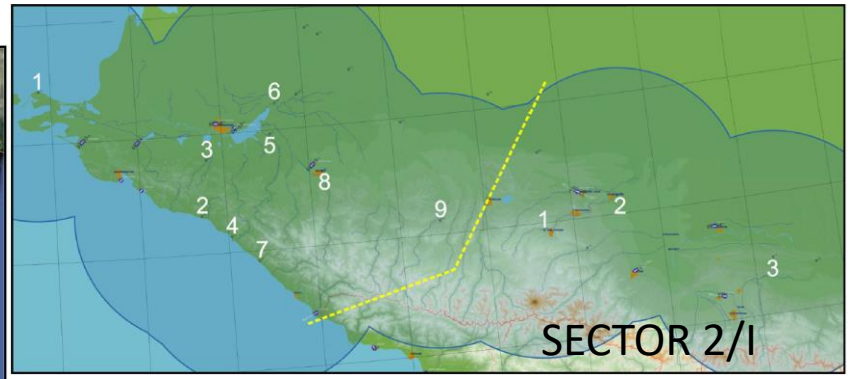
RSBN (VOR) RANGE IN FUNCTION OF MINIMUM ALTITUDE						
Distance from station (km)	20	40	60	80	100	120
Minimum altitude (m)	350	700	1050	1400	1750	2100

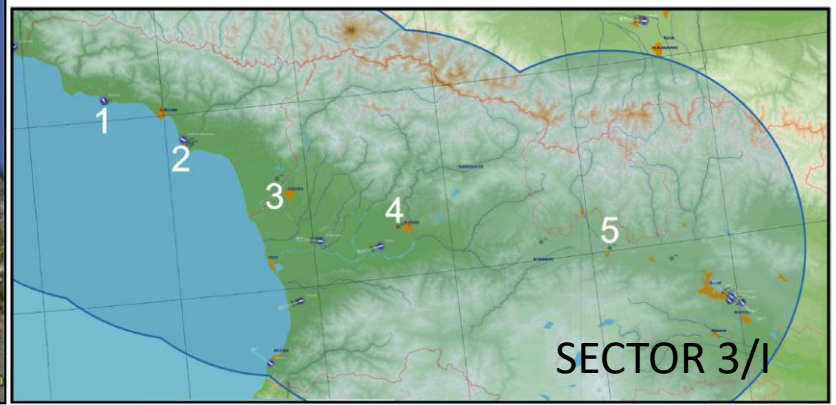
ARC STATIONS (NDB)

- 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 compass**.
- ARC signals give you a direction, but not a distance.
- To pick up ARC signals, make sure you are flying at an altitude of at least 2,500 m.



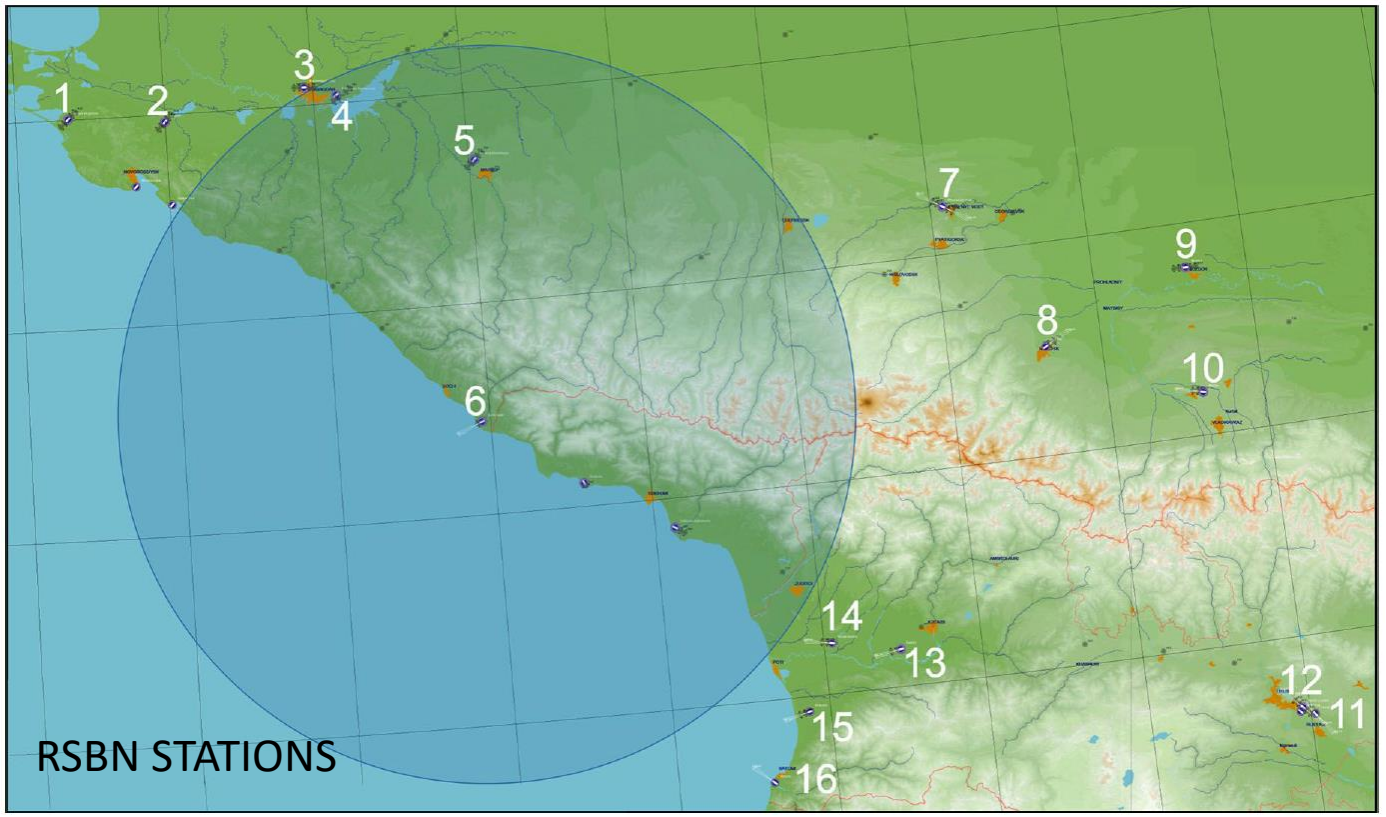






RSBN STATIONS (VOR)

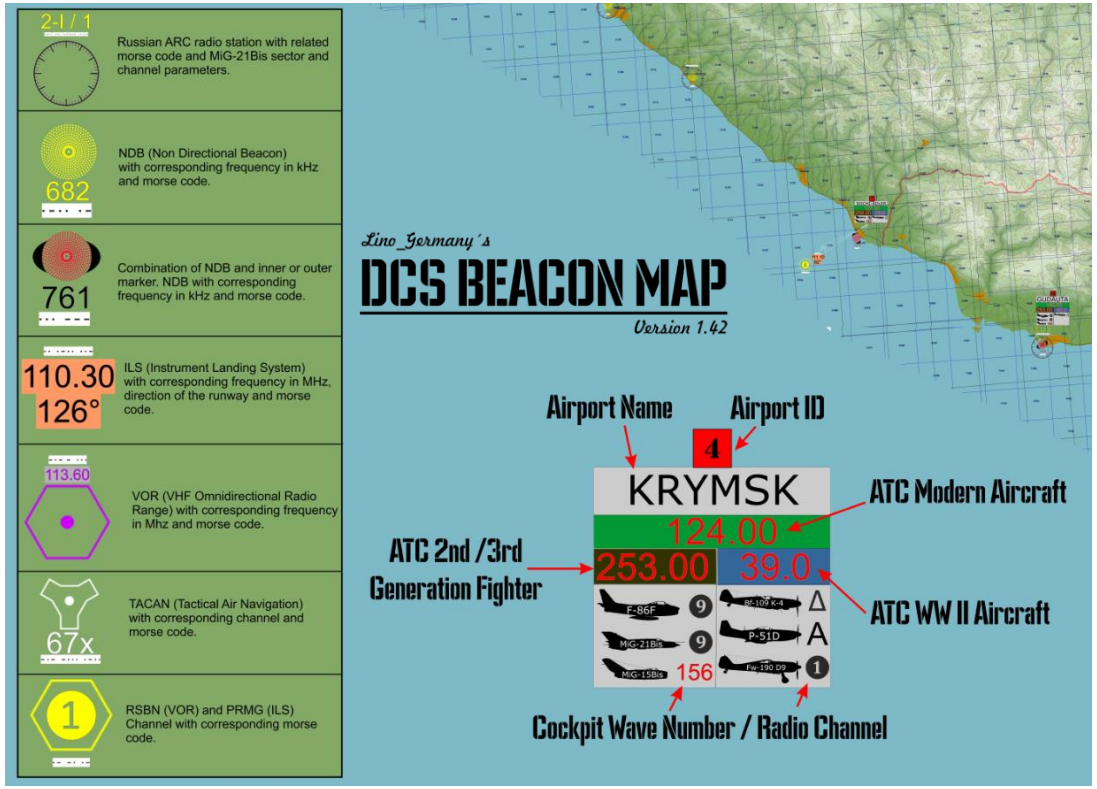
- RSBN VOR stations are generally set next to airstrips to guide air traffic towards airfields, unlike NDBs which can be placed anywhere… sort of. In simple terms, you could compare NDBs to waypoints on an “air highway” and VOR stations to the exits of this “air highway”.
- You are guided to RSBN stations by both your **NPP** (HSI: Horizontal Situation Indicator, or radio compass) and your **KPP** , which works like an ADI (Attitude Director Indicator) augmented with an ILS (Instrument Landing System).
- RSBN signals give you a direction AND a distance.
- 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.

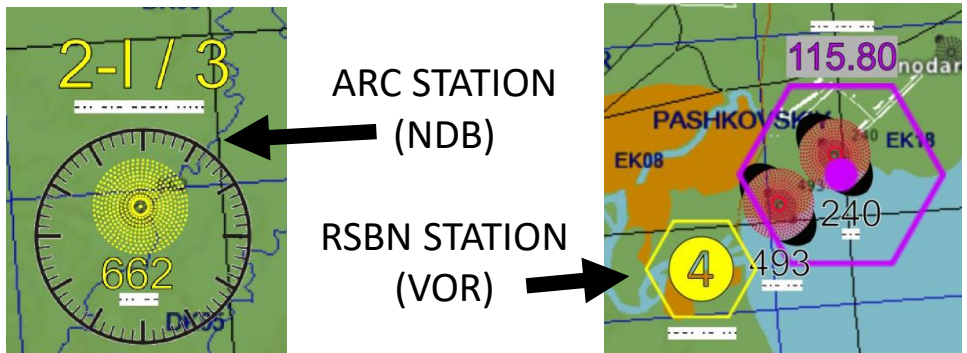


RSBN AND ARC STATIONS – HOW TO FIND THEM?

