DCS GUIDE

L-39ZA ALBATROS

By Chuck

LAST UPDATED: 13/10/2023

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

PART 1 – INTRODUCTION

With over 3,000 aircraft produced, the L-39 Albatros has become one of the most popular and widespread trainer aircraft in the world. Developed in Czechoslovakia by Aero Vodochody, it was designed during the 1960s as a replacement for the Aero L-29 Delfin as a principal training aircraft. The Albatros has the distinction of being the first of the second-generation jet trainers to be produced, as well as being the first trainer aircraft to be equipped with a turbofan powerplant.

it became the first trainer aircraft in the world to be equipped with a turbofan powerplant. Quantity production of the L-39 Albatros proceeded in 1971; one year later, it was formally recognized by the majority of the Warsaw Pact countries as their preferred primary trainer. Accordingly, thousands of L39s would be produced for various military customers in Eastern Europe. Additionally, it was exported to a range of countries across the world both as a trainer and a light attack aircraft. Since the 1990s, it has also become popular among civilian operators. By the end of the century, in excess of 2,800 L-39s had served with over 30 air forces.

L-29 Delfin (Georgian Air Force)
Credit: Marcus Fülber

Developed in 1956, the L-29 “Delfin” won the Warsaw pact countries’ jet trainer competition. It marked a new era in pilot training, was very easy to pilot, robust and undemanding in service. At the same time, this airplane had several disadvantages and enhancement attempts showed that the L-29 had limited potential for modernization. Besides that, the fast evolution of aviation posed new requirements in young pilots’ training. Thus, there was a need for a new jet trainer. The Ministry of National Defense (MND) of Czechoslovakia officially ordered the airplane. MND started developing technical specifications in 1963. Work was ongoing in collaboration with the main customer – the Ministry of Defense of the Soviet Union. In particular, it was required to keep the positive qualities of the L-29, increase thrust-to-weight ratio and reliability in operations from unpaved runways. It was indicated that the maximum speed should not exceed 700 km/h. Special attention was paid to the trainee and trainer cockpits. They should be similar to the cockpits of combat airplanes. This task was delivered to the team, headed by the main constructor **Jan Vlček** from the Aeronautical Research Institute in Letňany (LVÚ, now the Aeronautical Research and Test Institute, a.s. – VZLÚ). **Karel Dlouhý** was the project’s chief designer.

On July 15th, 1964, final specifications of the new jet trainer were ready and the name for the new airplane L-39C “Albatros” was approved. After 1,5 years of work, all design activities were transferred to Aero Vodochody, where Jan Vlček moved with his team. From the beginning, Jan Vlček decided on the classical cantilever low-wing scheme, three-point retractable gear and with trainer behind the trainee tandem cockpit. For the L-39C a trapezoidal wing was chosen. It was decided to equip the L-39C with a ruggedized landing gear, which is quite common for all jet trainers. To protect the engine from foreign objects, air intakes were located on both sides of the fuselage over the wing. To teach trainees how to employ weapons, two hardpoints could be installed. The ground maintenance of the airplane was well thought out; in particular, size and location of various inspection covers were chosen thoroughly to ease ground maintenance as much as possible.

In the spring of 1968, the airframe for the X-02 prototype was ready. By mid-autumn, all necessary equipment and systems were mounted on the X-02. Due to a delay in the AI-25TL engine delivery, the AI-25W was installed. On October 25th, 1968, the airplane was rolled out for the first time. Ground testing started at the factory airfield, where special attention was given to engine operation, landing gear, control system and wing mechanization. The tests were performed by Aero Vodochody chief pilot **Rudolf Duchoň**. On October 28th, 1968, the airplane on three occasions accelerated up to 175 km/h with nose gear lifting. The pilot noted good airplane behavior, brake efficiency and a surprisingly good view from the cockpit. After fixing several small issues, the L-39C was prepared for its first flight. On November 4th, 1968, Duchoň took off for the first time.

It was planned to start manufacturing the L-39C in 1971, but the implementation of this program faced several serious difficulties. First of all, the prototypes were still under testing and the final production configuration was not defined yet. In addition, initial delivery dates for the AI-25TL lagged behind schedule. As a result, it was decided in 1971 to build an initial production lot, consisting of 10 L-39Cs, equipped with the AI-25W, which had to be received by MND.

PART 1 – INTRODUCTION

Designed to be a cost-effective trainer aircraft, the L-39 was also capable of performing ground attack missions. For operational flexibility, simplicity, and affordability, the majority of onboard systems have been simplified to avoid incurring high levels of maintenance, as well as to minimize damage caused by mishandling when flown by inexperienced air crew. It could be readily flown from austere airstrips such as frozen lakebeds, enabled through the rugged design of the landing gear and favourable low landing speeds. The aircraft's flying qualities are reportedly simple, which is made easier by way of a rapid throttle response, making it easier for students who had never previously flown before to successfully control.

There are two variants of the L-39 in DCS: the L-39C training variant (C for Cvičná – training) and the L-39ZA Light Combat variant (Z for Zbraně – weapons). This guide is focused on the L-39ZA since it has better combat capabilities while retaining the trainer capabilities of the L-39C. Being the first DCS module that is “multicrew-capable” (meaning that two players can sit in the same plane), the Albatros is a perfect platform to learn the basics of instrument flying. It is also a great aircraft to perform aerobatic flying and this nimble Czech plane is prized by aerobatic teams like the French **Breitling** Jet Team, the American **Patriots** Jet Team and the Russian **Russ** Aerobatic Team.

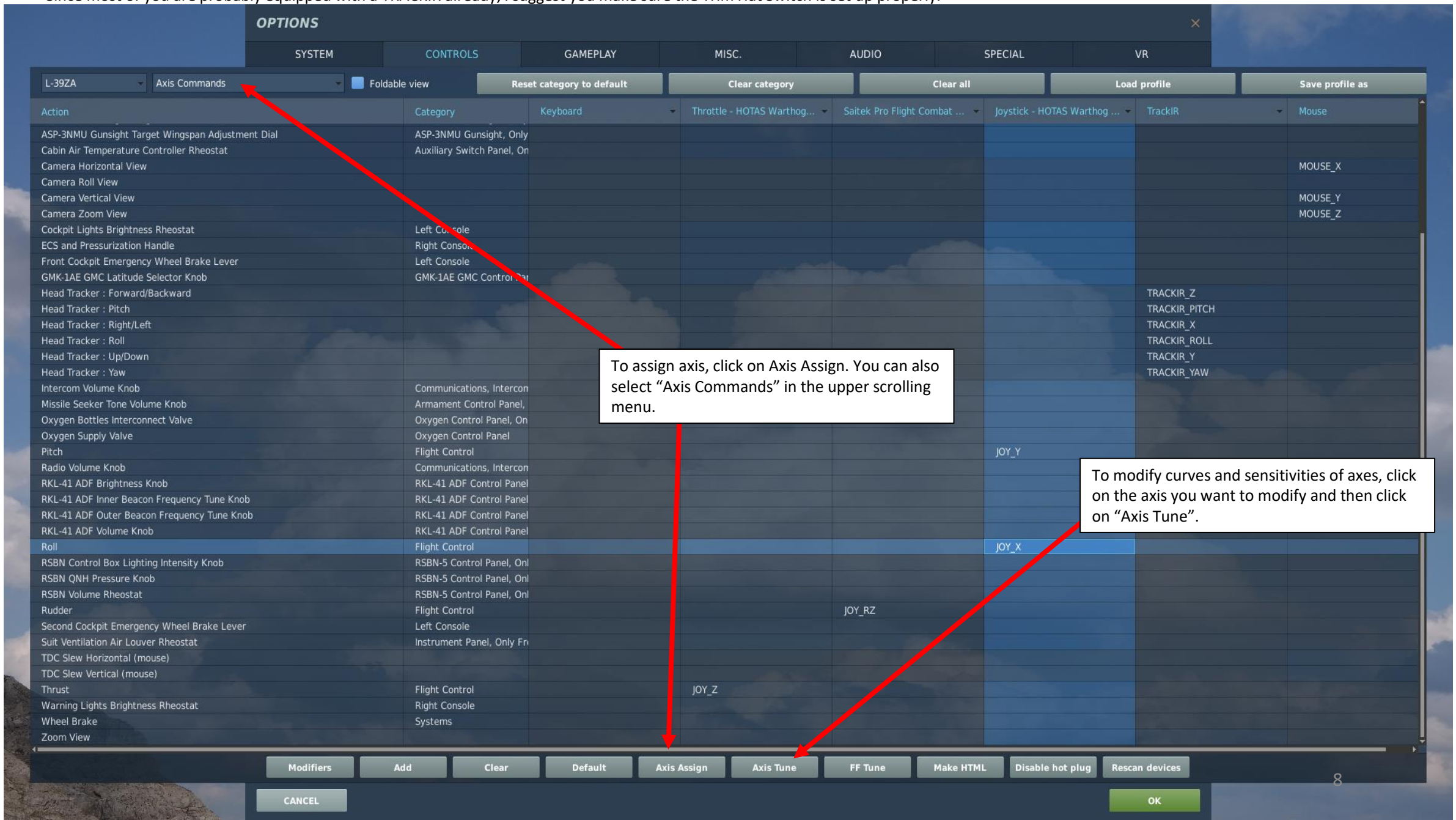
While newer versions are now replacing older L-39s in service, thousands remain in active service as trainers, and many are finding new homes with private warbird owners all over the world. It has been claimed that the L-39's desirability stems from the fact that it is "the only available second-generation jet trainer". This trend is particularly evident in the United States, where their $200,000–$300,000 price puts them in range of moderately wealthy pilots looking for a fast, agile personal jet. Their popularity led to a purely L-39 Jet class being introduced at the Reno Air Races in 2002, though it has since been expanded to include other, similar aircraft.

Despite being initially underwhelmed by the “trainer” aspect of the L-39 (after all, this is no Su-27 or F-15), this jet rapidly grew on me and helped me learn a tremendous amount of things about flying. Unless your name is Chuck Yeager, the Albatros will teach you much more than you’d expect, I guarantee it. Being a good “virtual” pilot does not necessarily equate to getting kills online… it also means that you have a thorough understanding of the inner workings of aircraft instruments and navigation systems.

The L-39 is the embodiment of my philosophy about flight simulators: **ANY** aircraft can be enjoyable to fly if you give it a chance.

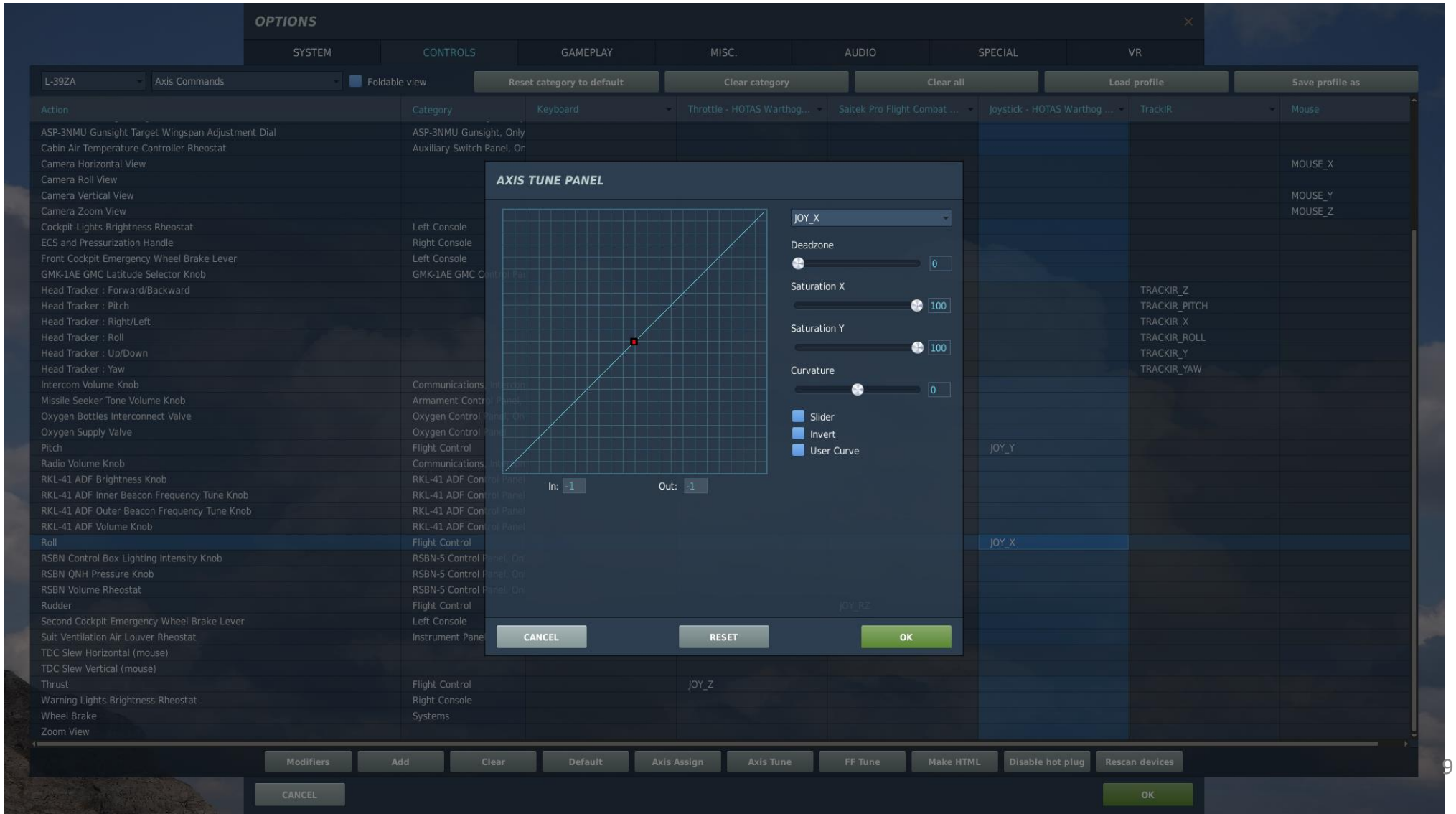
WHAT YOU NEED MAPPED

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



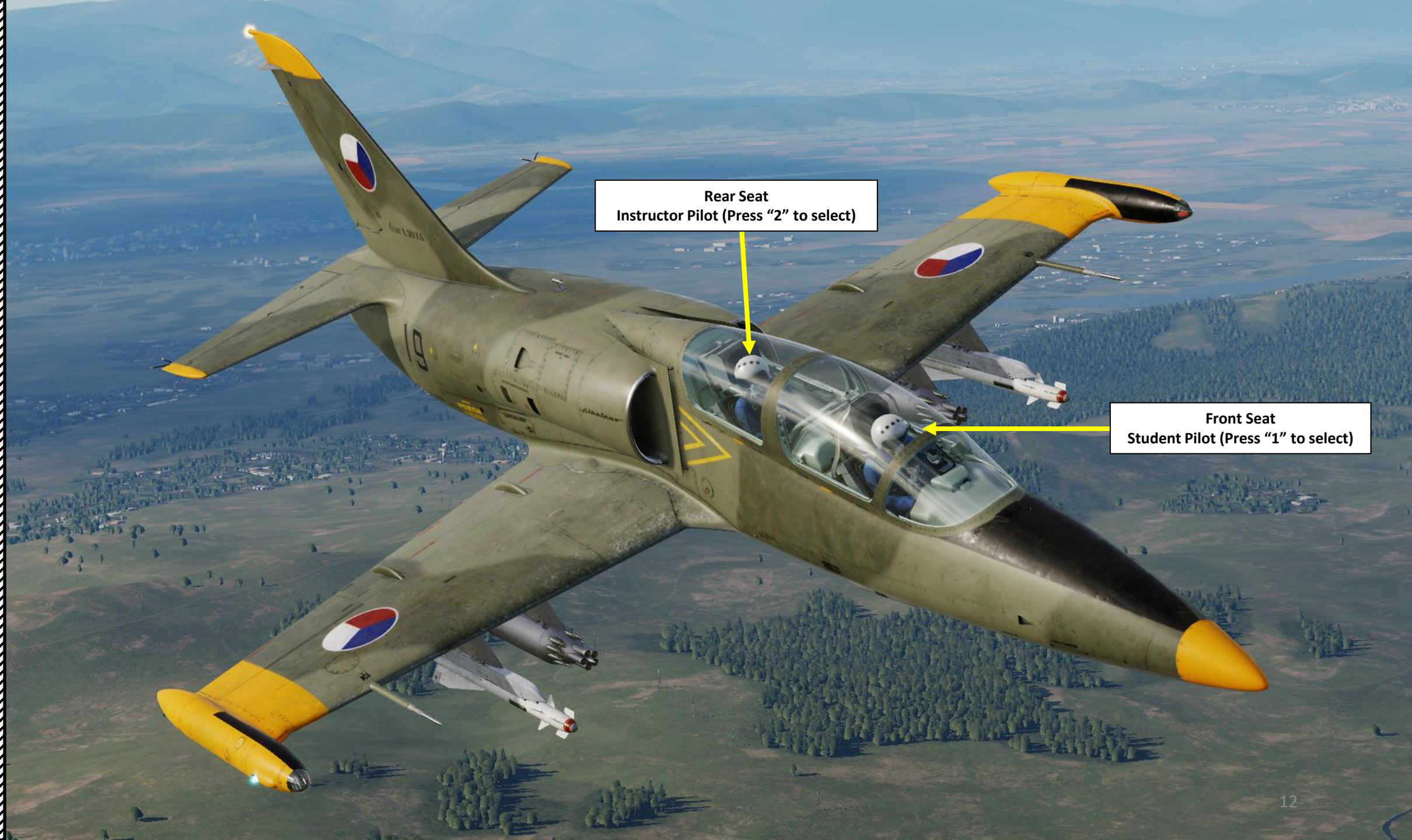
Bind the following axes:

- PITCH (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 0)
- ROLL (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 0)
- RUDDER (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 0)
- THRUST – THROTTLE CONTROLS ENGINE RPM



In the Special Options tab, you can choose cockpit languages and if the gun camera and SARPP (Flight Recorder) are active or not.


L-39C
C for Cvičná – Training
Trainer Variant
2 x Pylons
L-39ZA
Z for Zbraně – Weapons
Attack Variant
4 x Pylons
1 x Cannon


Rear Seat
Instructor Pilot (Press “2” to select)
Front Seat
Student Pilot (Press “1” to select)

1 Nose cone
2 External pressure gauge
3 Access panel
4 Antennae
5 Nose bay access doors (port and starboard)
6 Nosewheel well
7 Main radio equipment (RTL-11 VHF and intercom; RKL-41 radio-compass; MRP-56-P/S marker-beacon receiver and IFF)
8 Air cylinders
9 Nosewheel leg
10 Axle fork
11 Forward-retracting nosewheel
12 Oleo-pneumatic shock-absorber
13 Nosewheel centering jack
14 Fuselage skin
15 Forward pressure bulkhead
16 Instrument panel shroud
17 Curved one-piece windshield
18 ASP-3-NMU-39 gunsight

19 Individual canopies (hinged to starboard)
20 Control column
21 Forward port console (throttle)
22 Rudder pedals
23 Control linkage
24 Retractable entry steps
25 Control rods
26 Canopy release
27 Front zero-height ejection seat
28 Rear instrument panel shroud
29 Rear starboard console
30 Tail surface controls

31 Aileron control linkage
32 Canopy release
33 Rear zero-height ejection seat
34 Rear pressure bulkhead
35 All-metal stressed-skin wing
36 Rocket pod (16× unguided rockets)
37 Starboard weapons pylon
38 Starboard pitot head
39 Starboard landing light
40 Non-jettisonable wingtip fuel tank
41 Fuel dump
42 Starboard aileron
43 Aileron trim tab
44 Trailing-edge fence
45 Flap track fairing
46 Double-slotted flaps
47 Starboard intake
48 Starboard saddle tank (rubber bag-type)
49 Main fuel filler cap
50 Main fuselage fuel tank (rubber bag-type)
51 Intake splitter plate
52 Port intake

53 Flap control linkage
54 Port saddle tank (rubber bag-type)
55 Auxiliary intakes
56 3,792-lb st (1 720-kgp) Walter Titan (Motorlet-built Ivchenko AI-25-TL) turbofan
57 Engine upper mounting
58 Control runs
59 Semi-monocoque fuselage construction
61 Tailfin root fairing
61 Rudder linkage
62 Tailfin structure
63 Variable-incidence tailplane
64 Starboard elevator
65 Fin tip
66 Rear navigation light
67 Rudder
68 Rudder central hinge
69 Rudder trim tab
70 Exhaust outlet

71 Elevator trim tab (port only)
72 Port elevator
73 RV-5 radio-altimeter antenna (port and starboard)
74 Port tailplane
75 Elevator actuator
76 Elevator control linkage
77 Tailplane root fillet

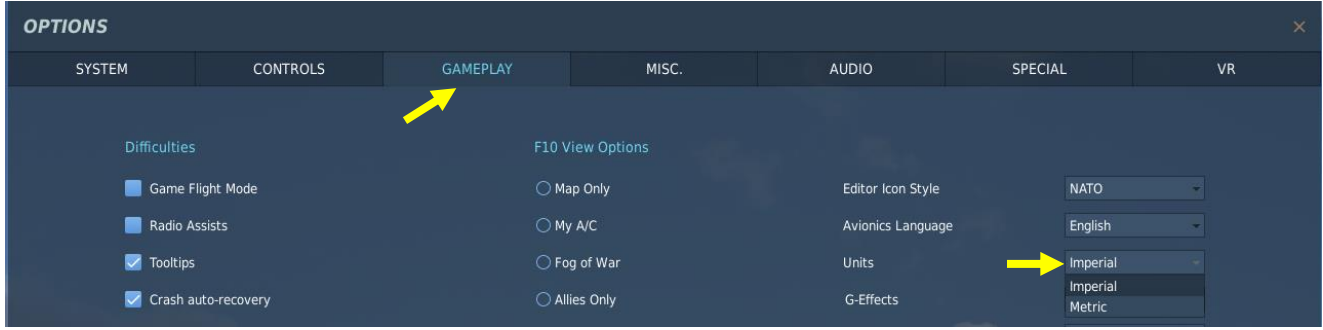
78 Tailpipe
79 APU
80 APU exhaust
81 Engine accessories bay
82 Wingroot fillet
83 Double-slotted flaps
84 Flap track fairings
85 Flap actuating mechanism
86 Undercarriage leg pivot
87 Hydraulic retraction cylinder
88 Port mainwheel well
89 Mainwheel leg fairing
90 Aileron control rod

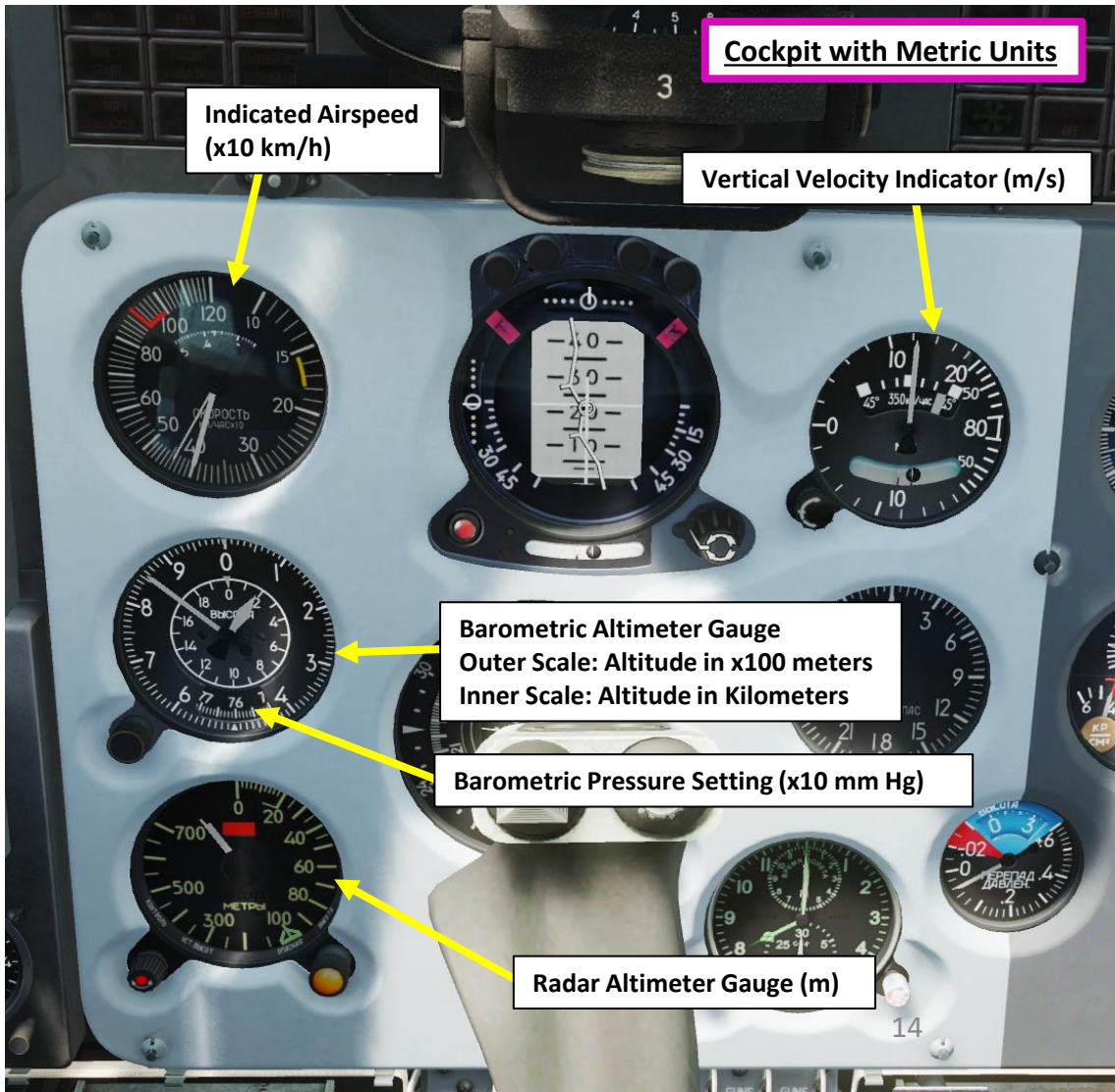
91 Wingroot fillet
92 Ventral airbrakes (two)
93 Port mainwheel
94 Port weapons pylon
95 Guided missile installation
96 Port pitot head
97 Aileron linkage
98 Electrical/fuel leads
99 Aileron actuation mechanism
100 Trailing-edge fence
101 Aileron trim tab
102 Port aileron
103 Non-jettisonable wingtip fuel tank
104 Port navigation light
105 Port landing light

Aero L 39

Note: the instrument gauge units will change depending on which Units Setting you have selected in the Gameplay tab.

For simplicity, we will **use the metric cockpit as a visual reference** but **procedures will include both imperial and metric units**.





L-39ZA


19
POZOR


L-39ZA
Front Seat

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


L-39ZA
Front Seat
GYRO
FIXED
BRIGHT

L-39ZA
Front Seat

PART 3 – COCKPIT & EQUIPMENT

L-39ZA Front Seat

L-39ZA
Front Seat

Circuit Breakers *(UP=ON/DOWN=OFF)*

- **Air Conditioning**
- **Anti-Ice System**
- **Stand-by (Left) Pitot Tube**
- **Main (Right) Pitot Tube**
- **PT-500C Inverter**
- **ARK - RKL-41 ADF**
- **SRO-2M IFF transponder**
- **Seat Helmet**

RT-12 JPT Regulator (EGT Limiter) Power Switch

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

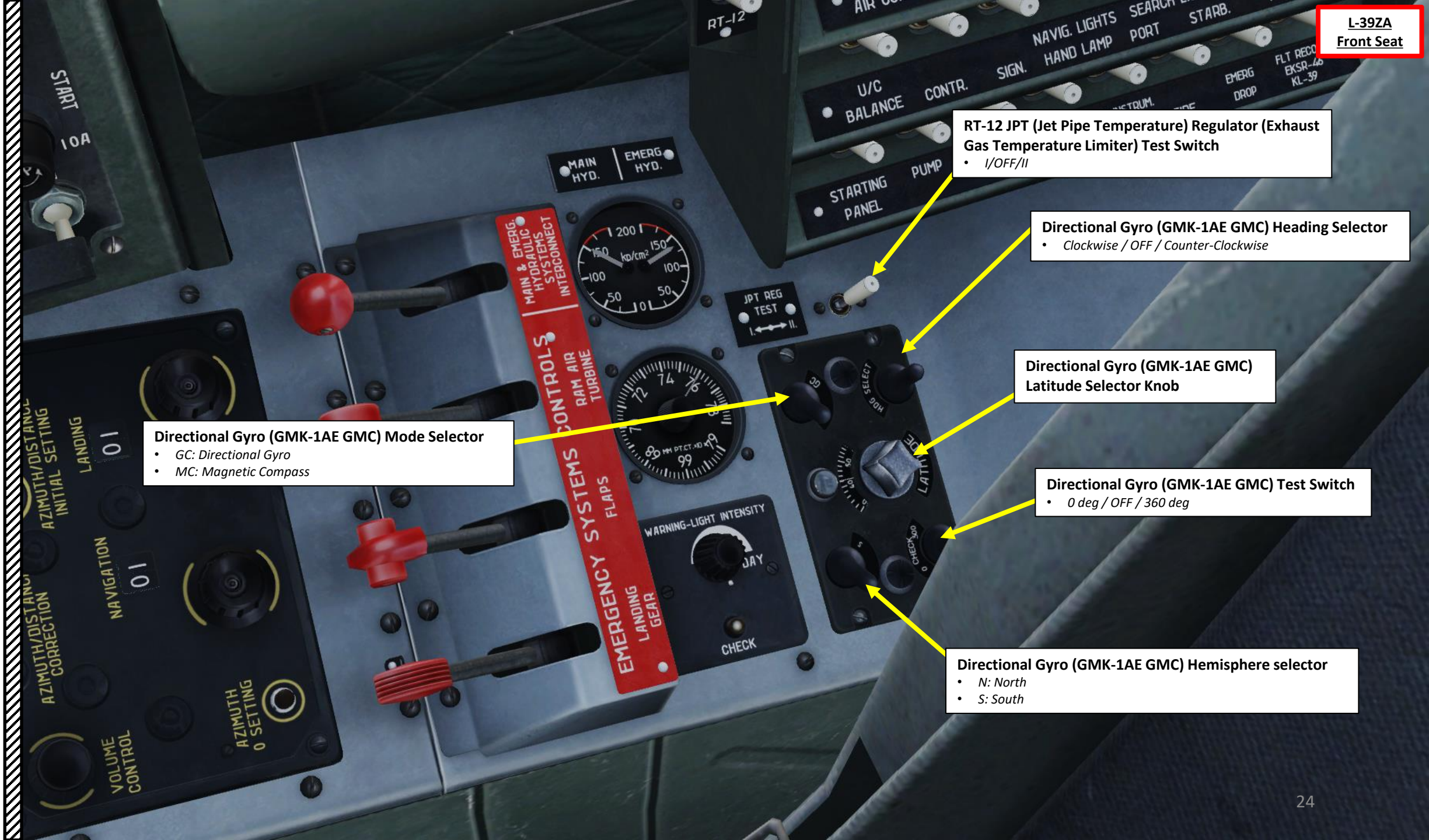
Circuit Breakers *(UP=ON/DOWN=OFF)*

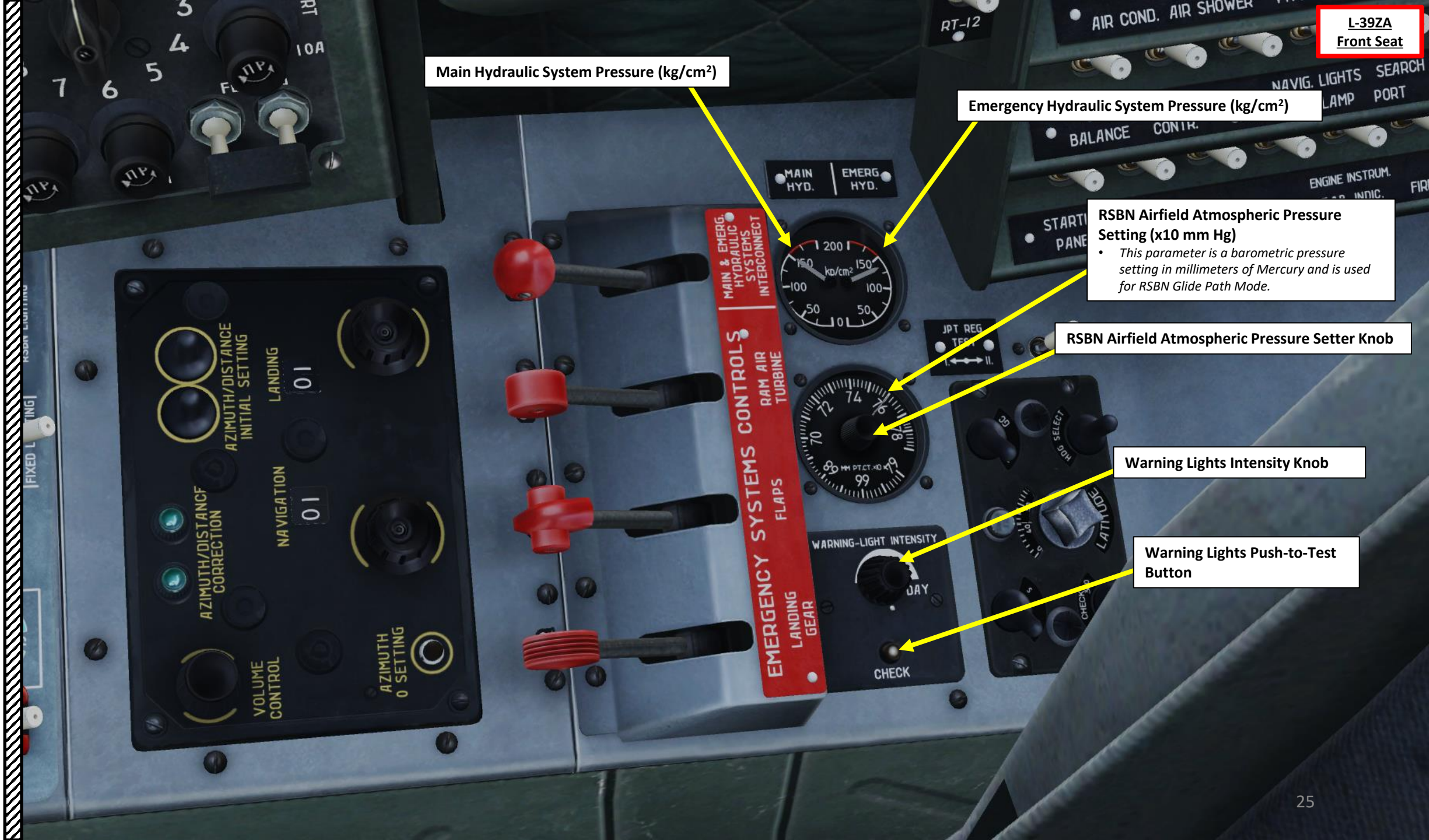
- **U/C Balance (aileron & elevator trimmer, landing gear and flaps indications)**
- **CONTR (flaps, brake and airbrake control)**
- **SIGN (indicator lamps on front cockpit)**
- **Navigation lights hand lamp (floodlights + nav lights)**
- **Search lights portside**
- **Search lights starboard**
- **Cockpit lighting – red floodlights**
- **Cockpit lighting – white floodlights**

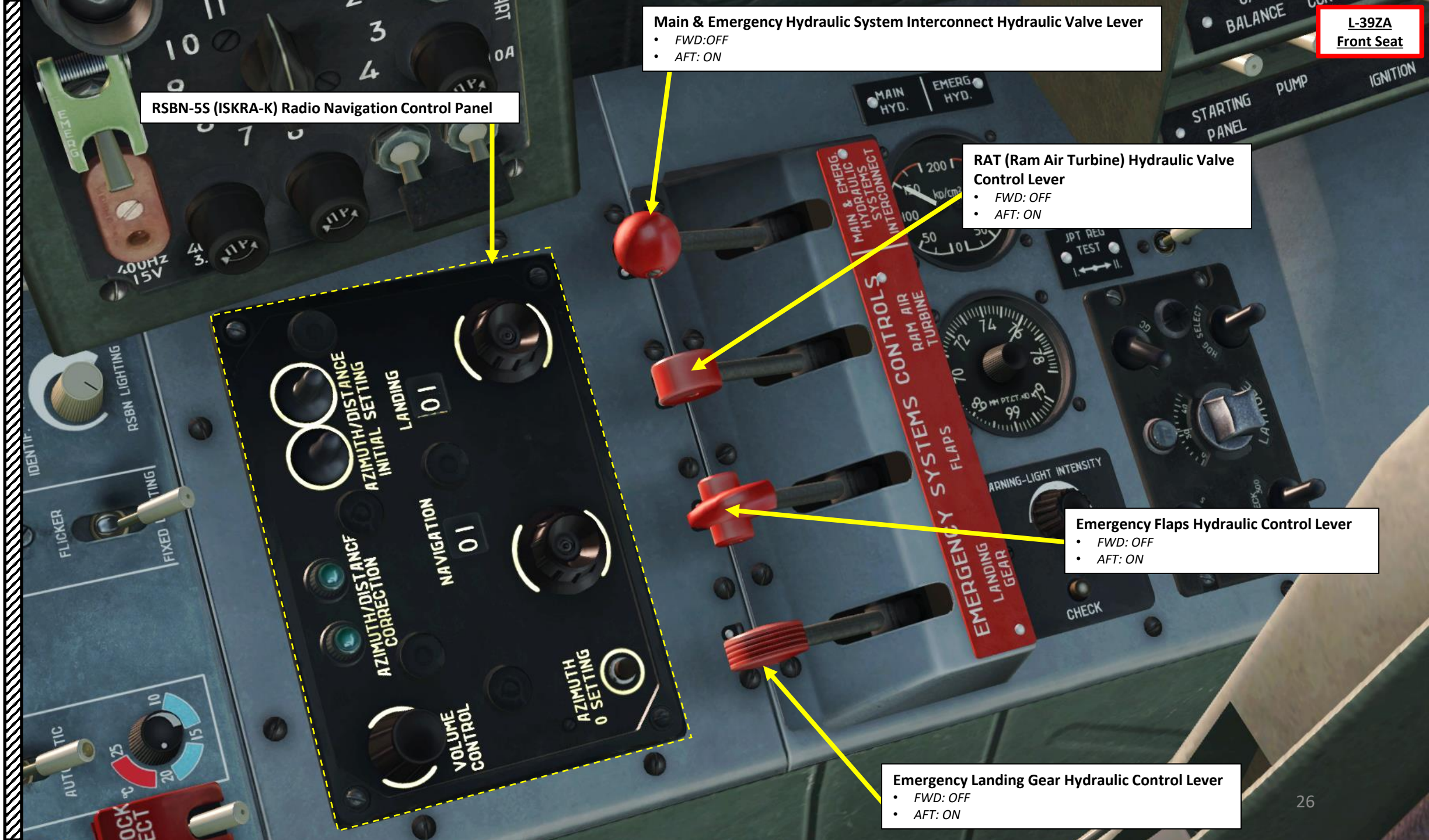
Circuit Breakers *(UP=ON/DOWN=OFF)*

- **Engine starting Panel**
- **Engine fuel pump**
- **Engine Ignition CB #1**
- **Engine Ignition CB #2**
- **SPT-40 Inverter - Engine Instruments**
- **Fire Extinguishing System**
- **Emergency Jettison**
- **EKSR-46 Flare Launcher, KL-39 Ejection System and SARPP-12GM Flight Data Recorder**

L-39ZA Front Seat

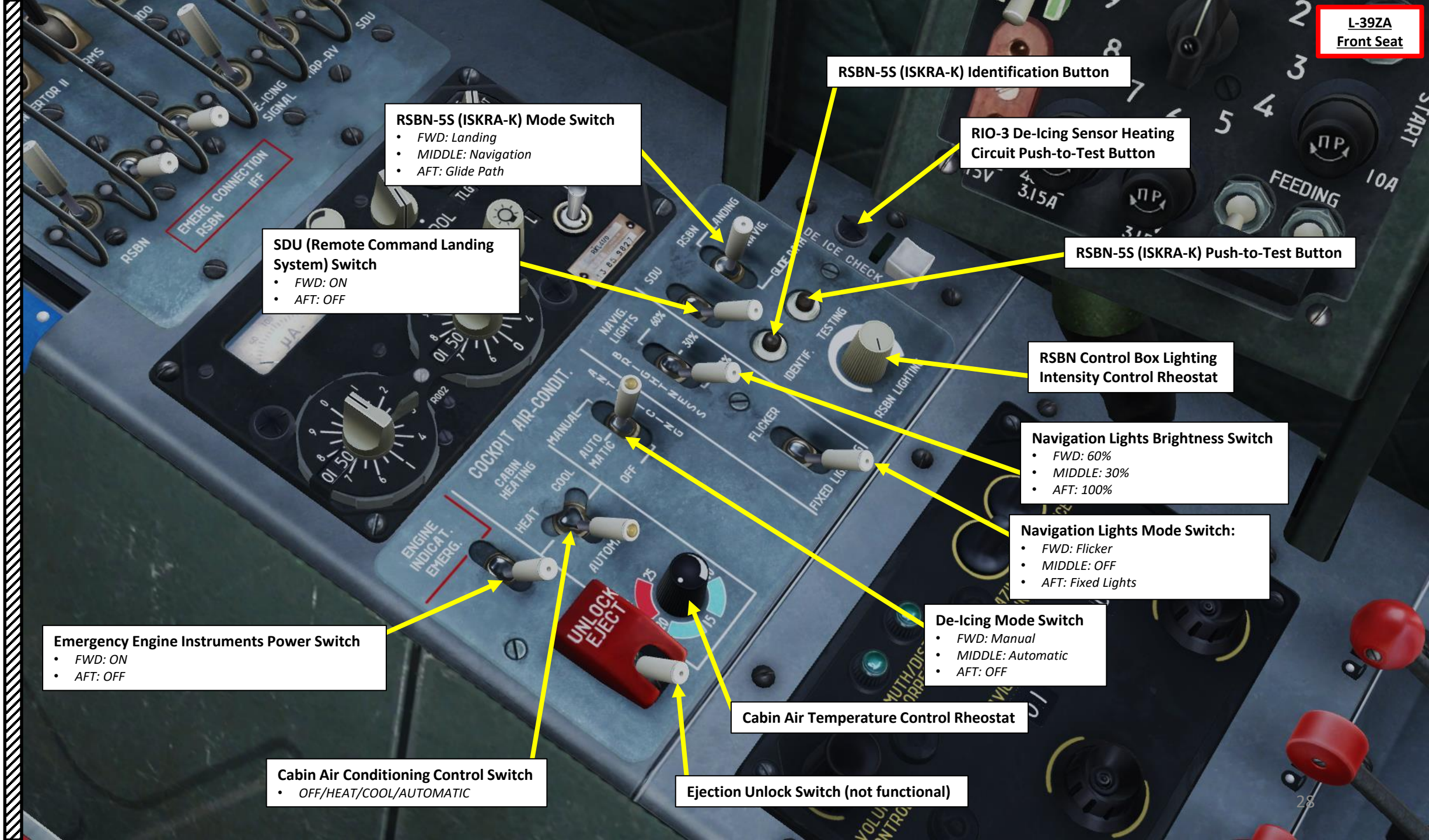



L-39ZA Front Seat
Main Hydraulic System Pressure (kg/cm²)
Emergency Hydraulic System Pressure (kg/cm²)
RSBN Airfield Atmospheric Pressure Setting (x10 mm Hg)
• This parameter is a barometric pressure setting in millimeters of Mercury and is used for RSBN Glide Path Mode.
RSBN Airfield Atmospheric Pressure Setter Knob
Warning Lights Intensity Knob
Warning Lights Push-to-Test Button
MAIN HYD.
EMERG HYD.
MAIN & EMERG. HYDRAULIC SYSTEMS INTERCONNECT
EMERGENCY SYSTEMS CONTROLS
LANDING GEAR
FLAPS
RAM AIR TURBINE
WARNING-LIGHT INTENSITY
DAY
CHECK
AZIMUTH/DISTANCE INITIAL SETTING
LANDING
NAVIGATION
AZIMUTH/DISTANCE CORRECTION
VOLUME CONTROL
AZIMUTH 0 SETTING
AIR COND. AIR SHOWER
BALANCE CONTR.
NAVIG. LIGHTS
SEARCH LAMP
PORT
ENGINE INSTRUM.
JPT REG
RT-12


L-39ZA Front Seat
Main & Emergency Hydraulic System Interconnect Hydraulic Valve Lever
• FWD:OFF
• AFT: ON
RSBN-5S (ISKRA-K) Radio Navigation Control Panel
RAT (Ram Air Turbine) Hydraulic Valve Control Lever
• FWD: OFF
• AFT: ON
Emergency Flaps Hydraulic Control Lever
• FWD: OFF
• AFT: ON
Emergency Landing Gear Hydraulic Control Lever
• FWD: OFF
• AFT: ON
AZIMUTH/DISTANCE INITIAL SETTING
LANDING
NAVIGATION
AZIMUTH/DISTANCE CORRECTION
VOLUME CONTROL
AZIMUTH 0 SETTING
MAIN HYD.
EMERG HYD.
MAIN & EMERG HYDRAULIC SYSTEMS INTERCONNECT
EMERGENCY SYSTEMS CONTROLS
RAM AIR TURBINE
FLAPS
LANDING GEAR
STARTING PANEL
PUMP
IGNITION
BALANCE
TEST
RSBN LIGHTING
FLICKER
CHECK


IFF (Identify-Friend-or-Foe) Panel (not simulated)
RKL-41 ADF (Automatic Direction Finder) Control Panel
FEED.CHECK
CODE ON
VOLT. REG.
START
FEEDING
10A
400Hz
15V
3.15A
3.15A
CONTROL
COCKPIT AIR-CONDIT.
UNLOCK
EJECT
AZIMUTH/DISTANCE
CORRECTION
AZIMUTH/DISTANCE
INITIAL SETTING
LANDING
NAVIGATION
MAIN & EMERG.
HYDRAULIC
SYSTEMS
INTERCONNECT

L-39ZA Front Seat



L-39ZA Front Seat

Note
The switches on this panel are called **ACBs** (Automatic Circuit Breakers), or "A3C" in russian. They act as both switches and individual circuit breakers at once.

AGD-GMK Directional Gyro ACB Switch
- *FWD=ON/AFT=OFF*

AoA (Angle of Attack) Sensor Heater ACB Switch
- *FWD=ON/AFT=OFF*

Engine ACB Switch
- *FWD=ON/AFT=OFF*

RDO (Intercom Switch and Radio) ACB Switch
- *FWD=ON/AFT=OFF*

Emergency Generator ACB Switch
- *FWD=ON/AFT=OFF*

External Fuel Drop Tank & Wingtip Tank Status Indication System ACB Switch
- *FWD=ON/AFT=OFF*

Main Generator ACB Switch
- *FWD=ON/AFT=OFF*

SDU (Remote Command Landing System) ACB Switch:
- *FWD=ON/AFT=OFF*

Battery ACB Switch
- *FWD=ON/AFT=OFF*

MRP-RV (Marker Beacon Receiver and Radio Altimeter) ACB Switch
- *FWD=ON/AFT=OFF*

RIO-3 De-Icing Signal ACB Switch
- *FWD=ON/AFT=OFF*

Weapons (ARMS) ACB Switch
- *FWD=ON/AFT=OFF*

Inverter 2 ACB Switch
- *FWD=ON/AFT=OFF*

IFF (Identify-Friend-or-Foe) SRO Transponder Emergency Connection ACB Switch
- *FWD=ON/AFT=OFF*

Inverter 1 ACB Switch
- *FWD=ON/AFT=OFF*

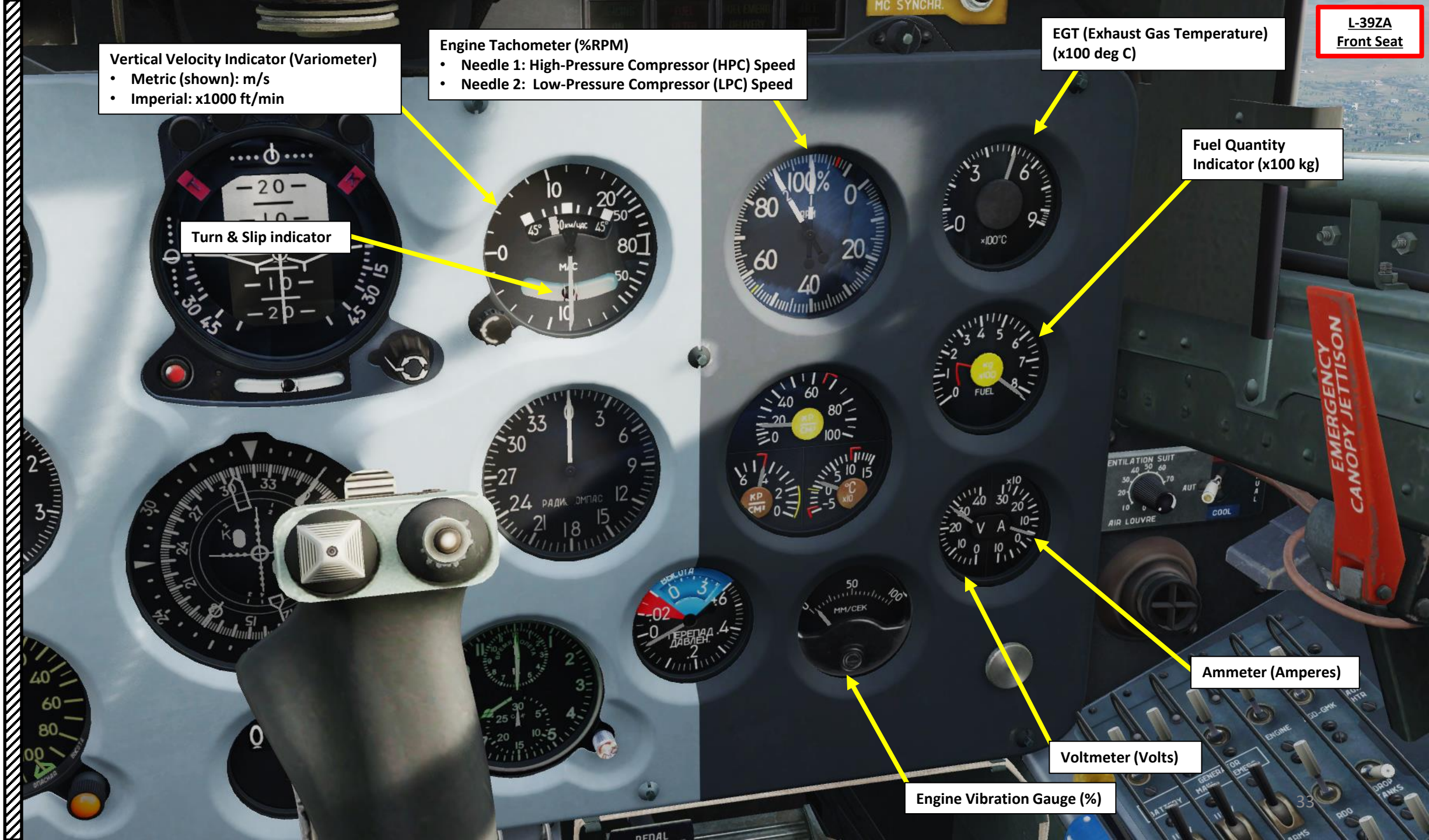
RSBN-5S (ISKRA-K) Emergency Connection ACB Switch
- *FWD=ON/AFT=OFF*

RSBN-5S (ISKRA-K) ACB Switch
- *FWD=ON/AFT=OFF*

L-39ZA Front Seat

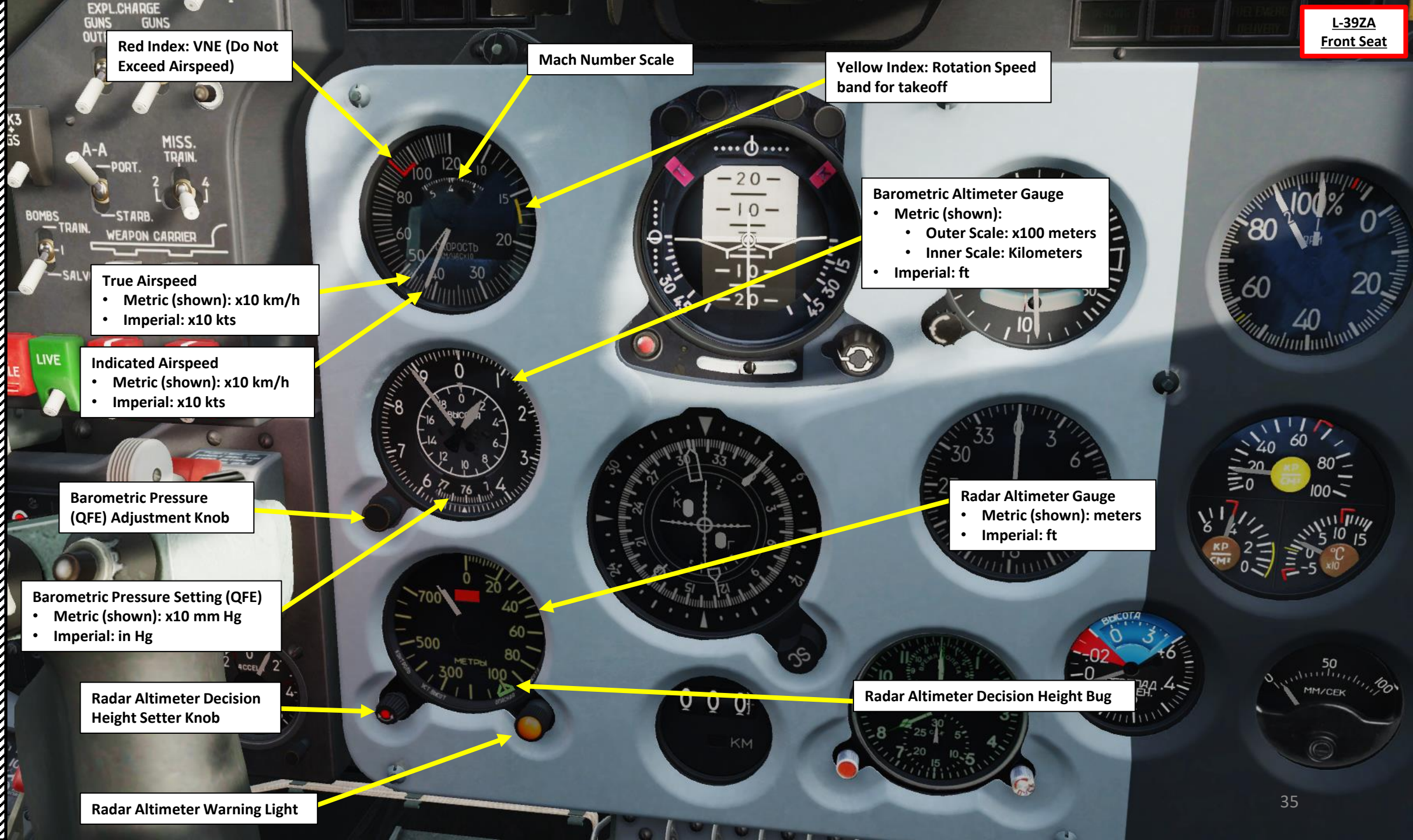

Diffuser and Flight Suit Air Conditioning Control
• HEAT/AUTO/COOL
Diffuser and Flight Suit Temperature Rheostat (deg C)
Air Conditioning Outlet
ECS (Environmental Control System) and Pressurization Control Handle
• FWD: ON
• AFT: OFF
HEAT
COOL
AUT
AIR LOUVRE
FUEL
MM/CEK
CONTROL
COCKPIT PRESSURIZATION


L-39ZA
Front Seat
EMERG. LIGHT
GYRO
FIXED
BRIGHT
PYRO
EXPL.CHARGE GUNS OUTER
GUNS INNER
EXPL.CHARGE GS
PK3 GS
A-A
PORT.
STARB.
MISS. TRAIN.
BOMBS TRAIN.
SALVO
WEAPON CARRIER
EMERGENCY
AA MISSILE
LIVE
EMERGENCY CANOPY JETTISON

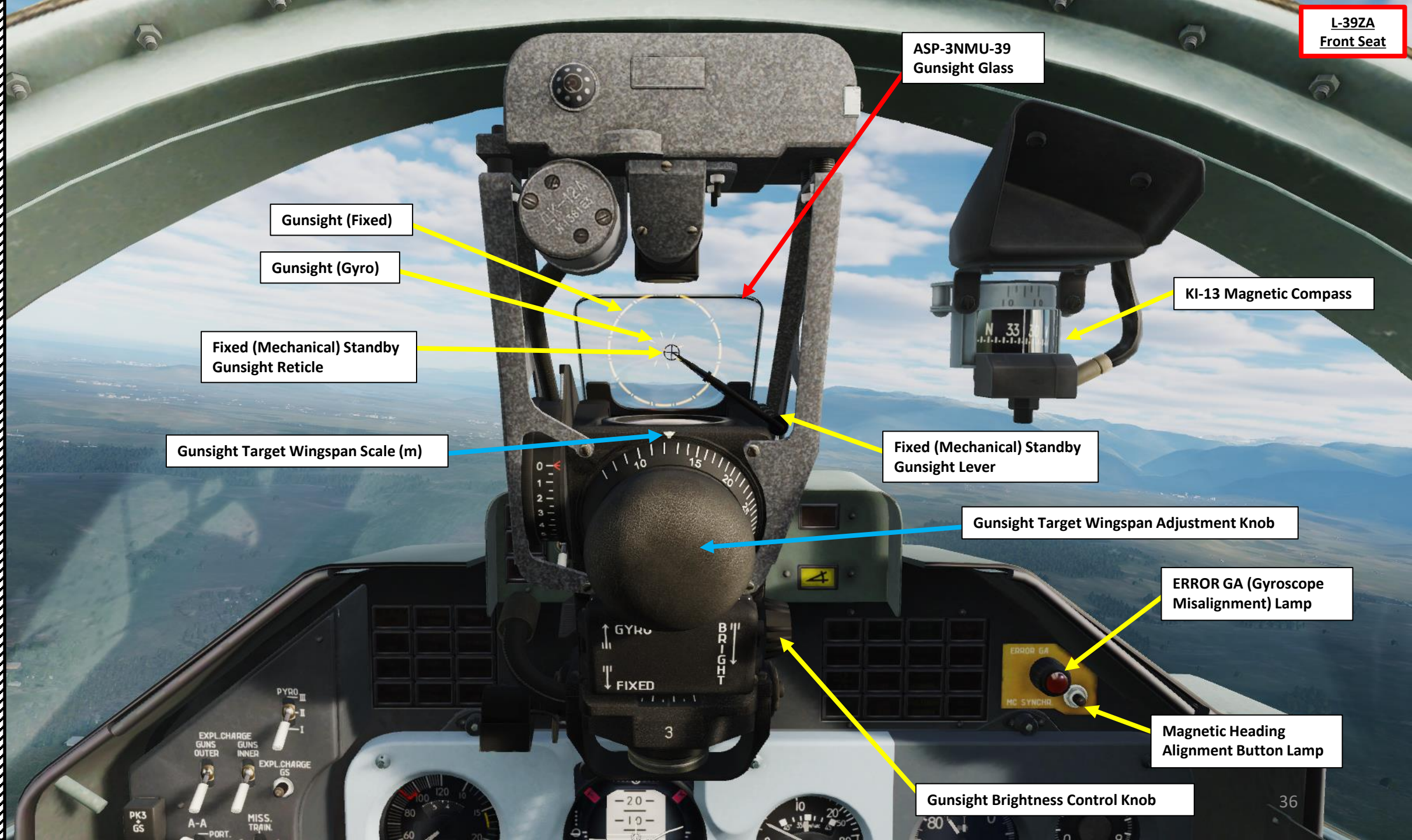

Vertical Velocity Indicator (Variometer)
• Metric (shown): m/s
• Imperial: x1000 ft/min
Engine Tachometer (%RPM)
• Needle 1: High-Pressure Compressor (HPC) Speed
• Needle 2: Low-Pressure Compressor (LPC) Speed
EGT (Exhaust Gas Temperature) (x100 deg C)
Fuel Quantity Indicator (x100 kg)
Turn & Slip indicator
Ammeter (Amperes)
Voltmeter (Volts)
Engine Vibration Gauge (%)
EMERGENCY CANOPY JETTISON


L-39ZA
Front Seat
Radio Magnetic Indicator (RMI)
Attitude Directional Indicator (ADI)
RKL-41 Automatic Direction Finder (ADF) Gauge
Fuel Pressure (kg/cm²)
Oil Temperature (deg C)
Oil Pressure (kg/cm²)
Cockpit Altitude and Pressure Difference Gauge
Clock
RSBN Range Indicator (km)

L-39ZA
Front Seat



L-39ZA Front Seat




FKP-2-2 Gun Camera
Gun Camera Operating Control Disk
L-39ZA Front Seat
GYRO
FIXED
BRIGHT
Gunsight Target Range (x100 m) (Controlled by Twist Grip on Throttle)
ERROR GA
MC SYNCHR.

L-39ZA Front Seat

L-39ZA Front Seat

Master Caution Light

AoA Signal Warning Light

- *Indicates that the allowable Angle of Attack is exceeded and/or the airspeed decreases below 400 km/h when equipped with a missile*

Caution & Advisory Panel

DROP TANKS *External fuel drop tanks are empty.*	**WING TIP TANKS** *Wing tip fuel tanks are empty. When the wingtip tanks run out of fuel and the WING TIP TANKS indicator illuminates, it is necessary to switch off the DROP TANKS automatic circuit breaker on the main CB panel in the front cockpit.*	**END OF DESCENT** *Aircraft is over termination point of descent when using RSBN-5S "ISKRA-K" Short Range Navigation System*	**INV 3x36V FAIL** *Inverter Failure.*
AIRCONDIT EMERG *Air conditioning temperature regulator is in emergency mode. This is controlled by the air conditioning emergency shut-off switch in the rear cockpit, labeled AIR COND, which must be in the neutral position.*	**MARKER** *Aircraft is flying over a marker beacon*	**CONFORM AZIMUTH** *RSBN-5S "ISKRA-K" Short Range Navigation System Azimuth Channel is tuned correctly*	**ENG MIN OIL PRESS** *Oil pressure at 95% of HPC RPM is less than 3 kg/cm², for other engine modes not less than 2 kg/cm².*
Snowflake Symbol *Ice Detected*	**AIRCONDIT OFF** *Air conditioning system is OFF. This advisory appears 30 seconds after the ECS (Environmental Control System) and Pressurization Control Handle is set to OFF (AFT).*	**TURBINE STARTER** *Turbine starter (APU, auxiliary power unit) is running*	**JPT 730 DEG C** *Jet pipe temperature is over 730 deg C*
DE-ICING ON *Anti-Ice system is ON.*	**FUEL FILTER** *Fuel pressure difference is detected on the fuel filter*	**FUEL EMERG DELIVERY** *SEC. REG. (Emergency Fuel) system is ON.*	**JPT 700 DEG C** *Jet pipe temperature is over 700 deg C*

Warning Panel

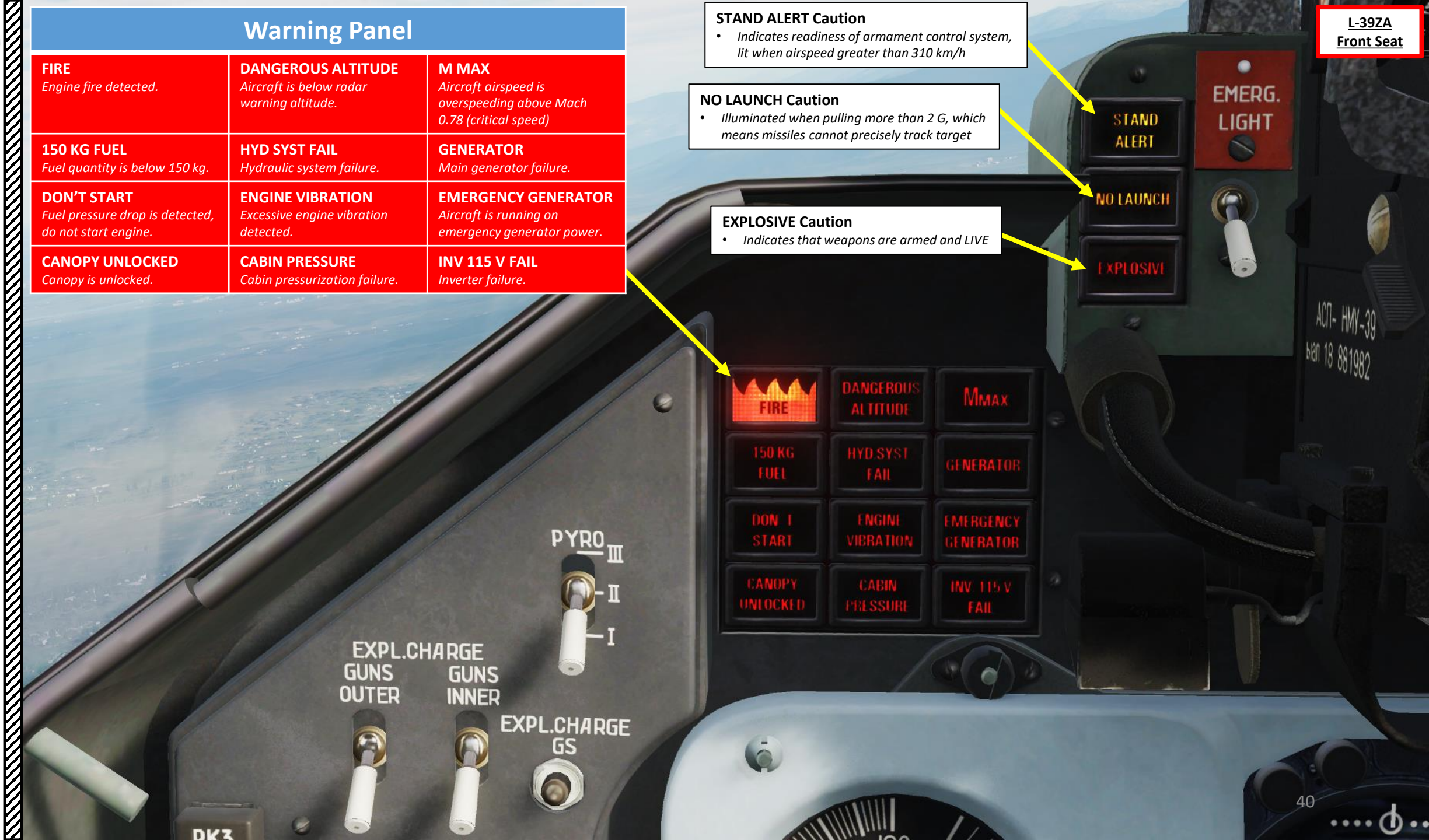
FIRE *Engine fire detected.*	**DANGEROUS ALTITUDE** *Aircraft is below radar warning altitude.*	**M MAX** *Aircraft airspeed is overspeeding above Mach 0.78 (critical speed)*
150 KG FUEL *Fuel quantity is below 150 kg.*	**HYD SYST FAIL** *Hydraulic system failure.*	**GENERATOR** *Main generator failure.*
DON'T START *Fuel pressure drop is detected, do not start engine.*	**ENGINE VIBRATION** *Excessive engine vibration detected.*	**EMERGENCY GENERATOR** *Aircraft is running on emergency generator power.*
CANOPY UNLOCKED *Canopy is unlocked.*	**CABIN PRESSURE** *Cabin pressurization failure.*	**INV 115 V FAIL** *Inverter failure.*

STAND ALERT Caution
- *Indicates readiness of armament control system, lit when airspeed greater than 310 km/h*

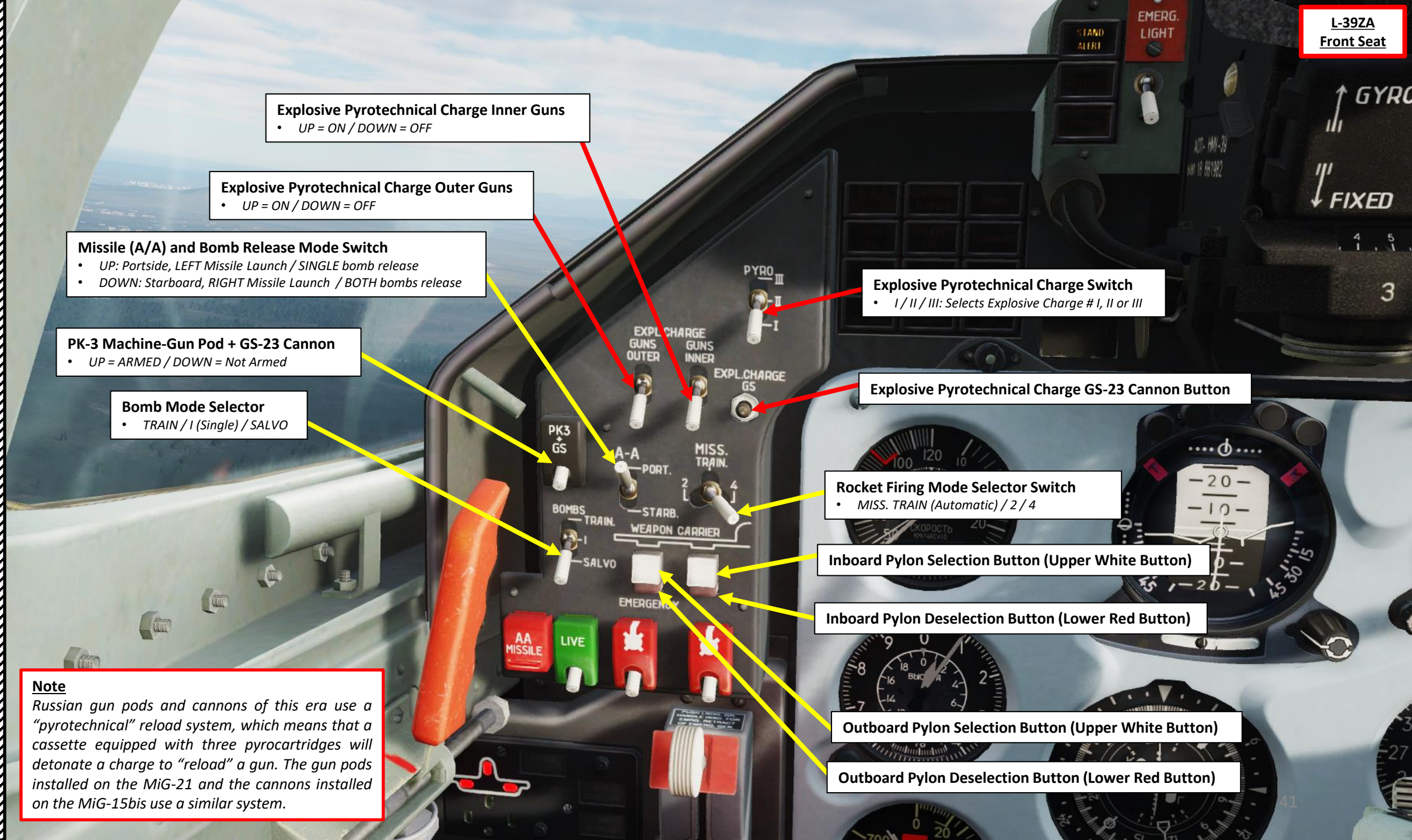
NO LAUNCH Caution
- *Illuminated when pulling more than 2 G, which means missiles cannot precisely track target*

EXPLOSIVE Caution
- *Indicates that weapons are armed and LIVE*

L-39ZA Front Seat



L-39ZA Front Seat



Explosive Pyrotechnical Charge Inner Guns
- *UP = ON / DOWN = OFF*

Explosive Pyrotechnical Charge Outer Guns
- *UP = ON / DOWN = OFF*

Missile (A/A) and Bomb Release Mode Switch
- *UP: Portside, LEFT Missile Launch / SINGLE bomb release*
- *DOWN: Starboard, RIGHT Missile Launch / BOTH bombs release*

PK-3 Machine-Gun Pod + GS-23 Cannon
- *UP = ARMED / DOWN = Not Armed*

Bomb Mode Selector
- *TRAIN / I (Single) / SALVO*

Explosive Pyrotechnical Charge Switch
- *I / II / III: Selects Explosive Charge # I, II or III*

Explosive Pyrotechnical Charge GS-23 Cannon Button

Rocket Firing Mode Selector Switch
- *MISS. TRAIN (Automatic) / 2 / 4*

Inboard Pylon Selection Button (Upper White Button)

Inboard Pylon Deselection Button (Lower Red Button)

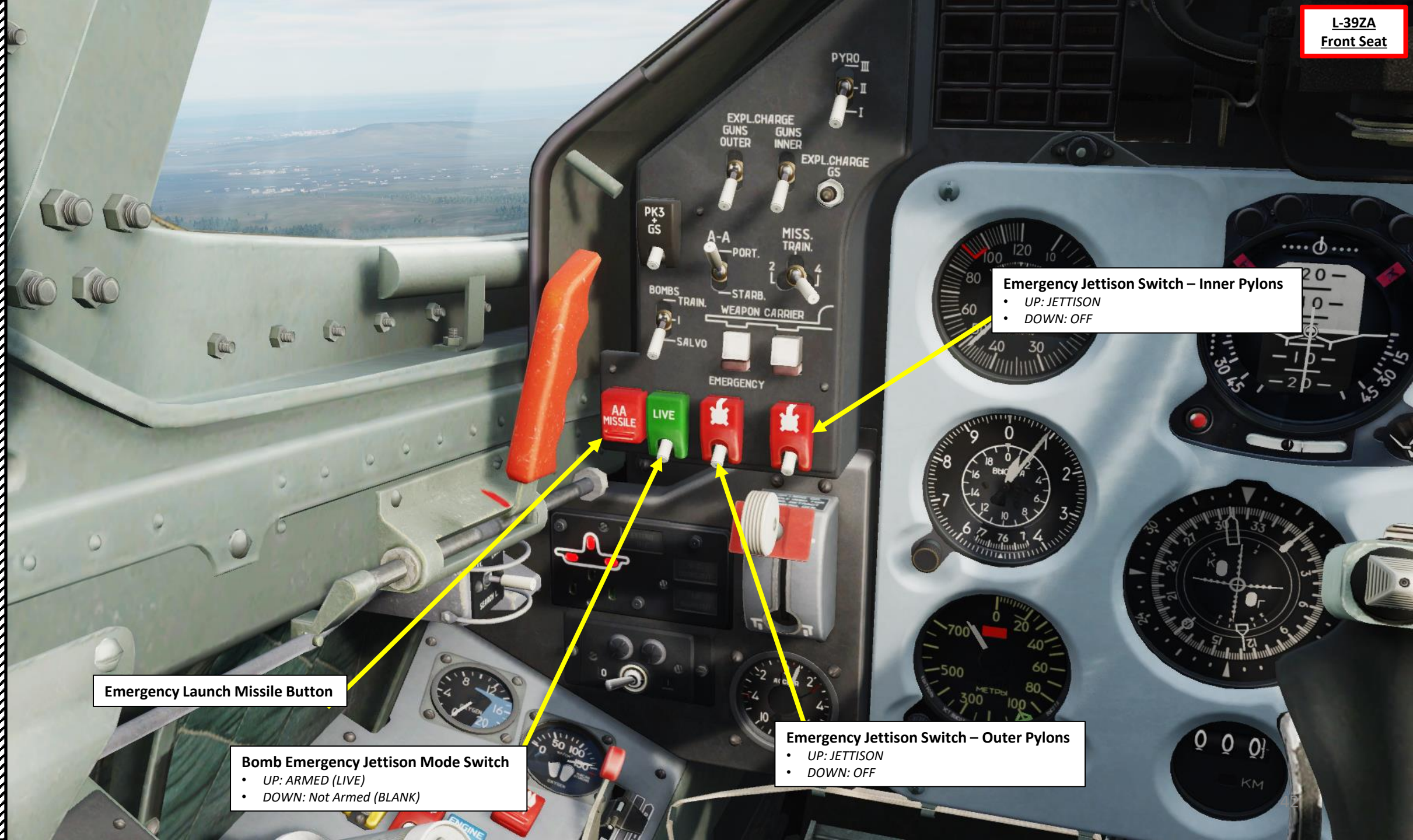
Outboard Pylon Selection Button (Upper White Button)

Outboard Pylon Deselection Button (Lower Red Button)

Note

Russian gun pods and cannons of this era use a "pyrotechnical" reload system, which means that a cassette equipped with three pyrocartridges will detonate a charge to "reload" a gun. The gun pods installed on the MiG-21 and the cannons installed on the MiG-15bis use a similar system.

L-39ZA Front Seat



Emergency Jettison Switch – Inner Pylons
- *UP: JETTISON*
- *DOWN: OFF*

Emergency Launch Missile Button

Bomb Emergency Jettison Mode Switch
- *UP: ARMED (LIVE)*
- *DOWN: Not Armed (BLANK)*

Emergency Jettison Switch – Outer Pylons
- *UP: JETTISON*
- *DOWN: OFF*

L-39ZA Front Seat

Landing Gear Extend Caution Light
- *EXTEND U/C = Flaps are deployed in landing position but landing gear is not deployed*

Landing Gear Door Status Indicator
- *U/C DOORS OUT= DOORS OPEN*

Airbrake Status Indicator
- *AIR BRAKE OUT = DEPLOYED*

Landing Gear Control Lever
- *UP = Retracted*
- *DOWN = Deployed*

Landing Gear Status Indicator
- *RED = RETRACTED*
- *GREEN = DEPLOYED*

Accelerometer (g)

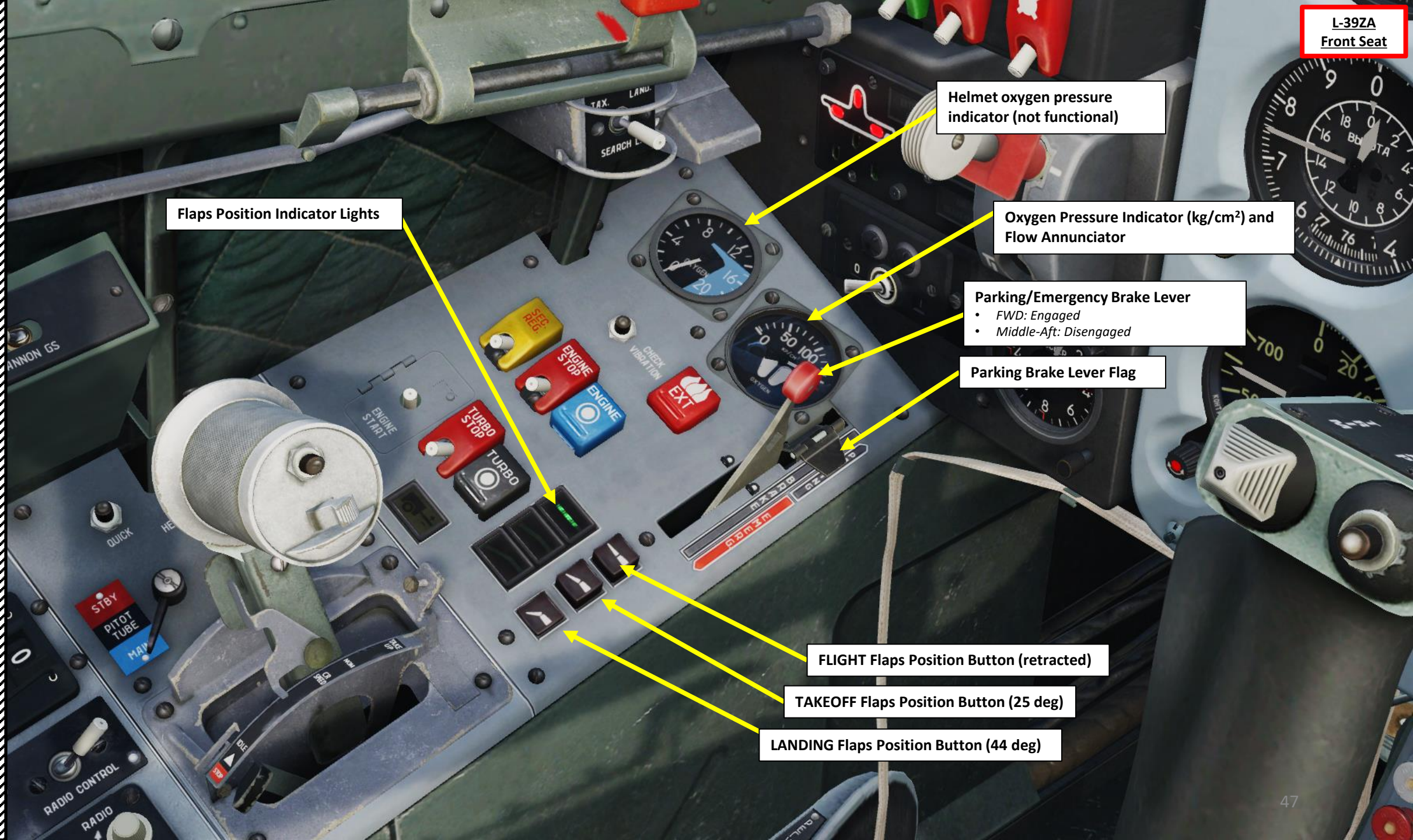
RKL-41 ADF Outer-Inner Beacon Selector (Far-Near NDB switch)
- *O: Outer (Far)*
- *I: Inner (Near)*

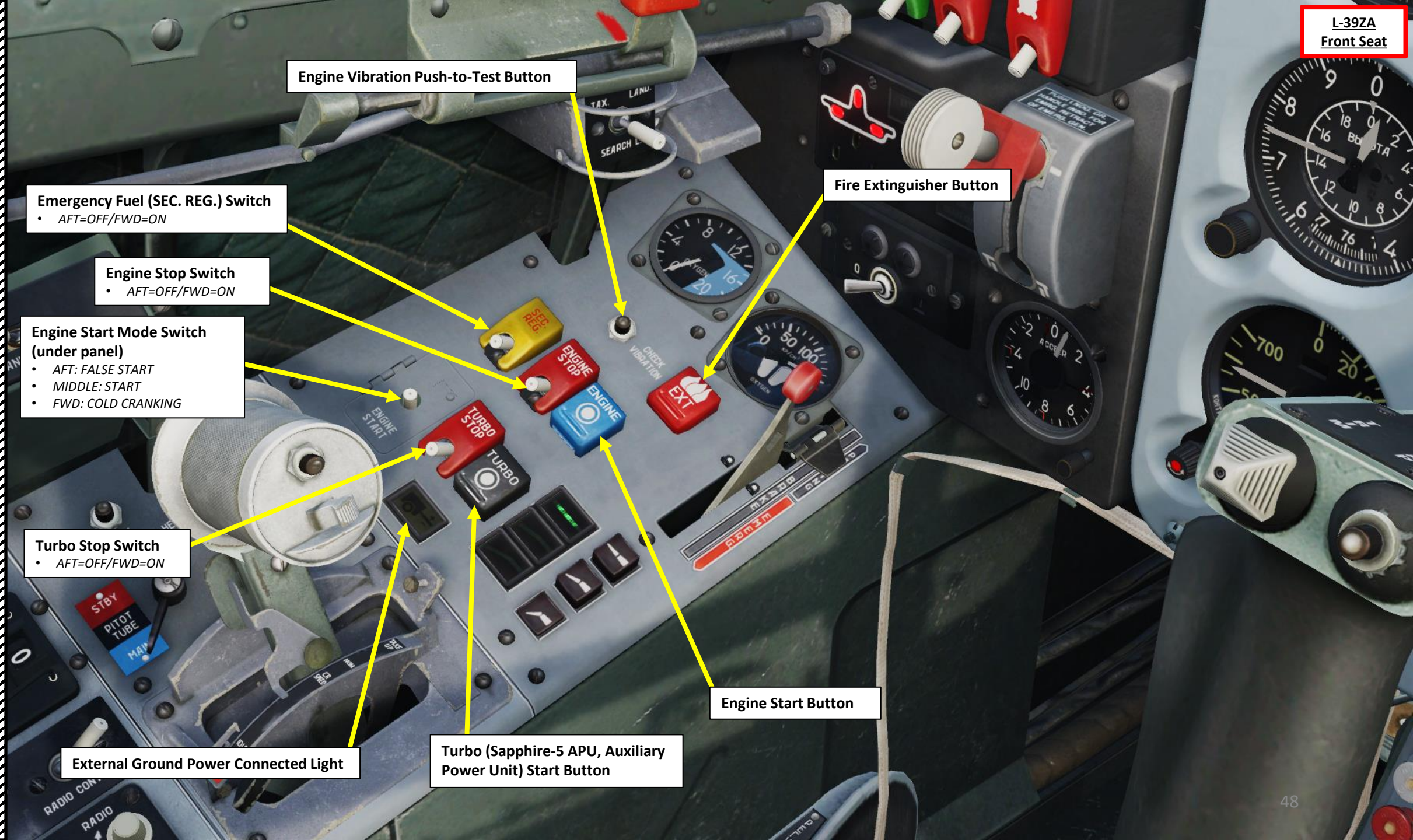
L-39ZA Front Seat


L-39ZA
Front Seat
PK3
GS
A-A
PORT.
STARB.
BOMBS
TRAIN.
SALVO
WEAPON CARRIER
AA
MISSILE
LIVE
EMERGENCY
HEATING ON
SLOWING ON
CANNON GS
RSBN TUNE
OFF
OXYGEN
FUEL SHUTOFF
SHUT
OPEN
INTERCOM
VOLUME
STAND-BY
MAIN
RADIO CONTROL
SQUELCH
TURBO
ENGINE
EXT

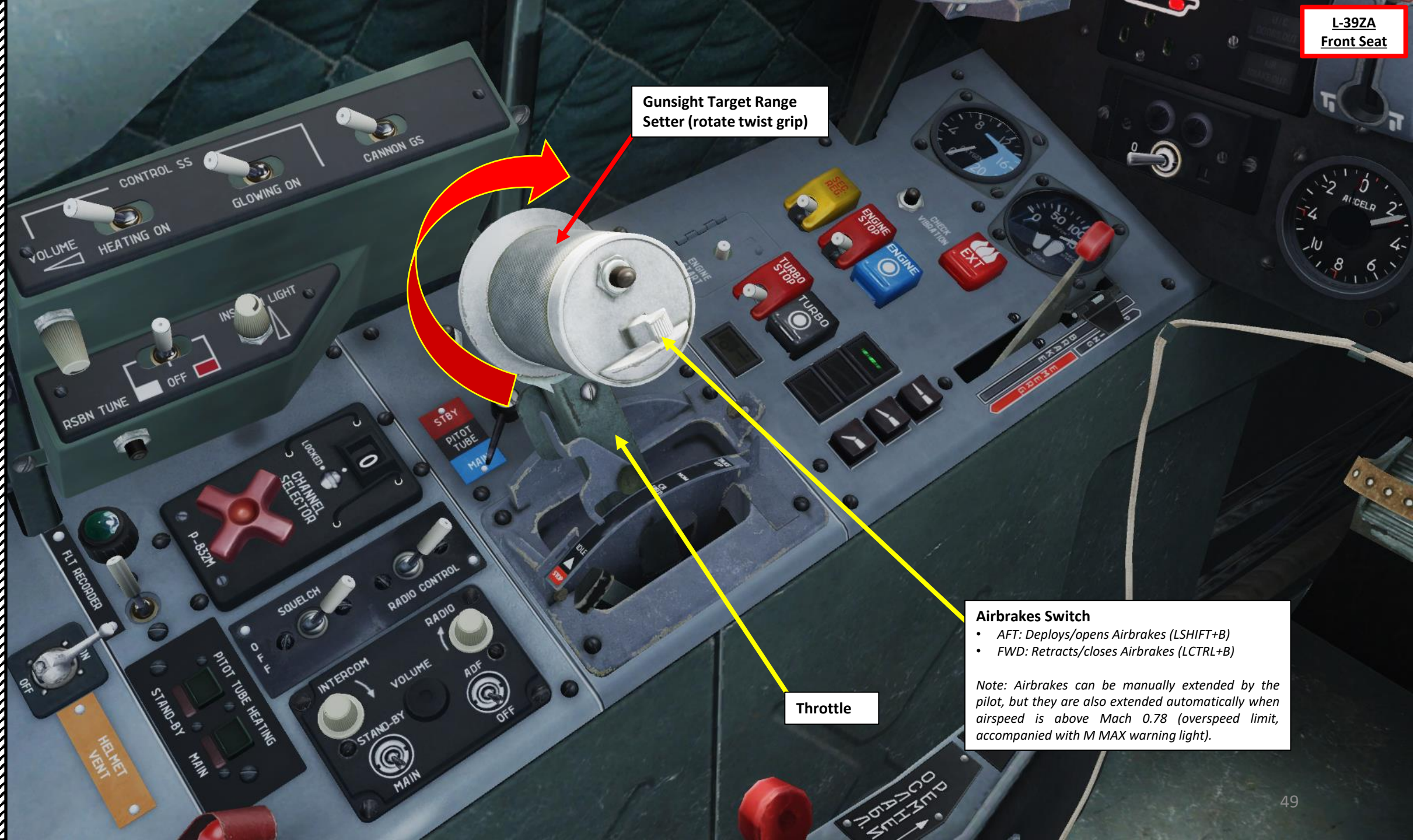
L-39ZA Front Seat

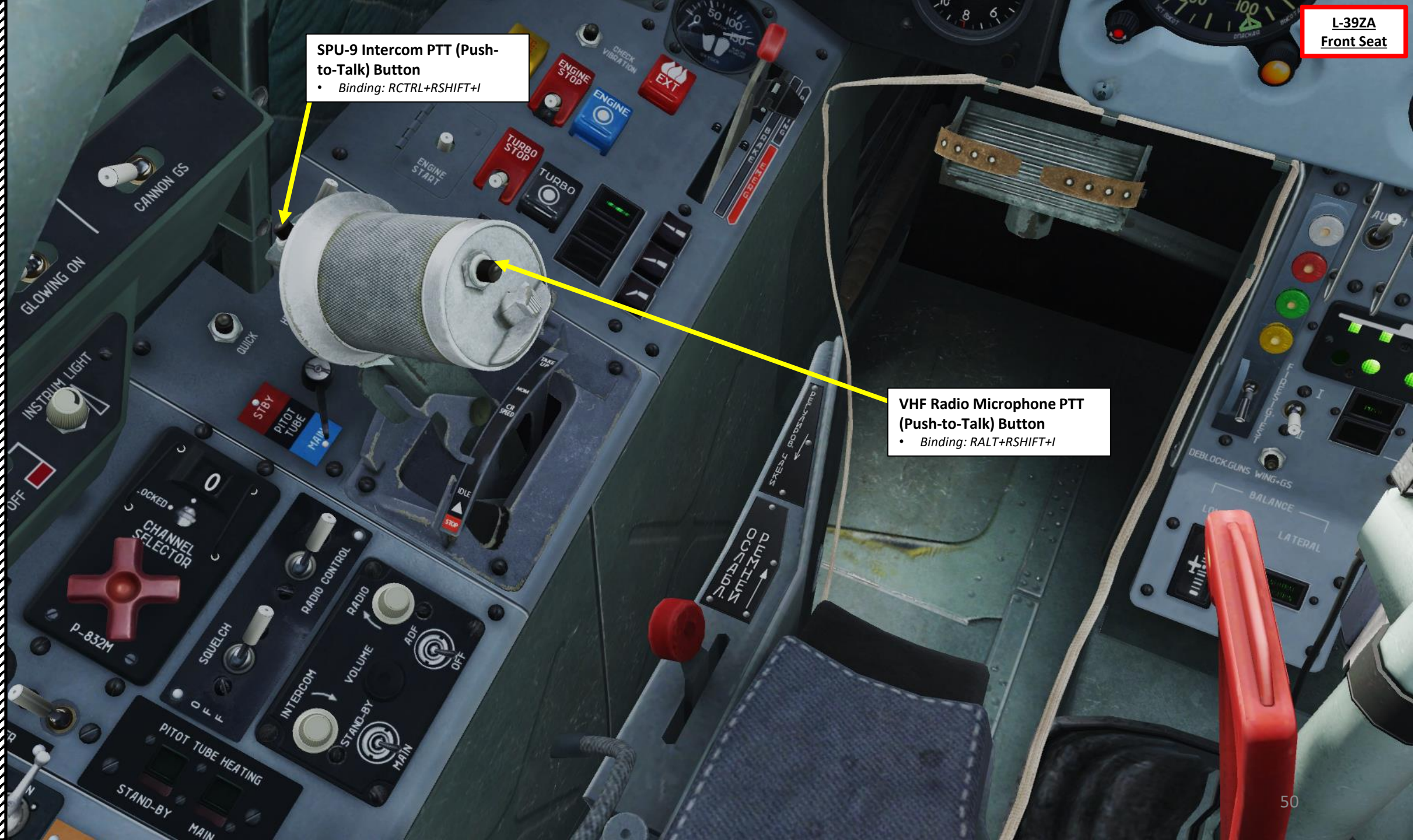
L-39ZA Front Seat

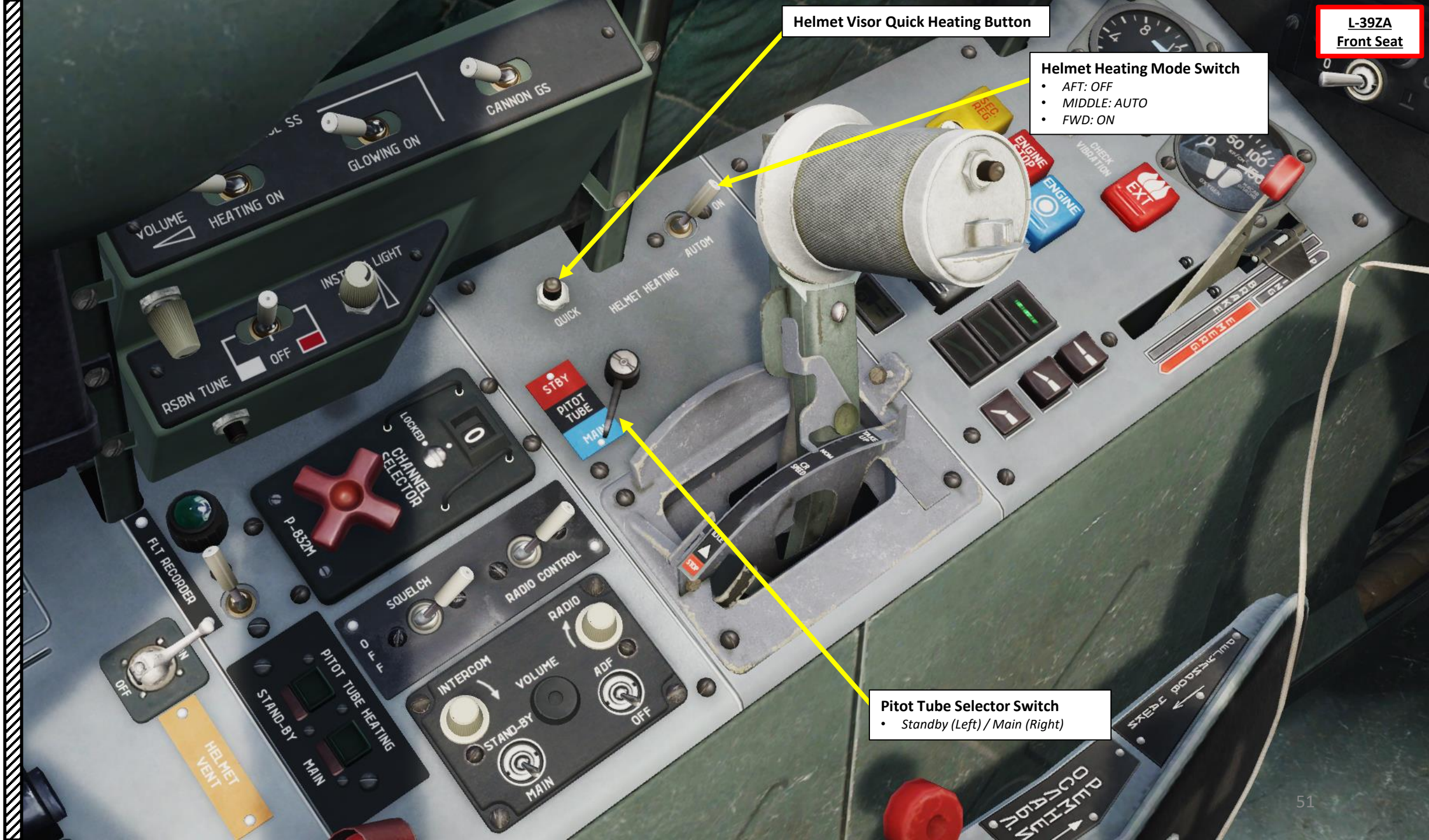



Engine Vibration Push-to-Test Button
Emergency Fuel (SEC. REG.) Switch
• AFT=OFF/FWD=ON
Engine Stop Switch
• AFT=OFF/FWD=ON
Engine Start Mode Switch (under panel)
• AFT: FALSE START
• MIDDLE: START
• FWD: COLD CRANKING
Turbo Stop Switch
• AFT=OFF/FWD=ON
External Ground Power Connected Light
Turbo (Sapphire-5 APU, Auxiliary Power Unit) Start Button
Engine Start Button
Fire Extinguisher Button
SEC REG
ENGINE STOP
ENGINE
EXT
TURBO STOP
TURBO
ENGINE START
CHECK VIBRATION
STBY
PITOT TUBE

