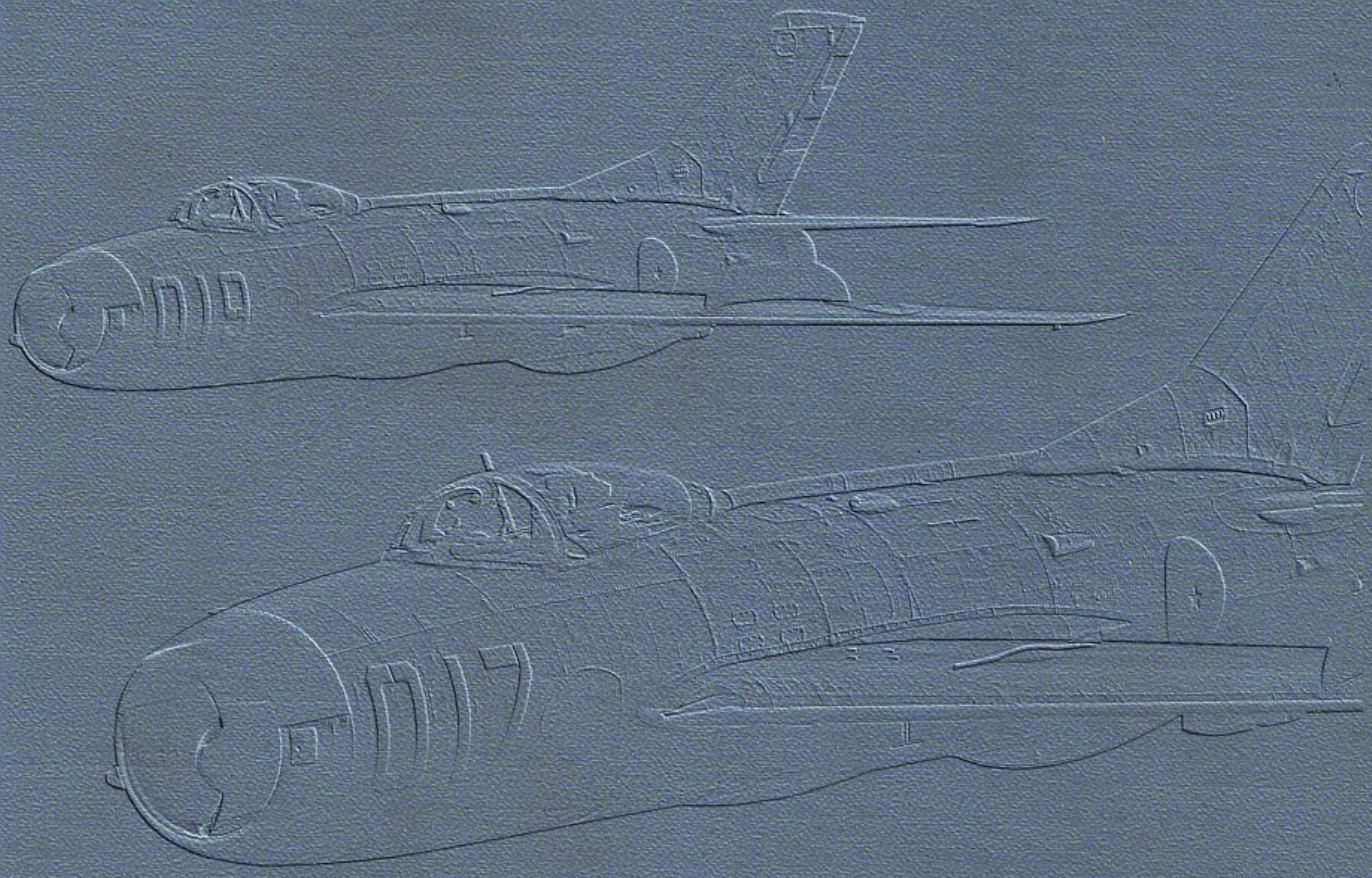
САМОЛЕТЫ

МиГ-19

FLIGHT MANUAL



ОБОРОНГИЗ

1958

Introduction & Credits

Thank you for your Purchase of the RAZBAM MiG-19P, we hope you enjoy Flying the Module as much as we enjoyed making it. We would like to thank everyone involved in bringing the Project to fruition.