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



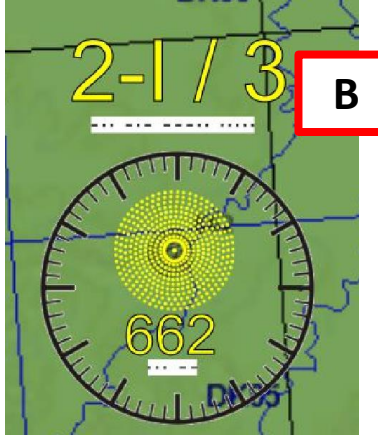


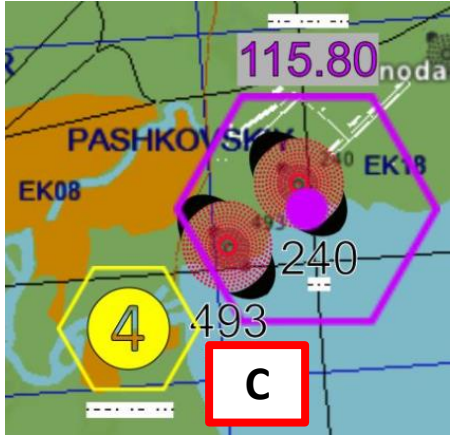
RADIO	RSBN	AIRPORT / RUNWAY HDG	RSBN MORSE CODE
0		MAIN CHANNEL	.- -. .-
1		AUX	-... .- -
2	1	ANAPA-VITYAZEVO / 42	-... . ...
3	16	BATUMI / 126	
4	10	BESLAN / 94	
5		GELENDZIK	-.- --- -...
6		GUDAUTA-BOMBORA	-.- ... -..
7	15	KOBULETI / 70	.-- .- ...
8	3	KRASNODAR-CENTER / 87	-.- ... -..
	4	KRASNODAR-PASHKOVSKIY / 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	- ...- .-

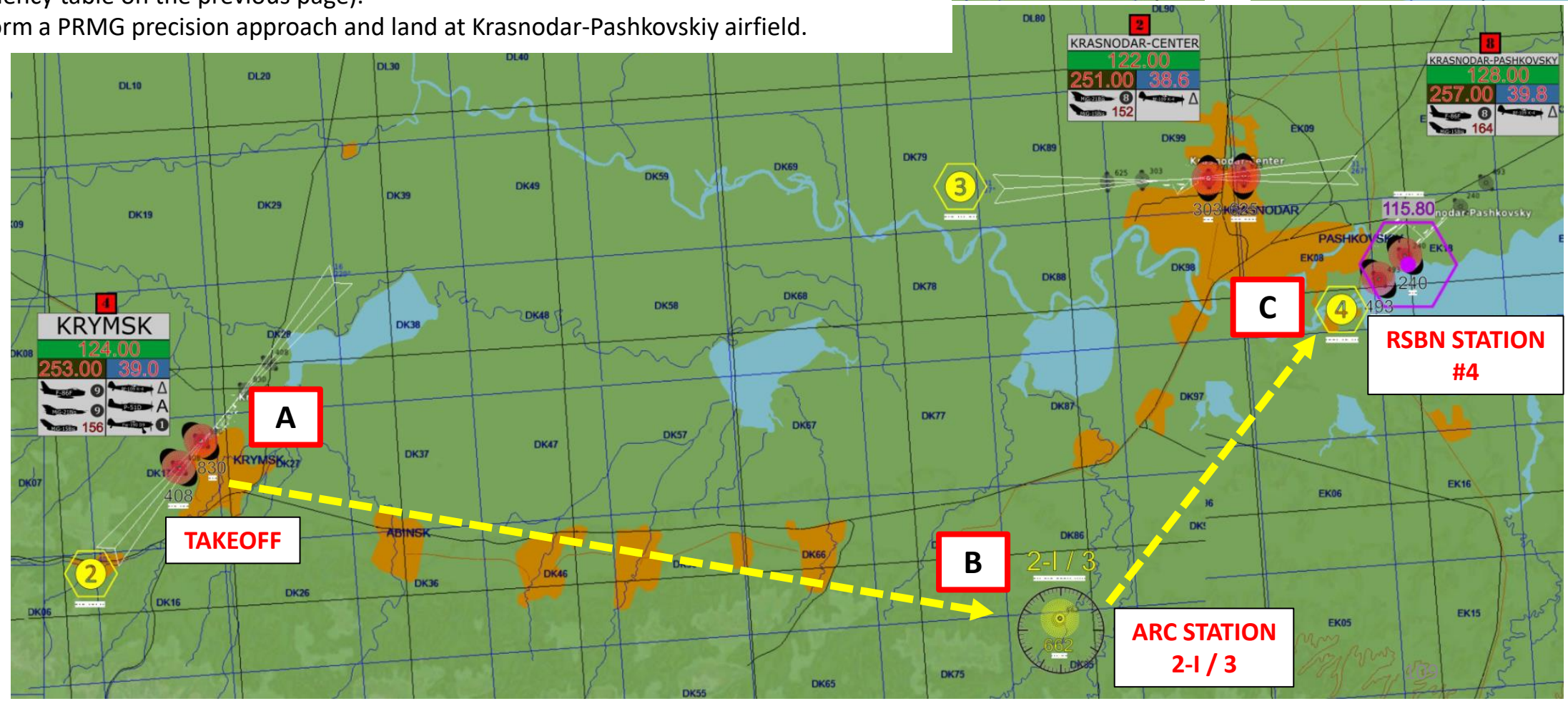
NAVIGATION EXAMPLE (ARC + RSBN + PRMG LANDING)

In this example, we will plan a flight from Krymsk to Krasnodar-Pashkovskiy. We will do the following:

A. Takeoff from Krymsk and gain an altitude of at least 2,500 m.
B. Use the ARC-10 radio compass to navigate to ARC NDB station 2-I / 3 (obtained through Lino_Germany's HD map).
C. Use the RSBN system to navigate to RSBN VOR station # 4 (obtained through RSBN frequency table on the previous page).
D. Perform a PRMG precision approach and land at Krasnodar-Pashkovskiy airfield.

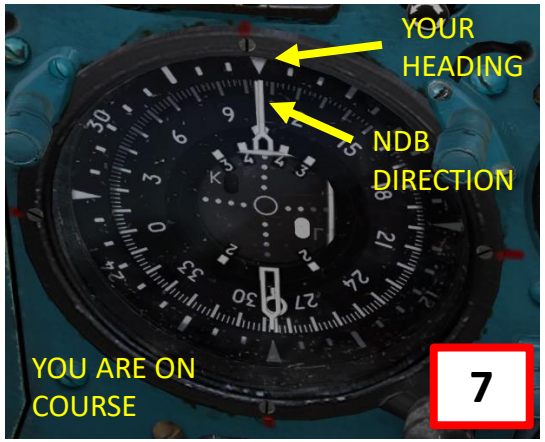


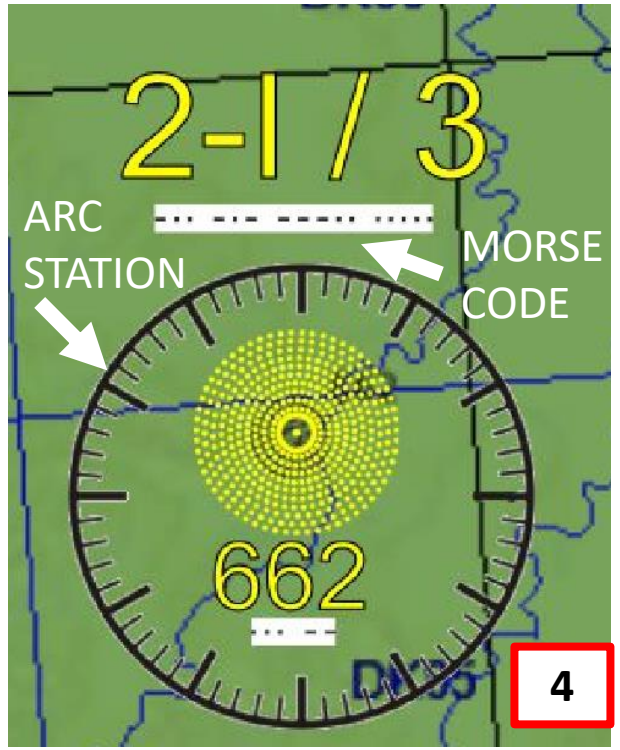


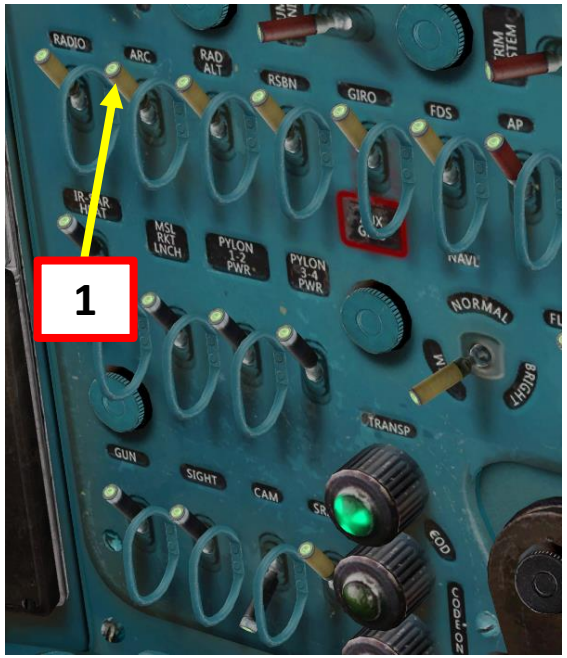


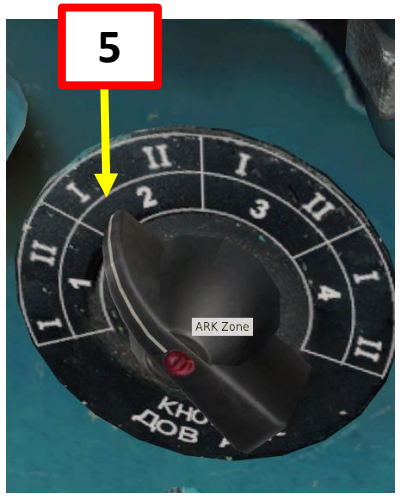
NAVIGATION EXAMPLE – ARC STATION

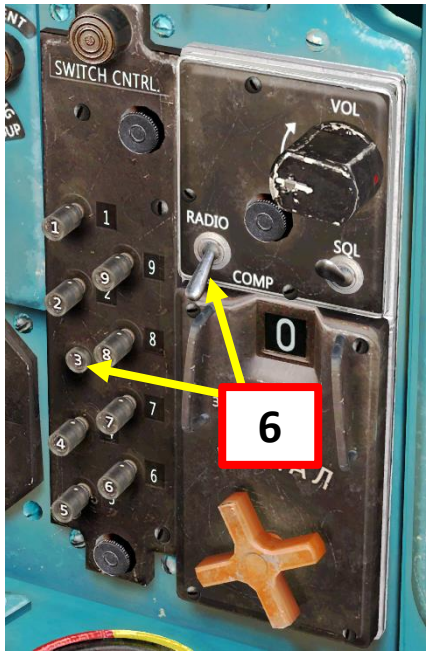
1. Turn on ARC switch (UP).
2. Set ARC/RSBN mode switch to ARC (DOWN).
3. Hold FDS switch for 3-4 seconds to align NPP with magnetic compass.
4. Our ARC NDB is in sector 2-I / 3. On Lino_Germany's map, you can also see the morse code we should expect to hear.
5. Select ARC channel 2-I.
6. Select sub-channel # 3 on the radio panel and make sure the radio switch is set to COMP (DOWN) to hear the NDB morse code.
7. NPP 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.
8. 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.
9. Once you are over the NDB, proceed towards the RSBN beacon.