L-39ZA Front Seat




L-39ZA
Front Seat
SPU-9 Intercom PTT (Push-to-Talk) Button
• Binding: RCTRL+RSHIFT+I
VHF Radio Microphone PTT (Push-to-Talk) Button
• Binding: RALT+RSHIFT+I
CANNON GS
GLOWING ON
INSTRUM LIGHT
QUICK
STBY
PITOT TUBE
MAIN
ENGINE STOP
ENGINE
EXT
ENGINE START
TURBO STOP
TURBO
CHECK VIBRATION
CHANNEL SELECTOR
P-832M
SQUELCH
RADIO CONTROL
RADIO
ADF
OFF
VOLUME
INTERCOM
STAND-BY
MAIN
PITOT TUBE HEATING
STAND-BY
MAIN
IDLE
STOP
TAKE OFF
MCM
CR SPEED
DEBLOCK GUNS
WING+GS
BALANCE
LATERAL


L-39ZA
Front Seat
Helmet Visor Quick Heating Button
Helmet Heating Mode Switch
• AFT: OFF
• MIDDLE: AUTO
• FWD: ON
Pitot Tube Selector Switch
• Standby (Left) / Main (Right)
QUICK
HELMET HEATING
AUTOM
ON
STBY
PITOT TUBE
MAIN
CANNON GS
GLOWING ON
VOLUME
HEATING ON
RSBN TUNE
OFF
LIGHT
LOCKED
CHANNEL SELECTOR
P-832M
SQUELCH
RADIO CONTROL
FLT RECORDER
OFF
HELMET VENT
PITOT TUBE HEATING
STAND-BY
MAIN
INTERCOM
VOLUME
RADIO
ADF
OFF
STAND-BY
MAIN
ENGINE
EXT

L-39ZA Front Seat

Missile Seeker Glowing Circuit Breaker
- *AFT=OFF / FWD=ON*

GS-23 Cannon Arming Switch
- *AFT=OFF/FWD=ON*

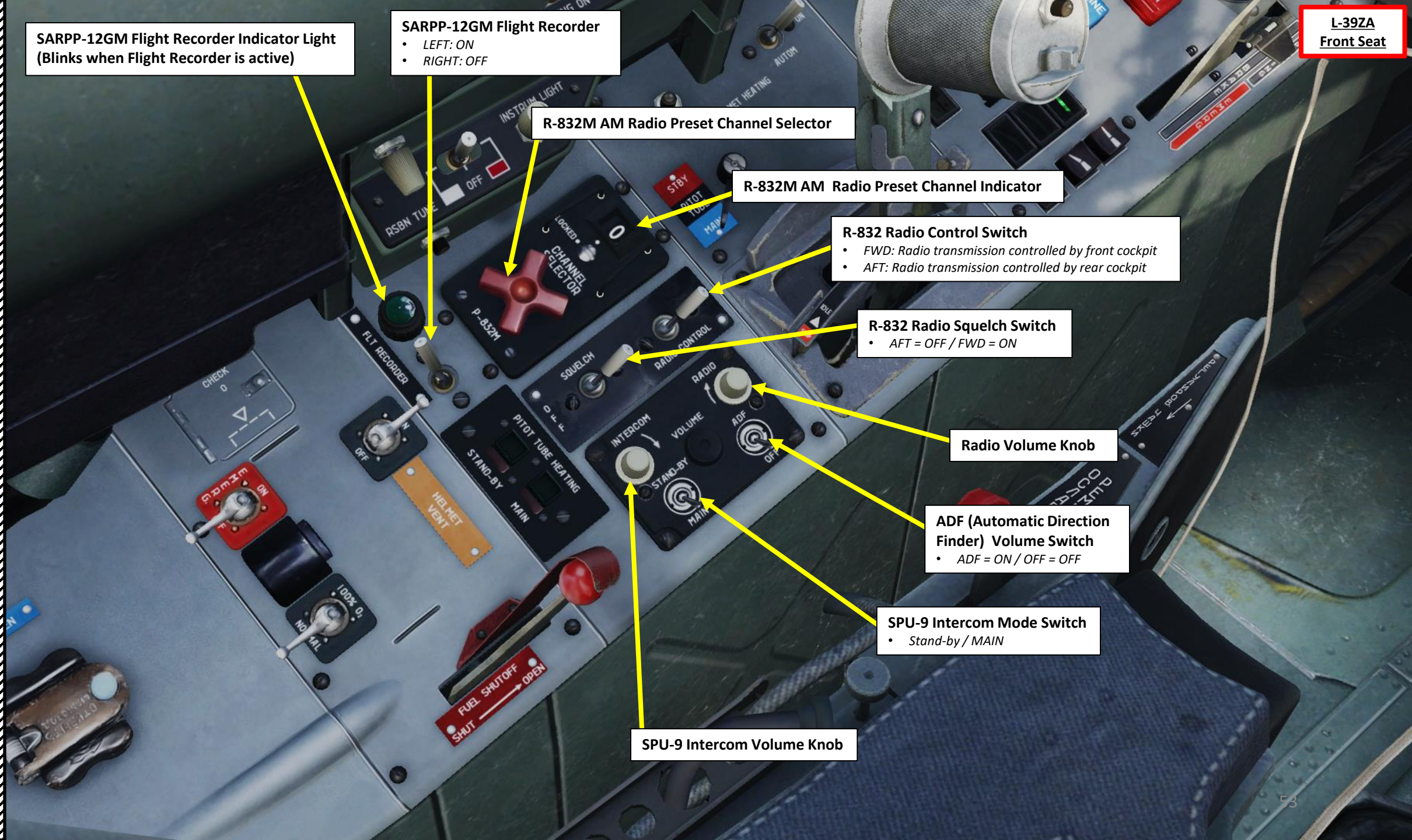
Missile Seeker Heating Circuit Breaker
- *AFT=OFF / FWD=ON*

Missile Seeker Tone Volume Knob

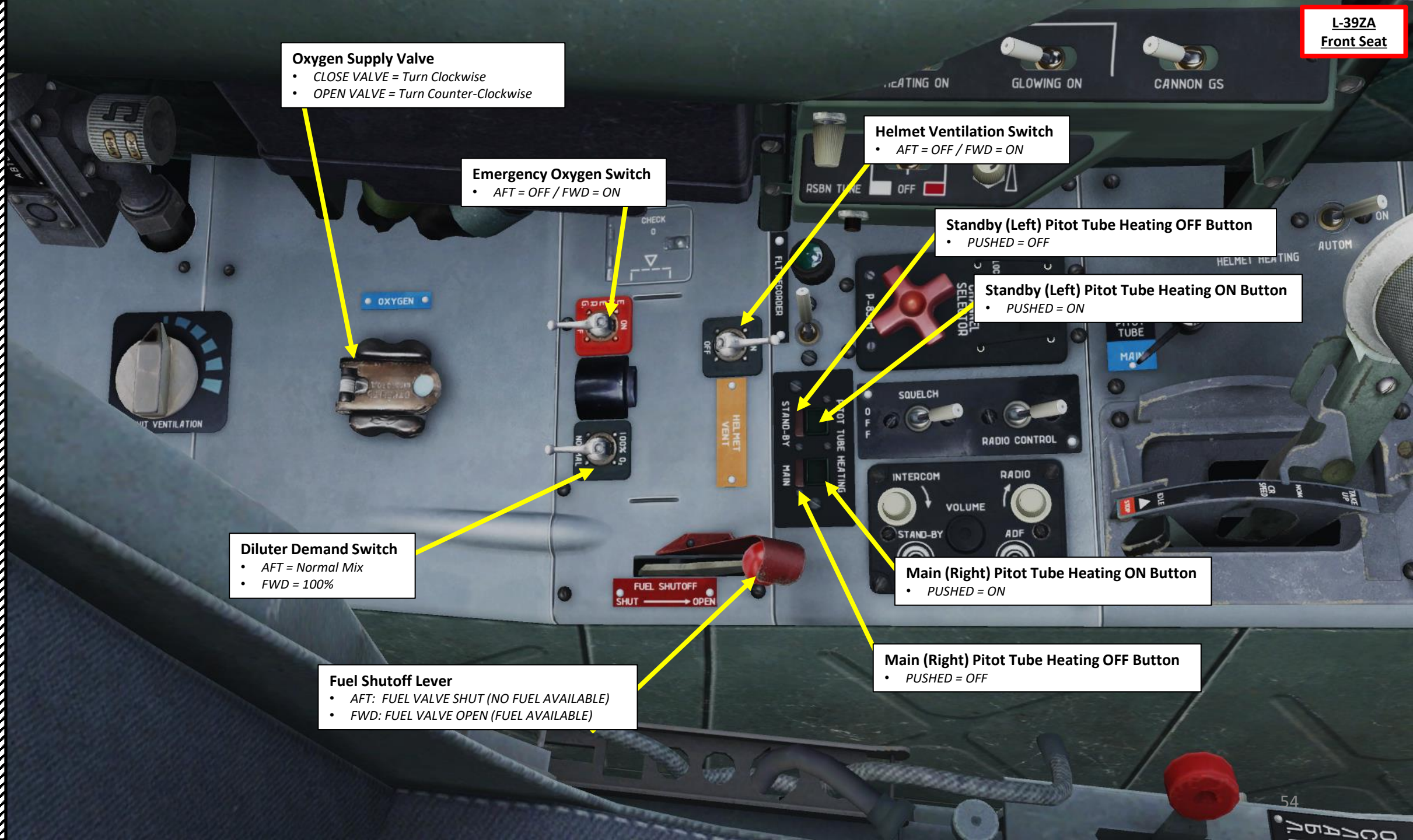
Instrument Lighting Switch
- *White / OFF / Red*

RSBN Tune Button
- *When pushed, RSBN ground beacon callsigns are heard.*

Instrument Lighting Intensity Knob


L-39ZA
Front Seat
SARPP-12GM Flight Recorder Indicator Light
(Blinks when Flight Recorder is active)
SARPP-12GM Flight Recorder
• LEFT: ON
• RIGHT: OFF
R-832M AM Radio Preset Channel Selector
R-832M AM Radio Preset Channel Indicator
R-832 Radio Control Switch
• FWD: Radio transmission controlled by front cockpit
• AFT: Radio transmission controlled by rear cockpit
R-832 Radio Squelch Switch
• AFT = OFF / FWD = ON
Radio Volume Knob
ADF (Automatic Direction Finder) Volume Switch
• ADF = ON / OFF = OFF
SPU-9 Intercom Mode Switch
• Stand-by / MAIN
SPU-9 Intercom Volume Knob

L-39ZA Front Seat



Oxygen Supply Valve
- *CLOSE VALVE = Turn Clockwise*
- *OPEN VALVE = Turn Counter-Clockwise*

Emergency Oxygen Switch
- *AFT = OFF / FWD = ON*

Helmet Ventilation Switch
- *AFT = OFF / FWD = ON*

Standby (Left) Pitot Tube Heating OFF Button
- *PUSHED = OFF*

Standby (Left) Pitot Tube Heating ON Button
- *PUSHED = ON*

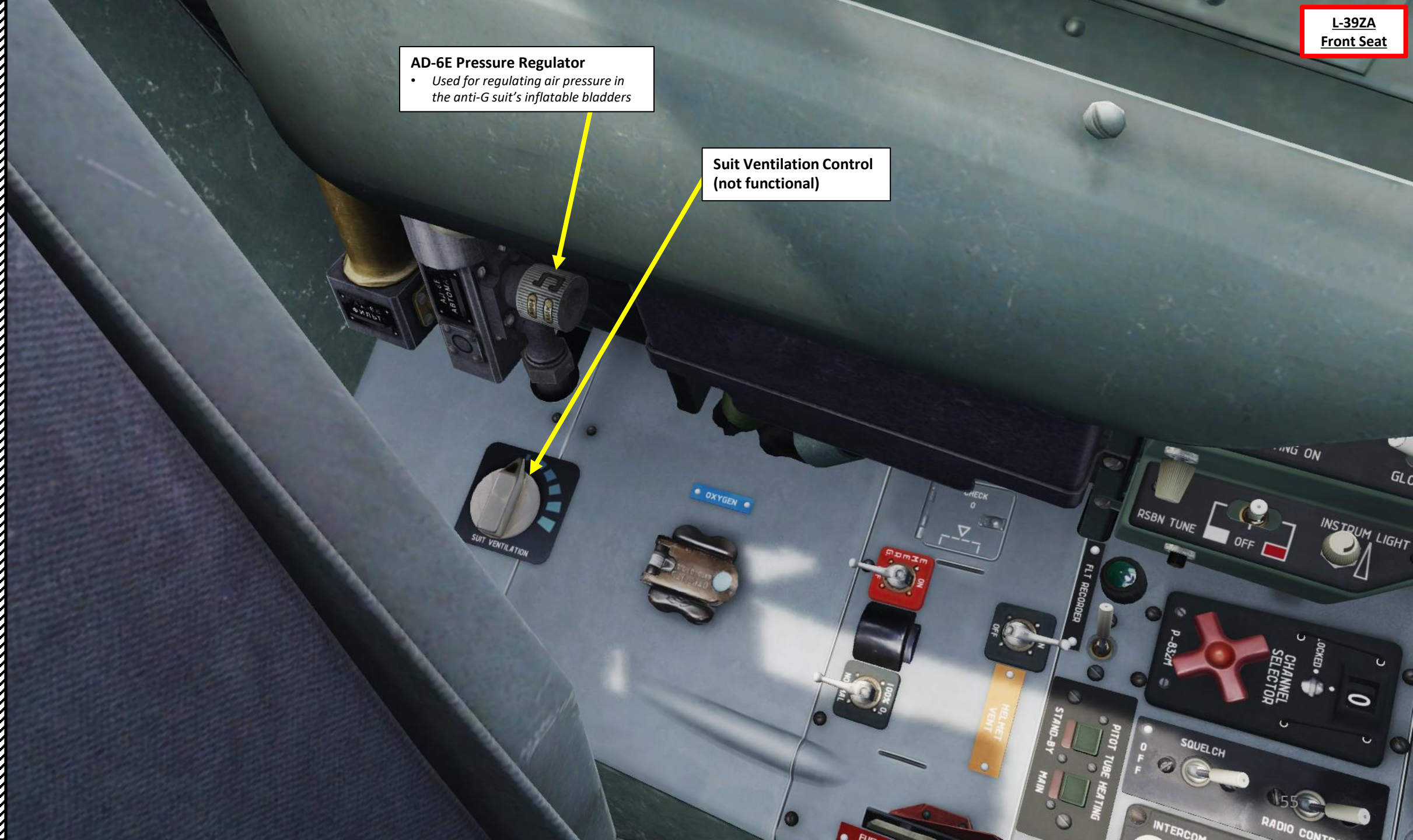
Diluter Demand Switch
- *AFT = Normal Mix*
- *FWD = 100%*

Main (Right) Pitot Tube Heating ON Button
- *PUSHED = ON*

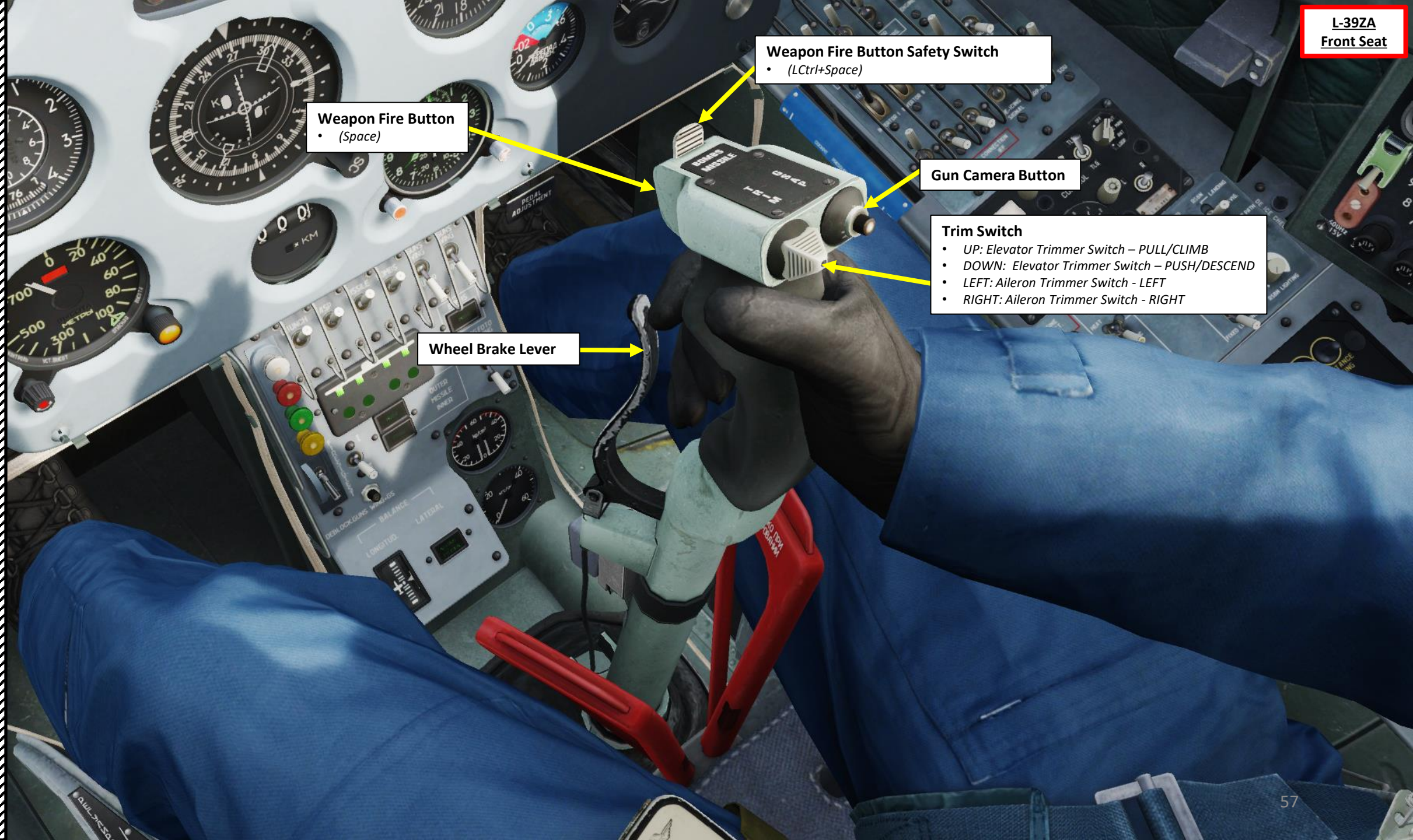
Main (Right) Pitot Tube Heating OFF Button
- *PUSHED = OFF*

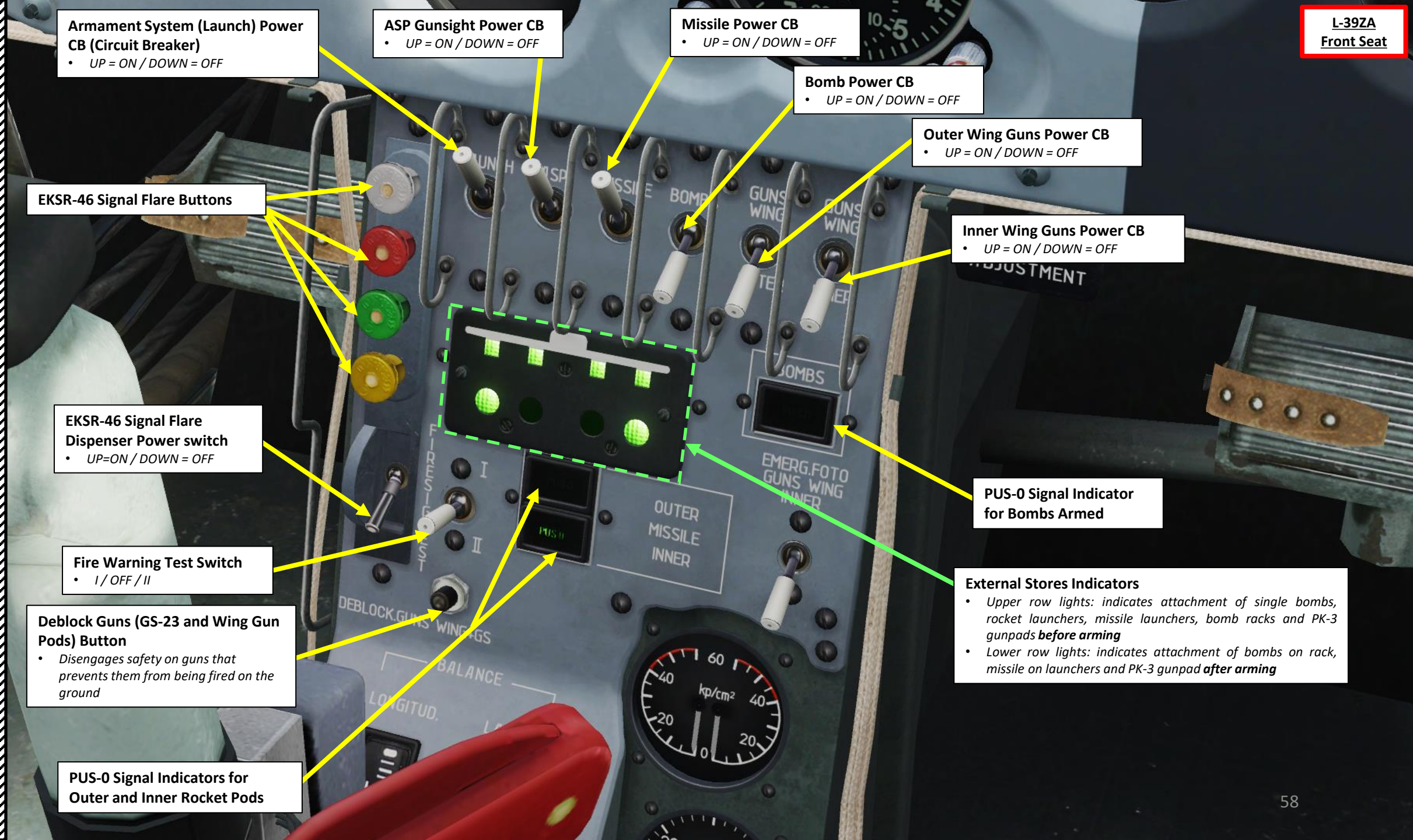
Fuel Shutoff Lever
- *AFT: FUEL VALVE SHUT (NO FUEL AVAILABLE)*
- *FWD: FUEL VALVE OPEN (FUEL AVAILABLE)*

L-39ZA Front Seat

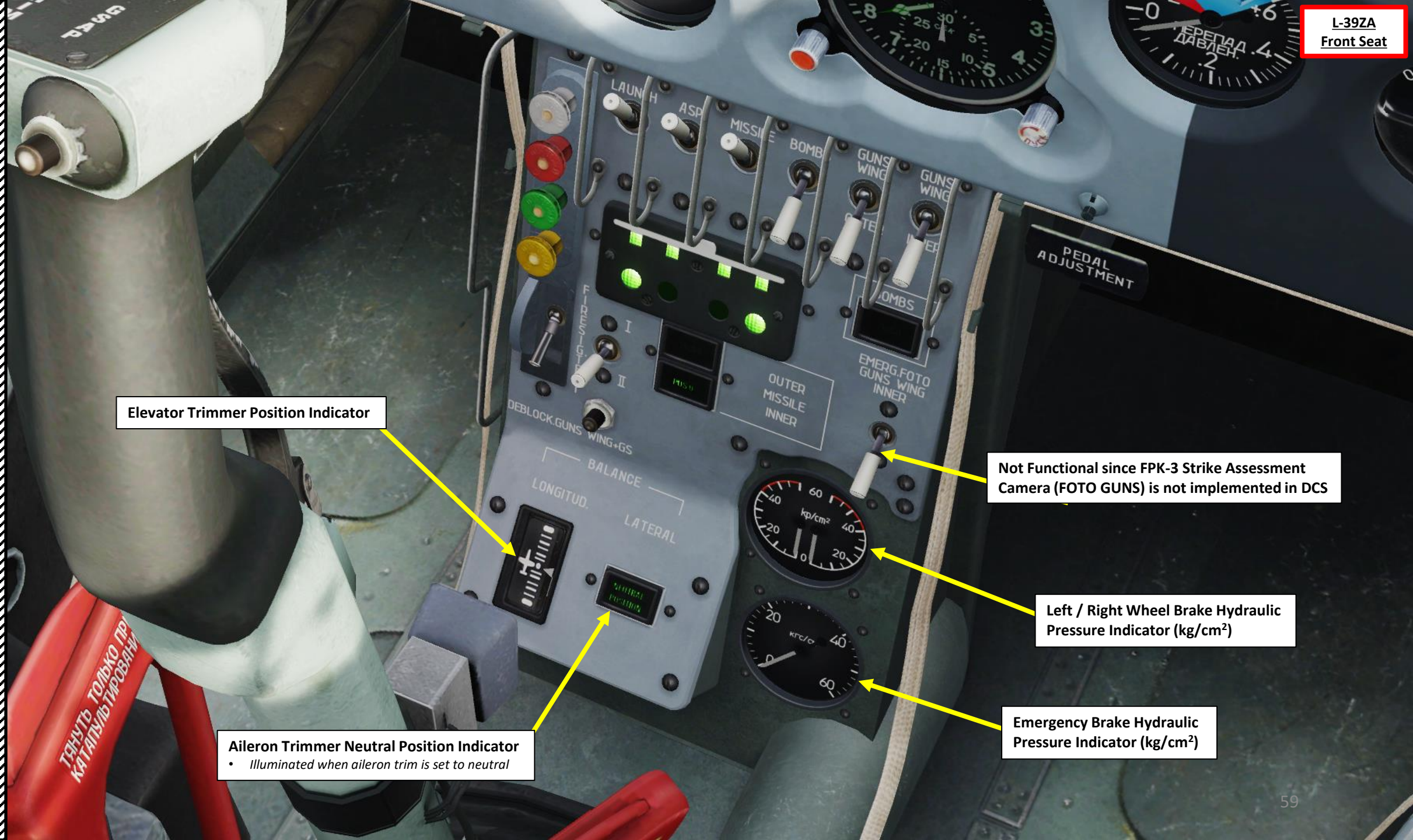


L-39ZA
Front Seat


L-39ZA
Front Seat
Weapon Fire Button Safety Switch
• (LCtrl+Space)
Weapon Fire Button
• (Space)
Gun Camera Button
Trim Switch
• UP: Elevator Trimmer Switch – PULL/CLIMB
• DOWN: Elevator Trimmer Switch – PUSH/DESCEND
• LEFT: Aileron Trimmer Switch - LEFT
• RIGHT: Aileron Trimmer Switch - RIGHT
Wheel Brake Lever


L-39ZA
Front Seat
Armament System (Launch) Power CB (Circuit Breaker)
• UP = ON / DOWN = OFF
ASP Gunsight Power CB
• UP = ON / DOWN = OFF
Missile Power CB
• UP = ON / DOWN = OFF
Bomb Power CB
• UP = ON / DOWN = OFF
Outer Wing Guns Power CB
• UP = ON / DOWN = OFF
Inner Wing Guns Power CB
• UP = ON / DOWN = OFF
EKSR-46 Signal Flare Buttons
EKSR-46 Signal Flare Dispenser Power switch
• UP=ON / DOWN = OFF
Fire Warning Test Switch
• I / OFF / II
Deblock Guns (GS-23 and Wing Gun Pods) Button
• Disengages safety on guns that prevents them from being fired on the ground
PUS-0 Signal Indicators for Outer and Inner Rocket Pods
PUS-0 Signal Indicator for Bombs Armed
External Stores Indicators
• Upper row lights: indicates attachment of single bombs, rocket launchers, missile launchers, bomb racks and PK-3 gunpads before arming
• Lower row lights: indicates attachment of bombs on rack, missile on launchers and PK-3 gunpad after arming
OUTER MISSILE INNER
BOMBS
EMERG.FOTO GUNS WING
FIRE TEST
DEBLOCK.GUNS WING GS
BALANCE
kp/cm²

L-39ZA
Front Seat



Elevator Trimmer Position Indicator

Not Functional since FPK-3 Strike Assessment Camera (FOTO GUNS) is not implemented in DCS

Left / Right Wheel Brake Hydraulic Pressure Indicator (kg/cm²)

Emergency Brake Hydraulic Pressure Indicator (kg/cm²)

Aileron Trimmer Neutral Position Indicator

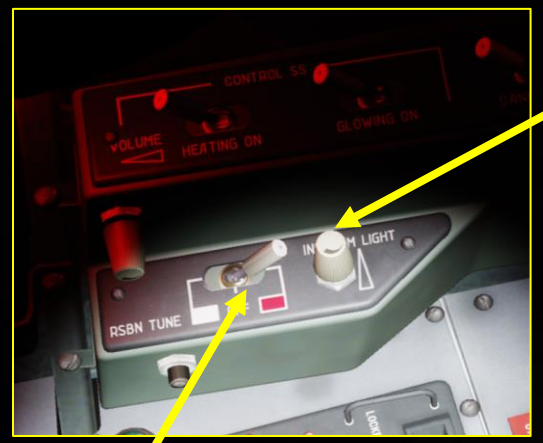
- *Illuminated when aileron trim is set to neutral*


RSBN TUNE
OFF
INSTRUM LIGHT
CANNON GS
CHANNEL SELECTOR
SQUELCH
RADIO CONTROL
INTERCOM
VOLUME
RADIO
STAND-BY
MAIN
OFF
FUEL SHUTOFF
SHUT
OPEN
STBY
PITOT TUBE
HELMET HEATING
QUICK
TURBO STOP
ENGINE STOP
TURBO
ENGINE
EXT
EMERGENCY SYSTEMS CONTROLS
LANDING GEAR
FLAPS
EMERGENCY CANOPY JETTISON
L-39ZA
Front Seat

L-39ZA Front Seat

L-39ZA
Front Seat

L-39ZA Front Seat



Instrument Lighting Intensity Knob

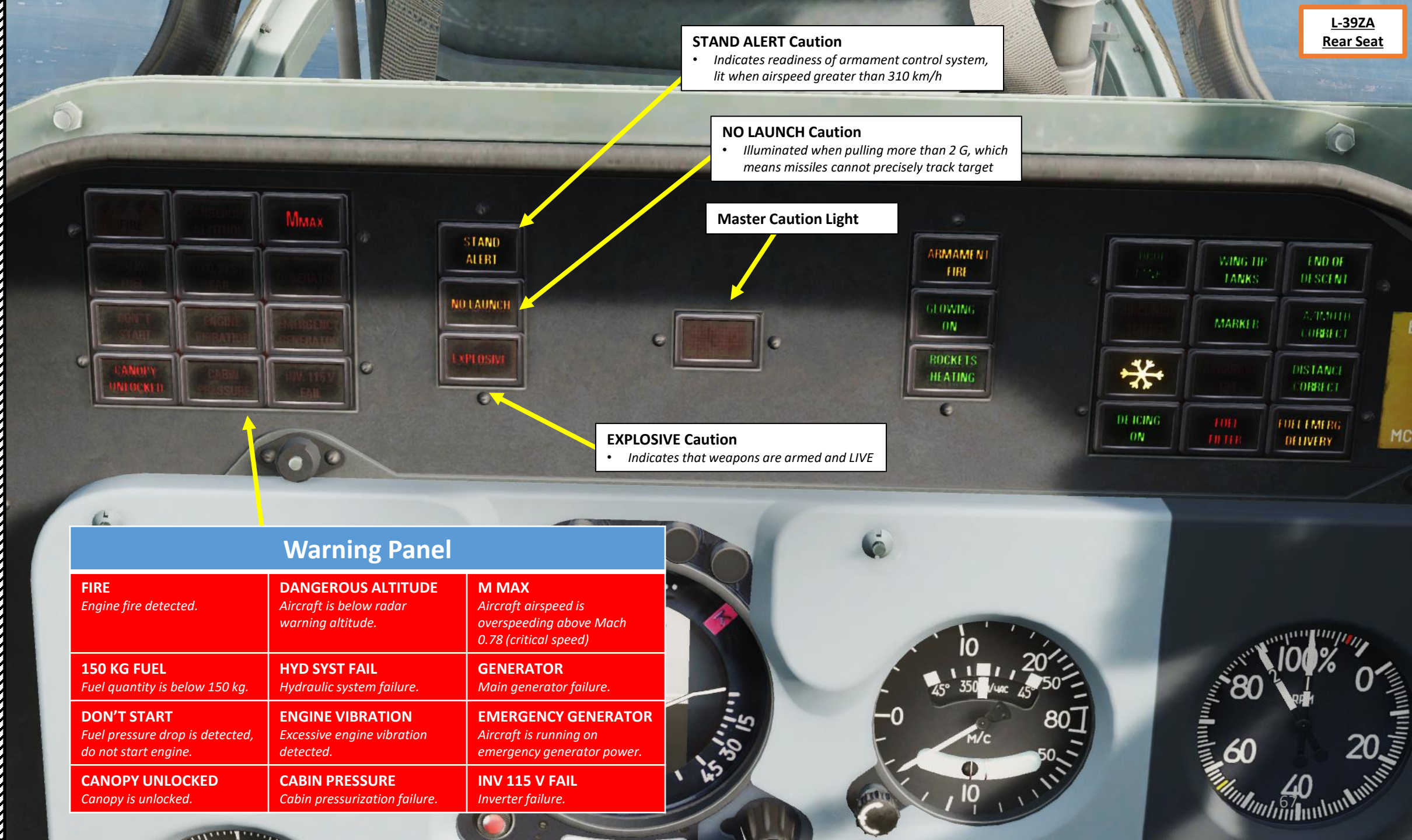
Instrument Lighting Switch
- *White / OFF / Red*

L-39ZA
Rear Seat

L-39ZA
Rear Seat

L-39ZA
Rear Seat

L-39ZA
Rear Seat



STAND ALERT Caution
- *Indicates readiness of armament control system, lit when airspeed greater than 310 km/h*

NO LAUNCH Caution
- *Illuminated when pulling more than 2 G, which means missiles cannot precisely track target*

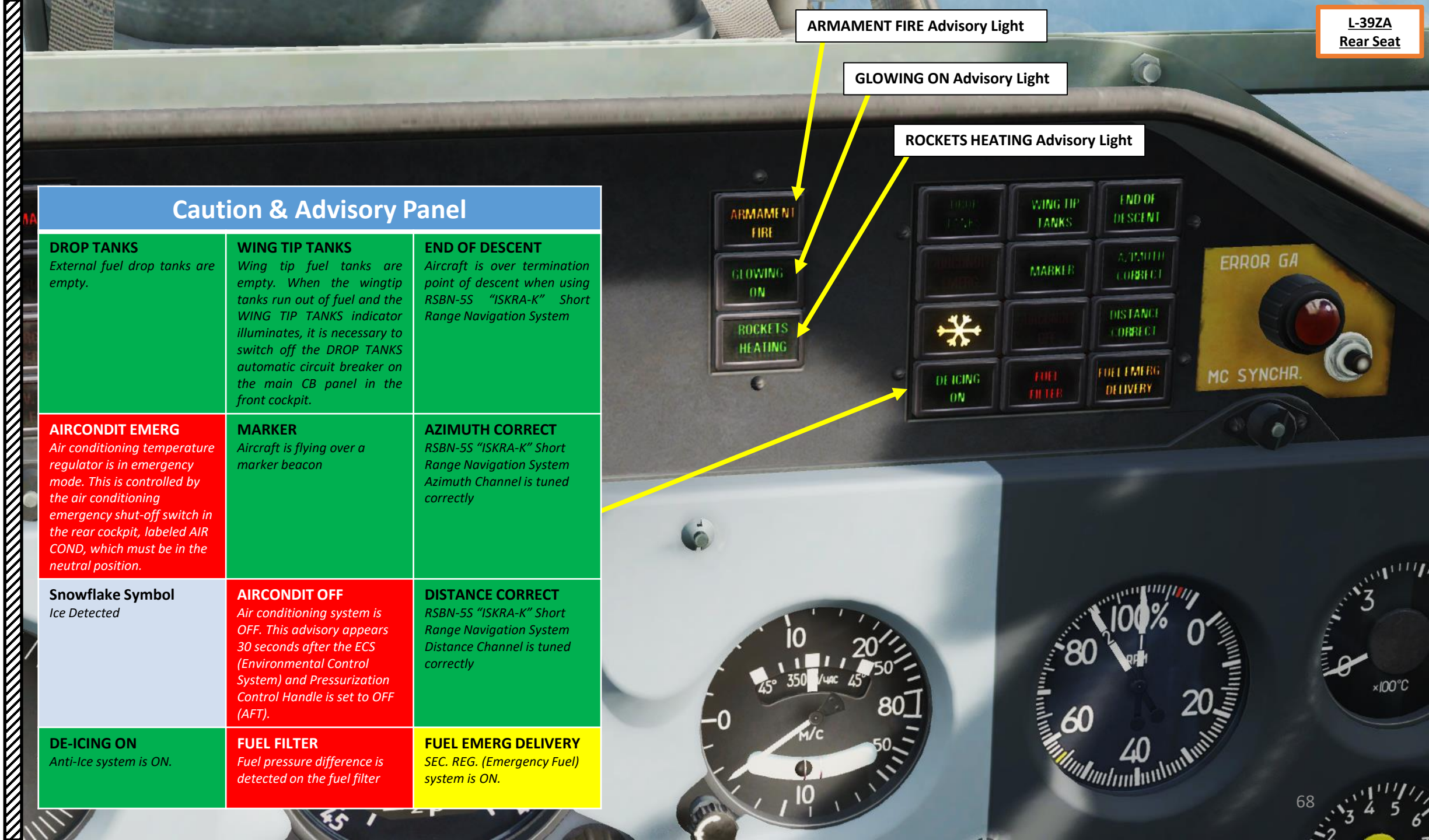
Master Caution Light

EXPLOSIVE Caution
- *Indicates that weapons are armed and LIVE*

Warning Panel

FIRE *Engine fire detected.*	**DANGEROUS ALTITUDE** *Aircraft is below radar warning altitude.*	**M MAX** *Aircraft airspeed is overspeeding above Mach 0.78 (critical speed)*
150 KG FUEL *Fuel quantity is below 150 kg.*	**HYD SYST FAIL** *Hydraulic system failure.*	**GENERATOR** *Main generator failure.*
DON'T START *Fuel pressure drop is detected, do not start engine.*	**ENGINE VIBRATION** *Excessive engine vibration detected.*	**EMERGENCY GENERATOR** *Aircraft is running on emergency generator power.*
CANOPY UNLOCKED *Canopy is unlocked.*	**CABIN PRESSURE** *Cabin pressurization failure.*	**INV 115 V FAIL** *Inverter failure.*

L-39ZA Rear Seat



Caution & Advisory Panel

DROP TANKS *External fuel drop tanks are empty.*	**WING TIP TANKS** *Wing tip fuel tanks are empty. When the wingtip tanks run out of fuel and the WING TIP TANKS indicator illuminates, it is necessary to switch off the DROP TANKS automatic circuit breaker on the main CB panel in the front cockpit.*	**END OF DESCENT** *Aircraft is over termination point of descent when using RSBN-5S "ISKRA-K" Short Range Navigation System*
AIRCONDIT EMERG *Air conditioning temperature regulator is in emergency mode. This is controlled by the air conditioning emergency shut-off switch in the rear cockpit, labeled AIR COND, which must be in the neutral position.*	**MARKER** *Aircraft is flying over a marker beacon*	**AZIMUTH CORRECT** *RSBN-5S "ISKRA-K" Short Range Navigation System Azimuth Channel is tuned correctly*
Snowflake Symbol *Ice Detected*	**AIRCONDIT OFF** *Air conditioning system is OFF. This advisory appears 30 seconds after the ECS (Environmental Control System) and Pressurization Control Handle is set to OFF (AFT).*	**DISTANCE CORRECT** *RSBN-5S "ISKRA-K" Short Range Navigation System Distance Channel is tuned correctly*
DE-ICING ON *Anti-Ice system is ON.*	**FUEL FILTER** *Fuel pressure difference is detected on the fuel filter*	**FUEL EMERG DELIVERY** *SEC. REG. (Emergency Fuel) system is ON.*

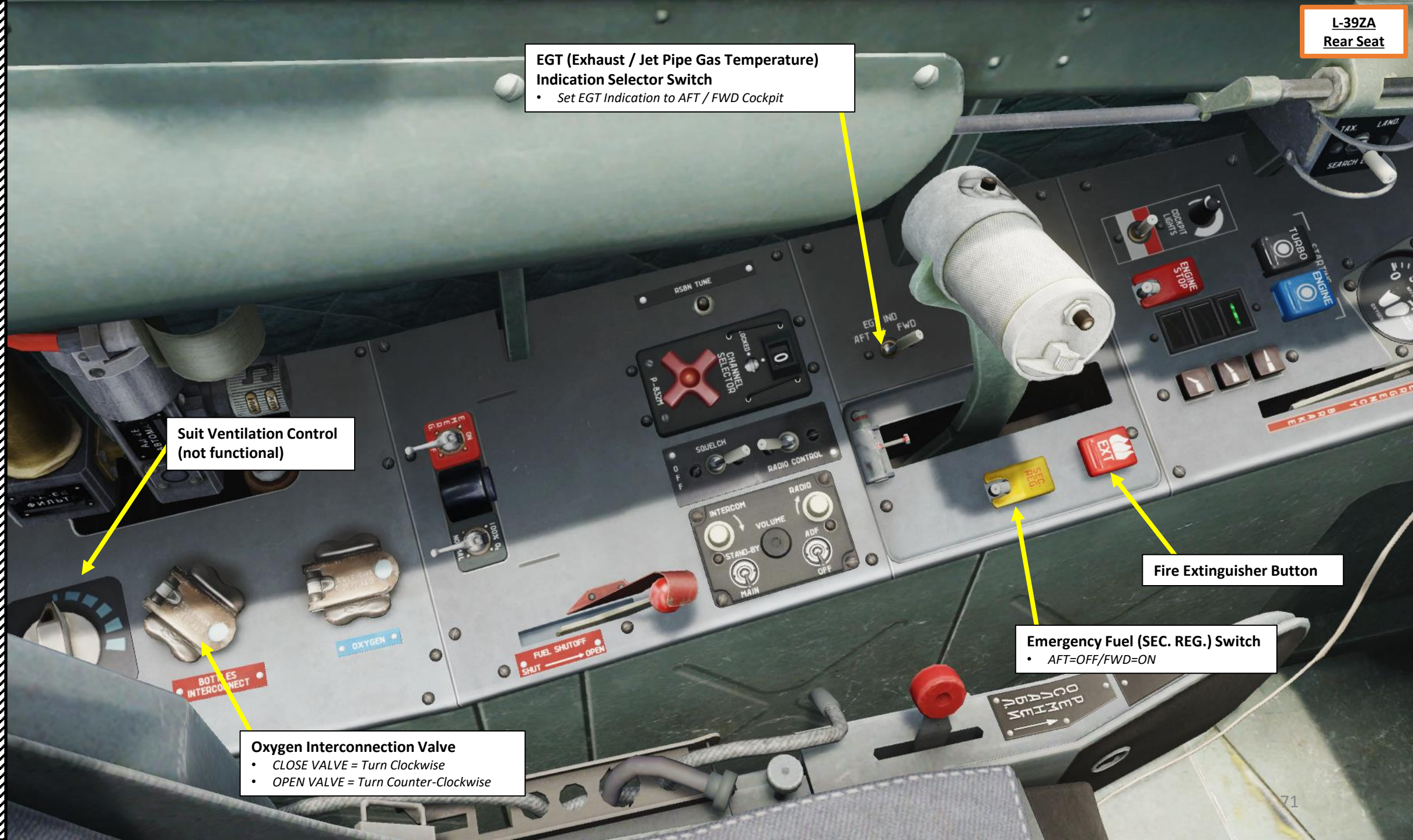
External Stores Indicators

- *Upper row lights: indicates attachment of single bombs, rocket launchers, missile launchers, bomb racks and PK-3 gunpads **before arming***
- *Lower row lights: indicates attachment of bombs on rack, missile on launchers and PK-3 gunpad **after arming***

L-39ZA Rear Seat

L-39ZA
Rear Seat

L-39ZA Rear Seat



EGT (Exhaust / Jet Pipe Gas Temperature) Indication Selector Switch
- *Set EGT Indication to AFT / FWD Cockpit*

Suit Ventilation Control (not functional)

Fire Extinguisher Button

Emergency Fuel (SEC. REG.) Switch
- *AFT=OFF/FWD=ON*

Oxygen Interconnection Valve
- *CLOSE VALVE = Turn Clockwise*
- *OPEN VALVE = Turn Counter-Clockwise*

L-39ZA
Rear Seat

L-39ZA Rear Seat

Total Pressure Pitot Failure Simulation Switch
- *ON = Pitot Functional*
- *FAILURE = Pitot Failure Simulated*

Static Pressure Pitot Failure Simulation Switch
- *ON = Pitot Functional*
- *FAILURE = Pitot Failure Simulated*

Failure Simulation Control Panel

Note
Pressure guards are installed on the front cockpit's pressure gauges to avoid damage to these gauges when switching from FAILURE to the ON position. To enable pressure gauges in the front cockpit after a pressure failure simulation, the Instructor Pilot must:
1. Ensure the appropriate Pitot Failure selector switch is set to FAILURE
2. Set selector switch to RED MIN 30''
3. Wait for 30 seconds
4. Set selector switch to ON

Aileron Trim "Neutral" Position Indicator

Elevator Trim "Neutral" Position Indicator

RKL-41 ADF (Automatic Direction Finder) Failure Simulation Switch
- *UP = Failure Simulated*

GMK Directional Gyro Failure Simulation Switch
- *UP = Failure Simulated*

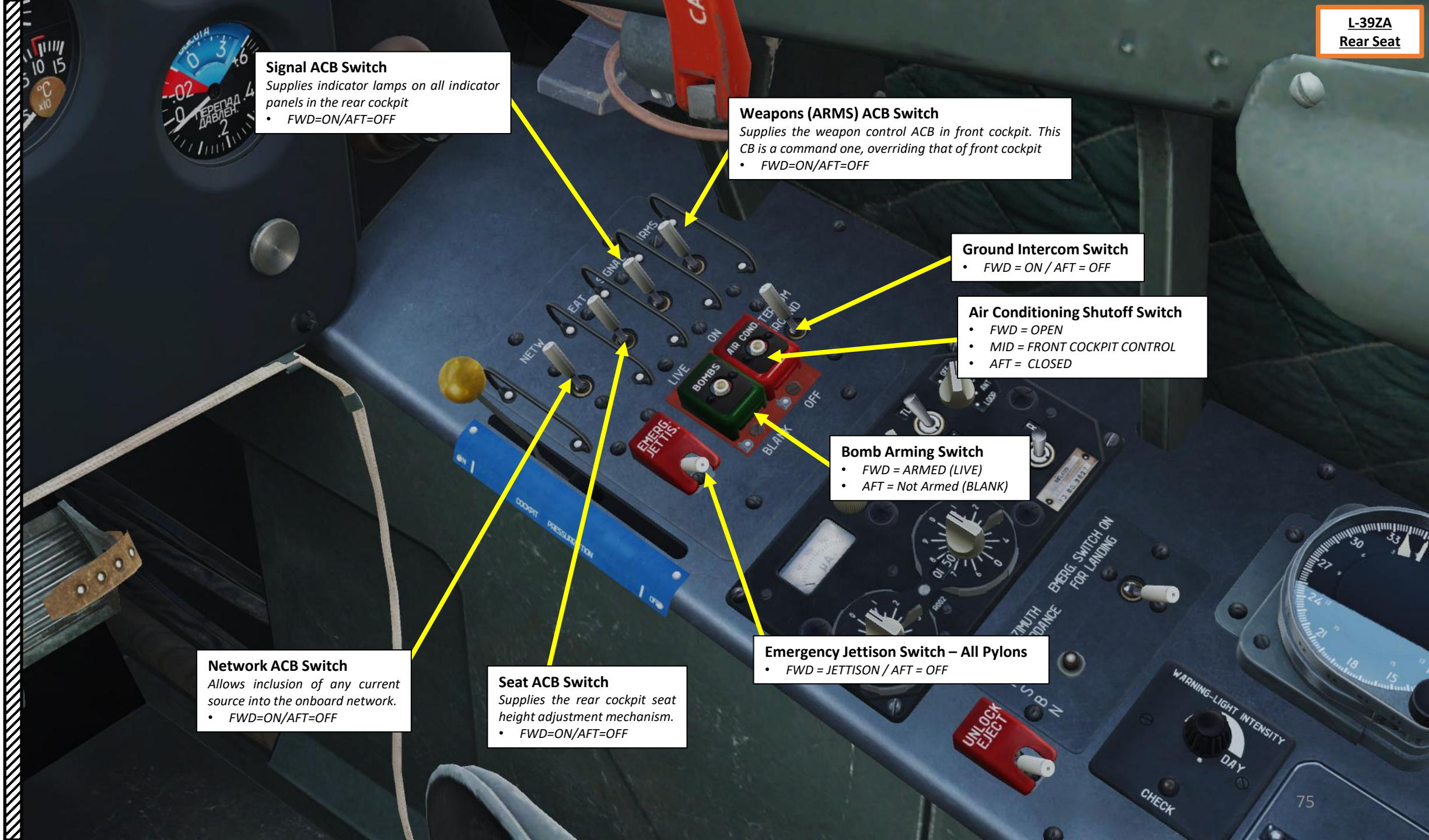
Attitude Directional Indicator (ADI) Roll Axis Failure Simulation Switch
- *UP = Failure Simulated*

Attitude Directional Indicator (ADI) Pitch Axis Failure Simulation Switch
- *UP = Failure Simulated*

Left / Right Wheel Brake Hydraulic Pressure Indicator (kg/cm2)

L-39ZA
Rear Seat

L-39ZA Rear Seat



Signal ACB Switch
Supplies indicator lamps on all indicator panels in the rear cockpit
- *FWD=ON/AFT=OFF*

Weapons (ARMS) ACB Switch
Supplies the weapon control ACB in front cockpit. This CB is a command one, overriding that of front cockpit
- *FWD=ON/AFT=OFF*

Ground Intercom Switch
- *FWD = ON / AFT = OFF*

Air Conditioning Shutoff Switch
- *FWD = OPEN*
- *MID = FRONT COCKPIT CONTROL*
- *AFT = CLOSED*

Bomb Arming Switch
- *FWD = ARMED (LIVE)*
- *AFT = Not Armed (BLANK)*

Emergency Jettison Switch – All Pylons
- *FWD = JETTISON / AFT = OFF*

Network ACB Switch
Allows inclusion of any current source into the onboard network.
- *FWD=ON/AFT=OFF*

Seat ACB Switch
Supplies the rear cockpit seat height adjustment mechanism.
- *FWD=ON/AFT=OFF*

L-39ZA Rear Seat

L-39ZA
Rear Seat

L-39ZA
Rear Seat

L-39ZA
Rear Seat


Instrument Flight Practice Hood Control Lever
• AFT: RETRACTED
• FWD: EXTENDED
Instrument Flight Practice Hood


Instrument Flight Practice Hood

L-39ZA

RAT: **R**am **A**ir **T**urbine

- *Automatically deployed in case of engine failure in order to supply hydraulic power to hydraulic systems, which powers flight controls.*

Static Dischargers

- *Devices used to remove static electricity from aircraft in flight.*

L-39ZA

Navigation Light

Navigation Light

Navigation Light

Navigation Lights Brightness Switch

- *FWD: 60%*
- *MIDDLE: 30%*
- *AFT: 100%*

Navigation Lights Mode Switch:

- *FWD: Flicker*
- *MIDDLE: OFF*
- *AFT: Fixed Lights*

L-39ZA

Combined Taxi/Landing Light

- *The difference between landing and taxi lights is the width of the light beam. Taxi lights have a wide beam, because they illuminate the runway / taxiway while moving on the ground during darkness and provide illumination just in front of the nose. Landing lights have a narrower beam, because they are used to illuminate the terrain and runway ahead during takeoff and landing from greater distances. and the beam of the landing light filament covers a larger (all-round) pattern*

Combined Taxi/Landing Light

Taxi & Landing (Search) Light Switch

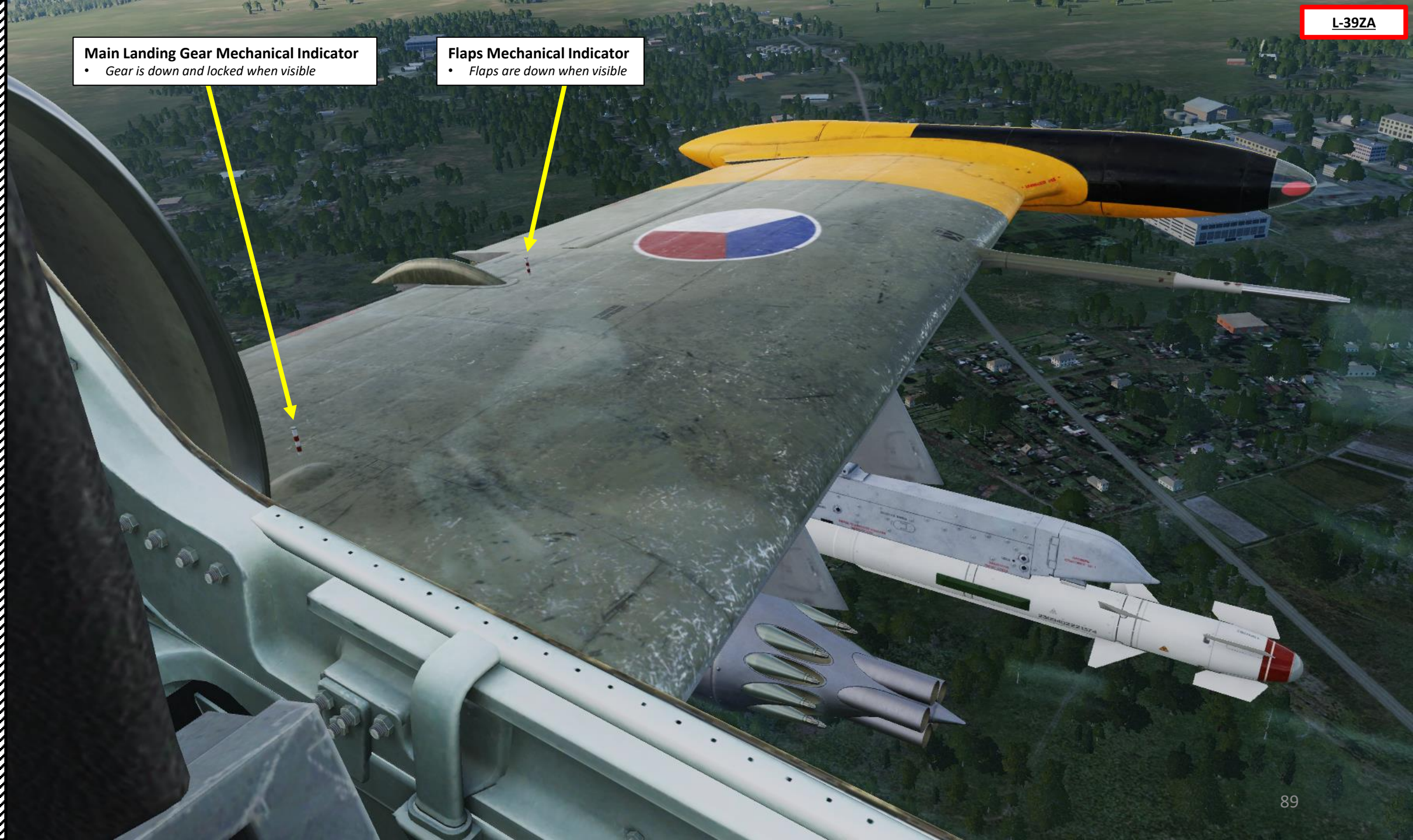
- *AFT: Taxi lights ON*
- *MIDDLE: OFF*
- *FWD: Landing Lights ON*

Landing Gear
- *Hydraulically actuated*

Landing Gear Lights
- *Illuminate when landing gear is deployed*


Flaps
• Hydraulically actuated, flaps automatically retract at indicated airspeeds above 310 km/h (167 kts).


Nose Landing Gear Mechanical Indicator
• Gear is down and locked when visible
GYRO
FIXED
RIGHT
EMERG. LIGHT
EXPL.CHARGE GUNS OUTER
GUNS INNER
EXPL.CHARGE GS
PYRO
MISS.


Main Landing Gear Mechanical Indicator
• Gear is down and locked when visible
Flaps Mechanical Indicator
• Flaps are down when visible

Airbrakes

- *Hydraulically actuated, airbrakes can be manually extended by the pilot, but they are also extended automatically when airspeed is above Mach 0.78 (overspeed limit, accompanied with M MAX warning light).*

L-39ZA

Gryazev-Shipunov GS-23L 23 mm Cannon

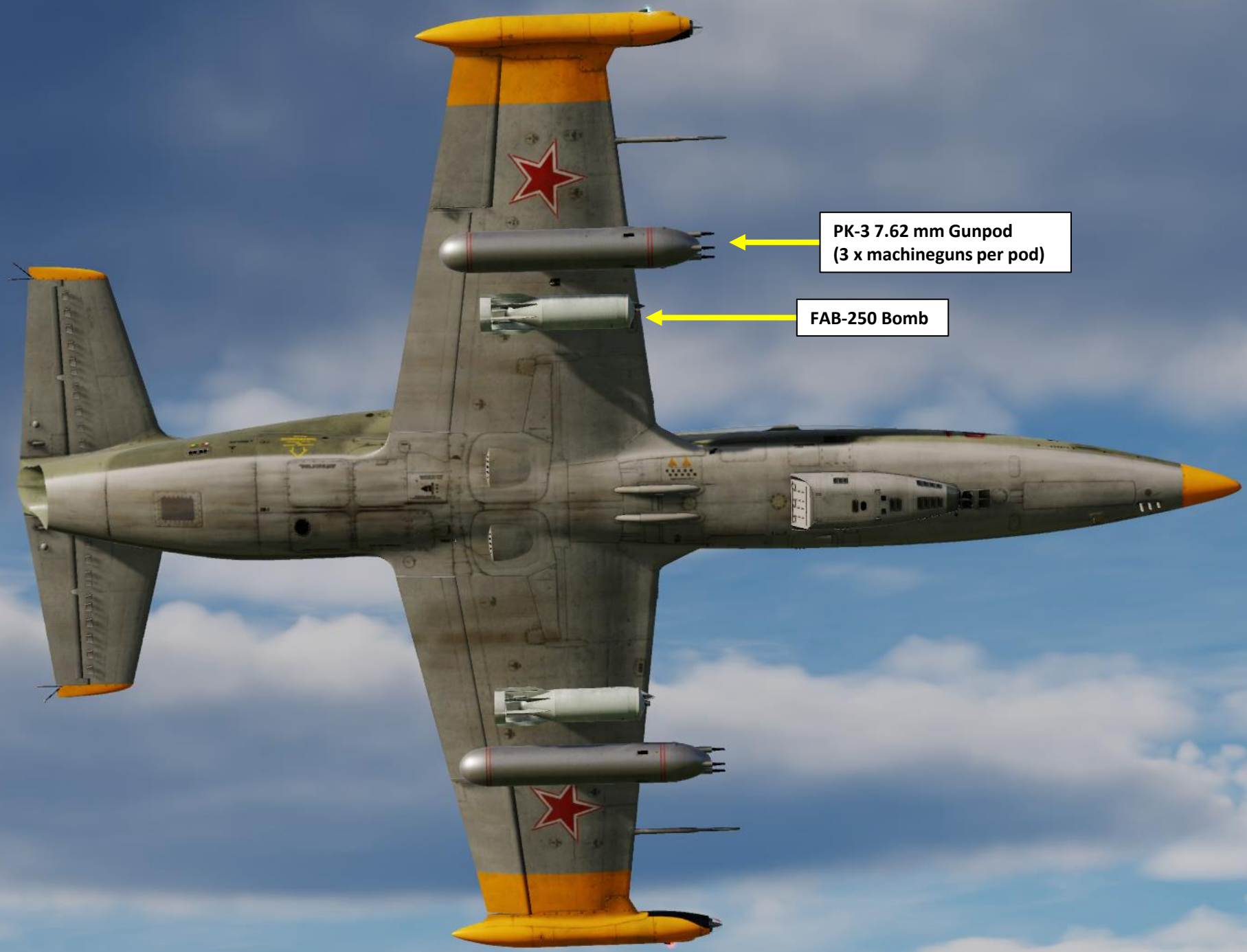
- *Twin-Barrel 23 mm autocannon (150 cartridges)*


Cannon Cartridge Ejection Ports

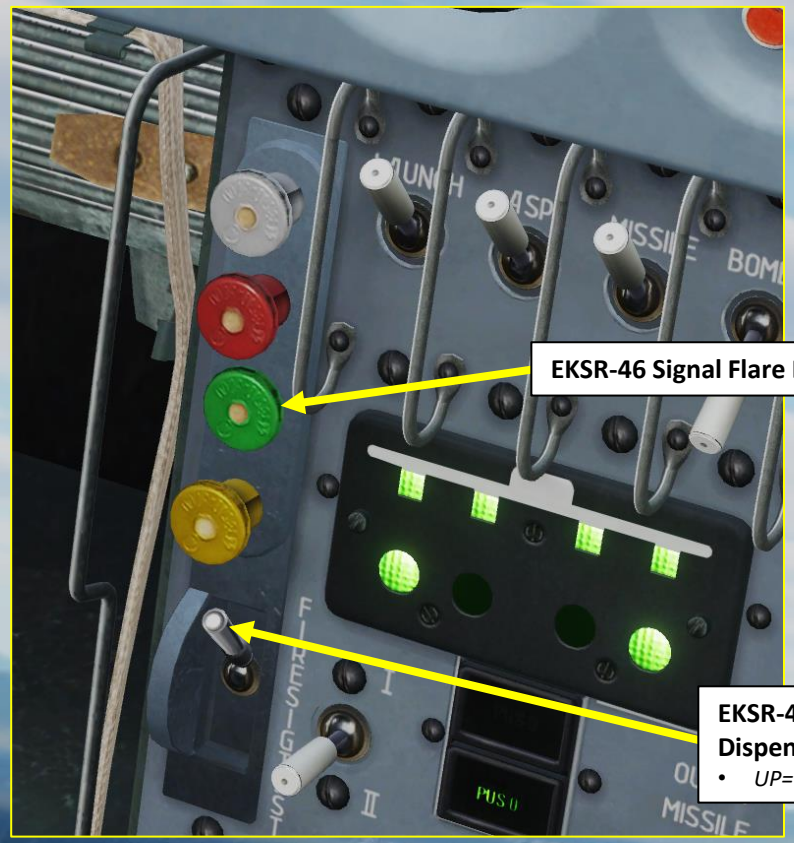
L-39ZA


UB-16 Rocket Launcher Pod
16 x S-5KO 57 mm Rockets
R-60M Aphid IR (Infrared)
Seeker Missile

L-39ZA



L-39ZA



Signal Flare Dispenser Cassettes


19

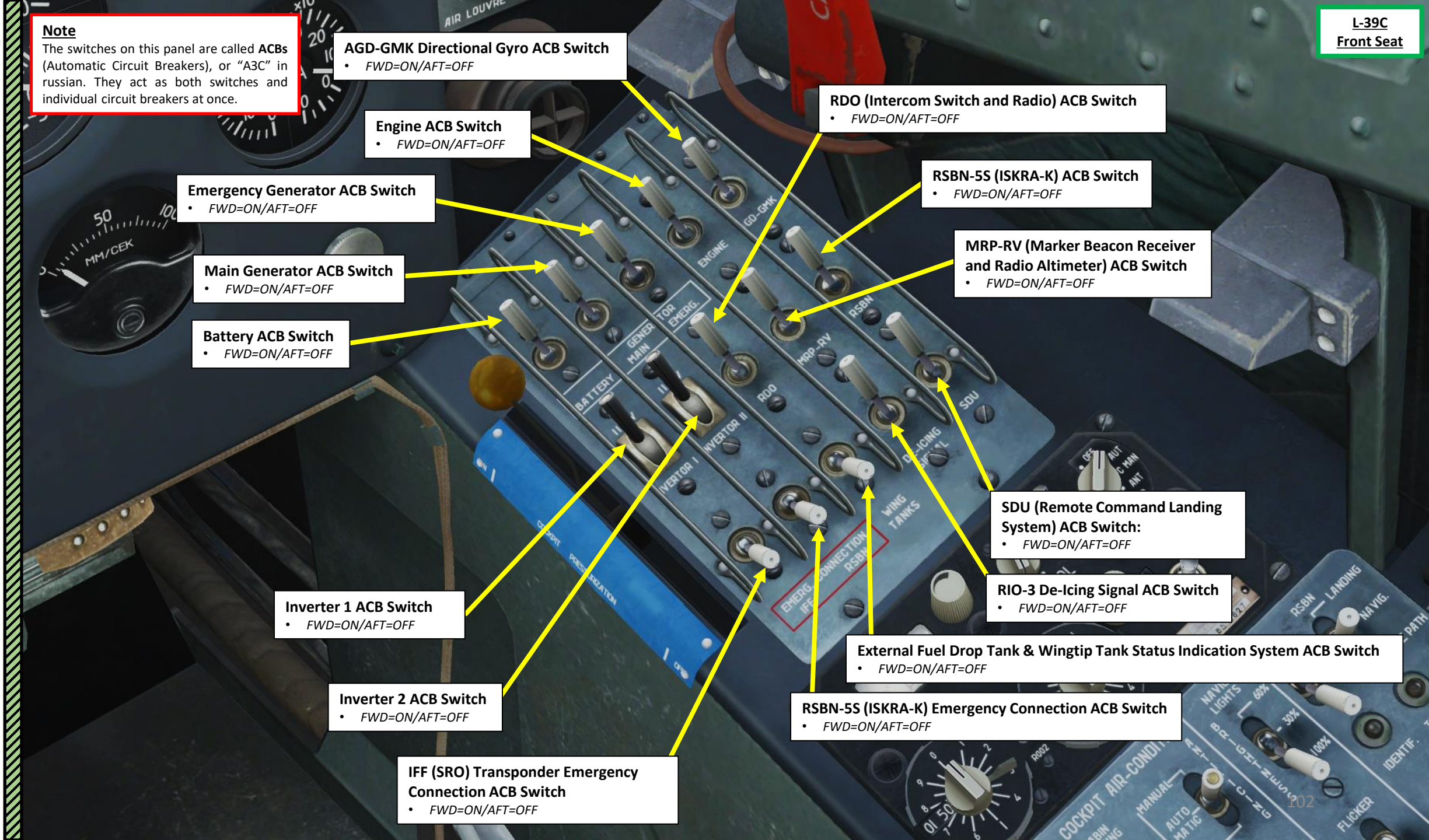

19

L-39C
Front Seat

L-39C
Front Seat

L-39C Front Seat

Note
The switches on this panel are called **ACBs** (Automatic Circuit Breakers), or "A3C" in russian. They act as both switches and individual circuit breakers at once.




L-39C
Front Seat
GYRO
FIXED
BRIGHT
УБ-12.7

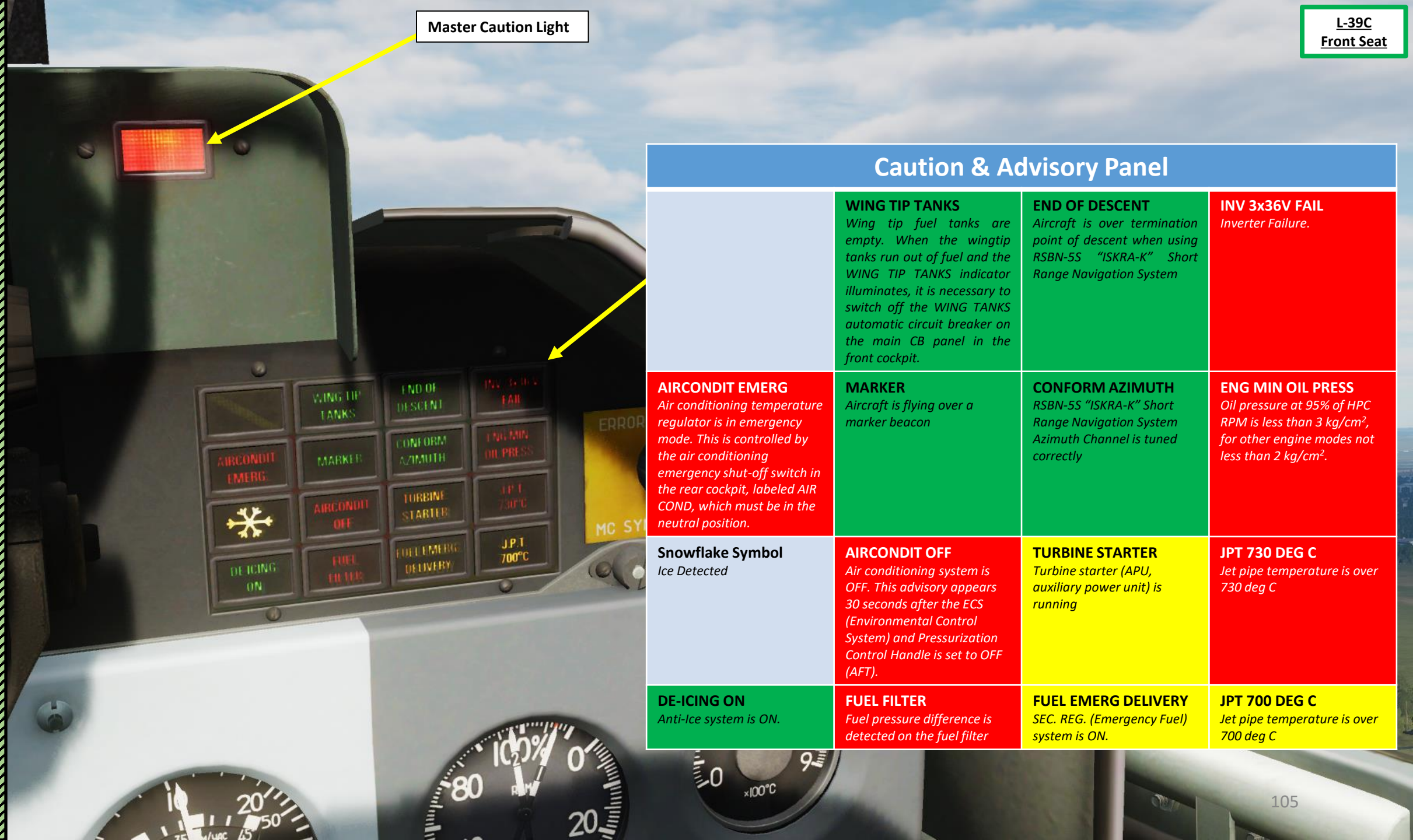
Warning Panel

FIRE *Engine fire detected.*	**DANGEROUS ALTITUDE** *Aircraft is below radar warning altitude.*	**M MAX** *Aircraft airspeed is overspeeding above Mach 0.78 (critical speed)*
150 KG FUEL *Fuel quantity is below 150 kg.*	**HYD SYST FAIL** *Hydraulic system failure.*	**GENERATOR** *Main generator failure.*
DON'T START *Fuel pressure drop is detected, do not start engine.*	**ENGINE VIBRATION** *Excessive engine vibration detected.*	**EMERGENCY GENERATOR** *Aircraft is running on emergency generator power.*
CANOPY UNLOCKED *Canopy is unlocked.*	**CABIN PRESSURE** *Cabin pressurization failure.*	**INV 115 V FAIL** *Inverter failure.*

STAND ALERT Caution
- *Indicates readiness of armament control system, lit when airspeed greater than 310 km/h*

NO LAUNCH Caution
- *Illuminated when pulling more than 2 G, which means missiles cannot precisely track target*

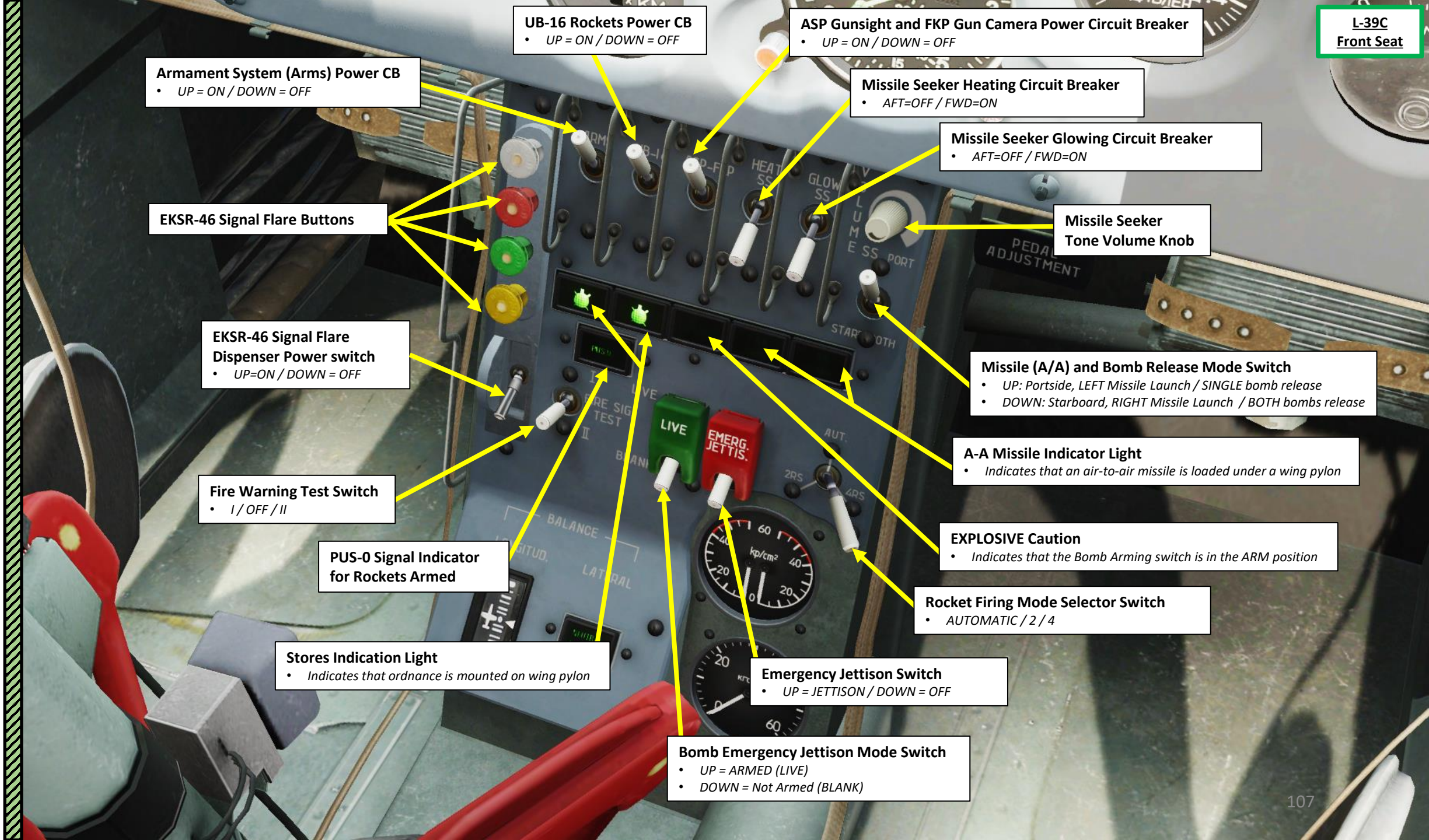
L-39C Front Seat



Caution & Advisory Panel

	WING TIP TANKS *Wing tip fuel tanks are empty. When the wingtip tanks run out of fuel and the WING TIP TANKS indicator illuminates, it is necessary to switch off the WING TANKS automatic circuit breaker on the main CB panel in the front cockpit.*	**END OF DESCENT** *Aircraft is over termination point of descent when using RSBN-5S "ISKRA-K" Short Range Navigation System*	**INV 3x36V FAIL** *Inverter Failure.*
AIRCONDIT EMERG *Air conditioning temperature regulator is in emergency mode. This is controlled by the air conditioning emergency shut-off switch in the rear cockpit, labeled AIR COND, which must be in the neutral position.*	**MARKER** *Aircraft is flying over a marker beacon*	**CONFORM AZIMUTH** *RSBN-5S "ISKRA-K" Short Range Navigation System Azimuth Channel is tuned correctly*	**ENG MIN OIL PRESS** *Oil pressure at 95% of HPC RPM is less than 3 kg/cm², for other engine modes not less than 2 kg/cm².*
Snowflake Symbol *Ice Detected*	**AIRCONDIT OFF** *Air conditioning system is OFF. This advisory appears 30 seconds after the ECS (Environmental Control System) and Pressurization Control Handle is set to OFF (AFT).*	**TURBINE STARTER** *Turbine starter (APU, auxiliary power unit) is running*	**JPT 730 DEG C** *Jet pipe temperature is over 730 deg C*
DE-ICING ON *Anti-Ice system is ON.*	**FUEL FILTER** *Fuel pressure difference is detected on the fuel filter*	**FUEL EMERG DELIVERY** *SEC. REG. (Emergency Fuel) system is ON.*	**JPT 700 DEG C** *Jet pipe temperature is over 700 deg C*


L-39C
Front Seat
FIXED
BRIGHT
УБ-12,7
ERROR GA
MC SYNCHR
FUEL
LIVE
VENTILAT
AIR LOUV
INVERTOR
GENERATOR
ENGINE
RSBN
RADIO CONTROL
VOLUME
ADF
OFF
STAND-BY
PITOT TUBE



UB-16 Rockets Power CB
- *UP = ON / DOWN = OFF*

ASP Gunsight and FKP Gun Camera Power Circuit Breaker
- *UP = ON / DOWN = OFF*

Armament System (Arms) Power CB
- *UP = ON / DOWN = OFF*

Missile Seeker Heating Circuit Breaker
- *AFT=OFF / FWD=ON*

Missile Seeker Glowing Circuit Breaker
- *AFT=OFF / FWD=ON*

EKSR-46 Signal Flare Buttons

Missile Seeker Tone Volume Knob

EKSR-46 Signal Flare Dispenser Power switch
- *UP=ON / DOWN = OFF*

Missile (A/A) and Bomb Release Mode Switch
- *UP: Portside, LEFT Missile Launch / SINGLE bomb release*
- *DOWN: Starboard, RIGHT Missile Launch / BOTH bombs release*

A-A Missile Indicator Light
- *Indicates that an air-to-air missile is loaded under a wing pylon*

Fire Warning Test Switch
- *I / OFF / II*

EXPLOSIVE Caution
- *Indicates that the Bomb Arming switch is in the ARM position*

PUS-0 Signal Indicator for Rockets Armed

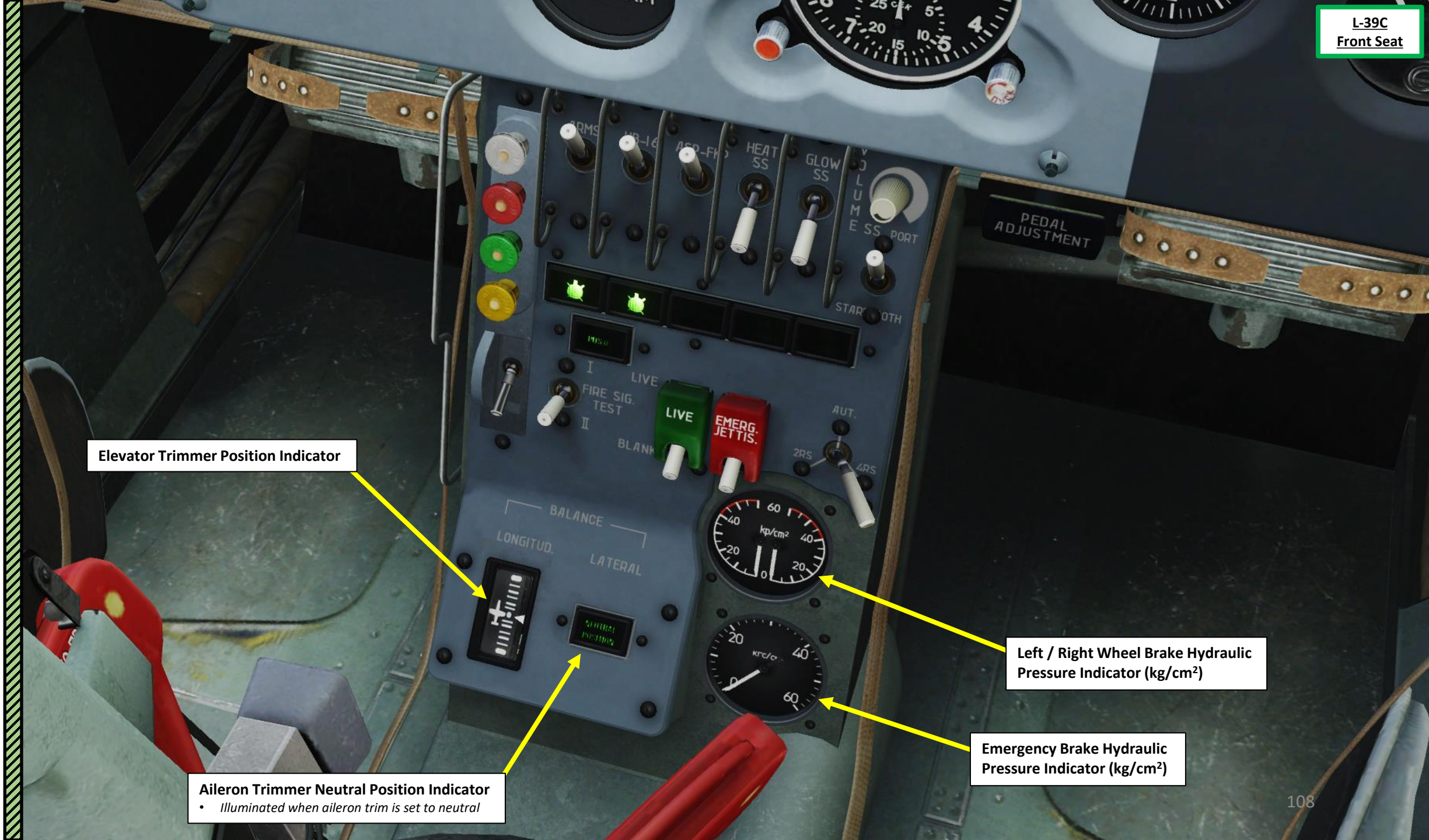
Rocket Firing Mode Selector Switch
- *AUTOMATIC / 2 / 4*

Stores Indication Light
- *Indicates that ordnance is mounted on wing pylon*

Emergency Jettison Switch
- *UP = JETTISON / DOWN = OFF*

Bomb Emergency Jettison Mode Switch
- *UP = ARMED (LIVE)*
- *DOWN = Not Armed (BLANK)*

L-39C
Front Seat



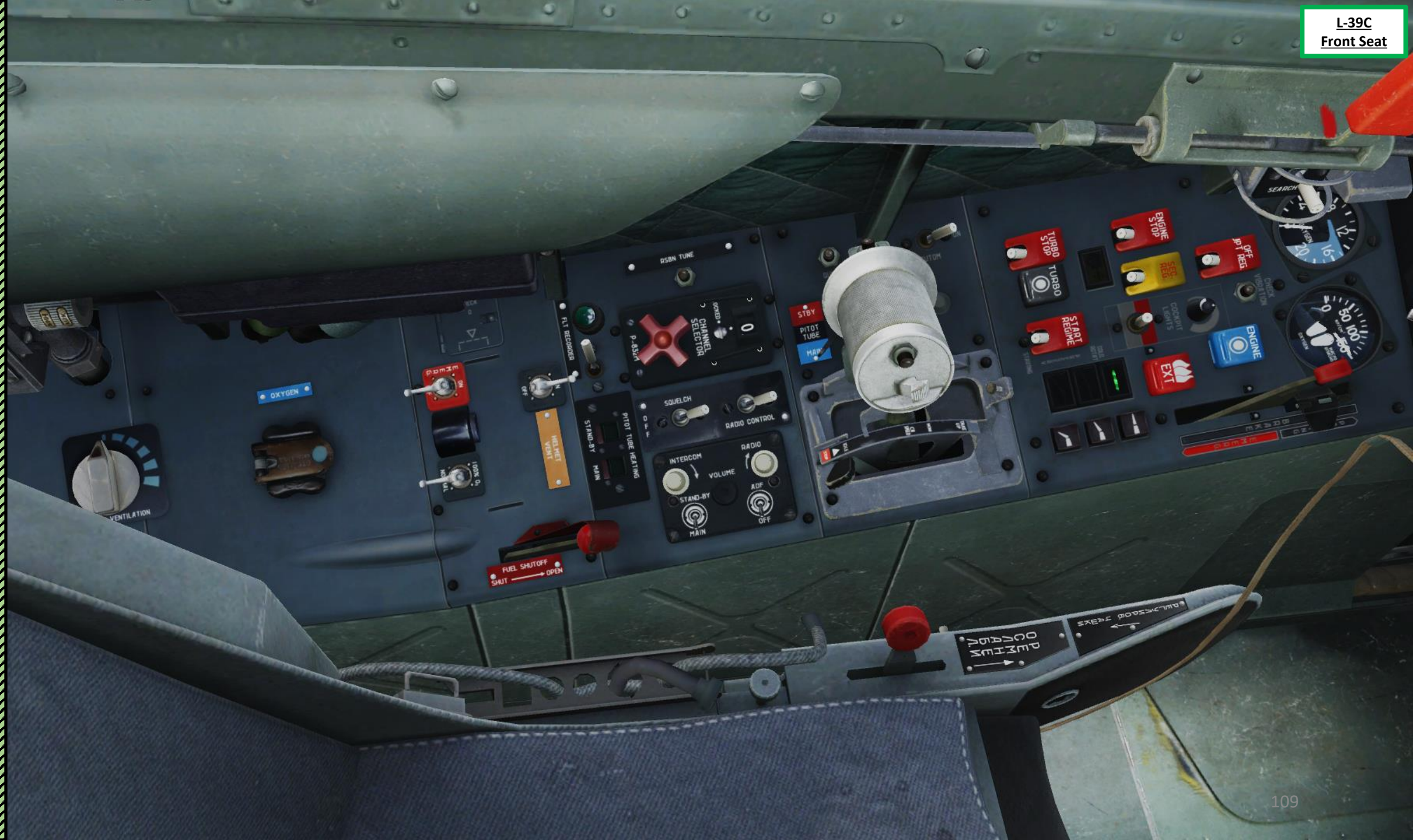
Elevator Trimmer Position Indicator

Aileron Trimmer Neutral Position Indicator
- *Illuminated when aileron trim is set to neutral*

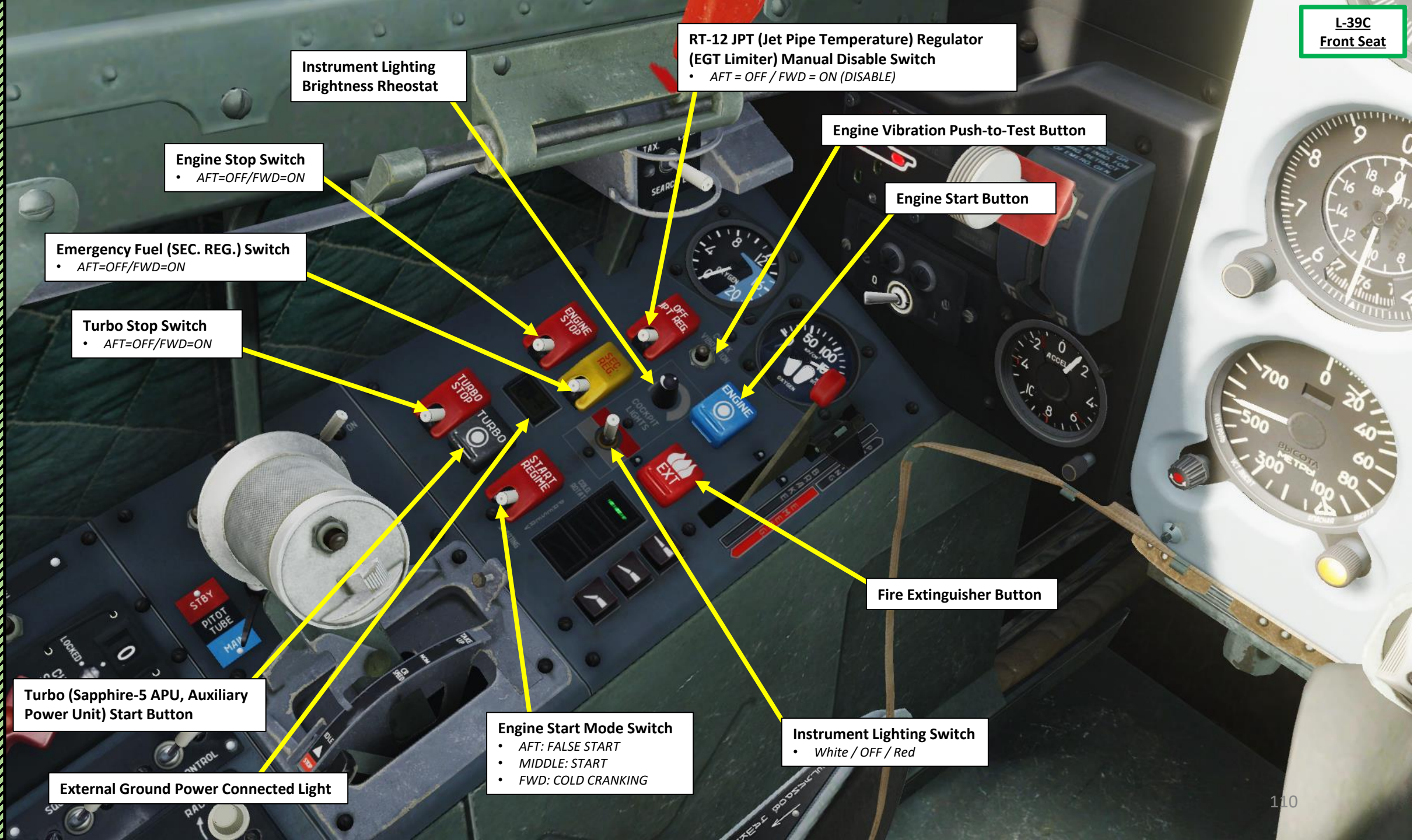
Left / Right Wheel Brake Hydraulic Pressure Indicator (kg/cm²)

Emergency Brake Hydraulic Pressure Indicator (kg/cm²)

L-39C
Front Seat



L-39C
Front Seat



L-39C
Front Seat

L-39C
Rear Seat

L-39C
Rear Seat

L-39C Rear Seat

L-39C
Rear Seat

L-39C Rear Seat

L-39C Rear Seat

STAND ALERT Caution
- *Indicates readiness of armament control system, lit when airspeed greater than 310 km/h*

NO LAUNCH Caution
- *Illuminated when pulling more than 2 G, which means missiles cannot precisely track target*

Master Caution Light

EXPLOSIVE Caution
- *Indicates that weapons are armed and LIVE*

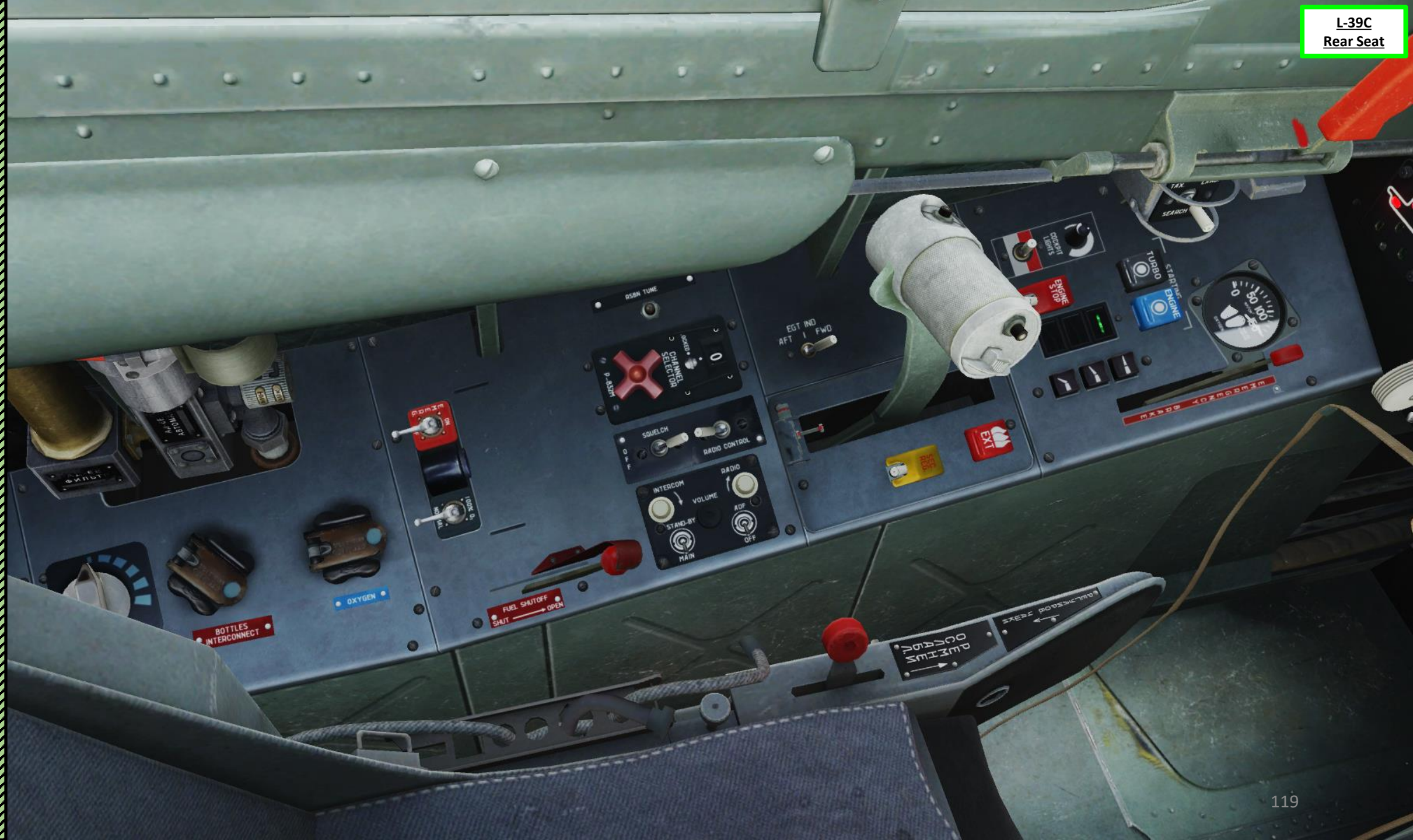
Warning Panel

FIRE *Engine fire detected.*	**DANGEROUS ALTITUDE** *Aircraft is below radar warning altitude.*	**M MAX** *Aircraft airspeed is overspeeding above Mach 0.78 (critical speed)*
150 KG FUEL *Fuel quantity is below 150 kg.*	**HYD SYST FAIL** *Hydraulic system failure.*	**GENERATOR** *Main generator failure.*
DON'T START *Fuel pressure drop is detected, do not start engine.*	**ENGINE VIBRATION** *Excessive engine vibration detected.*	**EMERGENCY GENERATOR** *Aircraft is running on emergency generator power.*
CANOPY UNLOCKED *Canopy is unlocked.*	**CABIN PRESSURE** *Cabin pressurization failure.*	**INV 115 V FAIL** *Inverter failure.*

Caution & Advisory Panel

	WING TIP TANKS *Wing tip fuel tanks are empty. When the wingtip tanks run out of fuel and the WING TIP TANKS indicator illuminates, it is necessary to switch off the WING TANKS automatic circuit breaker on the main CB panel in the front cockpit.*	**END OF DESCENT** *Aircraft is over termination point of descent when using RSBN-5S "ISKRA-K" Short Range Navigation System*
AIRCONDIT EMERG *Air conditioning temperature regulator is in emergency mode. This is controlled by the air conditioning emergency shut-off switch in the rear cockpit, labeled AIR COND, which must be in the neutral position.*	**MARKER** *Aircraft is flying over a marker beacon*	**AZIMUTH CORRECT** *RSBN-5S "ISKRA-K" Short Range Navigation System Azimuth Channel is tuned correctly*
Snowflake Symbol *Ice Detected*	**AIRCONDIT OFF** *Air conditioning system is OFF. This advisory appears 30 seconds after the ECS (Environmental Control System) and Pressurization Control Handle is set to OFF (AFT).*	**DISTANCE CORRECT** *RSBN-5S "ISKRA-K" Short Range Navigation System Distance Channel is tuned correctly*
DE-ICING ON *Anti-Ice system is ON.*	**FUEL FILTER** *Fuel pressure difference is detected on the fuel filter*	**FUEL EMERG DELIVERY** *SEC. REG. (Emergency Fuel) system is ON.*

L-39C
Rear Seat

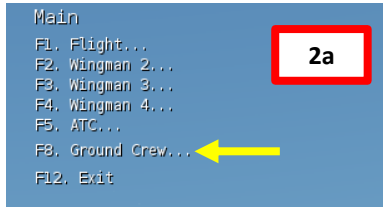


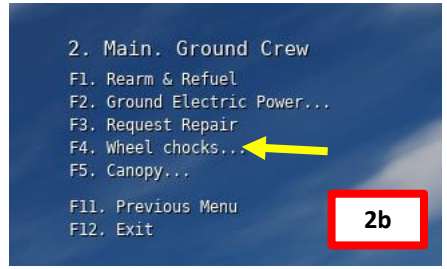
L-39C
Rear Seat

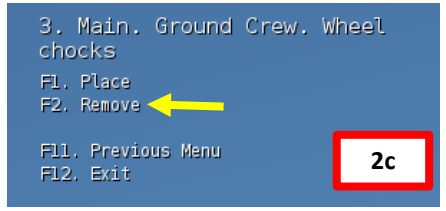

09

A – BEFORE START-UP

1. Perform exterior checks and request ground crew to install required ordnance for the mission.
2. If wheel chocks are installed, remove them by contacting ground crew since the aircraft is equipped with a parking brake.
   a) Press "\" (Communication Menu) and "F8" to select ground crew.
   b) Select "Wheel Chocks" by pressing "F4".
   c) Select "REMOVE" by pressing "F2" to remove wheel chocks.