• **Ron "Prowler111" Zambrano**	RAZBAM Owner, Projects Lead
• **Carlos "OverStratos"**	Project Manager,3D Model, Aircraft Documentation
• **Larry "Zeus67" Zambrano**	Aircraft Systems & Avionics Coder
• **CJ "CptSmiley"**	Flight Model & Engine Systems Coder
• **Hank Essers**	Aircraft External Panel Lines, Screws & Rivets
• **Clarke "Specter" Wardle**	External & Cockpit Textures
• **Tim Taylor, Metal2Mesh, LLC**	3D Model & Textures Optimization
• **"Baltic Dragon"**	Training Missions
• **Adam "Mikoyan74" Beeby** (from Red Star Manuals)	Manual Editing & Format

Special Thanks to **Piotr "Foxbat155" Gajewski** for providing valuable Documentation and Technical Advice.

To **Vincent "vincent90" Quak** for also providing Documentation.

To XQ **"U-boats"** Zao for the translation of all Cockpit Text to Chinese.

To **Alexander "Skylark" Dranikov** for helping immensely with the Aircraft Drawings and General Scale.

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Chapter 1 - General Description

ГЛАВА 1 - ОБЩИЕ СВЕДЕНИЯ

MIG-19P General Description
МИГ-19П ОБЩАЯ ХАРАКТЕРИСТИКА

The Mikoyan-Gurevich MiG-19P (МИГ-19П), the P standing for "Perekhvahtchik" meaning Interceptor, Aircraft is a Single-Seat Supersonic Interceptor. The design is of a Mid-Wing, All-Metal Monoplane, with a Swept Back Wing and All-Movable Horizontal Stabilizers. It entered Production at the Gorkiy Plant in 1955 as Izdeliye 62. It differed from the Production Day Interceptor MiG-19S (МИГ-19С), being equipped with Radar for All-Weather and Night Interceptor capabilities. Later Aircraft were fitted with the RP-5 Izumrud-2 (Emerald) Radar which had replaced the earlier RP-1 Izumrud-1. The installation of a Radar during the MiG-19P design had required a new redesigned Nose Section up to Frame 12 with a wider Cockpit, the removal of the Nose Fuselage mounted Cannon, a relocated Pitot Probe and changes to the Electrical, Pneumatic and Oxygen Systems to accommodate the Radar Equipment.

The Aircraft has two integral Nudelman-Rikhter NR-30 Auto-Cannons with 70 Rounds each. The Aircraft also has a limited Air-to-Ground capability, with the ability to carry ORO-57K FFAR Pods and Free Fall Bombs up to 250kg. The Aircraft entered service with the VVS (Soviet Air Force) and PVO (Soviet Anti-Air Defense) in 1956 and was tested by the Naval Air Arm (AV-MF – Aviahtsiya Voyenno – Morskovo Flota) who explored the possibilities of a Carrier Version.

The Radar; RP-5 Izumrud-2 (*Nate Code Name: Scan Odd*) Radar could detect a Bomber size Aircraft at 11 km, and a Fighter size Aircraft at 9 km. Because of the technology limitations at the time, the Search Radar is only useful above a height of 2,000 meters. Below this Altitude, strong Ground Clutter reflections hindered the identification of Targets. The Lock Radar however could still be operated down to an Altitude of 1,200 meters.

The Aiming Equipment comprised the ASP-5N Computing Gunsight and the AR-18-8 Radar Sight. The combination of both Sights assures Target Interception and Aiming Solutions in Low Visibility conditions, either at night or in heavy cloud cover. The two NR-30 30-mm cannons were capable of accurate fire up to 1,500 meters.

Later in its service life, the MiG-19P was upgraded to be able to carry two R-3S (K-13) Air-to-Air IR Guided Missiles and was retrofitted with the SPO-2B Rear-Aspect RWR.

The Avionics suite fitted to the MiG-19P was designed to allow it to operate in all weathers and at night. It included an Artificial Horizon and a GIK-1 Compass System integrated with an ARK-5 NDB Radio Navigation Receiver. For communications the MiG-19P was fitted with the RSIU-4V VHF Radio which could store up to 6 Preset Radio Frequencies.