NAVIGATION – 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.

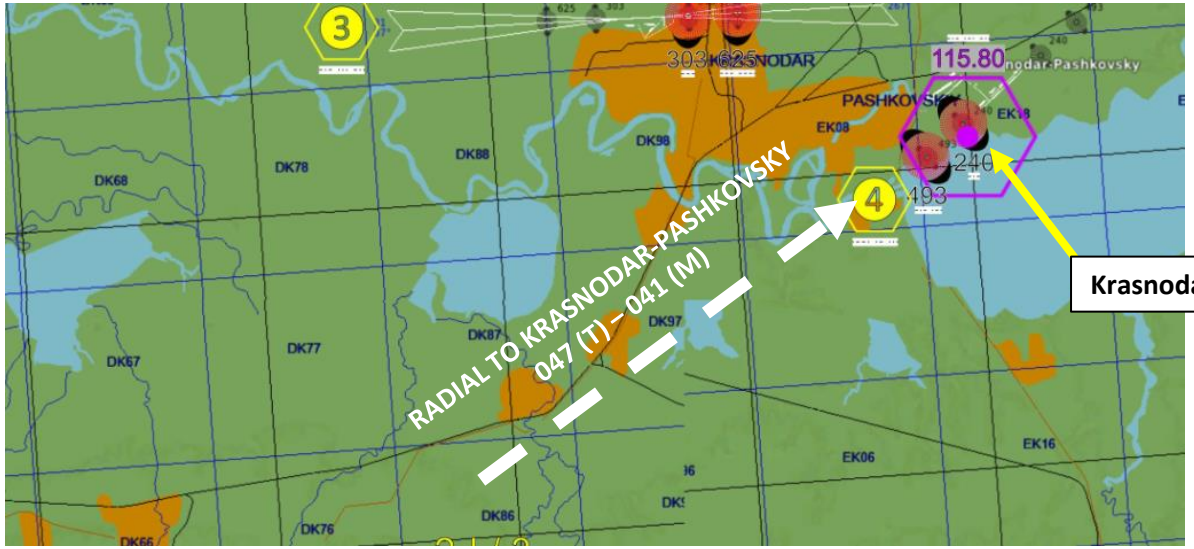
This is the reason why in DCS, the course to a runway needs to be “adjusted” to take into account this magnetic declination of the magnetic North pole (which is actually modelled in the sim, which is pretty neat).

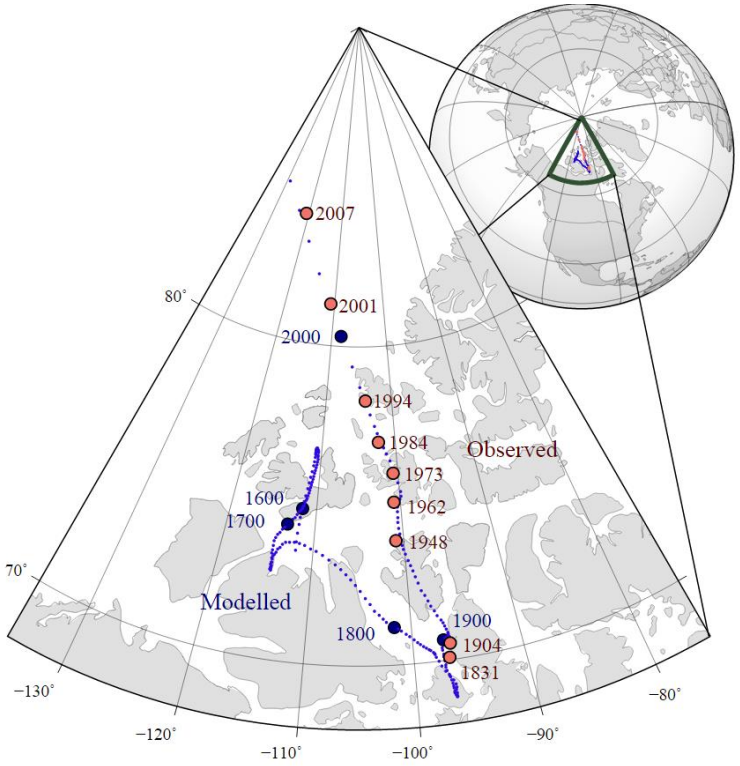
True Heading = Magnetic Heading + Magnetic Deviation

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 HSI / NPP.

Magnetic Declination:

- **Caucasus = approx +6° (East)**
- **Nevada = approx +12° (East)**
- **Normandy = approx +8 ° (East)**
- **Persian Gulf = approx +1.6° (East)**



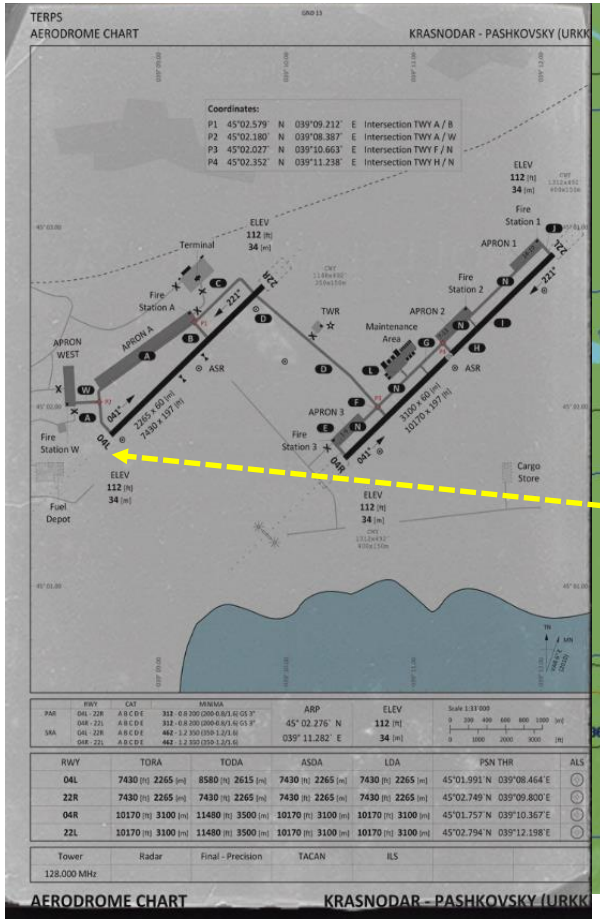


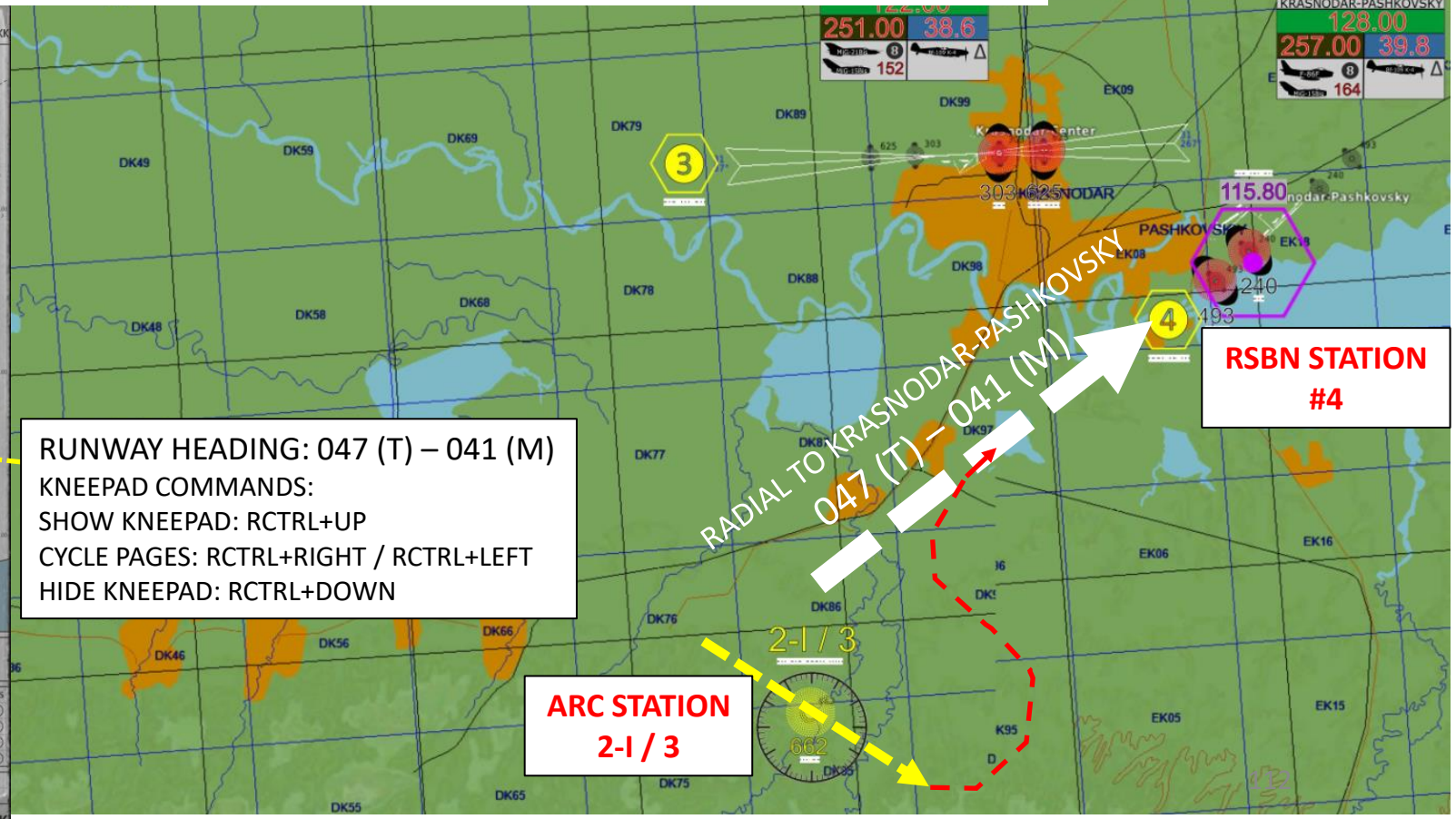
The movement of Earth's north magnetic pole across the Canadian arctic, 1831–2007.