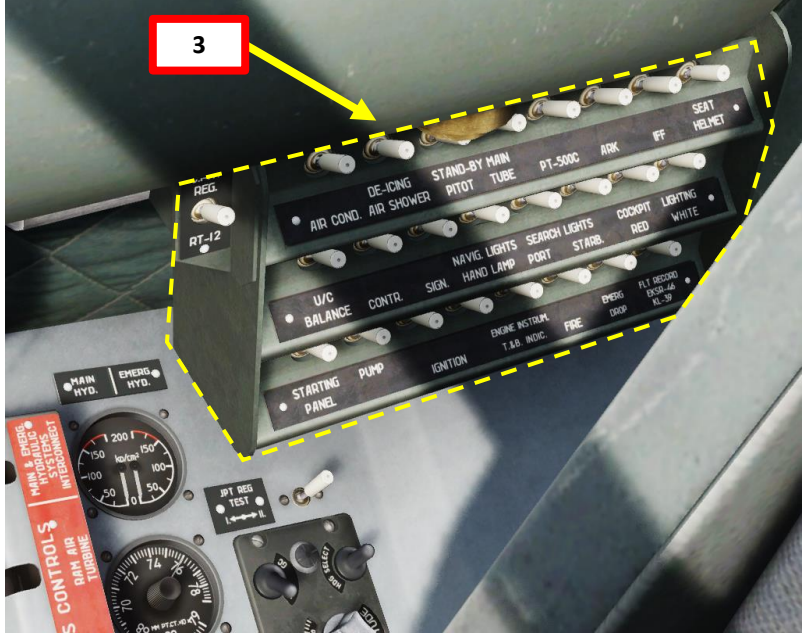


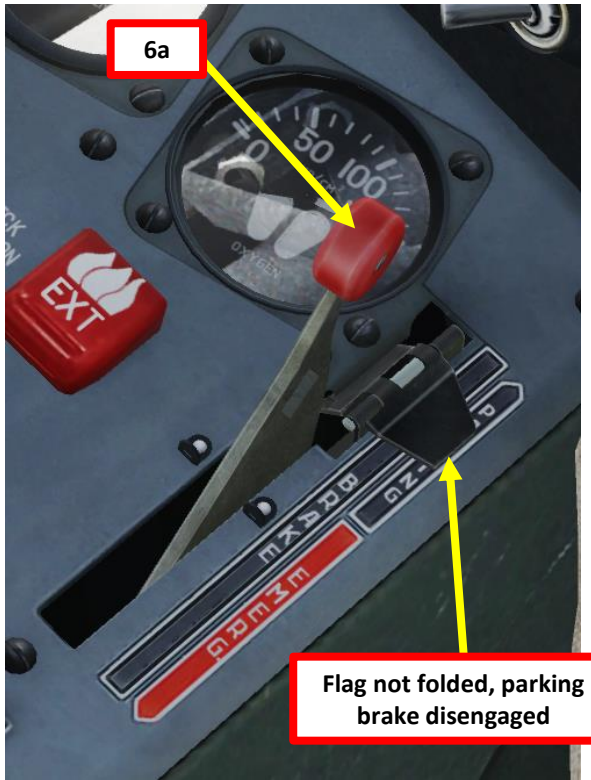


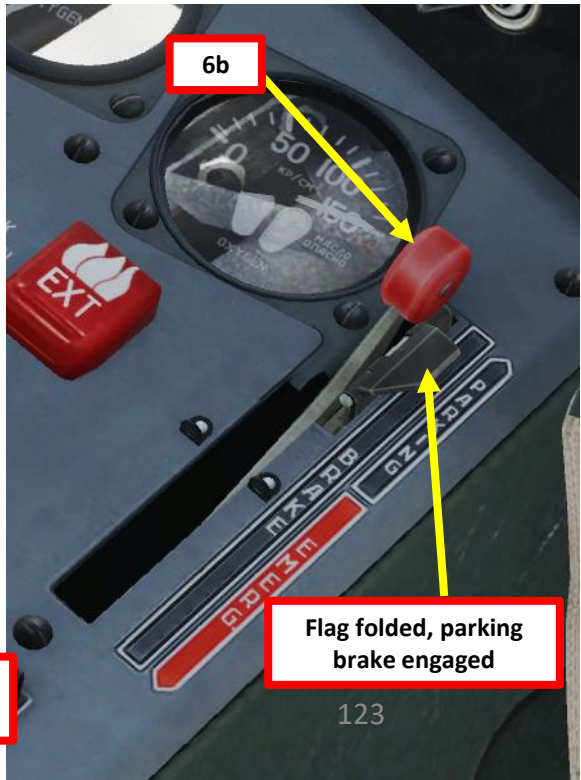


A – BEFORE START-UP

3. Ensure all circuit breakers on electrical panel are ON (UP)
4. Set Battery ACB (Automatic Circuit Breaker) – ON (FWD)
5. Confirm that Voltmeter reading indicates 24 Volts or higher.
6. Set Parking Brake – ON.
    - Bring all the way forward and ensure lever touches the black flag to set to PARKING.

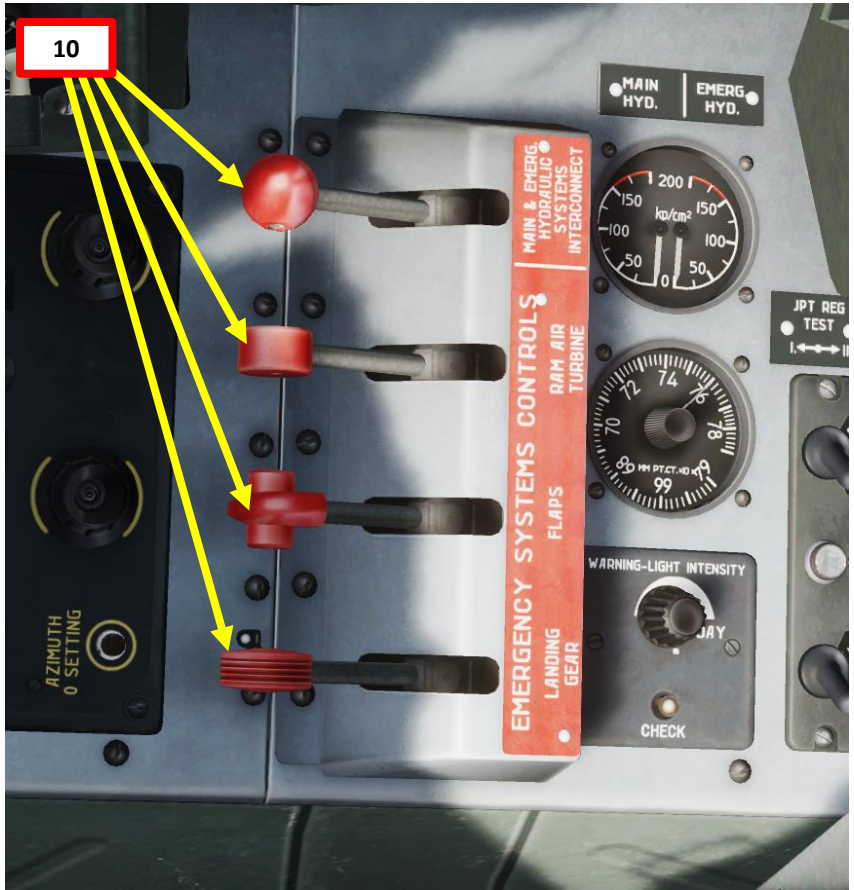


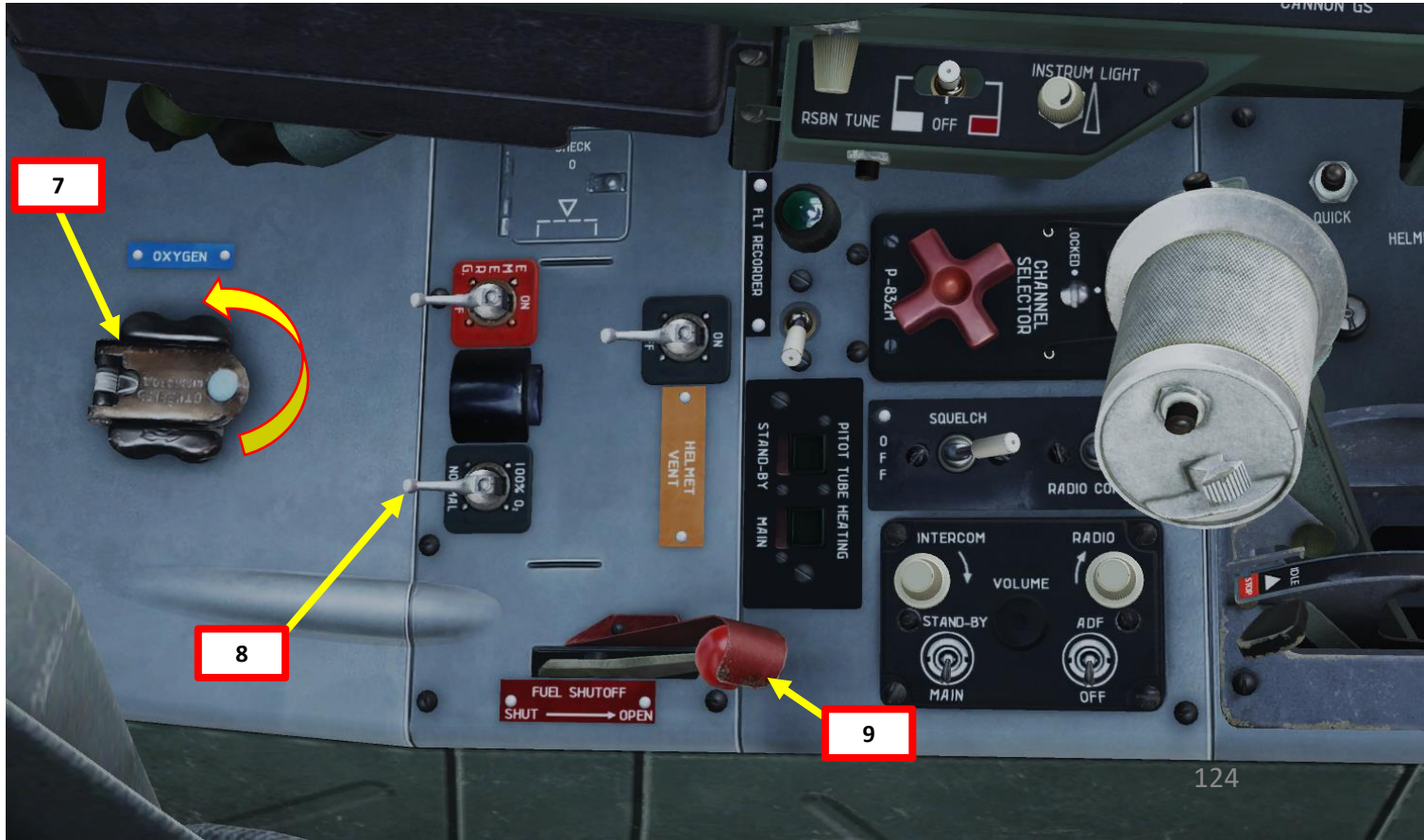




A – BEFORE START-UP

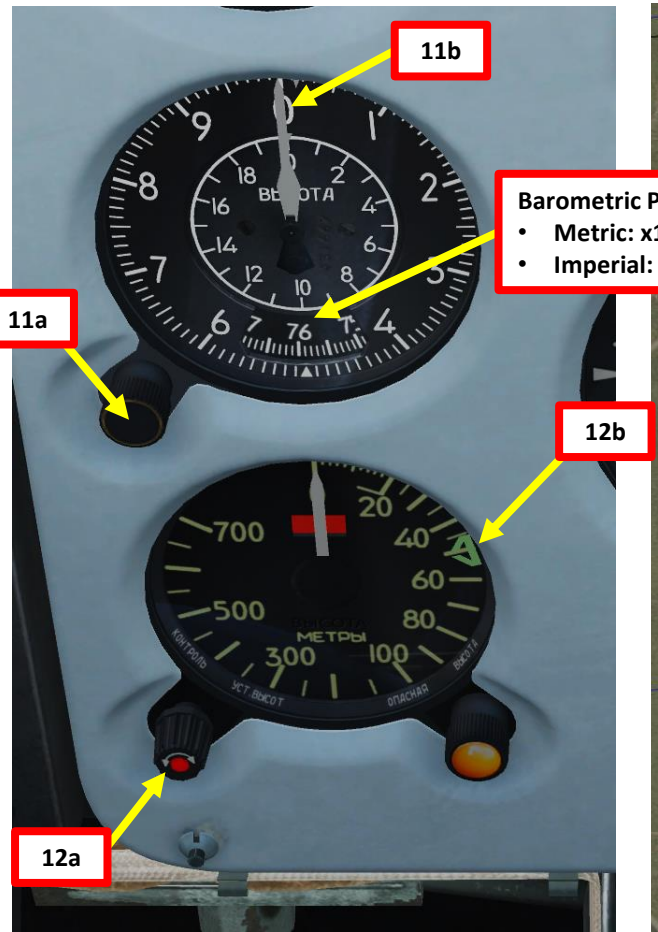
7. Open Oxygen Valve with mousewheel - Turn Counter-Clockwise
8. Set Diluter Demand Switch – NORMAL (AFT)
9. Set Fuel Shutoff Lever – FORWARD AND GUARDED (OPEN)
10. Set Hydraulic Emergency Levers – OFF (FWD)





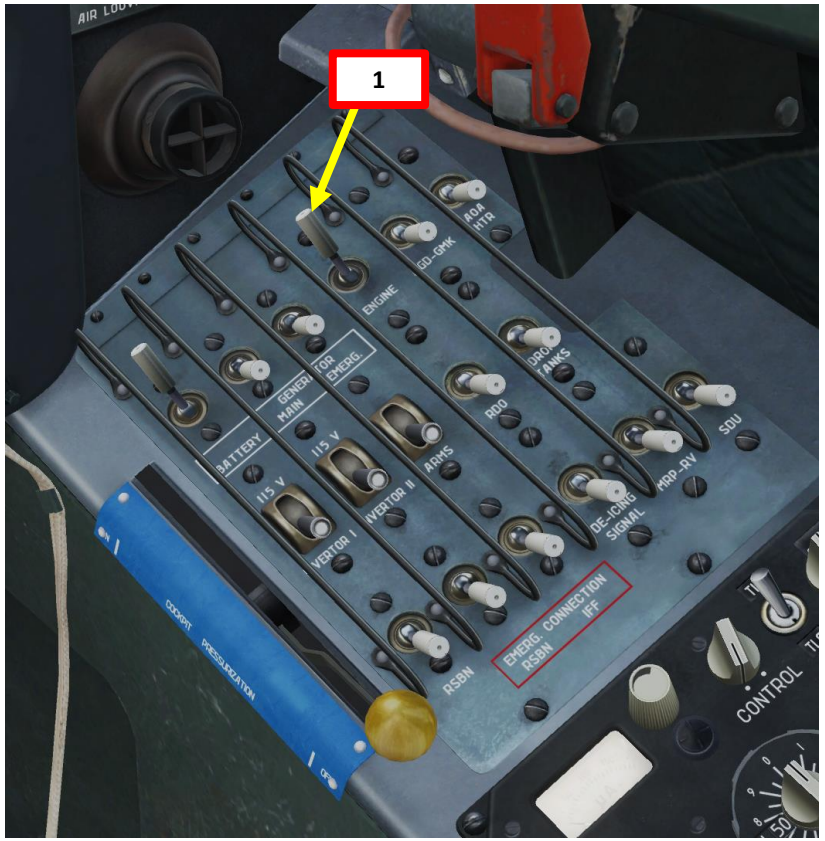
A – BEFORE START-UP

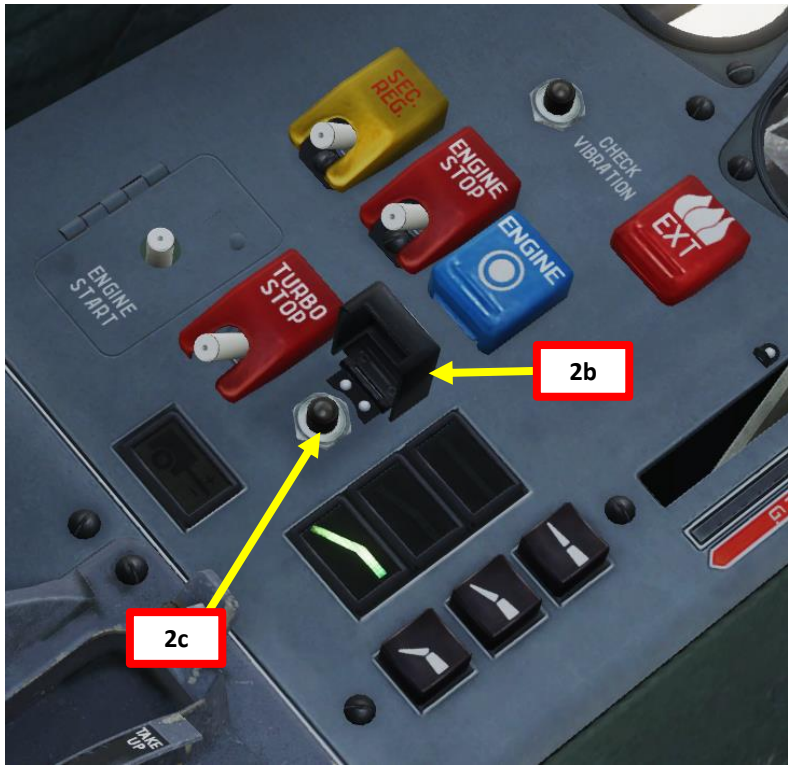
11. Set altimeter barometric pressure setting.
    - If airfield elevation data is available, you can adjust the barometric pressure knobs to make the altimeter reading match the airfield elevation (which would be 13 m in our case since we takeoff from Senaki-Kolkhi). However, you will have to keep in mind that your altitude reading will be AMSL (Above Mean Sea Level), not above ground level. This is important to remember when being directed by the ATC (Air Traffic Controller). For airfields with variable elevation, you might want to perform this step when lined up on the runway.
    - Alternatively, you can set the barometric pressure knob to make the altimeter reading match "0". In that case, the altitude reading will be AGL (Above Ground Level), not from sea level.
12. Set desired "Dangerous Height" bug on radar altimeter by rotating lower left knob (recommended: 50 m, or 160 ft)



B – TURBO/APU (AUXILIARY POWER UNIT) START-UP

1. Set Engine ACB (Automatic Circuit Breaker) – ON (FWD)
2. Flip TURBO safety cover switch and press the TURBO button to start APU



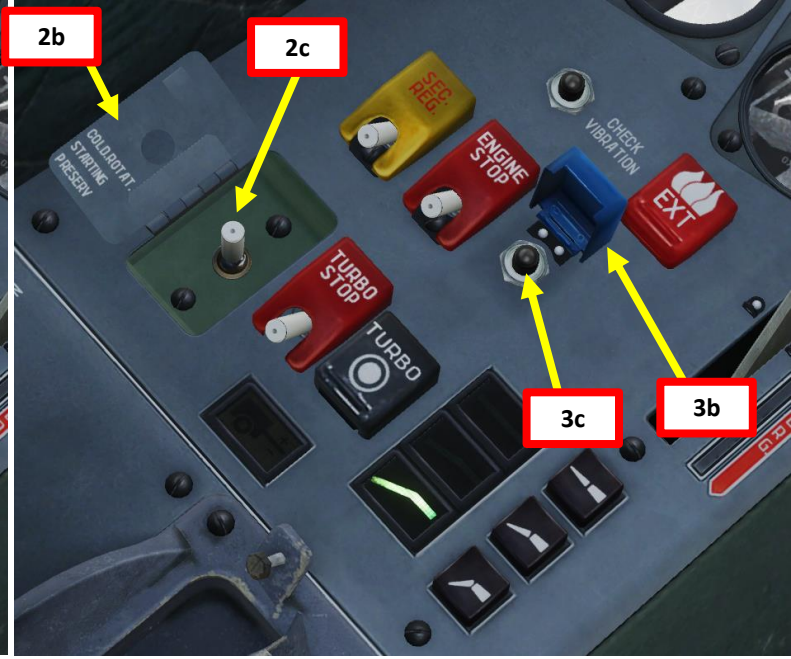


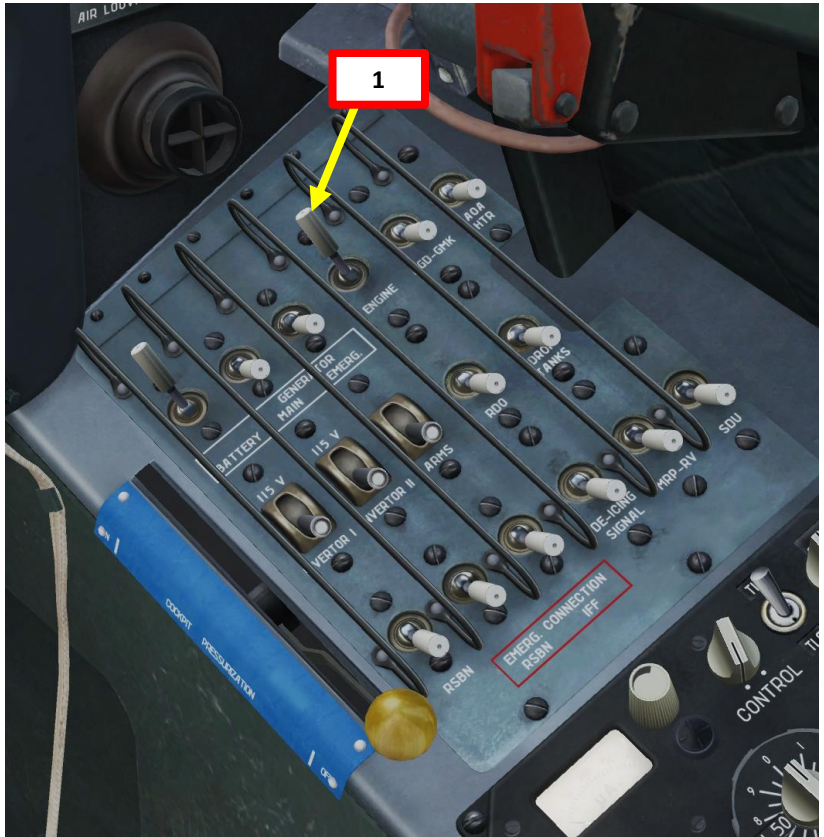
B – TURBO/APU (AUXILIARY POWER UNIT) START-UP

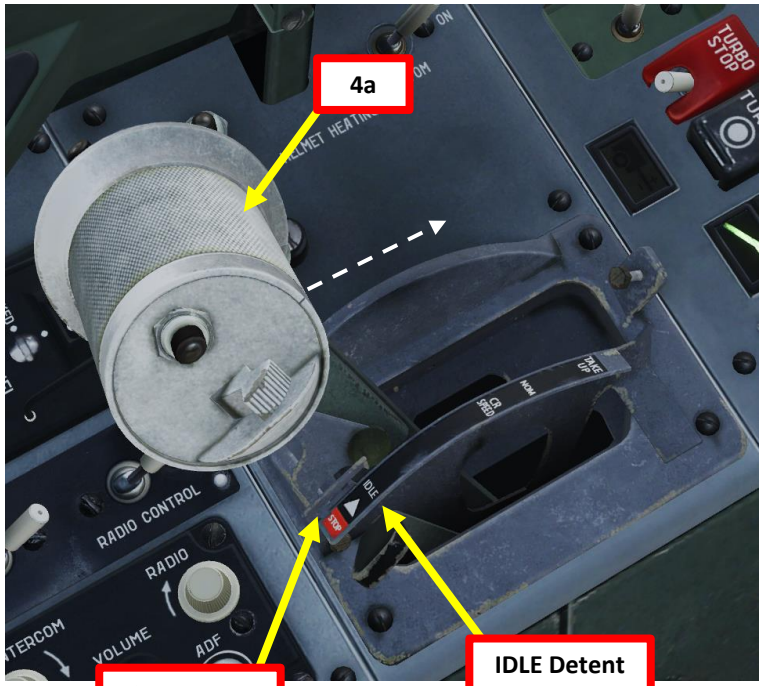
3. Within 25 seconds, the “TURBINE STARTER” caution light on the caution panel should illuminate to indicate that APU is running.
4. The APU will provide pneumatic air pressure to drive the engine starter.

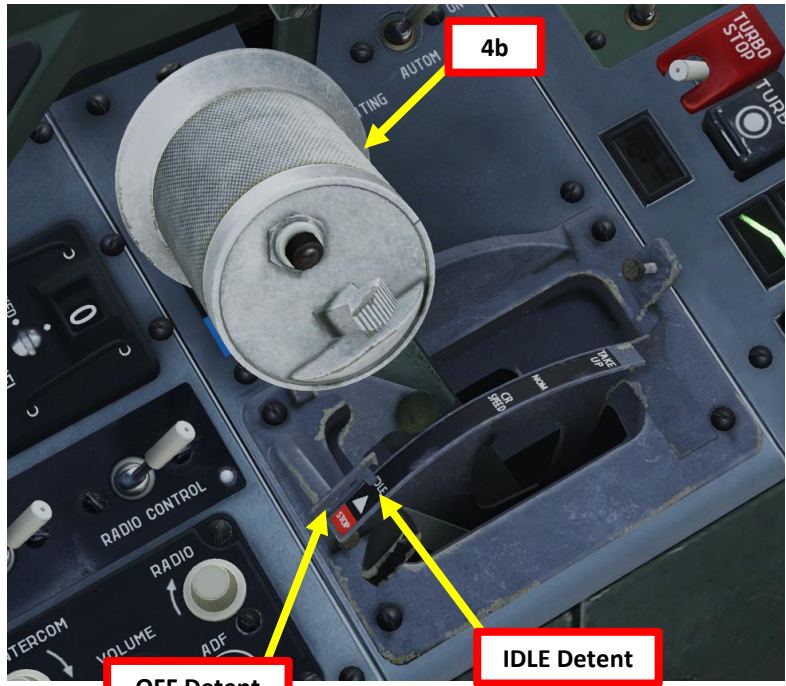
C – ENGINE START-UP

1. Verify Engine ACB (Automatic Circuit Breaker) is set to ON (FWD)
2. Open Engine Start Mode Switch Panel and ensure the Engine Start Mode Switch is set to the MIDDLE (START) position.
3. Flip ENGINE safety cover switch and press the ENGINE STARTER button for 3 seconds to start the engine.
    - The engine starter is driven by pneumatic air pressure supplied by the APU (Auxiliary Power Unit).
4. Approximately 3 to 6 seconds after pressing the ENGINE STARTER button, move throttle from OFF detent to the IDLE detent by pressing RAlt+HOME.



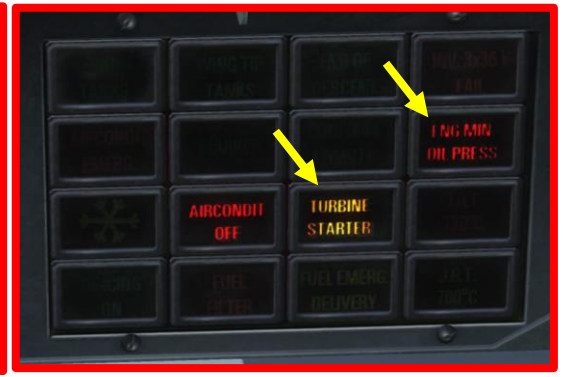




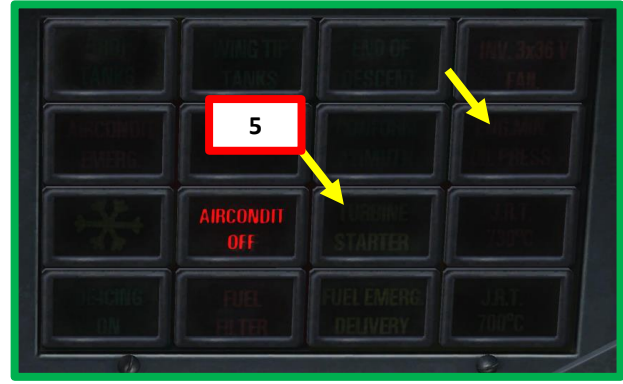


C – ENGINE START-UP

4. Observe engine parameters rising and ensure your N1 reaches IDLE setting within 50 seconds. Engine parameters should stabilize at the following values:
   - N1 (High-Pressure Compressor) Speed: 56 % RPM
   - N2 (Low-Pressure Compressor) Speed: 30 % RPM
   - JPT/EGT (Jet Pipe Temperature/Exhaust Gas Temperature): no more than 600 deg C
   - Oil pressure: above 2 kg/cm^2. Confirm ENG MIN OIL PRESS warning is not visible.
5. When Engine HPC (High-Pressure Compressor) RPM reaches 41,5—44,5% within 45 seconds, the Sapphire-5 APU automatically shuts off, air starter disconnects, TURBINE STARTER signal goes off, finishing starting cycle.
6. Engine reaches IDLE mode (HPC RPM within 56±1,5%;) on its own.

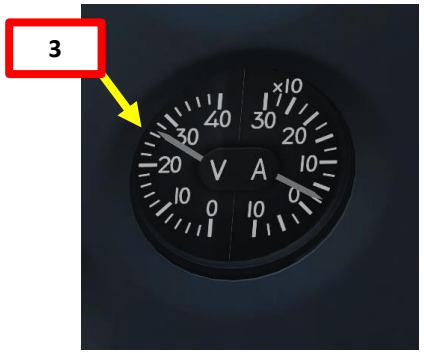


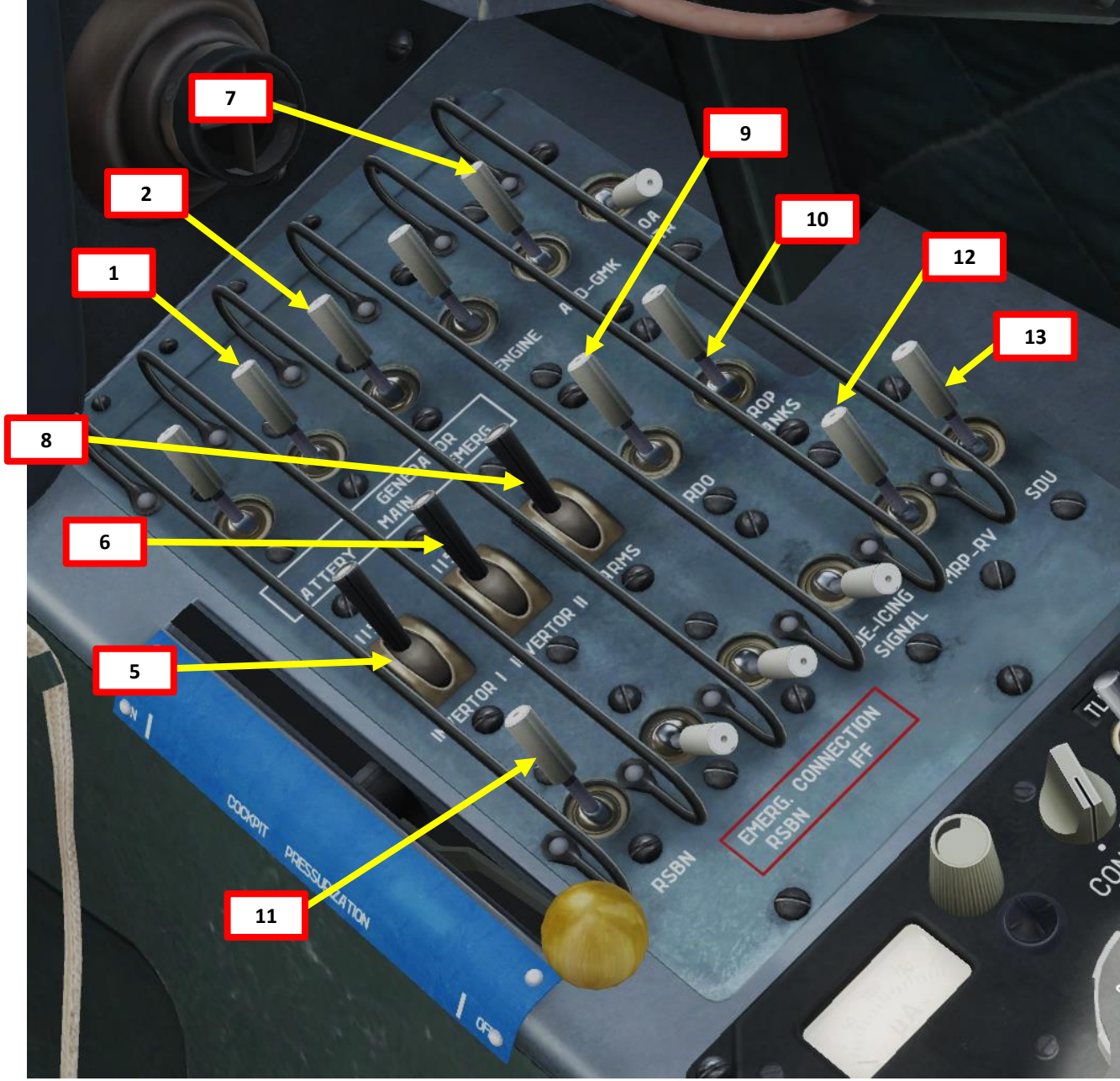
Engine Tachometer (%RPM)
- **Needle 1: High-Pressure Compressor (HPC) Speed**
- **Needle 2: Low-Pressure Compressor (LPC) Speed**



D – POST START-UP

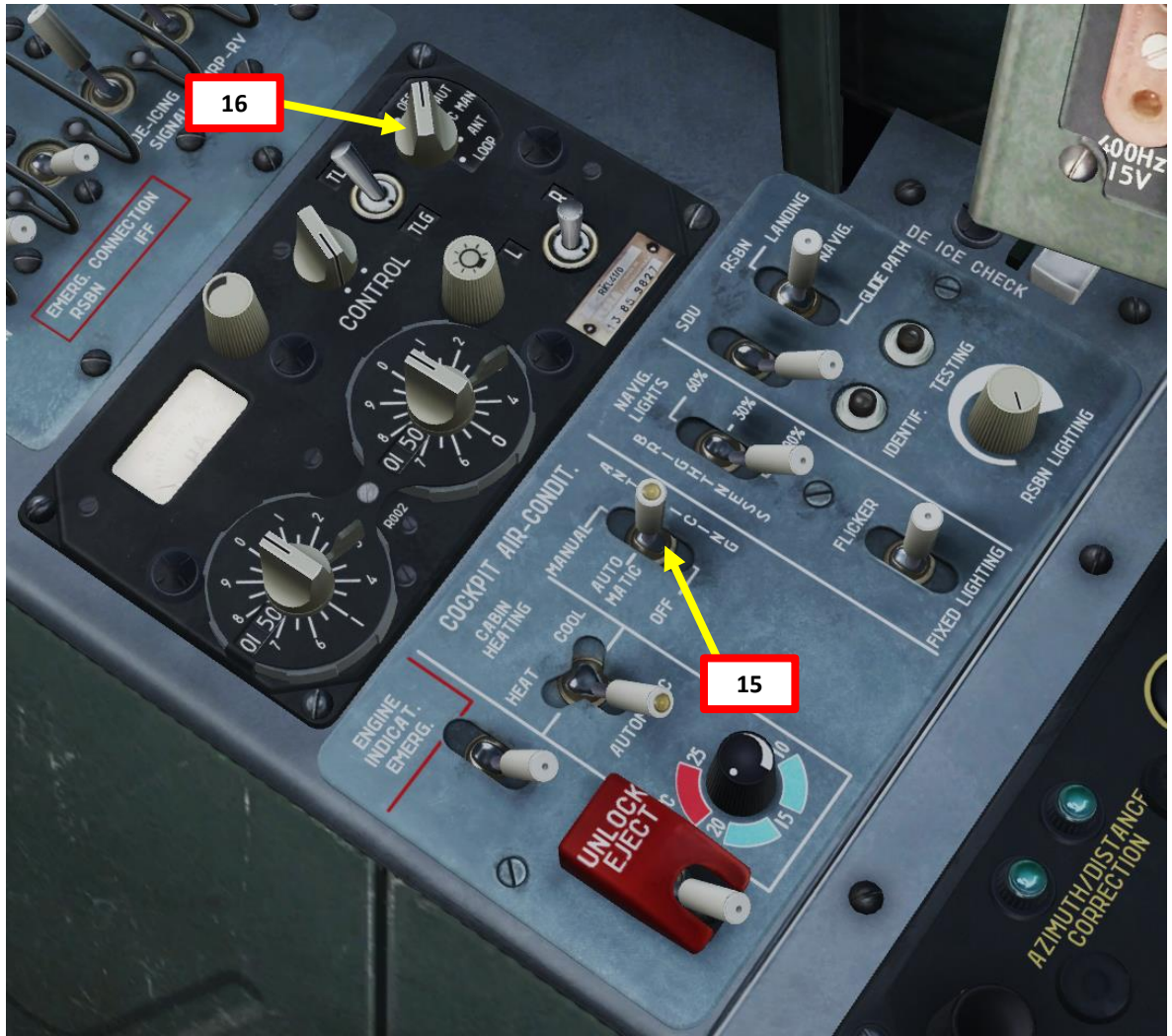
1. Set Main Generator ACB (Automatic Circuit Breaker) – ON (FWD)
2. Set Emergency Generator ACB – ON (FWD)
3. Check that Voltmeter reading indicates between 27 and 29 Volts.
4. Confirm GENERATOR and EMERGENCY GENERATOR cautions are extinguished.
5. Set Inverter #1 (115V) ACB – ON (FWD)
6. Set Inverter #2 (115V) ACB – ON (FWD)
7. Set AGD-GMK Directional Gyro ACB – ON (FWD)
8. Set Weapons (ARMS) ACB – ON (FWD)
9. Set RDO (Intercom & Radio) ACB – ON (FWD)
10. If external drop tanks are installed or wingtip tanks are filled (internal fuel level is above 84 %), set External Fuel Drop Tank & Wingtip Tank Status Indication System ACB – ON (FWD). Otherwise, leave OFF (AFT).
11. Set RSBN-5S (ISKRA-K) ACB – ON (FWD)
12. Set MRP-RV (Marker Beacon Receiver & Radio Altimeter) ACB – ON (FWD)
13. Set SDU (Remote Command Landing System) ACB – ON (FWD)

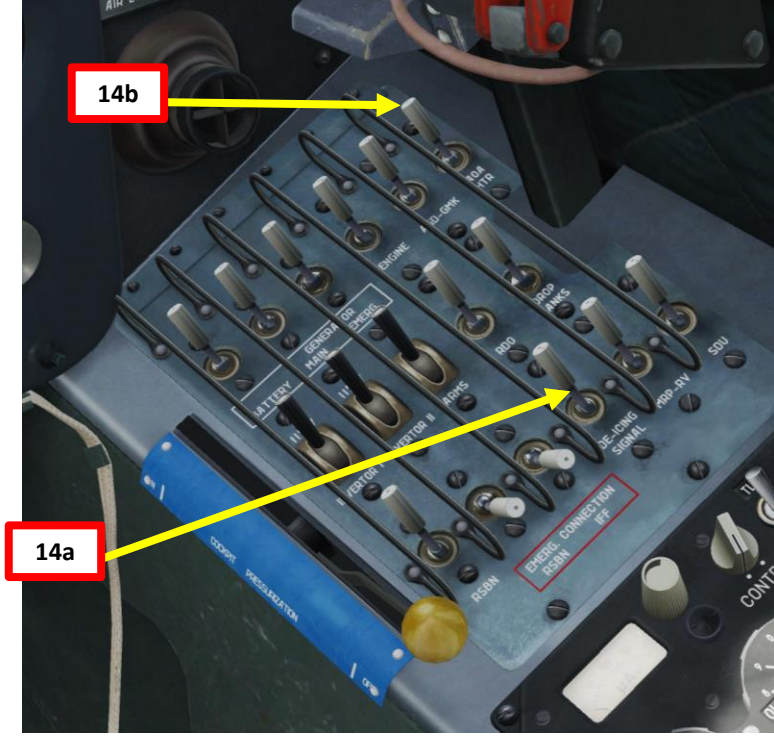


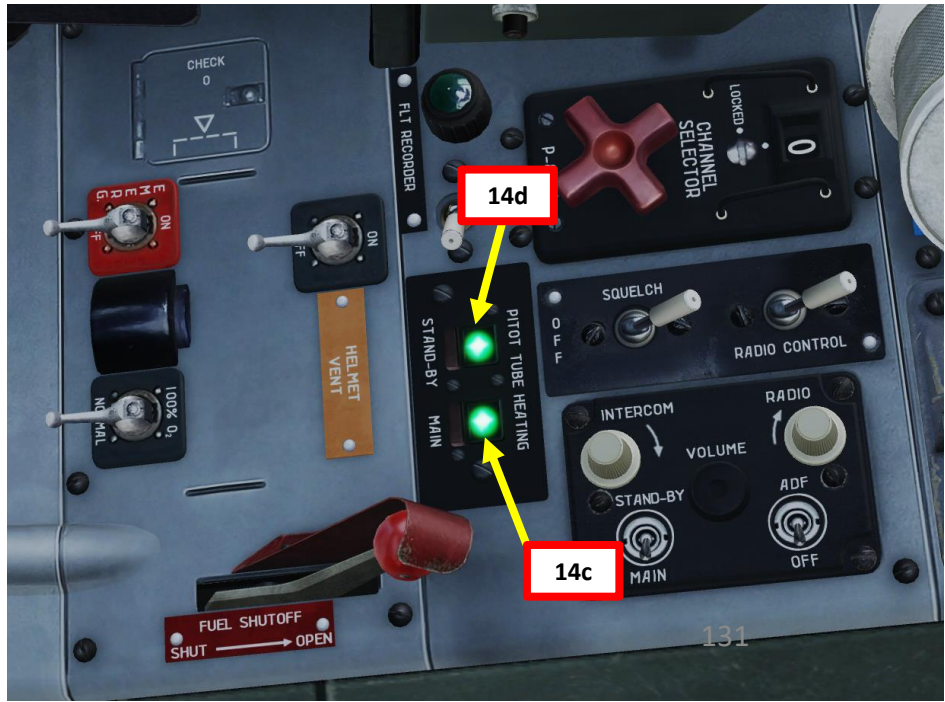


D – POST START-UP

14. If ambient temperature is below 5 deg C or you are flying in adverse conditions:
    a) Set RIO-3 De-Icing Signal ACB – ON (FWD)
    b) Set AoA (Angle of Attack) Sensor Heater ACB – ON (FWD)
    c) Set Main Pitot Tube Heating – ON
    d) Set Standby Pitot Tube Heating – ON
15. Set De-Icing Mode Switch – AUTOMATIC (MIDDLE)
16. Set RKL-41 ADF (Automatic Direction Finder) Operation Mode – C AUT (Compass Automatic).

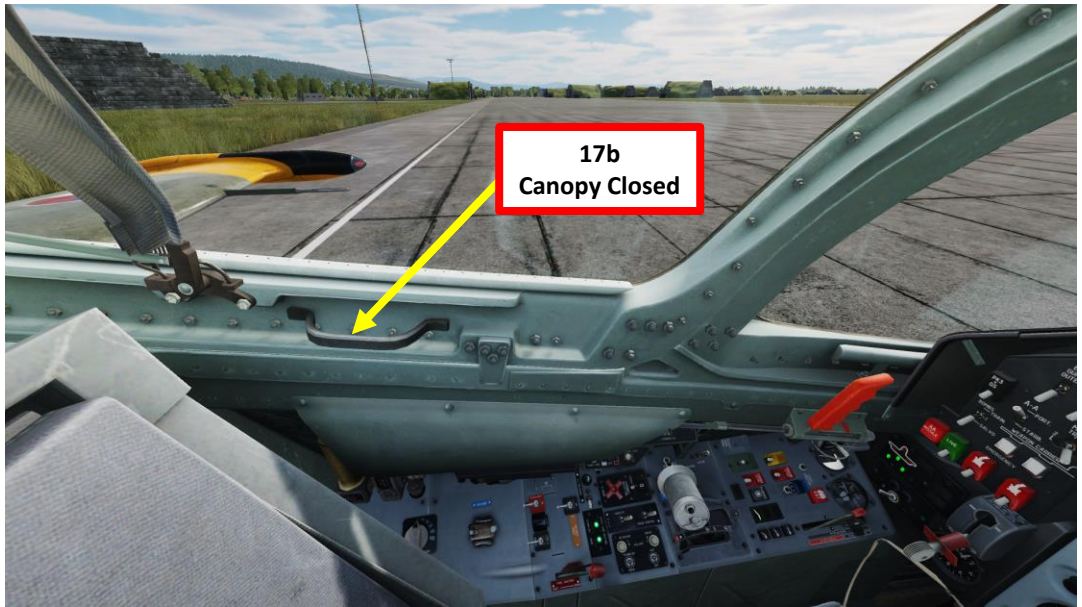






D – POST START-UP

17. Close canopy by pulling on the canopy handle (right click).
    - Alternatively, you can also request the ground crew to close the canopy for you.

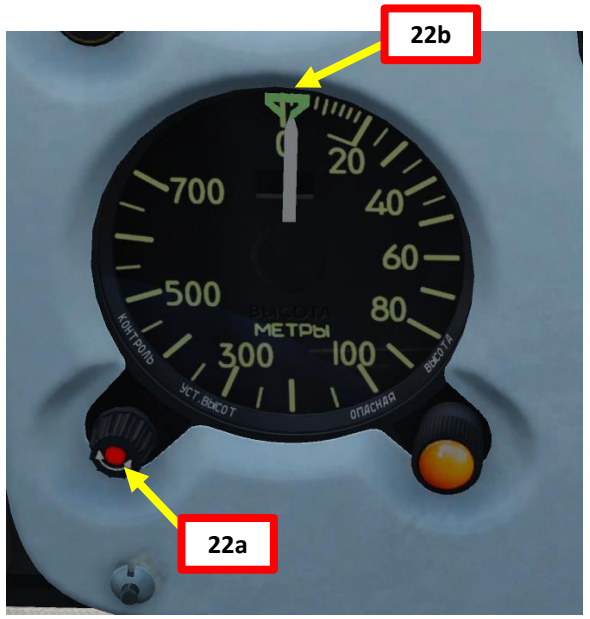


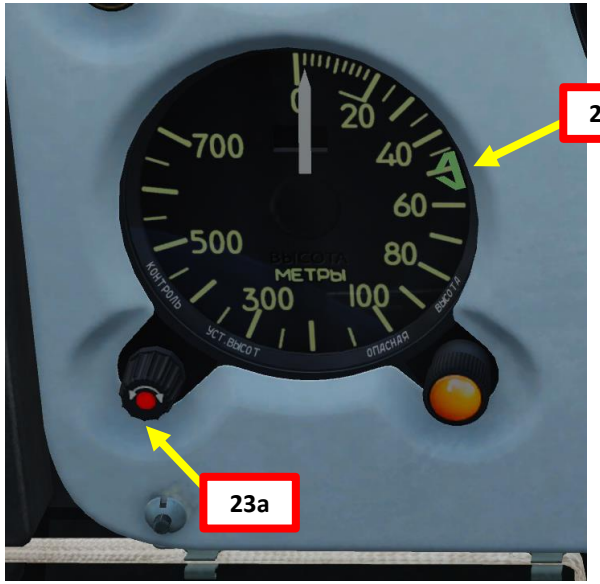
D – POST START-UP

18. Lock Canopy by pushing the Lock Handle forward
19. Pressurize cockpit by setting the ECS (Environmental Control System) and Pressurization Control Handle FWD (ON).
20. Wait 30 seconds for the ECS to pressurize the cockpit, then confirm that the CANOPY UNLOCKED and AIRCONDIT OFF cautions are both extinguished.

D – POST START-UP

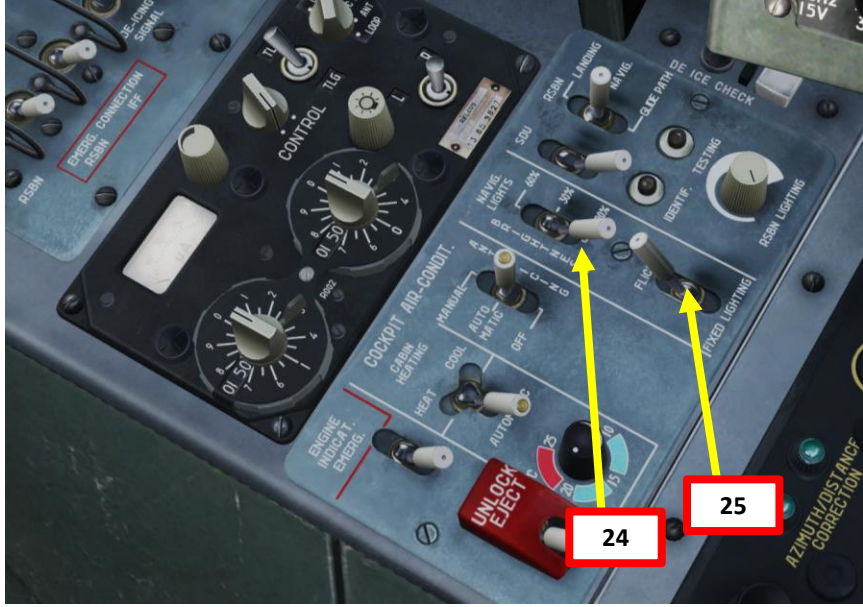
21. An automated “Dangerous Altitude” test will be performed on the radar altimeter. This test is accompanied by:
    a) An audio warning sound
    b) The radar altimeter warning light illuminating
    c) A flashing DANGEROUS ALTITUDE caution
22. Set your “Dangerous Altitude” index to 0 by rotating lower left knob. This will extinguish the warning light and stop the warning tone.
23. Set desired “Dangerous Height” bug on radar altimeter to the value set previously (50 m, or 160 ft) by rotating lower left knob.





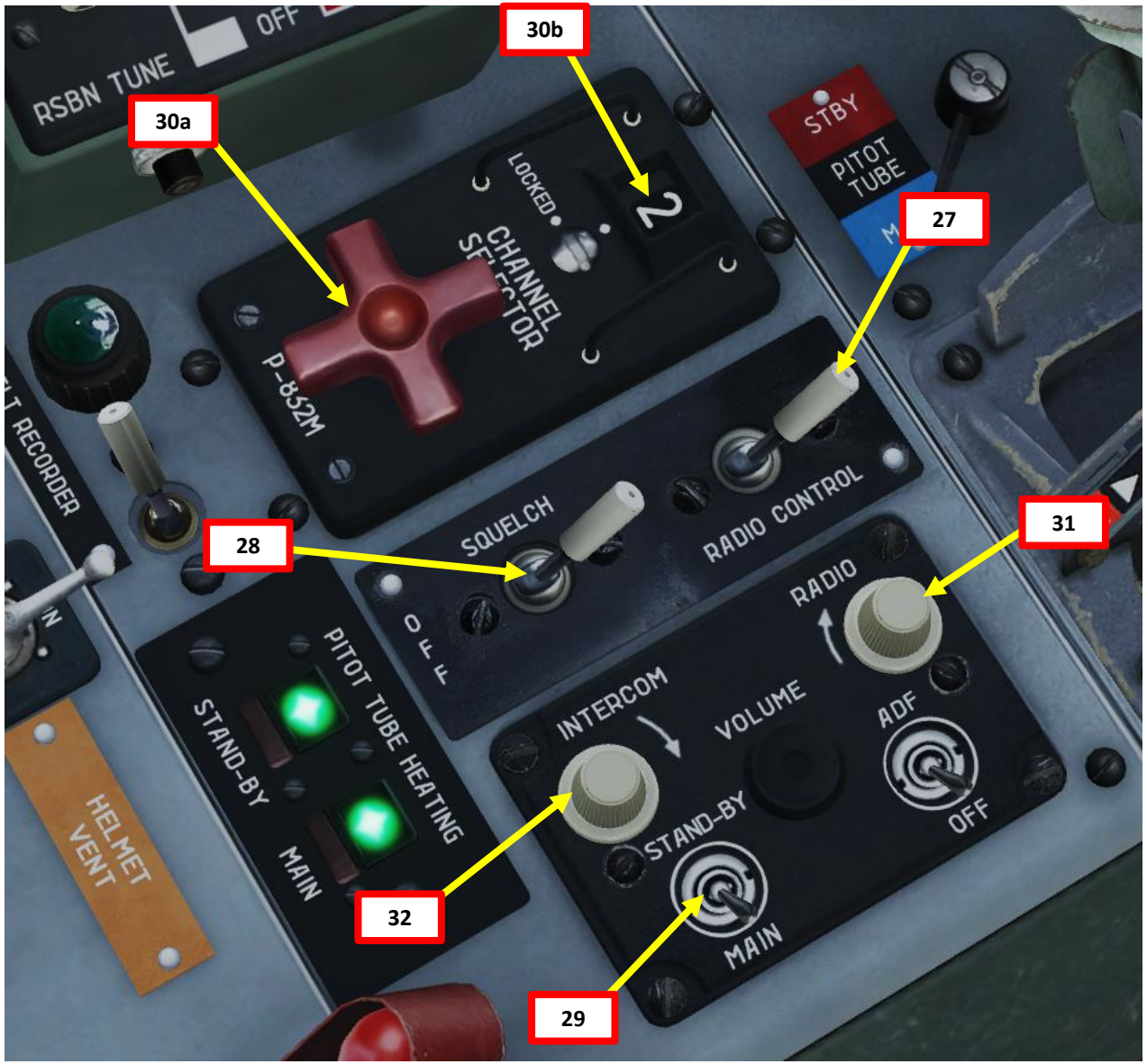
D – POST START-UP

24. Set Navigation Lights Brightness Switch – As Required (100 %)
25. Set Navigation Lights Mode Switch – As Required (Flickering Lights, FWD)
26. Set Taxi & Landing Light Switch – TAXI (AFT)



D – POST START-UP

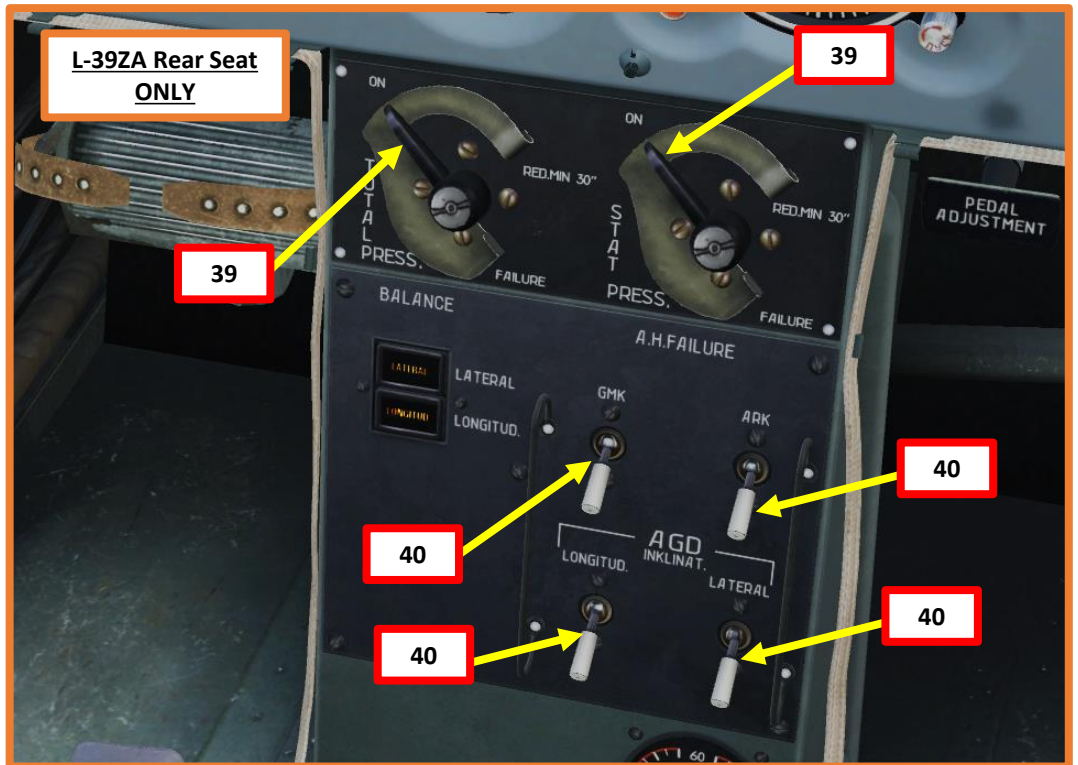
27. Set R-832 Radio Control Switch – FRONT/FWD.
    Radio transmission will be controlled by the front cockpit.
28. Set R-832 Radio Squelch Switch – ON (FWD).
29. Set SPU-9 Intercom Mode Switch – MAIN.
30. Set R-832 Radio Preset Channel Selector – As required by Mission Briefing. In this example, the tower is on Channel 2.
31. Adjust Radio Volume – As required.
32. Adjust Intercom Volume – As required.

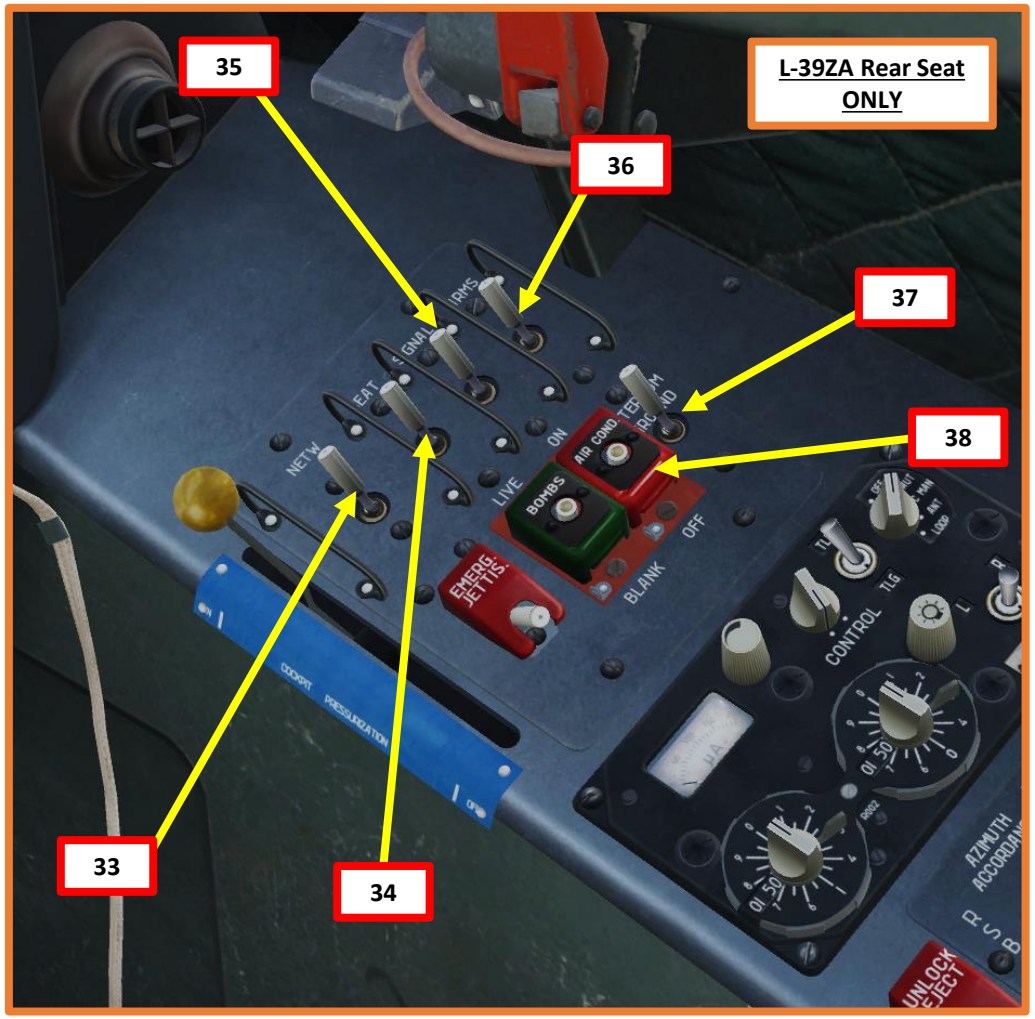


D – POST START-UP

From the Rear Seat (if flying with an Instructor):

33. Set Network ACB Switch – ON (FWD)
    - This switch allows inclusion of any current source into the onboard network.
34. Set Seat ACB Switch – ON (FWD)
    - This switch supplies the rear cockpit seat height adjustment mechanism.
35. Set Signal ACB Switch – ON (FWD)
    - This switch supplies indicator lamps on all indicator panels in the rear cockpit
36. Set Weapons (ARMS) ACB Switch – ON (FWD)
    - This switch supplies the weapon control ACB in front cockpit. This CB is a command one, overriding that of front cockpit
37. Set Ground Intercom Switch – As Required (ON/FWD).
38. Verify Air Conditioning Shutoff Switch – FRONT COCKPIT CONTROL (MIDDLE).
39. Verify that Total Pressure Pitot Failure Simulation Switch and Static Pressure Pitot Failure Simulation Switch are set to ON (Pitot Functional).
40. Set GMK, ARK, AGD LONGITUD and AGD LATERAL Failure Simulation Switches – DOWN (Failure Inactive)



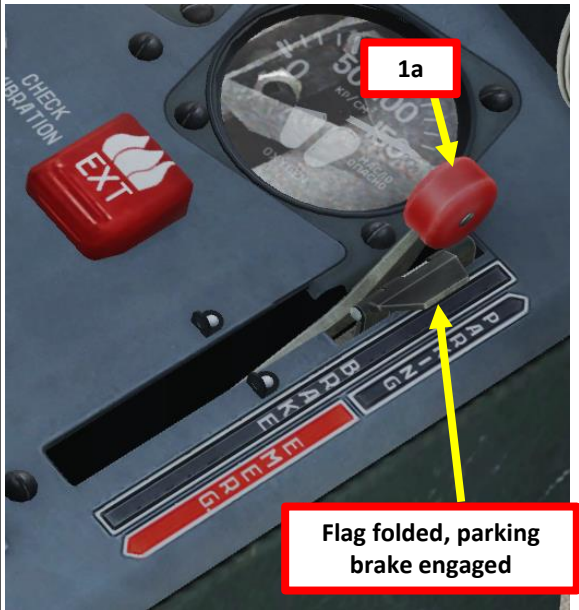


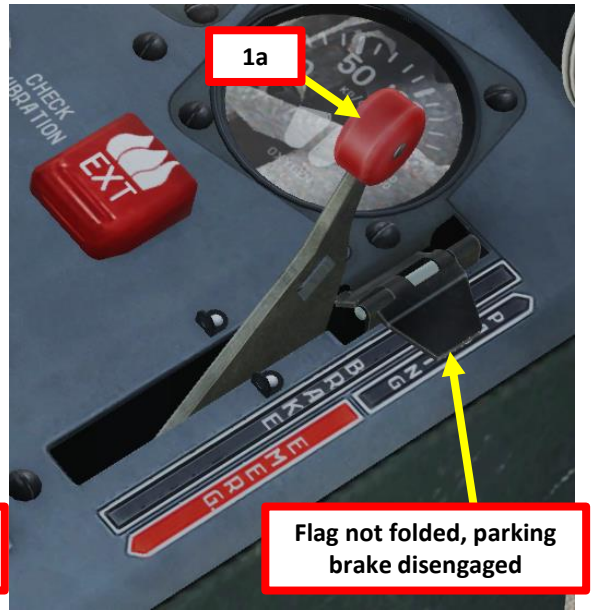
D – POST START-UP

41. You are now ready to taxi.

TAXI

1. Release/disengage parking brake
    a) Bring the parking brake lever to the CENTER position and ensure the lever does not touch the black flag.
    b) Tap then release the Wheel Brake Lever.
2. Set Flaps to Takeoff Position (25 deg)
3. Increase throttle to start taxiing.
4. Turn by holding the Wheel Brake lever and using the rudder pedals to steer the aircraft. As an example, you can steer right by holding the brake lever while pushing the right rudder pedal.





TAXI

5. If taxiing straight, throttle up and allow aircraft to gather 15 km/h (8 kts) airspeed maximum with external stores, then decrease power to maintain that speed.
    - Without external stores, the max allowable taxi speed is 30 km/h (16 kts).
6. If making turns, decelerate to 10 km/h (5 kts) and use rudder controls and brakes to turn the aircraft.

TAKEOFF

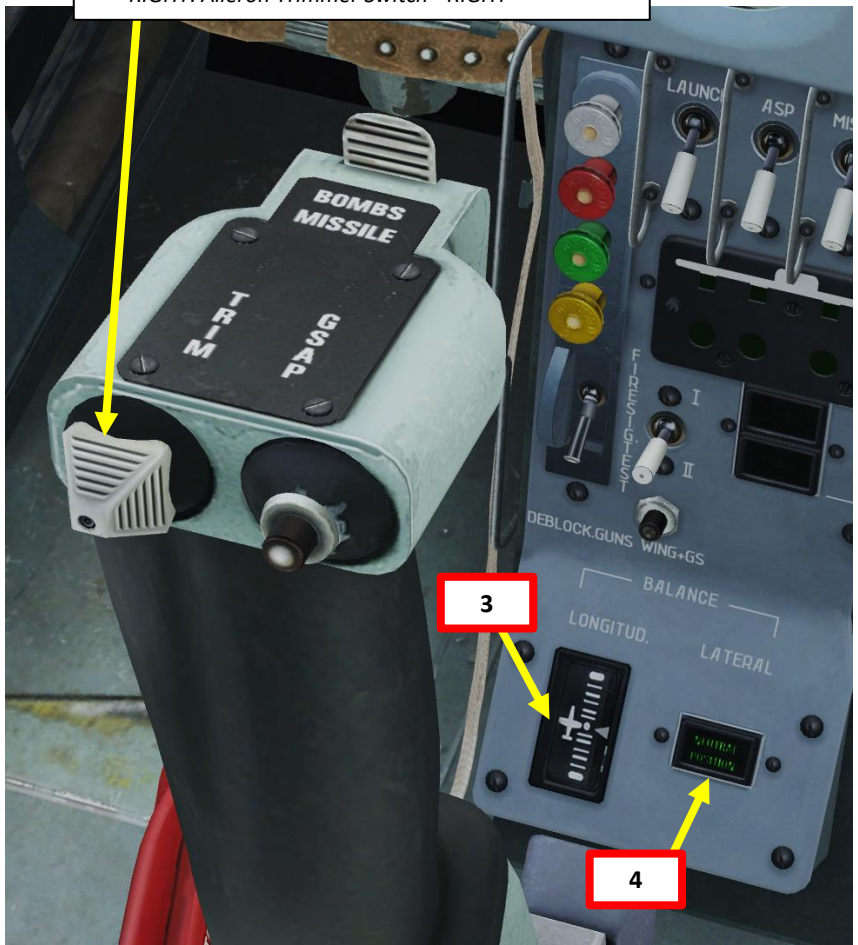
TAKEOFF

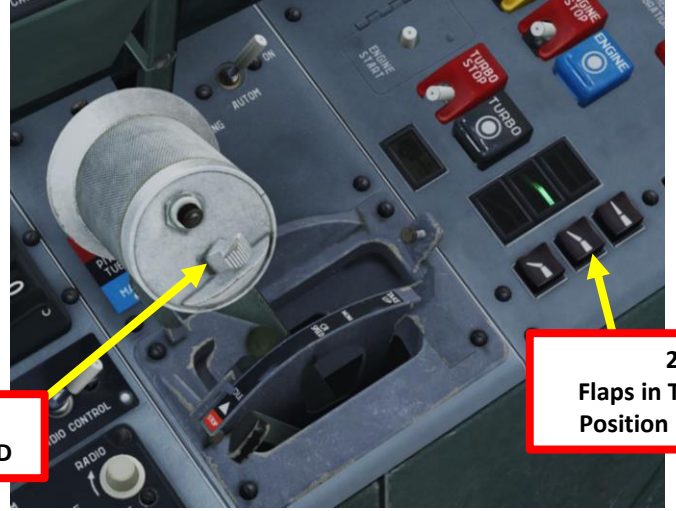
1. Line up the aircraft with the runway centerline.
2. Set your flaps to the TAKEOFF position (middle) and ensure airbrakes are retracted.
3. Set Elevator Trim to NEUTRAL position for takeoff (CENTER position).
4. Set Aileron Trim to NEUTRAL position for takeoff (NEUTRAL POSITION light illuminated).

Trim Switch
- *UP: Elevator Trimmer Switch – PULL/CLIMB*
- *DOWN: Elevator Trimmer Switch – PUSH/DESCEND*
- *LEFT: Aileron Trimmer Switch - LEFT*
- *RIGHT: Aileron Trimmer Switch - RIGHT*

3

4





2
Air Brake Switch FWD

2
Flaps in TAKEOFF Position (25 deg)

2
AIR BRAKE OUT Light Extinguished

TAKEOFF

5. Hold down brakes, advance throttle FULLY FORWARD to maximum power (TAKEOFF detent).
6. Release brakes and start rolling.
7. Gently start pulling on the stick to get the nosewheel up at 150 km/h (80 kts).
8. Rotate at 190-200 km/h (100-110 kts).

TAKEOFF

9. At a height of 15 m (50 ft) and airspeed above 220 km/h (120 kts), retract landing gear by setting the landing gear control lever in the upper position.

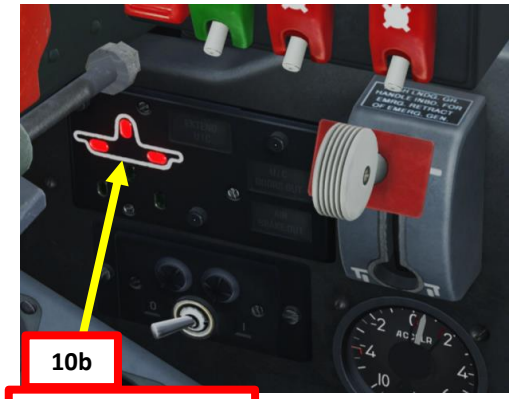
9a
Landing Gear Down & Locked

9b
Landing Gear In Transition

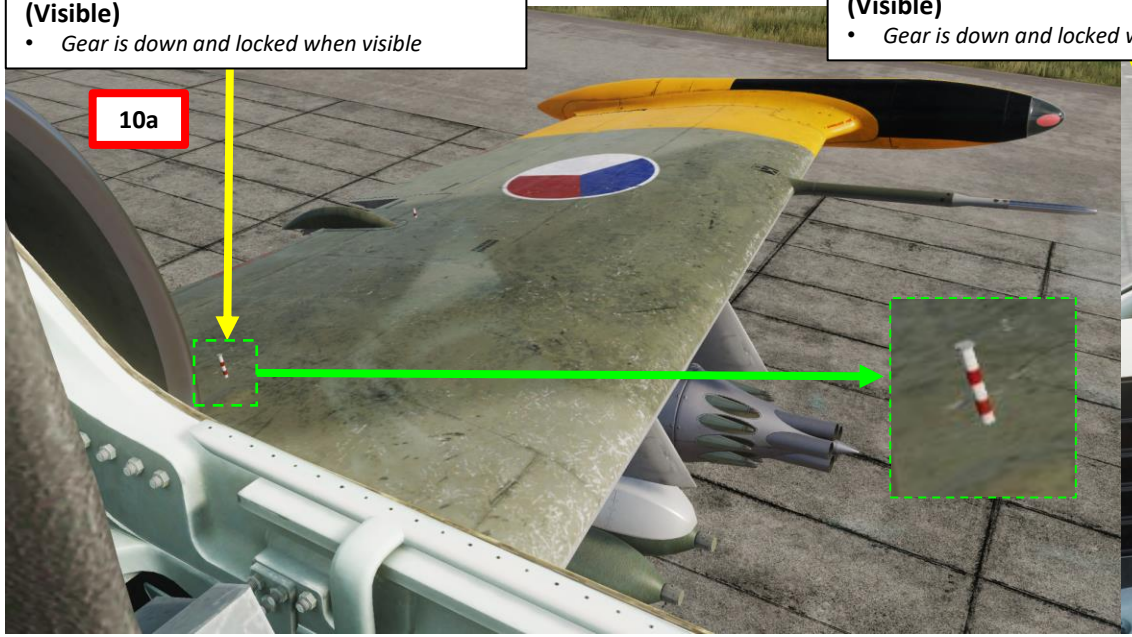
9c
Landing Gear Up

TAKEOFF

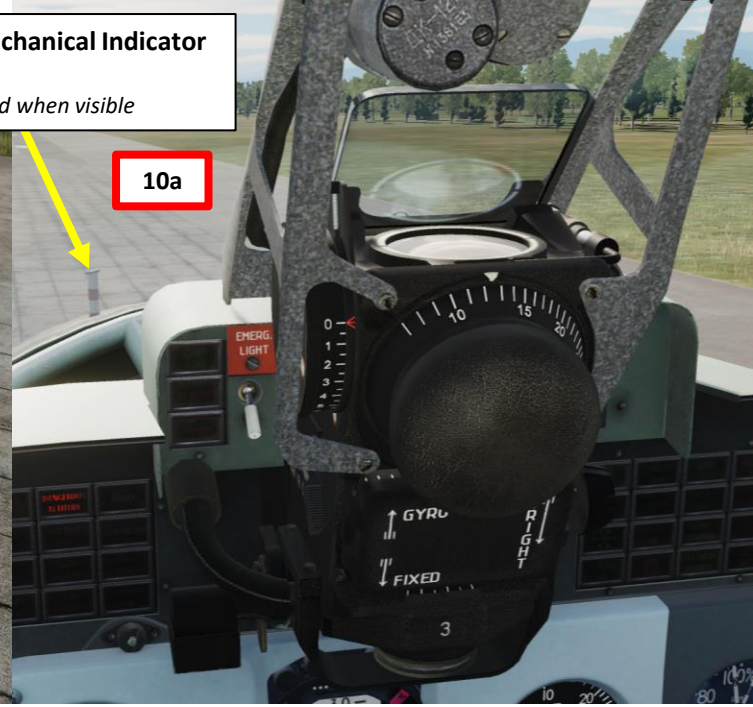
10. Check if gear was retracted using landing gear position indication panel (red lamps are on) and mechanical pointers (should be hidden in the wing).



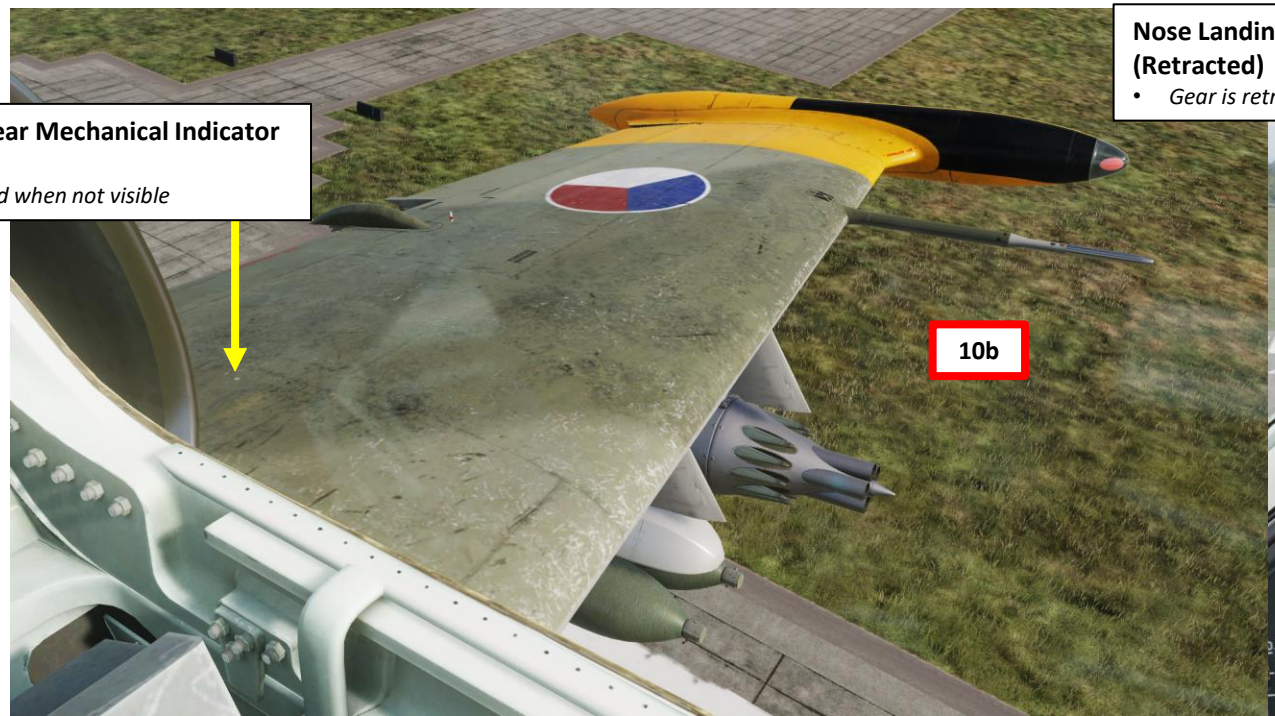
Main Landing Gear Mechanical Indicator (Visible)
- *Gear is down and locked when visible*



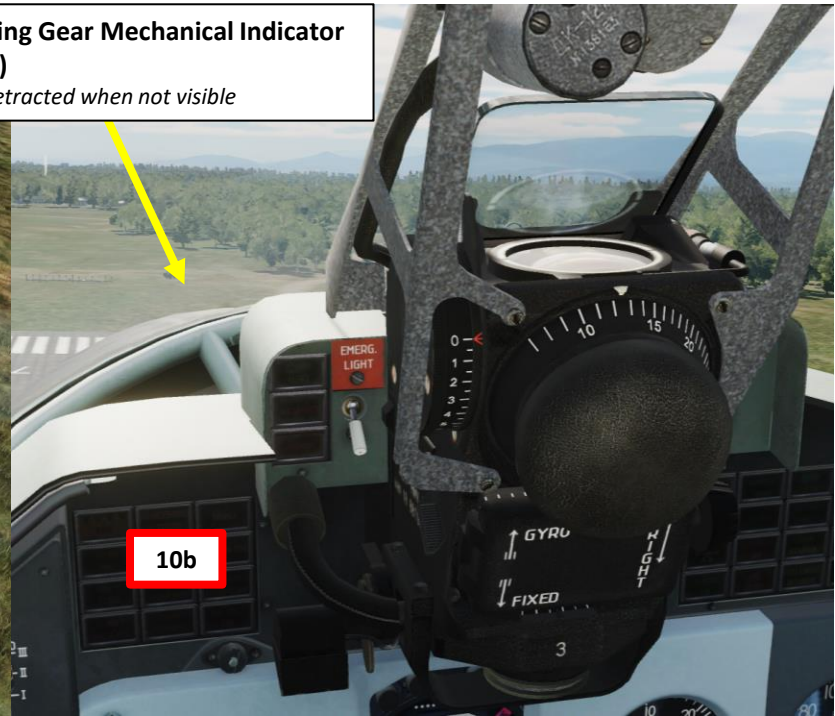
Nose Landing Gear Mechanical Indicator (Visible)
- *Gear is down and locked when visible*



Main Landing Gear Mechanical Indicator (Retracted)
- *Gear is retracted when not visible*



Nose Landing Gear Mechanical Indicator (Retracted)
- *Gear is retracted when not visible*

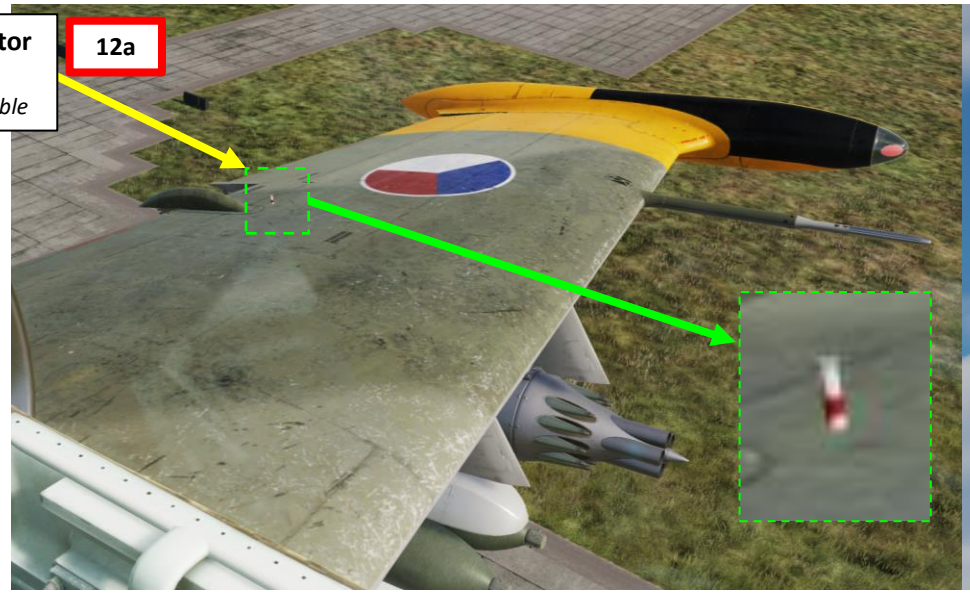


TAKEOFF

11. At a height of 50 meters (165 ft) and airspeed above 250 km/h (135 kts), retract flaps.
12. Check flaps retraction using corresponding signal lamp (should be on), flaps retraction button has to return to its initial position.
    - Note: At an indicated airspeed of 310 km/h (165 kts), flaps retract automatically

Flaps Mechanical Indicator (Visible)
- *Flaps are down when visible*

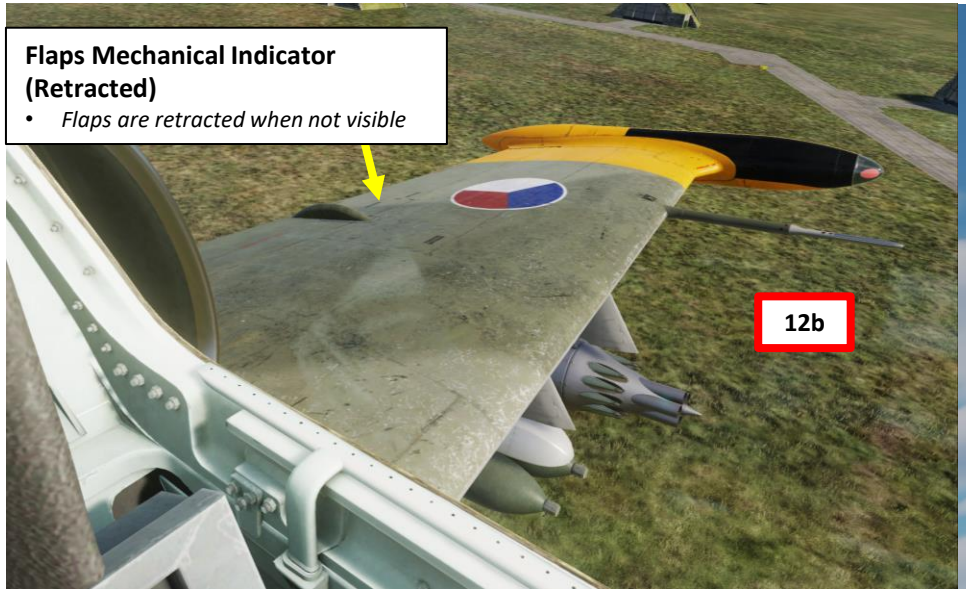
12a



Flaps Retracted

11

Flaps Mechanical Indicator (Retracted)
- *Flaps are retracted when not visible*



12b

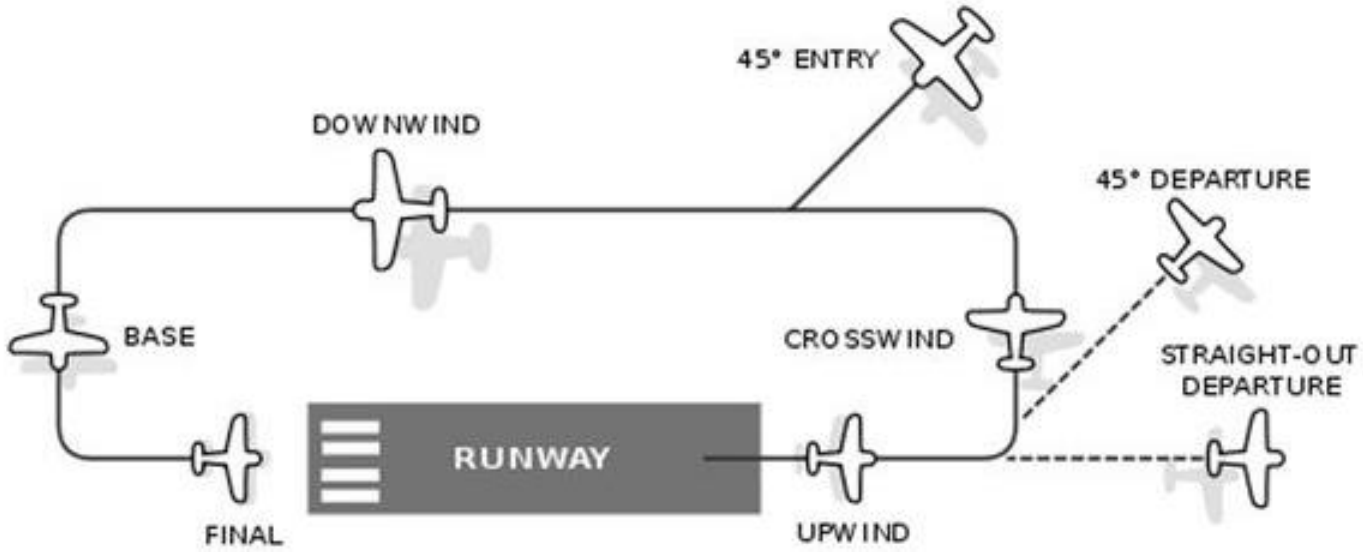
TAKEOFF

13. After flaps retraction, at altitude of 100 m (330 ft), set throttle to maintain an engine RPM to 100% and continue climbing, increasing speed to 350 km/h (190 kts).
14. Set Taxi & Landing Light Switch – OFF (MIDDLE).