TECHNICAL DATA

PARAMETER	VALUE
Overall Length, m	13.025
Fuselage Length, m	10.788
Wing Span, m	9.0
Stabilizer Span, m	4.490
Height, m	3.880
Wheel Track, m	4.156
Wheel Base, m	4.448
Max Fuselage Diameter, m	1.45
Wing Leading Edge Angle	57°
Wing Area, m²	25.16
Wing Anhedral	4° 30´
Wing Airfoil Type at the Root	TSAGI S-12S
Wing Airfoil Type from Mac	TSAGI SR-7S
Wing/Stab Incidence	0°
Wing Chord, m	3.023
Wing Aspect Ratio	3.24
Wing Taper Ratio	3.04
Relative Thickness	0,0824
Aileron Deflection Angle	±20°
Aileron Area, m²	1.56
Aileron Length, m	1.72
Aileron Chord, m	0.311
Aileron Trim Tab Area (LH Aileron Only), m²	0.053
Aileron Trim Tab Deflection Angle	±15°
Flaps Area, m²	3.43
Flaps Length, m	1.781

Flaps Deployment Angles	Take Off: 15° Landing: 25°
Flaps Relative Chord	0.383
Max Stabilizers Area (with fixed part), m²	7.78
Stabilizer Area (with counter-weight), m²	5
Stabilizers Area, m²	4.40
Stabilizers Anhedral	4°
Stabilizer Aspect Ratio	2.56
Stabilizer Taper Ratio	2.49
Stabilizer Airfoil Type	NACA-M
Stabilizer Deflection Angle	+11°/-26°
Fin Area, m²	4.17
Fin Leading Edge Angle	57°
Fin Taper Ratio	1.78
Fin Airfoil Type	TSAGI S-11S
Fin Chord	2.537
Rudder Area, m²	0.93
Rudder Deflection Angle	±25°
Keel Area, m²	0.54
Lateral Airbrakes Deflection Angle	25°
Ventral Airbrake Deflection Angle	45°
Front Wheel Dimensions, mm	480x220
Main Wheels Dimensions, mm	660x200

WEIGHTS	**VALUE**
Empty, kg	5,468
Take-Off, No External Stores, kg	7,384
Max Take-Off Weight, kg	8,738
Landing Weight with 7% remaining Fuel and no External Stores, kg	5,878
Landing Weight with 7% remaining fuel, with only 2xPTB760 installed, kg	5,984

DESIGN LIMITATITIONS	VALUE
Max allowed G	8
Max G with External Fuel Drop Tanks and/or Bombs fitted	5
Max G with Empty External Fuel Drop Tanks fitted	6.5
Max Dynamic Airflow	7,000 kg/m^2 / 1,300 km/h (IAS); 1,700 km/h (TAS)
Max Dynamic Airflow with External Tanks fitted	4,830 kg/m^2 / 1,000 km/h (IAS)

SPEEDS	VALUE
Max Speed At 10,000m (Afterburner), km/h	1,370
Max Speed At 1,000 m (Military Power), km/h	1,152
Max IAS km/h	1,200
Max IAS Speed External Tanks fitted, km/h*	1,000
Landing Speed, km/h	235
Take-Off Distance (Afterburner), m	580-600
Landing Run with Drag Chute deployed, m	610
Landing Run without Drag Chute operation, m	890

PERFORMANCE	VALUE
Max G Load	8/7.95
Climb to 10,000m (Afterburner)	1.8 min
Climb to 15,000m (Afterburner)	3.8 min
Service Ceiling (Afterburner), m	17,250
Service Ceiling (Military Power), m	15,600
Time to Service Ceiling	7.5 min
Thrust/Weight (Normal Takeoff-Weight)	0.88