NAVIGATION EXAMPLE – RSBN STATION

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

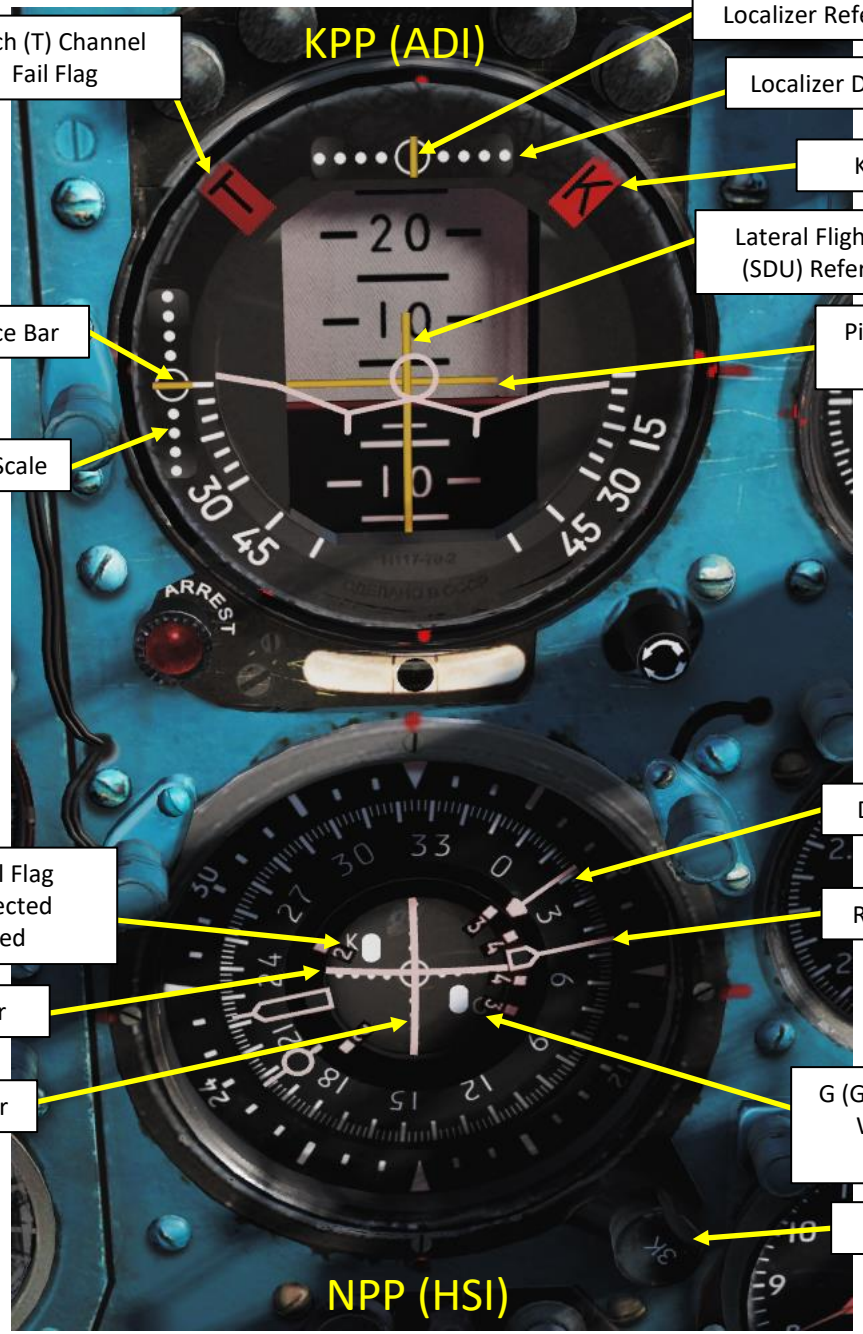
- We have now reached the ARC station. What now?
- In real life, there are designated air corridors that pilots need to take in order to get to certain airfields. This is what we call a "radial" (think of it like an aerial highway).
- "Intercepting a radial" is just a fancy way of saying that you fly 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 kneepad to find the right page OR by contacting the control tower at Kranodar-Pashkovskiy with the radio by telling them that you are inbound (they will give you the runway heading). However, we cannot talk to the control tower since there is no preset channel assigned to this particular airfield.
- 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.
- We will use the RSBN system to intercept the 041 radial next page.





RUNWAY HEADING: 047 (T) – 041 (M)
KNEEPAD COMMANDS:
SHOW KNEEPAD: RCTRL+UP
CYCLE PAGES: RCTRL+RIGHT / RCTRL+LEFT
HIDE KNEEPAD: RCTRL+DOWN

NAVIGATION EXAMPLE – RSBN STATION
NPP & KPP BASICS



Pitch (T) Channel Fail Flag

Localizer Reference Bar

Localizer Deviation Scale

K (Localizer) Fail Flag

Lateral Flight Director (SDU) Reference Bar

Glide Slope Reference Bar

Pitch Flight Director (SDU) Reference Bar

Glide Slope Deviation Scale

Direction to tracked RSBN (VOR)

K (Localizer, "Kurs") Fail Flag
White = No Signal Detected
Black = Signal Detected

Radial Course (set by 3K Knob)

G (Glide Slope) Deviation Bar

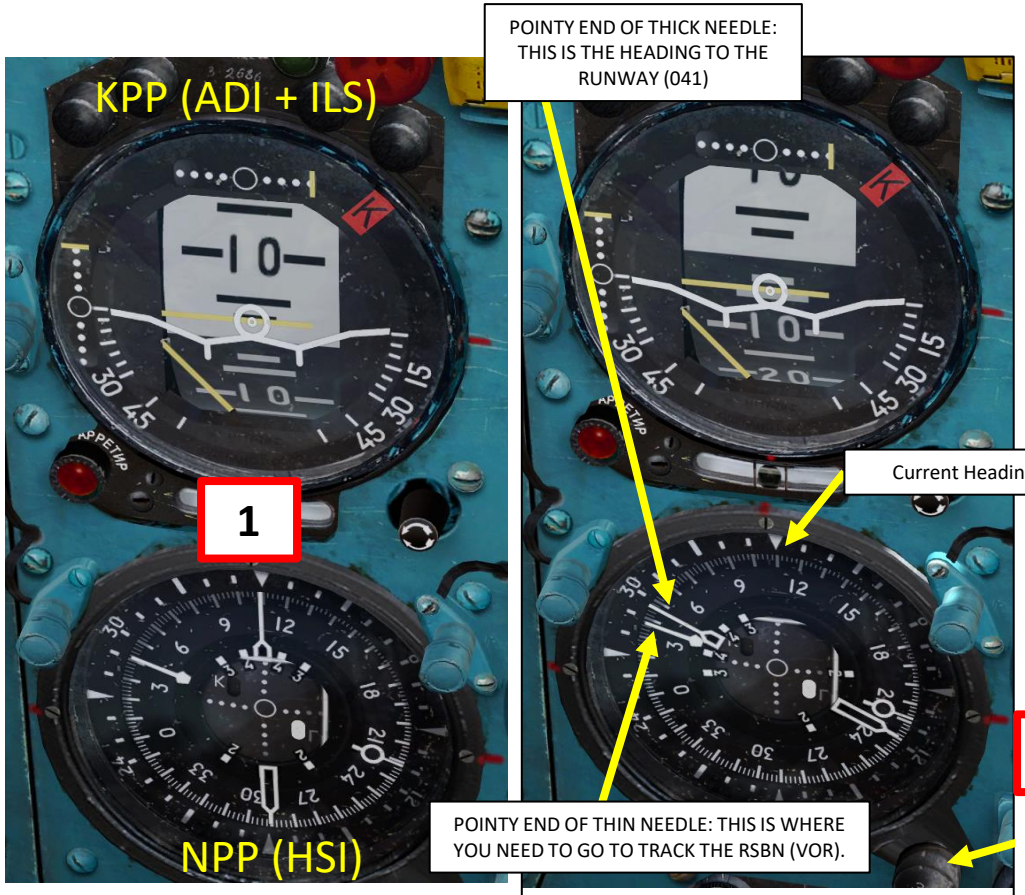
K (Localizer) Deviation Bar

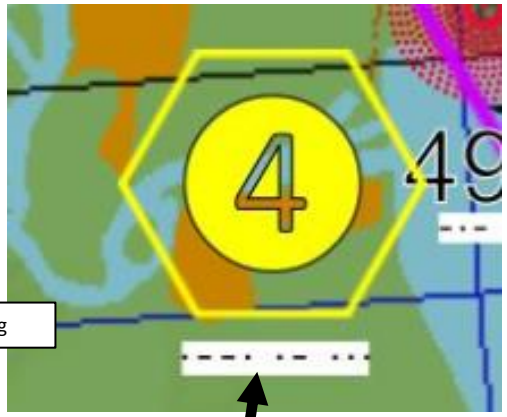
G (Glide Slope, "Glisada") Fail Flag
White = No Signal Detected
Black = Signal Detected

RSBN 3K Course Selector Knob

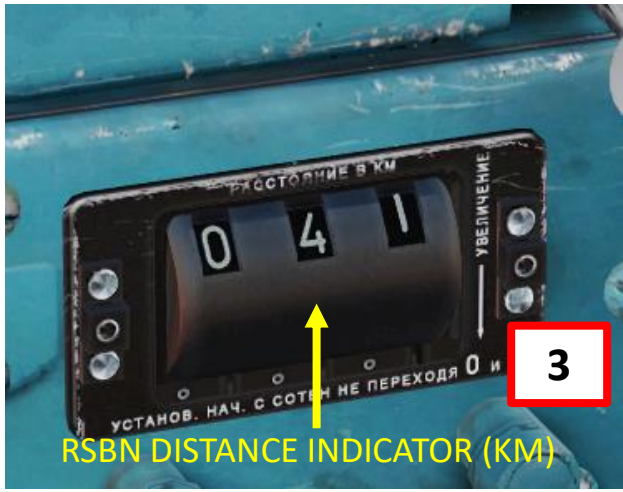
NAVIGATION EXAMPLE – RSBN STATION

1. This is what I have once I crossed the NDB.
2. Turn RSBN/ARC switch to the "RSBN" position (UP) and click on the RSBN and PRMG tuners to set the RSBN channel number (which is #4). You will hear the morse code. You can turn volume down.
3. Check the RSBN distance indicator: we currently are 41 km away from the beacon.
4. Rotate the 3-K knob with mousewheel to set the pointy 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.