PART 6 – LANDING

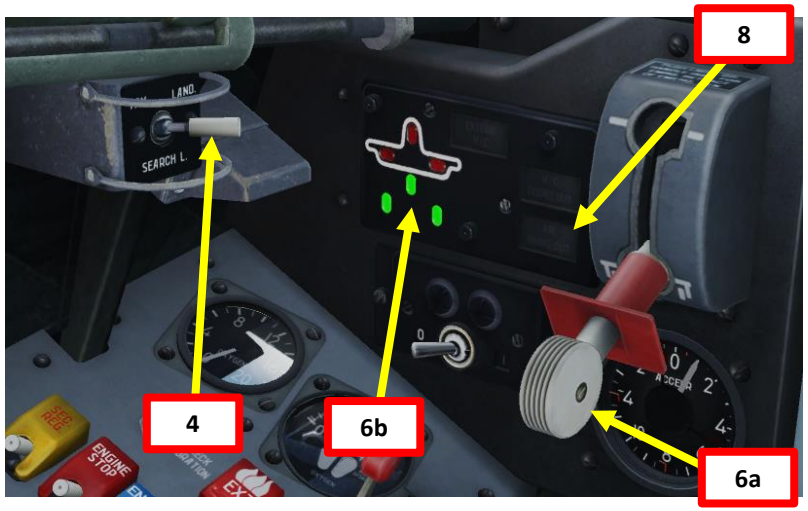
NORMAL 360-DEGREE LANDING APPROACH

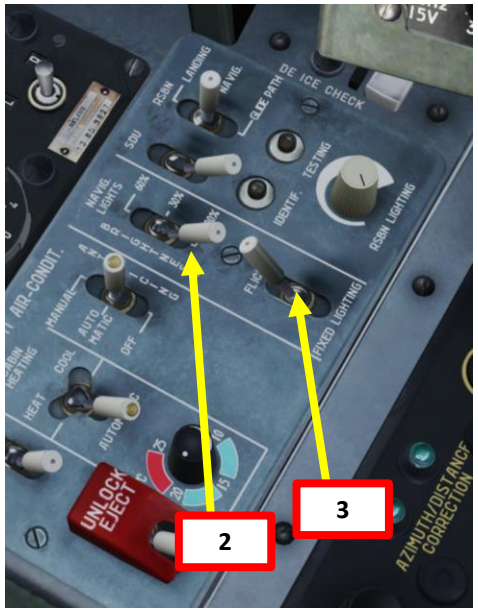
1. Initial Approach
   - Altitude: 500 m (1500 ft)
   - Airspeed: 450+ km/h (240+ kts)
   - Airbrakes and throttle as required
2. Downwind leg
   - Altitude: 500 m (1500 ft)
   - Airspeed: Below 300 km/h (160 kts)
   - Lower Landing Gear
   - Flaps at TAKEOFF position (25 deg position)
   - Airbrakes Retracted
3. Base Leg
   - Altitude: 400 m (1300 ft)
   - Airspeed: 280 km/h (150 kts)
   - Use around 95-100 % throttle to maintain airspeed
4. Before Glide Path Final Approach (Final Turn)
   - Altitude: 250 m (800 ft)
   - Airspeed: 260 km/h (140 kts)
   - Flaps at LANDING position (fully extended, 44 deg)
5. On Glide Path Final Approach
   - Airspeed: 230 km/h MINIMUM (125 kts)
   - Throttle at 70 %
6. Touchdown speed at 180 km/h (100 kts). Flare gently.



LANDING

1. Enter Initial Approach at the following parameters.
    - Altitude: 500 m (1500 ft)
    - Airspeed: 450+ km/h (240+ kts)
    - Airbrakes and throttle as required
2. Set Navigation Lights Brightness Switch – As Required (100 %)
3. Set Navigation Lights Mode Switch – As Required (Flickering Lights, FWD)
4. Set Taxi & Landing Light Switch – LANDING (FWD)
5. When entering the downwind leg, maintain an altitude of 500 m (1500 ft) and an airspeed below 300 km/h (160 kts).
6. Lower Landing Gear. Verify mechanical pins are visible to confirm deployment.
7. Set Flaps at TAKEOFF position (25 deg). Verify mechanical pins are visible to confirm deployment.
8. Verify Airbrakes are retracted

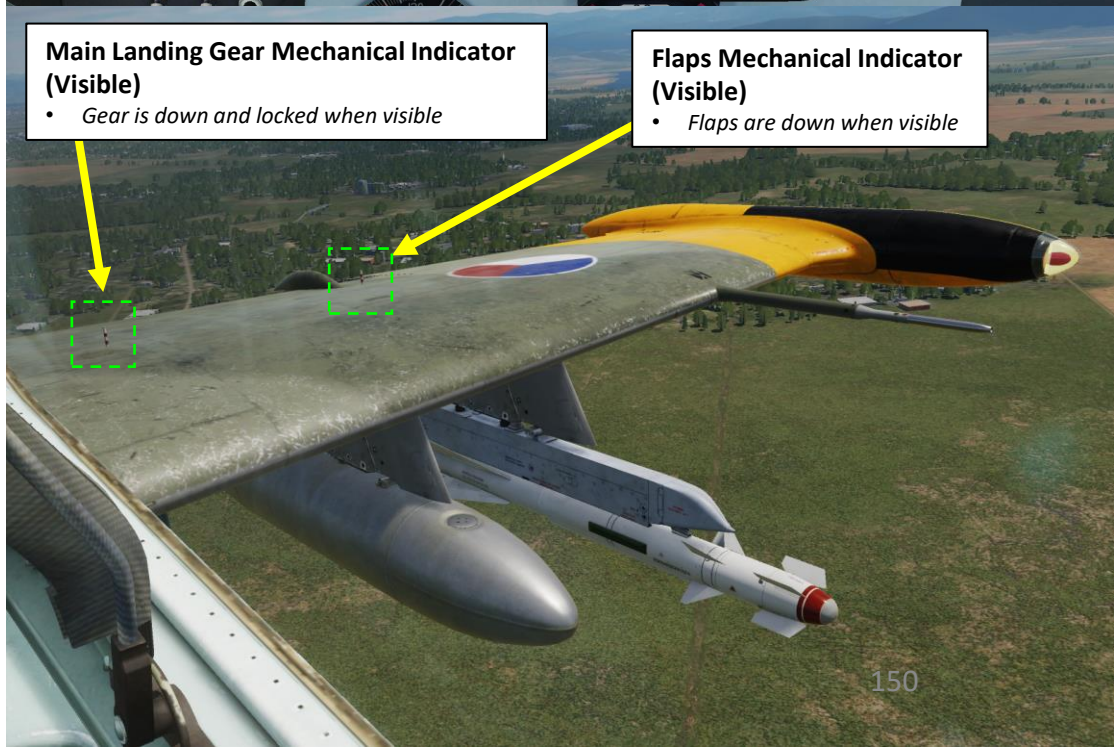




Nose Landing Gear Mechanical Indicator (Visible)
- *Gear is down and locked when visible*

Main Landing Gear Mechanical Indicator (Visible)
- *Gear is down and locked when visible*

Flaps Mechanical Indicator (Visible)
- *Flaps are down when visible*



LANDING

9. Turn into the Base Leg at the following parameters:
    - Altitude: 400 m (1300 ft)
    - Airspeed: 280 km/h (150 kts)
    - Use around 95-100 % throttle to maintain airspeed
10. Before Glide Path Final Approach (Final Turn), maintain an altitude of 250 m (800 ft) and an airspeed of 260 km/h (140 kts).
11. Set Flaps at LANDING position (fully extended, 44 deg)
12. When on Final Approach, fly at 230 km/h (125 kts) minimum and adjust throttle to maintain an engine RPM of 70 %.

LANDING

13. Touchdown at 180 km/h (100 kts).
14. Flare gently.
15. During the flare, as the speed decreases, the pilot increases pitch by pulling the stick towards him and thus deflecting the elevators upwards to keep the lift force counteracting the aircraft's weight constant. The airplane gradually and smoothly descends from 1 m altitude to touchdown.
16. Set throttle to IDLE after touchdown.
17. Gently press the wheel brake lever to slow down.

LANDING

18. Once runway is cleared, retract flaps and Set Taxi & Landing Light Switch – TAXI (AFT).
19. Taxi to parking area, then perform aircraft shutdown.

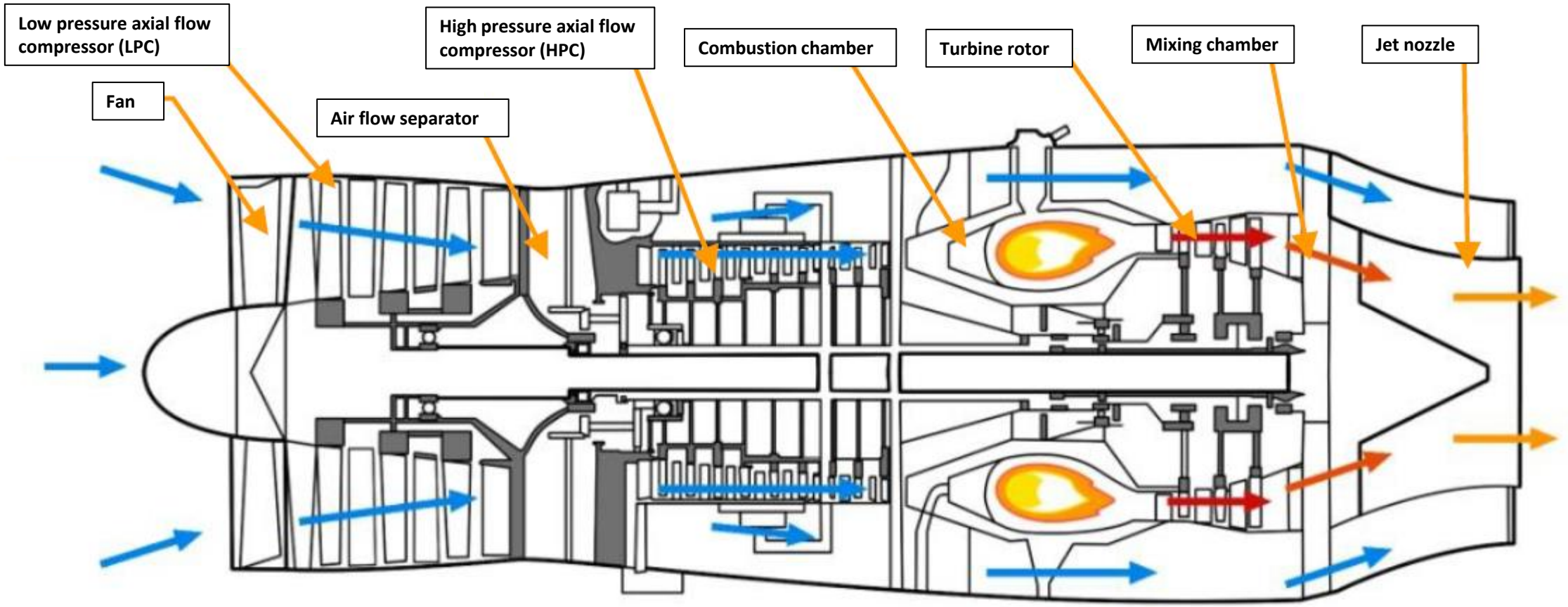
IVCHENKO AI-25TL TURBOFAN ENGINE

The engine installed on the L-39 is the twin-shaft Ivchenko AI-25TL turbofan engine. It was the first bypass engine ever used on short haul aircraft in the USSR. The AI-25 was designed to power the Yakovlev Yak-40 tri-jet airliner, often called the first regional jet transport aircraft, and is the starting point for the Lotarev DV-2 turbofan engine. The project was launched in 1965, with the AI-25s first test flight in 1966, and finally cleared for production in 1967. In 1972, the AI-25 was selected for the Polish PZL M-15 Belphegor, the world's only jet-powered biplane. Development of the AI-25 continued and the uprated AI-25TL was designed for use by the L-39. The AI-25 can generate a maximum thrust of 16.9 kN (3,800 lbf) with a thrust-to-weight ratio of 4.9:1. In comparison to modern jets, the L-39 is a bit underpowered.

AI-25 Engine – Photograph by Michael Pereckas

ENGINE SYSTEM OVERVIEW

From the inlet, air is fed through a three-stage low-pressure axial flow compressor and is then separated into two flows. The inner hot flow is fed to a nine-stage high-pressure axial flow compressor. The outer by-pass flow is directed to the by-pass exhaust through a mixer where the flow is converted into kinetic energy. The air flow from the high pressure axial flow compressor enters the combustion chamber, where fuel is mixed with some of the air and ignited, and then moves further through the turbine into the mixing chamber and jet nozzle.



ENGINE INDICATIONS

Here is an overview of the different engine parameters you need to monitor:

- N1 Tachometer: HPC RPM (High-Pressure Compressor rotation speed)
- N2 Tachometer: LPC RPM (Low-Pressure Compressor rotation speed)
- EGT / JPT Thermometer: Exhaust Gas Temperature / Jet Pipe Temperature in deg C
  - Note: EGT indicator provides an indication of the EGT measured at the point where the combusted gases exit the turbine. The system consists of a temperature transmitter located on the engine turbine ring and two indicators, one in each cockpit. The temperature transmitter output signal can be connected to only one indicator at a time. The EGT indicator selector switch (labeled ENG IND), located on the left panel in the rear cockpit selects EGT indication to be displayed on either the front (switch in FWD position) or rear (switch in AFT position) indicator.
- Oil Pressure (kg/cm^2)
- Oil Temperature (deg C)
- Fuel Pressure (kg/cm^2)
- Engine Vibration (%)

Engine Tachometer (%RPM)
- **Needle 1: High-Pressure Compressor (HPC) Speed**
- **Needle 2: Low-Pressure Compressor (LPC) Speed**

EGT (Exhaust Gas Temperature) (x100 deg C)

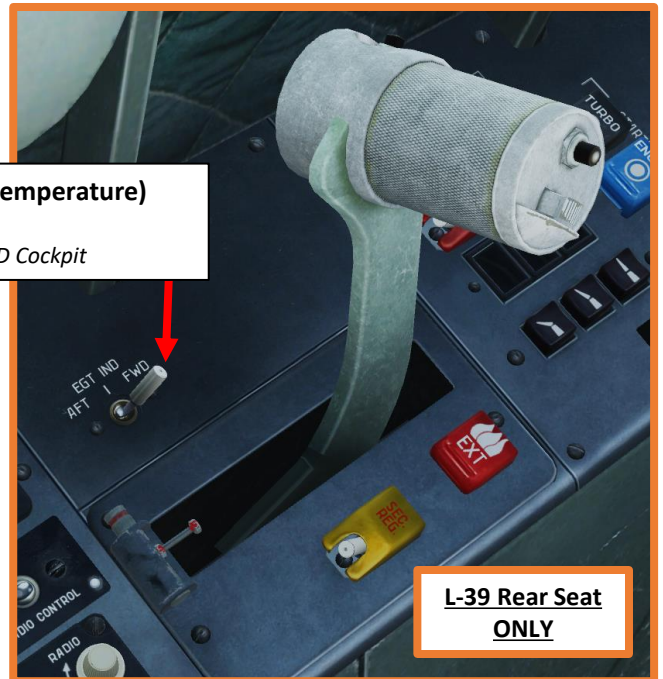
Fuel Pressure (kg/cm^2)

Oil Temperature (deg C)

Oil Pressure (kg/cm^2)

Engine Vibration Gauge (%)

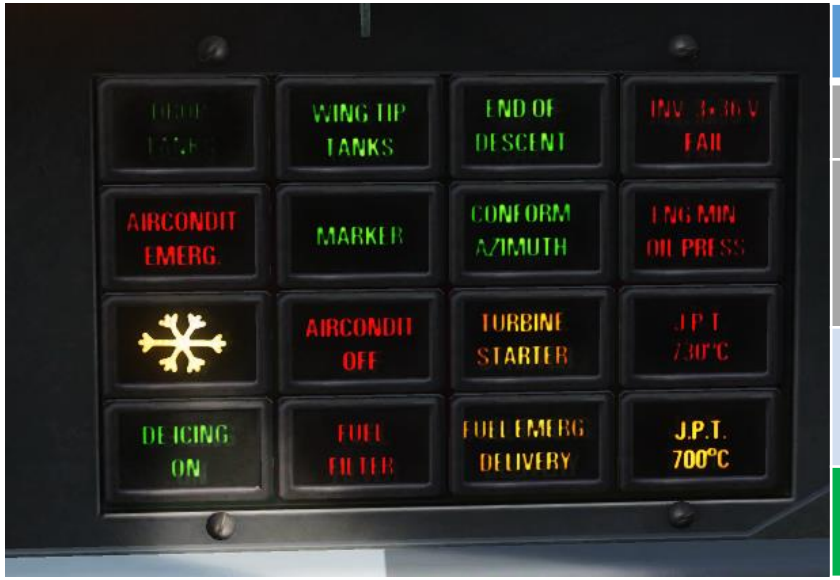
EGT (Exhaust / Jet Pipe Gas Temperature) Indication Selector Switch
- *Set EGT Indication to AFT / FWD Cockpit*



L-39 Rear Seat ONLY

ENGINE INDICATIONS

Here is an overview of the engine and fuel-related cautions and warnings:



Caution & Advisory Panel

-	-	-	-
-	-	-	**ENG MIN OIL PRESS** *Oil pressure at 95% of HPC RPM is less than 3 kg/cm², for other engine modes not less than 2 kg/cm².*
Snowflake Symbol *Ice Detected*	-	**TURBINE STARTER** *Turbine starter (APU, auxiliary power unit) is running*	**JPT 730 DEG C** *Jet pipe temperature is over 730 deg C*
DE-ICING ON *Anti-Ice system is ON.*	**FUEL FILTER** *Fuel pressure difference is detected on the fuel filter*	**FUEL EMERG DELIVERY** *SEC. REG. (Emergency Fuel) system is ON.*	**JPT 700 DEG C** *Jet pipe temperature is over 700 deg C*

Warning Panel

FIRE *Engine fire detected.*	-	-
150 KG FUEL *Fuel quantity is below 150 kg.*	-	-
DON'T START *Fuel pressure drop is detected, do not start engine.*	**ENGINE VIBRATION** *Excessive engine vibration detected.*	-

ENGINE CONTROLS & OPERATION MODES

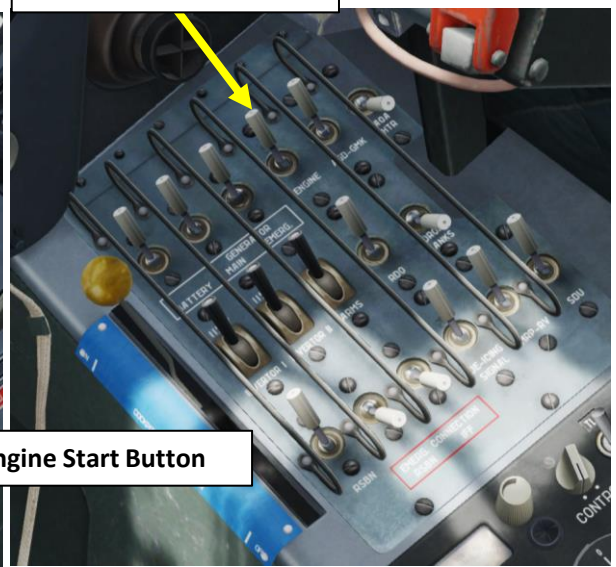
The engine is managed with the throttle.The throttle in the front cockpit has markings to show the selectable engine operation modes:

- **OFF**
- **Triangle mark**: used when the engine has to be started using the emergency fuel system
- **IDLE**: Corresponds to minimum allowed HPC RPM needed for stable engine operation and is equal to 56± 1,5% (n1 needle on the engine RPM gauge). EGT should not exceed 600 °C.
- **CR SPEED**: Cruise Speed (85 % of nominal speed), corresponds to 99,6% HPC RPM (n1 needle on the engine RPM gauge). This mode is used for flight at maximum range (maximum duration of flight), because the fuel consumption is the lowest. EGT should not exceed 590 °C.
- **NOM**: Nominal Mode corresponds to 103,2% of HPC RPM (n1 needle on the engine RPM gauge) and maximum thrust. This mode is used for long-term climbing for flight with near maximum speeds. EGT should not exceed 625 °C.
- **TAKEOFF**: Corresponds to the maximum allowed high pressure compressor (HPC) RPM of 106.8% (n1 needle on the engine RPM gauge) and maximum thrust. This mode is used for takeoff, climbing and increasing the flight speed. EGT should not exceed 660 °C.

Engine Start Mode Switch (under panel)
- *AFT: FALSE START*
- *MIDDLE: START*
- *FWD: COLD CRANKING*

Engine Start Button

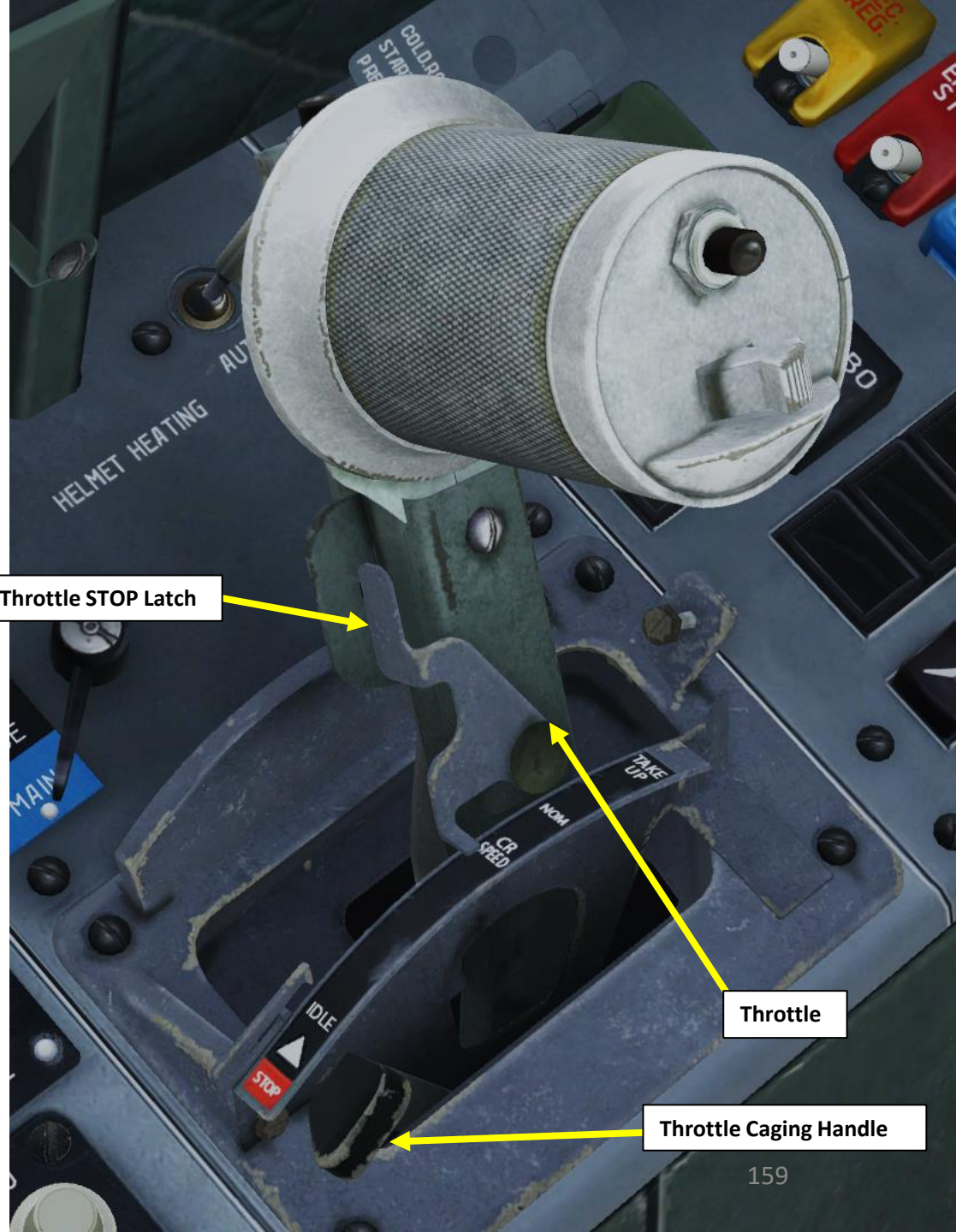
Engine ACB Switch
- *FWD=ON/AFT=OFF*



Throttle STOP Latch

Throttle

Throttle Caging Handle



RT-12-9 ENGINE OVERHEAT PROTECTION SYSTEM

The engine has a JPT (Jet Pipe Temperature) regulator, which is basically an EGT (Exhaust Gas Temperature) overheat protection system. This automated controller will regulate fuel flow sent to the combustion chamber to avoid damaging the engine.

Note: there is JPT regulator Manual Disable switch in the L-39C, but this switch is not present in the L-39ZA.

Here is an overview of how the overheat protection system operates in different conditions:

A - During ground operation (including engine check) and from takeoff roll until nose wheel lift-off:

- When operating from the main fuel supply system, there will be an indication of exhaust gas temperature (EGT) reaching 700±15 °C, followed by a reduction in fuel supply to prevent the temperature from exceeding 700±15 °C.
- When operating from the emergency fuel supply system, there will be an indication only and no reduction in fuel supply when the EGT reaches 700±15 °C.
- If the EGT continues to rise and reaches 730±15 °C, the J.P.T. 730°C indicator comes on and the engine is shut down automatically by enabling the fuel shut-off valve.

B - During takeoff roll after nose wheel lift-off and during flight with gear or flaps extended:

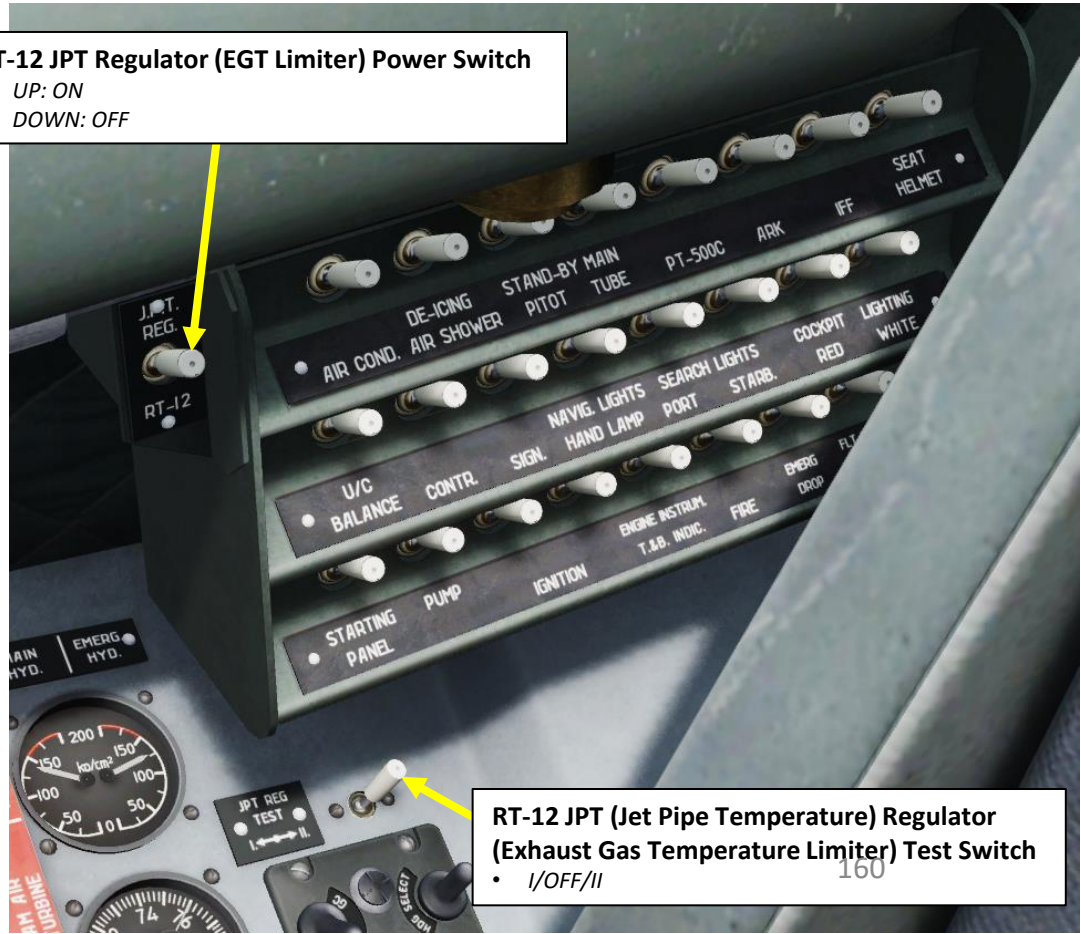
- When the EGT reaches 700±15 °C and 730±15 °C, there will be indications only and no engine limiting or shutdown. If the J.P.T. 700°C indicator is on during flight, fuel supply will be partially cut and engine thrust reduced only during and after retraction of the landing gear and flaps.

C - During flight with gear and flaps retracted:

- When operating from the main fuel supply system, there will be an indication of exhaust gas temperature (EGT) reaching 700±15 °C, followed by a reduction in fuel supply to prevent the temperature from exceeding 700±15 °C.
- When operating from the emergency fuel supply system, there will be an indication only and no reduction in fuel supply when the EGT reaches 700±15 °C.
- If the EGT continues to rise and reaches 730±15°C, the J.P.T. 730°C indicator comes on, while operating from main or emergency fuel supply system. In contrast to ground operation, there will be no immediate engine shutdown when this indicator illuminates in the air.
- If the J.P.T. 730°C indicator was on during flight, even if the EGT was later reduced, it remains on and during landing, when the nose wheel touches the ground, the engine will be shut down automatically.

RT-12 JPT (Jet Pipe Temperature) Regulator (EGT Limiter) Manual Disable Switch
- *AFT = OFF / FWD = ON (DISABLE)*

L-39C ONLY
Front Seat



RT-12 JPT Regulator (EGT Limiter) Power Switch
- *UP: ON*
- *DOWN: OFF*

RT-12 JPT (Jet Pipe Temperature) Regulator (Exhaust Gas Temperature Limiter) Test Switch
- *I/OFF/II*

ENGINE LIMITS

Engine Main Specification and Restrictions

Parameters	Operation mode			
	Takeoff	Nominal	Cruise	Idle
Thrust, kgF	1720	1500	1275	≤135
RPM, %	106,8	103,2	99,6	56±1,5
Maximum EGT, °C				
on ground	660	625	590	600
in flight	At H≤8000 m 685 (705*) At H>8000 m 715	650 670*	615 635*	600
Maximum fuel pressure, kgF/cm^2	65	65	65	65
Oil temperature at engine inlet, °C	-5 to +90	-5 to +90	-5 to +90	-5 to +90
Maximum operational altitude, m	10.000	12.000	12.000	12.000
Maximum duration of continuous operation, min	20	Unlimited	Unlimited	On ground: 30 In flight: unlimited
Engine response time when throttle handle is moved from idle to max mode, s	9-12			
Engine startup time on ground and in flight, s	≤50			
Maximum allowed EGT during startup, °C				
on ground	550			
in flight	600			

* when anti-icing system is enabled, EGT increases at 25-30°

ANTI-ICE SYSTEM

The anti-icing system is intended to protect the leading edges of the engine air intakes and the windshield from icing by using hot air from the engine.

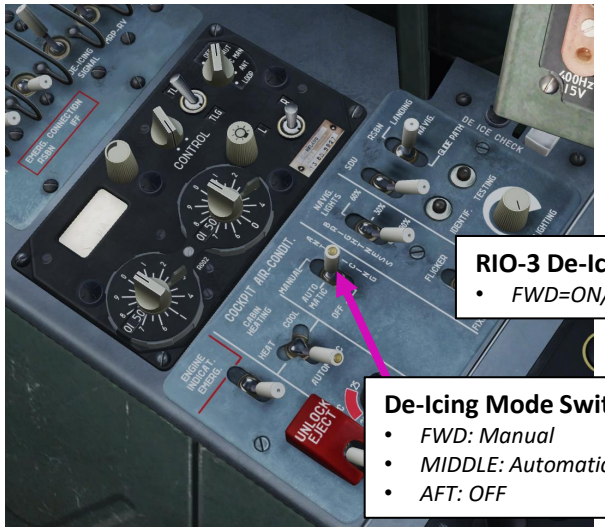
The system is controlled remotely and can operate in automatic or manual modes (from the front cockpit only). The modes are selected with the **de-icing mode switch labeled ANTI-ICING** located on the right panel in the front cockpit. In the AUTOMATIC position, the anti-icing system is enabled by signals from the RIO-3 radioisotope icing sensor. When enabled, the DE-ICING ON indicators on the caution & advisory lights panels in both cockpits are on.

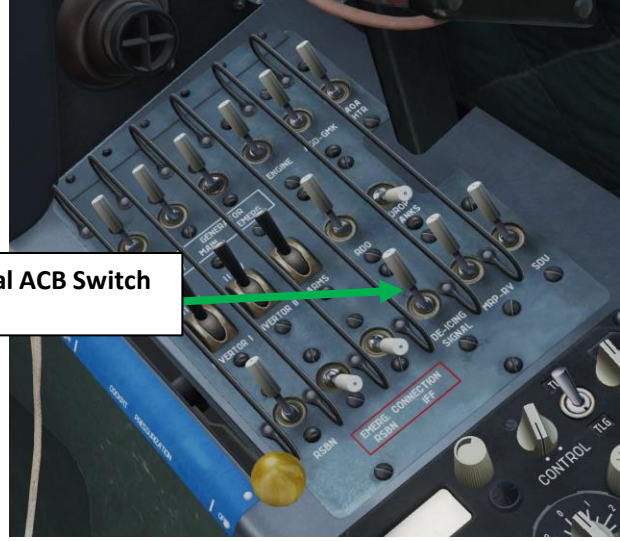
The RIO-3 sensor is enabled by the **DE-ICING SIGNAL CB** on the main CB panel in the front cockpit. On the right console in the front cockpit there is the RIO-3 de-icing sensor heating circuit check button and a green light for monitoring the heating circuit.

The RIO-3 sensor measures radiation between an emitter and a detector. When icing is formed between the two, the detector can no longer measure radiation from the emitter, and the anti-icing system is activated. The anti-icing system is activated before the flight when the outside temperature is below +5 °C, as well as before the flight in adverse weather conditions and night flights.

When the switch is in the **AUTOMATIC** position and an icing condition is detected, first the snowflake signal indicator illuminates and no later than 30 seconds after that, the DE-ICING ON indicator illuminates. After cessation of icing, the system turns off automatically: first the **snowflake indicator** goes out and after 30 seconds DE-ICING ON goes out as well. Both indicators are located on the caution & advisory lights panels in both cockpits. The **DE-ICING ON** and snowflake indicators operate in continuous mode.

In case of RIO-3 failure and the presence of icing, the anti-icing system has to be enabled manually. For that, the ANTI-ICING switch has to be set to the **MANUAL** position and not later than 30 seconds after that, the DE-ICING ON indicator illuminates. To turn off the anti-icing system, return the switch to the OFF position.





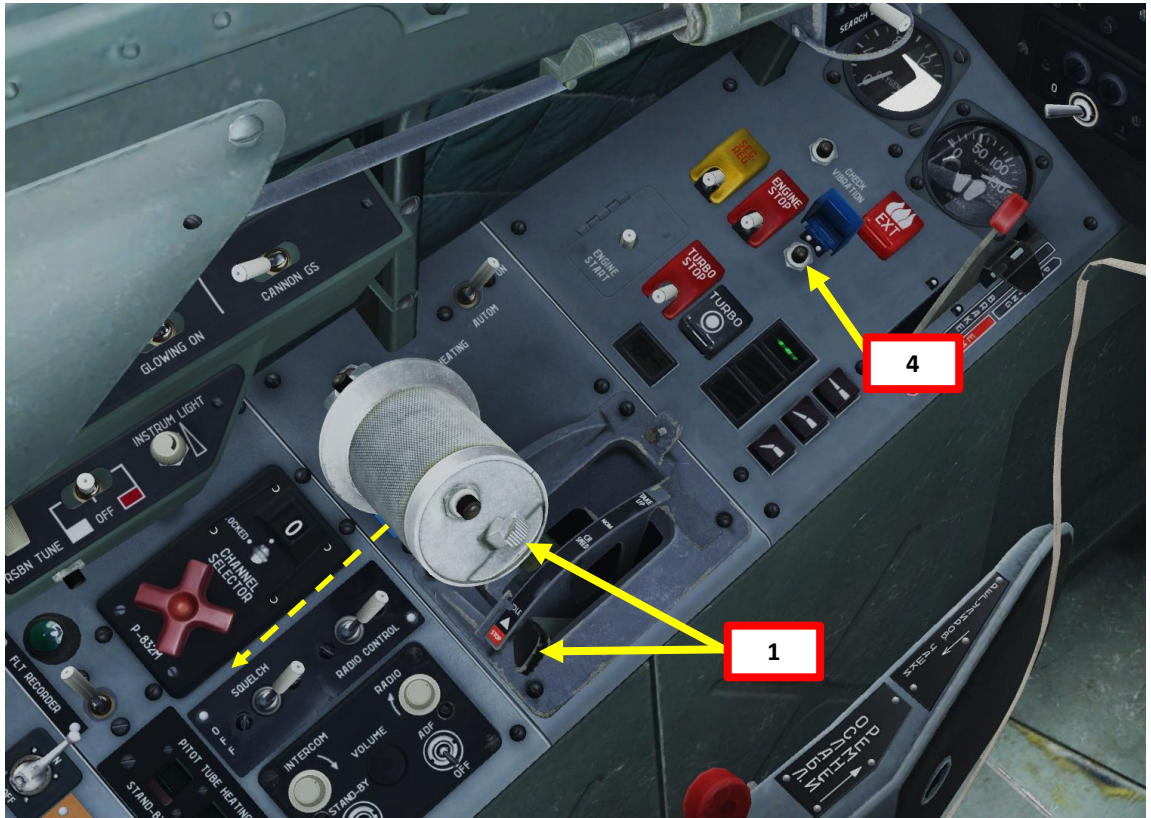
1. **Windshield air duct**
2. **Air ducts heating the leading edges of engine air intakes**
3. **Air consumption limiter**
4. **Shut-off valve**
5. **Hot air intake**

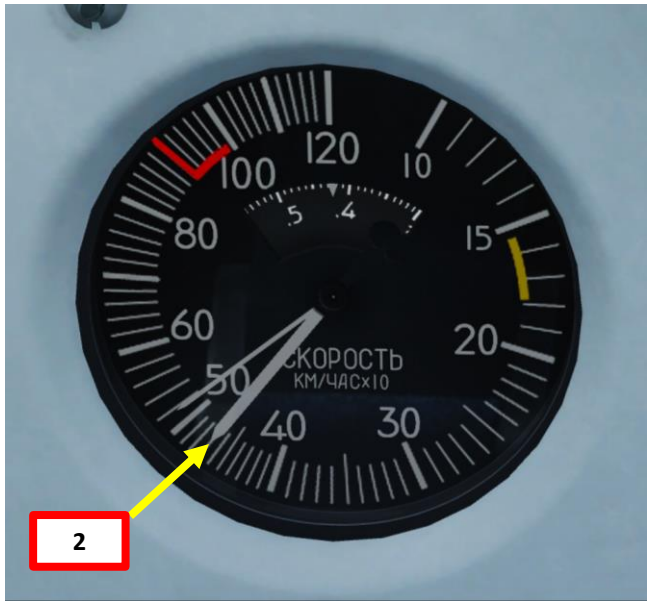
ENGINE RELIGHT PROCEDURE
A - Windmilling Engine Restart

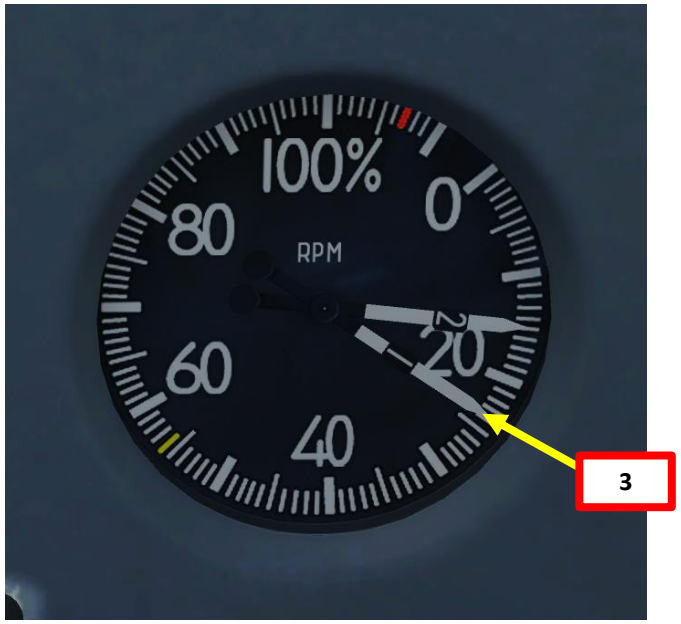
If N1 is higher than 15%, a windmilling engine restart can be performed.

An engine is "windmilling" when aircraft airspeed is sufficient to provide enough airflow to drive the compressor blades even without combustion.

1. Throttle back to STOP position
2. Maintain airspeed greater than 430 km/h (235 kts)
3. Ensure engine RPM is higher than 15 %
4. Press the ENGINE starter button for 2 seconds
5. After 3-6 seconds after the ENGINE starter button was pressed, move throttle from STOP to IDLE position
6. Progressively throttle up as engine RPM increases



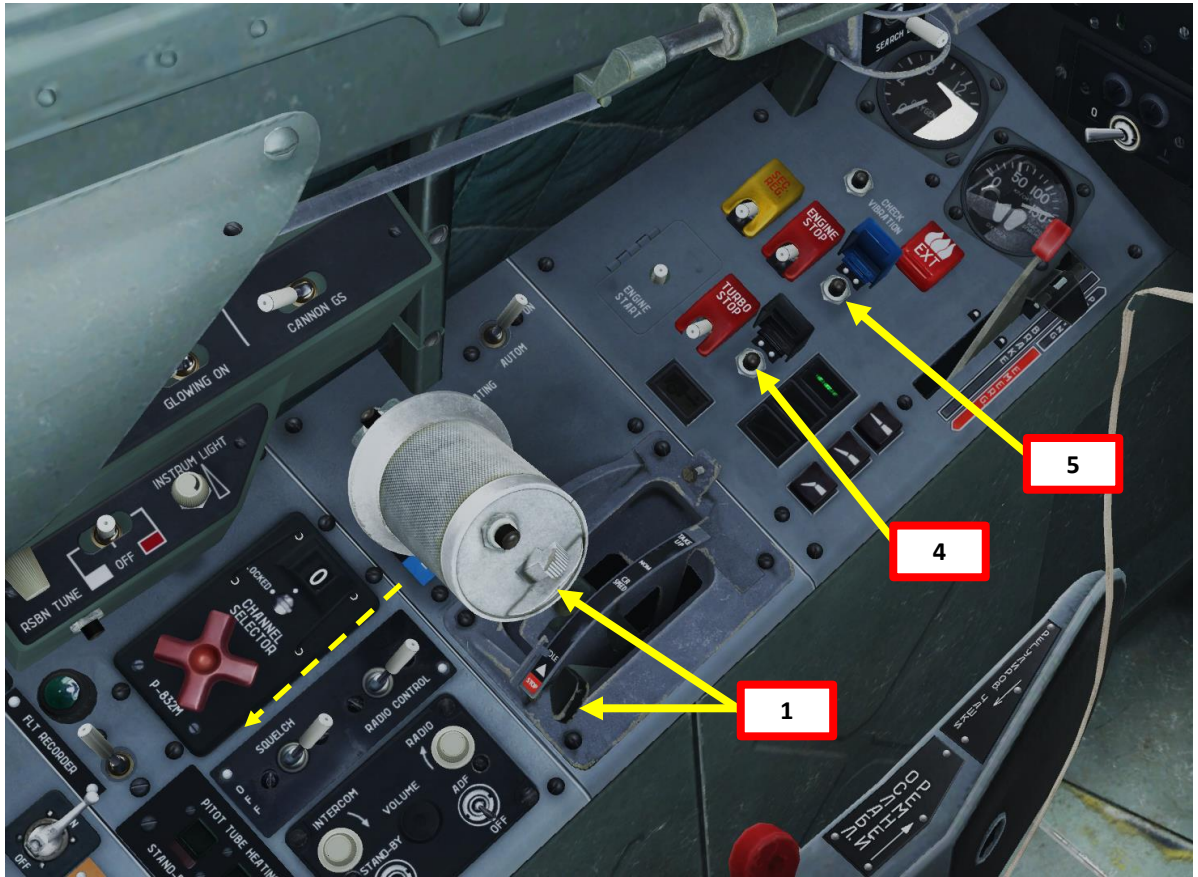


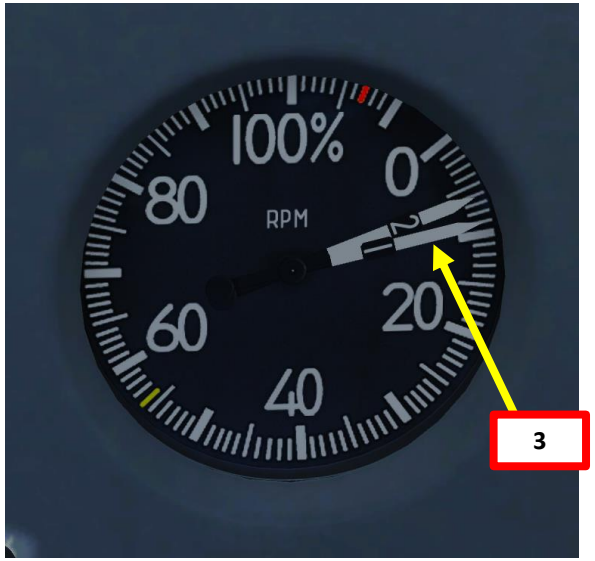


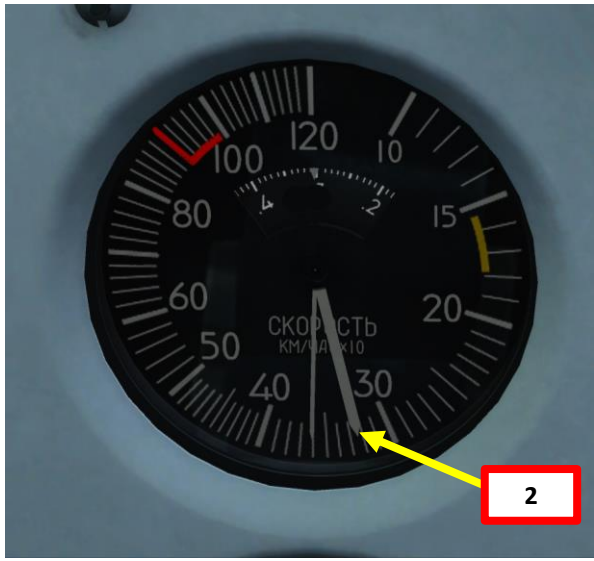
ENGINE RELIGHT PROCEDURE
B - APU-Assisted Engine Restart

If N1 is lower than 15 %, an APU-assisted engine restart is required

1. Throttle back to STOP position
2. Maintain airspeed between 300-350 km/h (160-190 kts).
3. Ensure engine RPM is lower than 15 %
4. Press the TURBO (APU start) button for 2 seconds
5. When the TURBINE STARTER caution is on, press the ENGINE starter button for 2 seconds
6. After 3-6 seconds after the ENGINE starter button was pressed, move throttle from STOP to IDLE position
7. Progressively throttle up as engine RPM increases







FIRE DETECTION & SUPPRESSION SYSTEM

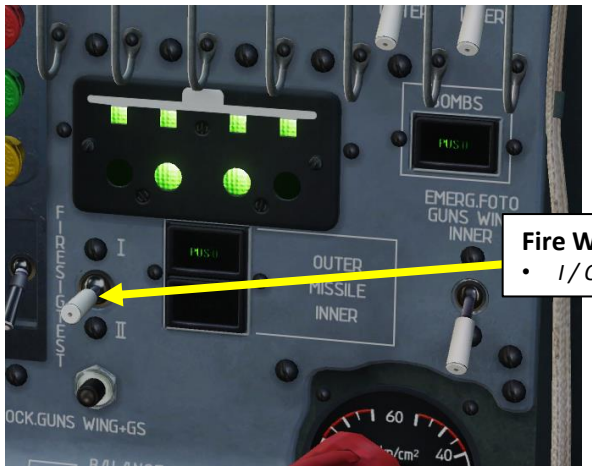
The **fire detection and indication system** is designed so that a light signals when a fire occurs. It consists of six thermal sensors in the engine compartment and FIRE warning lights on the emergency panels in the front and rear cockpit.

Six DTBG thermoelectric fire sensors are installed in the engine nacelle for fire detection. The six sensors are split into two groups with three sensors each. The sensors are located in the most dangerous places in the engine compartment: APU, generator, left & right igniter, waste can/FCU (Fuel Control Unit), air-starter/FCU. When the temperature in the engine compartment reaches 200 °C or increases at a rate of more than 4 °C per second, a relay closes and the FIRE warning lights illuminate. When the fire is extinguished or when the temperature in the engine compartment decreases rapidly, the warning lights extinguish and the warning circuit is rearmed.

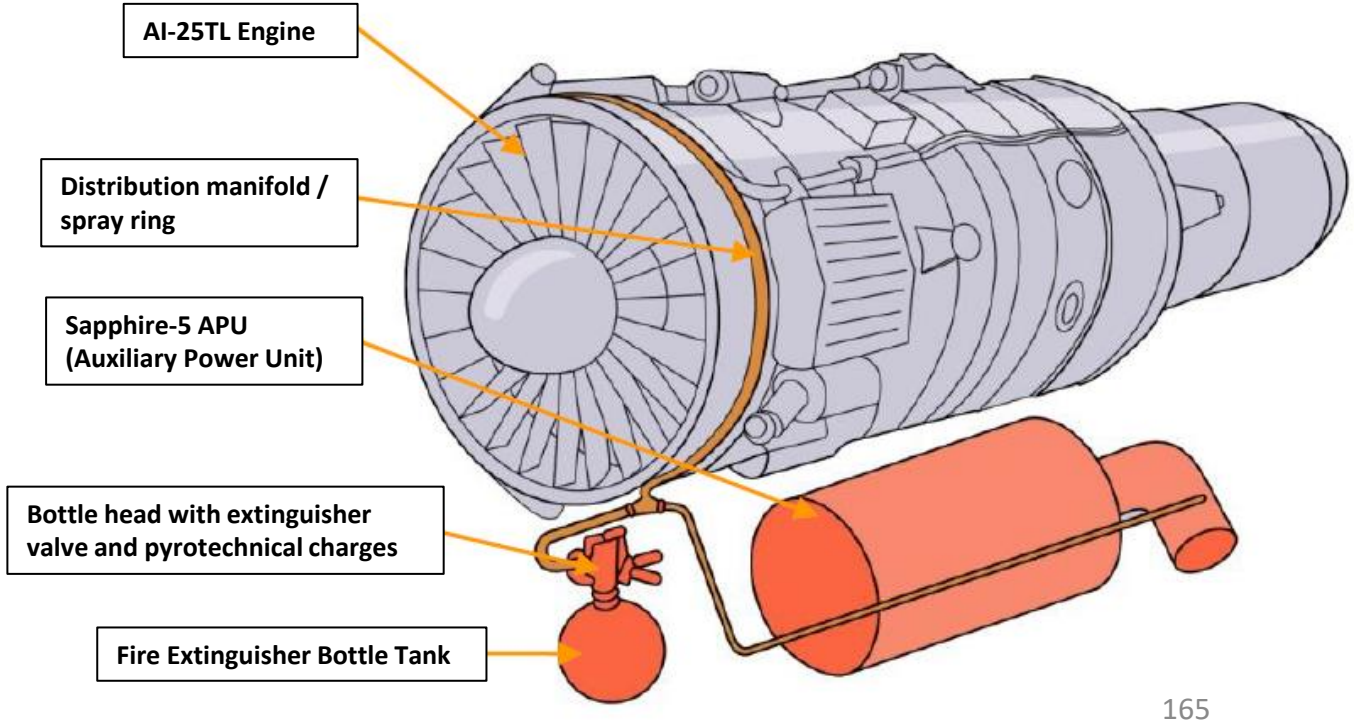
The **fire extinguishing system** consists of the fire extinguisher bottle and the tubes for distribution of the extinguishing agent. The tubes form a spray ring and spray bar and contain little holes located in special areas to allow spraying of critical items in the engine compartment. Two pyrotechnical charges blow open the valve of the fire extinguisher bottle, thus releasing its contents to be distributed to the manifold. For system operation at least one pyrotechnical charge must be fired.

Fire Warning Light

Fire Extinguisher Button



Fire Warning Test Switch
- *I / OFF / II*



AI-25TL Engine

Distribution manifold / spray ring

Sapphire-5 APU (Auxiliary Power Unit)

Bottle head with extinguisher valve and pyrotechnical charges

Fire Extinguisher Bottle Tank

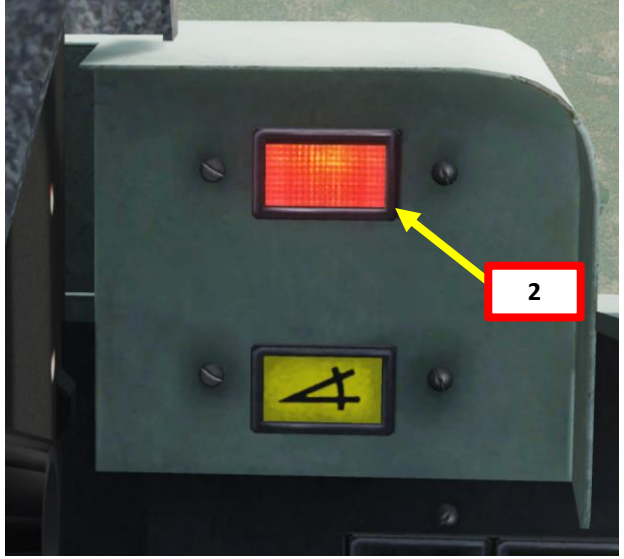
ENGINE FIRE

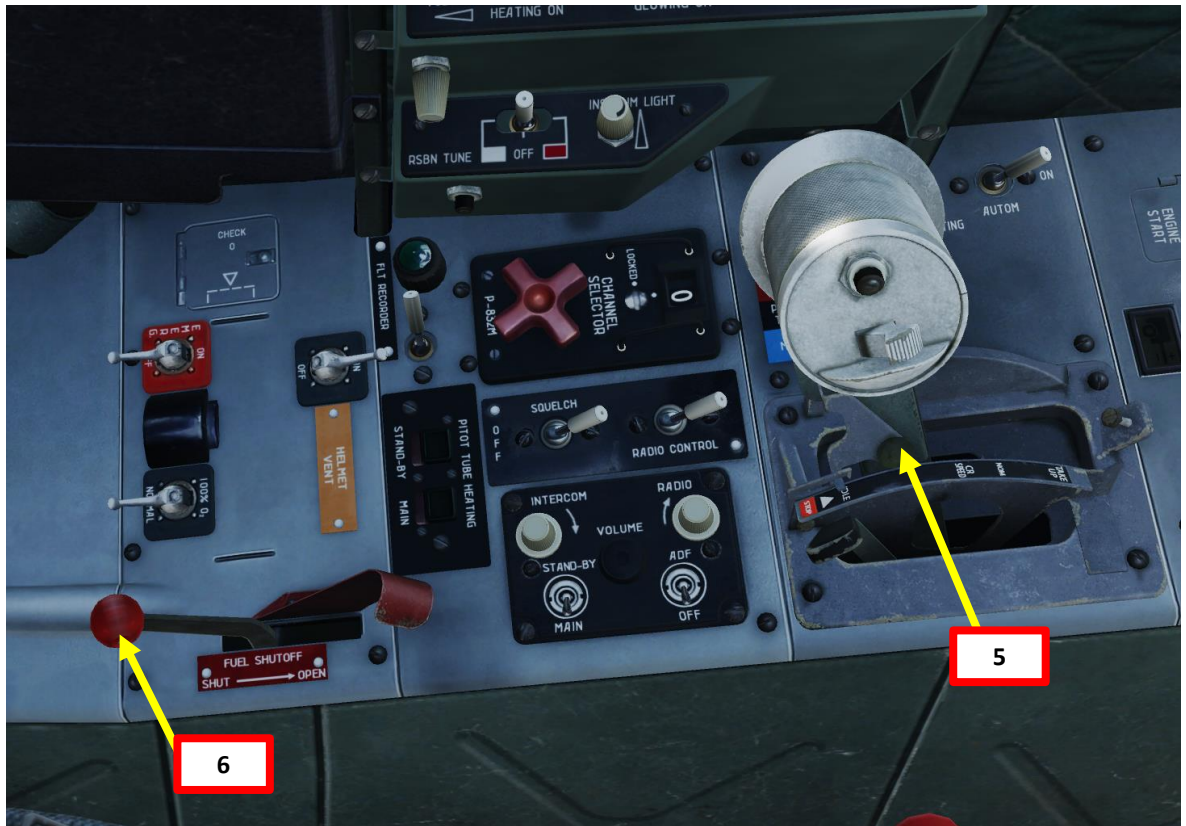
When an **engine fire is detected**, look out for the following:

1. FIRE signal light is illuminated
2. Master Caution is illuminated
3. JPT 700 and JPT 730 deg C signal lights are illuminated (Jet Pipe Temperature exceedance)
4. Smoke trail is visible behind the aircraft, which can be detected during turns.

To **extinguish fire**:

5. Set throttle to the STOP position
6. Close the shut-off fuel valve lever (AFT)
7. Flip the EXT (Fire Extinguisher) Button cover, then press button to release extinguishing agent.
8. After fire is extinguished, assess the situation and take a decision to either do an emergency forced landing or to eject if landing impractical.



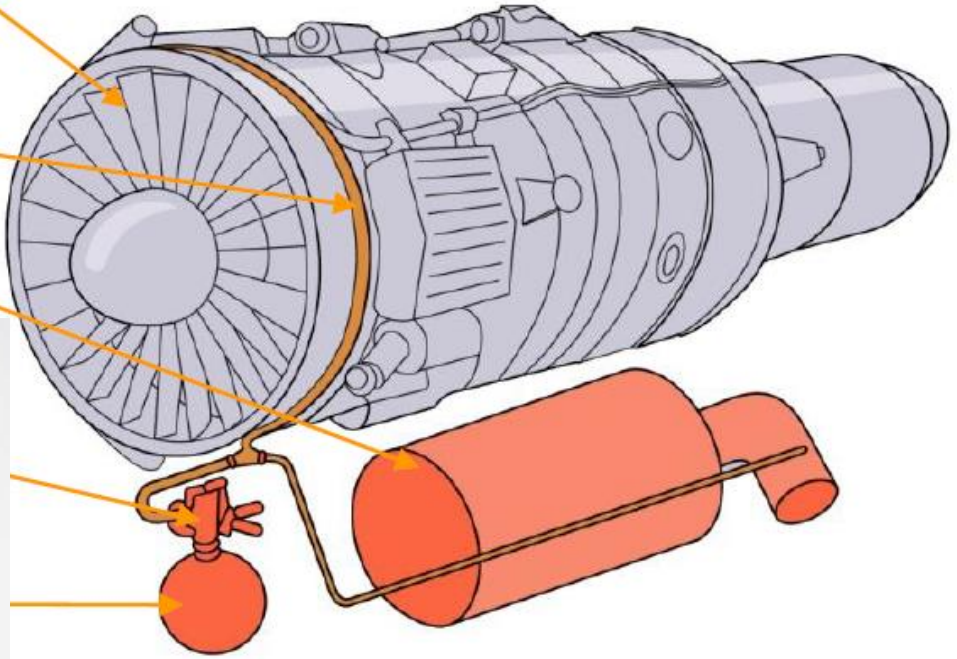


SAPPHIRE-5 TURBO/APU (AUXILIARY POWER UNIT)

The Sapphire-5 (also known as “Saphir-5” or “Safir-5”) is an auxiliary power unit (APU, also referred as “Turbo”). Produced by PBS Velká Bíteš under license from the French company Turbomeca, the Sapphire-5 is used as a source of compressed air for engine startup. It provides compressed air and feeds the starter, which spins up the AI-25TL’s high pressure rotor.

AI-25TL Engine

Sapphire-5 APU (Auxiliary Power Unit)



SAPPHIRE-5 TURBO/APU (AUXILIARY POWER UNIT)

Here is an overview of the APU controls and indications. The Turbo Start Button is used to start the APU, and the Turbo Stop Button is used to shut it down.

Note:

- During engine start, when Engine HPC (High-Pressure Compressor) RPM reaches 41,5—44,5% within 45 seconds, the APU automatically shuts off, air starter disconnects, TURBINE STARTER signal goes off, finishing starting cycle.

Turbo Stop Switch
- *AFT=OFF/FWD=ON*

Turbo (Sapphire-5 APU, Auxiliary Power Unit) Start Button

TURBINE STARTER Caution Light
- *Illuminates when APU is running*

APU Exhaust

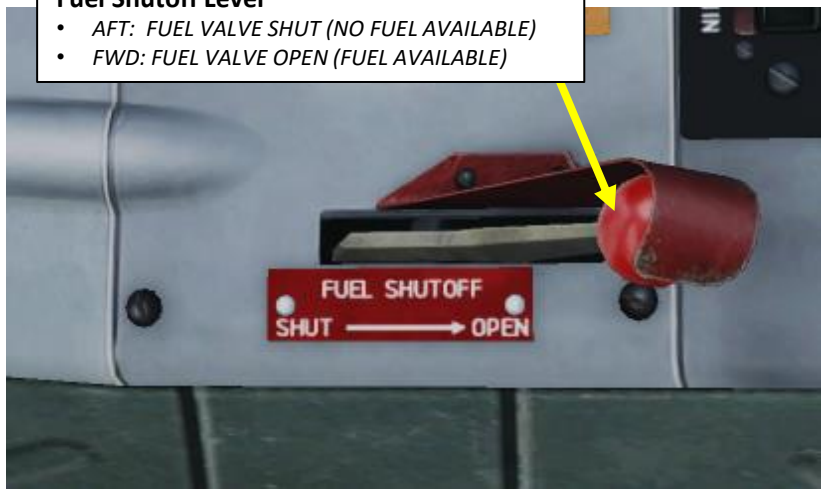
FUEL SYSTEM OVERVIEW

The fuel system of the airplane is used for fuel allocation and providing smooth engine operation throughout the operating range of altitudes and speed. The fuel system consists of the main fuel system and wingtip tanks' system. The fuel regulation is mainly automated based on throttle position.

- The Fuel Quantity Indicator **only displays fuel remaining in the fuselage fuel tanks**.
- The fuel reservoir is used to supply the engine with fuel while flying with negative G's. Flying with **negative G's for more than 20 seconds is not allowed**. The accumulator has to be refilled by flying horizontally for at least 20 seconds, before flying again with negative G's.
- To shut off fuel flow from the tanks into the fuel pipeline, the **fuel shut-off valve** has to be used. This valve is controlled with the help of levers, located on the left side of both cockpits.
- When the SPT-40 inverter fails, the fuel and oil pressure gauges do not operate. To enable capacitive fuel gauge operation, it is necessary to enable the **Emergency Engine Instruments Power (ENGINE INDICAT. EMERG**) switch in the front cockpit. The zero position on the scale corresponds to 37 kg fuel in the fuselage tanks.

Emergency Engine Instruments Power Switch
- *FWD: ON*
- *AFT: OFF*

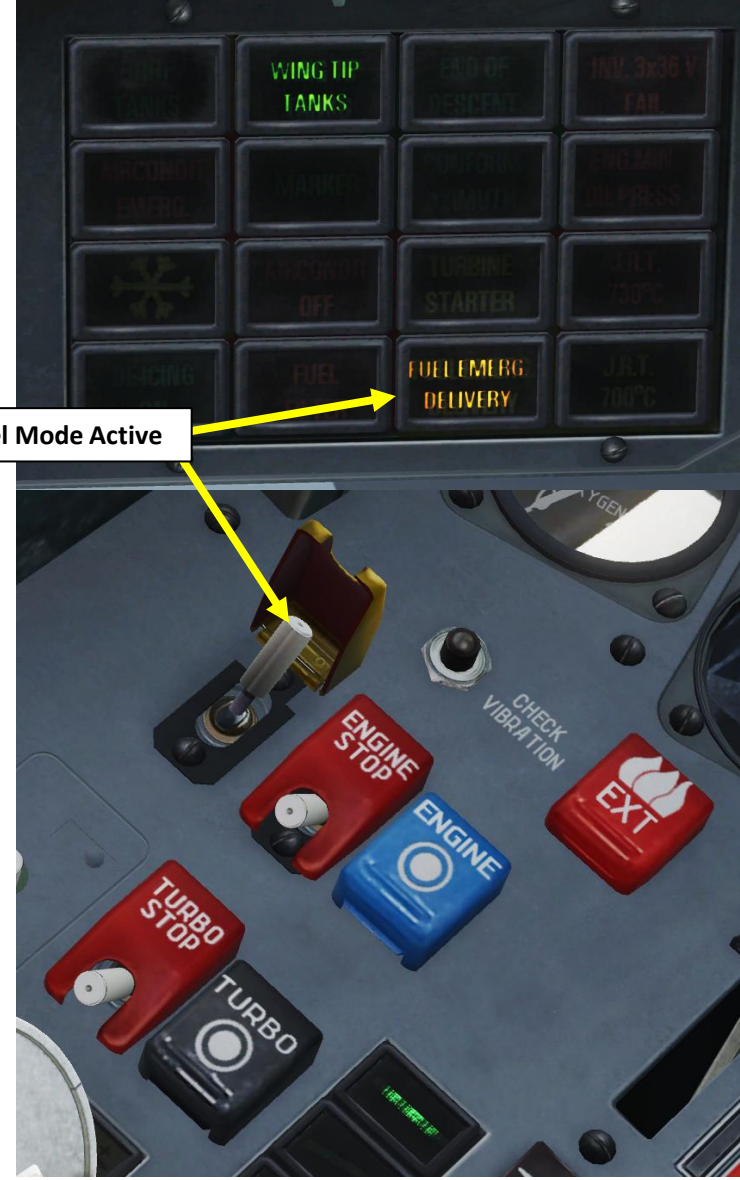
Fuel Shutoff Lever
- *AFT: FUEL VALVE SHUT (NO FUEL AVAILABLE)*
- *FWD: FUEL VALVE OPEN (FUEL AVAILABLE)*

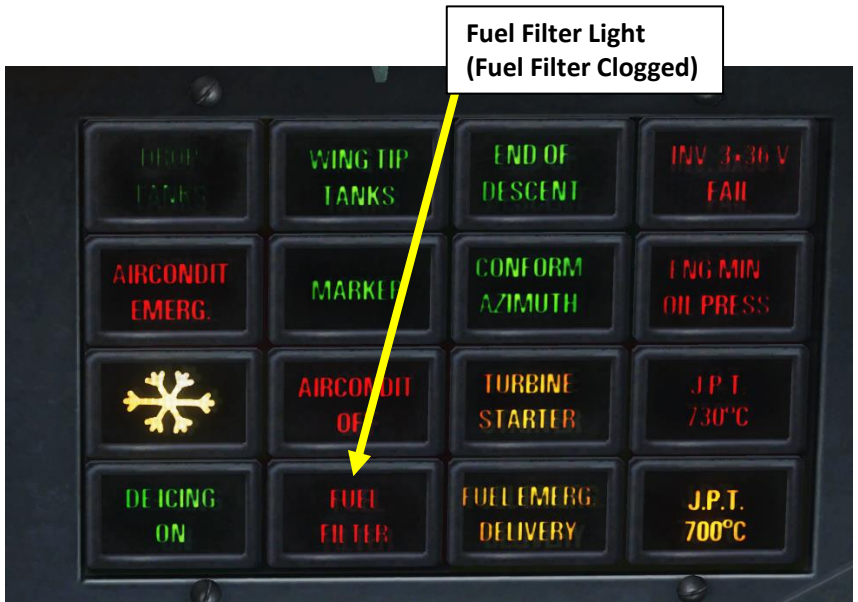


FUEL SYSTEM OVERVIEW

The fuel pressure at the engine nozzles should not be more than 65 kg/cm^2. In case of partial or complete main fuel supply system failure (combat damage), it is necessary to switch to the emergency fuel supply system by enabling the **Emergency Fuel (SEC. REG.) switch** located in both cockpits. After that, the **FUEL EMERG DELIVERY** light will illuminate on the caution & advisory lights panels in both cockpits. This indicator operates in continuous mode.

In case of fuel filter clogging or increased pressure difference, the **FUEL FILTER** signal light illuminates on the caution & advisory lights panels in both cockpits. This lamp operates in continuous mode.





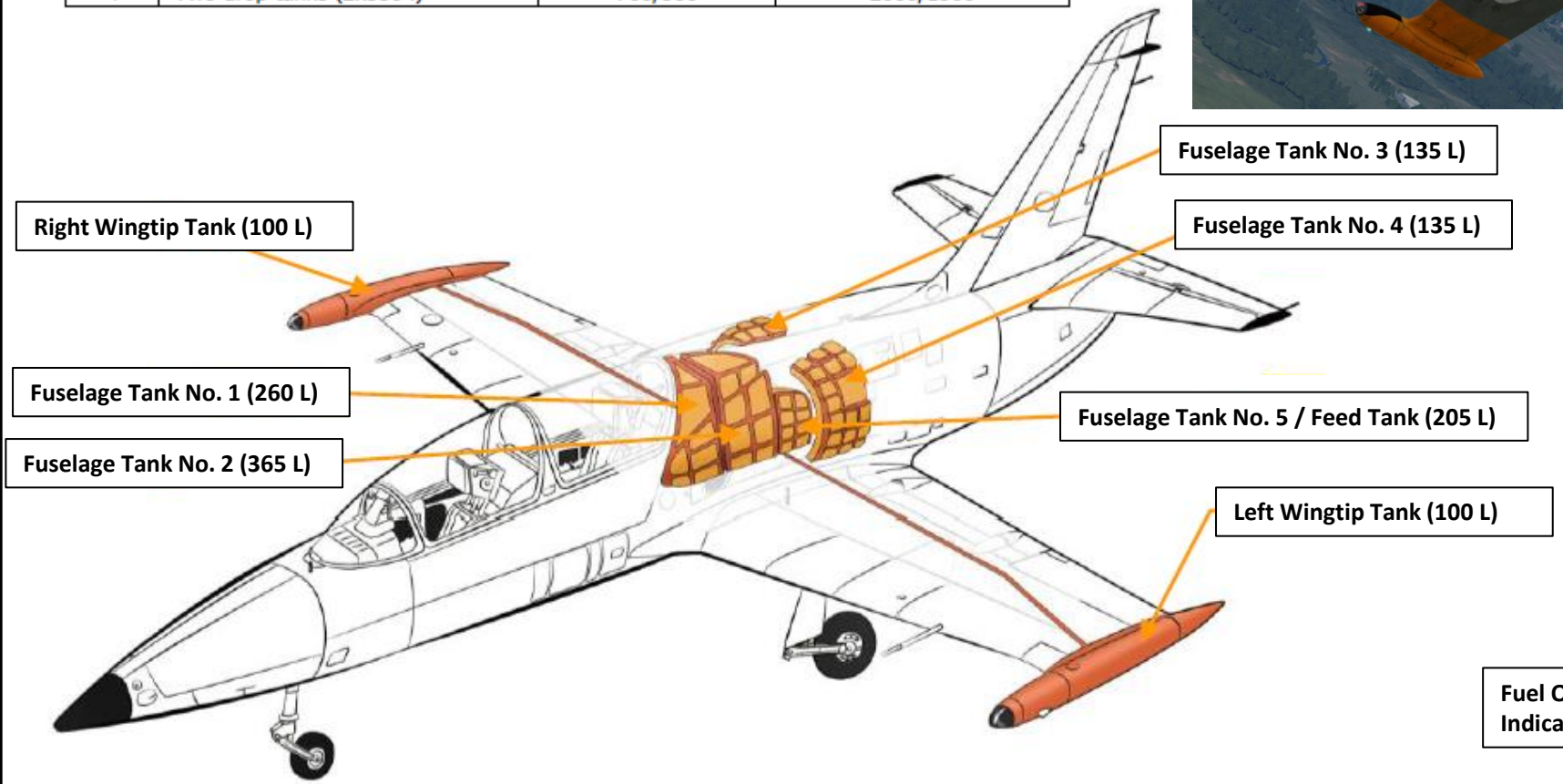
FUEL TANKS

The main fuel system incorporates five fuselage tanks with a total capacity of 1100 liters (825 kg). Two wingtip tanks are present with a capacity of 100 liters each.

The total fuel load is 975 kg, which can be monitored on the Fuel Quantity Indicator. The Fuel Quantity Indicator **only displays fuel remaining in the fuselage fuel tanks**.

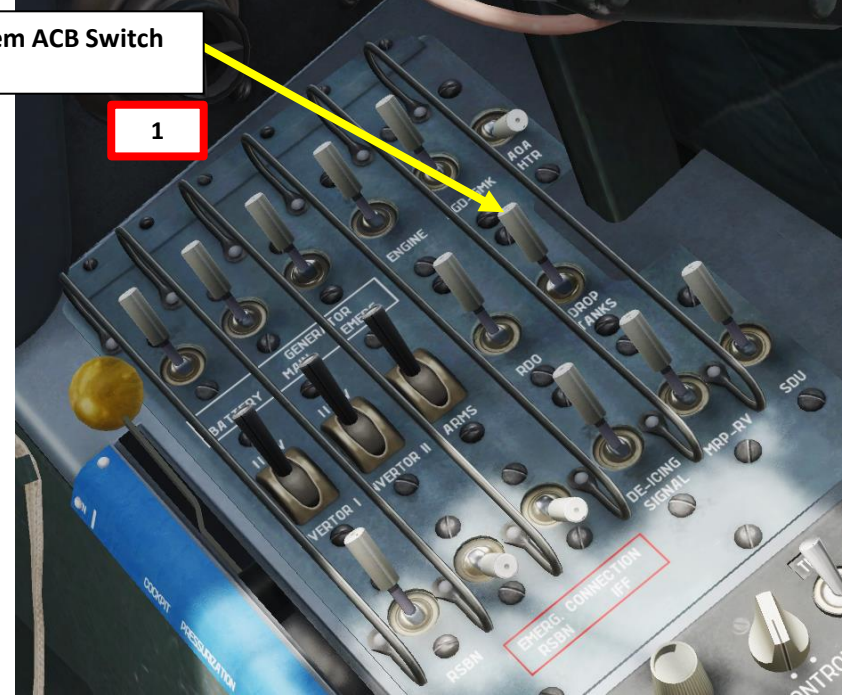
Additionally, the L-39 can equip 2 x 150 L or 2 x 350 L External Fuel Drop Tanks.

No.	Fuel tanks	Capacity, l/kg	Total capacity, l/kg
1	Fuselage	1100/824	1100/824
2	Two wing tip tanks	200/156	1300/980
3	Two drop tanks (2x150 l)	300/234	1600/1214
4	Two drop tanks (2x350 l)	700/580	2000/1560



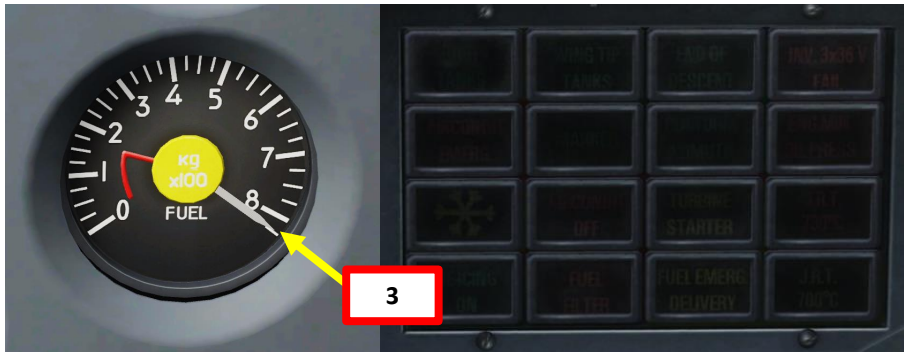
FUEL CONSUMPTION SEQUENCE (EXAMPLE WITHOUT EXTERNAL FUEL DROP TANKS)

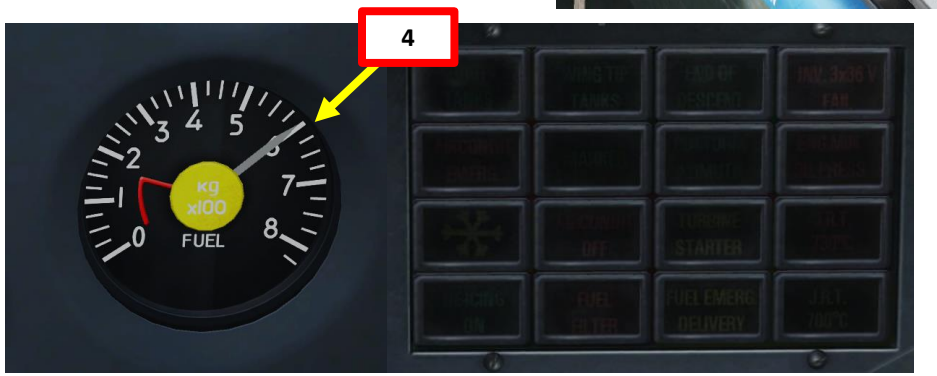
External Fuel Drop Tank & Wingtip Tank Status Indication System ACB Switch
- *FWD=ON/AFT=OFF*



The order of fuel consumption has to keep the airplane's center of gravity within specified operating limits.

1. Make sure you have set the External Fuel Drop Tank & Wingtip Tank Status Indication System ACB Switch – ON (FWD).
    - In the L-39ZA, the switch is labelled DROP TANKS. In the L-39C, the switch is labelled WING TANKS.
2. When fully refueled (1300 liters), fuel is initially consumed from the fuselage tanks.
3. When 575-625 kg remains in the fuselage tanks, fuel is consumed from the wingtip tanks. The fuel quantity indicator may appear "frozen", but this should be expected since the **Fuel Quantity Indicator only displays fuel remaining in the fuselage fuel tanks;** in this phase, fuel is consumed from the wingtip tanks instead.
4. It takes 15 minutes to consume all the fuel from the wingtip tanks.
5. Once Wingtip tanks are empty, the WING TIP TANKS caution light is visible. Then, the rest of the fuel in the fuselage tanks is consumed. The Fuel Quantity indicator will continue decreasing.
6. At this stage, you could turn off the External Fuel Drop Tank & Wingtip Tank Status Indication System ACB Switch since you no longer need to be notified that the wingtip tanks are empty.
7. The "150 KG FUEL" caution light indicates that only 150 kg of fuel remains.

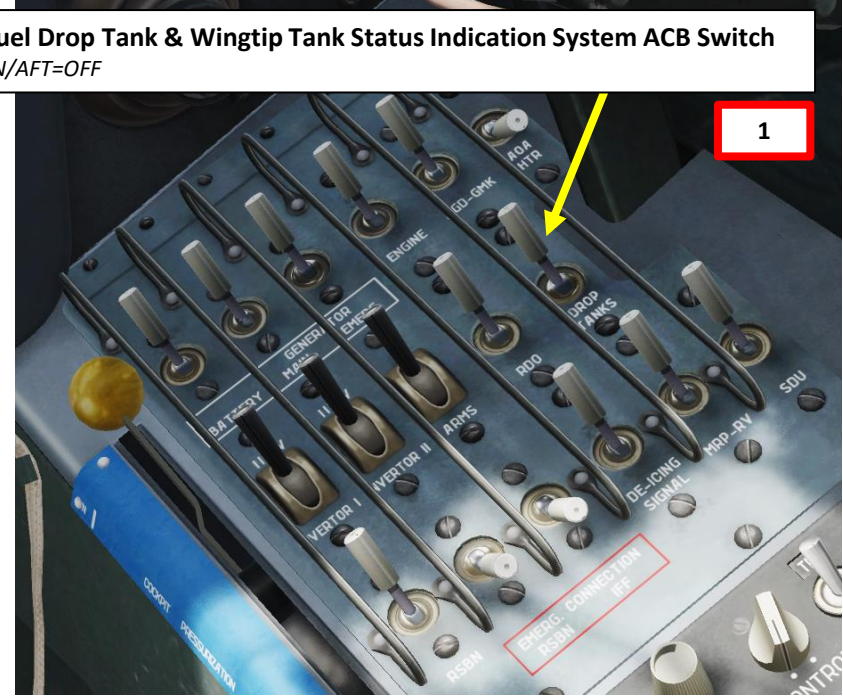


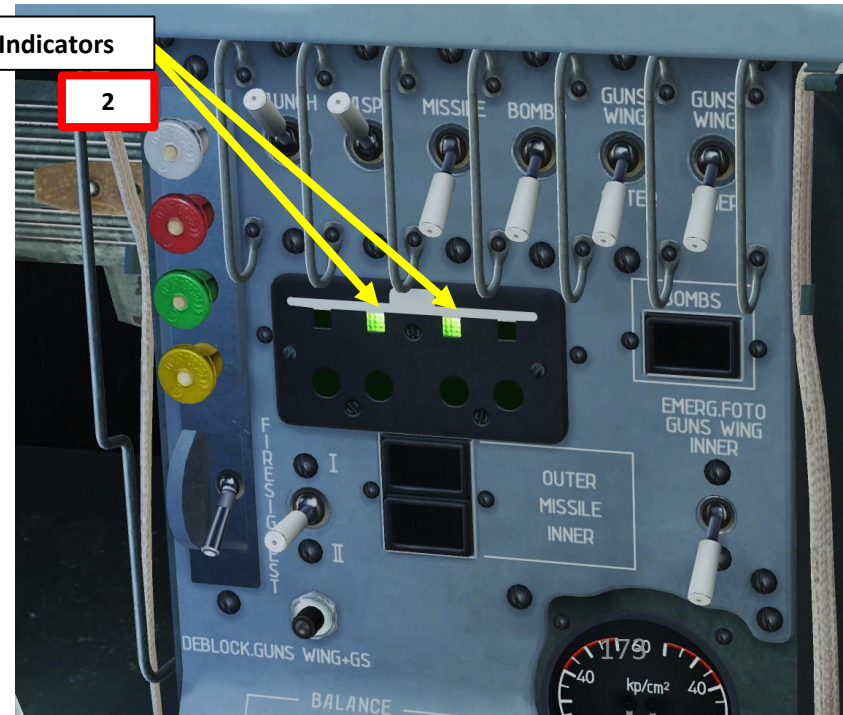


EXTERNAL FUEL DROP TANKS OPERATION

1. Make sure you have set the External Fuel Drop Tank & Wingtip Tank Status Indication System ACB Switch – ON (FWD).
   - In the L-39ZA, the switch is labelled DROP TANKS. In the L-39C, the switch is labelled WING TANKS.
2. When external fuel drop tanks are installed, the stations are indicated on the External Stores Indicators.

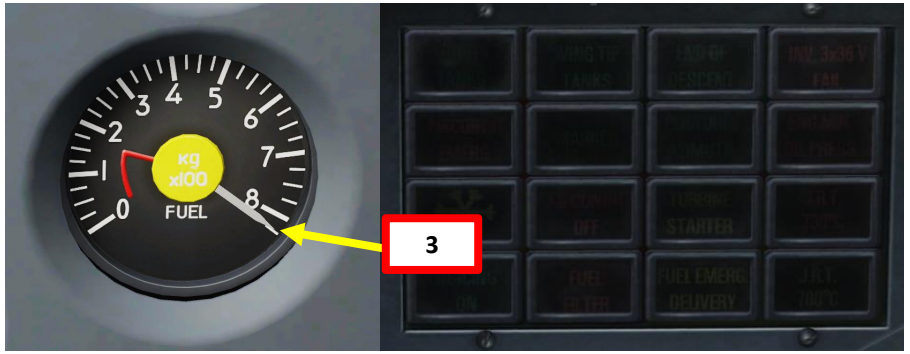
External Fuel Drop Tank & Wingtip Tank Status Indication System ACB Switch
- *FWD=ON/AFT=OFF*

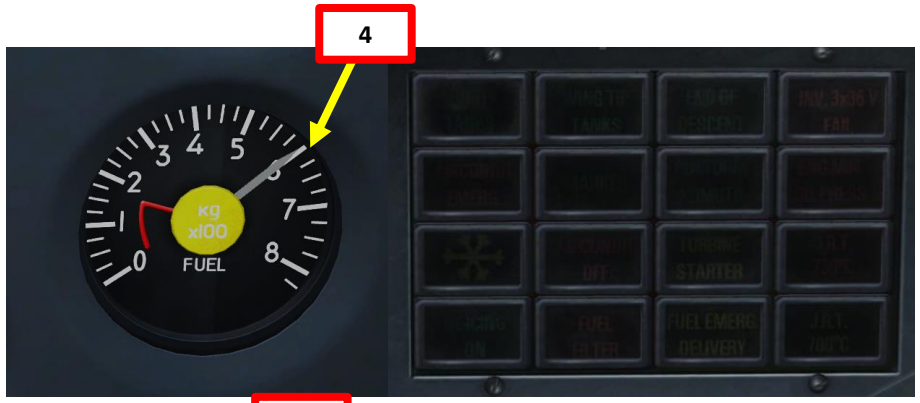


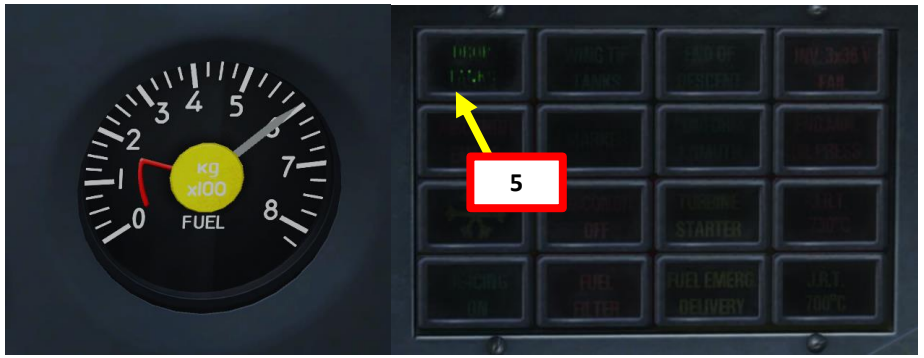


EXTERNAL FUEL DROP TANKS OPERATION

3. Fuel is initially consumed from the fuselage tanks.
4. When 575-625 kg remains in the fuselage tanks, fuel is consumed from the external fuel drop tanks. The fuel quantity indicator may appear “frozen”, but this should be expected since the **Fuel Quantity Indicator only displays fuel remaining in the fuselage fuel tanks;** in this phase, fuel is consumed from the external drop tanks instead.
5. Once external fuel drop tanks are empty, the DROP TANK caution light illuminates. Then, fuel is consumed from the wingtip tanks.
6. At this stage, you may jettison external drop tanks (see next tutorial).
7. It takes 15 minutes to consume all the fuel from the wingtip tanks.
8. Once Wingtip tanks are empty, the WING TIP TANKS caution light is visible. Then, the rest of the fuel in the fuselage tanks is consumed. The Fuel Quantity indicator will continue decreasing.
9. At this stage, you could turn off the External Fuel Drop Tank & Wingtip Tank Status Indication System ACB Switch since you no longer need to be notified that the wingtip tanks are empty.
10. The “150 KG FUEL” caution light indicates that only 150 kg of fuel remains.