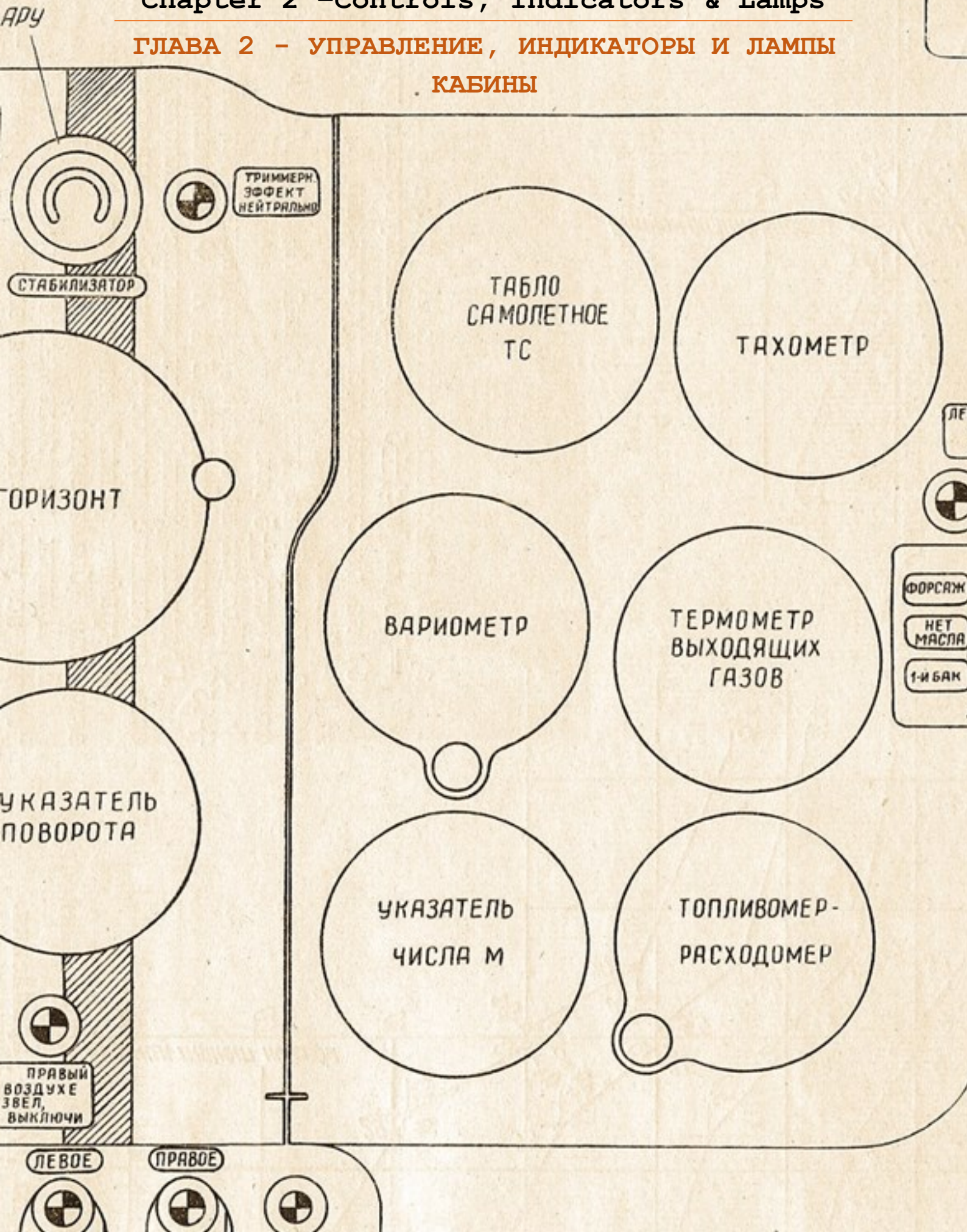
RANGE	VALUE
Internal Fuel Only, km	1,474
With 2xPTB760 Drop Tanks fitted, km	2,218
Endurance on Internal Fuel Only) at 14,000 m	1 h 43 min
Endurance (2xPTB760 Drop Tanks fitted)	2 h 38 min

RD-9B ENGINE DATA	VALUE
Dry Weight, kg	695
Diameter, mm	665
Max Static Thrust, kN	25.50
Nominal Thrust, kN	21.08
Maximum Afterburner, kN	31.87
Exhaust Gas Temperature	550-650 °C
Max RPM	11,150
FUEL DATA	**VALUE**
Max Internal Fuel Quantity** (1,700?)	1,800 kg (2,170 L)
Total Fuel Quantity with External Fuel Drop Tanks	2,960 kg (3,970 L)
Tank No. 1	1,485 L
Tank No. 2	330 L
Tank No. 3	180 L
Tank No. 4	175 L
External Fuel Drop Tanks PTB 760***	760 L
External Fuel Drop Tanks PTB 400	400 L

* Limited, because of the Structural Integrity of the Drop Tank attachments.