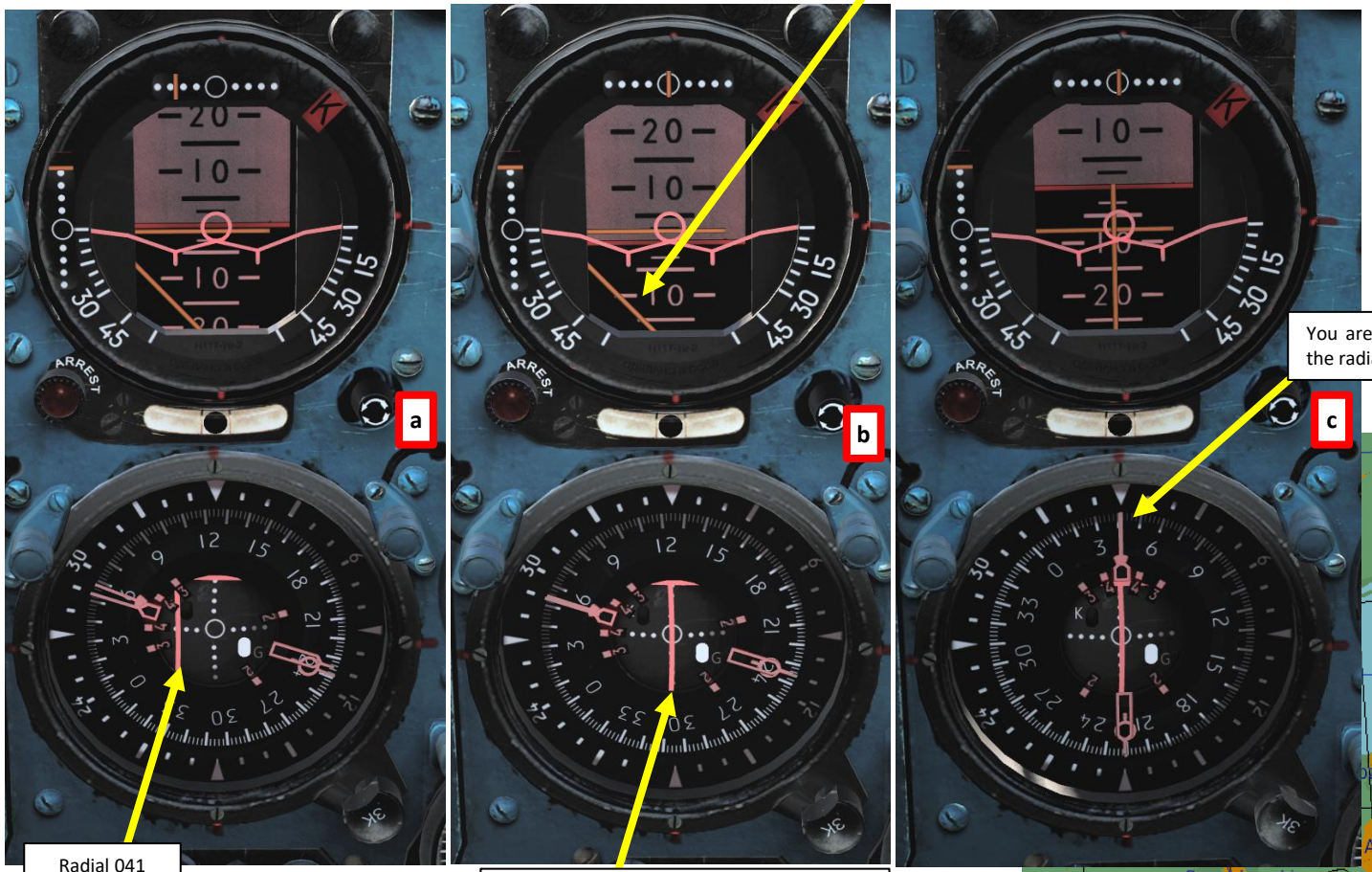
MORSE CODE (RSBN)

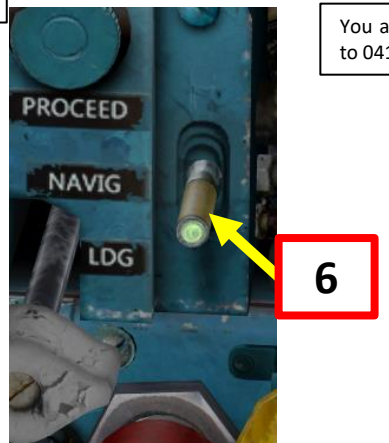


2

Rotate this knob (3K) to set pointy end of thick needle on runway radial heading.

NAVIGATION EXAMPLE – RSBN STATION





5. We will first align ourselves to ride the radial. We will use the RSBN NAVIG mode for that.
6. Click on NAVIG (middle position) and align your aircraft with the NPP (HSI).

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

NAVIGATION EXAMPLE RSBN 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.

NAVIGATION EXAMPLE RSBN CLOUD PENETRATION / DESCENT MODE

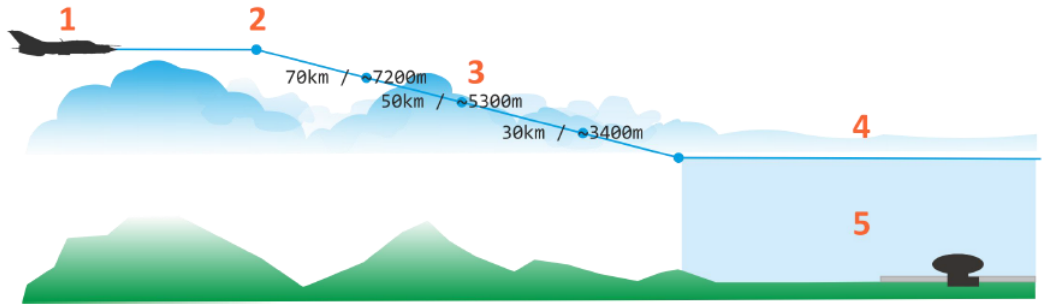


Image 9.9: Guidance program for CLOUD PENETRATION mode

1 - Engage CLOUD PENETRATION mode whenever you need it. At 120km or further from the RSBN station, your altitude should be 10,000m.

2 - Descent starting point is at 120km from station. Recommended IAS during descent is 600 km/h.

3 - Keep the GLIDE director needle near the center of the aircraft silhouette on the KPP. If you are flying on a certain radial, keep the LOCALIZER director and needles around the center.

4 - 20km from the RSBN, altitude is 600m and the descent program ends: at this point you can engage the LANDING mode or you can proceed with a visual approach. If you continue with CLOUDS PENETRATION mode, the needles will instruct you to maintain 600m.

5 - Area of constant altitude of 600m within 20km around RSBN station.

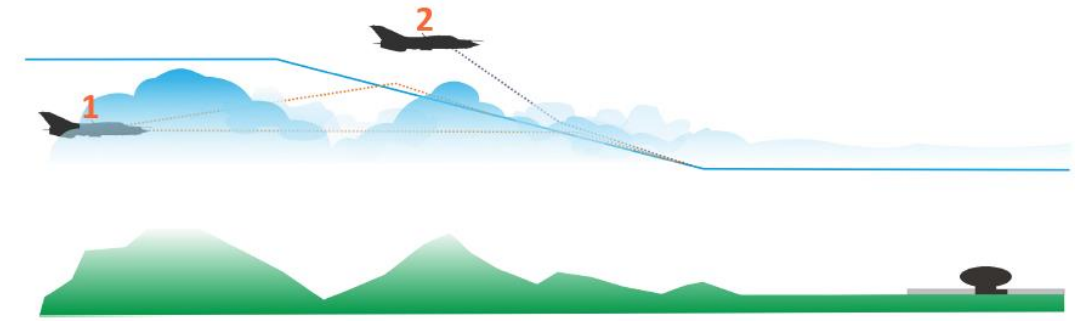


Image 9.10: Intercepting penetration glide

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, 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.

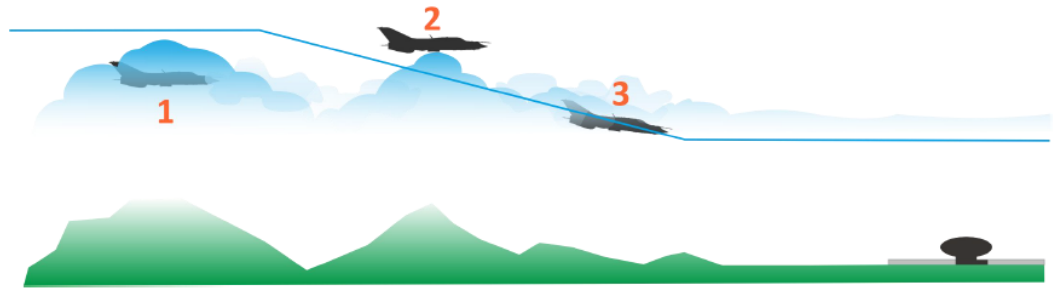


Image 9.11: Relation between aircraft position and needle position

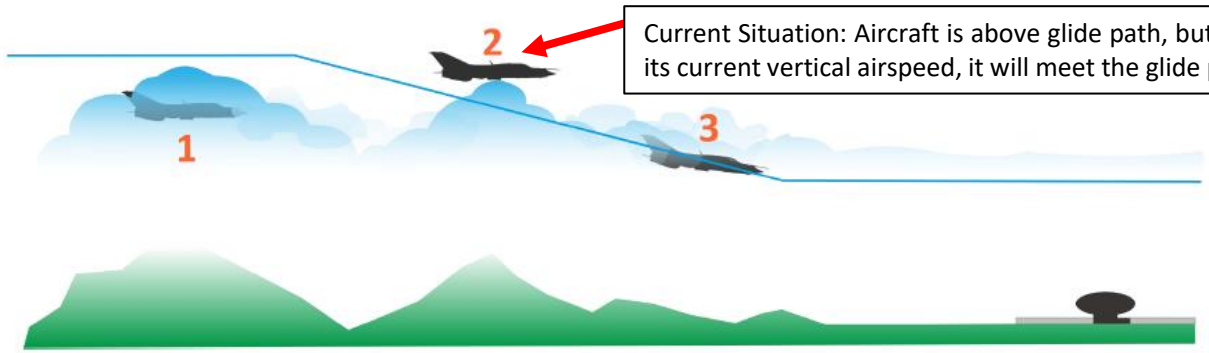
1 - Aircraft is below glide path - needles indicating path are above "horizon" on KPP and NPP.

2 - Aircraft is above glide path - needles indicating path are below "horizon" on KPP and NPP.

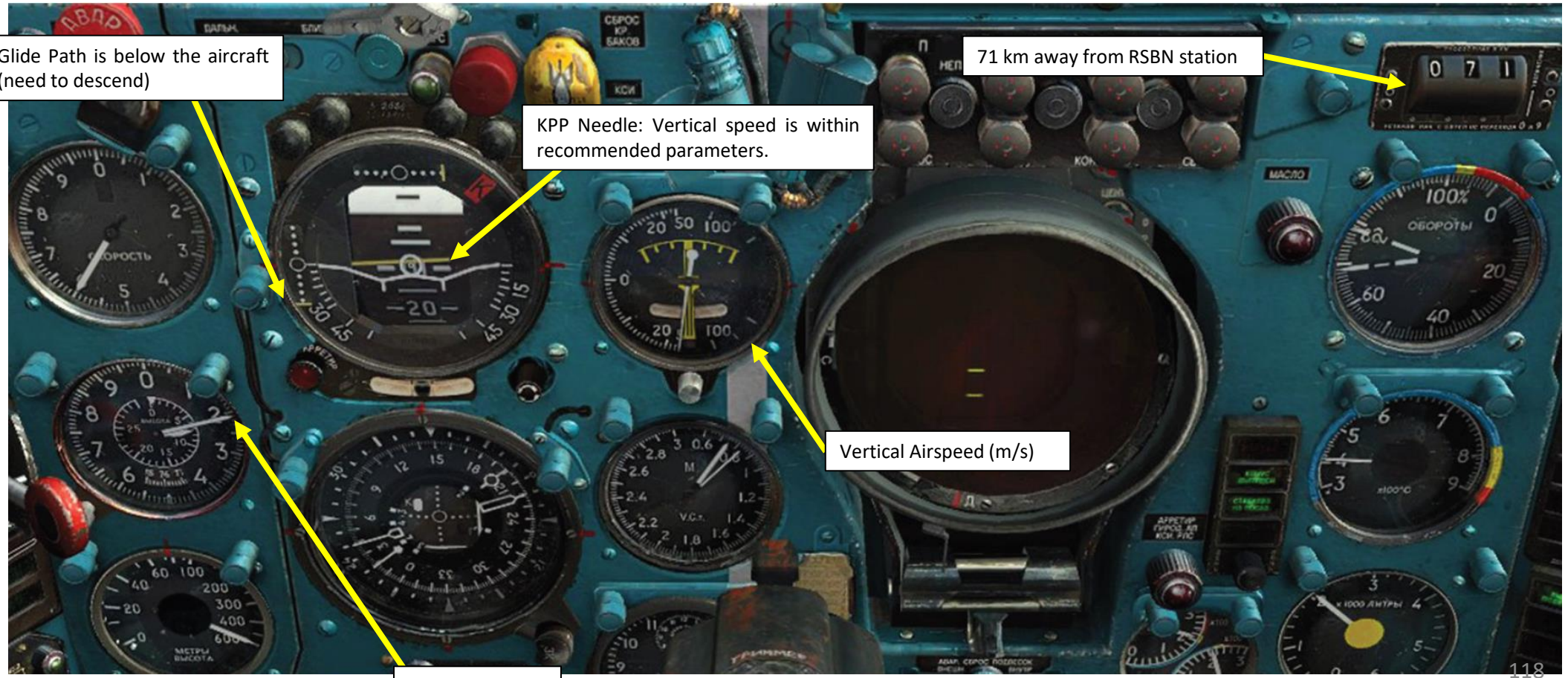
3 - Aircraft is on glide path, needles are on "horizon".