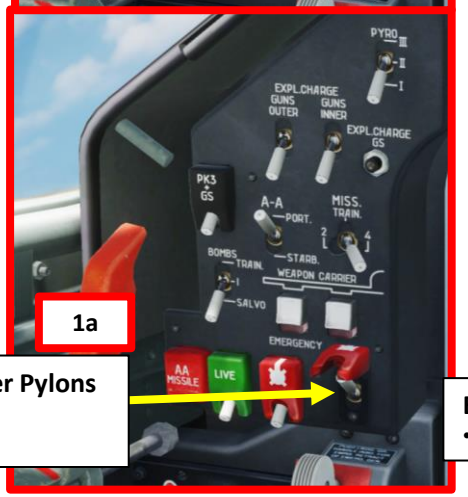




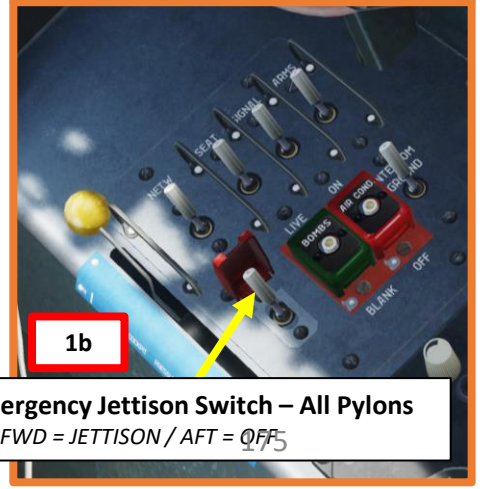


EXTERNAL FUEL DROP TANKS JETTISON

1. Jettison desired external fuel drop tanks using the Emergency Jettison Switch.
   a) To jettison external fuel drop tanks from the Front Seat, set the rightmost Emergency Jettison Switch UP. This will jettison inner pylon ordnance only.
   b) To jettison external fuel drop tanks from the Rear Seat, set the Emergency Jettison Switch FWD. This will jettison ordnance installed on all pylons.
2. Verify drop tanks have been jettisoned using the External Stores Indicators, which should be extinguished after drop tank jettison has been performed.



Emergency Jettison Switch – Inner Pylons
- *UP: JETTISON*
- *DOWN: OFF*



Emergency Jettison Switch – All Pylons
- *FWD = JETTISON / AFT = OFF*

FLIGHT CHARACTERISTICS L-39

Main specifications		
1. Maximum allowed true air speeds in horizontal flight (flight weight is 4000 kg):		
a) engine operating at maximum thrust (n_{1hpc}=106,8±1%)		
at ground level	km/h	702*
at 5000 m	km/h	757*
at 6000 m	km/h	760*
at 10000m	km/h	737
b) engine operating at nominal thrust (n_{1hpc} =103,2±1%)		
at ground level	km/h	640*
at 5000 m	km/h	712*
at 6000 m	km/h	720*
at 10000m	km/h	694*
2. Maximum vertical speeds (take off weight is 4300 kg):		
a) engine operating at maximum thrust (n_{1hpc}=106,8±1%)		
at ground level	m/s	22
at 6000 m	m/s	10,8
at 10000m	m/s	3,4
b) engine operating at nominal thrust (n_{1hpc} =103,2±1%)		
at ground level	m/s	16,3
at 6000 m	m/s	8
at 10000m	m/s	2,6
3. Service ceiling (standard conditions, take off weight 4300 kg)	m	11 500
4. Minimum time required for reaching altitudes (standard conditions, take off weight 4300 kg)		
a) engine operating at maximum thrust (n_{1hpc}=106,8±1%)		
6000 m	min	6,4
10000 m	min	16,9
service ceiling, when from 10000m engine operates at nominal thrust	min	40
b) engine operating at nominal thrust (n_{1hpc} =103,2±1%)		
6000 m	min	8,6
10000 m	min	22,4
service ceiling	min	40,8
5. Maximum range and duration of flight, when flying at 5000 m with 5% remaining fuel		
- with empty wing tanks is 850 km and 2 h 11 min		
- with full wing tanks 1015 km and 2 h 35 min.		
6. Take off roll on paved runway with engine operating at maximum thrust needed to reach take off speed of 185-190 km/h is 480-530 m.		
7. Landing roll on paved runway with use of gear brakes when landing with IAS of 180 km/h is 650-690 m.		

*: speeds listed here are in compliance with standard conditions (ISA).

TABLE OF STALL SPEEDS

Configuration		Without Stores		With Stores	
Aircraft Gross Weight (kg)		3,700	4,500	4,600	4,700
Flaps Deflection + Landing Gear Setting	0 deg Landing Gear retracted	172	190	196	198
	25 deg Landing Gear extended	157	173	182	184
	44 deg Landing Gear extended	148	163	174	176

TABLE OF MAX ALLOWABLE SPEEDS

	Flaps (Landing)	Landing Gear (Extended)
Airspeed (km/h)	310	340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SECTION STRUCTURE

- **1 – INTRODUCTION**
  - 1.1 – Armament Overview
  - 1.2 – ASP-3NMU-39 Optical Gunsight
  - 1.3 – Weapon Interface
  - 1.4 – Ground Attack Profiles

- **2 – AIR-TO-GROUND WEAPONS**
  - 2.1 – GS-23L Cannon (23 mm)
  - 2.2 – PK-3 Machinegun Pods (7.62 mm)
  - 2.3 – S-5KO Rockets (57 mm)
  - 2.4 – FAB-250 Bombs

- **3 – AIR-TO-AIR WEAPONS**
  - 3.1 – R-60M IR (Infrared Homing) Missile

- **4 – ORDNANCE JETTISON**
  - 4.1 – Inner/Outer Pylon Jettison
  - 4.2 – Missile Jettison

1 – INTRODUCTION

1.1 – Armament Overview

AIR-TO-AIR MISSILES

TYPE	DESCRIPTION
R-60M	"Aphid" missile – Infrared Homing Range: 7 km max / 2 km effective
R-3S	"Atoll" missile – Infrared Homing Similar to AIM-9B Sidewinder Range: 8 km max / 4 km effective

ROCKETS

TYPE	DESCRIPTION
UB-16 Pod S-5KO Rockets	16 x S-5KO rockets Caliber: 57 mm

GUNS

TYPE	DESCRIPTION
PK-3	7.62 mm machinegun pod 3 machineguns per pod
GS-23L	Twin-Barrel 23 mm cannon 150 cartridges Effective range: 2 km

BOMBS

TYPE	DESCRIPTION
FAB-100	100 kg general-purpose unguided bomb
FAB-250	250 kg general-purpose unguided bomb
OFAB-100 JUPITER	100 kg high-drag (parachute) unguided bomb
P-50T	50 kg practice unguided bomb
SAB-100	Night Illumination Flare

MISCELLANEOUS

TYPE	DESCRIPTION
SMOKE POD	Smoke Pod – External pod or inside engine exhaust
FUEL TANK (150 L)	150 L drop tank
FUEL TANK (350 L)	350 L drop tank

1 – INTRODUCTION
1.2 – ASP-3NMU-39 Optical Gunsight

The L-39's aiming equipment includes ASP-3NMU-39 gunsight. Aiming basically consist of two simultaneous operations: keeping central dot of aiming grid over target by maneuvering the airplane.

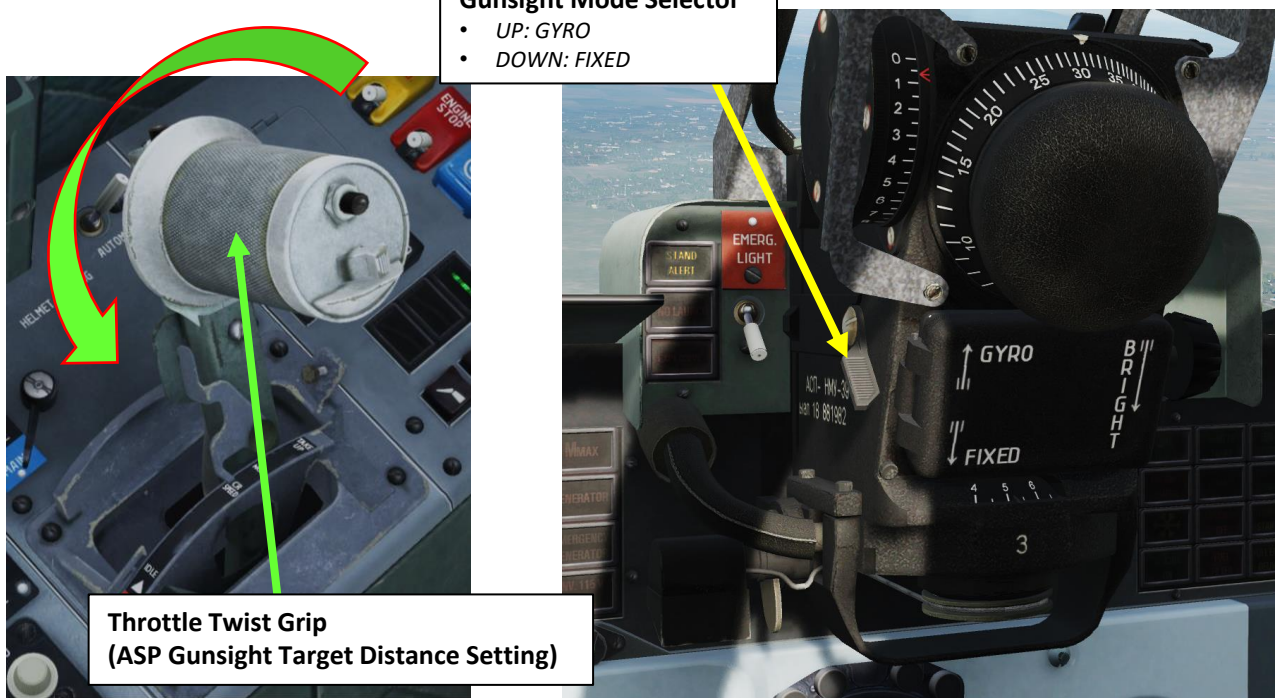
The gunsight has a distance rheostat and optical rangefinder. The operation principle of the rangefinder is based on target size measurement depending on distance to the target. The rangefinder can provide gunsight with distance within full range of 180-800m, but only if the target base is within 14-22 m. For targets with bases of less than 14 m, maximum distance cannot be entered into the gunsight. This is also the case for targets with bases of more than 22 m. – minimum distance. This is explained by the fact that optical rangefinder's grid diameter is limited by 17.5 milliradians or "mil" (maximum distance) – 122 mil (minimum distance).

The gunsight has two operating modes: **GYRO** and **FIXED**. In the GYRO target leading angle is being calculated automatically during aiming. To use gunsight as collimator sight, the FIXED mode with fixed grid is used. Gunsight operation mode is selected by the switch on the gunsight.

Fixed Reticle
- *132 mil diameter*

Gyro Sight
- *Diameter ranges from 17.5 mil to 122 mil.*

Gunsight Mode Selector
- *UP: GYRO*
- *DOWN: FIXED*

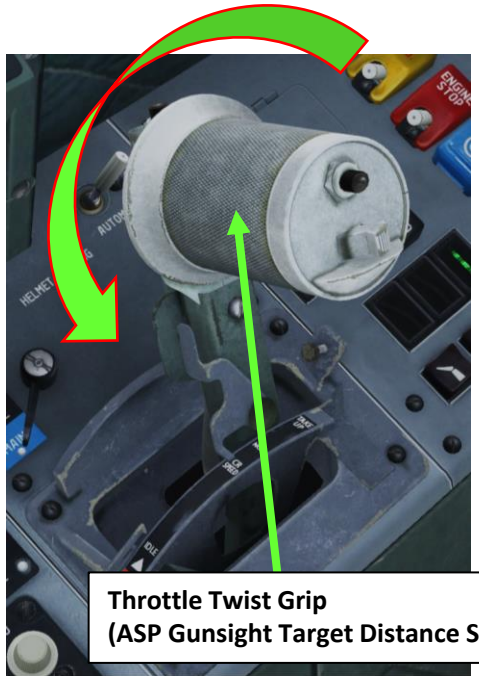


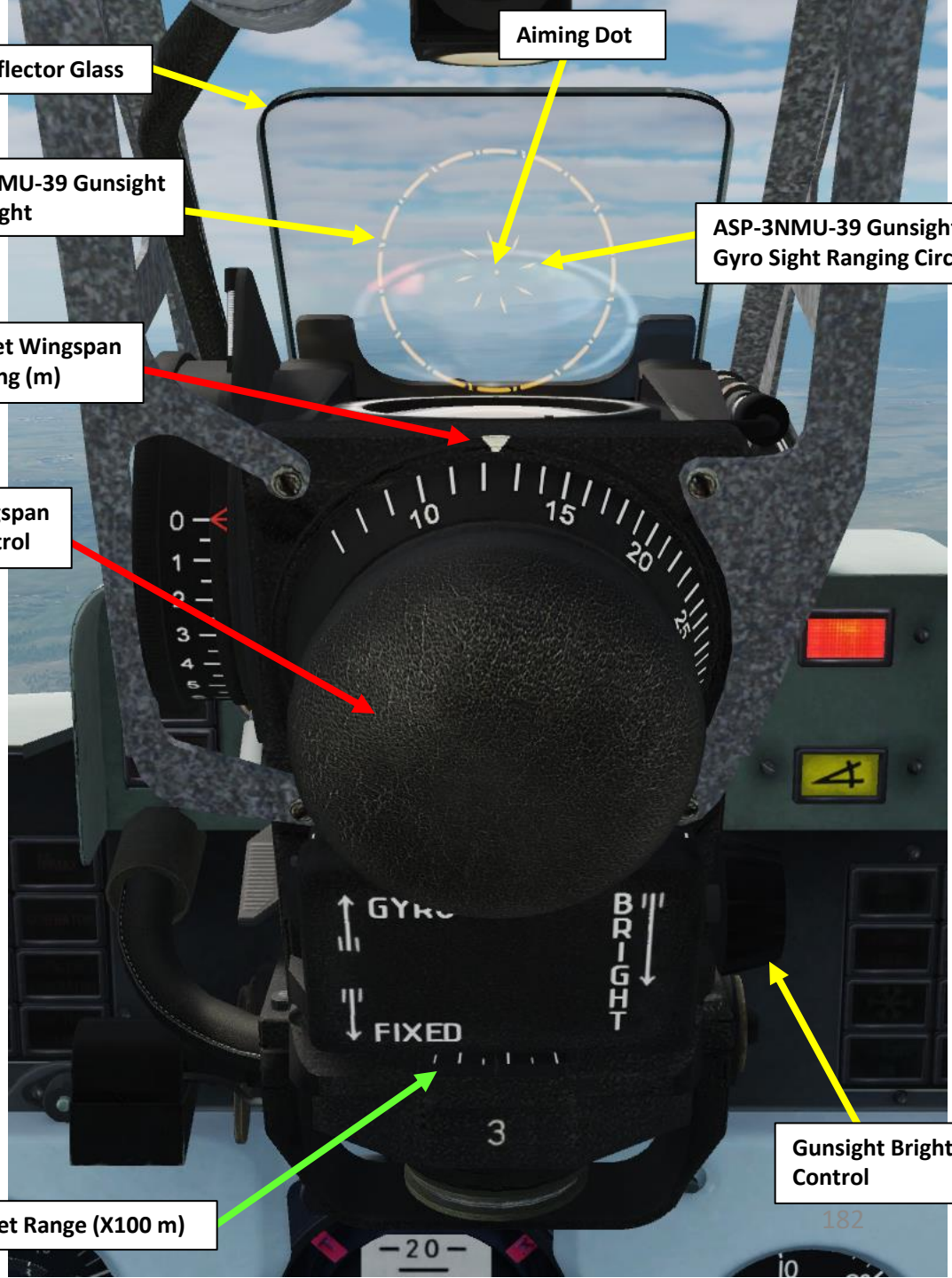
Throttle Twist Grip
(ASP Gunsight Target Distance Setting)

1 – INTRODUCTION
1.2 – ASP-3NMU-39 Optical Gunsight

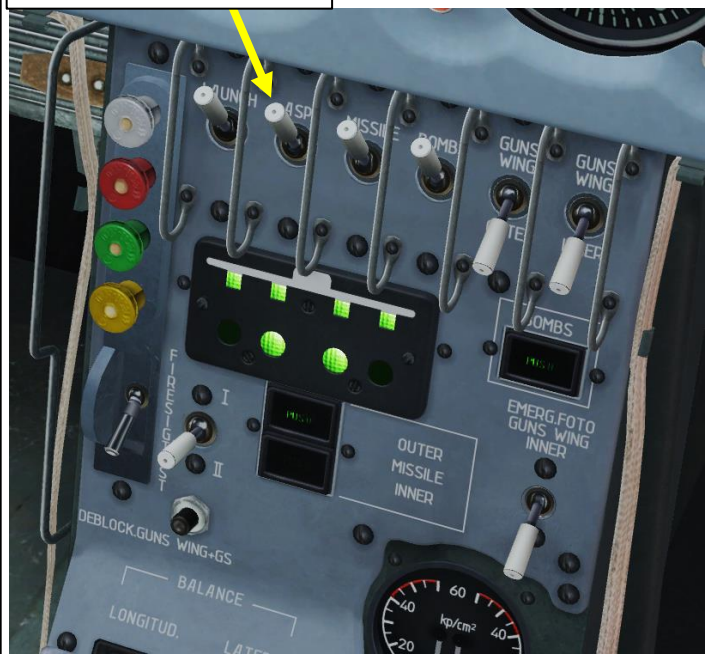
Your ASP-3NMU-39 gunsight will show you where and when to shoot a target. The gunsight has optics of collimator type with a backlight, which allows aiming independently from conditions of target and background light. A target distance measurement device allows distance ranging from 180 and up to 800 meters with a target size (wingspan) from 7 to 45 meters.

The gunsight has simple functions for calculating a firing solution and automatically computes target lead angles for the fixed onboard armament. Therefore, in the gunsight head's field of view there are two aiming marks: a fixed one with a fixed-radius circle and a central dot and a moving one (gyro) with a ranging circle consisting of 8 diamonds.



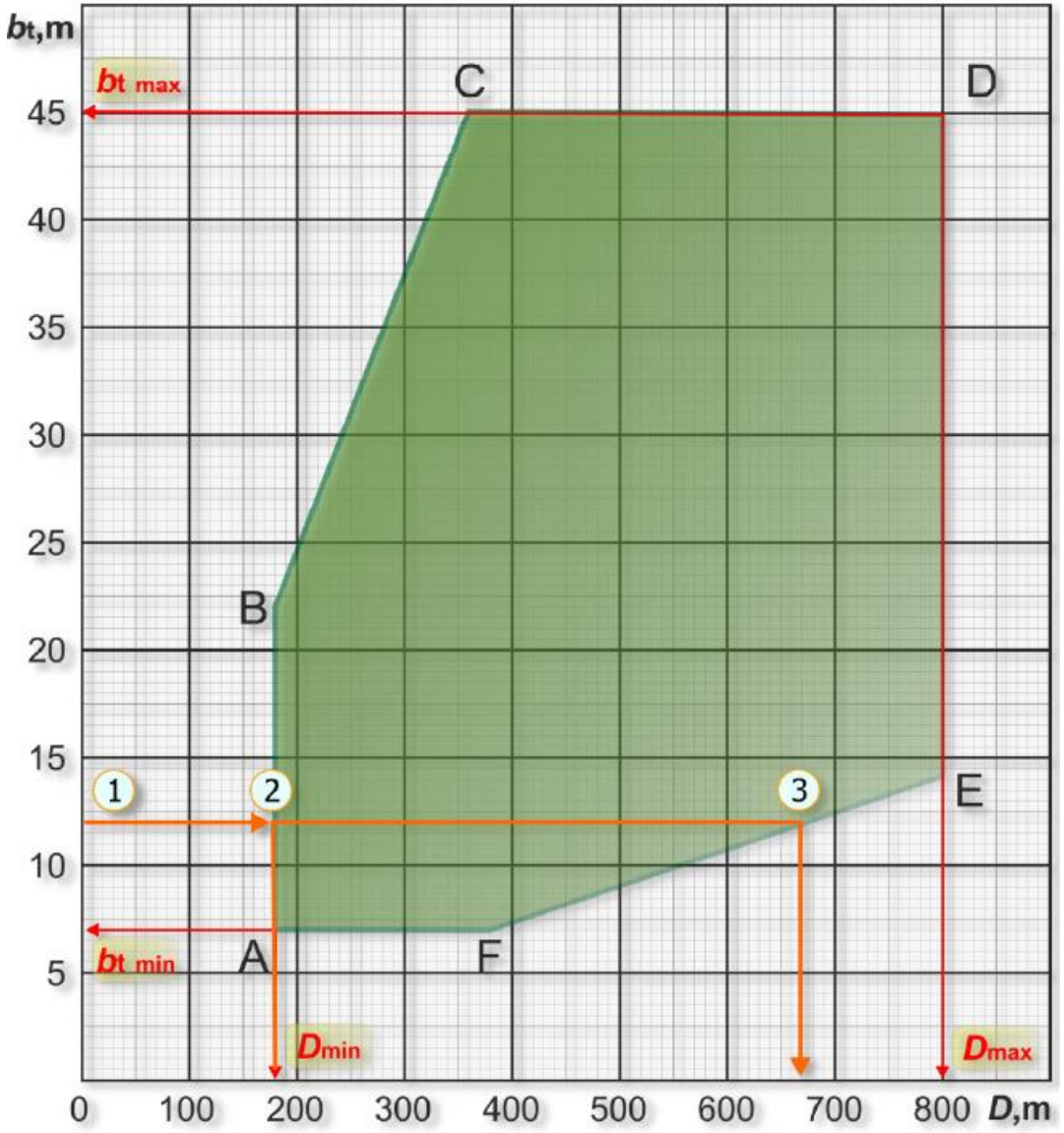


1 – INTRODUCTION
1.2 – ASP-3NMU-39 Optical Gunsight



1 – INTRODUCTION
1.2 – ASP-3NMU-39 Optical Gunsight

Dependence of operating ranges for accurate distance measurement on wingspan/target base
(derived from MiG-15 ASP-3N Gunsight)



Procedure for finding operating ranges for accurate distance measurement

Example: The target datum is 12 m. Let's determine the range interval for precise operation of the ASP-3.

1. In accordance with the known target datum (in m) represented on the vertical axis, draw a horizontal line until it intersects the ABCDEF polygon.
2. From the intersecting point of the ABC segment, drop a perpendicular to the range axis to obtain the **minimum range** value (**180 m**).
3. From the intersecting point of the DEF segment, drop a perpendicular to the range axis to obtain the **maximum range** value (**670 m**).

When parameters of the datum or range differ from the calculated ones, inaccuracy will reveal itself as the impossibility to frame the target when rotating the handle to increase the range (irremovable yawn between the diamonds and target will remain) or as placing the range to the locking stop with the target size surpassing the diamonds when rotating the handle to decrease the range.

1 – INTRODUCTION
1.2 – ASP-3NMU-39 Optical Gunsight

Shooting at ground targets

When shooting at ground targets with **sizes of more than 14 m**, it is necessary to set the target base, corresponding to the target dimensions, and before diving set the gunsight to the minimum distance. After the turn towards the target with the minimum distance set in the gunsight, the pilot has to put the reticle over the target and keeping it in this position, continue diving for 1-2 seconds. Set the maximum distance by rotating the handle and shoot a short burst when the target is framed by the diamond circle. Immediately after that, start exiting from dive and set the minimum distance on the gunsight.

When shooting at ground targets with **sizes of more than 18 m** at higher speeds or with drop tanks (non-empty) from approximately 1000 m distance, it is recommended to set a target base which is 20% less than the true size of the target. Start shooting when the target is framed accurately.

When shooting at ground targets with **sizes less than 14 m**, set 14 m target base on the gunsight. Rangefinder operation is similar to the one described above.

The shooting moment is determined based on target position in the aiming mesh at a distance of 800 m (i.e. rotating handle is on detent). Never should the pilot wait for precise target framing, because distance in this case will be as many times less than 800 m, how many times the size of the target is less than 14 m.

When shooting at **small dimension targets** at higher speed or with drop tanks (with fuel) present, from approximately 1000 m, the moment of shooting can be determined based on central aiming mark projection onto the target, taking into account that angular size of central mark is 2 mil. For example, when shooting at a car from a distance of 1000 m, central mark projection diameter is approximately equal to the transverse dimension of the car.

1 – INTRODUCTION
1.2 – ASP-3NMU-39 Optical Gunsight

A proper tutorial for rocket and bomb delivery is listed in Eagle Dynamics' manual from pages 209 to 216. There is also one in the Steam forums here: https://steamcommunity.com/sharedfiles/filedetails/?id=673640719

Shooting at ground targets

Since the recommended shooting and bombing ranges exceed maximum distance (800 m) which can be entered into gunsight, fictitious target base should be entered for external base rangefinder to operate correctly. It is defined by the following equation:

$$B_f = B_a \times D_m / D_s$$

where:

- B_f – *fictitious target base, m;*
- B_a – *actual target size, m;*
- D_m – *maximum distance, entered into gunsight - 800 m;*
- D_s * – *shooting (bombing) distance.*

D_s * - *see Tables 1 and 2.*

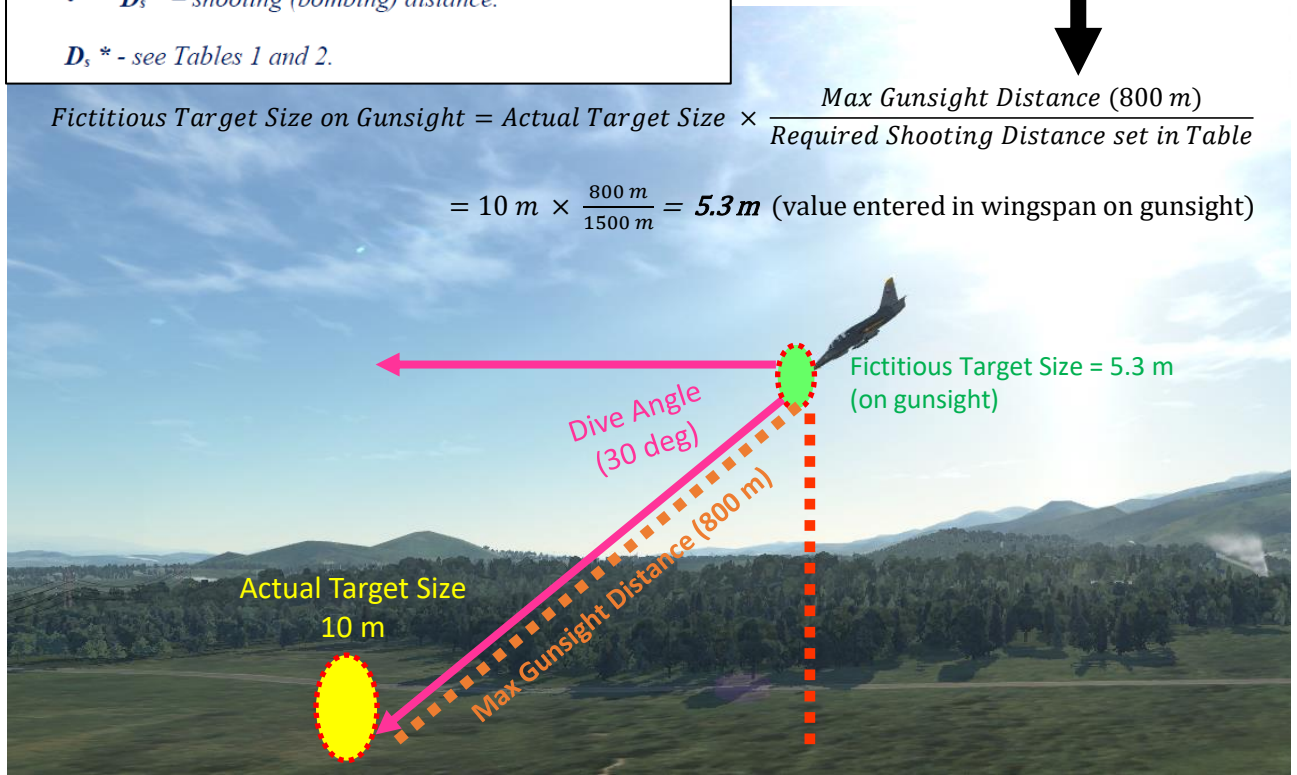
Example: a bomb delivery done at a **30** deg dive for an actual target size of **10** m.

The fictitious target size is the actual target size multiplied by the ratio of the maximum gunsight range (**800** m) over the required shooting distance/altitude in the **Bomb Delivery Diving Attack Profile Table**, which is **1500** m.

In other words: the "wingspan" (size) of the target you need to enter in your gunsight set at a max target range of **800** m is:

$$\text{Fictitious Target Size on Gunsight} = \text{Actual Target Size} \times \frac{\text{Max Gunsight Distance (800 m)}}{\text{Required Shooting Distance set in Table}}$$

$$= 10\ m \times \frac{800\ m}{1500\ m} = \mathbf{5.3\ m}\ \text{(value entered in wingspan on gunsight)}$$



Bomb Delivery Diving Attack Profile (Table 1)
(Recommended Diving Angles: 20, 30 or 40 deg)

№	Parameters	20°	30°	40°
1	Gunsight reflector deflection angle	13°	11°	10°
2	Dive entry altitude at ingress point	1200 m	1500 m	1800 m
3	Dive entry speed at ingress point	440 km/h	350 km/h	300 km/h
4	Release altitude	730 m.	800 m	1100 m
5	Release speed	570 km/h.	550 km/h.	560 km/h
6	RPM	97%	92%	МГ%

1 – INTRODUCTION
1.2 – ASP-3NMU-39 Optical Gunsight

Shooting at air targets

Point/Position 1: Start of an engagement. Gyro is caged, the pilot observes the target through central gunsight mark. Distance to target is set to 800 m (for example).

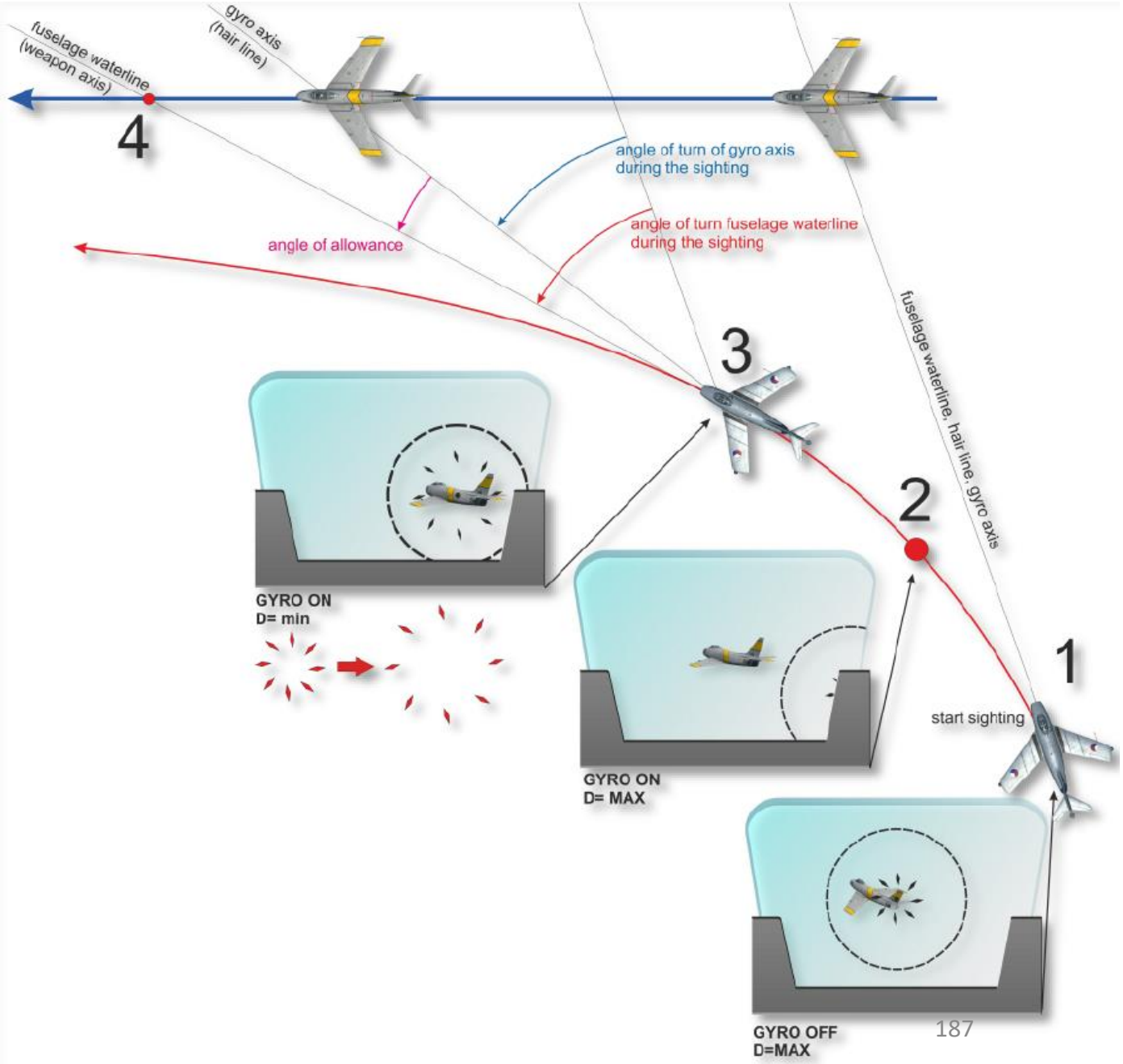
Point/Position 2: Pilot uncaged gunsight gyro and turned aircraft to keep target in field of view. Since in point 2 aircraft got angular velocity gunsight gyro precession begins. For entered target distance (800 m) gunsight computer calculated maximum leading angle, which at certain value of angular velocity during turn can move aiming mark out of gunsight field of view. Aiming mark will be seen behind target (gunsight reflector view for point 2).

Point/Position 3: Pilot reduced distance on rheostat to a minimum value (diamonds dispersed). The gunsight computer reduced angular adjustment, aiming mark moved closer to gunsight center, making it easier for the pilot to keep the target inside the area framed by the diamonds. When the target is correctly framed and seen inside internal diamonds vertices, the correct aiming angle (angle of allowance in the schematic) will be automatically computed. Angle of allowance is the angle between the gyro axis pointed at target and the fuselage axis (weapon axis).

Point/Position 4: Place where shells hit target if fired.

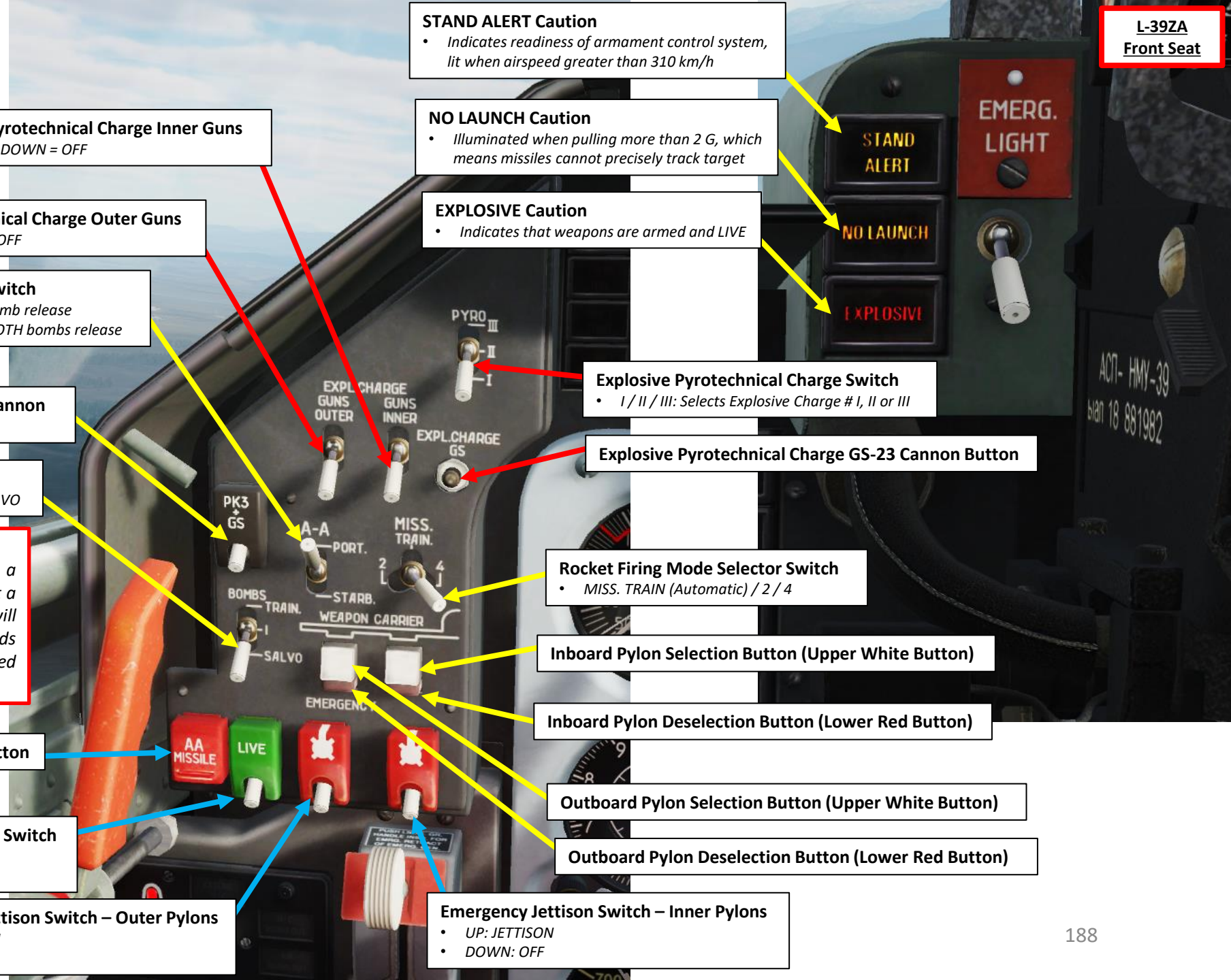
Note: the L-39's 23 mm cannon is ill-suited for air-to-air engagements, nor is the L-39's airspeed sufficient to catch up with other jet fighters. Take the theory of this sub-section as… err… "theoretical" information only.

Aiming technique with the use of the gyro gunsight (derived from MiG-15 ASP-3N Gunsight)



1 – INTRODUCTION
1.3 – Weapon Interface

L-39ZA Front Seat



STAND ALERT Caution
- *Indicates readiness of armament control system, lit when airspeed greater than 310 km/h*

NO LAUNCH Caution
- *Illuminated when pulling more than 2 G, which means missiles cannot precisely track target*

EXPLOSIVE Caution
- *Indicates that weapons are armed and LIVE*

Explosive Pyrotechnical Charge Inner Guns
- *UP = ON / DOWN = OFF*

Explosive Pyrotechnical Charge Outer Guns
- *UP = ON / DOWN = OFF*

Missile (A/A) and Bomb Release Mode Switch
- *UP: Portside, LEFT Missile Launch / SINGLE bomb release*
- *DOWN: Starboard, RIGHT Missile Launch / BOTH bombs release*

PK-3 Machine-Gun Pod + GS-23 Cannon
- *UP = ARMED / DOWN = Not Armed*

Bomb Mode Selector
- *TRAIN / I (Single) / SALVO*

Explosive Pyrotechnical Charge Switch
- *I / II / III: Selects Explosive Charge # I, II or III*

Explosive Pyrotechnical Charge GS-23 Cannon Button

Rocket Firing Mode Selector Switch
- *MISS. TRAIN (Automatic) / 2 / 4*

Inboard Pylon Selection Button (Upper White Button)

Inboard Pylon Deselection Button (Lower Red Button)

Outboard Pylon Selection Button (Upper White Button)

Outboard Pylon Deselection Button (Lower Red Button)

Note

Russian gun pods and cannons of this era use a "pyrotechnical" reload system, which means that a cassette equipped with three pyrocartridges will detonate a charge to "reload" a gun. The gun pods installed on the MiG-21 and the cannons installed on the MiG-15bis use a similar system.

Emergency Launch Missile Button

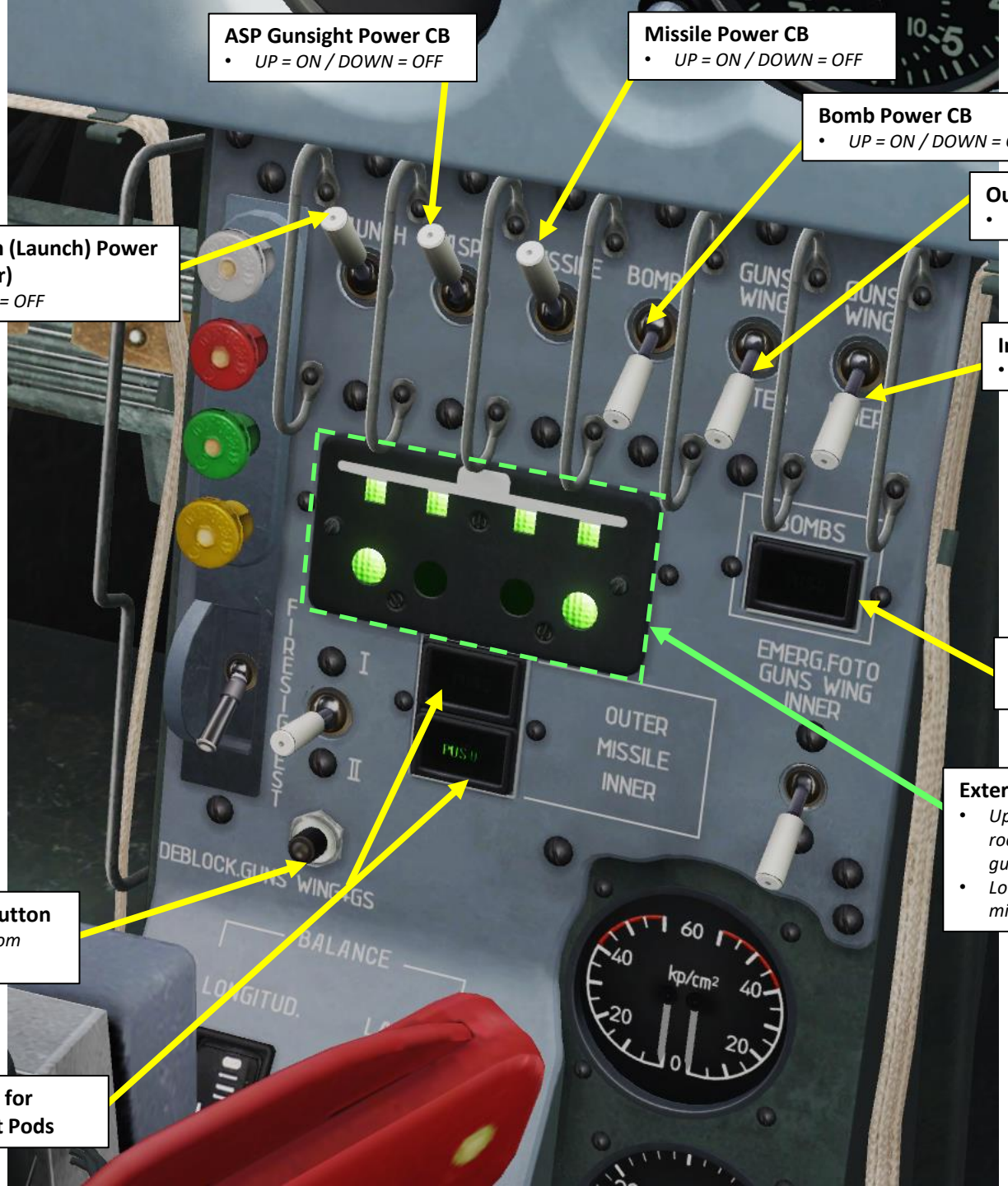
Bomb Emergency Jettison Mode Switch
- *UP: ARMED (LIVE)*
- *DOWN: Not Armed (BLANK)*

Emergency Jettison Switch – Outer Pylons
- *UP: JETTISON*
- *DOWN: OFF*

Emergency Jettison Switch – Inner Pylons
- *UP: JETTISON*
- *DOWN: OFF*

1 – INTRODUCTION
1.3 – Weapon Interface

L-39ZA Front Seat



ASP Gunsight Power CB
- *UP = ON / DOWN = OFF*

Missile Power CB
- *UP = ON / DOWN = OFF*

Bomb Power CB
- *UP = ON / DOWN = OFF*

Outer Wing Guns Power CB
- *UP = ON / DOWN = OFF*

Armament System (Launch) Power CB (Circuit Breaker)
- *UP = ON / DOWN = OFF*

Inner Wing Guns Power CB
- *UP = ON / DOWN = OFF*

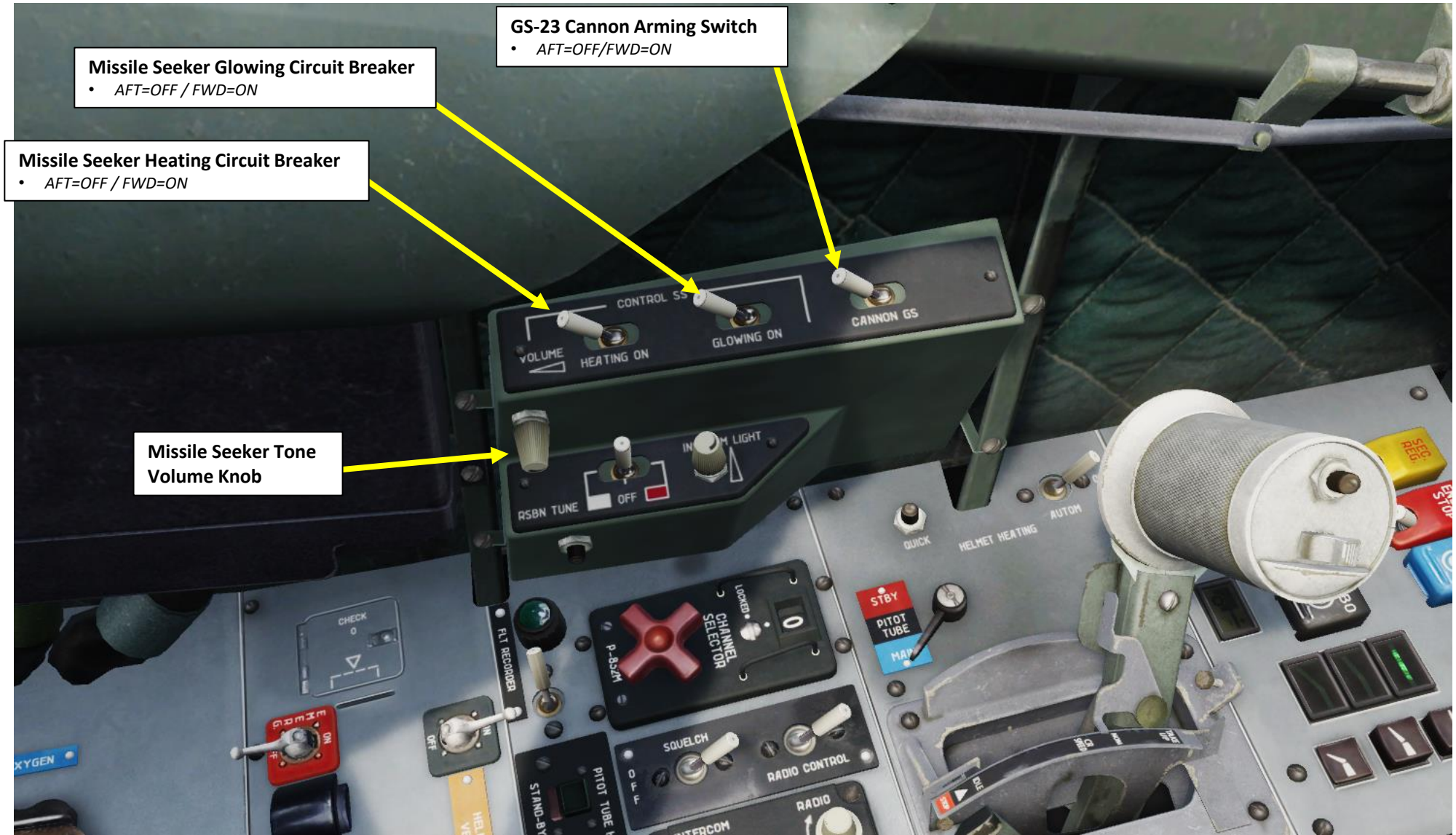
PUS-0 Signal Indicator for Bombs Armed

External Stores Indicators
- *Upper row lights: indicates attachment of single bombs, rocket launchers, missile launchers, bomb racks and PK-3 gunpads **before arming***
- *Lower row lights: indicates attachment of bombs on rack, missile on launchers and PK-3 gunpad **after arming***

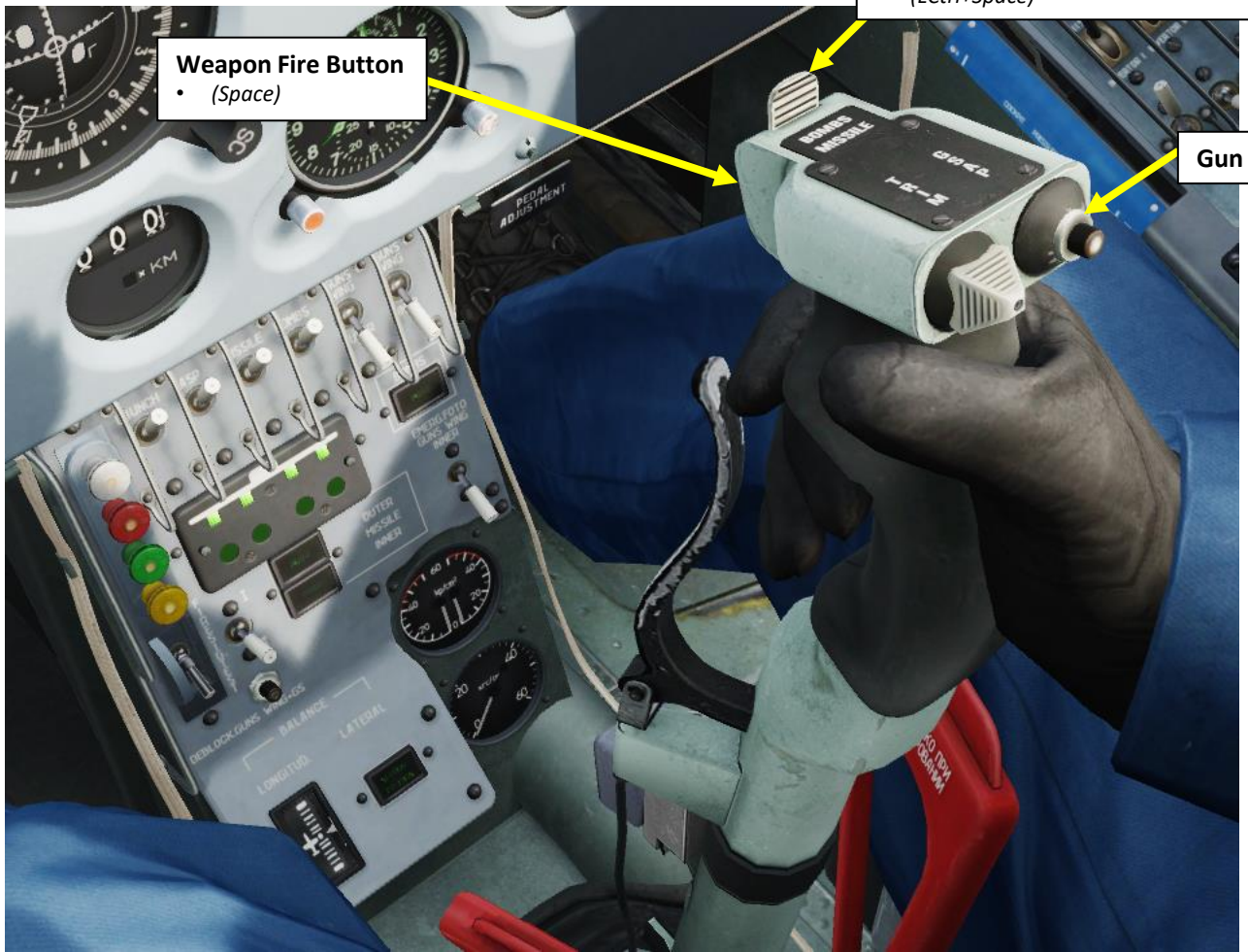
Deblock Guns (GS-23 and Wing Gun Pods) Button
- *Disengages safety on guns that prevents them from being fired on the ground*

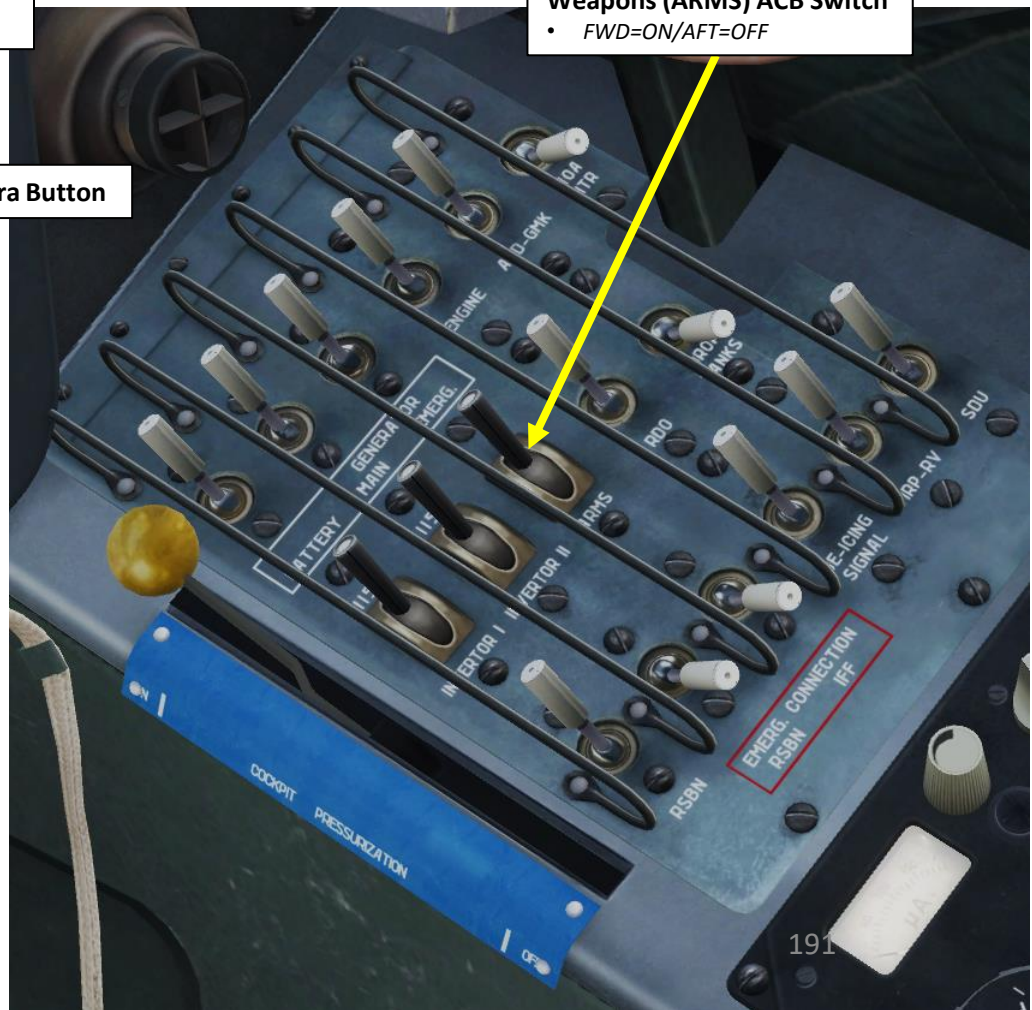
PUS-0 Signal Indicators for Outer and Inner Rocket Pods

1 – INTRODUCTION
1.3 – Weapon Interface

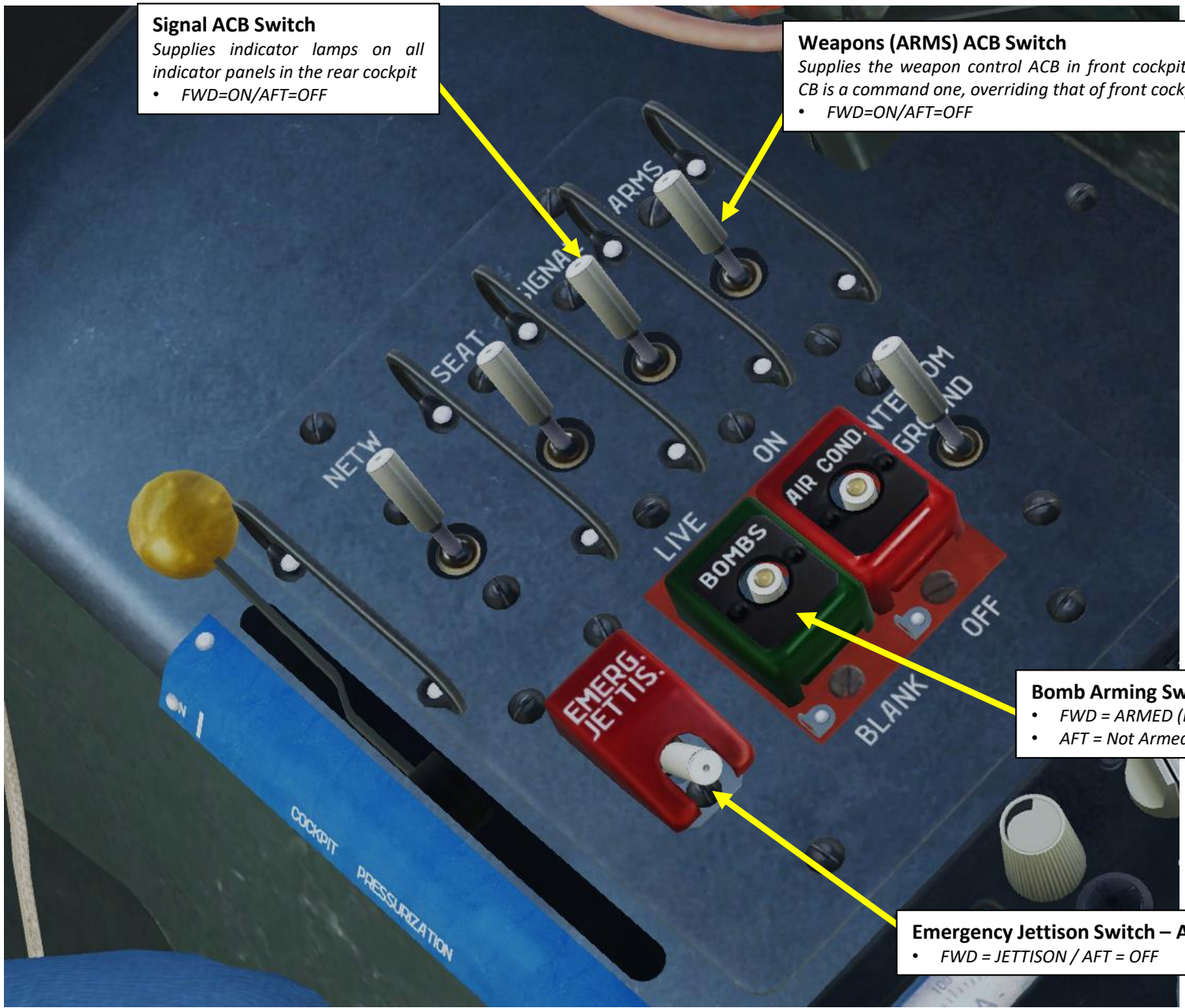


1 – INTRODUCTION
1.3 – Weapon Interface





1 – INTRODUCTION
1.3 – Weapon Interface



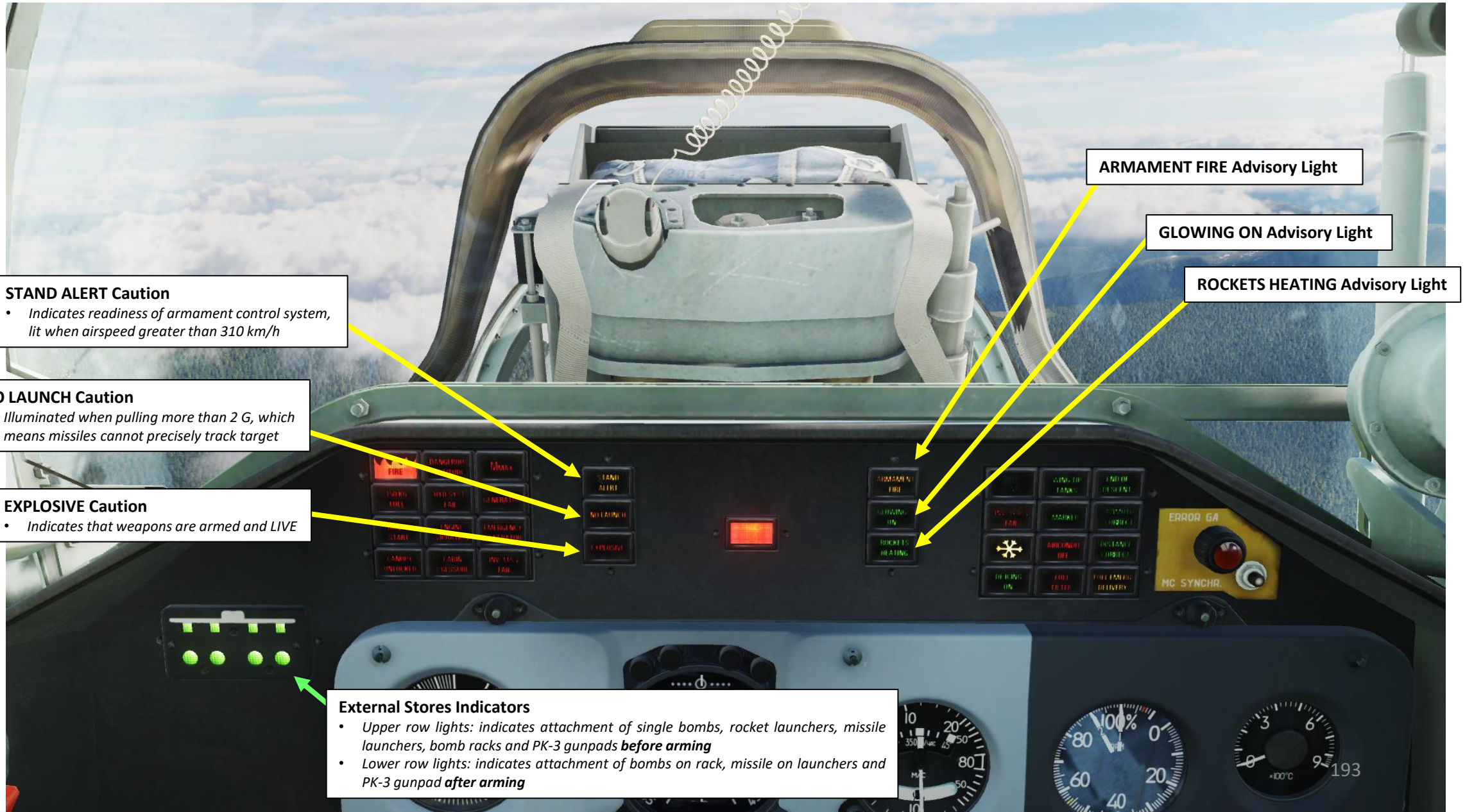
Signal ACB Switch
Supplies indicator lamps on all indicator panels in the rear cockpit
- *FWD=ON/AFT=OFF*

Weapons (ARMS) ACB Switch
Supplies the weapon control ACB in front cockpit. This CB is a command one, overriding that of front cockpit
- *FWD=ON/AFT=OFF*

Bomb Arming Switch
- *FWD = ARMED (LIVE)*
- *AFT = Not Armed (BLANK)*

Emergency Jettison Switch – All Pylons
- *FWD = JETTISON / AFT = OFF*

1 – INTRODUCTION
1.3 – Weapon Interface



1 – INTRODUCTION
1.4 – Ground Attack Profiles

Bomb Delivery Diving Attack Profile (Table 1)
(Recommended Diving Angles: 20, 30 or 40 deg)

№	Parameters	20°	30°	40°
1	Gunsight reflector deflection angle	13°	11°	10°
2	Dive entry altitude at ingress point	1200 m	1500 m	1800 m
3	Dive entry speed at ingress point	440 km/h	350 km/h	300 km/h
4	Release altitude	730 m.	800 m	1100 m
5	Release speed	570 km/h.	550 km/h.	560 km/h
6	RPM	97%	92%	МГ%

Rocket Delivery Diving Attack Profile (Table 2)
(Recommended Diving Angles: 20 or 30 deg)

№	Parameters	30°	20°
1	Gunsight reflector deflection angle	2,53°	2,30°
2	Dive entry altitude at ingress point	1200 m.	1200 m
3	Dive entry speed at ingress point	300 km/h	400 km/h
4	Shooting altitude	600 m.	500 m.
5	Speed at shooting moment	550 km/h	560 km/h
6	Shooting distance	1200 m	1460 m

GS-23L Cannon Diving Attack Profile (Table 3)
(Recommended Diving Angles: 20 or 30 deg)

No.	Parameters	30°	20°
1	Sight reflector inclination angle, degrees	1.38	1.51
2	Target approach and diving altitude, m	1200	1200
3	Target approach and diving speed, km/h	400	400
4	Firing altitude, m	600	500
5	Speed when firing, km/h	600	600
6	Firing range, m	1200	1460

PK-3 Machinegun Pods Diving Attack Profile (Table 4)
(Recommended Diving Angles: 20 or 30 deg)

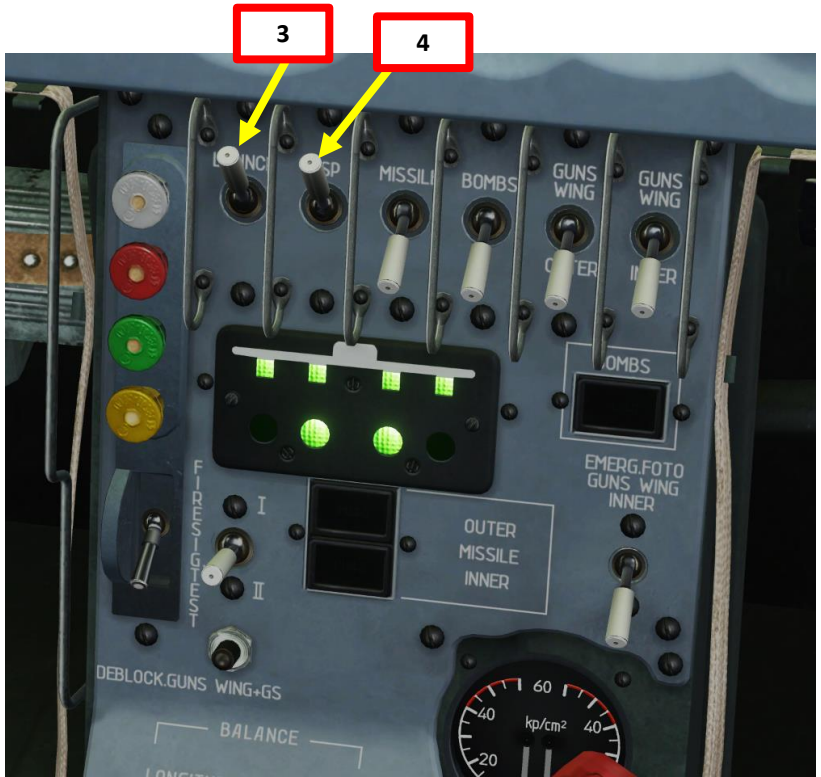
No.	Parameters	30°	20°
1	Sight reflector inclination angle, degrees	1.38	1.51
2	Target approach and diving altitude, m	1200	1200
3	Target approach and diving speed, km/h	400	400
4	Firing altitude, m	600	500
5	Speed when firing, km/h	600	600
6	Firing range, m	1200	1460

2 – AIR-TO-GROUND WEAPONS
2.1 – GS-23L Cannon (23 mm)

2 – AIR-TO-GROUND WEAPONS

2.1 – GS-23L Cannon (23 mm)

1. Set Weapons (ARMS) ACB Switch – ON (FWD)
2. Set AoA (Angle of Attack) Sensor Heater ACB Switch – ON (FWD)
3. Set Armament System (Launch) Power CB Switch – ON (UP).
4. Set ASP Gunsight Power CB Switch – ON (UP)
5. Set GS-23 Cannon Arming Switch – ON (FWD)
6. Set Explosive Pyrotechnical Charge Switch to desired position to choose which pyrotechnical explosive cartridge will be used to reload the cannon.
7. Press Explosive Pyrotechnical Charge GS-23 Cannon Button to reload the cannon.
8. Verify the PK-3 Machine-Gun Pod + GS-23 Cannon Switch is set to OFF (DOWN) since we only want to fire the cannon.



2 – AIR-TO-GROUND WEAPONS
2.1 – GS-23L Cannon (23 mm)

9. Choose a dive attack profile from the Cannon Diving Attack Profile (Table 3). In this example, we will perform:
   a) 20 deg dive for a 10 m wide target.
   b) Deflection/Depression sight angle: 1.51 deg
   c) Dive entry altitude at ingress point: 1200 m (approx. 4000 ft)
   d) Dive entry speed at ingress point: 400 km/h (215 kts)
   e) Firing altitude: 500 m (1650 ft)
   f) Speed at firing moment: 600 km/h (325 kts)
   g) Firing distance: 1460 m (4800 ft)
10. Adjust Gunsight Brightness – As desired.
11. Set Gunsight Mode Lever – CAGED/FIXED (DOWN)
12. Set depression angle based on the attack profile: 1.51 deg.
13. Adjust the throttle twist grip to the maximum gunsight distance setting, which is 800 m.
14. Since the recommended shooting range exceeds maximum distance (800 m) which can be entered into gunsight, a fictitious target base/size should be entered for external base rangefinder to operate correctly.
15. Calculate the Fictitious Target Size on Gunsight based on the required shooting distance obtained from the Rocket Delivery Diving Attack Profile. In this case, the shooting distance is 1460 m, the actual target size is 10 m and the resulting Fictitious Target Size is 5.5 m.
16. Set gunsight target wingspan value to the Fictitious Target Size obtained in the previous step, which is 5.5 m.

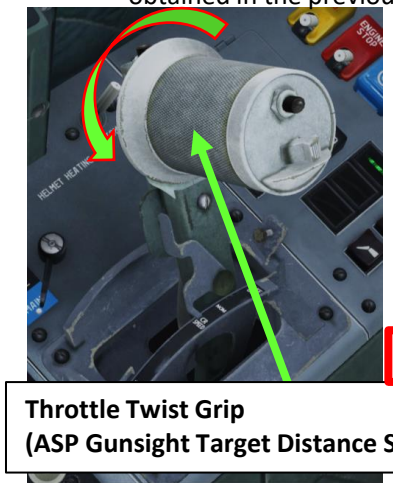
9 **GS-23L Cannon Diving Attack Profile (Table 3)**
(Recommended Diving Angles: 20 or 30 deg)

No.	Parameters	30°	20°
1	Sight reflector inclination angle, degrees	1.38	1.51
2	Target approach and diving altitude, m	1200	1200
3	Target approach and diving speed, km/h	400	400
4	Firing altitude, m	600	500
5	Speed when firing, km/h	600	600
6	Firing range, m	1200	1460

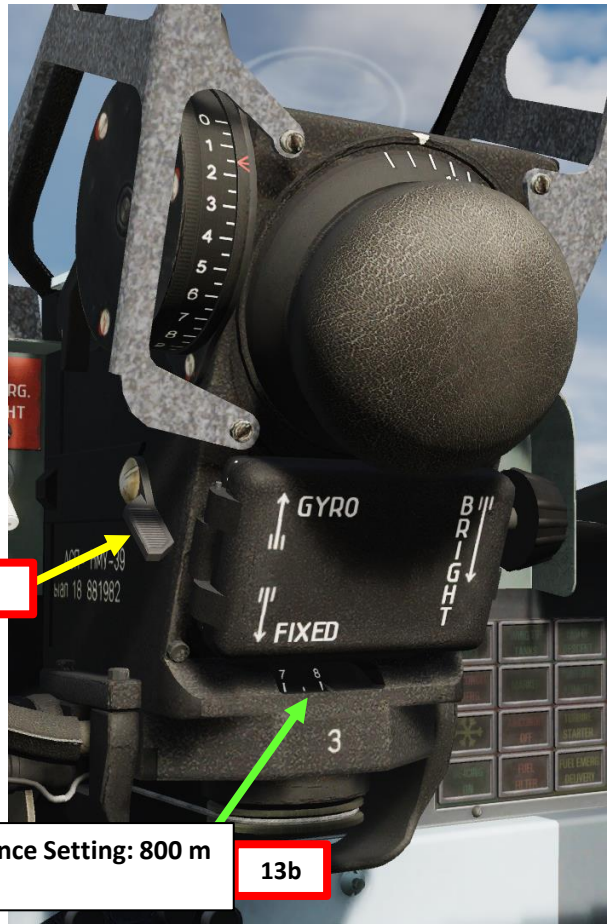
15

$$Fictitious\ Target\ Size\ on\ Gunsight = Actual\ Target\ Size \times \frac{Max\ Gunsight\ Distance\ (800\ m)}{Required\ Shooting\ Distance\ set\ in\ Table}$$

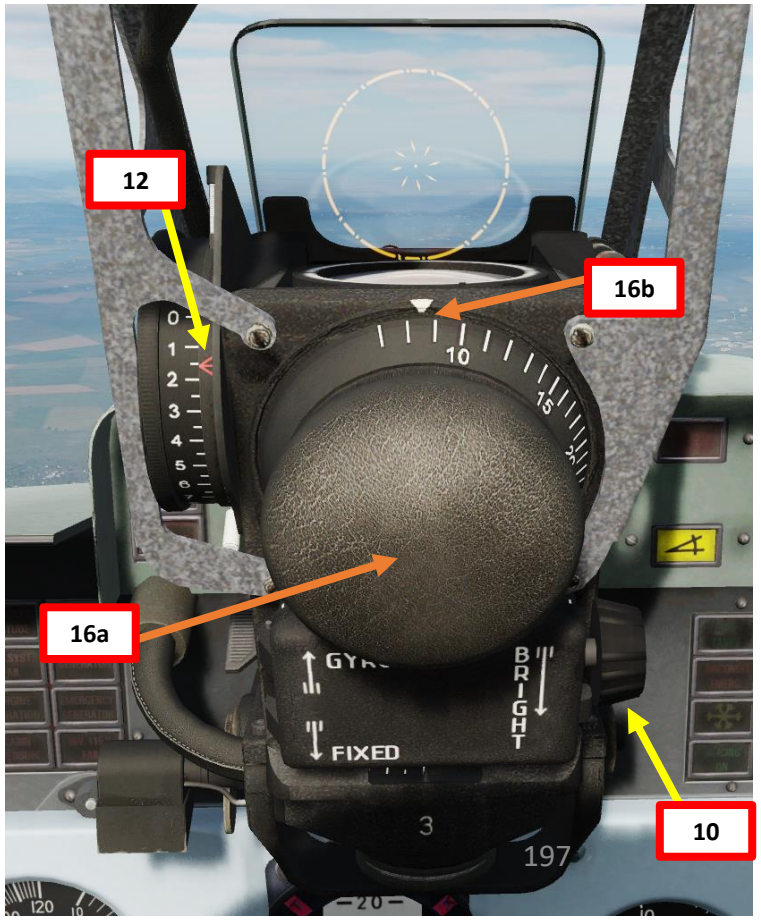
$$= 10\ m \times \frac{800\ m}{1460\ m} = \mathbf{5.5\ m}\ \text{(value entered in wingspan on gunsight)}$$



Throttle Twist Grip
(ASP Gunsight Target Distance Setting)

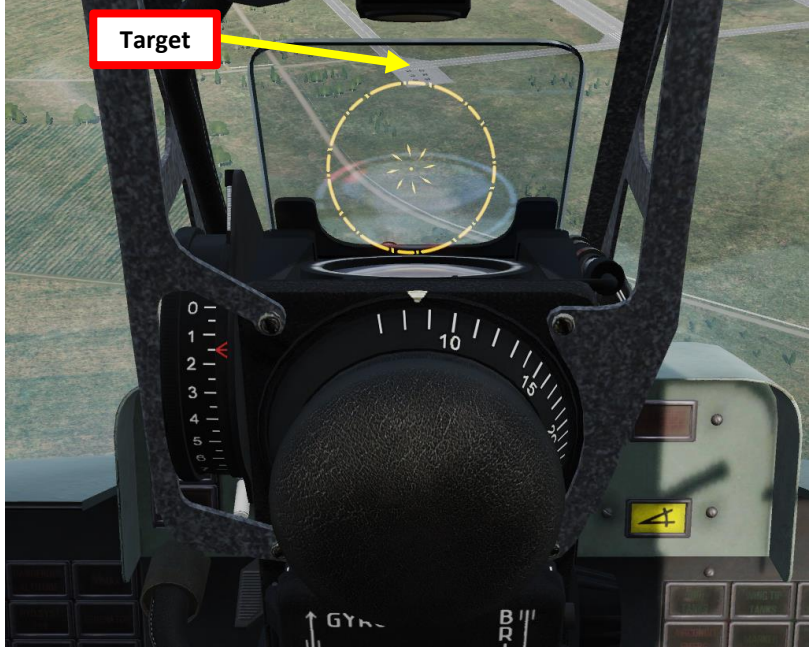


Gunsight Target Distance Setting: 800 m (Maximum)



2 – AIR-TO-GROUND WEAPONS
2.1 – GS-23L Cannon (23 mm)

17. Set Weapon Safety OFF by flipping DOWN the Weapon Fire Button Safety Switch (Binding: LCTRL+SPACE).
18. Perform diving attack from the required parameters:
    - 20 deg Dive Angle
    - Dive entry altitude at ingress point: 1200 m (approx. 4000 ft)
    - Dive entry speed at ingress point: 400 km/h (215 kts)
19. Turn and dive entry should be finished in such a way that aiming grid center is under the target at distance equal to 1 radius of the constant diameter aiming circle.
20. While you are diving, the central dot of the aiming circle will be moving towards the target.
21. Verify that STAND ALERT signal light is illuminated; it indicates the readiness of the armament control system and that aircraft speed is greater than 310 km/h (167 kts).



Safety ON (UP) 17a

Safety OFF (DOWN) 17b

2 – AIR-TO-GROUND WEAPONS
2.1 – GS-23L Cannon (23 mm)

22. Make sure the AoA Signal Warning Light is extinguished. If illuminated, this light indicates that the allowable Angle of Attack is exceeded and/or the speed decreased below 400 km/h when firing.
    - If this warning light is illuminated, the cannon will not fire.
23. When required speed and altitude are reached, the central dot is aligned with the target, and the target fits the circle formed by the diamonds, fire cannon by pressing the Weapon Fire Button (Binding: SPACE).
    - Firing altitude: 500 m (1650 ft)
    - Speed at firing moment: 600 km/h (325 kts)
    - Firing distance: 1460 m (4800 ft)
24. Firing the cannon is only possible if all the following conditions are met:
    - The front landing gear is retracted
    - Airspeed is no less than 400 km/h
    - The angle of attack does not exceed 6 degrees
    - The positive G is no more than 6
    - The negative G is no more than -2
25. When firing the cannon, the GS-23 smoke and gasses generated when firing the cannon are directly ingested by the engine. As an automated protection feature of the AI-25TL engine to prevent engine surge or flameout, the engine RPM will decrease automatically when the cannon is firing. Quick bursts are recommended to maintain engine RPM. This loss of power must be taken into account when going on gun run in a dive.
26. Pull out from the dive with a g-load equal to 3 to 3.5 G with simultaneous acceleration up to takeoff power.

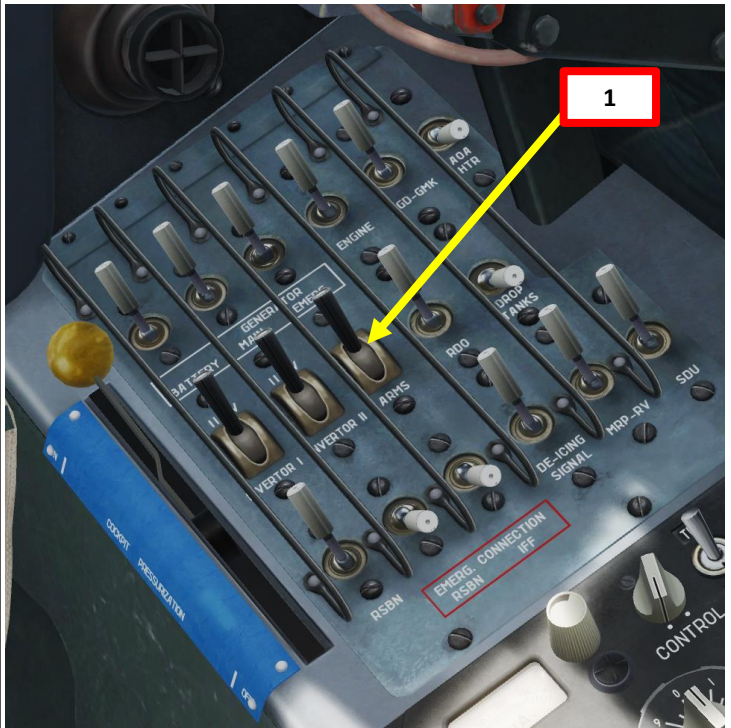
2 – AIR-TO-GROUND WEAPONS

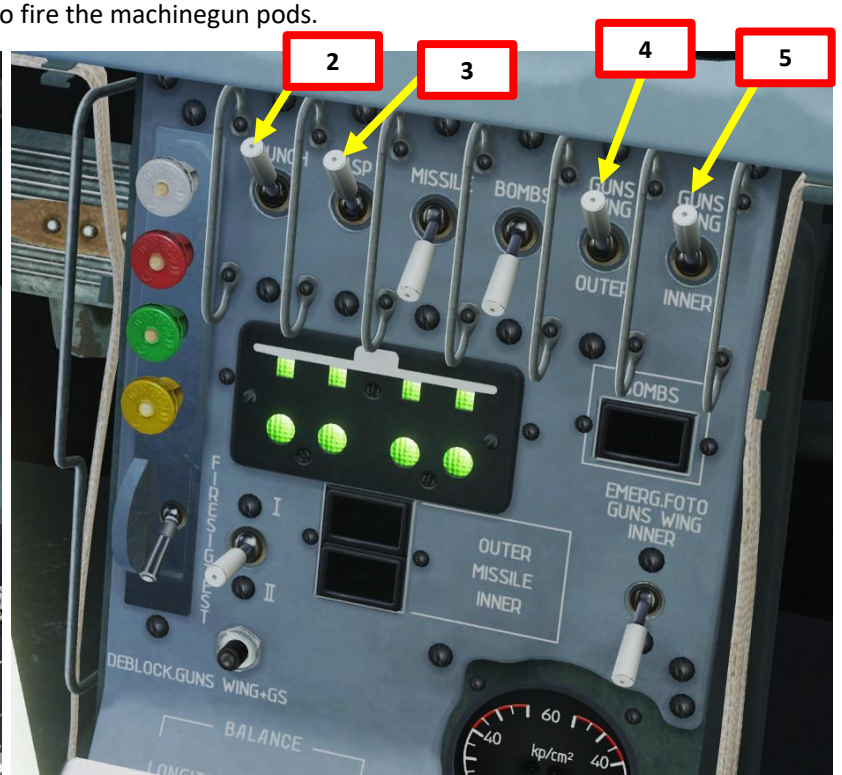
2.1 – GS-23L Cannon (23 mm)

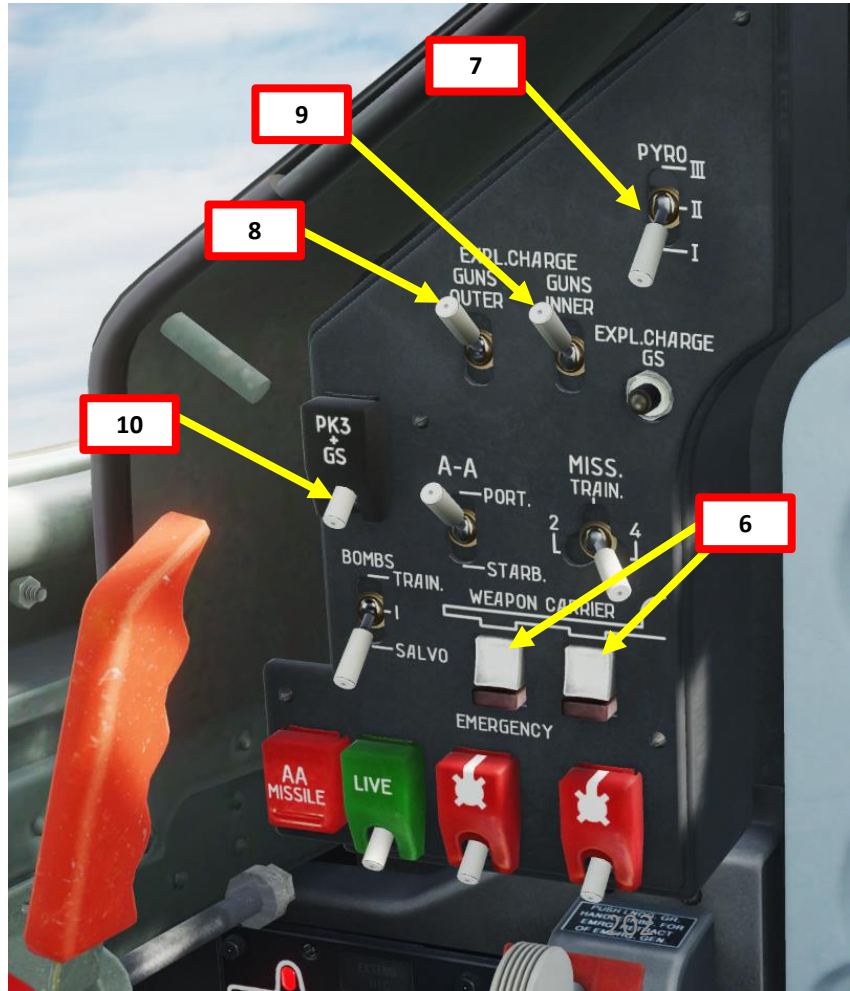
2 – AIR-TO-GROUND WEAPONS
2.2 – PK-3 Machinegun Pods (7.62 mm)

2 – AIR-TO-GROUND WEAPONS
2.2 – PK-3 Machinegun Pods (7.62 mm)

1. Set Weapons (ARMS) ACB Switch – ON (FWD)
2. Set Armament System (Launch) Power CB Switch – ON (UP).
3. Set ASP Gunsight Power CB Switch – ON (UP)
4. If PK-3 pods are on the outer pylons, set Outer Wing Guns Power CB Switch – ON (UP)
5. If PK-3 pods are on the inner pylons, set Inner Wing Guns Power CB Switch – ON (UP)
6. Select desired stations by using the relevant Pylon Selection Button. We will select both Inboard and Outboard stations.
    - Left button selects OUTBOARD stations.
    - Right button selects INBOARD stations.
7. Set Explosive Pyrotechnical Charge Switch to desired position to choose which pyrotechnical explosive cartridge will be used to reload the machinegun pods.
8. Set Explosive Pyrotechnical Charge Outer Guns Switch UP (ON) to reload the outer pylon machinegun pods.
9. Set Explosive Pyrotechnical Charge Inner Guns Switch UP (ON) to reload the inner pylon machinegun pods.
10. If you want to fire both PK-3 Machinegun Pods and GS-23L Cannon at once, set PK-3 Machine-Gun Pod + GS-23 Cannon Switch – ON (UP). Otherwise, leave to OFF (DOWN).
    - We will leave it to OFF since we only want to fire the machinegun pods.







2 – AIR-TO-GROUND WEAPONS
2.2 – PK-3 Machinegun Pods (7.62 mm)

11. Choose a dive attack profile from the PK-3 Machinegun Pods Diving Attack Profile (Table 4). In this example, we will perform:
    a) 20 deg dive for a 10 m wide target.
    b) Deflection/Depression sight angle: 1.51 deg
    c) Dive entry altitude at ingress point: 1200 m (approx. 4000 ft)
    d) Dive entry speed at ingress point: 400 km/h (215 kts)
    e) Firing altitude: 500 m (1650 ft)
    f) Speed at firing moment: 600 km/h (325 kts)
    g) Firing distance: 1460 m (4800 ft)
12. Adjust Gunsight Brightness – As desired.
13. Set Gunsight Mode Lever – CAGED/FIXED (DOWN)
14. Set depression angle based on the attack profile: 1.51 deg.
15. Adjust the throttle twist grip to the maximum gunsight distance setting, which is 800 m.
16. Since the recommended shooting range exceeds maximum distance (800 m) which can be entered into gunsight, a fictitious target base/size should be entered for external base rangefinder to operate correctly.
17. Calculate the Fictitious Target Size on Gunsight based on the required shooting distance obtained from the Rocket Delivery Diving Attack Profile. In this case, the shooting distance is 1460 m, the actual target size is 10 m and the resulting Fictitious Target Size is 5.5 m.
18. Set gunsight target wingspan value to the Fictitious Target Size obtained in the previous step, which is 5.5 m.