** At least 80 Liters of Fuel remains in the Fuel System, which cannot be utilized by Engines.

*** Because of Weight Limitations, when carrying R-3S Air-to-Air IR Guided Missiles, PTB-760 External Fuel Drop Tanks were only fueled with 600 Liters of Fuel.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ТРИММЕРН. ЭФФЕКТ НЕЙТРАЛЬНО
СТАБИЛИЗАТОР
ТАБЛО САМОЛЕТНОЕ ТС
ТАХОМЕТР
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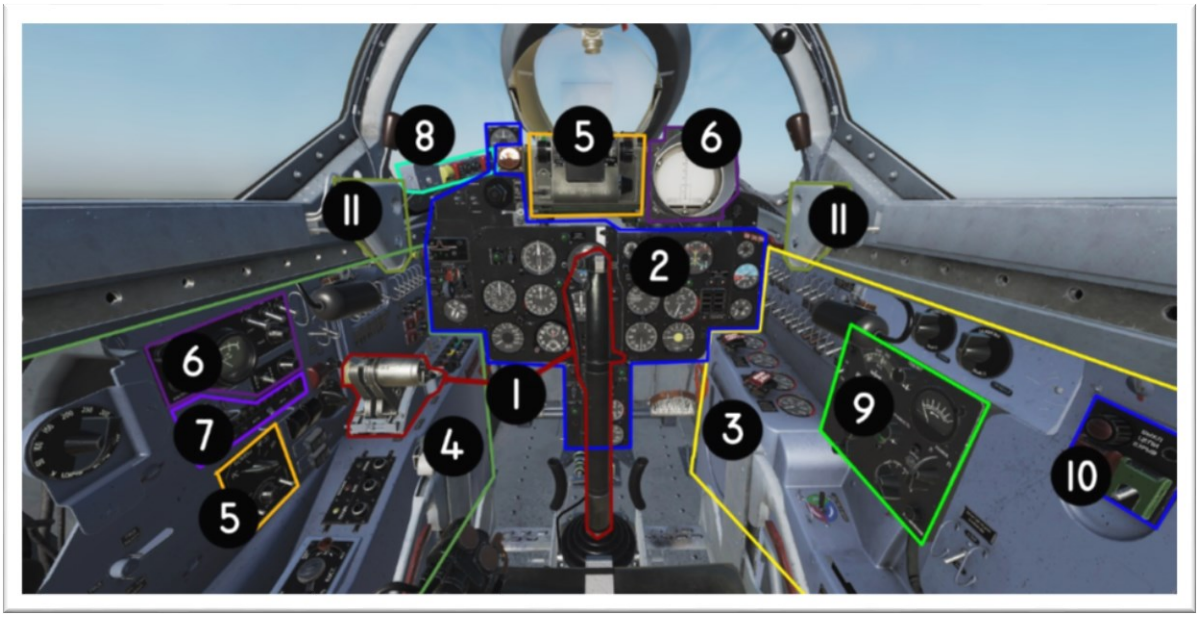
ТЕРМОМЕТР ВЫХОДЯЩИХ ГАЗОВ
ФОРСАЖ
НЕТ МАСЛА
1-И БАК
УКАЗАТЕЛЬ ПОВОРОТА
УКАЗАТЕЛЬ ЧИСЛА М
ТОПЛИВОМЕР-РАСХОДОМЕР
ПРАВЫЙ ВОЗДУХЕ ЗВЕЛ, ВЫКЛЮЧИ
ЛЕВОЕ
ПРАВОЕ