Cloud Penetration / Descent Mode Switch (Proceed)

NAVIGATION EXAMPLE RSBN CLOUD PENETRATION / DESCENT MODE



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



Glide Path is below the aircraft (need to descend)

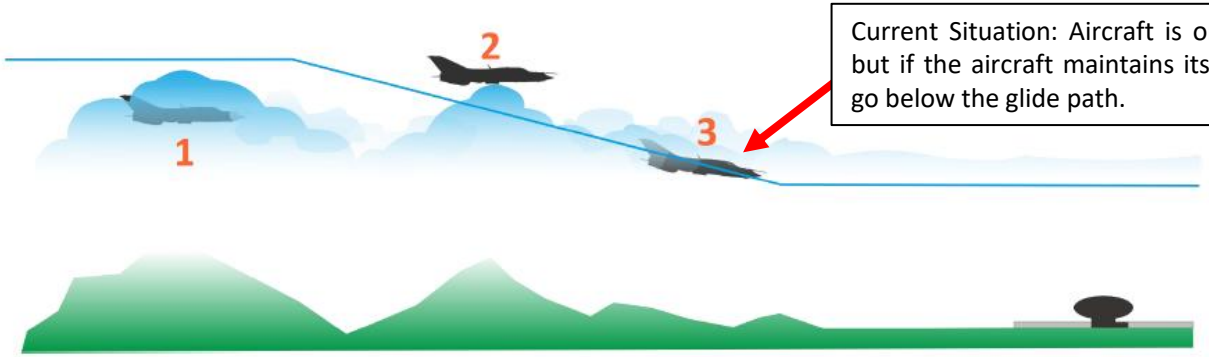
71 km away from RSBN station

KPP Needle: Vertical speed is within recommended parameters.

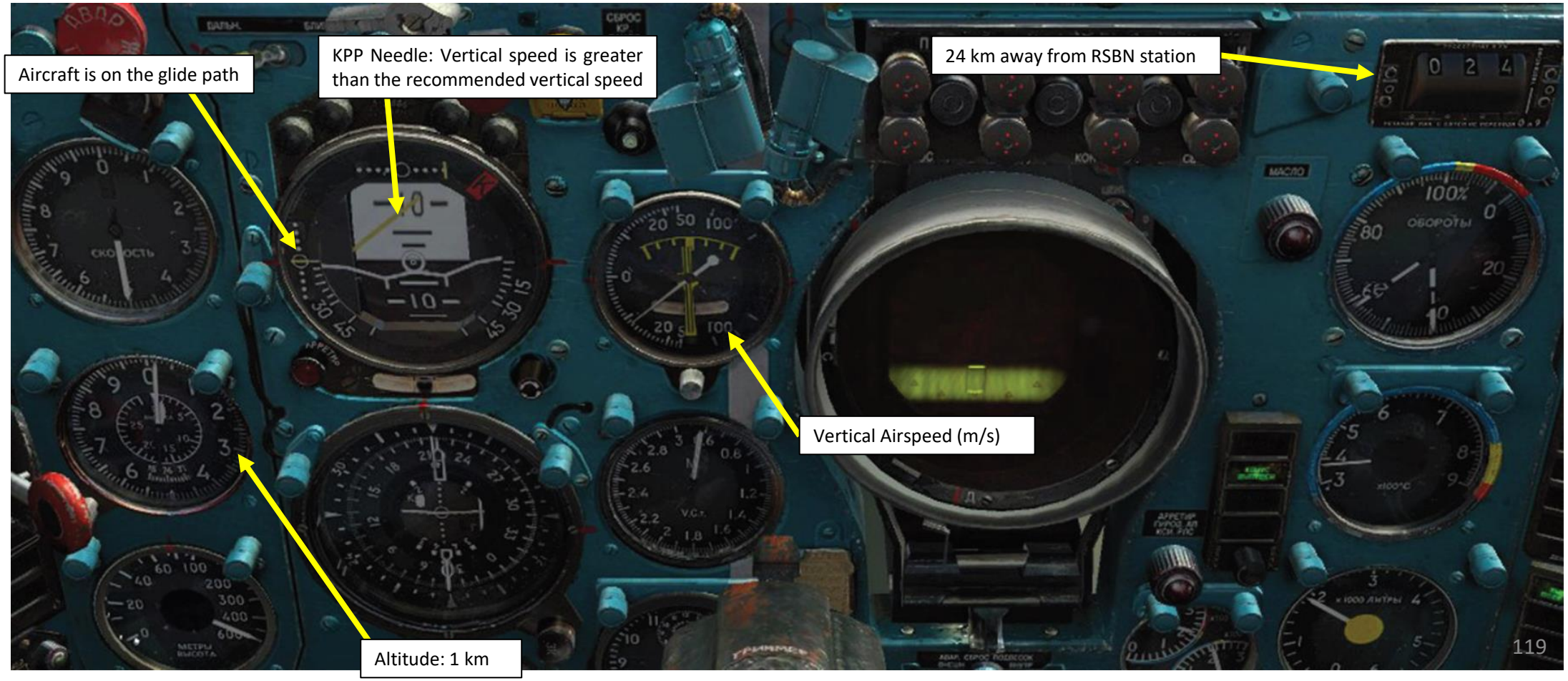
Vertical Airspeed (m/s)

Altitude: 7.2 km

NAVIGATION EXAMPLE RSBN CLOUD PENETRATION / DESCENT MODE



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.



NAVIGATION EXAMPLE – PRMG 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.

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_
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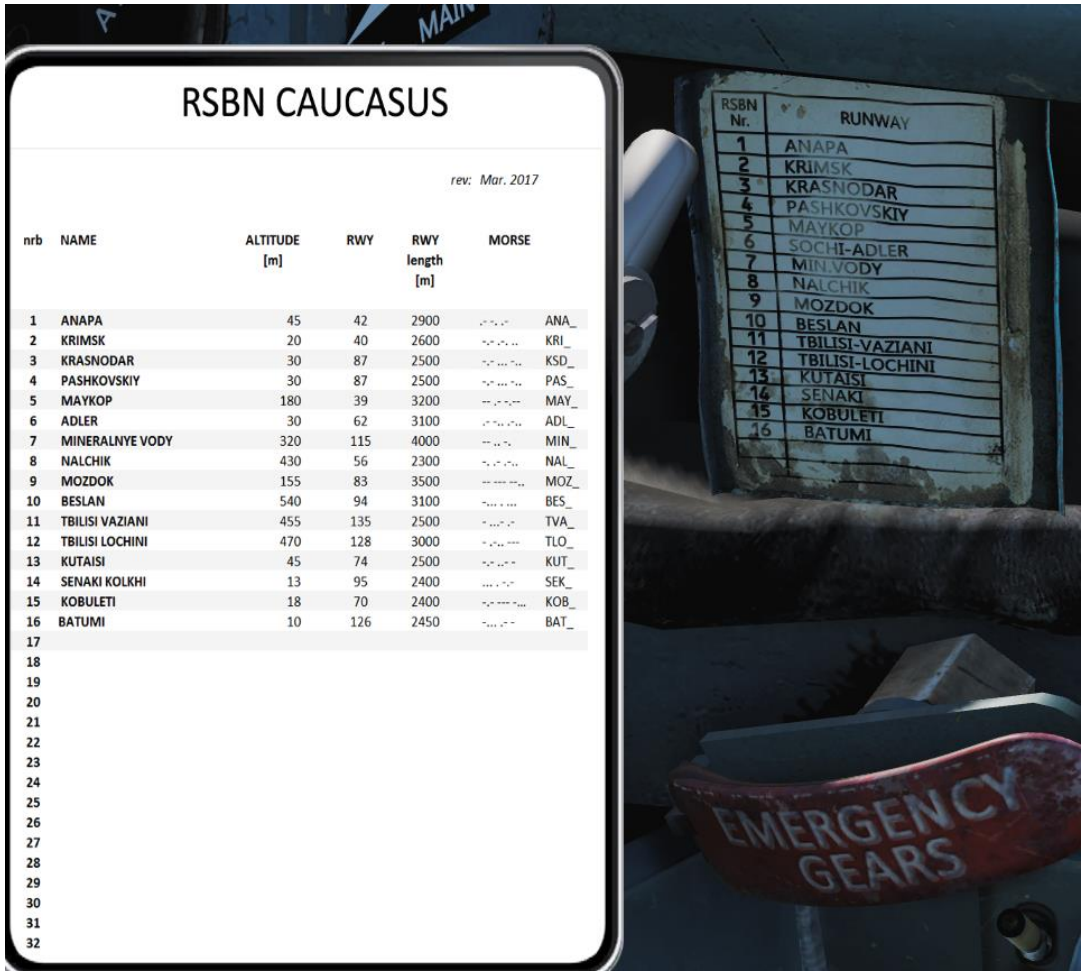
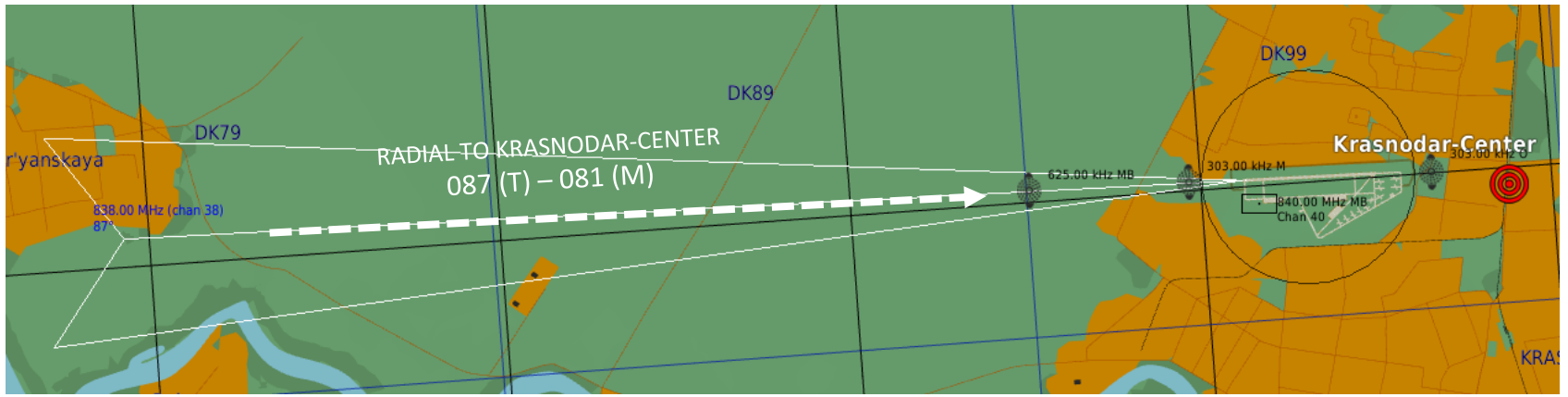
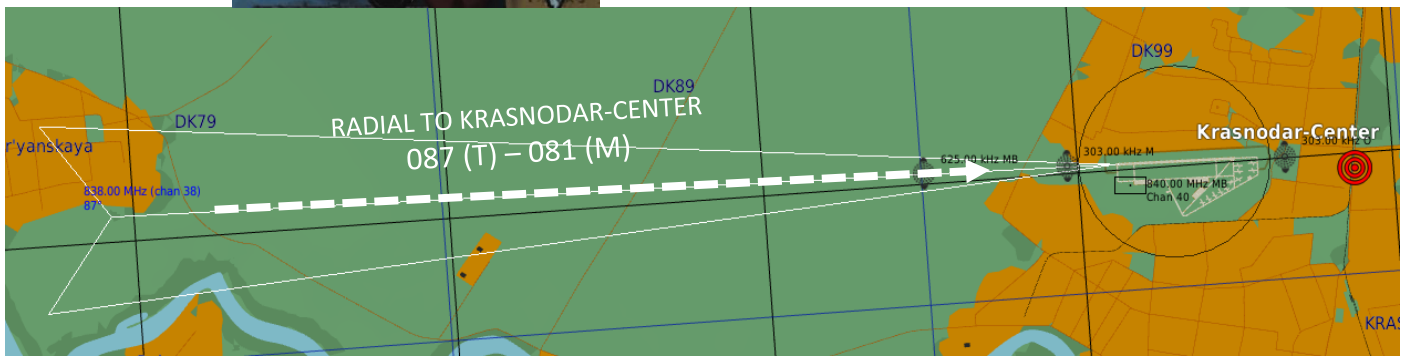