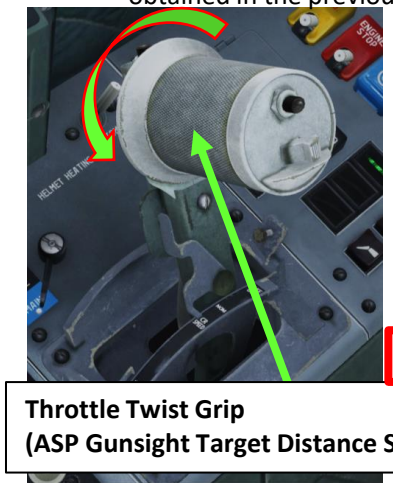
11 **PK-3 Machinegun Pods Diving Attack Profile (Table 4)**
(Recommended Diving Angles: 20 or 30 deg)

No.	Parameters	30°	20°
1	Sight reflector inclination angle, degrees	1.38	1.51
2	Target approach and diving altitude, m	1200	1200
3	Target approach and diving speed, km/h	400	400
4	Firing altitude, m	600	500
5	Speed when firing, km/h	600	600
6	Firing range, m	1200	1460

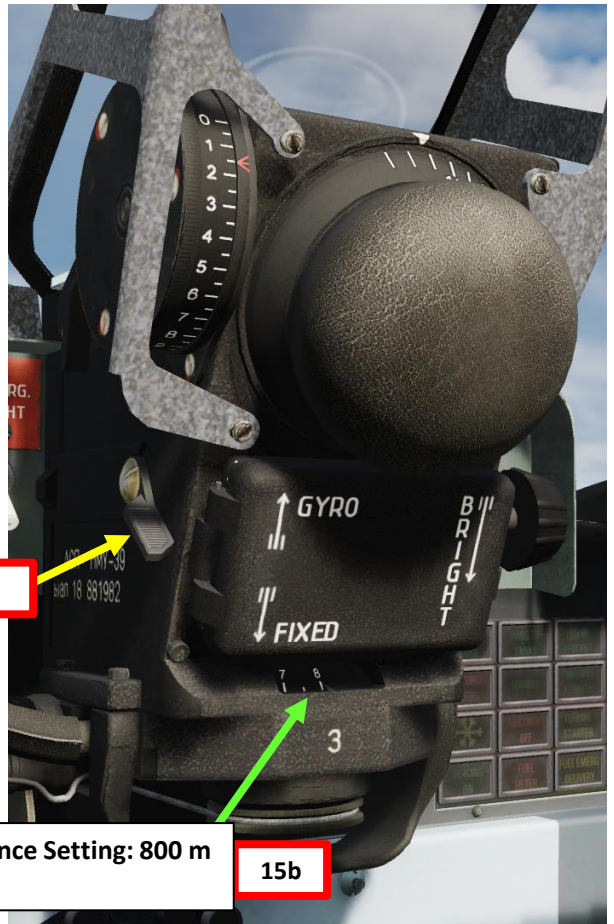
17

$$Fictitious\ Target\ Size\ on\ Gunsight = Actual\ Target\ Size \times \frac{Max\ Gunsight\ Distance\ (800\ m)}{Required\ Shooting\ Distance\ set\ in\ Table}$$

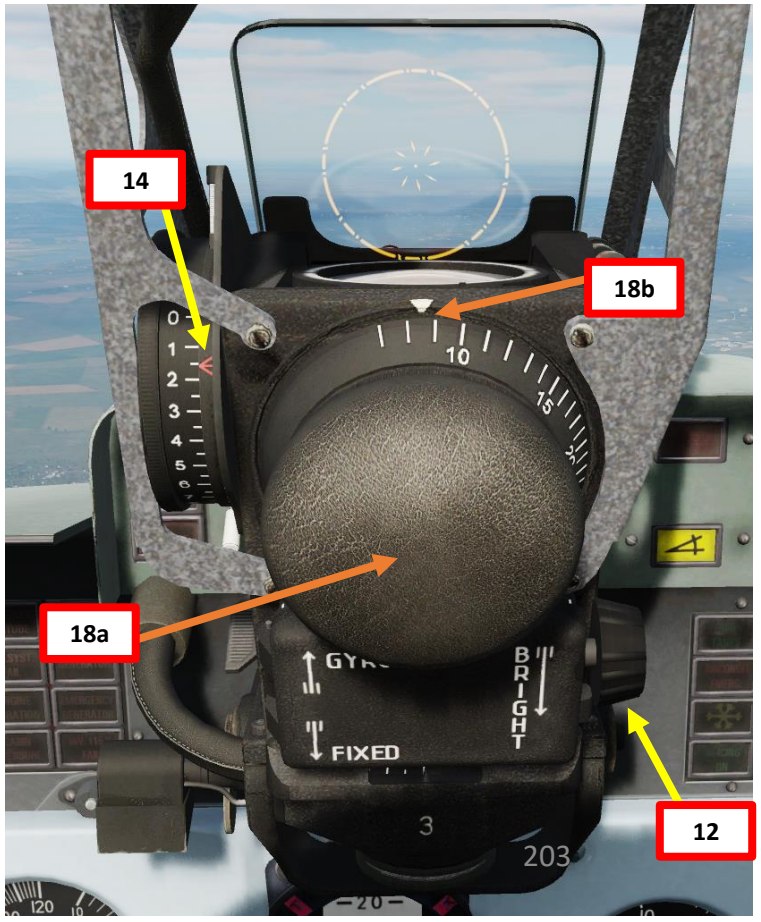
$$= 10\ m \times \frac{800\ m}{1460\ m} = \mathbf{5.5\ m}\ \text{(value entered in wingspan on gunsight)}$$



Throttle Twist Grip
(ASP Gunsight Target Distance Setting)

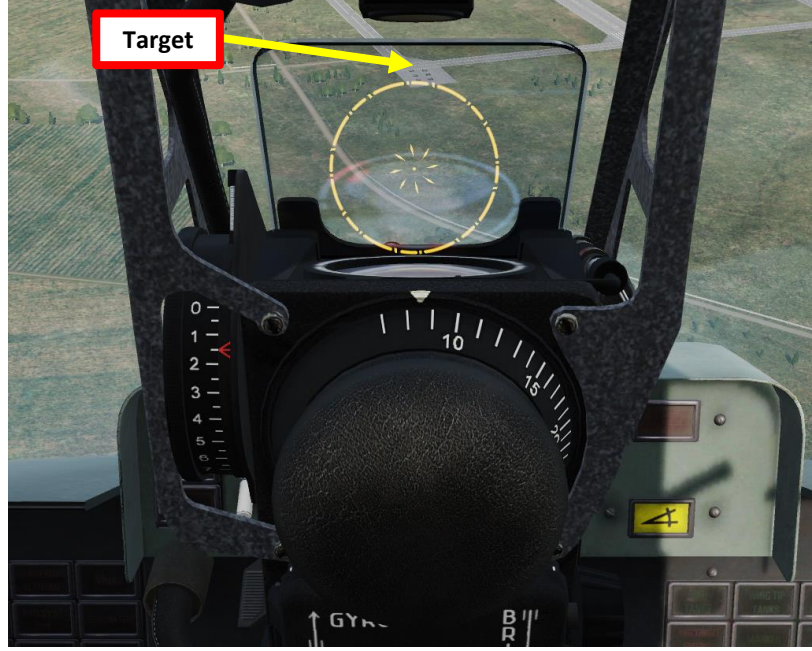


Gunsight Target Distance Setting: 800 m (Maximum)



2 – AIR-TO-GROUND WEAPONS
2.2 – PK-3 Machinegun Pods (7.62 mm)

19. Set Weapon Safety OFF by flipping DOWN the Weapon Fire Button Safety Switch (Binding: LCTRL+SPACE).
20. Perform diving attack from the required parameters:
    - 20 deg Dive Angle
    - Dive entry altitude at ingress point: 1200 m (approx. 4000 ft)
    - Dive entry speed at ingress point: 400 km/h (215 kts)
21. Turn and dive entry should be finished in such a way that aiming grid center is under the target at distance equal to 1 radius of the constant diameter aiming circle.
22. While you are diving, the central dot of the aiming circle will be moving towards the target.
23. Verify that STAND ALERT signal light is illuminated; it indicates the readiness of the armament control system and that aircraft speed is greater than 310 km/h (167 kts).

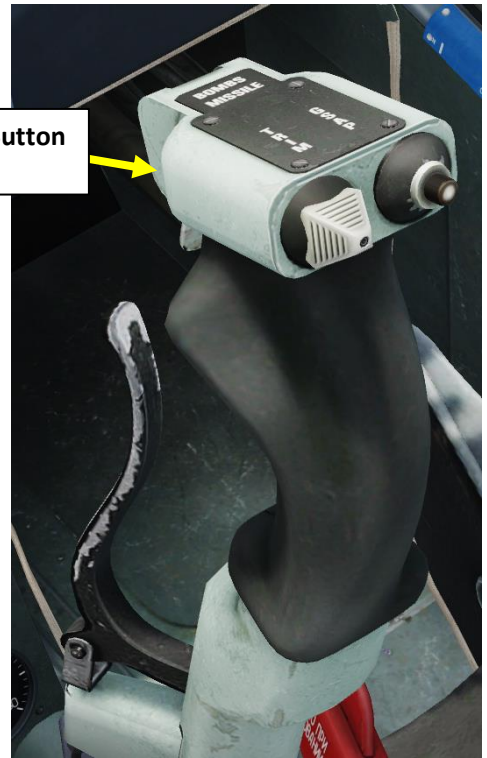


Safety ON (UP) 19a

Safety OFF (DOWN) 19b

2 – AIR-TO-GROUND WEAPONS
2.2 – PK-3 Machinegun Pods (7.62 mm)

24. When required speed and altitude are reached, the central dot is aligned with the target, and the target fits the circle formed by the diamonds, fire PK-3 machinegun pods by pressing the Weapon Fire Button (Binding: SPACE).
    - Firing altitude: 500 m (1650 ft)
    - Speed at firing moment: 600 km/h (325 kts)
    - Firing distance: 1460 m (4800 ft)
25. Pull out from the dive with a g-load equal to 3 to 3.5 G with simultaneous acceleration up to takeoff power.



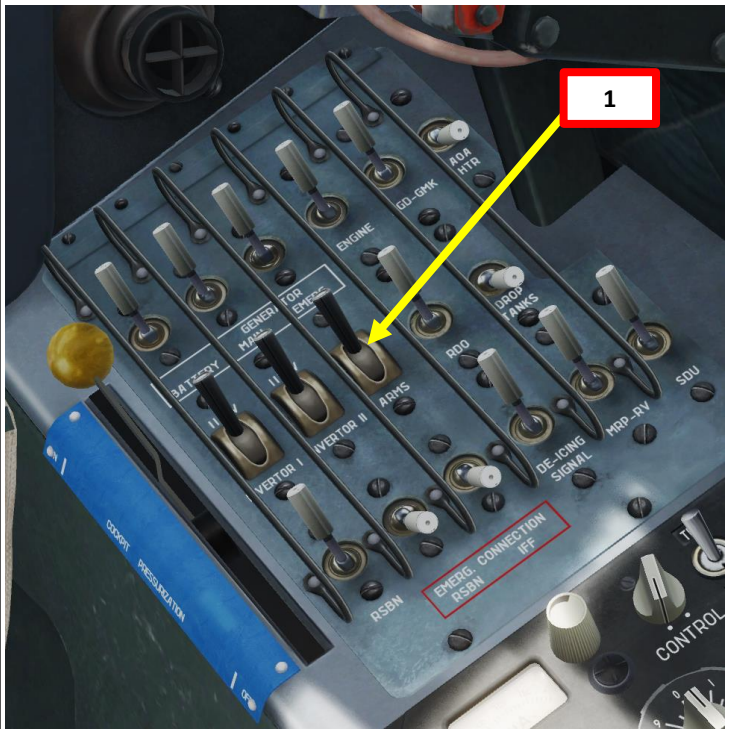
2 – AIR-TO-GROUND WEAPONS
2.2 – PK-3 Machinegun Pods (7.62 mm)

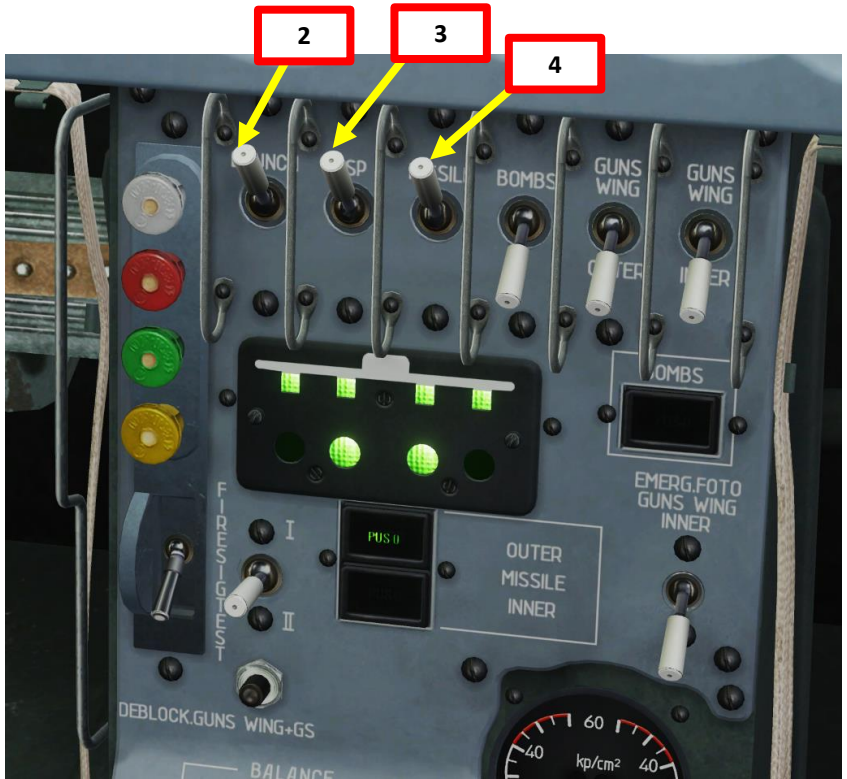
2 – AIR-TO-GROUND WEAPONS
2.3 – S-5KO Rockets (57 mm)

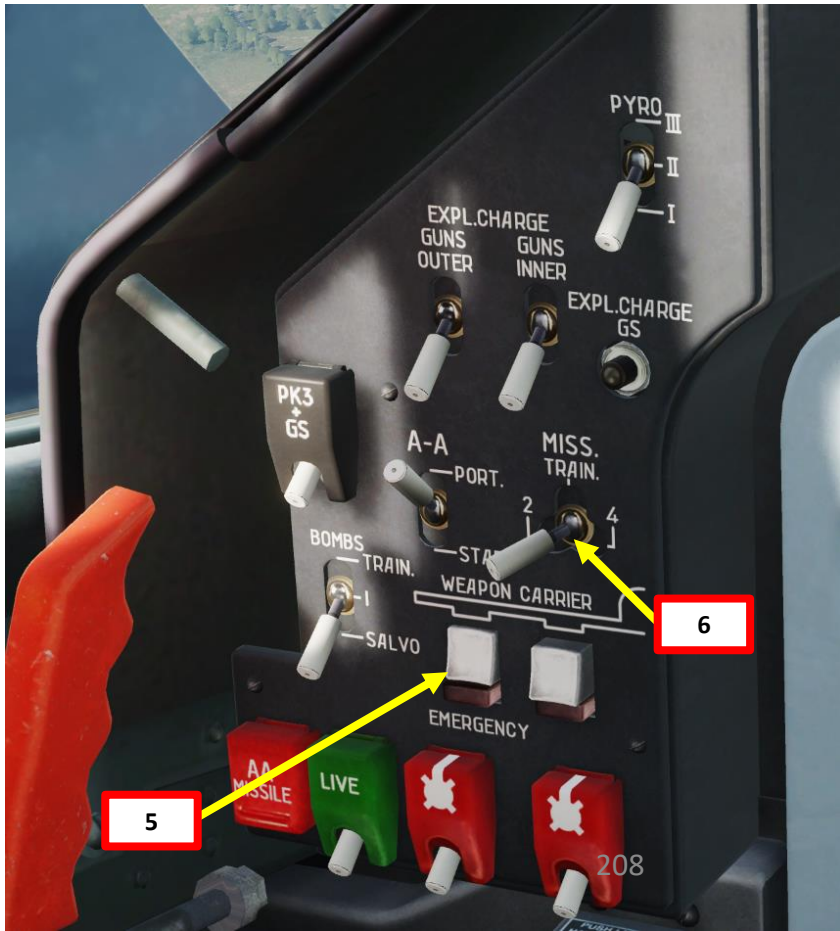
2 – AIR-TO-GROUND WEAPONS
2.3 – S-5KO Rockets (57 mm)

1. Set Weapons (ARMS) ACB Switch – ON (FWD)
2. Set Armament System (Launch) Power CB Switch – ON (UP).
3. Set ASP Gunsight Power CB Switch – ON (UP)
4. Set Missile Power CB Switch – ON (UP)
5. Select desired stations by using the relevant Pylon Selection Button. We will select Outboard stations.
    - Left button selects OUTBOARD stations.
    - Right button selects INBOARD stations.
6. Set desired rocket firing mode using the Rocket Firing Mode Selector Switch. We will select “2”.
    - UP: TRAIN/Automatic, all rockets all fired after trigger press.
    - LEFT: ”2”, two rockets from the left and right launchers are fired after trigger press.
    - RIGHT: ”4”, four rockets from the left and right launchers are fired after trigger press.

    - Note: When all four rocket pads are selected, 32 rockets are launched first from the outboard pylons, and then 32 rockets are launched from the inboard pylons.







2 – AIR-TO-GROUND WEAPONS
2.3 – S-5KO Rockets (57 mm)

7. Choose a dive attack profile from the Rocket Delivery Diving Attack Profile (Table 2). In this example, we will perform:
   a) 20 deg dive for a 10 m wide target.
   b) Deflection/Depression sight angle: 2.3 deg
   c) Dive entry altitude at ingress point: 1200 m (approx. 4000 ft)
   d) Dive entry speed at ingress point: 400 km/h (215 kts)
   e) Shooting altitude: 500 m (1650 ft)
   f) Speed at shooting moment: 560 km/h (305 kts)
   g) Shooting distance: 1460 m (4800 ft)
8. Adjust Gunsight Brightness – As desired.
9. Set Gunsight Mode Lever – GYRO (UP)
10. Set depression angle based on the attack profile: 2.3 deg.
11. Adjust the throttle twist grip to the maximum gunsight distance setting, which is 800 m.
12. Since the recommended shooting range exceeds maximum distance (800 m) which can be entered into gunsight, a fictitious target base/size should be entered for external base rangefinder to operate correctly.
13. Calculate the Fictitious Target Size on Gunsight based on the required shooting distance obtained from the Rocket Delivery Diving Attack Profile. In this case, the shooting distance is 1460 m, the actual target size is 10 m and the resulting Fictitious Target Size is 5.5 m.
14. Set gunsight target wingspan value to the Fictitious Target Size obtained in the previous step, which is 5.5 m.

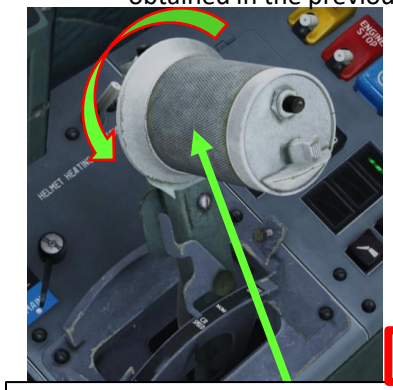
7 **Rocket Delivery Diving Attack Profile (Table 2)**
(Recommended Diving Angles: 20 or 30 deg)

№	Parameters	30°	20°
1	Gunsight reflector deflection angle	2,53°	2,30°
2	Dive entry altitude at ingress point	1200 m.	1200 m
3	Dive entry speed at ingress point	300 km/h	400 km/h
4	Shooting altitude	600 m.	500 m.
5	Speed at shooting moment	550 km/h	560 km/h
6	Shooting distance	1200 m	1460 m

13

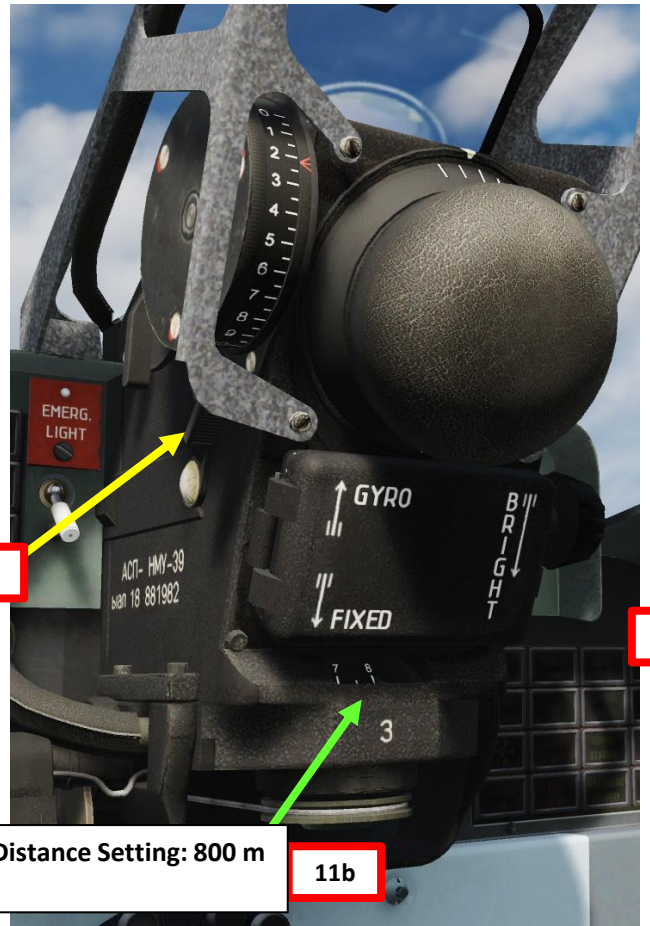
$$Fictitious\ Target\ Size\ on\ Gunsight = Actual\ Target\ Size \times \frac{Max\ Gunsight\ Distance\ (800\ m)}{Required\ Shooting\ Distance\ set\ in\ Table}$$

$$= 10\ m \times \frac{800\ m}{1460\ m} = \mathbf{5.5\ m}\ \text{(value entered in wingspan on gunsight)}$$



11a

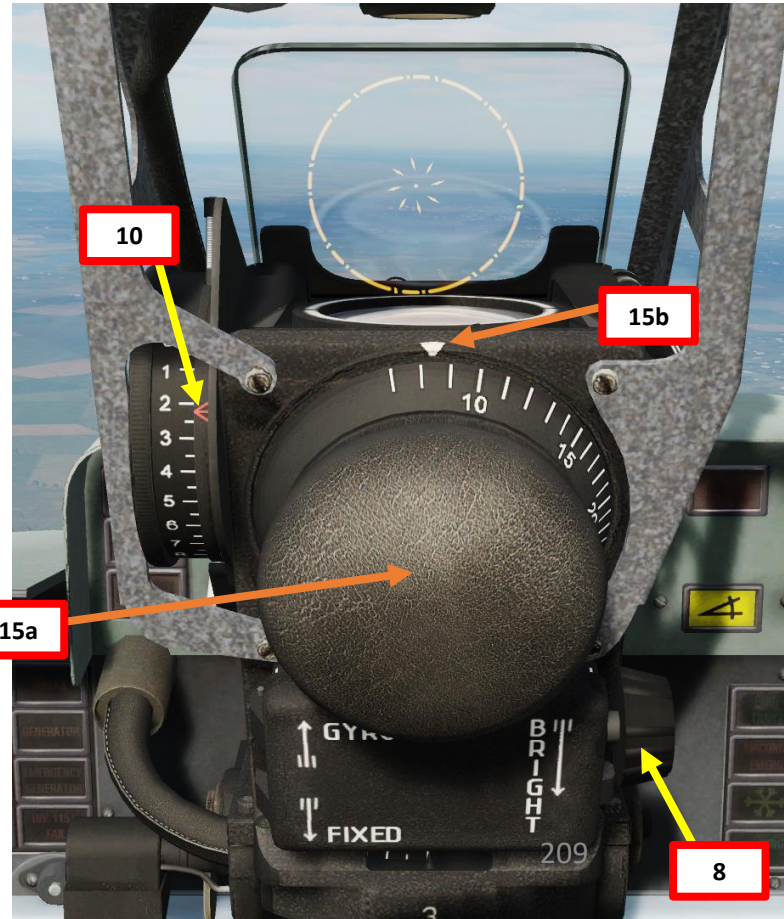
Throttle Twist Grip
(ASP Gunsight Target Distance Setting)



9

Gunsight Target Distance Setting: 800 m
(Maximum)

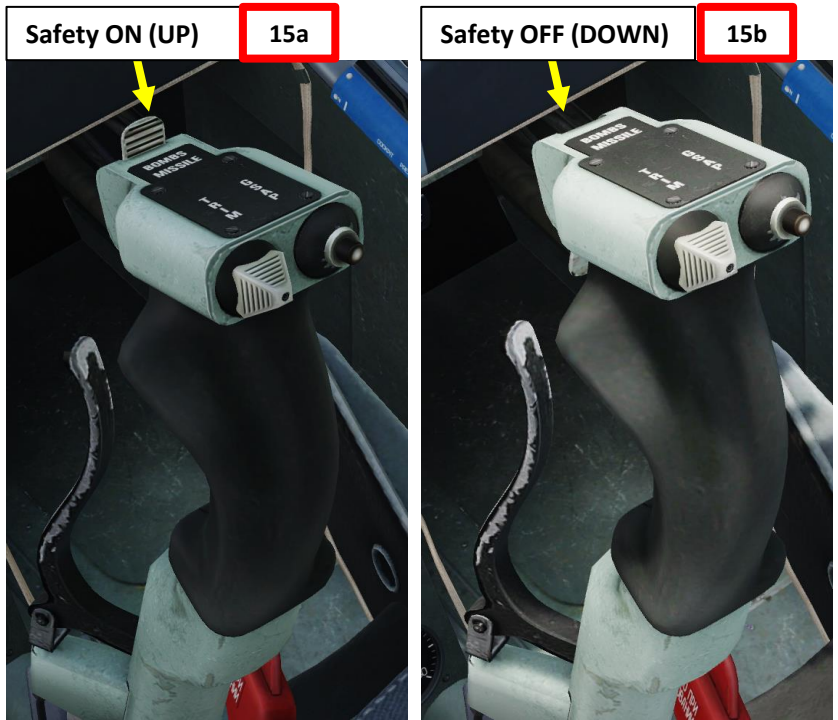
11b



8

2 – AIR-TO-GROUND WEAPONS
2.3 – S-5KO Rockets (57 mm)

15. Set Weapon Safety OFF by flipping DOWN the Weapon Fire Button Safety Switch (Binding: LCTRL+SPACE).
16. Perform diving attack from the required parameters:
    - 20 deg Dive Angle
    - Dive entry altitude at ingress point: 1200 m (approx. 4000 ft)
    - Dive entry speed at ingress point: 400 km/h (215 kts)
17. Turn and dive entry should be finished in such a way that aiming grid center is under the target at distance equal to 1 radius of the constant diameter aiming circle.
18. While you are diving, the central dot of the aiming circle will be moving towards the target.
19. Verify that STAND ALERT signal light is illuminated; it indicates the readiness of the armament control system and that aircraft speed is greater than 310 km/h (167 kts).



2 – AIR-TO-GROUND WEAPONS
2.3 – S-5KO Rockets (57 mm)

20. When required speed and altitude are reached and central dot is aligned with the target, and the target fits the circle formed by the diamonds, fire rockets by pressing the Weapon Fire Button (Binding: SPACE) for 1 second.
    - Shooting altitude: 500 m (1650 ft)
    - Speed at shooting moment: 560 km/h (305 kts)
    - Shooting distance: 1460 m (4800 ft)

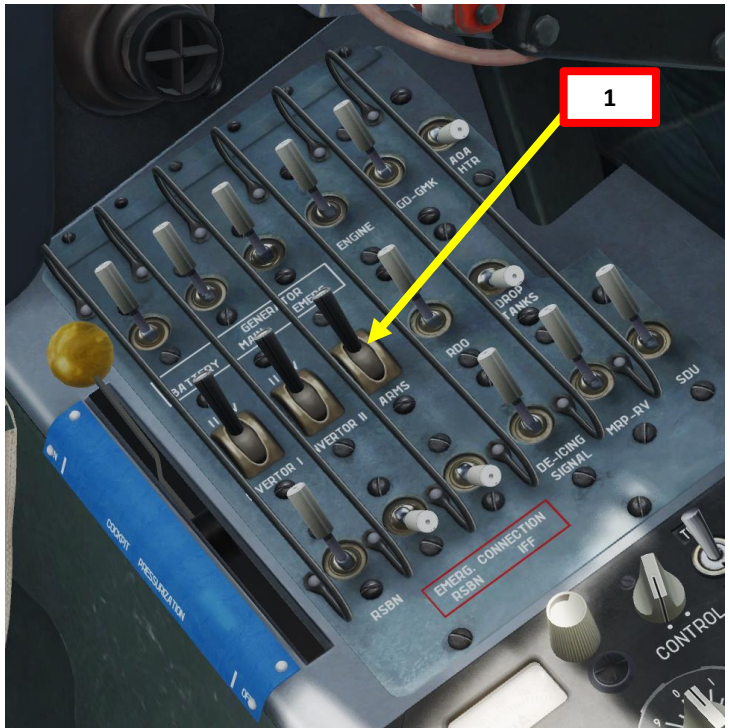
    - Note: the electrical rocket fire control system permits firing at a flight speed above 310 km/h (167 kts). At speeds below 310 km/h (167 kts), the firing control system is blocked and will inhibit the firing mechanism.
21. Pull out from the dive with a g-load equal to 3 to 3.5 G with simultaneous acceleration up to takeoff power.

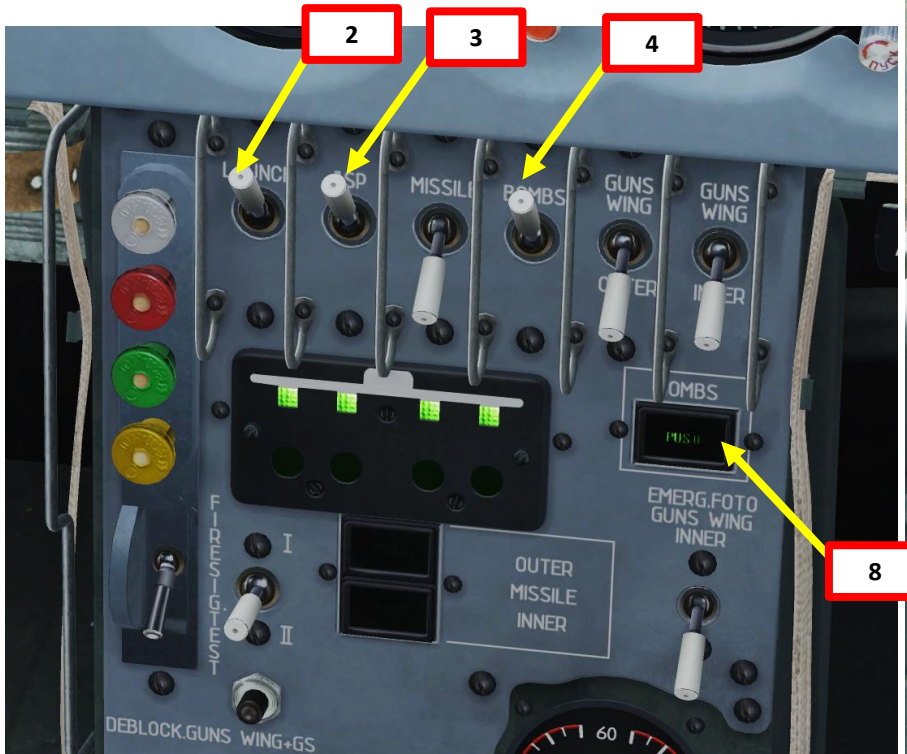
2 – AIR-TO-GROUND WEAPONS
2.3 – S-5KO Rockets (57 mm)

2 – AIR-TO-GROUND WEAPONS
2.4 – FAB-250 Bombs

2 – AIR-TO-GROUND WEAPONS
2.4 – FAB-250 Bombs

1. Set Weapons (ARMS) ACB Switch – ON (FWD)
2. Set Armament System (Launch) Power CB Switch – ON (UP).
3. Set ASP Gunsight Power CB Switch – ON (UP)
4. Set Bomb Power CB Switch – ON (UP)
5. Select desired stations by using the relevant Pylon Selection Button. We will select Outboard stations.
    - Left button selects OUTBOARD stations.
    - Right button selects INBOARD stations.
6. Set desired bomb drop mode using the Bomb Mode Selector. We will select SALVO.
    - DOWN: SALVO releases all selected bombs.
    - UP: I / SINGLE releases a single bomb.
7. Set Bomb Release Mode using the Missile (A/A) and Bomb Release Mode Switch. We will select BOTH bombs release.
    - UP: Portside, LEFT Missile Launch / SINGLE bomb release
    - DOWN: Starboard, RIGHT Missile Launch / BOTH bombs release
8. Confirm the PUS-0 Signal Indicator is illuminated, which confirms that bombs are armed.





2 – AIR-TO-GROUND WEAPONS
2.4 – FAB-250 Bombs

9. Choose a dive attack profile from the Bomb Delivery Diving Attack Profile (Table 1). In this example, we will perform:
    a) 30 deg dive for a 10 m wide target.
    b) Deflection/Depression sight angle: 11 deg
    c) Dive entry altitude at ingress point: 1500 m (approx. 5000 ft)
    d) Dive entry speed at ingress point: 350 km/h (190 kts)
    e) Release altitude: 800 m (2600 ft)
    f) Release speed: 550 km/h (300 kts)
    g) Engine RPM setting: 92 % N1
10. Adjust Gunsight Brightness – As desired.
11. Set Gunsight Mode Lever – CAGED/FIXED (DOWN)
12. Set depression angle based on the attack profile: 11 deg.
13. Adjust the throttle twist grip to the maximum gunsight distance setting, which is 800 m.
14. Since the recommended shooting and bombing ranges exceed maximum distance (800 m) which can be entered into gunsight, a fictitious target base/size should be entered for external base rangefinder to operate correctly.
15. Calculate the Fictitious Target Size on Gunsight based on the required shooting distance obtained from the Bomb Delivery Diving Attack Profile. In this case, the dive entry altitude is 1500 m, the actual target size is 10 m and the resulting Fictitious Target Size is 5.3 m.
16. Set gunsight target wingspan value to the Fictitious Target Size obtained in the previous step (5.3 m).
17. The gunsight should now be set properly.

9

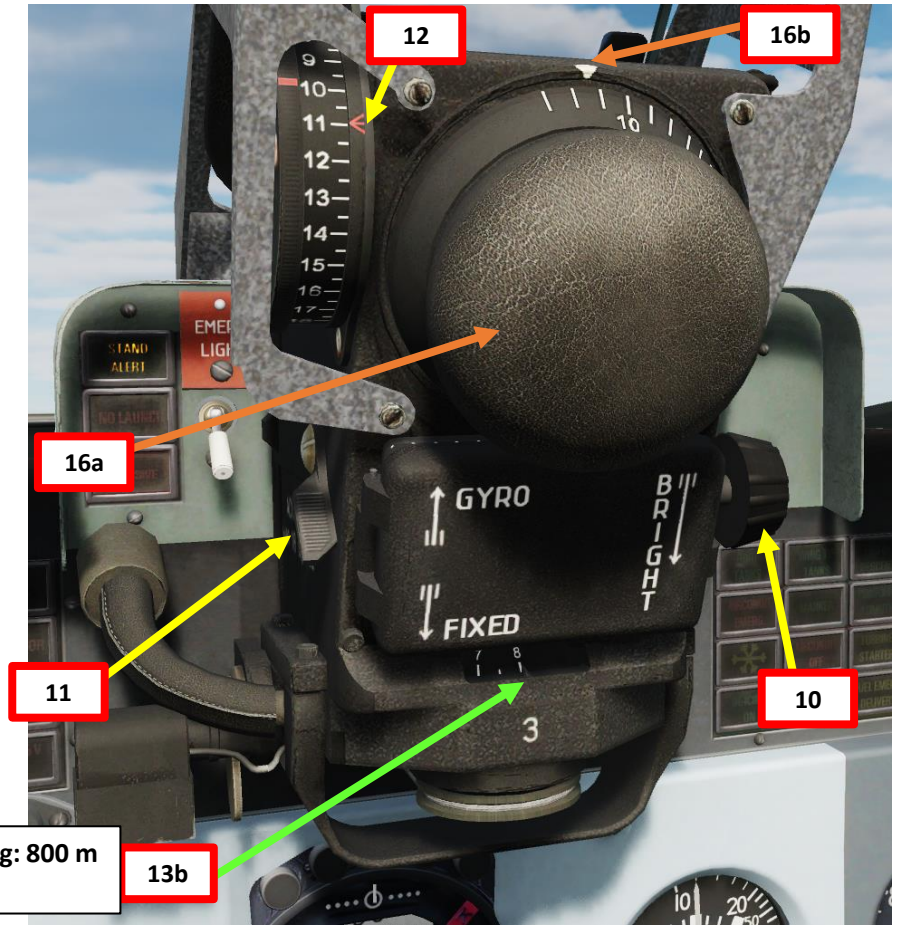
Bomb Delivery Diving Attack Profile (Table 1)
(Recommended Diving Angles: 20, 30 or 40 deg)

№	Parameters	20°	30°	40°
1	Gunsight reflector deflection angle	13°	11°	10°
2	Dive entry altitude at ingress point	1200 m	1500 m	1800 m
3	Dive entry speed at ingress point	440 km/h	350 km/h	300 km/h
4	Release altitude	730 m.	800 m	1100 m
5	Release speed	570 km/h.	550 km/h.	560 km/h
6	RPM	97%	92%	МГ%

15

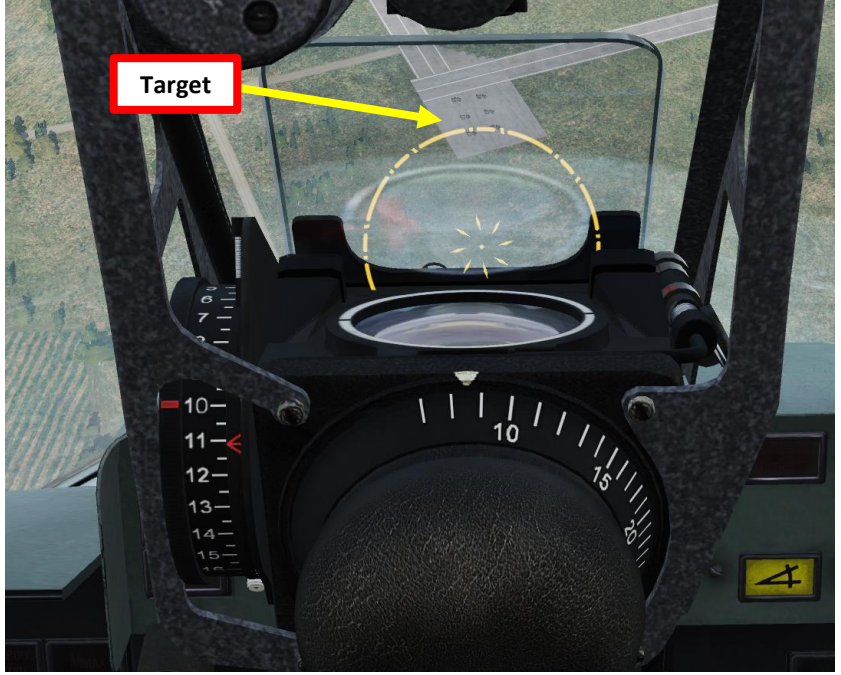
$$Fictitious\ Target\ Size\ on\ Gunsight = Actual\ Target\ Size \times \frac{Max\ Gunsight\ Distance\ (800\ m)}{Required\ Shooting\ Distance\ set\ in\ Table}$$

$$= 10\ m \times \frac{800\ m}{1500\ m} = \mathbf{5.3\ m}\ \text{(value entered in wingspan on gunsight)}$$



2 – AIR-TO-GROUND WEAPONS
2.4 – FAB-250 Bombs

18. Set Weapon Safety OFF by flipping DOWN the Weapon Fire Button Safety Switch (Binding: LCTRL+SPACE).
19. Set throttle to required power setting for the dive (92 % N1 RPM).
20. Perform diving attack from the required parameters:
    - 30 deg Dive Angle
    - Dive entry altitude at ingress point: 1500 m (approx. 5000 ft)
    - Dive entry speed at ingress point: 350 km/h (190 kts)
21. Turn and dive entry should be finished in such a way that aiming grid center is under the target at distance equal to 1 radius of the constant diameter aiming circle.
22. While you are diving, the central dot of the aiming circle will be moving towards the target.
23. Verify that STAND ALERT signal light is illuminated; it indicates the readiness of the armament control system and that aircraft speed is greater than 310 km/h (167 kts).



2 – AIR-TO-GROUND WEAPONS
2.4 – FAB-250 Bombs

24. When required speed and altitude are reached and central dot is aligned with the target, release bombs by pressing the Weapon Fire Button (Binding: SPACE) for 1 second.
    - Release altitude: 800 m (2600 ft)
    - Release speed: 550 km/h (300 kts)

    - Note: the electrical fire control system permits dropping bombs at a flight speed above 310 km/h (167 kts). At speeds below 310 km/h (167 kts), the firing control system is blocked and will inhibit the bomb drop mechanism.
25. Pull out from the dive with a g-load equal to 4 to 5 G with simultaneous acceleration up to takeoff power.

Weapon Fire Button
- *(Space)*

24

2 – AIR-TO-GROUND WEAPONS
2.4 – FAB-250 Bombs

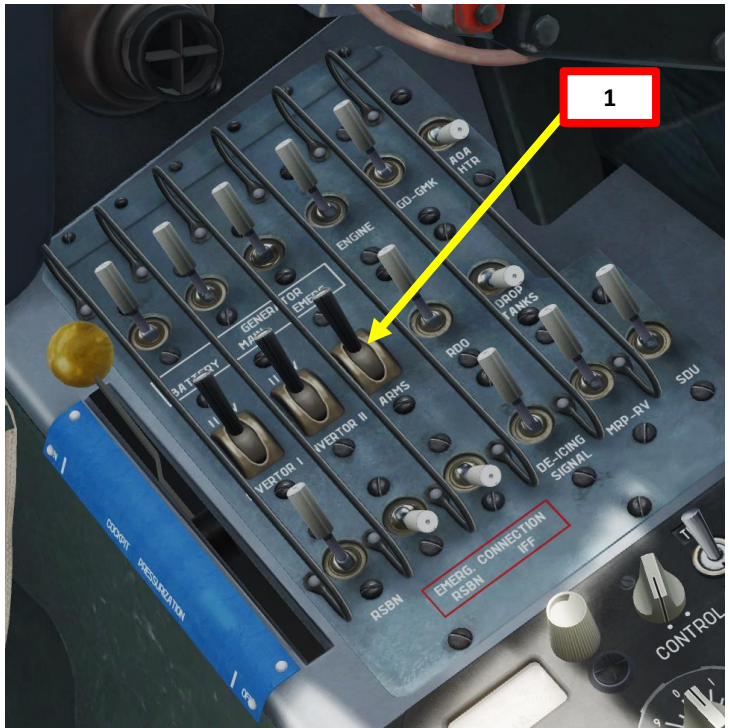
3 – AIR-TO-AIR WEAPONS

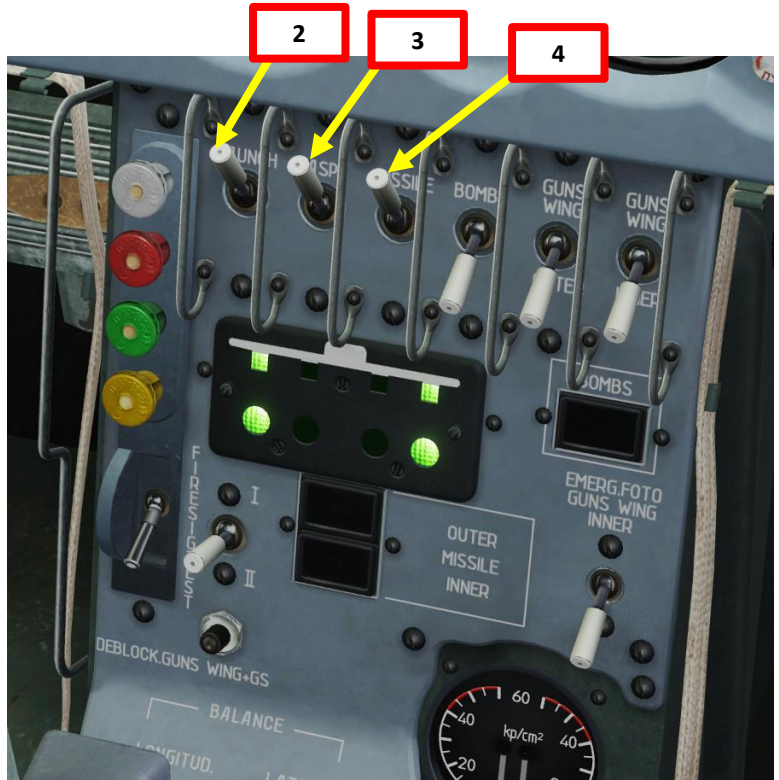
3.1 – R-60M IR (Infrared Homing) Missile

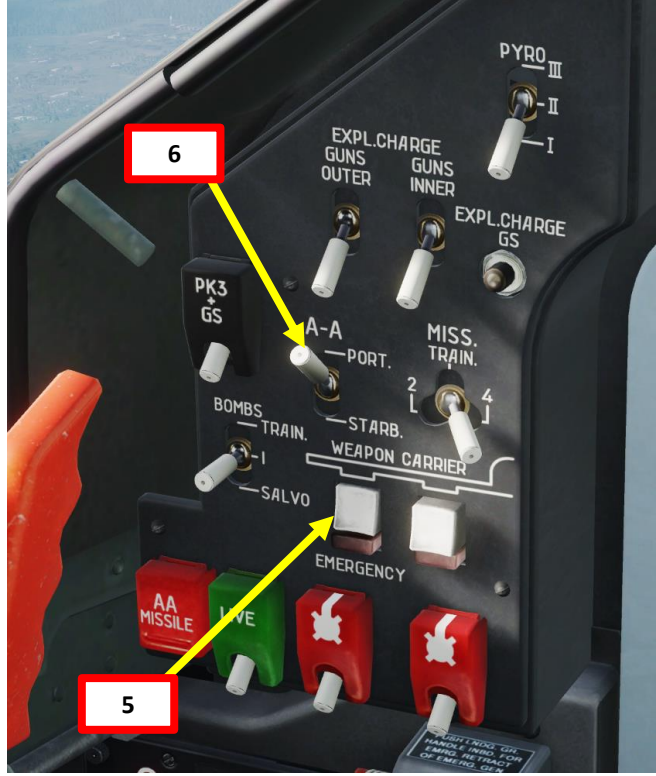
3 – AIR-TO-AIR WEAPONS

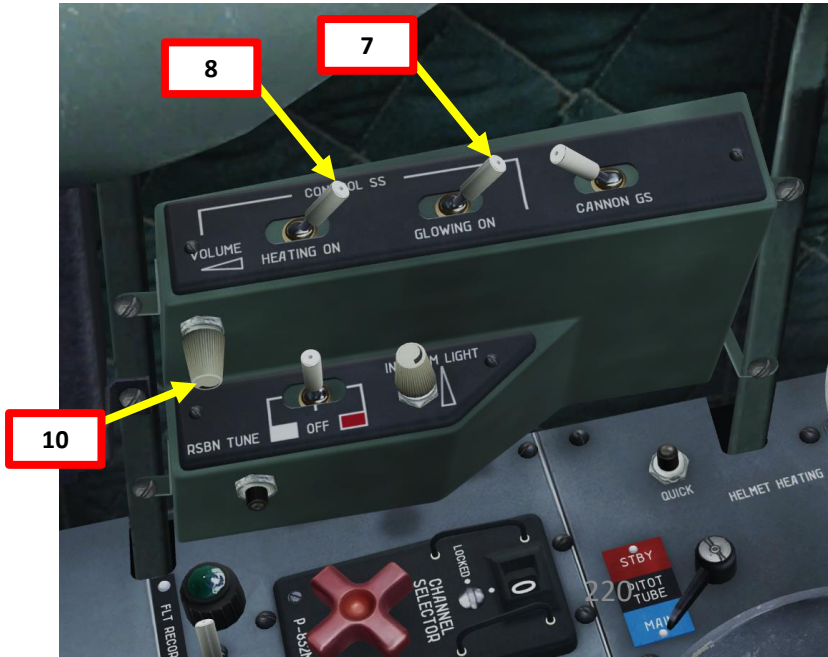
3.1 – R-60M IR (Infrared Homing) Missile

1. Set Weapons (ARMS) ACB Switch – ON (FWD)
2. Set Armament System (Launch) Power CB Switch – ON (UP).
3. Set ASP Gunsight Power CB Switch – ON (UP)
4. Set Missile Power CB Switch – ON (UP)
5. Select outboard stations by using the Outboard Pylon Selection Button.
    - Left button selects OUTBOARD stations.
6. Set Missile Release Mode using the Missile (A/A) and Bomb Release Mode Switch. We will select LEFT Missile.
    - UP: Portside, LEFT Missile Launch / SINGLE bomb release
    - DOWN: Starboard, RIGHT Missile Launch / BOTH bombs release
7. Set Missile Seeker Glowing Circuit Breaker – ON (FWD)
8. Set Missile Seeker Heating Circuit Breaker – ON (FWD)
9. As the missile seeker head is powered, a low-pitch growling sound is audible.
10. Adjust Missile Seeker Tone Volume Knob – As desired.



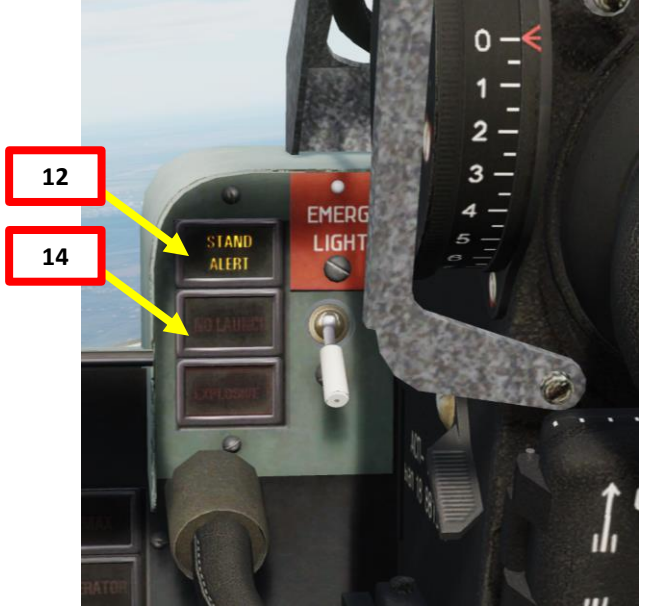






3 – AIR-TO-AIR WEAPONS
3.1 – R-60M IR (Infrared Homing) Missile

10. Set Weapon Safety OFF by flipping DOWN the Weapon Fire Button Safety Switch (Binding: LCTRL+SPACE).
11. Locate the target and take the initial attack position at a range of 2 km, an angle of sight to the target between 50 and 60 deg, and an altitude excess or deficiency of 300 to 400 m.
12. Verify that STAND ALERT signal light is illuminated; it indicates the readiness of the armament control system and that aircraft speed is greater than 310 km/h (167 kts).
13. Get behind the enemy target. When the missile seeker tracks a valid heat signature (target's engine exhaust), the low-pitch growling sound changes to a high-pitch growling sound.
14. Verify that the NO LAUNCH signal light is extinguished. If illuminated, the light indicates that the maximum allowable G-load value (2 Gs) is exceeded and accurate missile targeting is impossible.



Safety ON (UP) 10a

Safety OFF (DOWN) 10b

3 – AIR-TO-AIR WEAPONS

3.1 – R-60M IR (Infrared Homing) Missile

15. When a valid missile lock is obtained, fire missile by pressing the Weapon Fire Button (Binding: SPACE) for 1 second.

Some important notes on the missiles equipped on the L-39:

- The R-3S and R-60 missiles equipped on the L-39 have a short range and will not track maneuverable targets
- Your air-to-air missiles should be used against big and slow air targets like bombers or tankers
- In order to get a kill, you will have to acquire the target visually. There is no on-board radar equipment to help you.
- Gather intelligence on what enemy opposition you might run into and plan ahead. The L-39 is basically outmatched by most modern jets in the game (F-15, Mirage, Su-27, MiG-29, Su-33, MiG-21, etc.), which means that you should avoid picking up fights you cannot win. You have no countermeasures system, no radar, no jammer, no RWR (radar warning receiver)… so you are basically completely "blind" and will have to rely on your sharp eagle eyes. Engaging every contact or target visually is quite a challenging task, so make sure that you never fly alone and always have a wingman by your side.

Weapon Fire Button
- *(Space)*

15

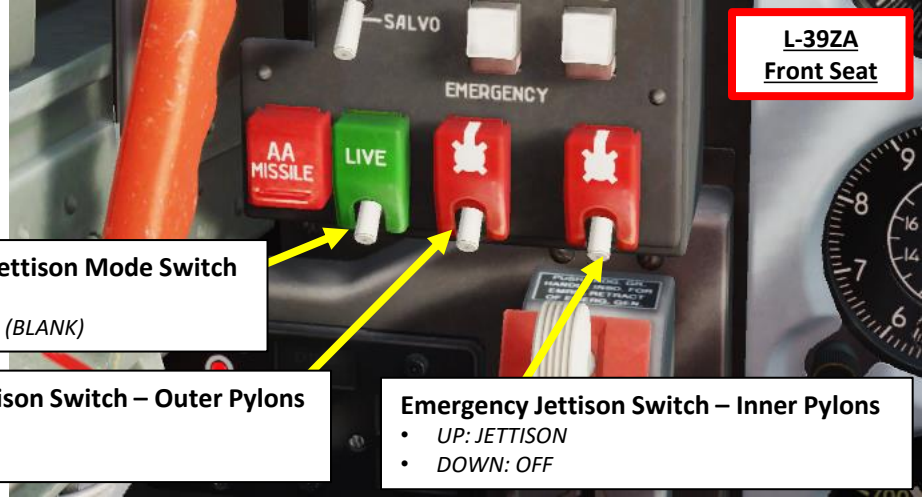
3 – AIR-TO-AIR WEAPONS

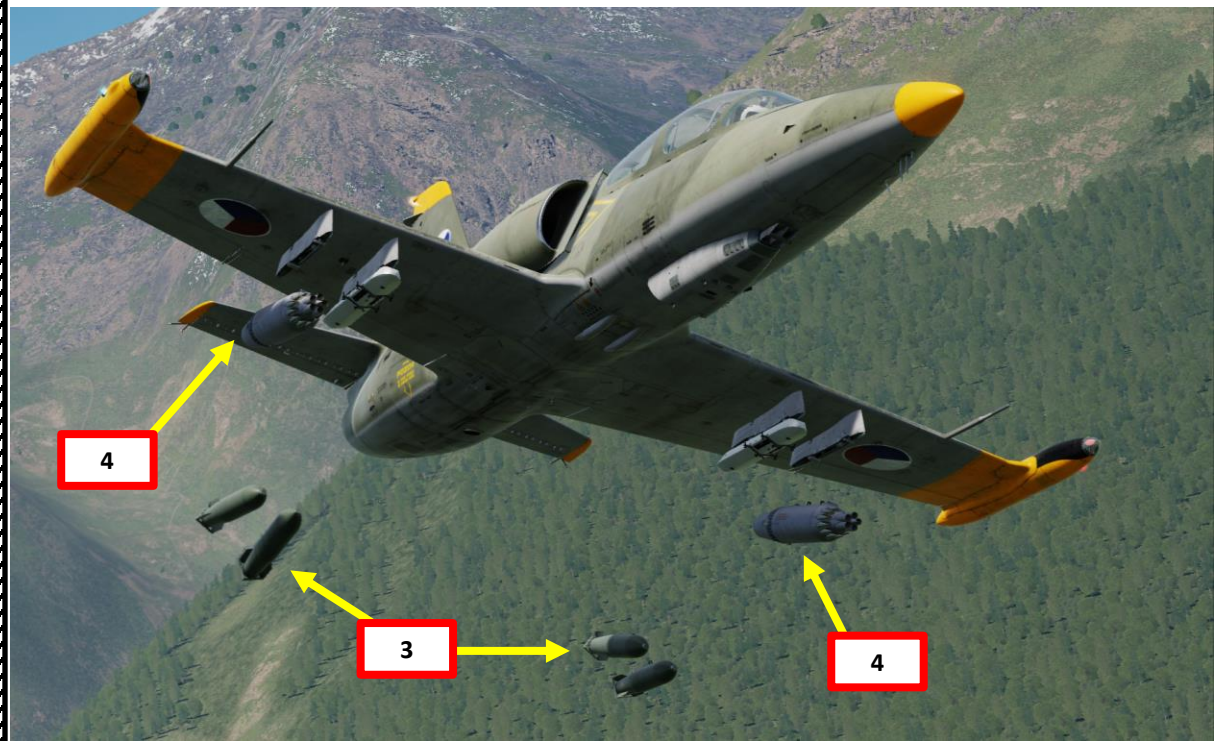
3.1 – R-60M IR (Infrared Homing) Missile

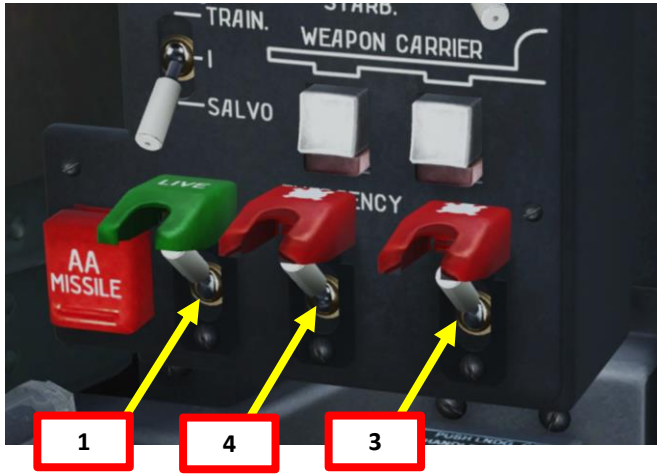
4 – ORDNANCE JETTISON

4.1 – Inner/Outer Pylon Jettison

1. If jettisoning bombs, set Bomb Emergency Jettison Mode (LIVE/BLANK) Switch as desired as a safety measure.
    - Since we want to jettison bombs with the fuzes armed, we will set the switch to LIVE (UP). However, in normal circumstances you would prefer to set it to BLANK (DOWN) in order to avoid the risk of civilian infrastructure or friendly units.
    - Note: If other types of ordnance are loaded, disregard this step.
2. If jettisoning bombs, The EXPLOSIVE Caution light will be illuminated or extinguished based on the position of the Bomb Emergency Jettison Mode (LIVE/BLANK) Switch.
    - Since we are jettisoning armed/live bombs, the EXPLOSIVE caution light should be illuminated.
    - Note: If other types of ordnance are loaded, disregard this step.
3. To jettison inner pylons, set Emergency Jettison (Inner Pylons) Switch – UP (Jettison).
4. To jettison outer pylons, set Emergency Jettison (Outer Pylons) Switch – UP (Jettison).





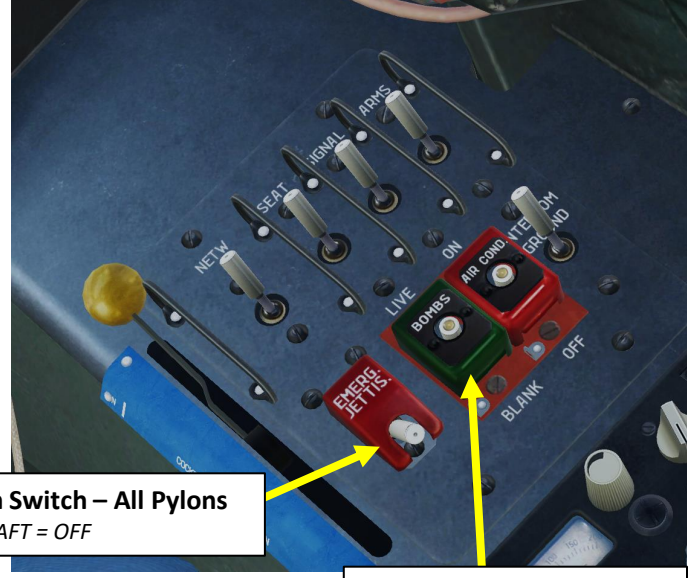


4 – ORDNANCE JETTISON

4.1 – Inner/Outer Pylon Jettison

Jettisoning ordnance can also be done from the rear cockpit. The interface is largely similar, with one difference being that you can only jettison all pylons at once. You do not have the option to select outboard or inner pylons.

L-39ZA Rear Seat



Emergency Jettison Switch – All Pylons
- *FWD = JETTISON / AFT = OFF*

Bomb Arming Switch
- *FWD = ARMED (LIVE)*
- *AFT = Not Armed (BLANK)*

EXPLOSIVE Caution
- *Indicates that weapons are armed and LIVE*

4 – ORDNANCE JETTISON

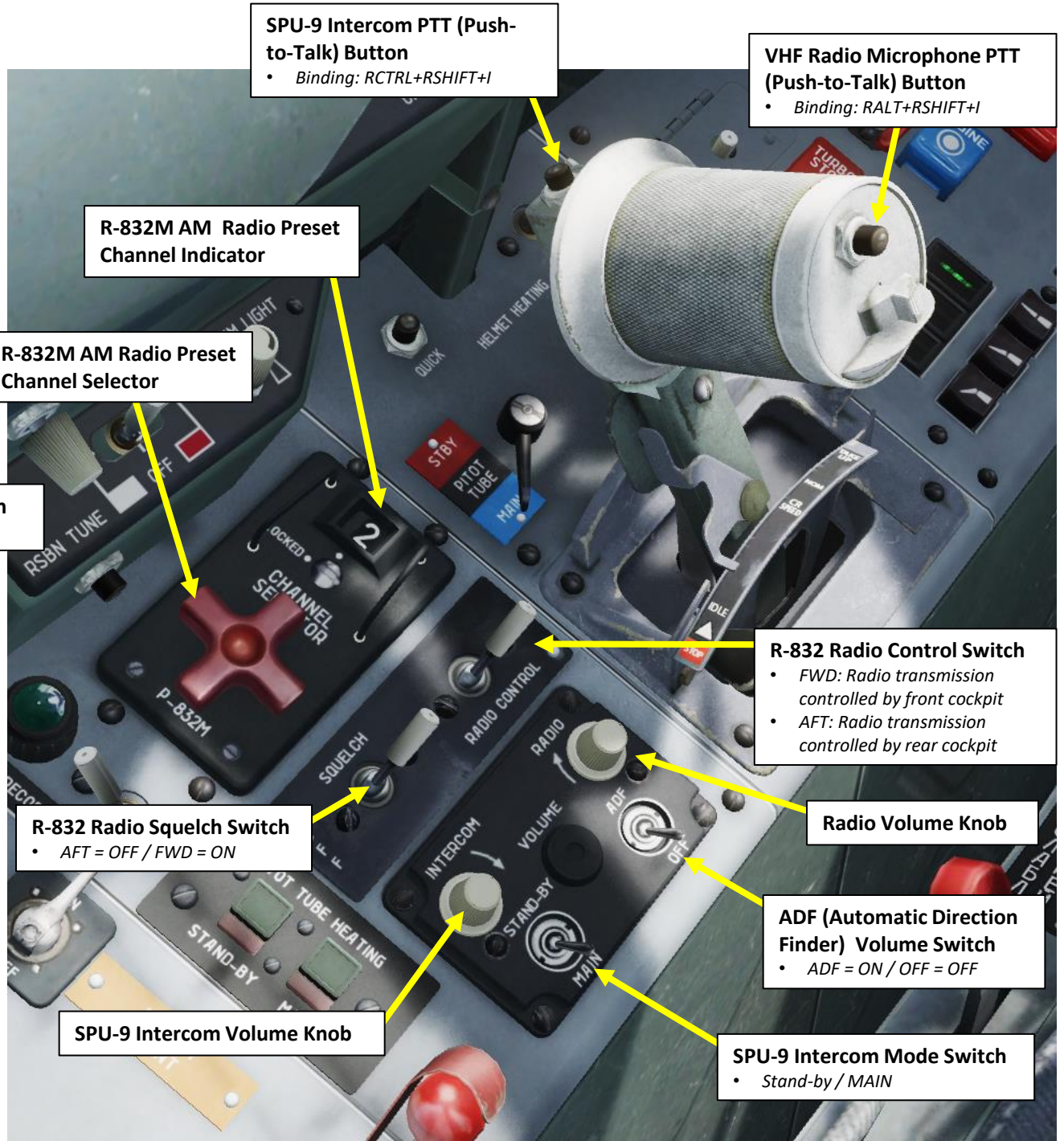
4.2 – Missile Jettison

To jettison missiles, flip AA MISSILE safety guard UP, then press Emergency Launch Missile Button.

RADIO SYSTEM OVERVIEW

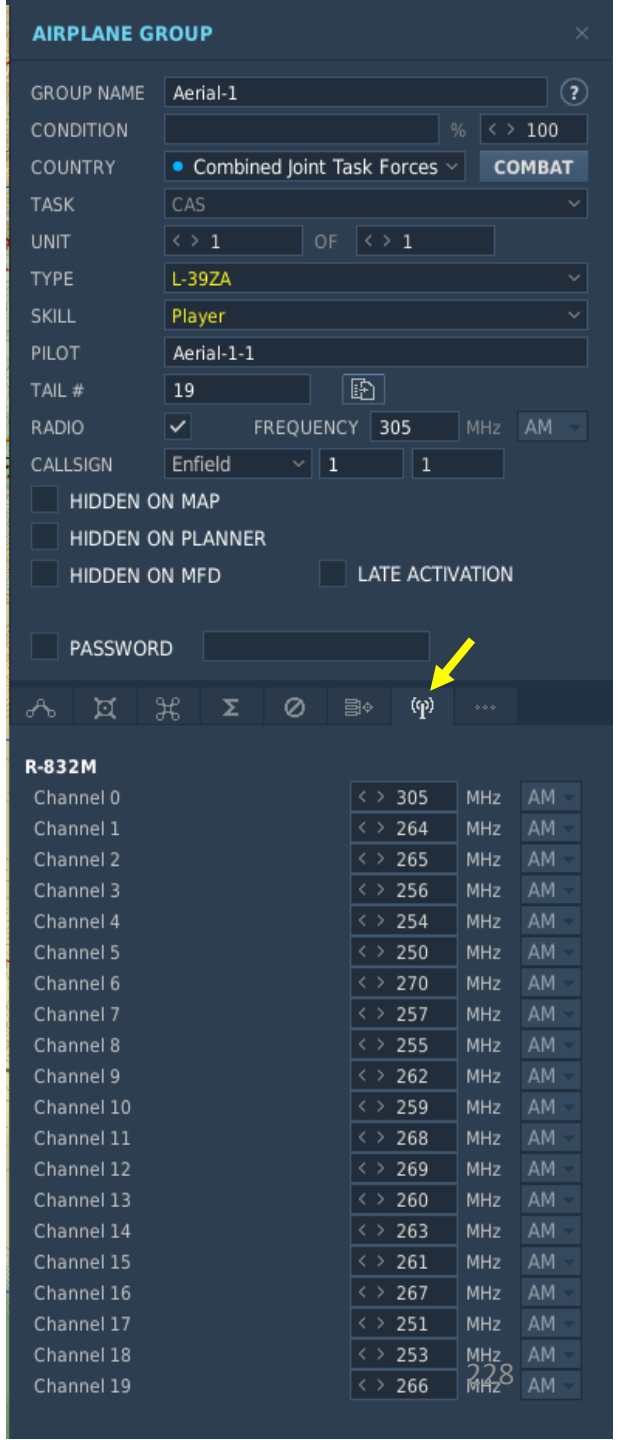
The L-39 simulated in DCS uses the R-832M V/UHF radio. This radio has 20 preset channels, which can only be set via the Mission Editor.

R-832M V/UHF AM Radio Frequency Range
VHF: 118 MHz to 140 MHz
UHF: 220 to 389.95 MHz



PRESET CHANNEL FREQUENCIES

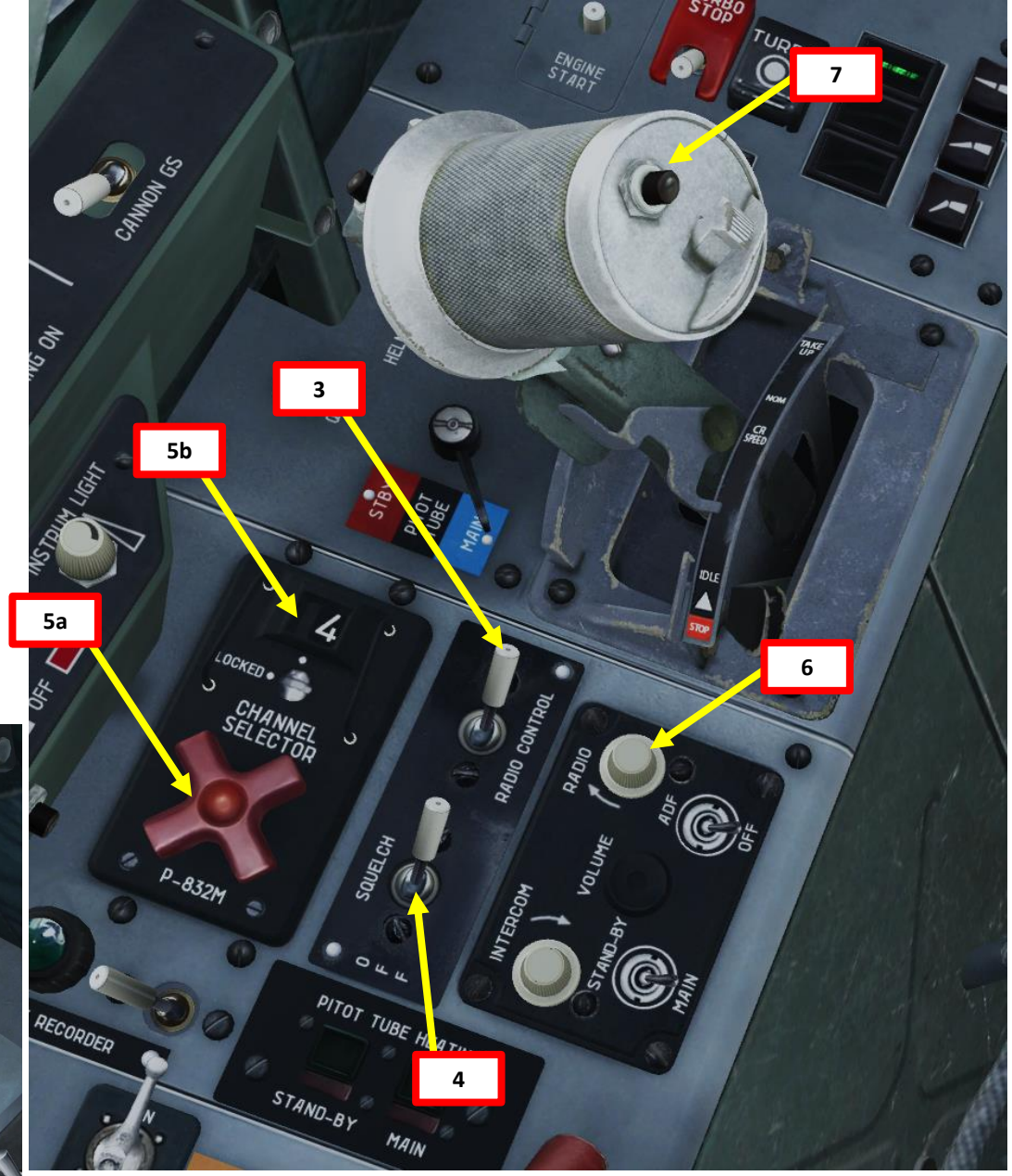
Normally, frequencies associated with radio channels should be available in the Mission Briefing or on your kneeboard since preset channel frequencies are set up via the Mission Editor.



R-832M V/UHF AM RADIO TUTORIAL

In this example, we want to transmit on preset Channel 4; its frequency is 254 MHz, which has been set via the Mission Editor.

1. Set RDO (Intercom Switch and Radio) ACB Switch - ON (FWD)
2. After Battery, Invertor I, Invertor II and RDO Circuit Breakers are first turned ON, a delay of 2 to 3 minutes is required for the radio to initialize and become operational.
3. Set R-832 Radio Control Switch – FRONT/FWD. Radio transmission will be controlled by the front cockpit.
4. Set R-832 Radio Squelch Switch – ON (FWD).
5. Set R-832 Radio Preset Channel Selector – As desired. We will select Channel 2.
6. Adjust Radio Volume – As required.
7. Transmit by pressing the VHF Radio Microphone PTT (Push-to-Talk) Button (Binding: RALT+RSHIFT+I).



SPU-9 INTERCOM TUTORIAL

1. Set RDO (Intercom Switch and Radio) ACB Switch - ON (FWD)
2. Set SPU-9 Intercom Mode Switch – MAIN.
3. Adjust Intercom Volume – As required.
4. Transmit on the intercom to the other seat by pressing the SPU-9 Intercom PTT (Push-to-Talk) Button (Binding: RCTRL+RSHIFT+I)

R-832M AM RADIO FREQUENCIES – AIRFIELDS

LOCATION	AM FREQUENCY (Mhz)
Anapa	250.00
Batumi	260.00
Beslan	270.0
Gelendzhik	255.00
Gudauta	259.00
Kobuleti	262.00
Kutaisi	263.00
Krasnodar Center	251.00
Krasnodar Pashkovsky	257.00
Krymsk	253.00
Maykop	254.00
Mineral'nye Vody	264.00
Mozdok	266.00
Nalchik	265.00
Novorossiysk	252.00
Senaki	261.00
Sochi	256.00
Soganlug	268.00
Sukhumi	258.00
Tblisi	267.00
Vaziani	269.00

SECTION STRUCTURE

- **1 – NAVIGATION AIDS INTRODUCTION**
  - 1.1 – ADF, RSBN & PRMG
  - 1.2 – Navigation Aid Database
- **2 – MAGNETIC VARIATION**
- **3 – NAVIGATION INSTRUMENTS OVERVIEW**
- **4 – RKL-41 ADF (AUTOMATIC DIRECTION FINDER) NAVIGATION**
  - 4.1 – Overview
  - 4.2 – Tutorial
- **5 – RSBN-5S "ISKRA-K" (VOR) NAVIGATION**
  - 5.1 – Overview
  - 5.2 – RSBN in Navigation Mode
  - 5.3 – RSBN in Glide Path Mode
- **6 – PRMG (PRECISION/INSTRUMENT APPROACH LANDING)**

1 – NAVIGATION AIDS INTRODUCTION

1.1 – ADF, RSBN & PRMG

Navigation is an extensive subject. You can check chapter 16 of FAA manual for more details on navigation.
LINK: https://www.faa.gov/regulationspolicies/handbooksmanuals/aviation/phak/chapter-16-navigation

- "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), which is the RKL-41 ADF system on the L-39. 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 L-39 is equipped with the RKL-41 ADF (Automatic Direction Finder) system, which can help you track NDB stations.

- The RSBN (Short Range Radio Navigation System) is the russian equivalent of a VOR system.

- NDBs have a max range of approximately 120 km.
- RSBN stations are similar to VOR stations and have a max range of approximately 200 km.
- NDB 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.

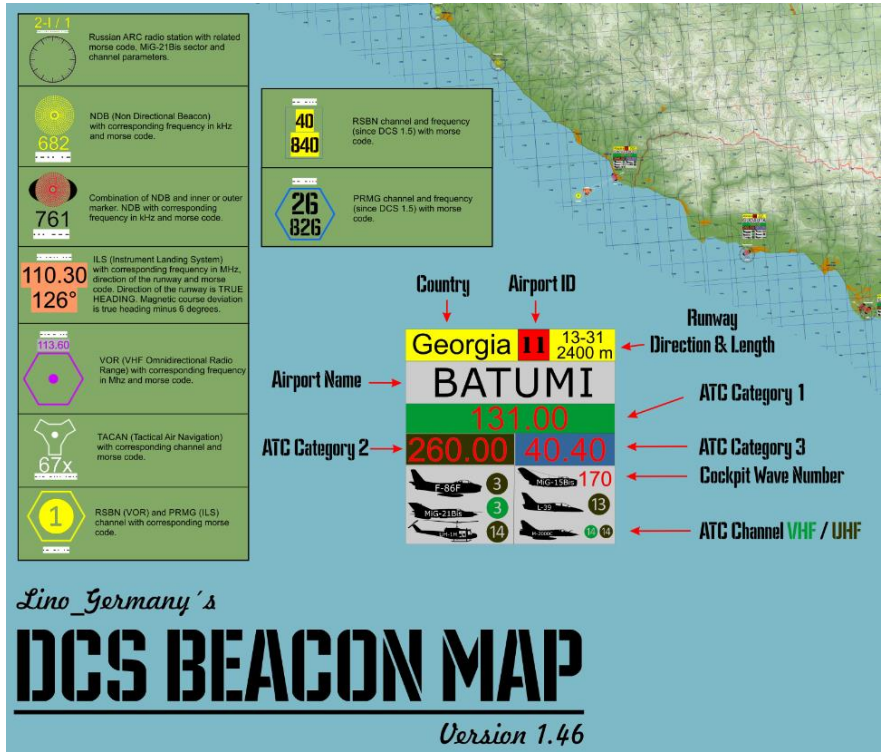
NDB RANGE IN FUNCTION OF MINIMUM ALTITUDE						
Distance from station (km)	20	40	60	80	100	120
Minimum altitude (m)	350	700	1050	1400	1750	2100

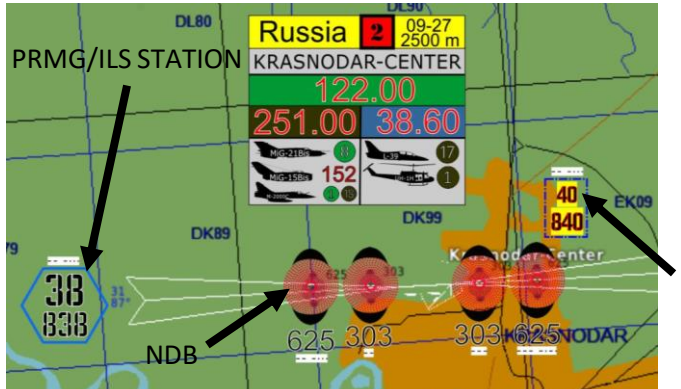
RSBN (VOR) RANGE IN FUNCTION OF MINIMUM ALTITUDE						
Distance from station (km)	20	40	60	80	100	120
Minimum altitude (m)	350	700	1050	1400	1750	2100

1 – NAVIGATION AIDS INTRODUCTION

1.2 – Navigation Aid Database

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





Note: Only a few airports are equipped with adequate RSBN beacons useable by the L-39. RSBN frequencies in the table below are for RSBN Navigation beacons and for PRMG Beacons.

RSBN FREQ.	PRMG FREQ.	AIRPORT / RUNWAY HDG	RSBN MORSE CODE
N/A	N/A	ANAPA-VITYAZEVO / 42	-... . ...
N/A	N/A	BATUMI / 126	
N/A	N/A	BESLAN / 94	
N/A	N/A	GELENDZIK	-.- --- -...
N/A	N/A	GUDAUTA-BOMBORA	-.- ... -..
N/A	N/A	KOBULETI / 70	.-- .- ...
40	**38**	KRASNODAR-CENTER / 87	-.- ... -..
N/A	N/A	KRASNODAR-PASHKOVSKIY / 47	.-- .- ...
28	**26**	KRYMSK / 40	-.- .-. ..
N/A	N/A	KUTAISI-KOPITNARI / 74	-.- ..- -
34	**36**	MAYKOP-KHANSKAYA / 39	-- .- -.--
N/A	N/A	MINERANYE VODY / 115	-- .. -.
20	**22**	MOZDOK / 83	-- ---- --..
N/A	N/A	NALCHIK / 56	-. .- .-..
N/A	N/A	NOVOROSSIYSK	
N/A	N/A	SENAKI-KOLKHI / 95	... . -.-
N/A	N/A	SOCHI-ADLER / 62	.- -.. .-..
N/A	N/A	SUKHUMI-BABUSHARA	
N/A	N/A	TBILISI-LOCHINI / 128	- .-.. ---
N/A	N/A	TBILISI-VAZIANI / 135	- ...- .-

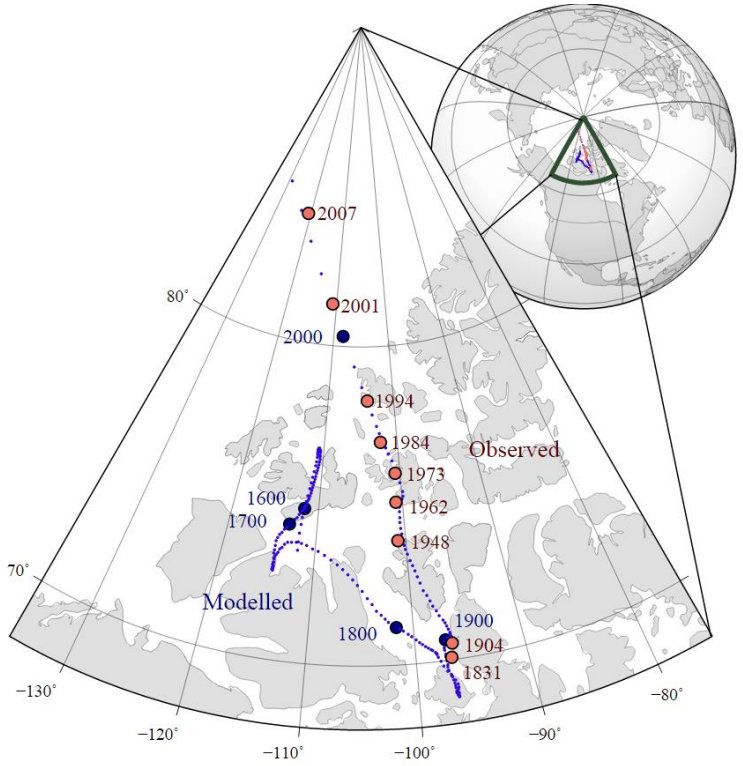
2 – MAGNETIC VARIATION

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 variation. Most **map coordinate** systems are based on **true north**, and magnetic variation 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 variation of the magnetic North pole (actually modelled in the sim, which is pretty neat).

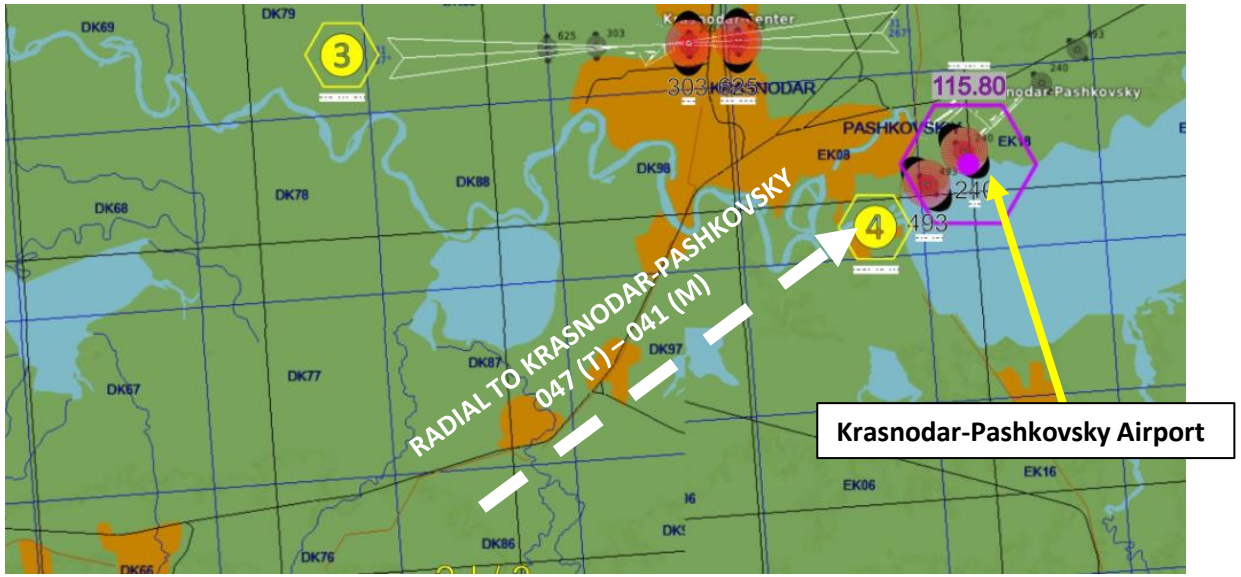
True Heading = Magnetic Heading + Magnetic Variation

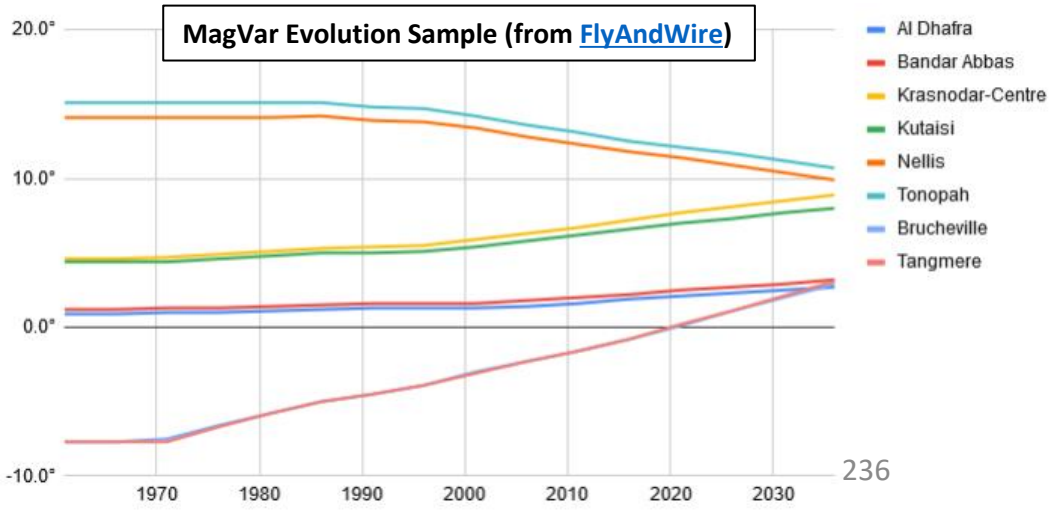
As an example, if the runway heading that you read on the F10 map in Krasnodar-Pashkovsky is 047 (True Heading), then the input to your magnetic compass course should be 047 subtracted with the Magnetic Variation (+6 degrees), or 041. You would need to enter a course of 041 (M) on the NPP Course Indicator.

Magnetic variation varies from place to place, but it also changes with time. This means this value will be highly dependent on the mission time and map.



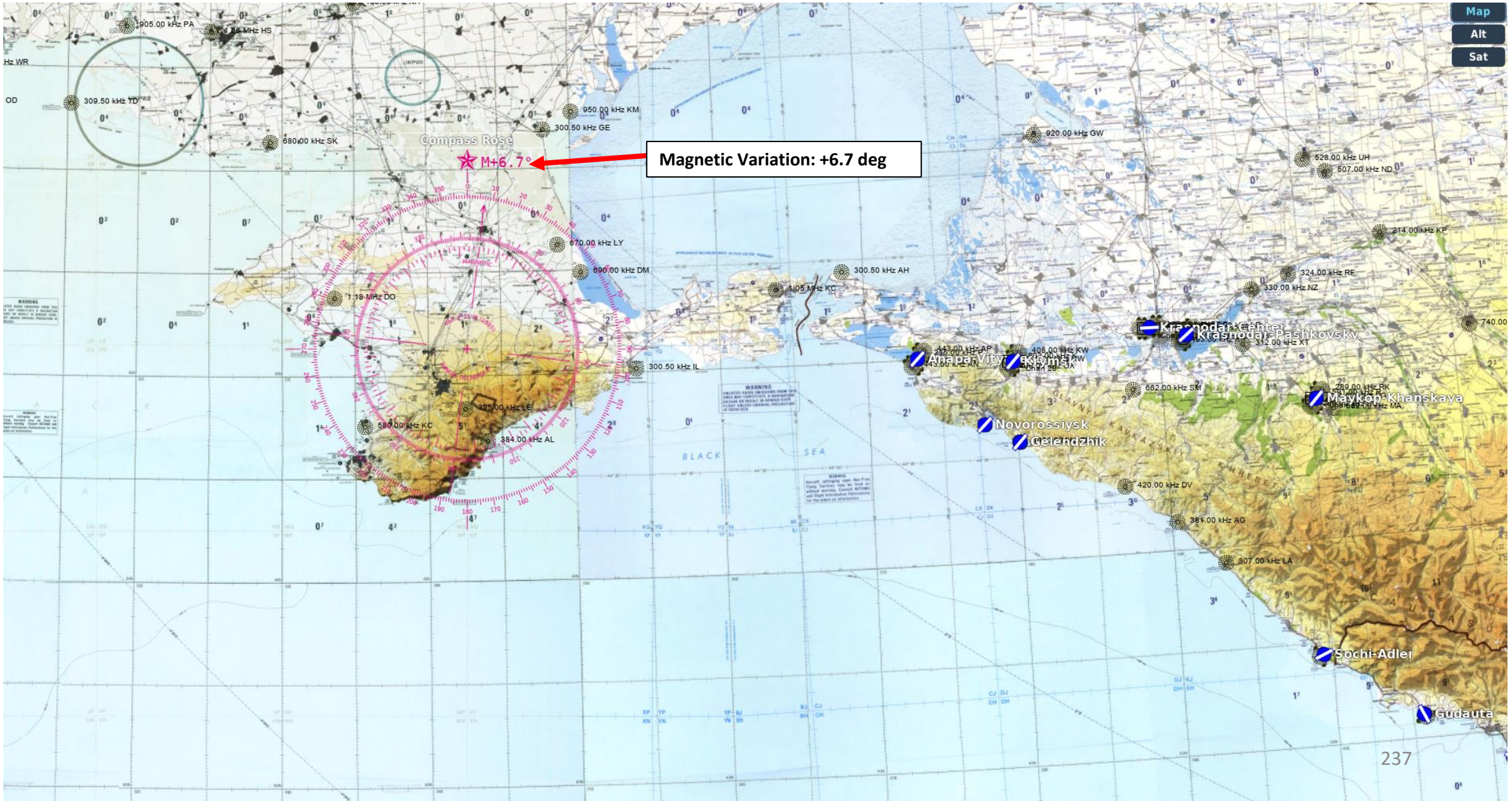
The movement of Earth's north magnetic pole across the Canadian arctic, 1831–2007.





2 – MAGNETIC VARIATION

Checking the magnetic variation is now very easy: you can access it directly from the F10 map, shown with the Compass Rose.

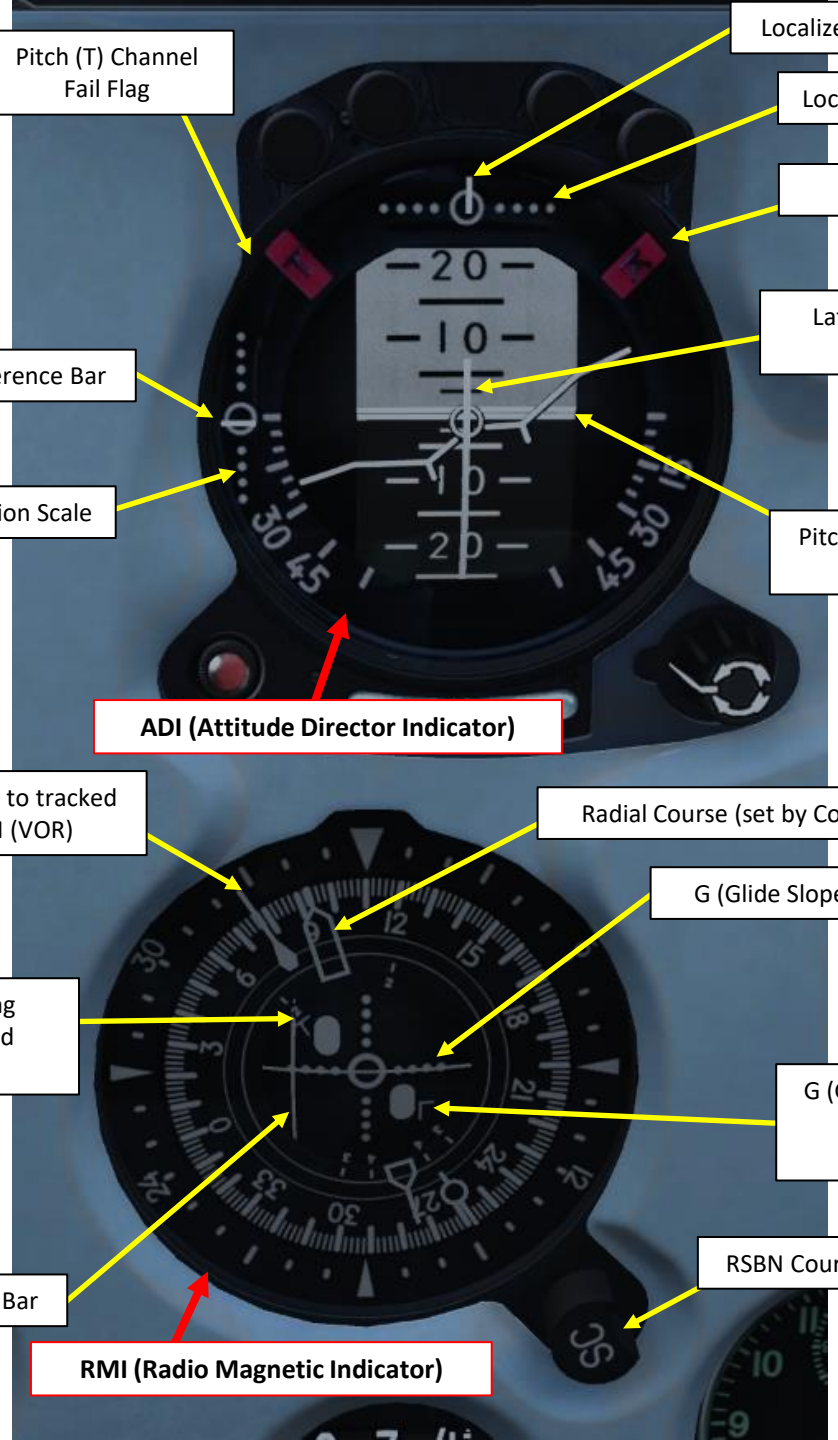


3 – NAVIGATION INSTRUMENTS OVERVIEW

The **ADI (Attitude director indicator)** is the Artificial Horizon.