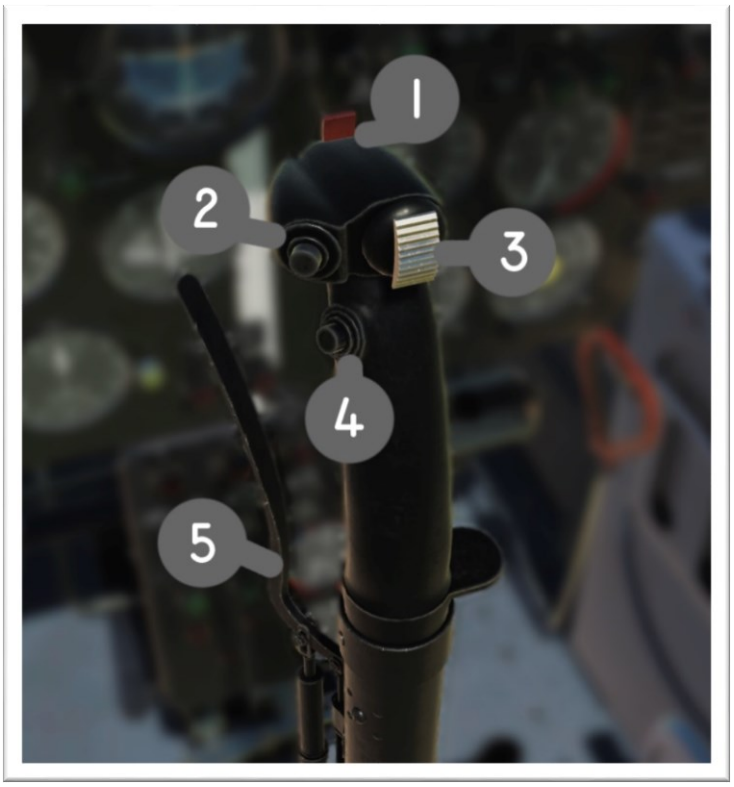
Cockpit Panel Layout
АППАРАТУРА КАБИНЫ



MIG-19 COCKPIT PANELS LAYOUT

1. Control Stick and Throttle Quadrant
2. Main Instrument Panel
3. RH Side Panel
4. LH Side Panel
5. ASP-5N Gunsight, AR-18-8 Radar Sight and ASP-5 Control Panel
6. RP-5 Izumrud-2/Emerald Radar (Cathode Ray Tube) Screen and RP-5 Izumrud-2/Emerald Radar Control Panel
7. ORO-57K Unguided Rocket Pod Control Panel
8. Upper left Control Panel
9. ARK-5P Radio-navigation system Control Panel.
10. SRO-2 IFF system Control Panel.
11. Canopy Controls