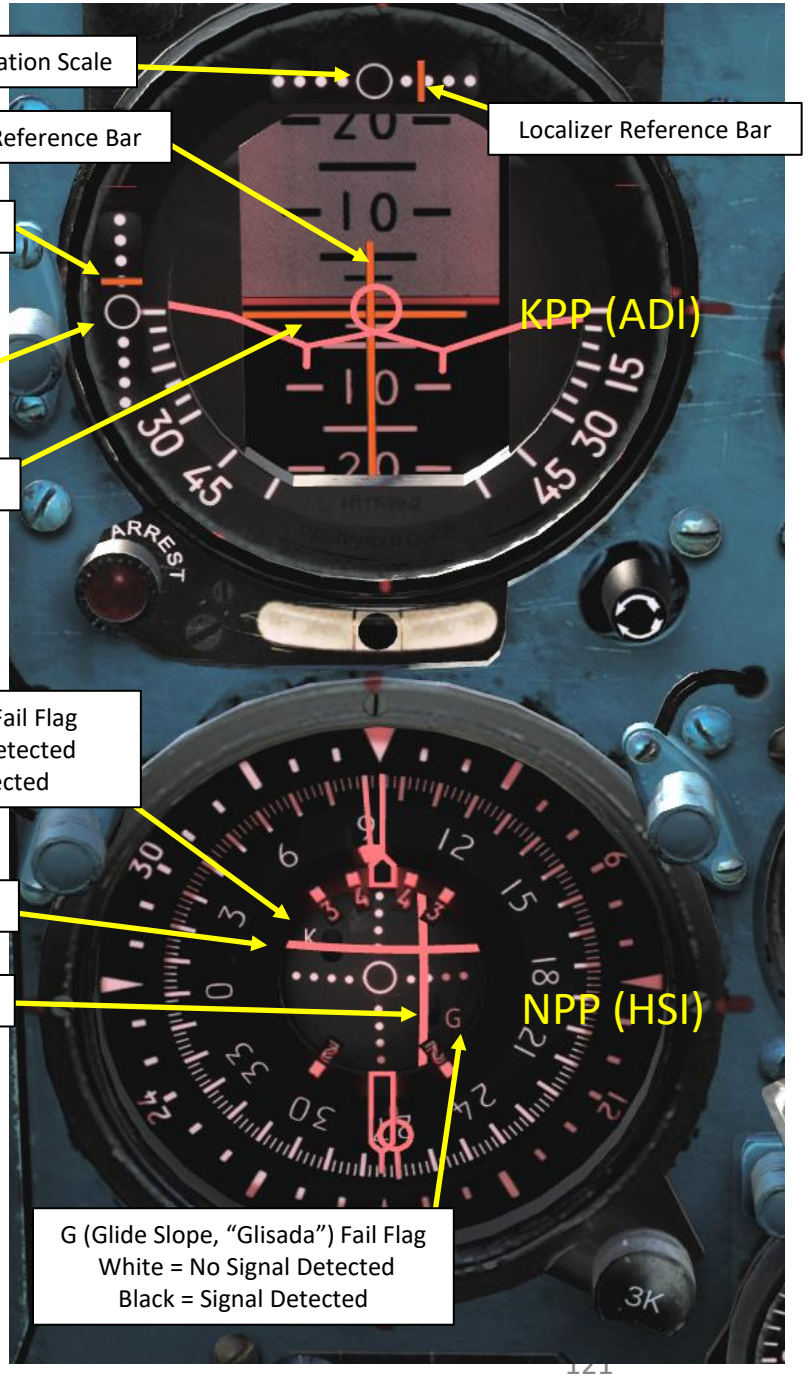


NAVIGATION EXAMPLE – PRMG LANDING

- 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 and KPP 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 NAV mode before using the LANDING mode since the NAV mode has a much greater range.