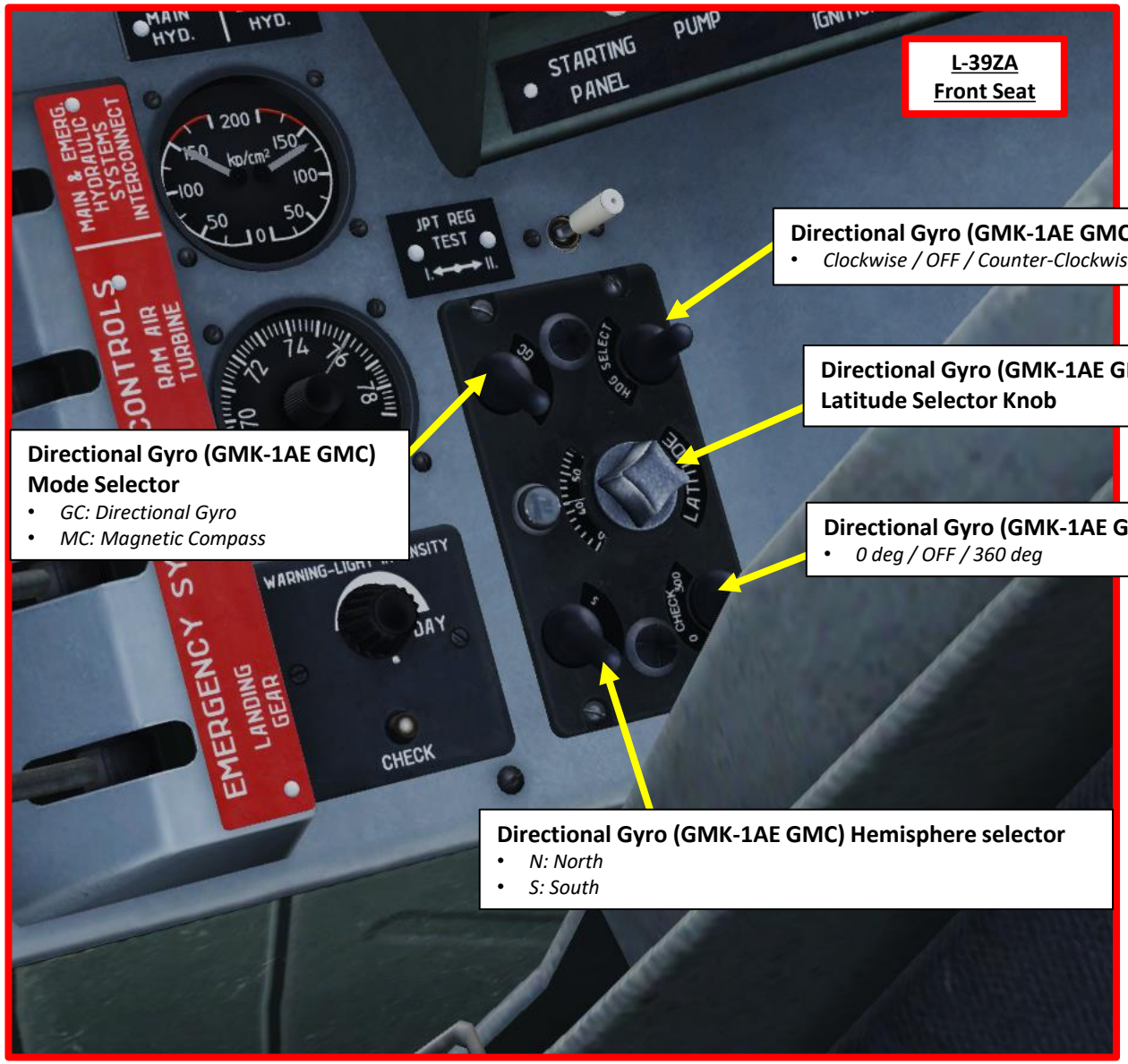
The **RMI (Radio Magnetic Indicator)** is similar to a western Horizontal Situation Indicator (HSI). The RMI can track either a RSBN station or a NDB (ADF) station.

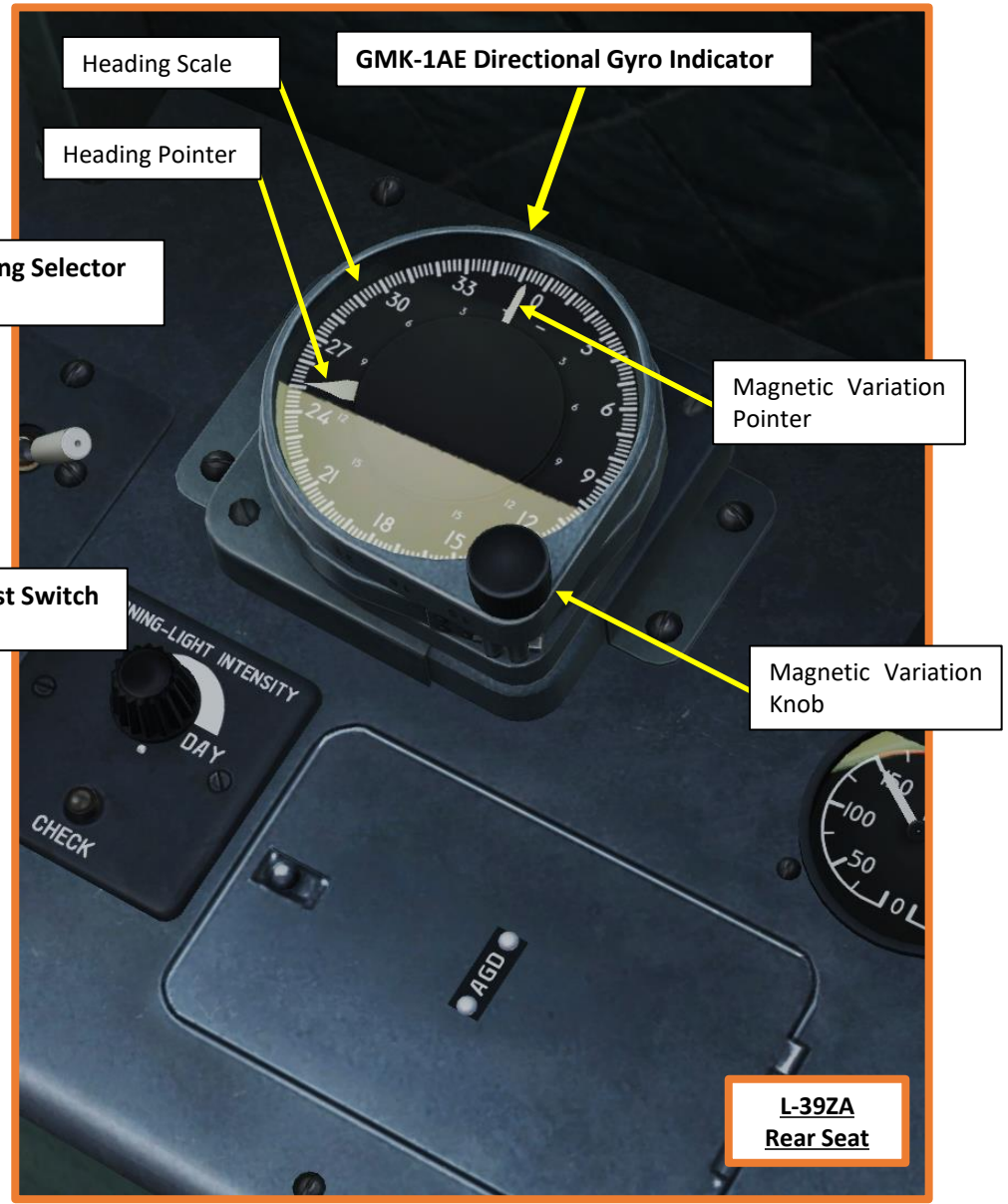
The **KI-13 Magnetic Compass** is used as a standby instrument in case of gyro failure.



3 – NAVIGATION INSTRUMENTS OVERVIEW

The **GMK-1AE Directional Gyro** is designed for heading and turn angles determination. Heading is indicated on the Radio Magnetic Indicator (RMI). To control the GMK-1AE system in the front cockpit on the right panel PU-26E control panel is installed and in the rear cockpit on the right panel the KM-8 correction mechanism is installed. The KM-8 is designed for entering magnetic variation in the system.





4 – RKL-41 ADF (AUTOMATIC DIRECTION FINDER) NAVIGATION

4.1 – Overview

You are guided to NDB stations by your RKL-41 ADF (Automatic Direction Finder) Gauge. NDB signals give you a direction to the station, but no distance information. To pick up NDB signals, make sure you are flying at an altitude of at least 2,500 m.

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

4 – RKL-41 ADF (AUTOMATIC DIRECTION FINDER) NAVIGATION

4.1 – Overview

ADF Volume Tuning Knob

ADF Tuning Indicator (Pointer Deflection)

Frequency Selectors with "O" (Outer NDB)
- *Internal (Flag) Handle: KHz Tens*
- *External Ring: KHz Hundreds*

Frequency Selectors with "I" (Inner NDB)
- *Internal (Flag) Handle: KHz Tens*
- *External Ring: KHz Hundreds*

Precision Tuning Handles
- *Based on signals audibility in TLF (Telephone) Mode and on maximum pointer deflection in TLG (Telegraph) Mode.*

Internal (Flag) Handle

External (Ring) Handle

ADF Control Panel Switch
- *Changes control of ADF to the panels from either front cockpit (switch in LEFT position) or rear cockpit (switch in RIGHT position)*

Telephone/Telegraph (TLF/TLG) Selector Switch
- *FWD: Telephone (TLF)*
- *AFT: Telegraph (TLG)*

RKL-41 ADF (Automatic Direction Finder) Operation Mode Selector

ADF Control Panel Illumination Brightness Adjustment Knob

Manual Antenna Rotation Control Switch
- *L: Left*
- *R: RIght*

RKL-41 ADF (Automatic Direction Finder) Operation Modes
- *OFF*
- *C AUT: Compass Automatic, NDB direction is determined automatically.*
- *C MAN: Compass Manual, no automatic switching from outer NDB to inner (near) NDB*
- *ANT: Antenna Mode, direction to NDB is not determined. Used to adjust ADF to the NDB frequency.*
- *LOOP: Use to find radio station direction by hearing*

4 – RKL-41 ADF (AUTOMATIC DIRECTION FINDER) NAVIGATION

4.2 – Tutorial

NDBs (Non-Directional Beacons) can be used not only to navigate but also to land. Before Russian VOR (RSBN) beacons were installed as navigation aids by the Soviet Union, NDBs were routinely used to get a bearing towards a specific station (mostly placed near airports). However, from the 1960s NDBs have become increasingly limited in comparison to ILS (Instrument Landing System) approach installations. NDBs are now very gradually being phased out of service. In our tutorial, we will do an old school approach using two NDBs, referred to as an Outer Marker and an Inner Marker. A switch in the cockpit allows us to toggle between the Outer (FAR) marker and the Inner (NEAR) marker.

The Outer Marker, which normally identifies the final approach fix (FAF), is located on the same course/track as the runway center-line, four to seven nautical miles before the runway threshold. The Inner Marker is located at the beginning (threshold) of the runway on some ILS approach systems having decision heights of less than 200 ft (60 m) above ground level.

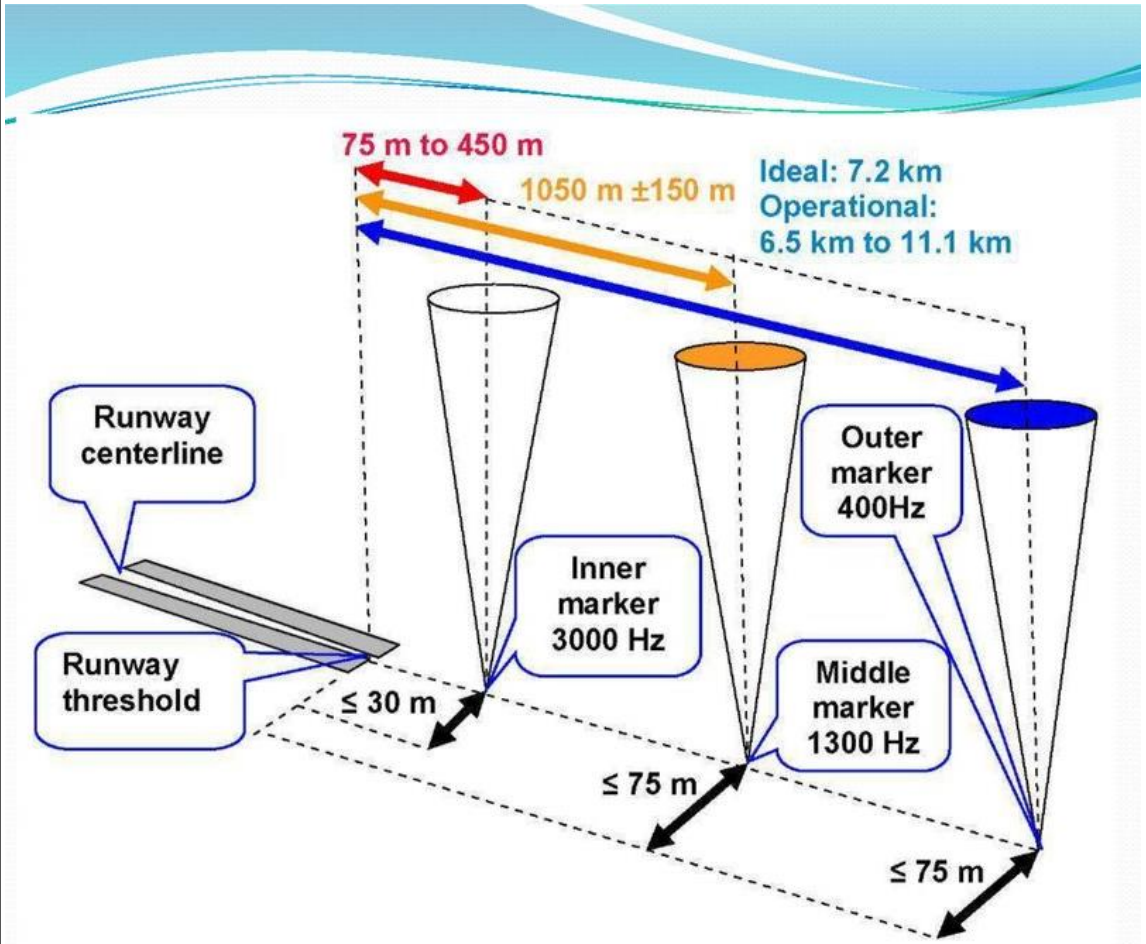
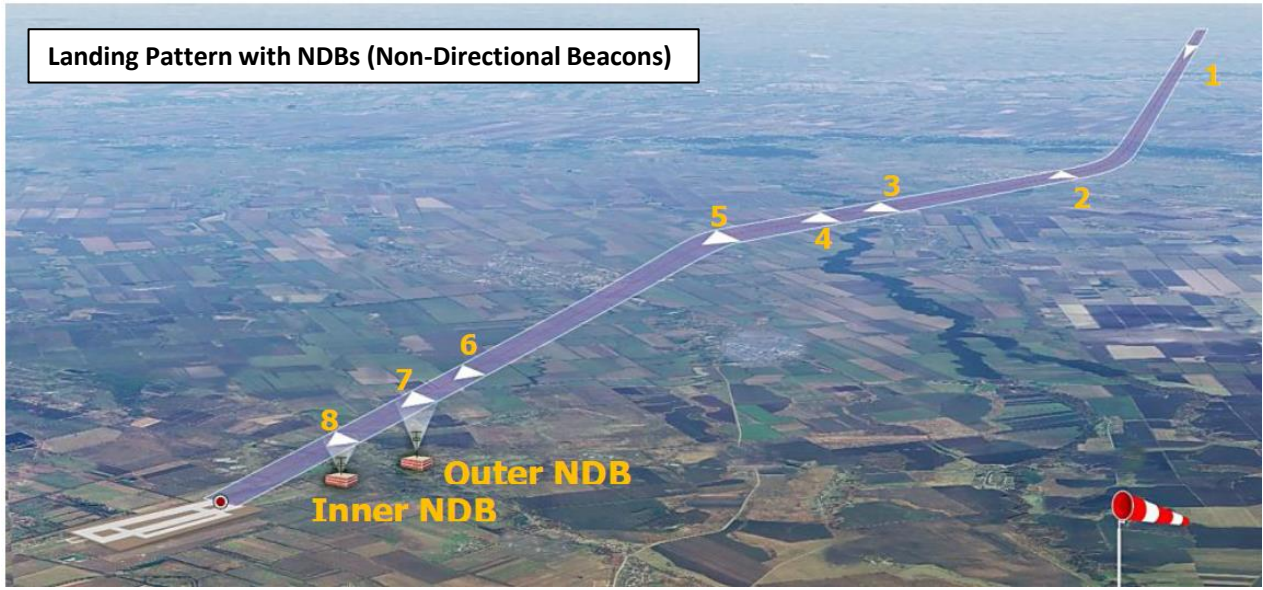


Figure 14: Marker beacon placement with respect to runway



4 – RKL-41 ADF (AUTOMATIC DIRECTION FINDER) NAVIGATION

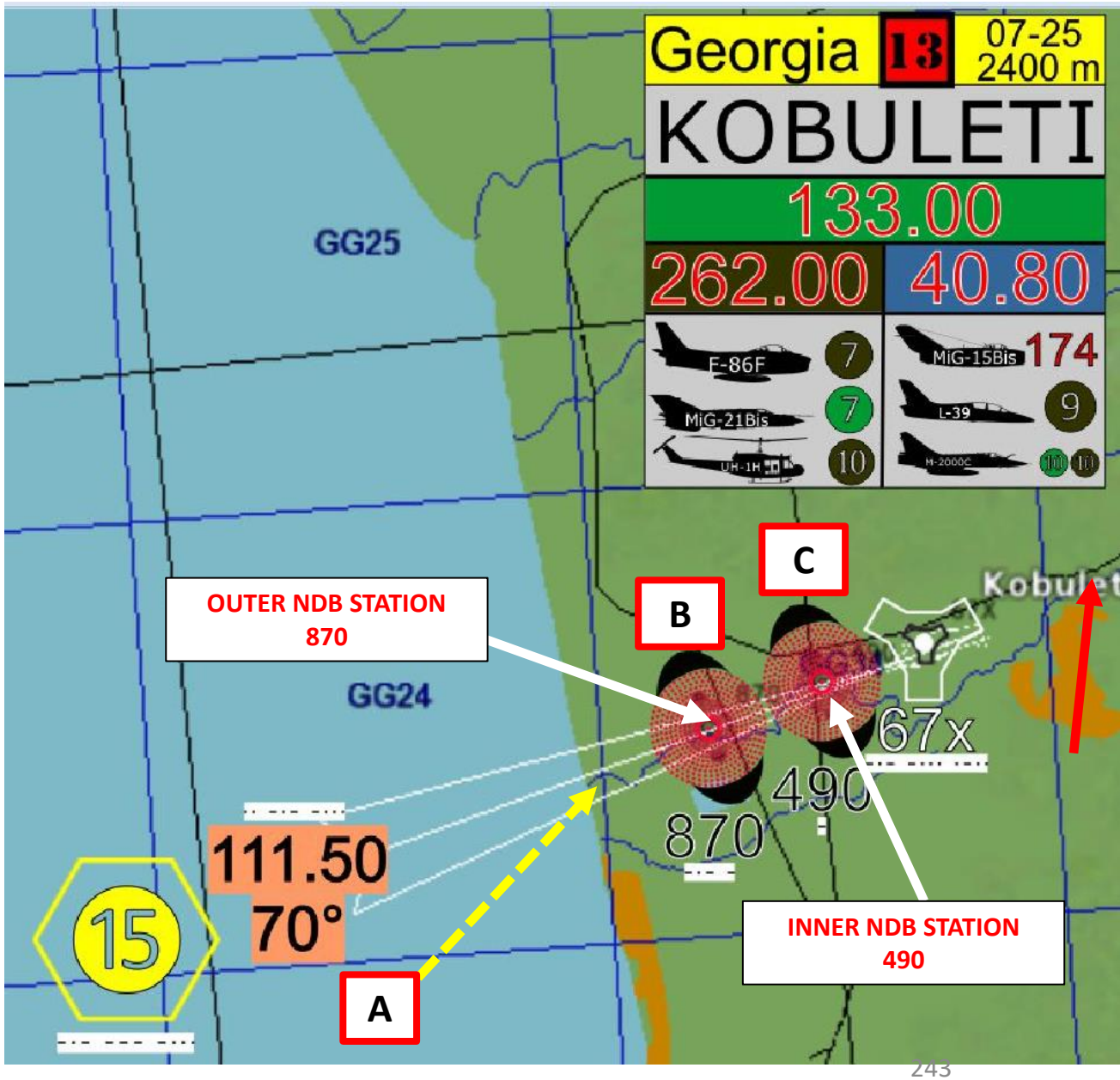
4.2 – Tutorial

In this example, we will fly over the outer and inner NDB beacons placed in the vicinity of Kobuleti using the RKL-41 ADF (Automatic Direction Finder).

We will do the following:

A. Fly towards Kobuleti and gain an altitude of at least 2,500 m.
B. Use the RKL-41 ADF system to navigate to Kobuleti's Outer NDB Beacon, ADF frequency 870 (obtained through Lino Germany's map).
C. Use the RKL-41 ADF system to navigate to Kobuleti's Inner NDB Beacon, ADF frequency 490 (obtained through Lino Germany's map).

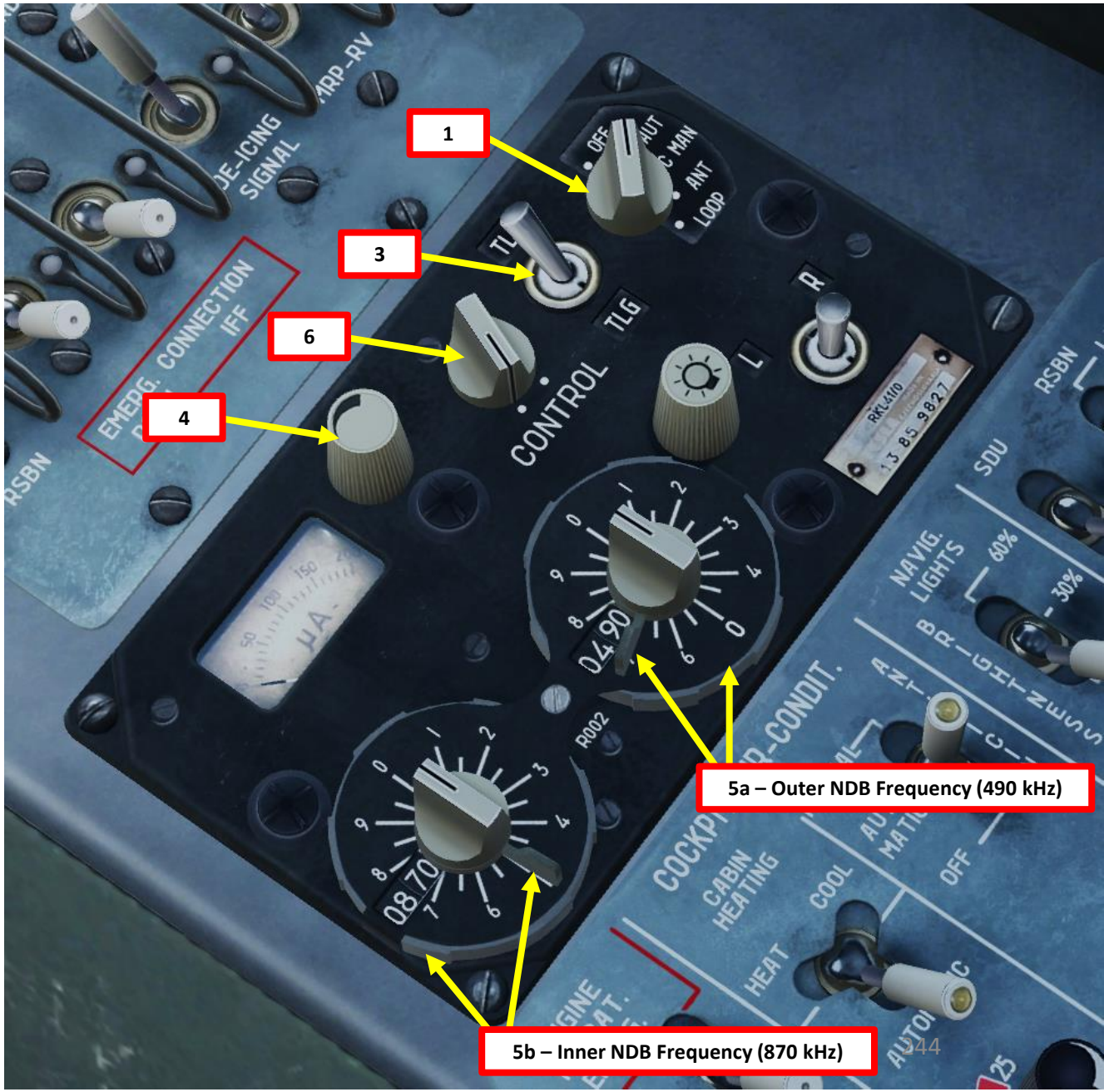
Check out XXJohnXX's excellent tutorial on NDB navigation:
https://youtu.be/cOz2Ue6U680



4 – RKL-41 ADF (AUTOMATIC DIRECTION FINDER) NAVIGATION

4.2 – Tutorial

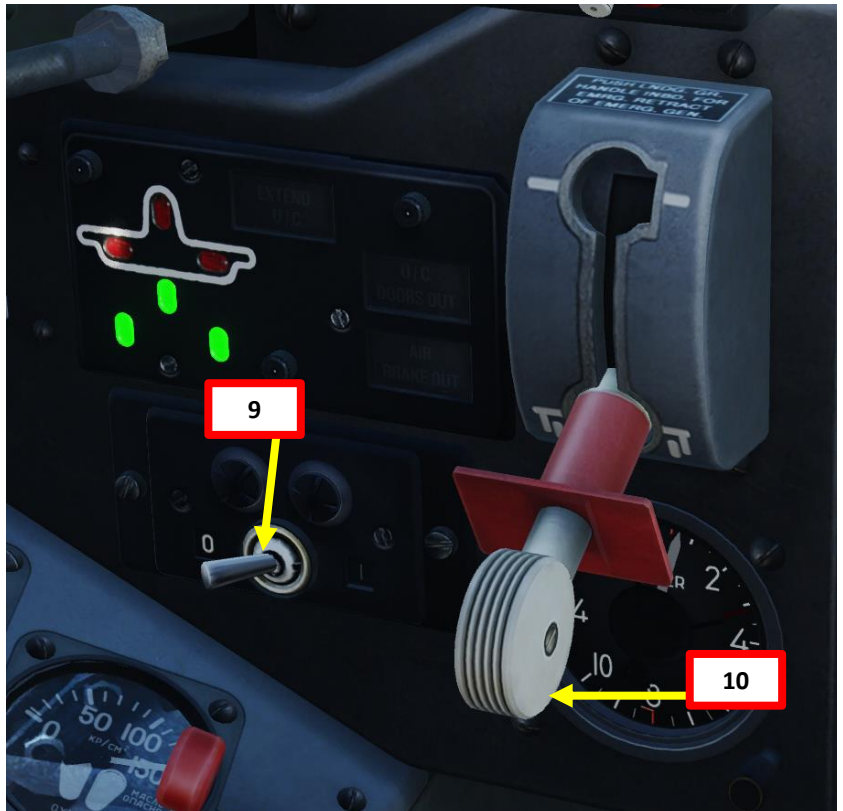
1. Set RKL-41 ADF (Automatic Direction Finder) Operation Mode Selector – C AUT or C MAN, as desired. In this example, we will use C AUT.
   - C AUT: Compass Automatic, NDB direction is determined automatically. This mode will automatically switch from your Outer to your Inner NDB when you reach the Outer marker. However, Inner NDB will be selected automatically only if you are on course and if your landing gear is down.
   - C MAN: Compass Manual, no automatic switching from outer NDB to inner (near) NDB
2. Set ADF (Automatic Direction Finder) Volume Switch – ADF (UP)
3. Set Telephone/Telegraph (TLF/TLG) Selector Switch – TLF (FWD). This will allow you to hear the morse code broadcast of the NDB station.
4. Tune ADF volume knob as required
5. Set your ADF frequencies for
   a) the Outer NDB (490)
   b) the Inner NDB (870)
6. Set ADF Control Panel Switch to the LEFT if you are in the front cockpit or to the RIGHT if you are in the rear cockpit.



4 – RKL-41 ADF (AUTOMATIC DIRECTION FINDER) NAVIGATION

4.2 – Tutorial

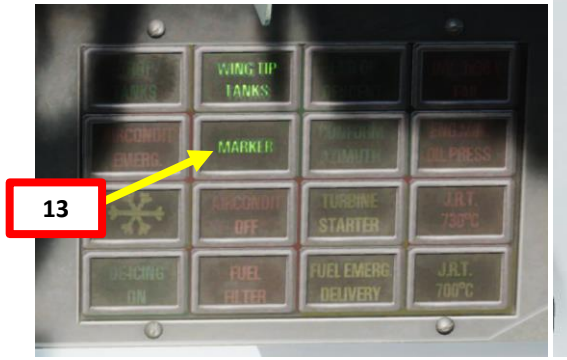
7. Set Telephone/Telegraph (TLF/TLG) Selector Switch – TLG (AFT).
8. Verify that the ADF signal intensity indication needle points to the right to confirm that the NDB signals are received correctly.
9. Set your RKL-41 ADF Outer-Inner Beacon Selector (Far-Near NDB switch) - “OUTER” (LEFT). The system will then track the Outer NDB.
10. If using C AUT (Compass Automatic) Operation Mode, make sure the landing gear is DOWN if you want the system to switch from Outer NDB to Inner NDB automatically when overflying the Outer NDB.

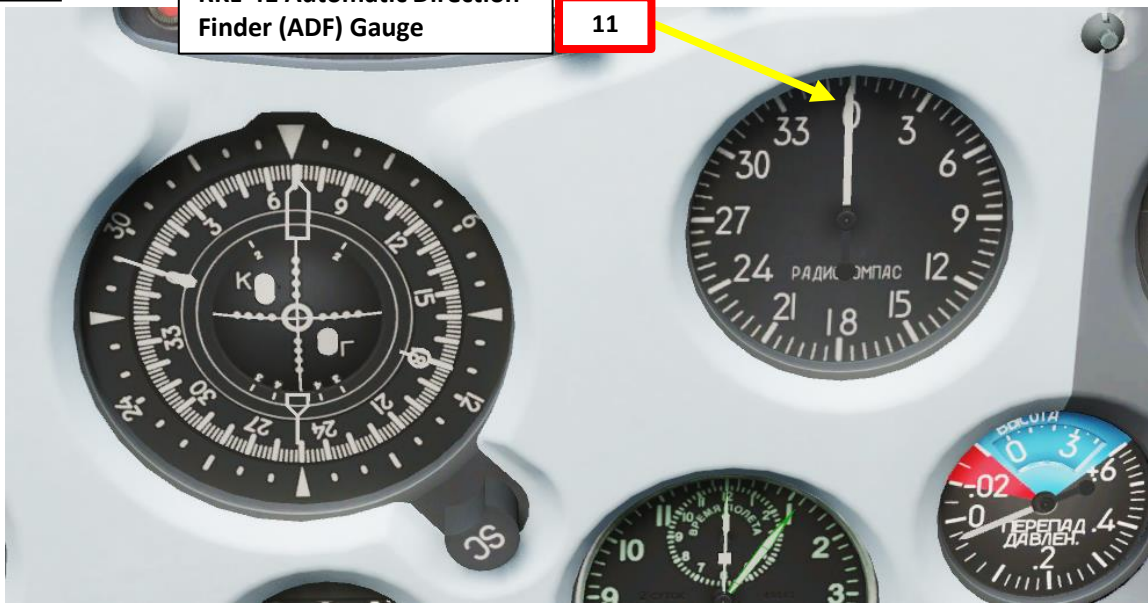


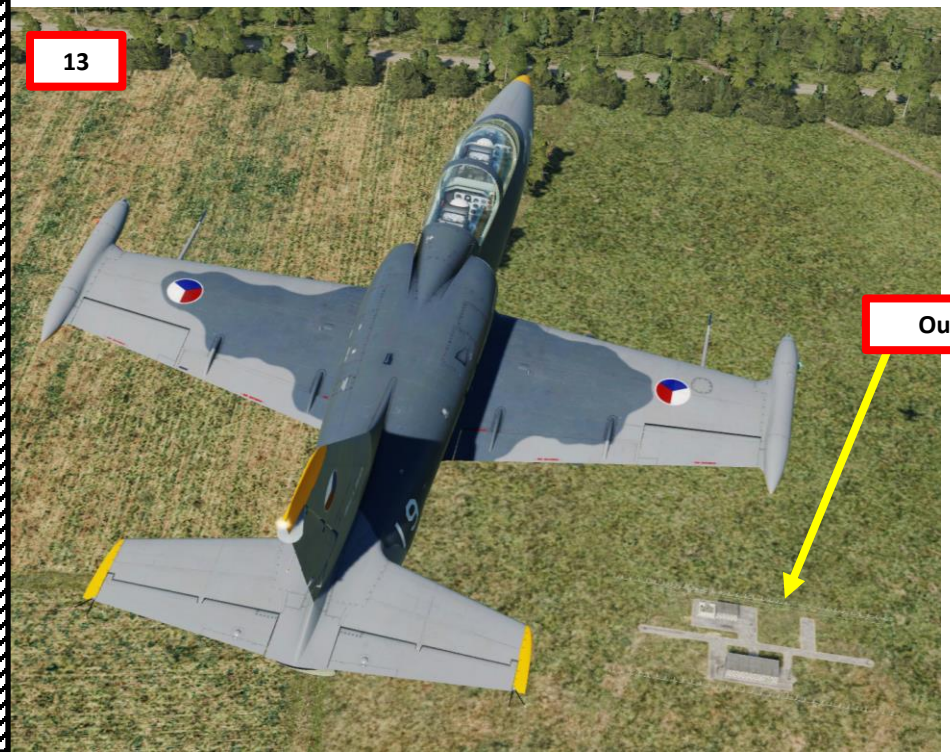
4 – RKL-41 ADF (AUTOMATIC DIRECTION FINDER) NAVIGATION

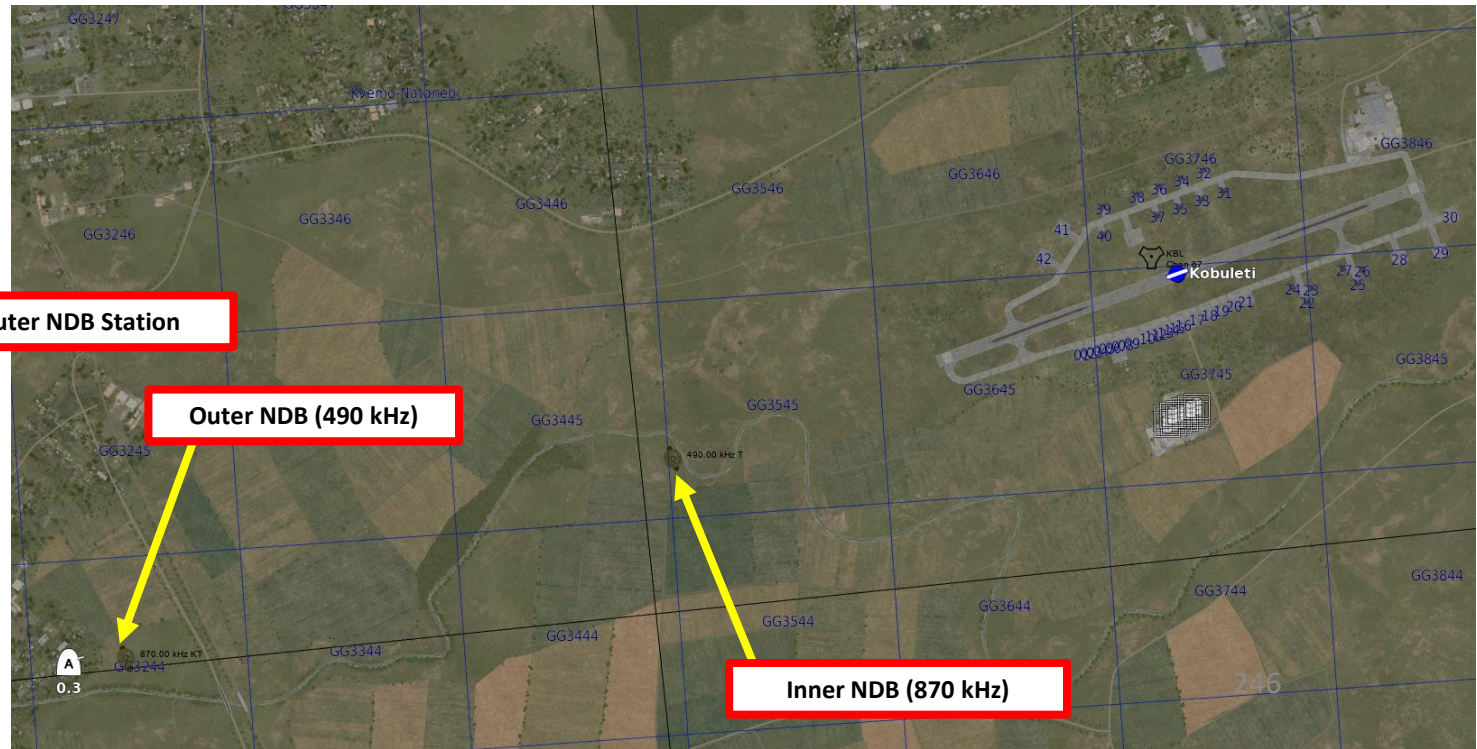
4.2 – Tutorial

11. Consult ADF gauge and follow the needle tracking the NDB.
12. You will be heading towards the NDB when your ADF needle will point towards “0” (vertical).
13. You will fly over the Outer NDB when the “MARKER” caution will illuminate.





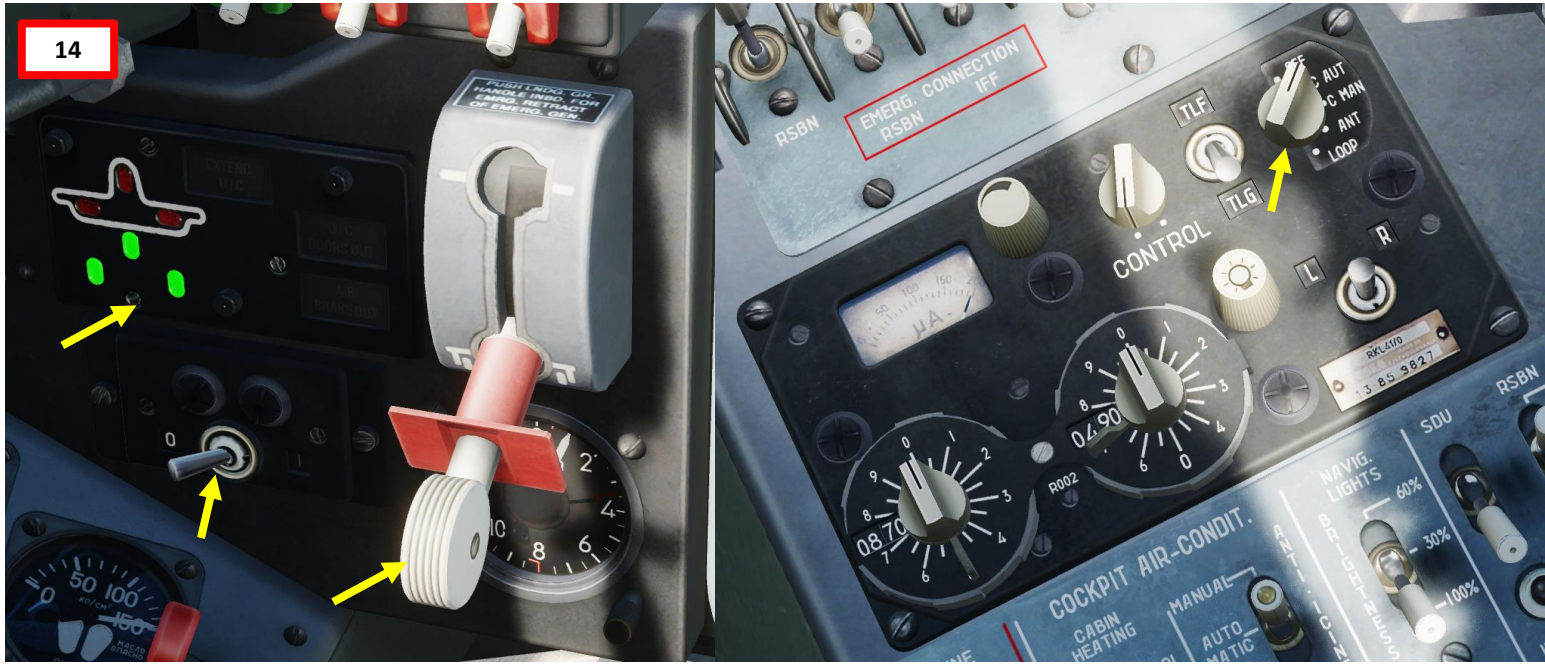




4 – RKL-41 ADF (AUTOMATIC DIRECTION FINDER) NAVIGATION

4.2 – Tutorial

14. If ADF Operation Mode is set to Automatic (C AUT) mode, INNER NDB will be selected automatically (provided you are on course and the landing gear is down). In this case, there is no need to touch the RKL-41 ADF Outer-Inner Beacon Selector (Far-Near NDB switch).
15. If ADF Operation Mode is set to Manual (C MAN) mode, set the RKL-41 ADF Outer-Inner Beacon Selector (Far-Near NDB switch) to “INNER” (RIGHT). The system will then track the Inner NDB.
16. Your ADF gauge will now be tracking the INNER NDB.

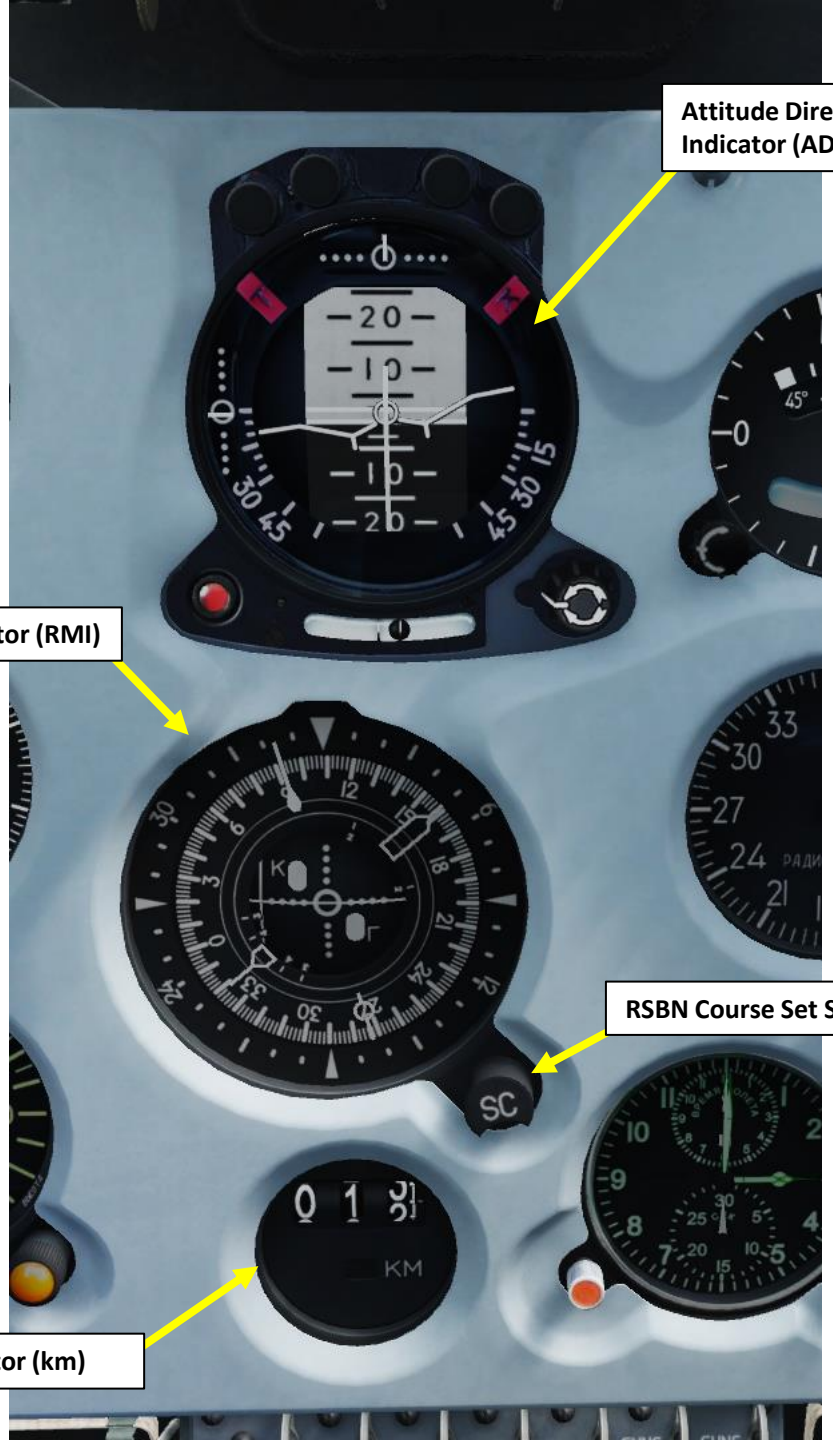


5 – RSBN-5S “ISKRA-K” (VOR) NAVIGATION

5.1 – Overview

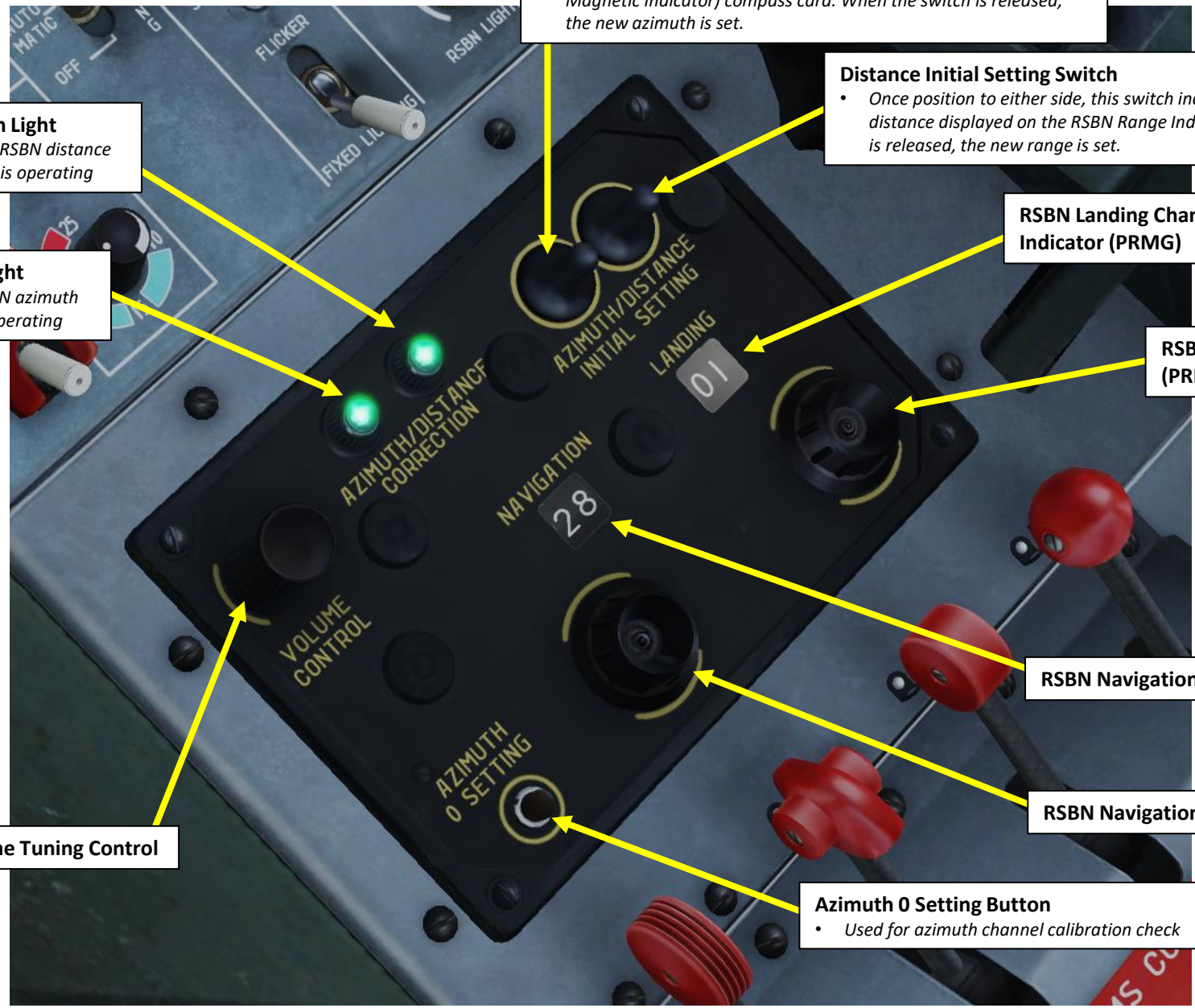
You are guided to RSBN stations by your RMI (Radio Magnetic Indicator). RSBN signals give you a direction and distance information to the station. To pick up RSBN signals, make sure you are flying at an altitude of at least 2,500 m.

Important note: all units in the RSBN examples are in metric for simplification purposes since RSBN is a Russian system and uses the metric system.



5 – RSBN-5S "ISKRA-K" (VOR) NAVIGATION

5.1 – Overview



Azimuth Initial Setting Switch
- *Once position to either side, this switch rotates the RMI (Radio Magnetic Indicator) compass card. When the switch is released, the new azimuth is set.*

Distance Initial Setting Switch
- *Once position to either side, this switch increases or decreases the distance displayed on the RSBN Range Indicator. When the switch is released, the new range is set.*

Distance Correction Light
- *When illuminated, RSBN distance correction channel is operating*

RSBN Landing Channel Indicator (PRMG)

Azimuth Correction Light
- *When illuminated, RSBN azimuth correction channel is operating*

RSBN Landing Channel (PRMG) Selector

RSBN Navigation Channel Indicator

RSBN Navigation Channel Selector

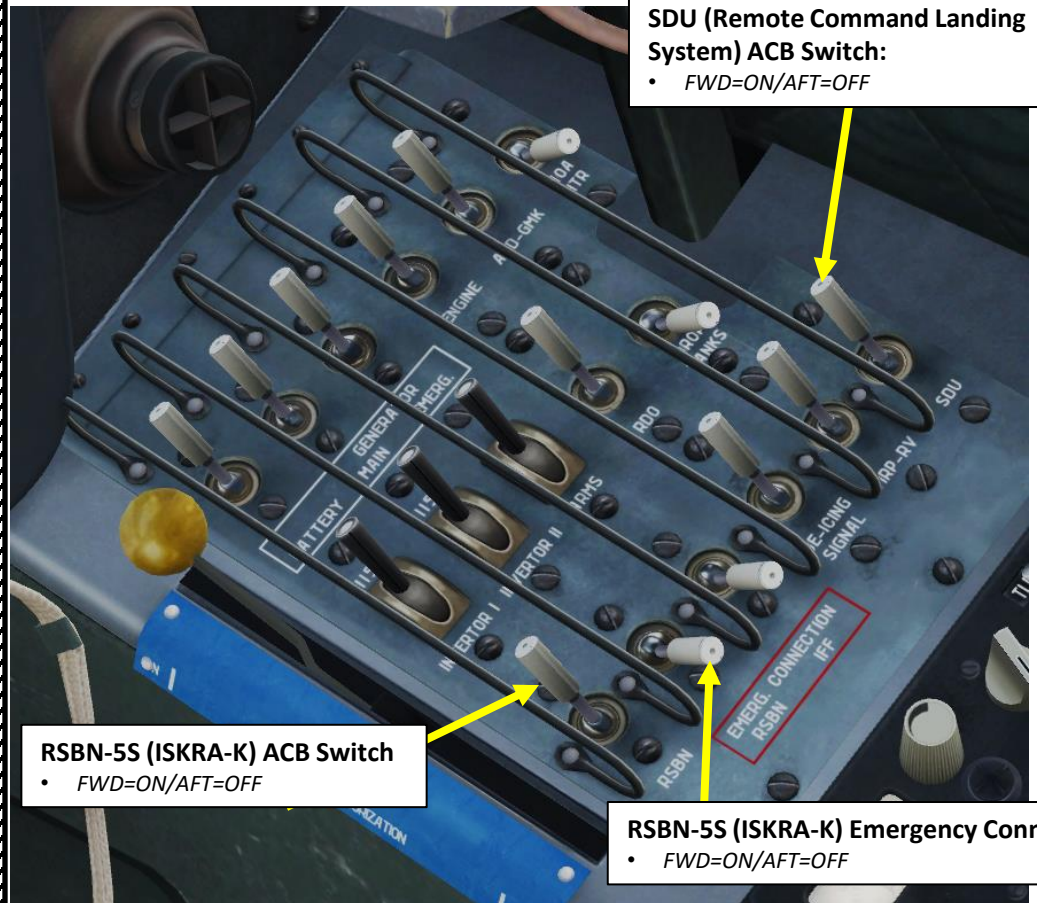
RSBN Volume Tuning Control

Azimuth 0 Setting Button
- *Used for azimuth channel calibration check*

5 – RSBN-5S "ISKRA-K" (VOR) NAVIGATION

5.1 – Overview

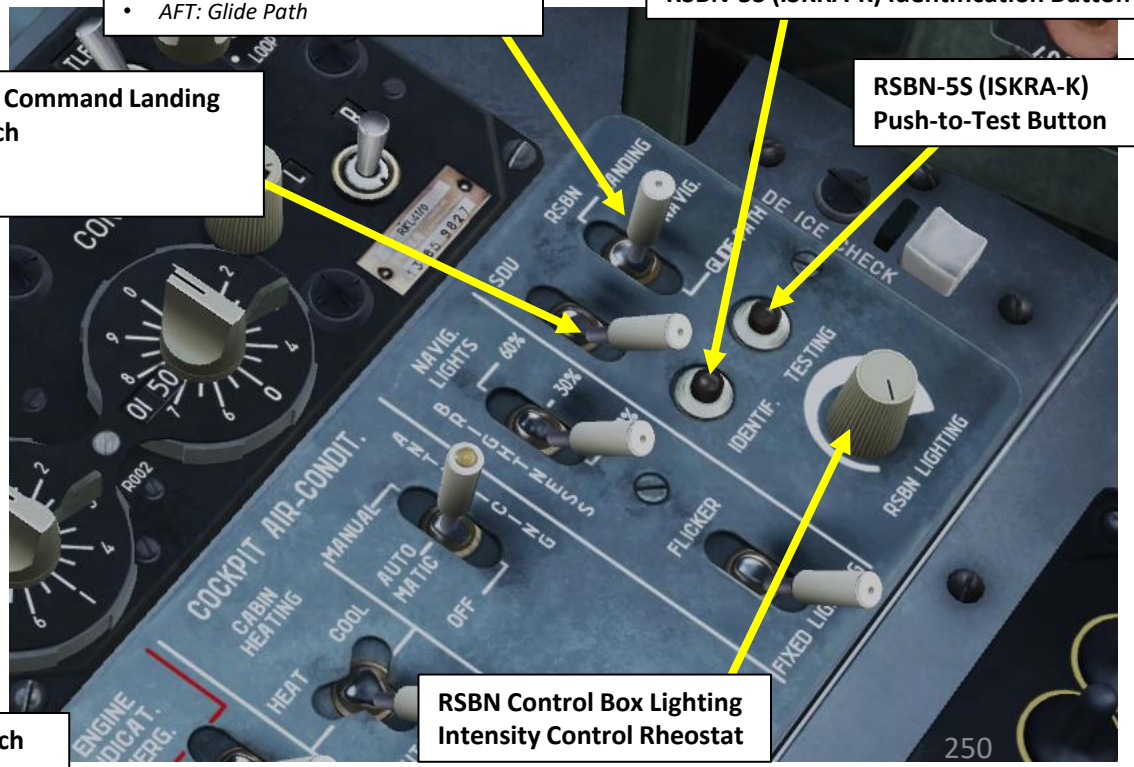
RSBN Tune Button
- *When pushed, RSBN ground beacon callsigns are heard.*



SDU (Remote Command Landing System) ACB Switch:
- *FWD=ON/AFT=OFF*

RSBN-5S (ISKRA-K) ACB Switch
- *FWD=ON/AFT=OFF*

RSBN-5S (ISKRA-K) Emergency Connection ACB Switch
- *FWD=ON/AFT=OFF*



RSBN-5S (ISKRA-K) Mode Switch
- *FWD: Landing*
- *MIDDLE: Navigation*
- *AFT: Glide Path*

SDU (Remote Command Landing System) Switch
- *FWD: ON*
- *AFT: OFF*

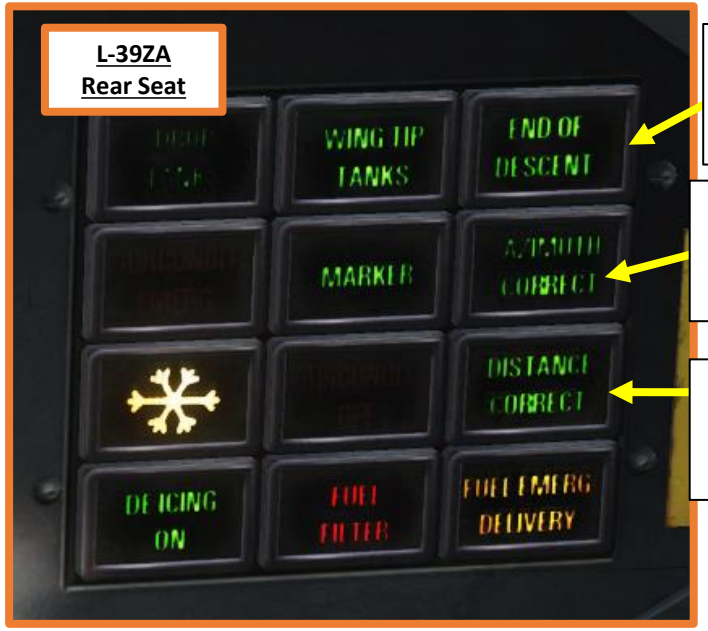
RSBN-5S (ISKRA-K) Identification Button

RSBN-5S (ISKRA-K) Push-to-Test Button

RSBN Control Box Lighting Intensity Control Rheostat

5 – RSBN-5S "ISKRA-K" (VOR) NAVIGATION

5.1 – Overview



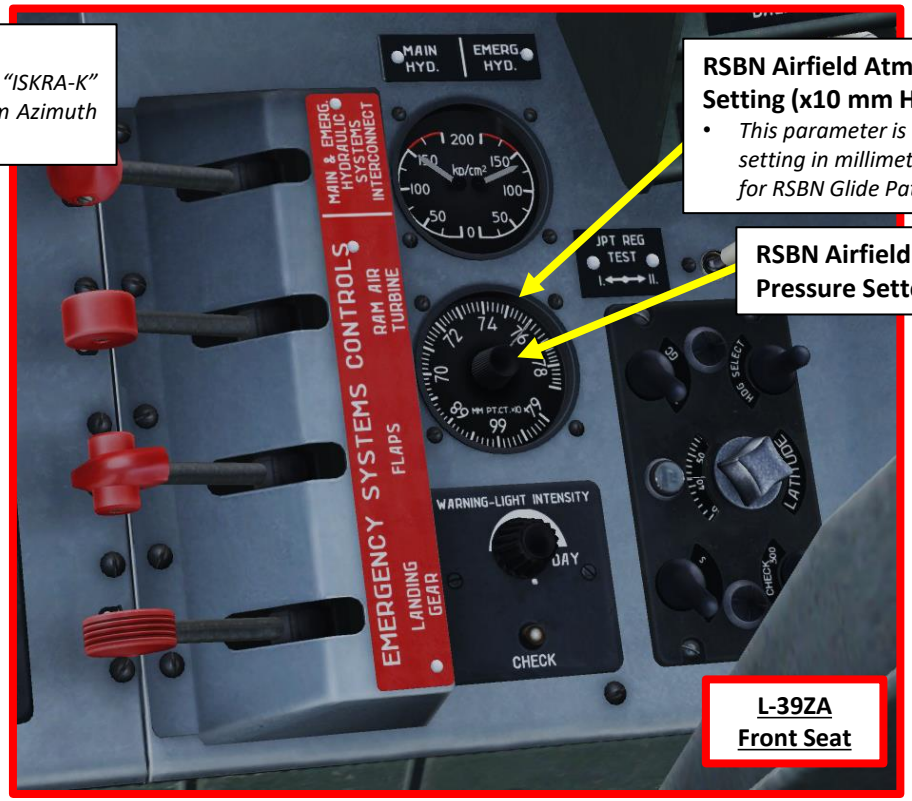
END OF DESCENT Light
- *Illuminates when aircraft is over termination point of descent when using RSBN-5S "ISKRA-K" Short Range Navigation System*

AZIMUTH CORRECT Light
- *Illuminates when RSBN-5S "ISKRA-K" Short Range Navigation System Azimuth Channel is tuned correctly*

DISTANCE CORRECT Light
- *Illuminates when RSBN-5S "ISKRA-K" Short Range Navigation System Distance Channel is tuned correctly*

END OF DESCENT Light
- *Illuminates when aircraft is over termination point of descent when using RSBN-5S "ISKRA-K" Short Range Navigation System*

CONFORM AZIMUTH Light
- *Illuminates when RSBN-5S "ISKRA-K" Short Range Navigation System Azimuth Channel is tuned correctly*



RSBN Airfield Atmospheric Pressure Setting (x10 mm Hg)
- *This parameter is a barometric pressure setting in millimeters of Mercury and is used for RSBN Glide Path Mode.*

RSBN Airfield Atmospheric Pressure Setter Knob

5 – RSBN-5S "ISKRA-K" (VOR) NAVIGATION

5.1 – Overview

The RSBN-5S system can operate in three modes: NAV (Navigation), GP (Glide Path) and LANDING.

NAVIGATION MODE:

- This mode provides airplane bearing on the RMI (Radio Magnetic Indicator), distance to ground station and autonomous computing of aircraft location beyond the radio signal range of the station.

GLIDE PATH MODE:

- This mode provides airplane bearing on the RMI (Radio Magnetic Indicator), distance to ground station, deviation from the required course with course deviation pointer on the RMI, and programmed descending trajectory using glide-slope pointer on the RMI.
- Descent termination point is marked when the END OF DESCENT signal light illuminates.

LANDING MODE:

- This mode provides indication that the airplane is within operating range of course and glide slope PRMG beacons, deviation from glide-slope trajectory using glide-slope pointer on the RMI, deviation from landing course with course deviation pointer on the RMI, and distance-to-distance re-translator, which is included in the glide slope beacon.

RSBN-5S (ISKRA-K) Mode Switch

- *FWD: Landing*
- *MIDDLE: Navigation*
- *AFT: Glide Path*

5 – RSBN-5S “ISKRA-K” (VOR) NAVIGATION

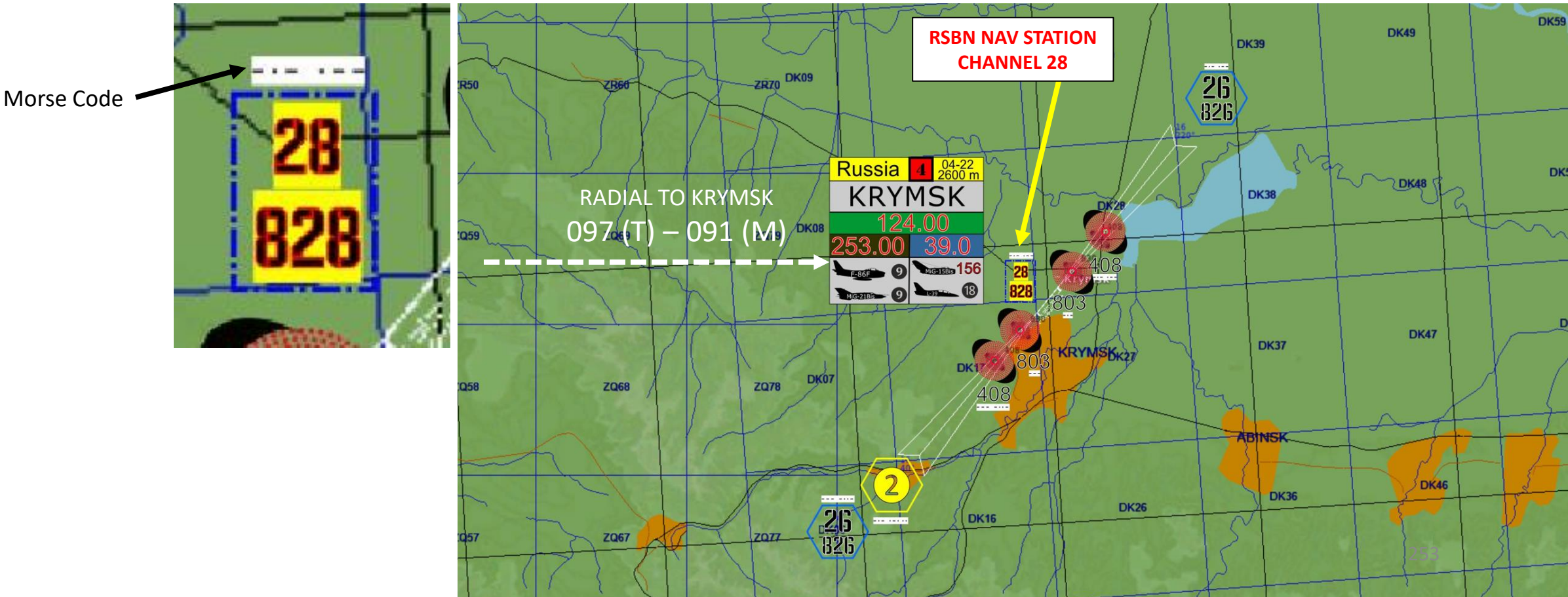
5.2 – RSBN in Navigation Mode

In real life, there are designated air corridors that pilots need to take in order to get to certain airfields or navigation reference points. 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. In this example, we will take a radial to Krymsk with a heading of 097 (True Heading) or 091 (Magnetic Heading). 091 is the radial we will need to intercept. Within the realm of DCS, we could use any radial direction of our liking, but radials are typically lined up with the airport runway axes.

In this example, we will use the RSBN system to intercept the 091 radial from an altitude of 2500 m.

See this table for RSBN station channels.

Check out XXJohnXX’s excellent tutorial on RSBN navigation: https://youtu.be/qUVslmJ57Vw

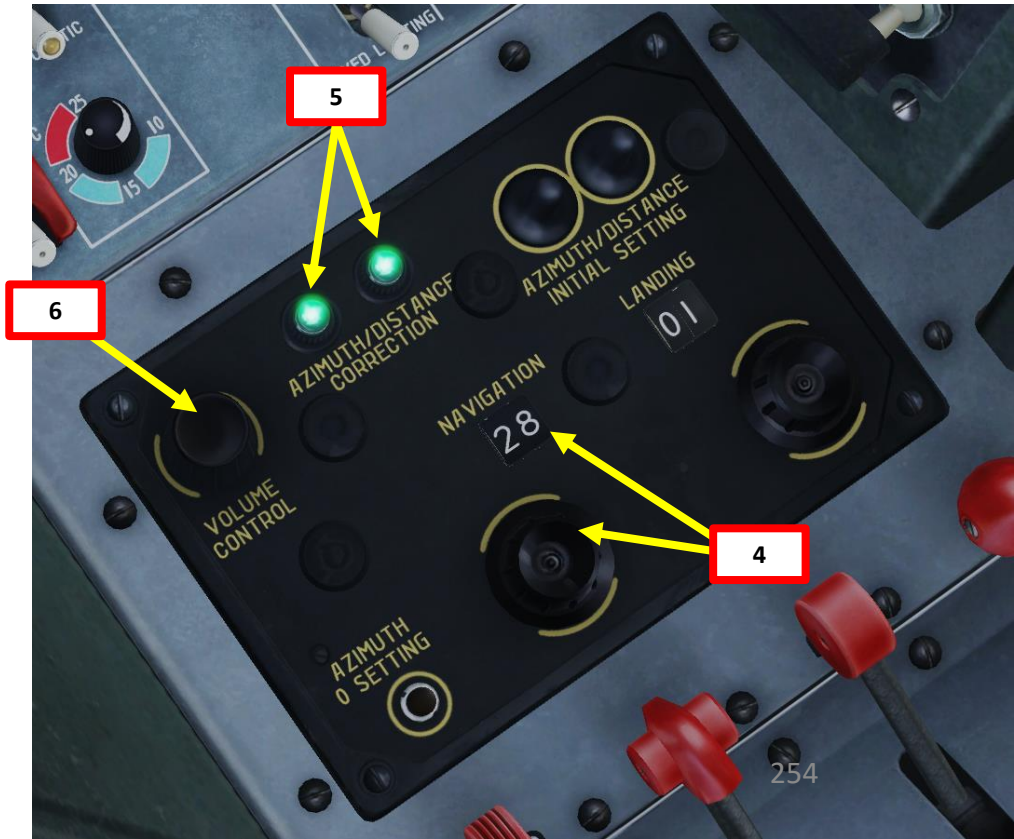


5 – RSBN-5S “ISKRA-K” (VOR) NAVIGATION

5.2 – RSBN in Navigation Mode

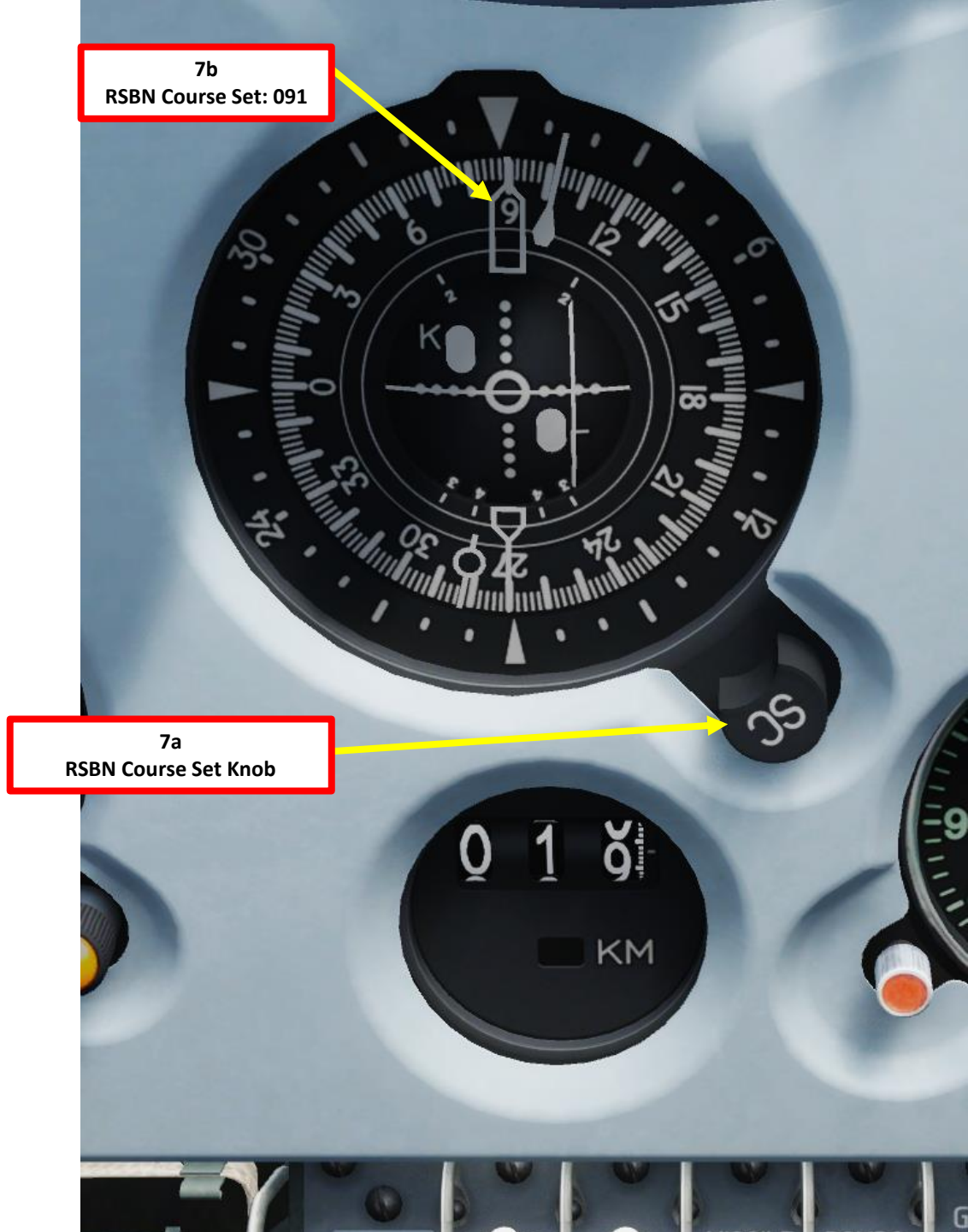
1. Fly to an altitude of 2500 m to ensure RSBN signal can be captured.
2. Set RSBN-5S (ISKRA-K) ACB Switch – ON (FWD)
3. Set RSBN-5S (ISKRA-K) Mode Switch – NAVIG (MIDDLE).
4. Set RSBN NAVIGATION channel to 28 (Krymsk RSBN).
5. When signal from the RSBN station is picked up, AZIMUTH & DISTANCE lights will illuminate.
6. Adjust RSBN Volume – As desired.

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



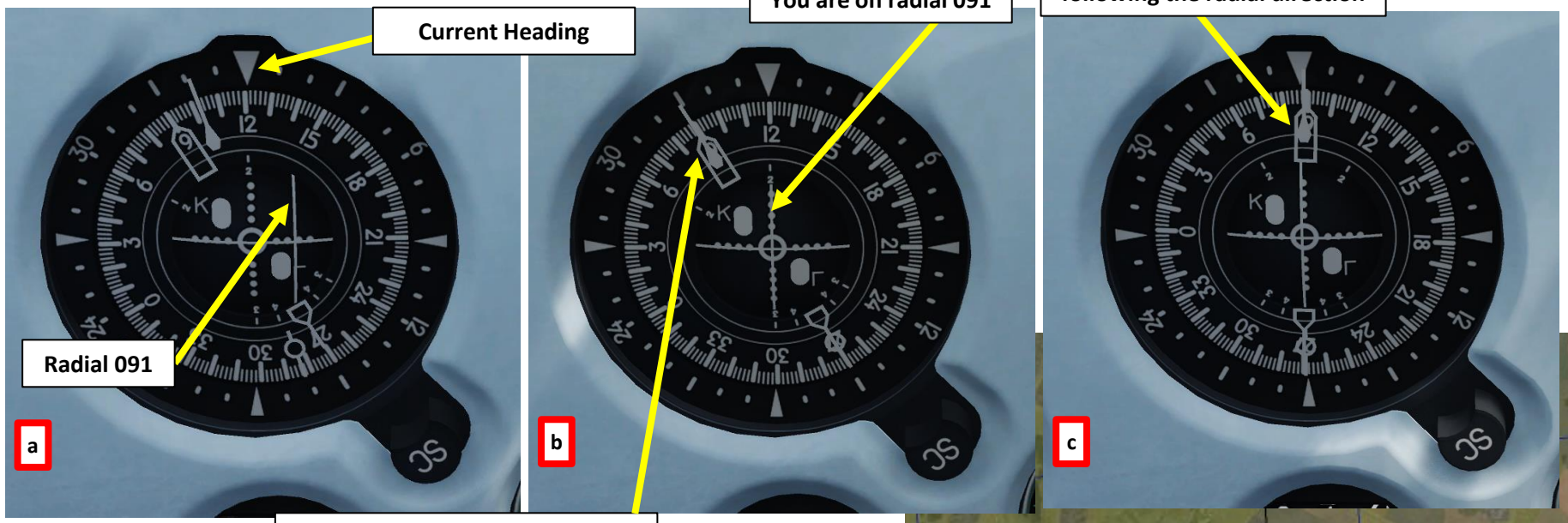
5 – RSBN-5S “ISKRA-K” (VOR) NAVIGATION
5.2 – RSBN in Navigation Mode

7. Rotate the Course Set knob with mousewheel to set the largest/longest end of the thick needle to 091, 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.



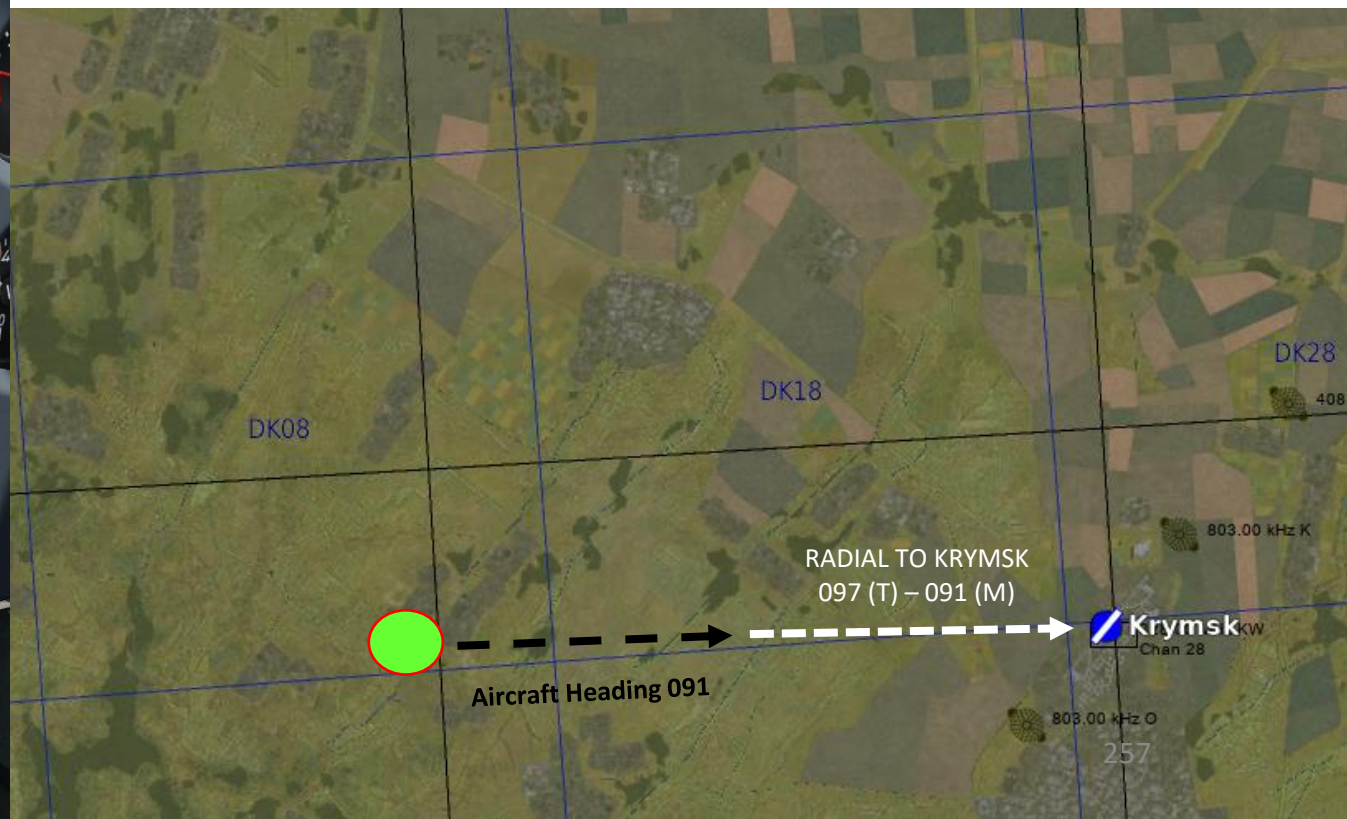
5 – RSBN-5S "ISKRA-K" (VOR) NAVIGATION
5.2 – RSBN in Navigation Mode

8. Intercept radial 091 by using the RMI Course Indicator.



5 – RSBN-5S “ISKRA-K” (VOR) NAVIGATION
5.2 – RSBN in Navigation Mode

9. Once you have intercepted radial 091, steer towards the RSBN station.



5 – RSBN-5S “ISKRA-K” (VOR) NAVIGATION

5.2 – RSBN in Navigation Mode

5 – RSBN-5S “ISKRA-K” (VOR) NAVIGATION

5.3 – RSBN in Glide Path Mode

GLIDE PATH 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 “GLIDE PATH” (AFT) 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.

5 – RSBN-5S “ISKRA-K” (VOR) NAVIGATION

5.3 – RSBN in Glide Path Mode

Glide Path mode 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 Course Set knob, he needs to intercept it using the localizer (*kurs*) needle, while at the same time descending using the glide path (*glisada*) needle.

In a nutshell:

- At distances higher than 132 ±5 km, glideslope deviation pointer shows airplane position relative to cruise altitude, which is equal to 8000 m.
- At distances from 132±5 to 21 ±3 km. glideslope deviation pointer shows airplane position relative to cloud penetration trajectory.
- At distances of less than 21 ±3 km glideslope deviation pointer shows position of the airplane relative to safe altitude, equal to 600 m.
- When distance of 21±3 km is reached, then in front and rear cockpits, the END OF DESCENT signal will be on and glideslope deviation pointer show airplane position relative to altitude of 600 m. To follow glideslope descent trajectory, engage the LANDING mode.

Note: Concentrate on glide slope and course deviation pointers on RMI (Radio Magnetic Indicator) only. It is also necessary to monitor speed and altitude. Speed at glide path trajectory should be within 400 to 500 km/h.

RSBN-5S (ISKRA-K) Mode Switch

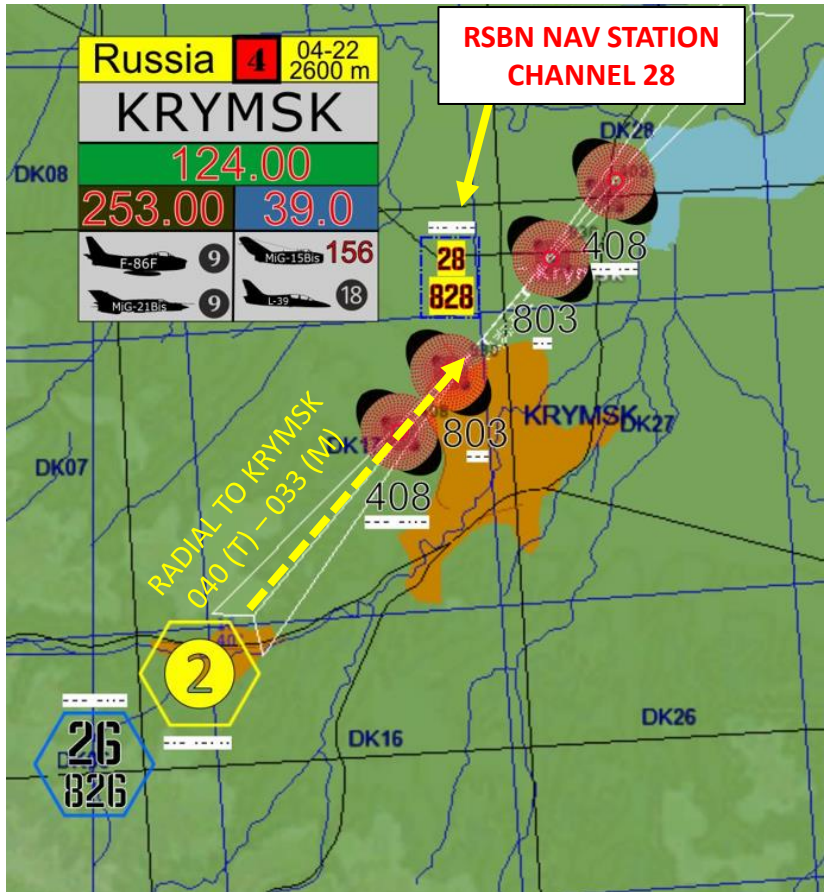
- *FWD: Landing*
- *MIDDLE: Navigation*
- *AFT: Glide Path*

5 – RSBN-5S "ISKRA-K" (VOR) NAVIGATION
5.3 – RSBN in Glide Path Mode

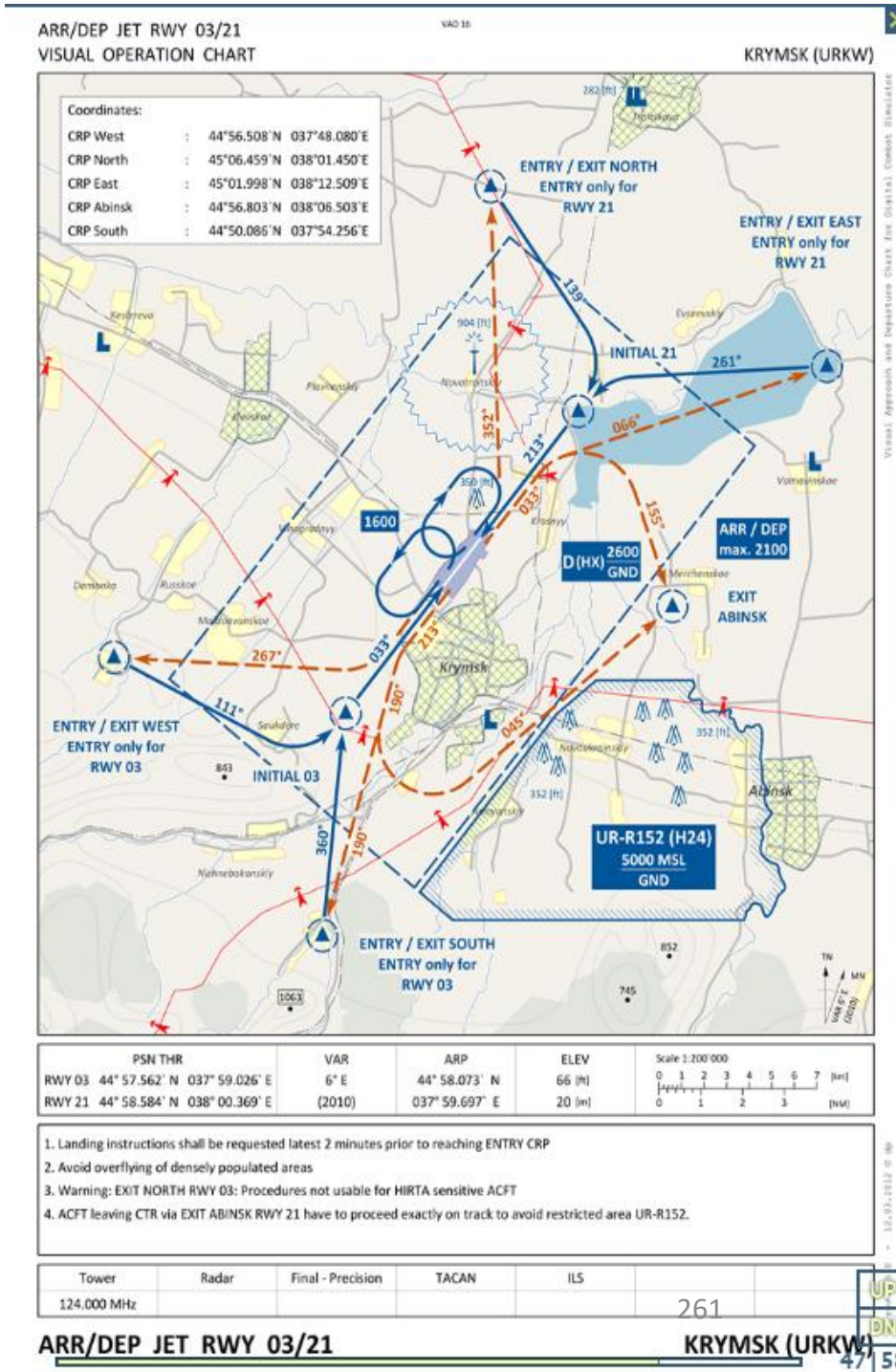
Initial Set Up:

Similarly to RSBN Navigation Mode, the RSBN Glide Path Mode is also done while "Intercepting a radial". In this example, we will take a radial to Krymsk lined up with a runway heading of 040 (True Heading) or 033 (Magnetic Heading).

In this example, we will use the RSBN system to intercept the 033 radial from an altitude of 10000 m.



Morse Code

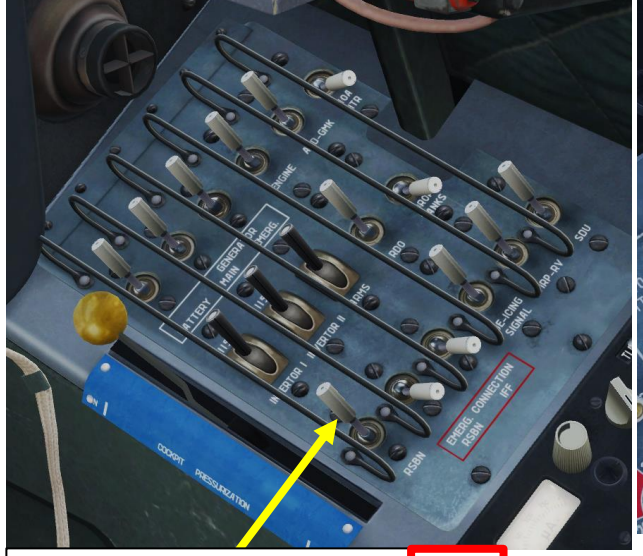


5 – RSBN-5S "ISKRA-K" (VOR) NAVIGATION
5.3 – RSBN in Glide Path Mode

Initial Set Up:

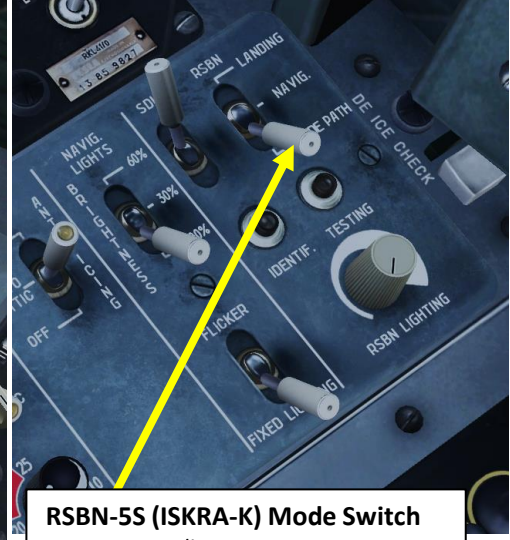
1. Fly to an altitude of 10000 m to ensure RSBN signal can be captured.
2. Set RSBN-5S (ISKRA-K) ACB Switch – ON (FWD)
3. Set RSBN-5S (ISKRA-K) Mode Switch – GLIDE PATH (AFT).
4. Set RSBN NAVIGATION channel to 28 (Krymsk RSBN).
5. When signal from the RSBN station is picked up, AZIMUTH & DISTANCE lights will illuminate.
6. Adjust RSBN Volume – As desired.
7. Set RSBN Field Elevation Setting to the barometric pressure at the airfield. We will use 760 mm Hg for this example, which is the standard barometric pressure (29.92 in Hg, 1013.2 mBar or 101.3 kPa).
8. Rotate the Course Set knob with mousewheel to set the largest/longest end of the thick needle to 033, since this is the radial we intend to follow to the airfield. When both needles are aligned, you are surfing on the radial. It is YOUR job to know if you're going in the right direction (TO the RSBN or AWAY FROM the RSBN) as there is no TO/FROM indicator. Use common sense.