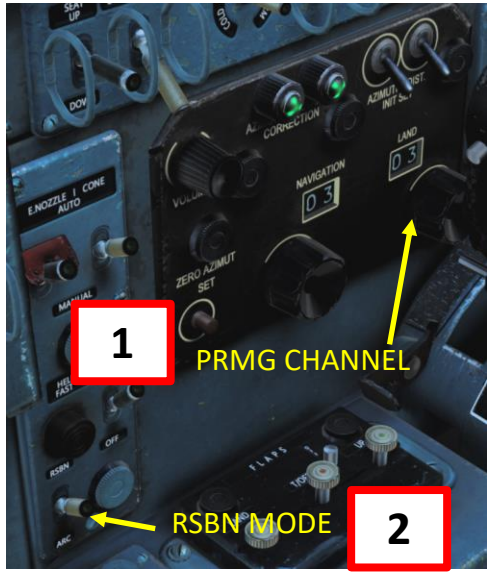
RSBN Mode Selector

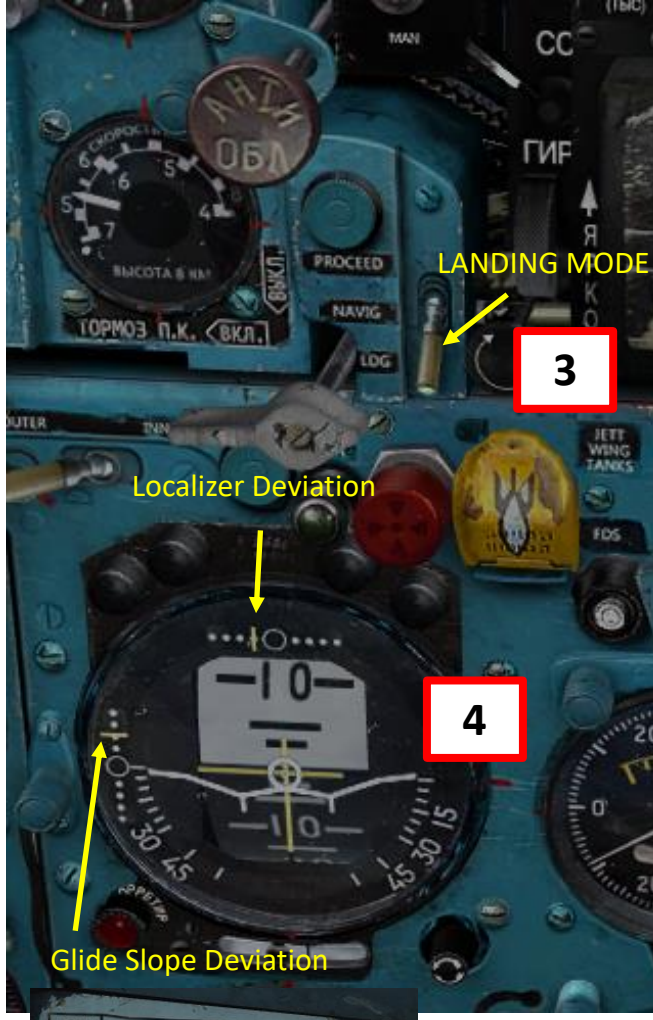




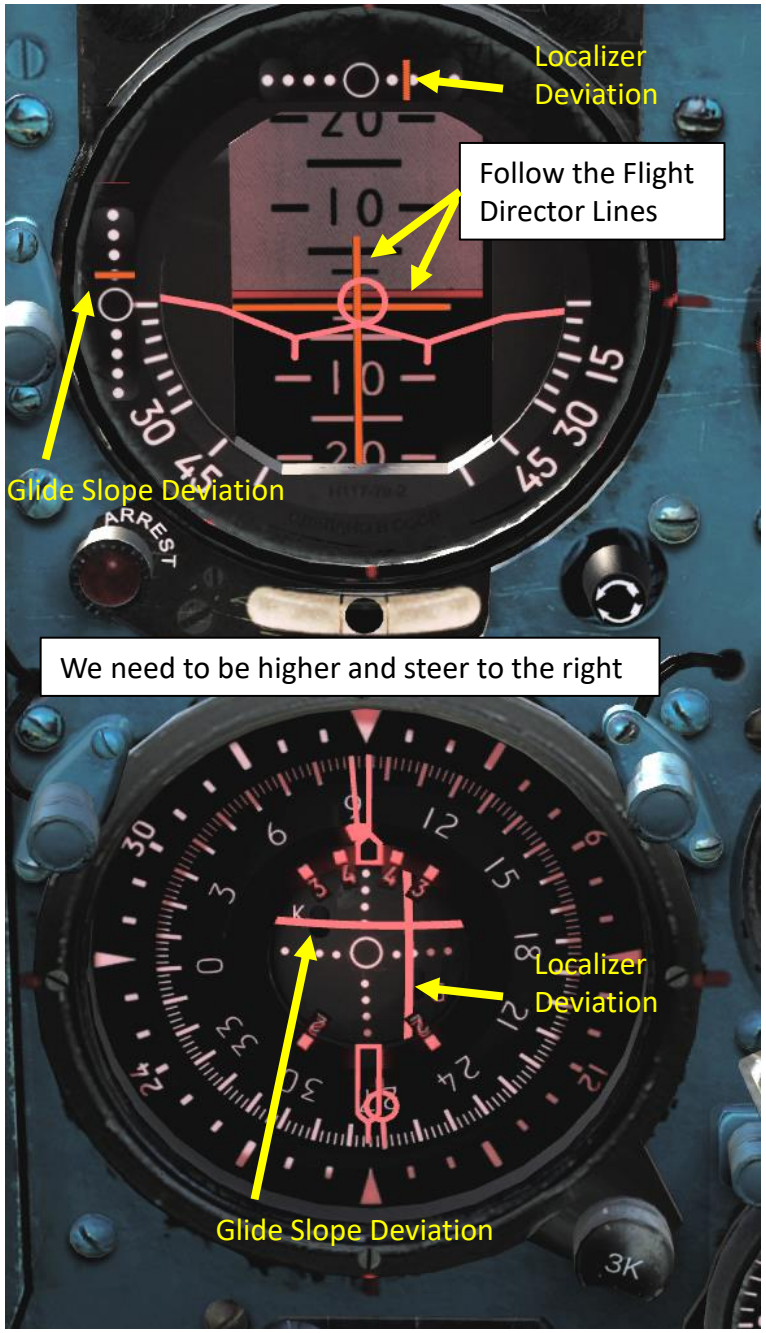
NAVIGATION EXAMPLE – PRMG LANDING

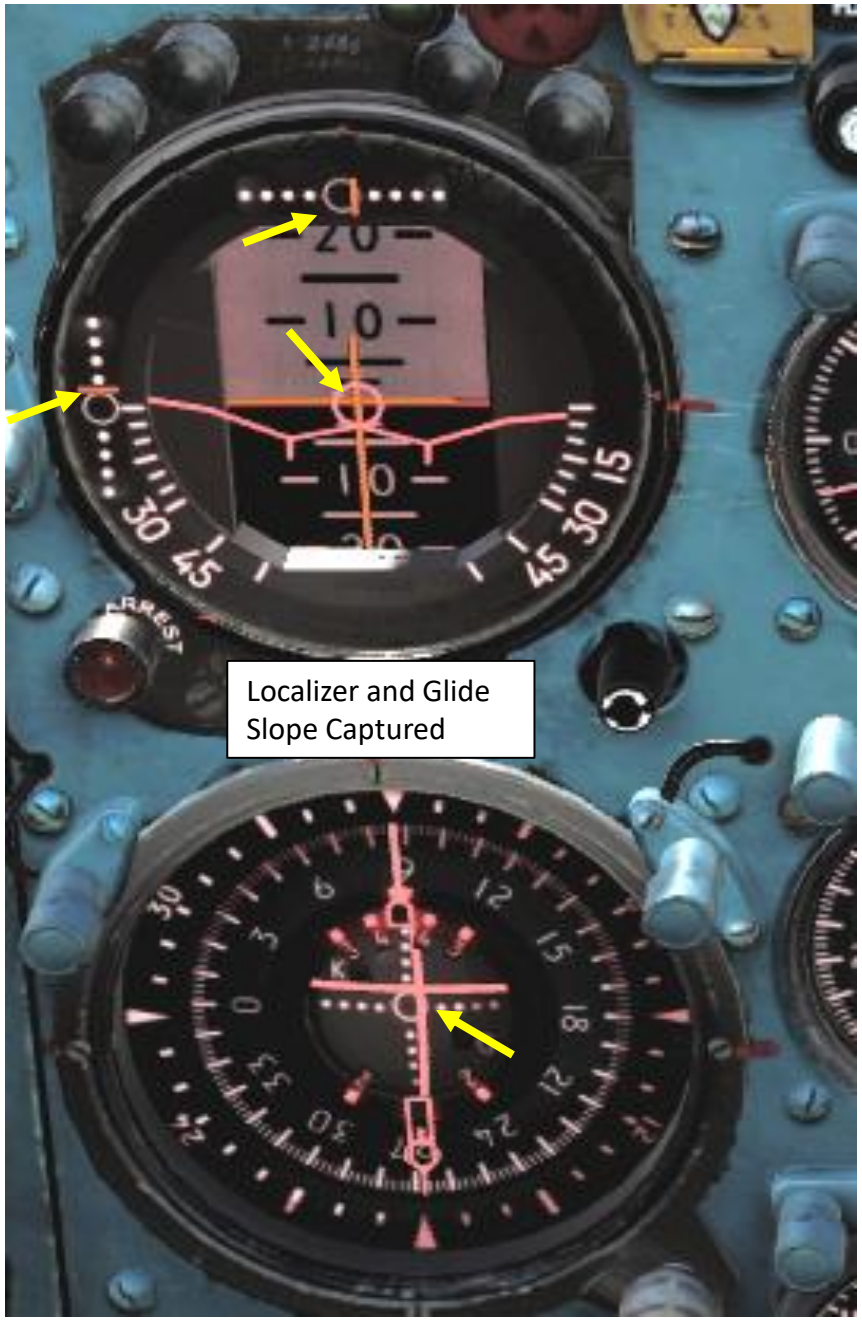
1. Set the Krasnodar-Center PRMG and RSBN channels to 03 as per the RSBN chart.
2. Make sure the RSBN/ARK switch is set to RSBN
3. Set RSBN switch to LDG (Landing)
4. When we reach 25 km, we should be able to capture the PRMG localizer signal. Once we are on a good gliding slope and on a good heading, follow the flight director steering lines. 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).





NAVIGATION EXAMPLE – PRMG LANDING



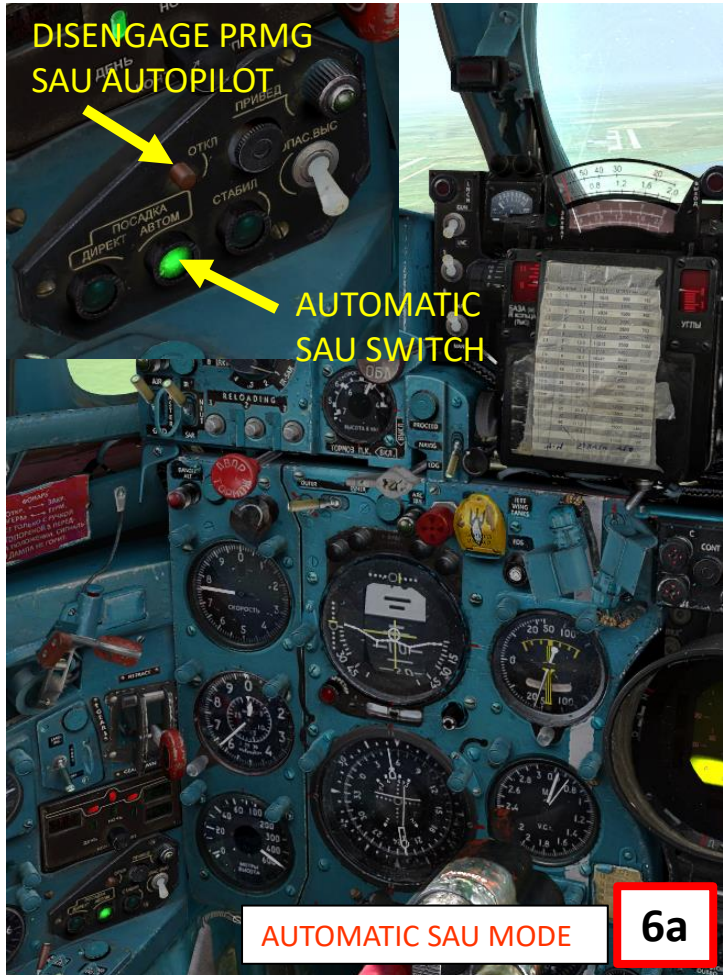


NAVIGATION EXAMPLE – PRMG LANDING

NAVIGATION EXAMPLE – PRMG LANDING

NAVIGATION EXAMPLE – PRMG LANDING

5. The PRMG system helps you to set an approach, NOT to perform a landing. Whatever you do, you will still have to manually fly the aircraft to the airstrip. You can either:
6. A) Use the SAU auto-pilot in “AUTOMATIC” mode (click left green switch). The auto-pilot will control aileron, rudder and elevators. This is useful to give you time to deploy landing gear and flaps. Make sure that you give enough throttle to maintain a speed of approx. 400 km/h. When you are 1 km away from airstrip (or 100 m high), disengage auto-pilot by pressing the “Disengage SAU autopilot” on the SAU panel and land the plane manually.
   B) Use the SAU auto-pilot in “DIRECTIONAL” mode (click center green switch). Yellow bars appear to give you a referential for glide slope and heading to runway. You still have full control of your aircraft.
   C) Go full manual (like a BOSS!). This is hands down the least complicated and most reliable way.
7. Land the aircraft manually as shown in the LANDING section of the guide. PRMG should only be used in bad visibility conditions where you NEED to get to the airstrip but you can’t because you don’t see it. Personally, I only use it when I don’t have a choice.



NAVIGATION – IN CONCLUSION

- Navigation can easily become even more complex than what you just read (or didn't read). We just scratched the surface here: for instance, we haven't touched RSBN Box Landings. It's an interesting topic… there is just so much cool stuff about the MiG-21 that I could easily have written twice that amount of pages. But I'm a lazy bastard… so you'll have to read the actual manual, which is much better and thorough than this guide.

- PRMG landings are a pain in the butt: they increase the pilot's workload (which is already very high) and are not safe and reliable. The autopilot PRMG approach is particularly dangerous since you give away control on the most critical part of flight (apart from combat, of course) to a system that is at times reliable (or plainly retarded… you don't want to see the number of craters around Krasnodar). Overall, I wouldn't bother with PRMG landings UNLESS it's night or you have a thick cloud layer that prevents you from seeing anything.

- RSBN modes "NAVIGATION" and "DESCENT" are useful to navigate precisely towards a runway. I still recommend doing your approaches manually. I've never been a big fan of autopilots: I just prefer to fly the plane. It's much more fun!

- XXJOHNXX's tutorials on youtube are excellent. I highly recommend them (see PART 15: OTHER RESOURCES). Take note that the needles on the NPP have been reversed since 2014 (the date he did these tutorials) with a patch from the devs.

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, but they are few and far between. My main tip is to NOT fly alone. Get a wingman!

- 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 afterburners 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.

- **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.**

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/

AVIALOGS MiG-21BIS MANUAL
http://www.avialogs.com/viewer/avialogs-documentviewer.php?id=15621

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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