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



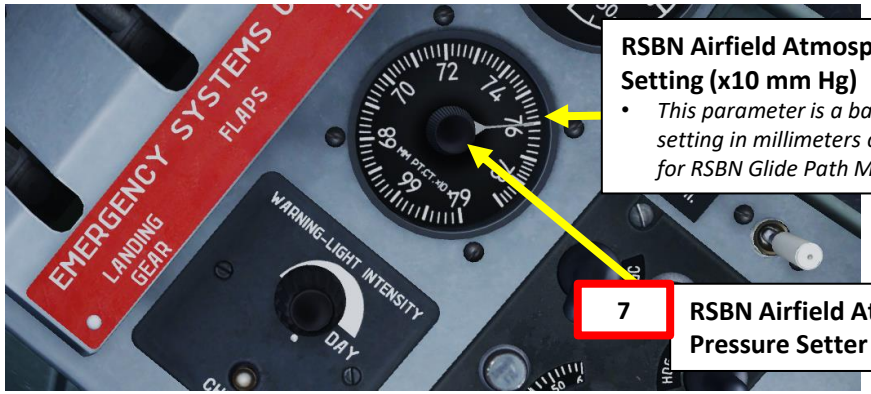
RSBN-5S (ISKRA-K) ACB Switch
- *FWD=ON/AFT=OFF*

2



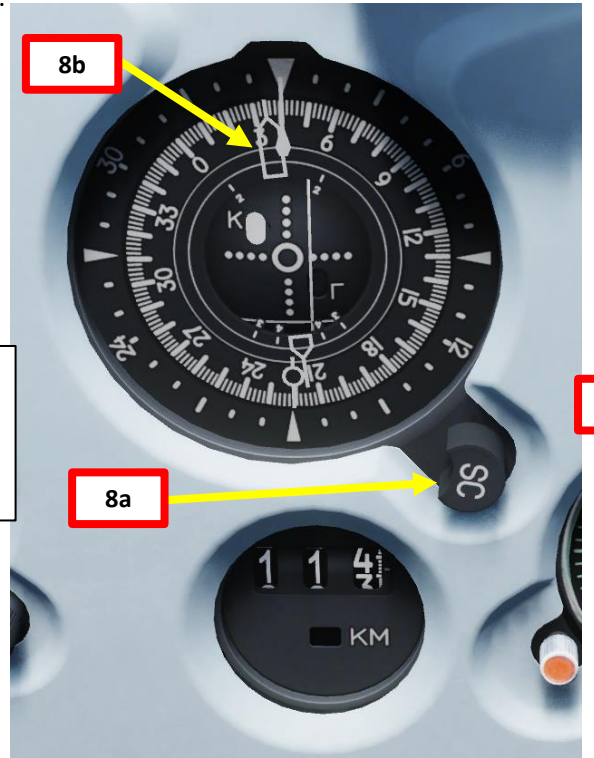
RSBN-5S (ISKRA-K) Mode Switch
- *FWD: Landing*
- *MIDDLE: Navigation*
- *AFT: Glide Path*

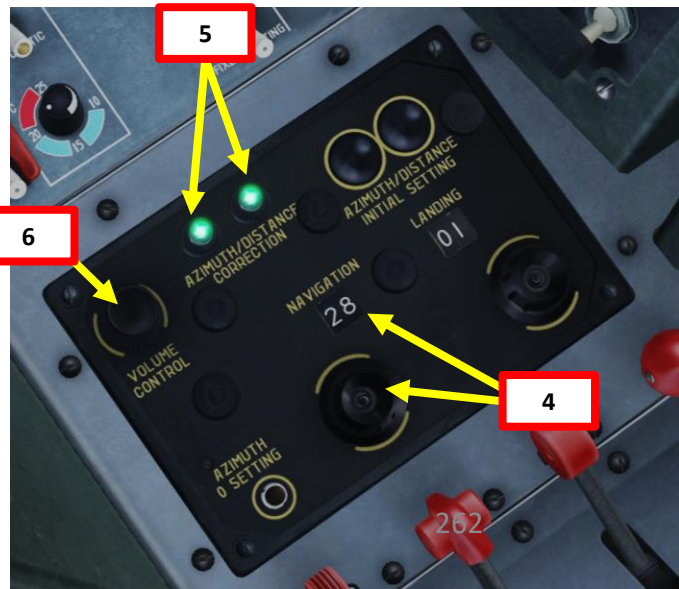
3



RSBN Airfield Atmospheric Pressure Setting (x10 mm Hg)
- *This parameter is a barometric pressure setting in millimeters of Mercury and is used for RSBN Glide Path Mode.*

7 **RSBN Airfield Atmospheric Pressure Setter Knob**

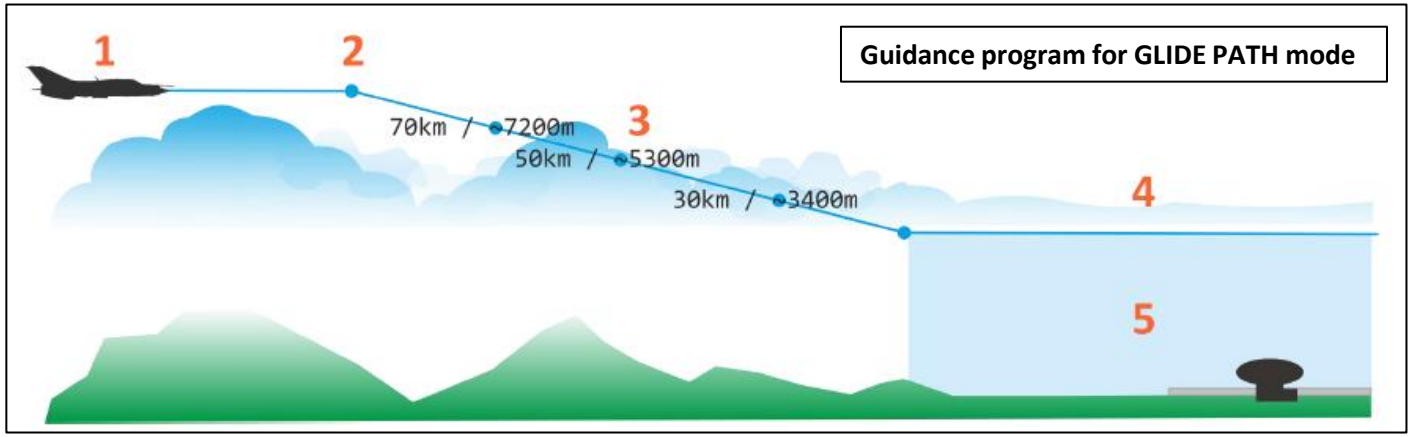




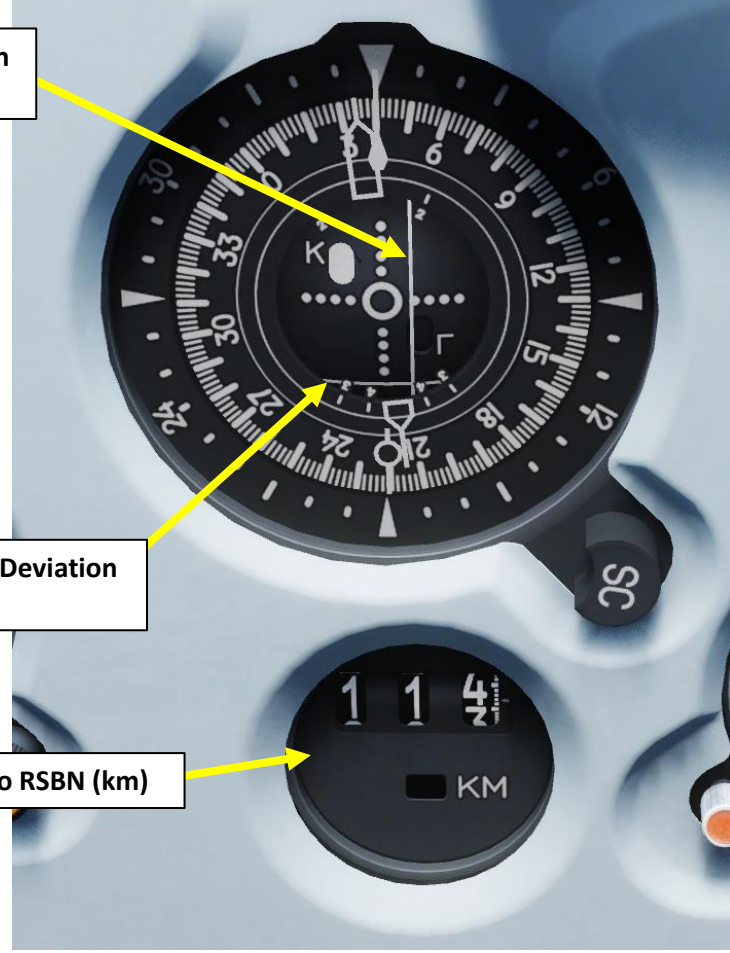
5 – RSBN-5S "ISKRA-K" (VOR) NAVIGATION
5.3 – RSBN in Glide Path Mode

Guidance Program – Overview

1. Once RSBN system and Radio Magnetic Indicator (RMI) are set up as required, steer aircraft as shown in the previous RSBN tutorial to intercept radial 033. Engage GLIDE PATH mode whenever you need it. At 120 km or further from the RSBN station, you altitude should be 10000 m.
    - On RMI: At **distances higher than 132 ±5 km, glideslope deviation pointer shows airplane position relative to cruise altitude, which is equal to 8000 m**.
2. Descent starting point is at 120 km from the RSBN station. Recommended airspeed during descent is 600 km/h.
3. Keep the GLIDE director needle near the center of the aircraft silhouette on the RMI (Radio Magnetic Indicator). If you are flying on a certain radial, keep the localizer director around the center.
    - On RMI: At **distances from 132±5 to 21 ±3 km. glideslope deviation pointer shows airplane position relative to cloud penetration trajectory**.
4. 20 km from the RSBN, altitude is 600 m and the descent program ends. The END OF DESCENT signal will be on and glideslope deviation pointer show airplane position relative to altitude of 600 m. At this point, you can engage the RSBN LANDING mode or you can proceed with a visual approach. If you continue with GLIDE PATH mode, the needles will instruct you to maintain 600 m.
    - On RMI: At **distances of less than 21 ±3 km glideslope deviation pointer shows position of the airplane relative to safe altitude, equal to 600 m**.
5. Area of constant altitude of 600 m within 20 km around RSBN station.



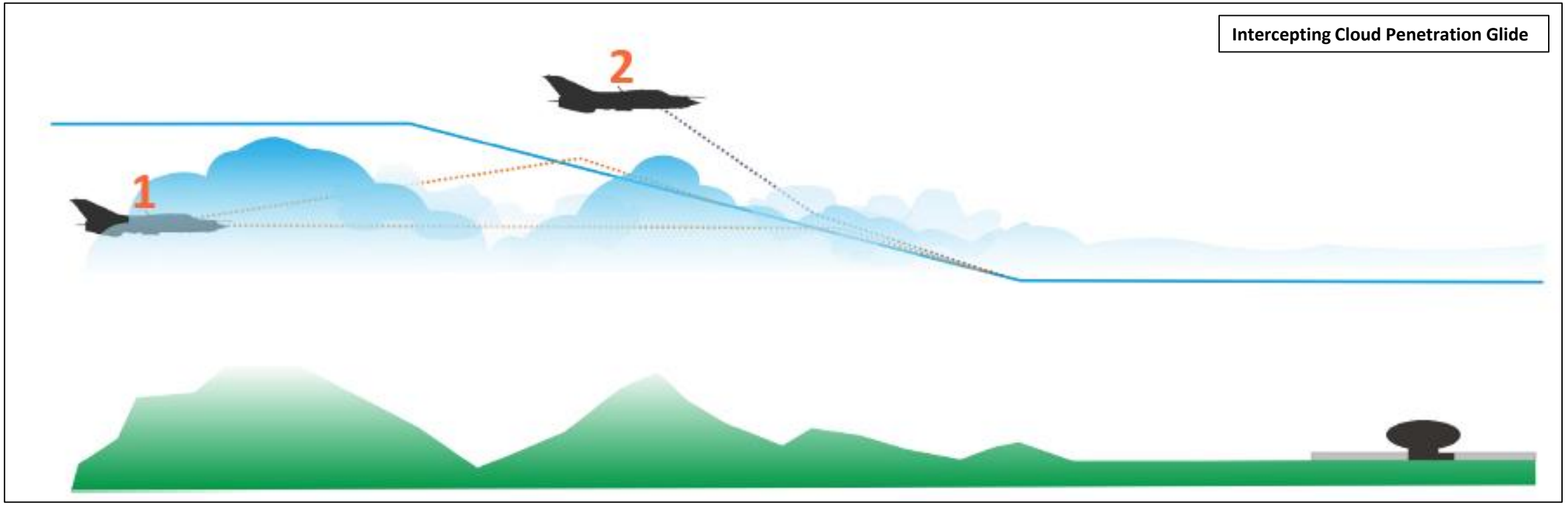
Guidance program for GLIDE PATH mode



5 – RSBN-5S "ISKRA-K" (VOR) NAVIGATION
5.3 – RSBN in Glide Path Mode

Guidance Program Example – Cloud Penetration Glide

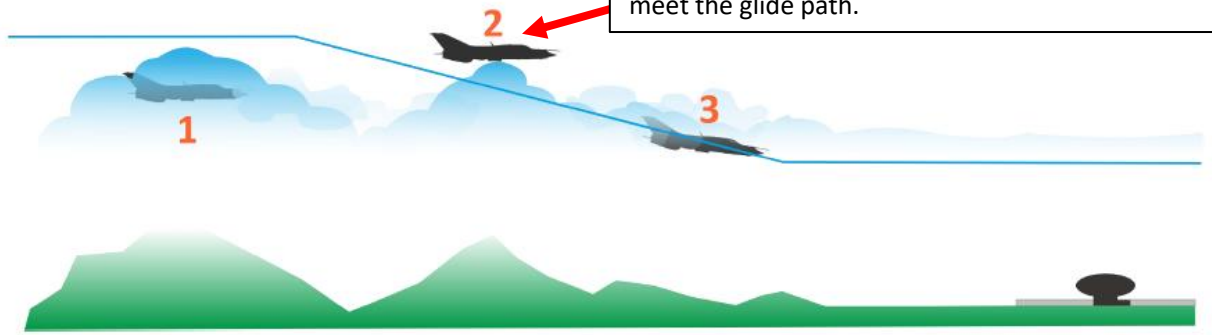
1. Aircraft is below the descent path. Either fly horizontally until you intercept the descent path, or climb to intercept. Once you intercept the glide path, continue your descent.
2. Aircraft is above descent path. Increase descent rate to intercept descent path. Don't descend too fast or you will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

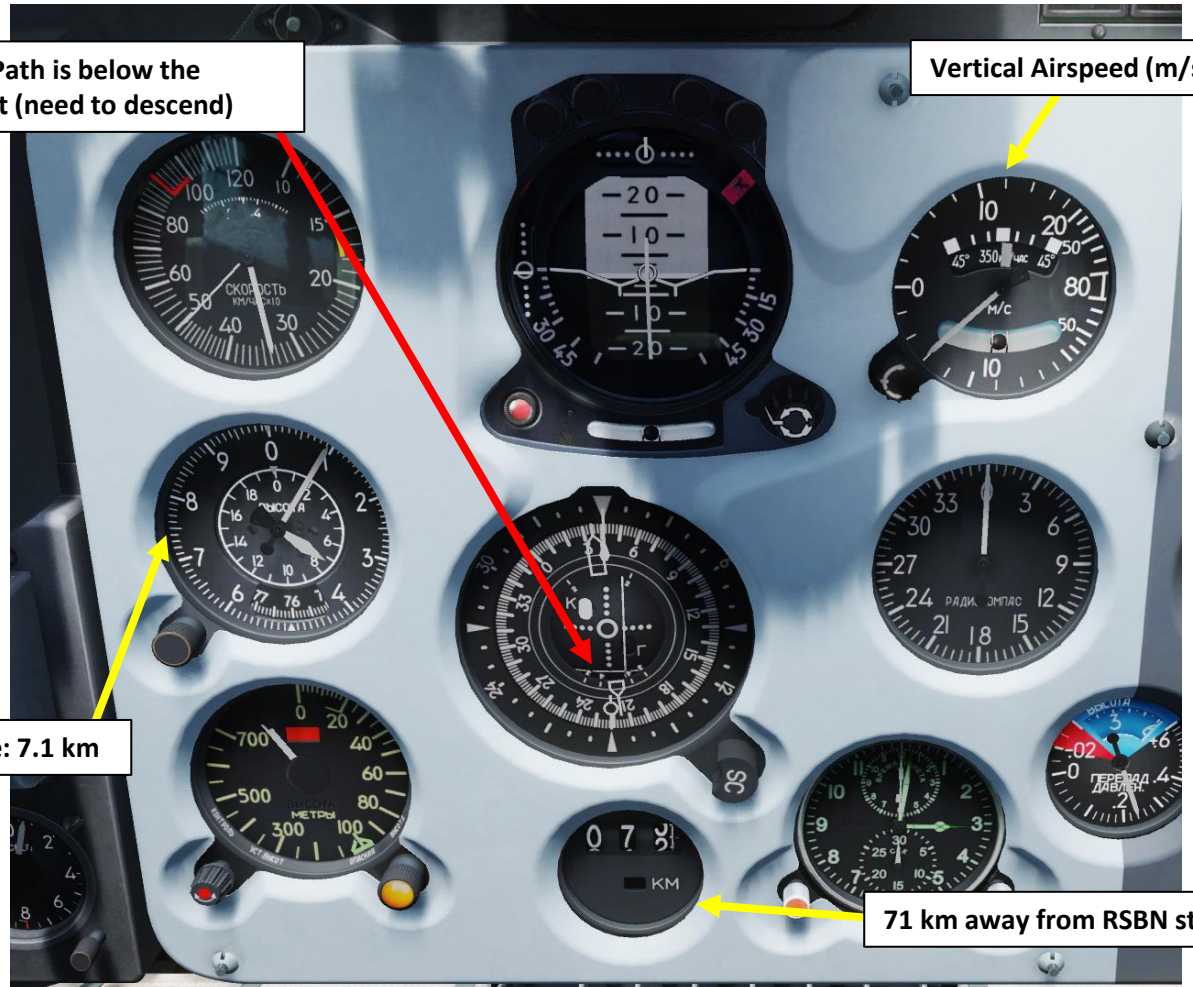


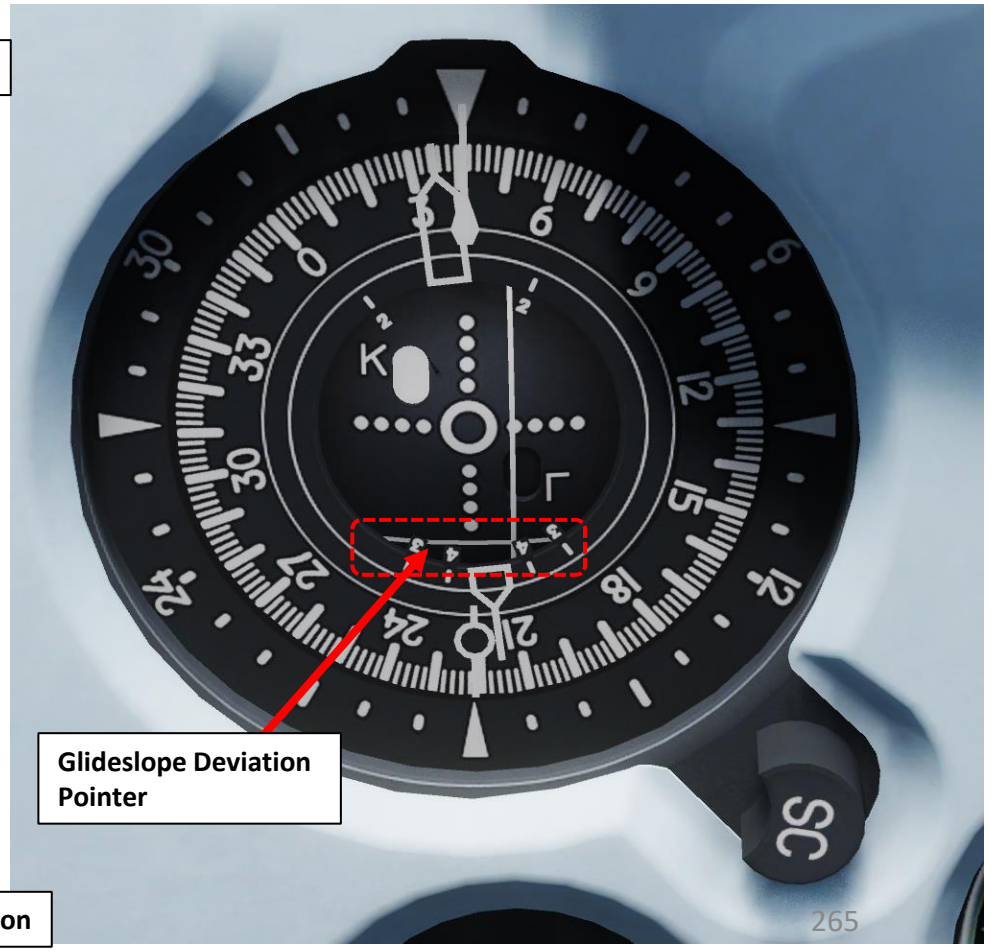
5 – RSBN-5S "ISKRA-K" (VOR) NAVIGATION
5.3 – RSBN in Glide Path Mode

Guidance Program Example – Cloud Penetration Glide

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



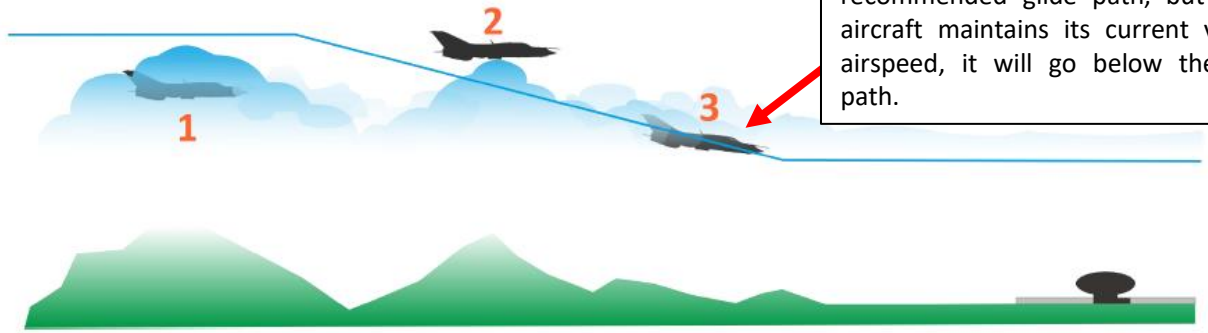




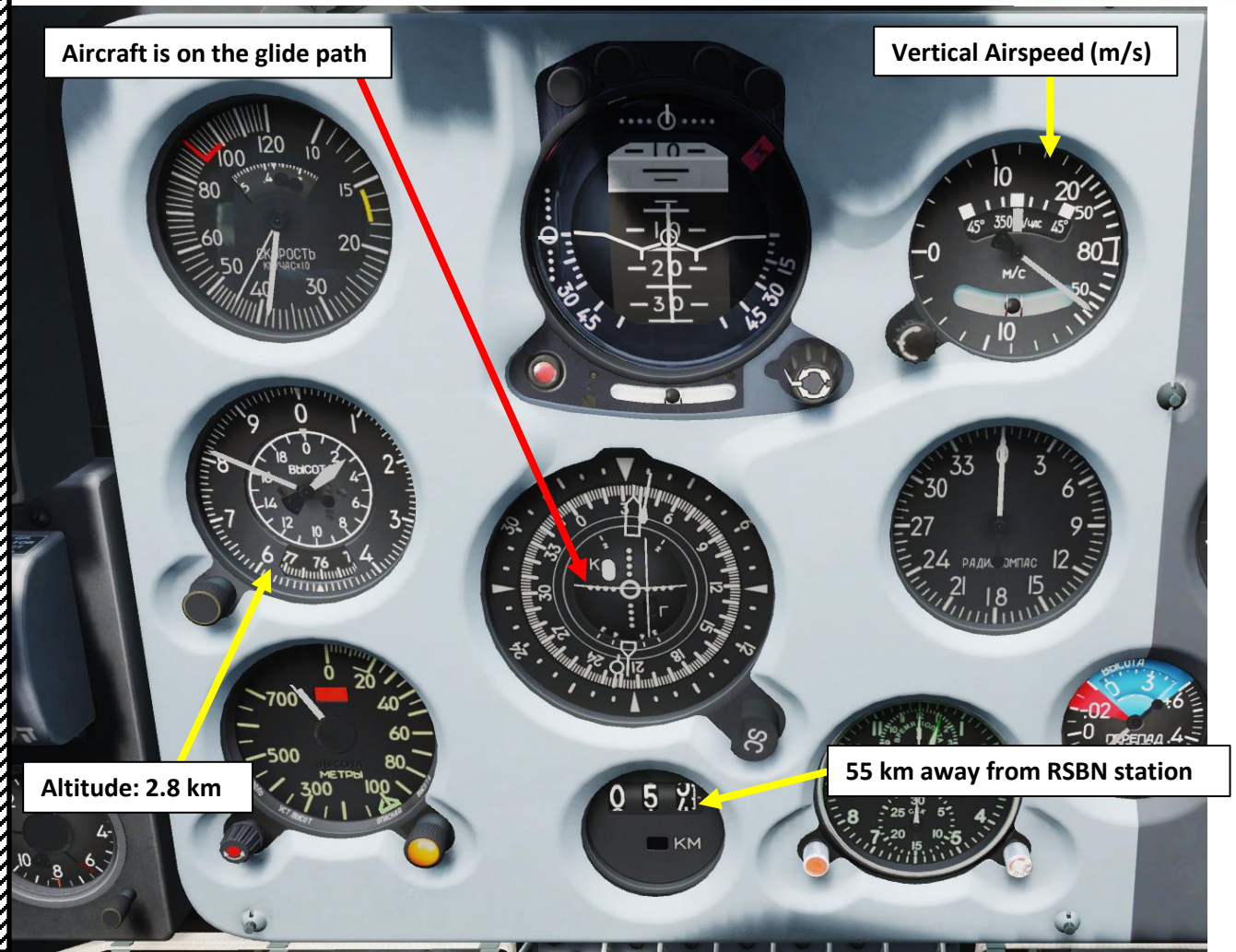
5 – RSBN-5S "ISKRA-K" (VOR) NAVIGATION
5.3 – RSBN in Glide Path Mode

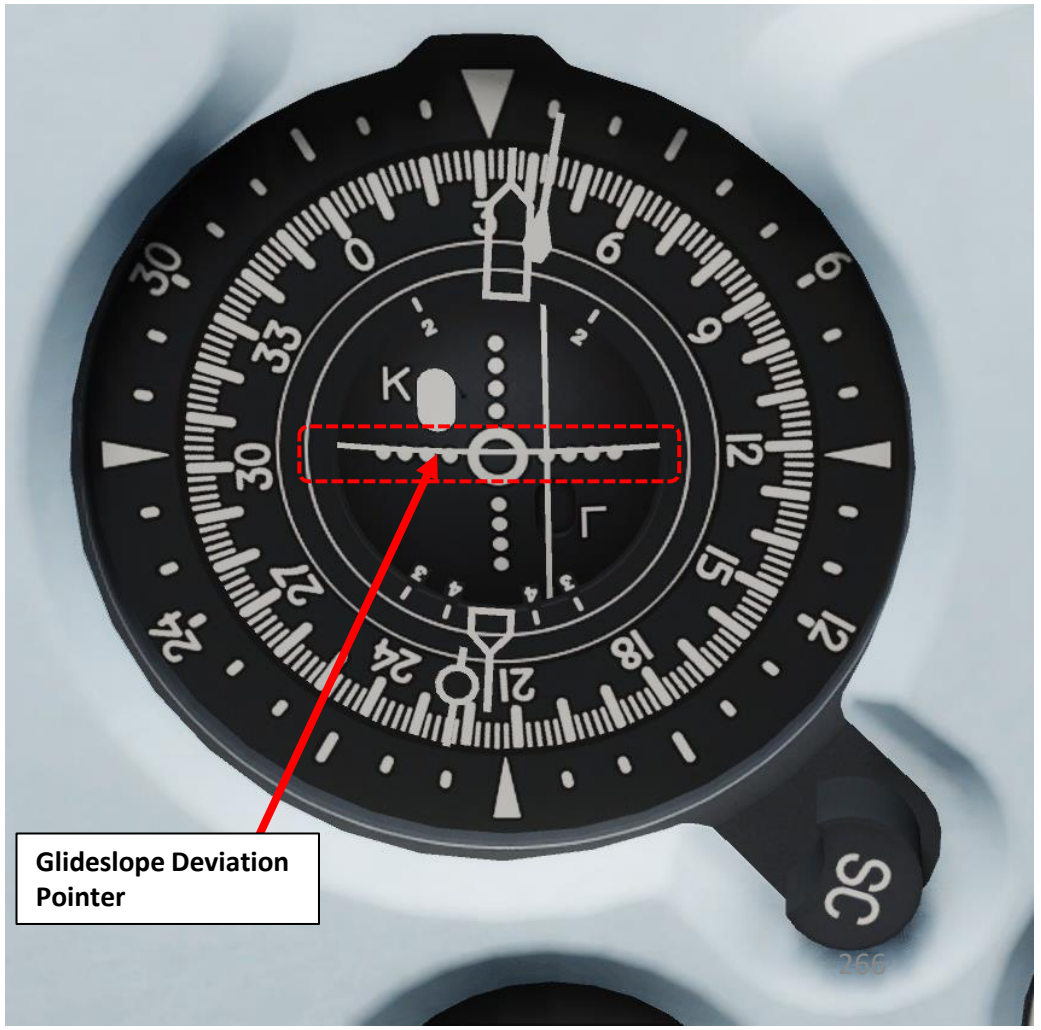
Guidance Program Example – Cloud Penetration Glide

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



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





6 – PRMG (PRECISION/INSTRUMENT APPROACH LANDING)

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

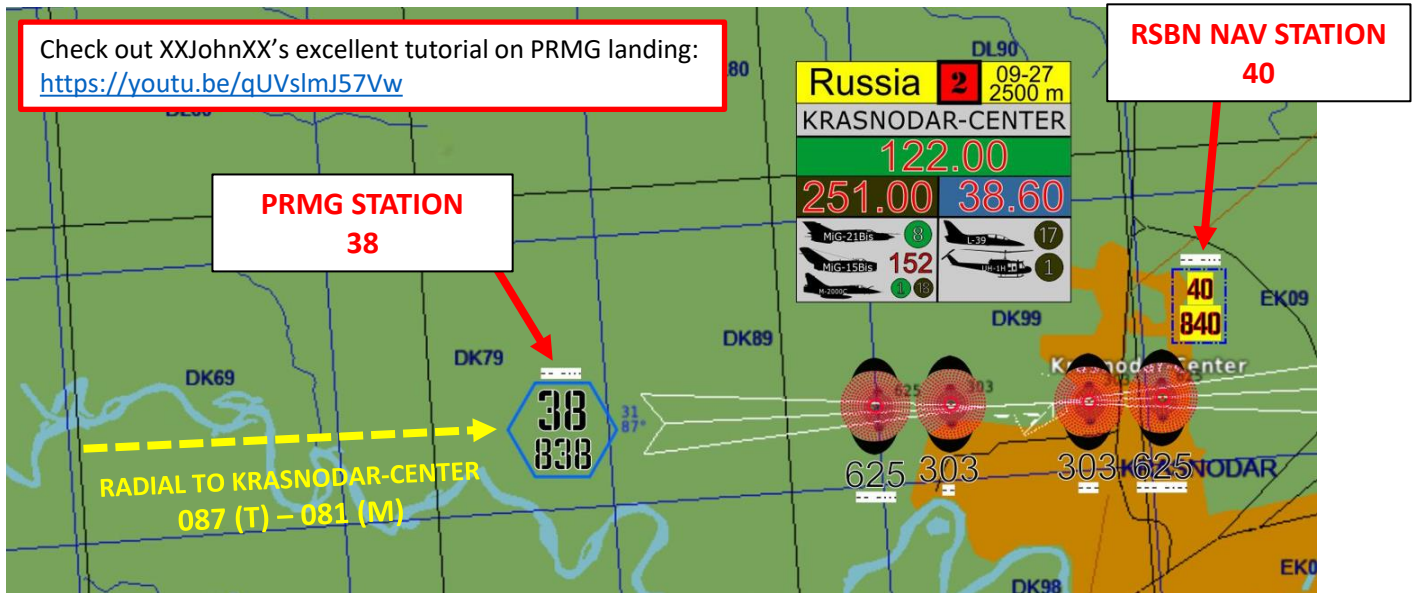
An important distinction needs to be made between RSBN (VOR) and PRMG (ILS) stations: RSBN stations are used by civilian air traffic while PRMG stations are generally used by the Russian military only. Both systems are independent from one another. Furthermore, PRMG systems are only available for use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

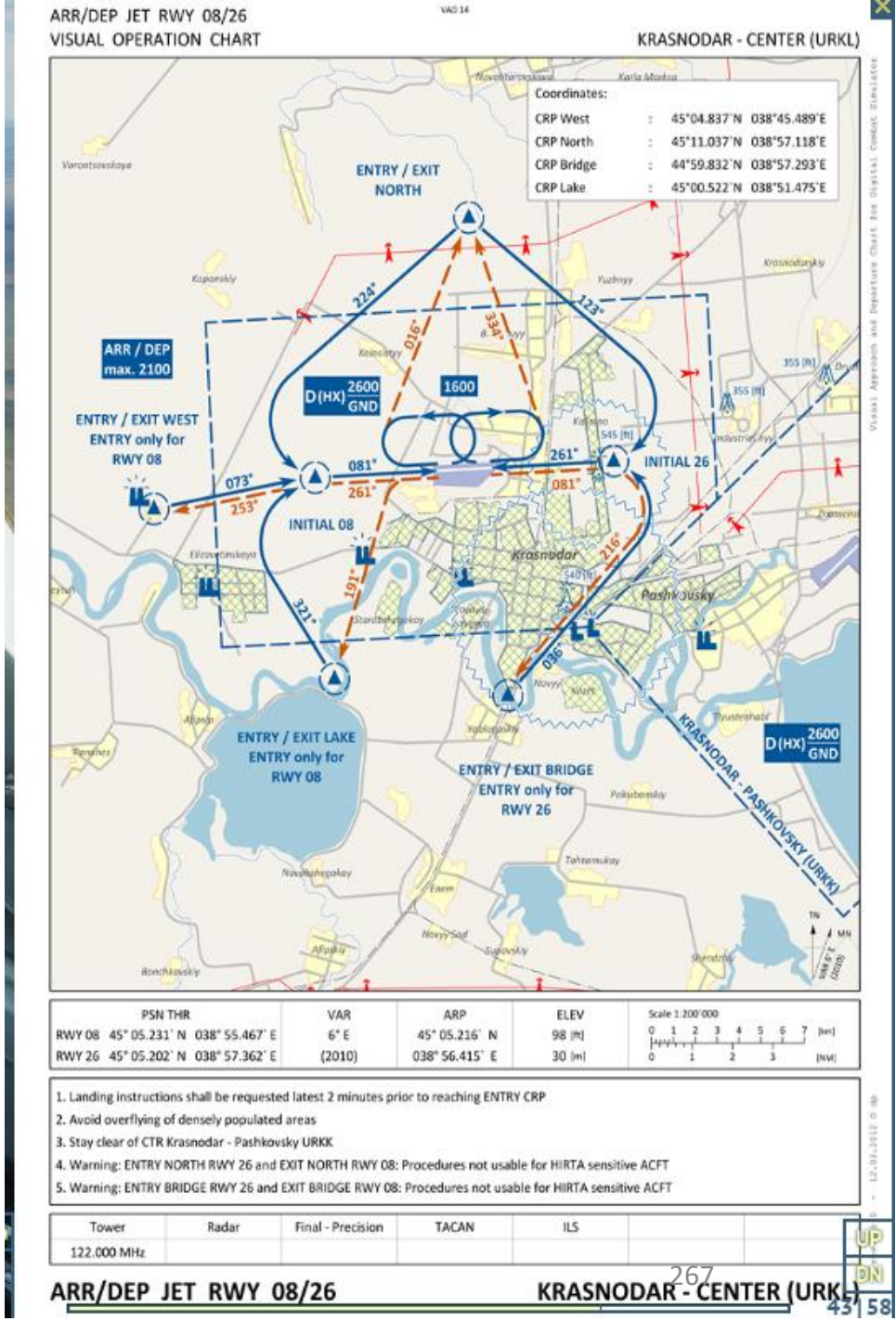
As in real life, PRMG systems are set for certain runways only, not for every single one. Tower Controllers in DCS will allow you to use certain runways in certain conditions only (bad weather and great winds for instance). As an example, PRMG systems will not be available if you have no head winds.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

For the Krasnodar-Center PRMG, we will use RSBN NAV station 40 and PRMG station 38.

See this table for RSBN and PRMG station channels.

Important note: all units in the PRMG example are in metric for simplification purposes since PRMG is a Russian system and uses the metric system.





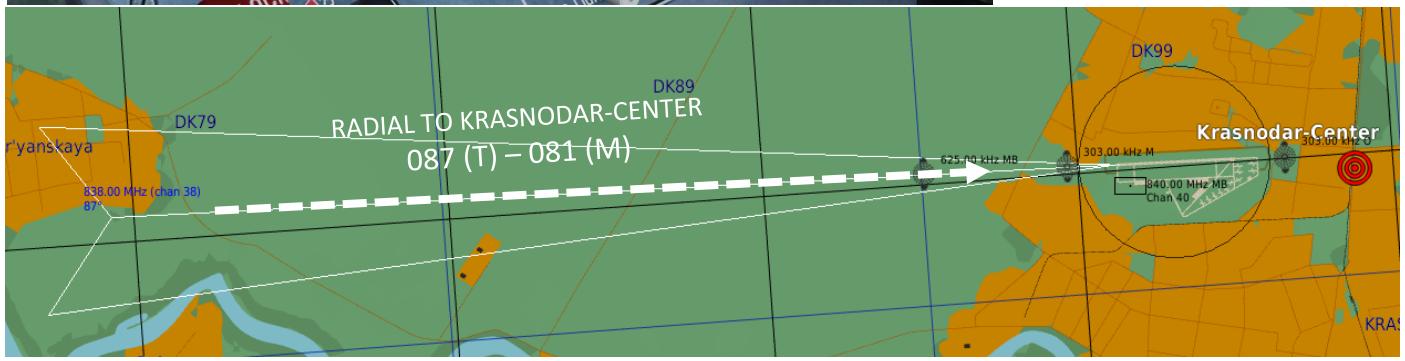
6 – PRMG (PRECISION/INSTRUMENT APPROACH LANDING)

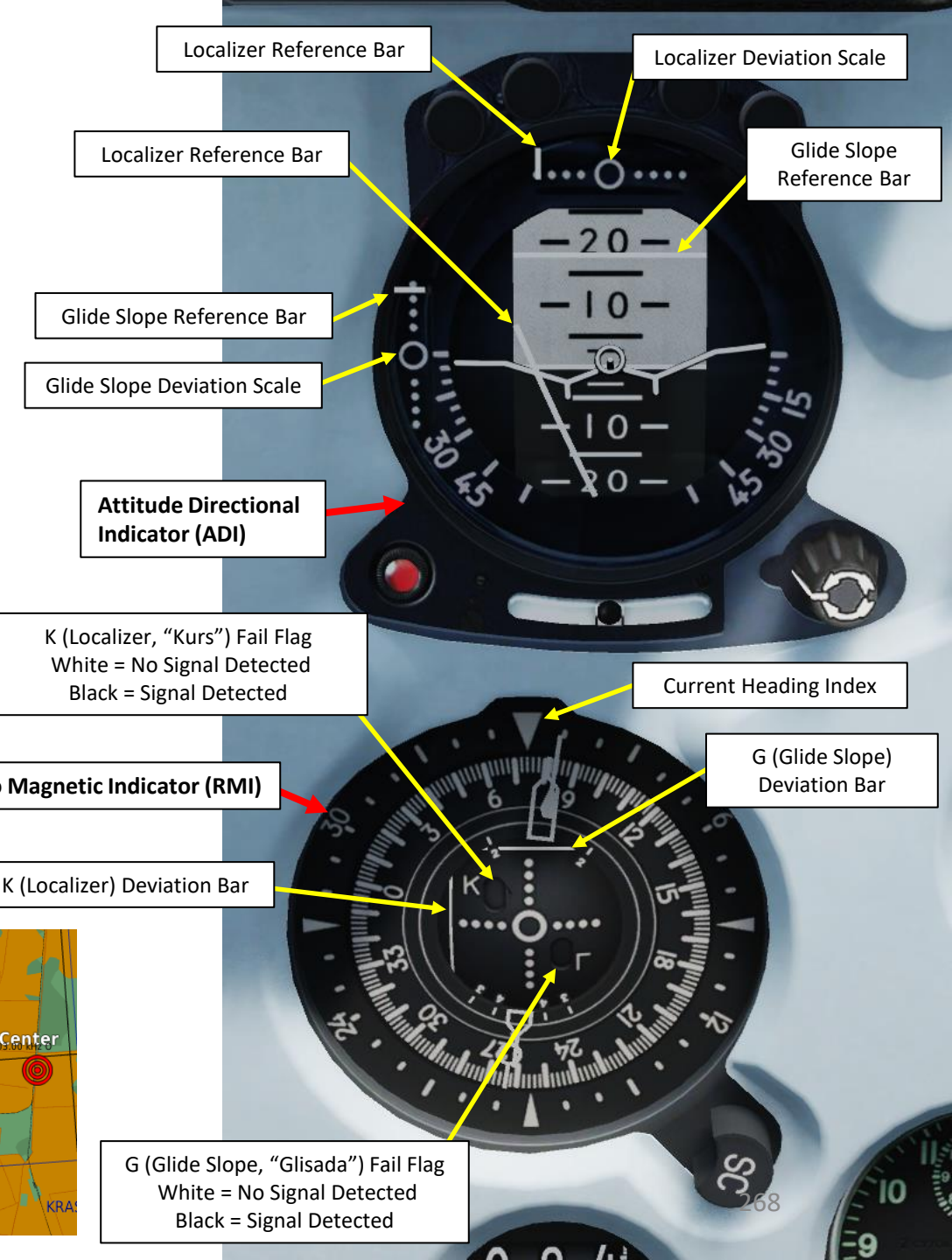
The Instrument Landing System (Rus. PRMG – ПРМГ – *Посадочная радиомаячная группа*) mode is used at a maximum range of 25 km from the selected PRMG station and in the direction of approach for landing. In this mode, the range (distance) indicator displays current distance to the PRMG station. The NPP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

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

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

RSBN-5S (ISKRA-K) Mode Switch
- *FWD: Landing*
- *MIDDLE: Navigation*
- *AFT: Glide Path*

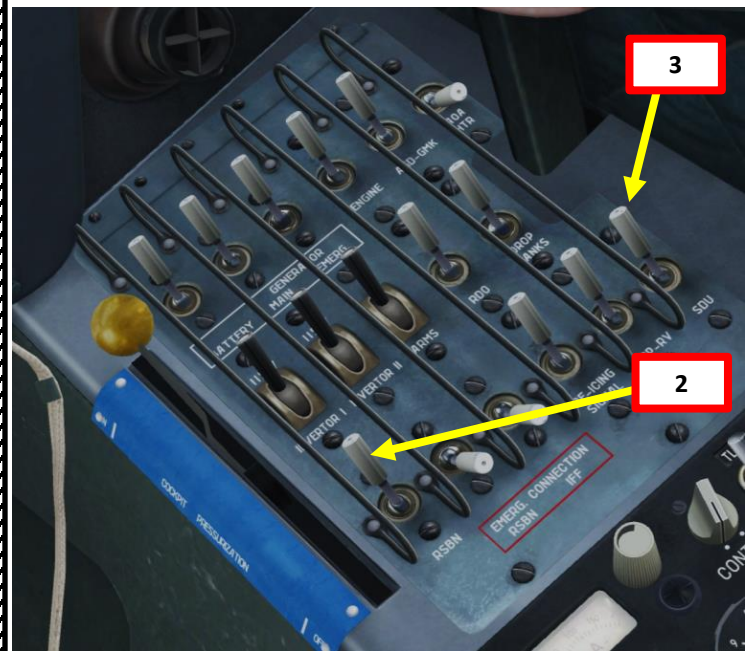


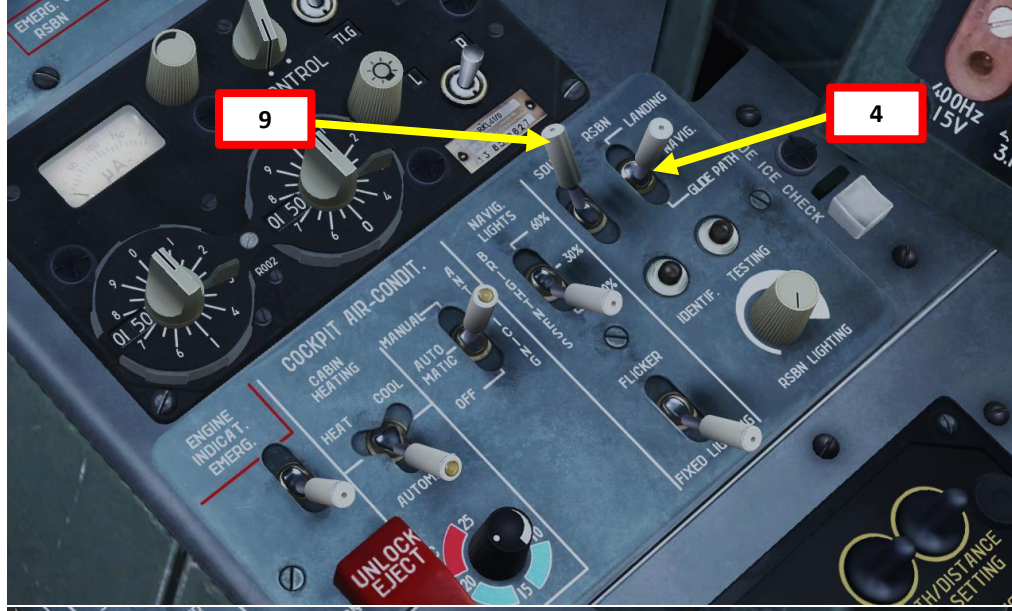


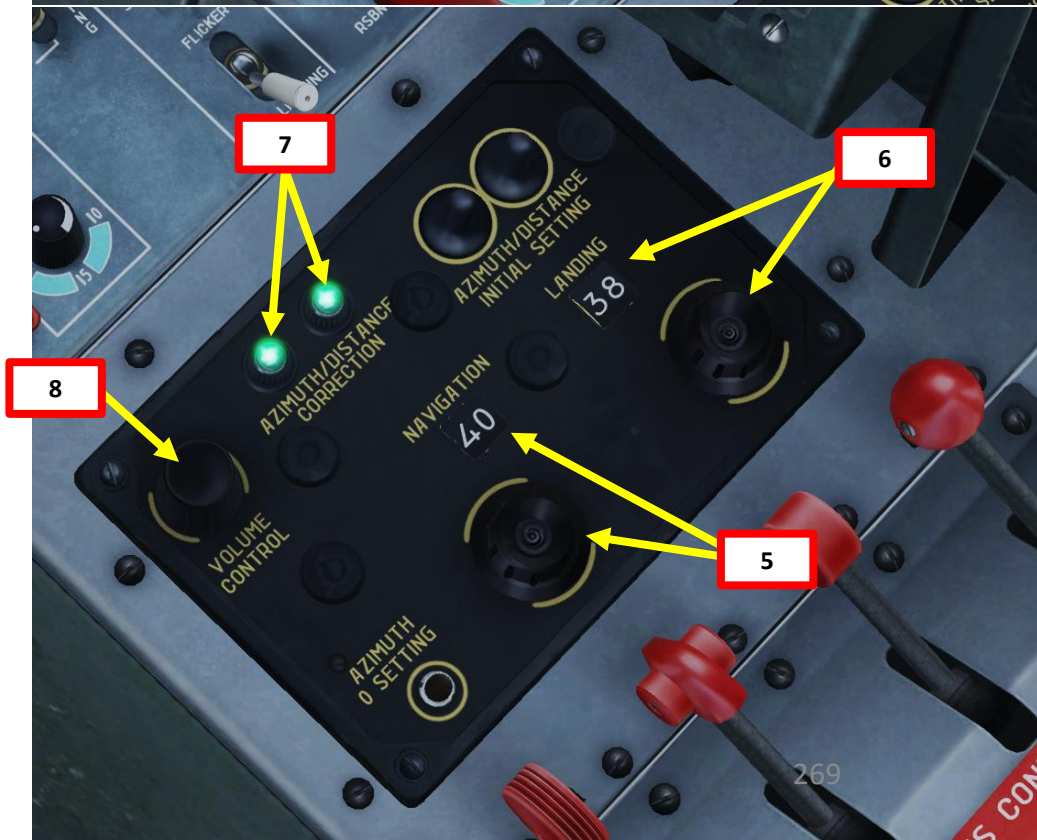
6 – PRMG (PRECISION/INSTRUMENT APPROACH LANDING)

1. Fly to an altitude of 2500 m to ensure RSBN signal can be captured.
2. Set RSBN-5S (ISKRA-K) ACB Switch – ON (FWD)
3. Set SDU (Remote Command Landing System) ACB Switch – ON (FWD)
4. Set RSBN-5S (ISKRA-K) Mode Switch – NAVIG (MIDDLE).
5. Set RSBN NAVIGATION channel to 40 (Krasnodar-Center RSBN).
6. Set RSBN LANDING channel to 38 (Krasnodar-Center PRMG).
7. When signal from the RSBN station is picked up, AZIMUTH & DISTANCE lights will illuminate.
8. Adjust RSBN Volume – As desired.
9. Set SDU (Remote Command Landing System) Switch – ON (FWD). This will allow the pilot to use the Flight Director symbology on the ADI (Attitude Director Indicator) when RSBN is in LANDING mode.

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





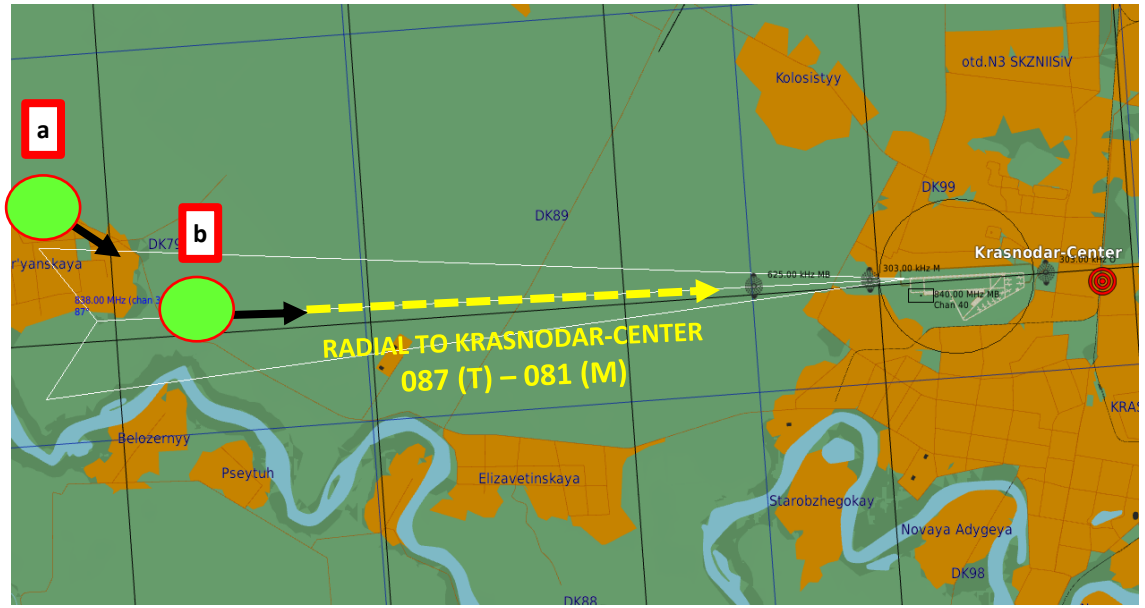


6 – PRMG (PRECISION/INSTRUMENT APPROACH LANDING)

11. Rotate the Course Set knob with mousewheel to set the largest/longest end of the thick needle to 081, since this is the radial we intend to follow to the airfield. When both needles are aligned, you are surfing on the radial. It is YOUR job to know if you're going in the right direction (TO the RSBN or AWAY FROM the RSBN) as there is no TO/FROM indicator. Use common sense.

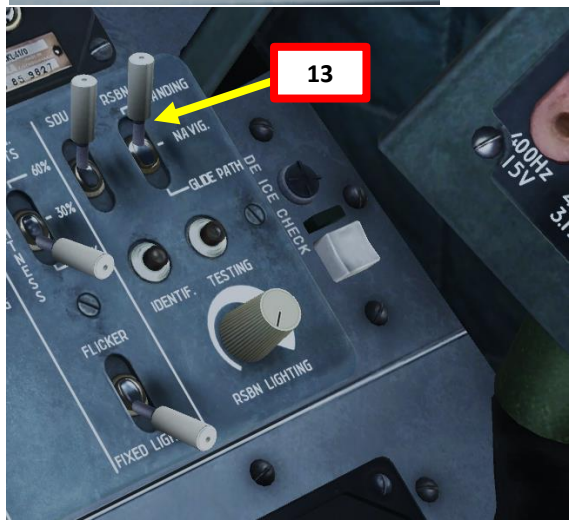
6 – PRMG (PRECISION/INSTRUMENT APPROACH LANDING)

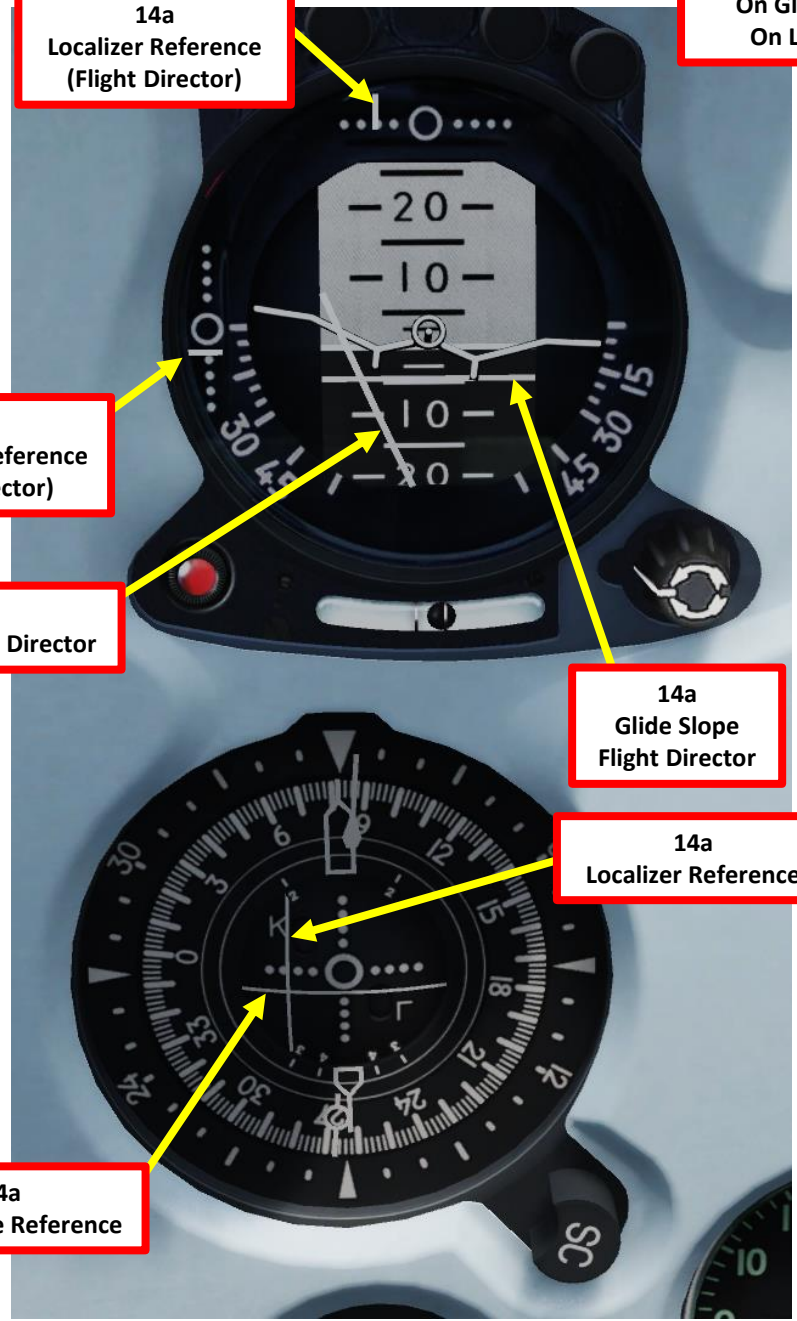
12. Intercept radial 081 by using the RMI Course Indicator.

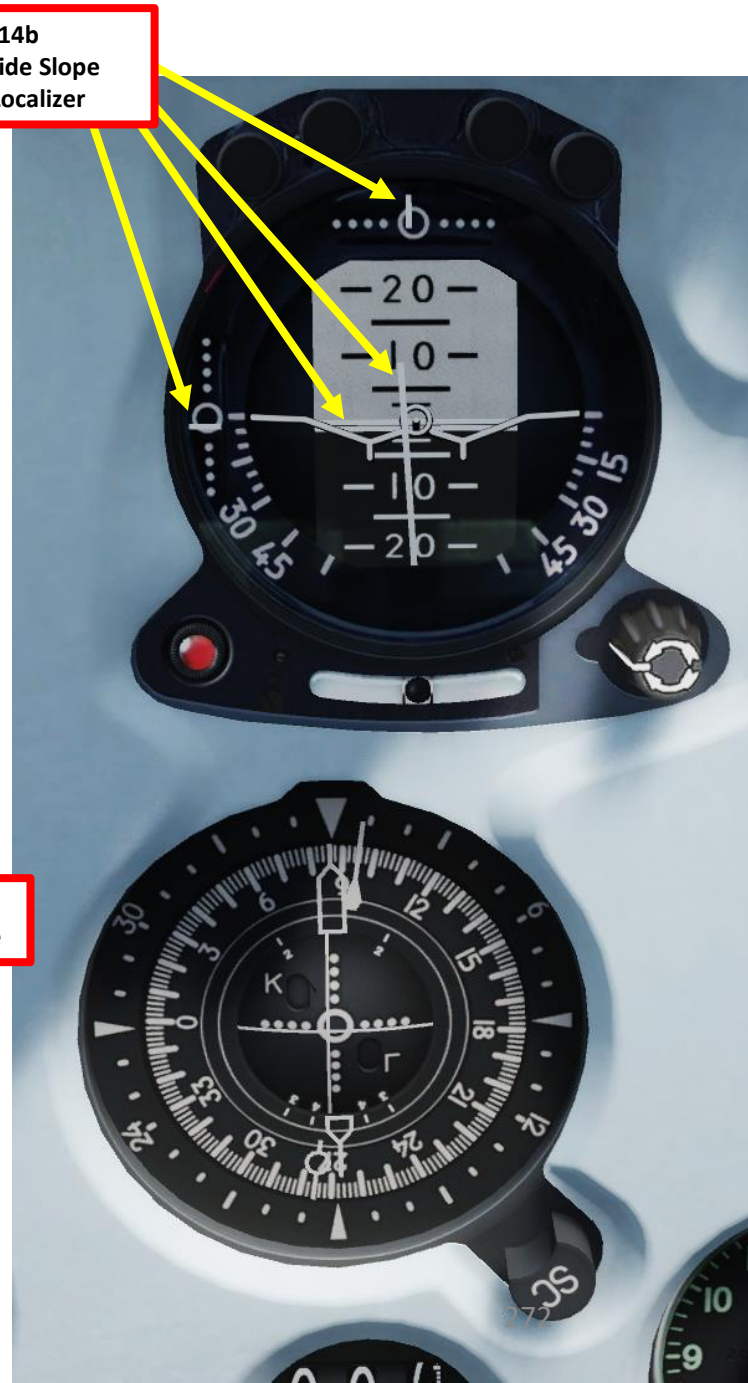


6 – PRMG (PRECISION/INSTRUMENT APPROACH LANDING)

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







6 – PRMG (PRECISION/INSTRUMENT APPROACH LANDING)

15. Set Navigation Lights Brightness Switch – As Required (100 %)
16. Set Navigation Lights Mode Switch – As Required (Flickering Lights, FWD)
17. Set Taxi & Landing Light Switch – LANDING (FWD)
18. When entering the downwind leg, maintain an altitude of 500 m (1500 ft) and an airspeed below 300 km/h (160 kts).
19. Lower Landing Gear. Verify mechanical pins are visible to confirm deployment.
20. Set Flaps at TAKEOFF position (25 deg). Verify mechanical pins are visible to confirm deployment.
21. Verify Airbrakes are retracted
22. If the airfield is equipped with an Outer and an Inner Marker beacon, the MARKER light will illuminate and marker signal sound (a short series of « beeps ») will be audible as you overfly these markers. For russian airfields:
    - The outer marker is typically set 4 km from the runway threshold
    - The inner marker is typically set 1 km from the runway threshold
23. When reaching the Outer Marker (4 km from the runway threshold) and maintaining an altitude of 250 m (800 ft) and an airspeed of 260 km/h (140 kts), set Flaps at LANDING position (fully extended, 44 deg)
24. When on Final Approach, fly at 230 km/h (125 kts) minimum and adjust throttle to maintain an engine RPM of 70 %.
25. Touchdown at 180 km/h (100 kts).
26. Flare gently.
27. During the flare, as the speed decreases, the pilot increases pitch by pulling the stick towards him and thus deflecting the elevators upwards to keep the lift force counteracting the aircraft's weight constant. The airplane gradually and smoothly descends from 1 m altitude to touchdown.
28. Set throttle to IDLE after touchdown.
29. Gently press the wheel brake lever to slow down.

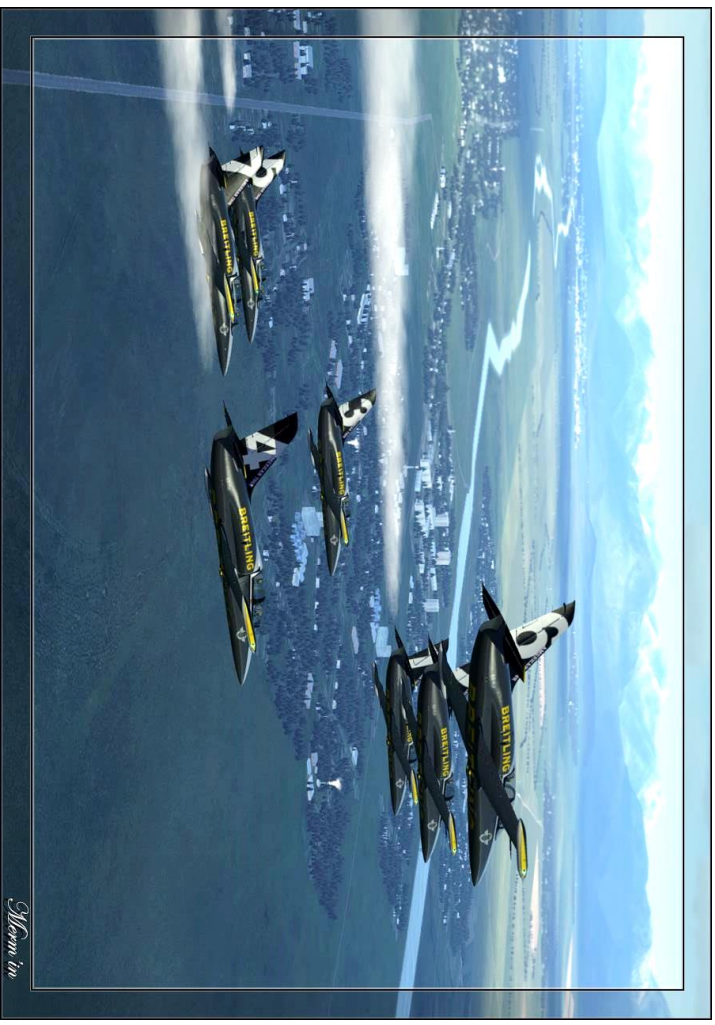
6 – PRMG (PRECISION/INSTRUMENT APPROACH LANDING)

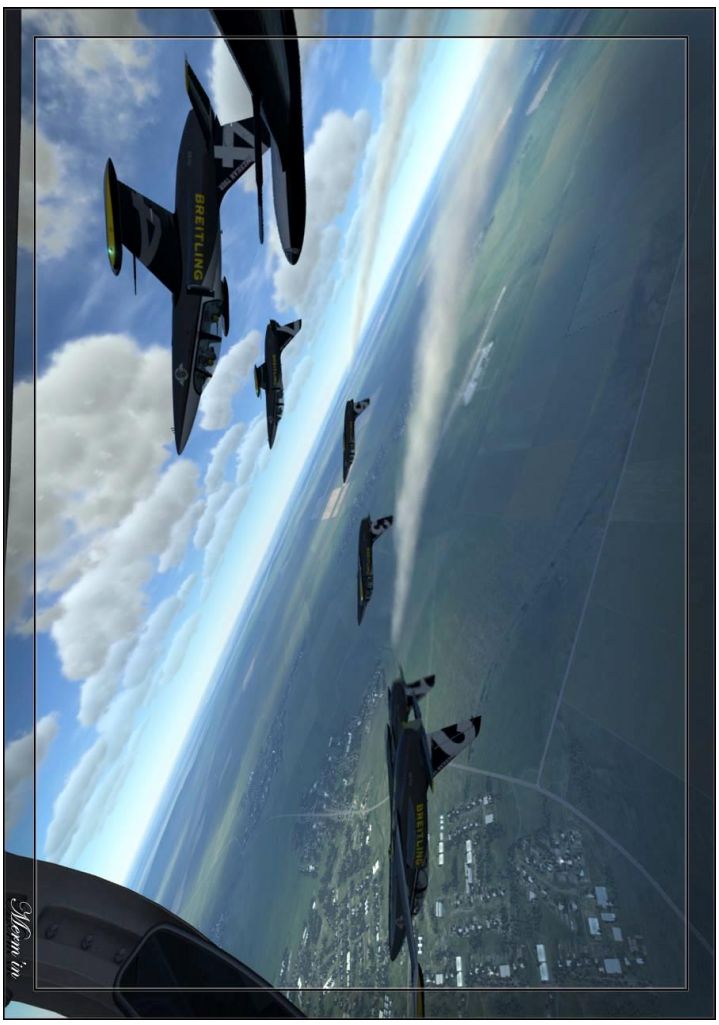
AEROBATICS

Aerobatic flying deserves a whole book written on it. Formation flying and airshow routines can be some of the toughest things to do in DCS. Many virtual aerobatic teams practice hundreds of hours in order to master their aircraft inside out. The L-39 highlights the fact that the flight sim community is diverse in the sense that everyone has different needs and flies for different reasons. Some folks are just not interested in combat. Although, that doesn't mean that they don't like to fly! Mastering the art of formation flying can be just as challenging as hunting down Flankers in the skies of Georgia.

This superb video of the mighty Breitling Jet Team says it all:
https://www.youtube.com/watch?v=M3zBE3Co2sY

The following screenshots were flown and taken by the "Virtual Breitling Jet Team".
Consult their facebook page to see them in glorious HD:
https://www.facebook.com/Virtual-Breitling-Jet-Team-685268548224607/


BREITLING
Morn in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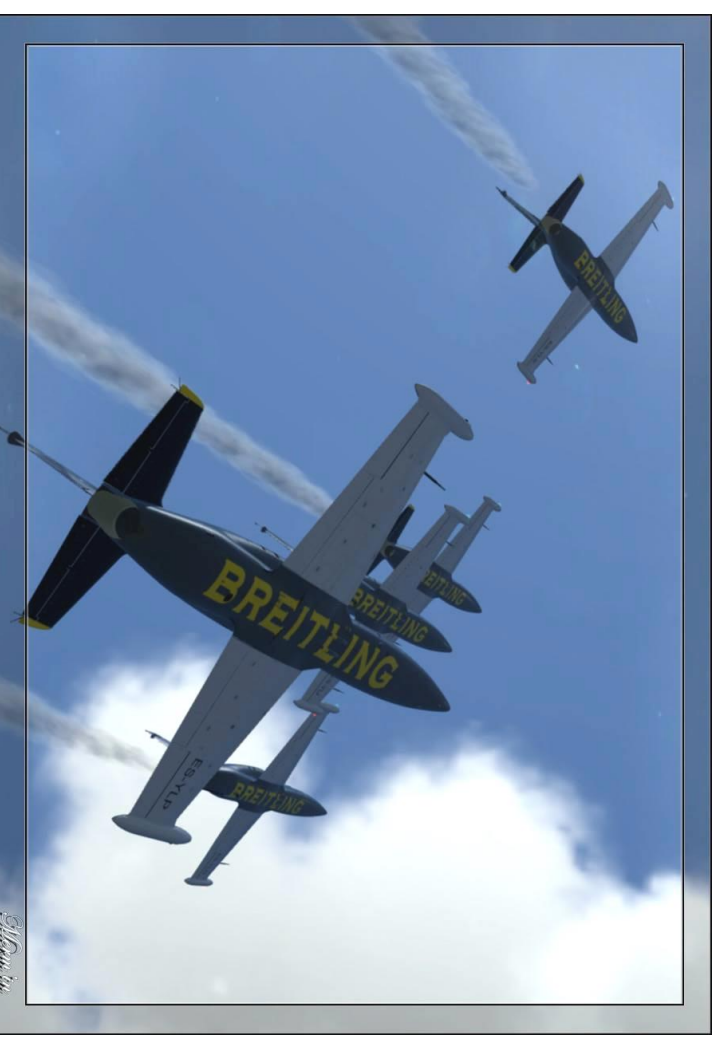
BREITLING
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BREITLING
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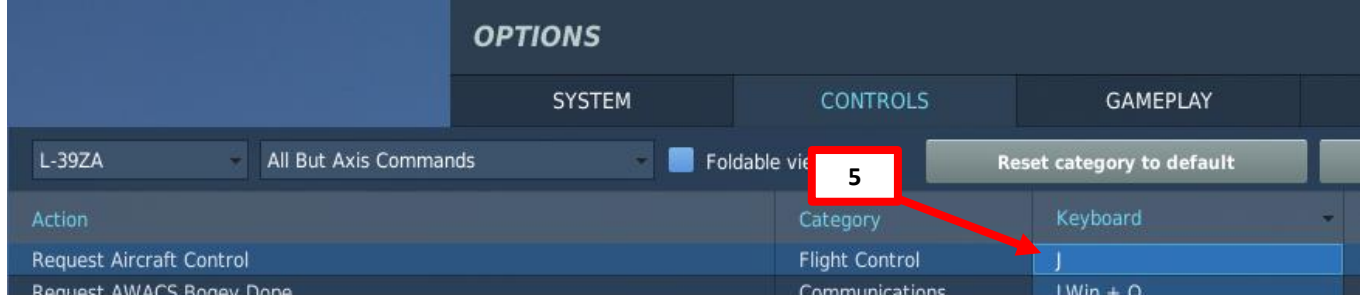
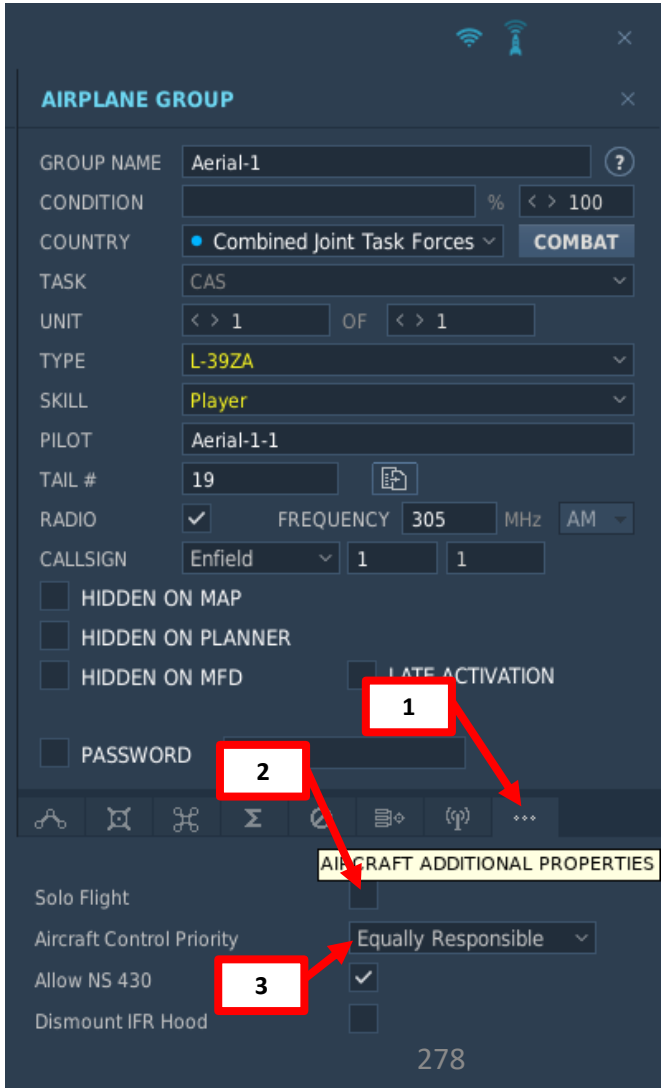
PART 12 – AEROBATIC FLYING

HOW TO MULTICREW

The Albatros can be flown by two players in multiplayer. However, you need to go in the Mission Editor and make sure the L-39 is set up in the following manner:

1. Select L-39 Unit and go in “Additional Properties for Aircraft” menu
2. Make sure “Solo Flight” option is not ticked
3. Set “Aircraft Control Priority” to “Equally Responsible”
4. When spawning in multiplayer in the rear seat of the L-39, the front seat pilot will receive a request to let you take control of the rear seat (or not).
5. Once you are spawned, you can take control of the aircraft by pressing the “Request Aircraft Control” binding (“J” key).





THE IMPORTANCE OF INSTRUMENTS

- **Pressure sensors** reading the air pressure outside your aircraft are what allow you to know at what **airspeed** you are flying, at what **altitude** you are and your **vertical velocity**. These indications are given on the airspeed indicator, altimeter and variometer.
- A Pitot-Static system consists of a **Pitot Tube** (reads total pressure) and a **Static Port** (reads static pressure).
- If you have a static port or a pitot tube malfunction, your total pressure and static pressure sensor readings will be affected.
- A wrong total pressure or static pressure reading will result in your gauges displaying wrong airspeed, altimeter and vertical velocity indications.
- There is a **relationship between airspeed, altimeter, the vertical velocity and a pitot-static system.**
- The ALTIMETER needs a static pressure sensor (static port)
- The VARIOMETER needs a static pressure sensor (static port)
- The AIRSPEED indicator needs a dynamic pressure reading (pitot tube + static port)

1. Airspeed can be found with air pressure sensors placed on the aircraft.
2. There are 2 types of pressure: static and dynamic.
3. Static pressure is the ambient air pressure
4. Dynamic pressure is based on the pressure differential between you and a moving fluid (like wind!)
5. Total pressure = dynamic pressure + static pressure
6. Dynamic pressure = total pressure - static pressure
7. Dynamic pressure is a function of air density (which varies with altitude) and airspeed.
8. $\text{Dynamic Pressure} = \frac{1}{2} * (Air\ Density) * (Airspeed)^2$
9. From that equation, we know that airspeed is found from dynamic pressure.
10. Therefore, if we have sensors for the total pressure (obtained from pitot tube, which is like a dog with its head out of a car) and a static pressure (obtained from a static port, more on that next slide), we can find easily your airspeed!
11. $Airspeed = \sqrt{\frac{Dynamic\ Pressure}{0.5 * (Air\ Density)}} = \sqrt{\frac{(Total\ Pressure) - (Static\ Pressure)}{0.5 * (Air\ Density)}}$

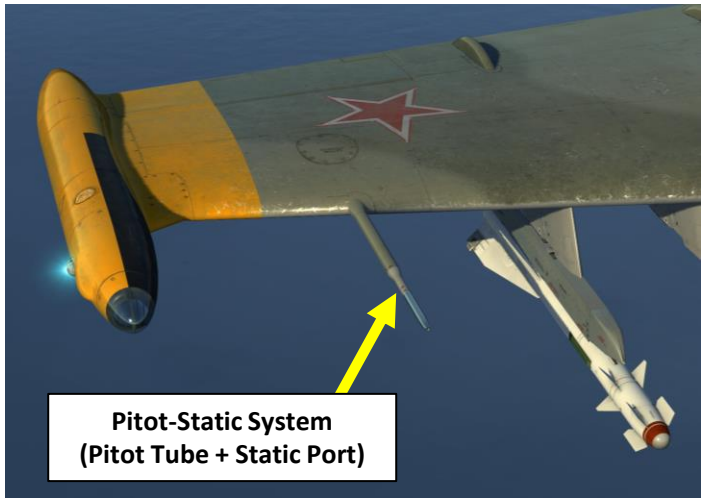
TOTAL PRESSURE (DOG FEELS THE WIND SPEED + AMBIENT PRESSURE)

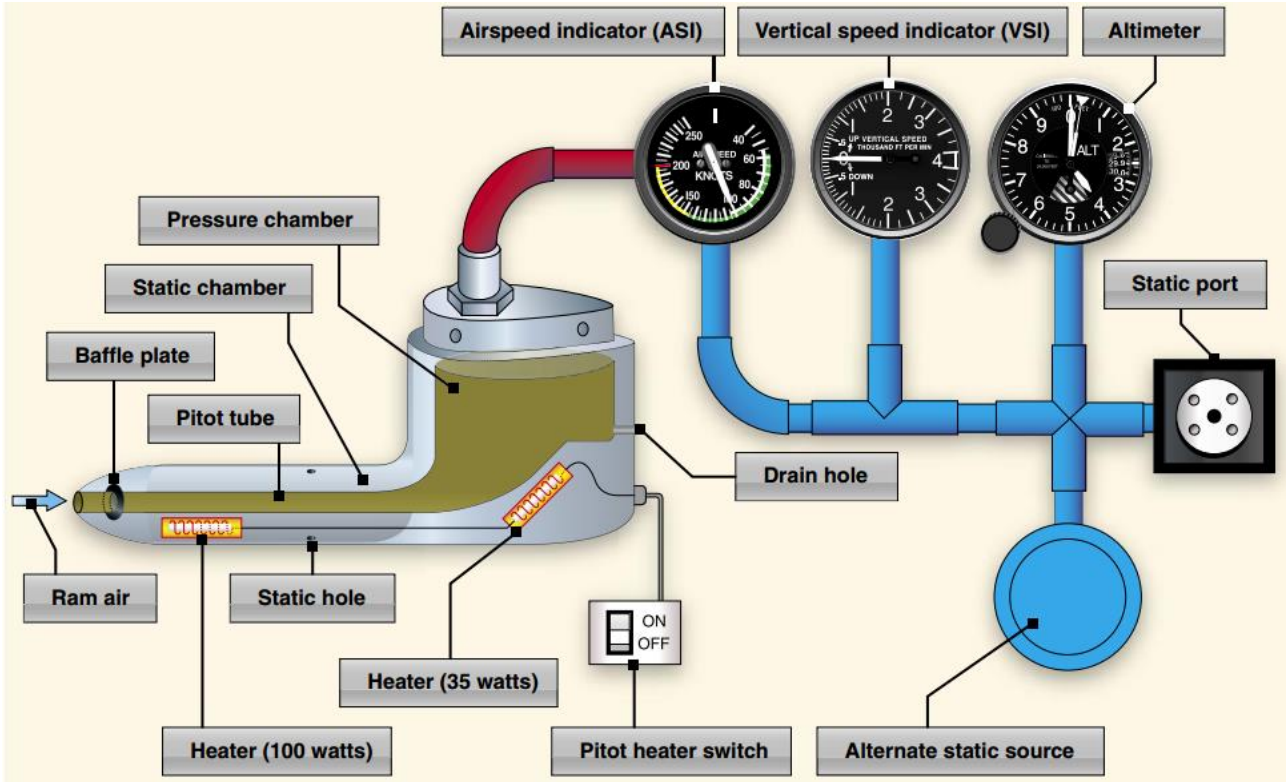
STATIC PRESSURE (DOG FEELS AMBIENT PRESSURE ONLY)

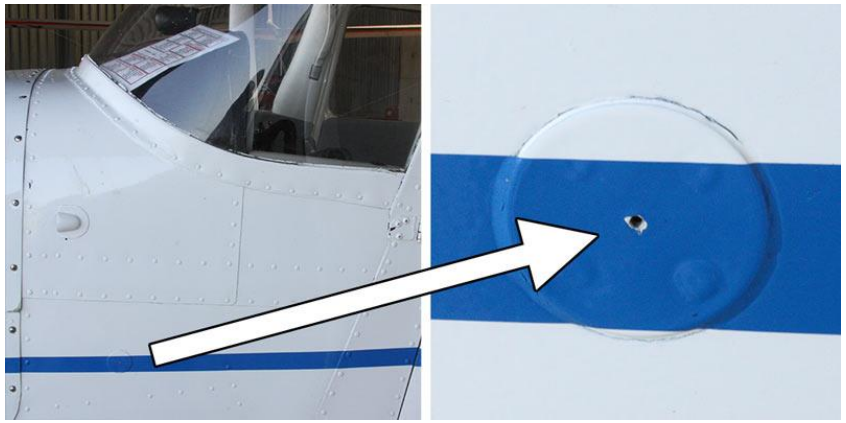
THE IMPORTANCE OF INSTRUMENTS

- A pitot tube is usually fit on the wings, which is where there is the most airflow to get the most accurate measurement of total pressure possible (since you need to be aligned with the moving fluid).
- A static port is a pressure sensor that needs to be placed in a particular place in order to measure a proper "static pressure" (which means in an area undisturbed by wind, undisturbed by dynamic effects). This means that the static port must be placed in a way that the sensor is perpendicular to the wind (and will not feel its pressure effect).

INSTRUMENT	NEEDS STATIC PRESSURE (STATIC PORT)	NEEDS TOTAL PRESSURE (PITOT TUBE)
Airspeed	X	X
Altimeter	X	
Variometer	X	



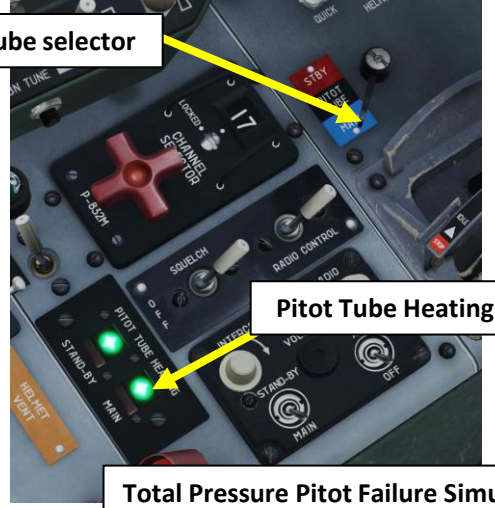


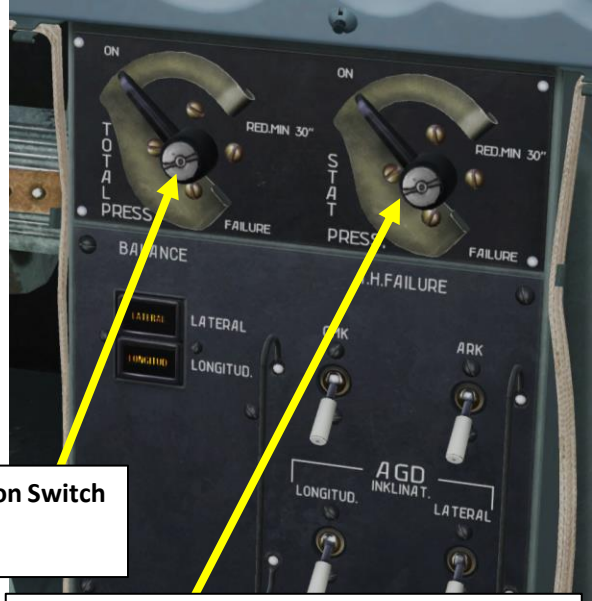


The static port pressure sensor will feel the pressure of the air laterally (or from the side of the aircraft), but will not feel the dynamic pressure created by the motion of the aircraft. See the "dog in car" analogy from previous page.

THE IMPORTANCE OF INSTRUMENTS

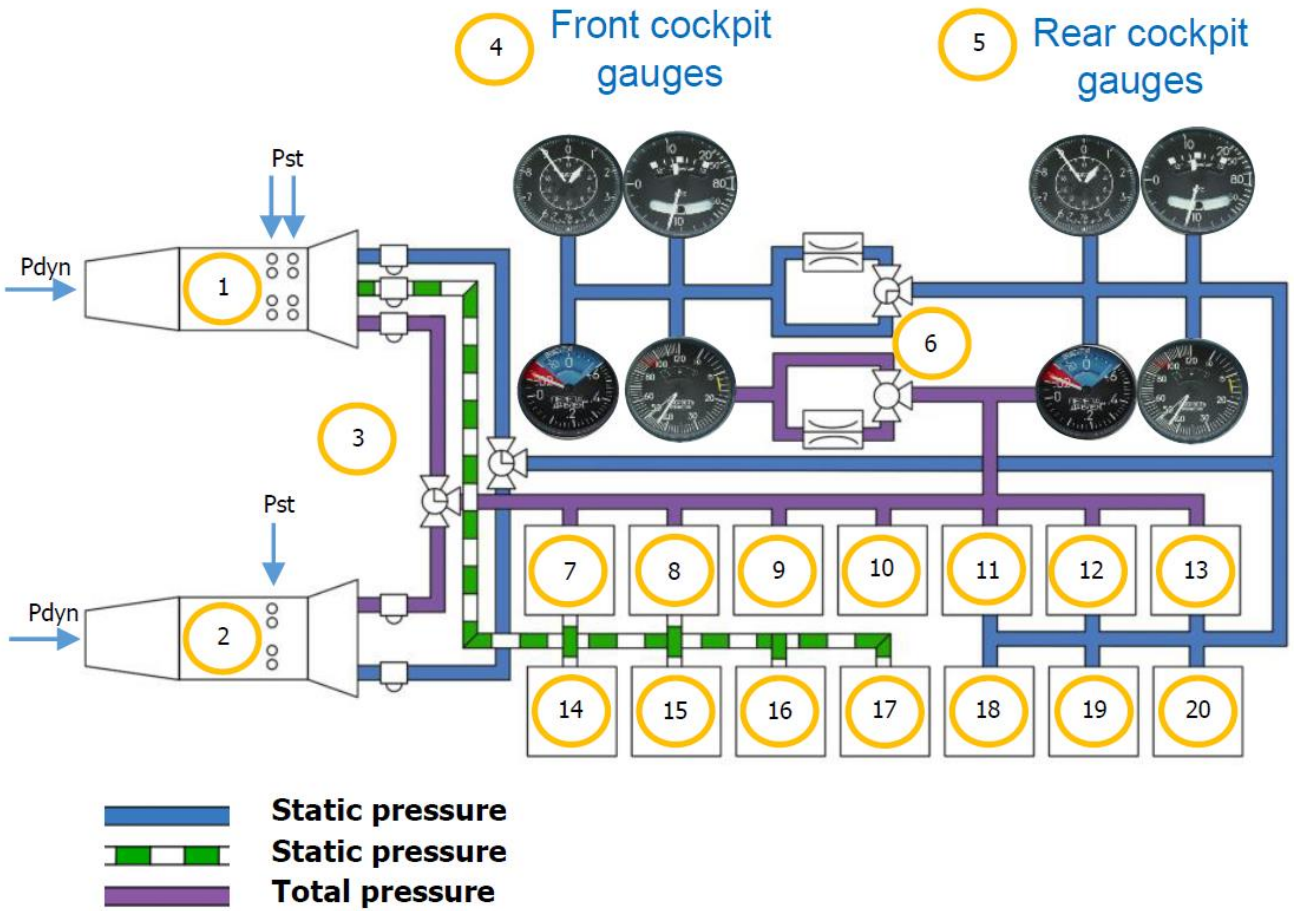
- Static and Total Pressure failures can be simulated in the instructor's rear cockpit.
- A student pilot can recognize a **static pressure failure** if his **altimeter** and **variometer** readings are all "frozen". The airspeed indicator will still function, but will use a "frozen" static pressure reference value, which will give you an **incorrect airspeed reading as you change altitude**.
- A student pilot can recognize a **total pressure failure** if his **airspeed** reading is "frozen".
- **Corrective actions include:**
  1. **Ensure Pitot Heat is ON (sensor could be blocked by ice) for selected pitot-static system**
  2. **Switch to standby pitot-static system as a backup**





Total Pressure Pitot Failure Simulation Switch
- *ON = Pitot Functional*
- *FAILURE = Pitot Failure Simulated*

Static Pressure Pitot Failure Simulation Switch
- *ON = Pitot Functional*
- *FAILURE = Pitot Failure Simulated*



1. **Primary pitot-static tube**
2. **Backup pitot-static tube**
3. **Primary/Backup pitot tube selector valve**
4. **Front cockpit gauges**
5. **Rear cockpit gauges**
6. **Pitot fault simulator valves**
7. **ISKRA-K unit airspeed sensor**
8. **ISKRA-K unit airspeed sensor**
9. **Front cockpit ejection seat speed pressure indicators**
10. **Rear cockpit ejection seat speed pressure indicators**
11. **SARPP-12GM FDR unit airspeed sensor**
12. **SARPP-12GM FDR speed and automatic activation sensor**
13. **Speed signalization in flap control sensor circuit**
14. **Cockpit pressure regulators**
15. **ASP-3NMU "altitude mechanism"**
16. **Cockpit pressure regulators**
17. **ISKRA-K unit pressure sensor**
18. **SARPP-12GM FDR unit altitude sensor**
19. **Radar altimeter sensor**
20. **Dangerous cockpit pressure alarm sensor**

RESOURCES

DCS L-39 Flight Manual
https://www.digitalcombatsimulator.com/upload/iblock/5b8/DCS_L-39_Flight_Manual_EN.pdf

Aero L-39C Flight Manual
http://www.anythingaboutaviation.com/wp-content/uploads/2013/01/Aero-L-39-Flight-Manual.pdf

Dangerous Passion – L-39 Experience Documentary
PART 1 - https://www.youtube.com/watch?v=-0tvPUQxl4c
PART 2 – https://www.youtube.com/watch?v=_3wFGcQ95SM
PART 3 – https://www.youtube.com/watch?v=0EzO0MM4ITY

XXJOHNXX's Youtube Tutorials
https://www.youtube.com/watch?v=OE-VT7XPm0s&list=PLxM0tbYYV7hKUQRfIIlvCHjeYvN62x2x_

BEASTYBAITER's Youtube Tutorials
https://www.youtube.com/watch?v=GBSO3Ht3u1g&list=PLXatIJ39zMX7FZIQDI-P_HZRp5EWOlJ4v

L-39 ALBATROS

INSTANT ACTION
CREATE FAST MISSION
MISSION
CAMPAIGN
MULTIPLAYER

LOGBOOK
ENCYCLOPEDIA
TRAINING
REPLAY

MISSION EDITOR
CAMPAIGN BUILDER

EXIT

A-10C	Bf 109 K-4	C-101	CA	F-86F	FC3	Fw 190 D-9	Hawk	Ka-50	L-39	M-2000C	Mi-8MTV2	MiG-15bis	MiG-21bis	P-51D	Su-25T	TF-51D	UH-1H
1.5.3	1.5.3 beta	1.5.3 Beta	1.5.3	1.5.3	1.5.3	1.5.3	1.5.3 Beta	1.5.3	1.5.3	2.0.0 Beta	1.5.3 beta	1.5.3	1.5.3	1.5.3	1.5.3	1.5.3	1.5.3

Version: 1.5.3.52478