Control Stick
КОЛОНКА УПРАВЛЕНИЯ



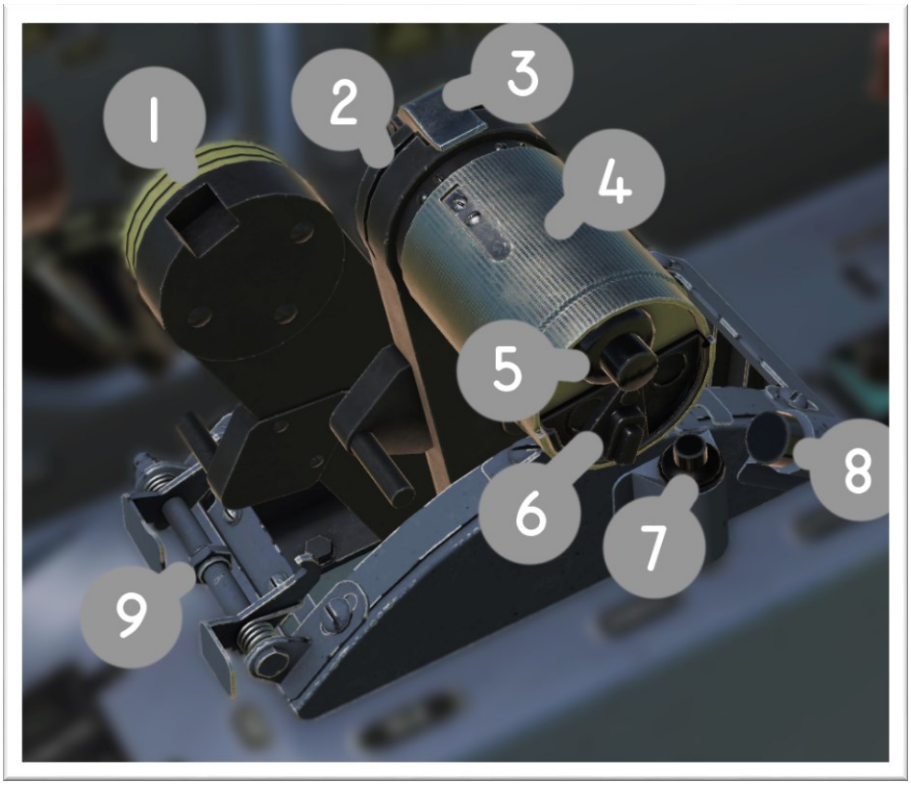
MIG-19P CONTROL STICK

1. Armament Trigger Switch – Press to Fire the Cannons, Missiles, Rockets or to release Bombs.
2. ASP-5N Aiming Reticle Dampening Button – used when the sight is in "Uncaged" mode to momentarily electrically "Cage" the System
3. Stabilizer Pitch Trim Switch
4. Airbrake Deploy Button – Press and hold to deploy the Airbrake for small Speed changes (This Switch has no effect if the Throttle Airbrake Switch is in the Deployed Position)
5. Landing Gear Wheel Brake Lever

The Cockpit features an "Orientation Stripe", which is a vertical white line painted down the middle of the Main Instrument Panel acting as a visual reference for the Pilot when centering the Control Stick during Spin Recovery. Often there is also a white line on the Control Stick that matches the one on the Main Instrument panel.
The correct procedure for recovering from a spin includes centering the Control Stick. So, when - from the Pilots' perspective - the two lines are aligned, the Control Stick is centered and in the proper position to recover from the spin.

Throttle Quadrant

СЕКТОР ГАЗА



MIG-19P THROTTLE QUADRANT

1. Left Engine Throttle Handle

2. Right Engine Throttle Handle

3. Throttle Locking Mechanism – to link the Throttle Handles together

4. ASP-5N Gunsight Distance to Target Selector

5. Radio PTT Button

6. Airbrake Selector Switch – Forward to Deploy, Aft to Retract

7. Engine Military Power Button*

8. Afterburner Button*

9. Engine Throttles STOP **(СТОП)** Position Lock

* The Function of Button **7** is to disconnect the Afterburner regime, so when the Throttles are advanced to the Afterburner Position **(ФОРСАЖ)**, the Engines will not engage the Afterburner but remain at the Military Power Setting. For the Afterburner to be available again after this, Button **8** must be pressed. Care should be taken as there is no visual indication of this, other than the Afterburner Lights will not illuminate when the Throttles are advanced to the Afterburner Position **(ФОРСАЖ)**. This Function was introduced on the Series 6 Engines.

Main Instrument Panel

ПРИБОРНАЯ ДОСКА

MIG-19P MAIN INSTRUMENT PANEL

1. Indicator - AM-10 3-pointer G-meter
2. Switch - Navigation Lights **(АНО)**
3. Switch - Landing/Taxi Light **(ПОСАДОЧНАЯ ФАРА – РУЛЕЖНАЯ)**
4. Nose Wheel Brake Control **(ТОРМОЗ ПЕРЕДНЕГО КОЛЕСА)**
5. Landing Gear Selector Handle **(ШАССИ)** and PPS-1 Gear, Flaps and Airbrake Position Indication Panel
6. Indicator - IK-18 Oxygen Pressure and Flow **(ИК-18 ИНДИКАТОР КИСЛОРОДА)**
7. Lamp – RP-5 IZUMRUD-2 Radar Emitting **(РП-5 ИЗУМРУД-2 РЛС ИЗЛ.)**
8. Switch – RP-5 Altitude Mode **(ВЫСОТЫ РЕЖИМЫ РЛС)**
9. Lamp – Pitch Trim Neutral Position **(ТРИММЕР ЭФФЕКТ НЕЙТРАЛЬНО)**
10. Indicator - GIK-1 Compass **(ГИК-1 УКАЗАТЕЛЬ КУРСА)** System Radio-Navigation

11. Lamp – Marker **(МАРКЕР)**
12. Indicator - AGI-1 Artificial Horizon **(АГИ-1 АВИАГОРИЗОНТ)**
13. Indicator - VD-20 Barometric Altimeter (m) **(ВД-20 УКАЗАТЕЛЬ ВЫСОТЫ)**
14. Button - GIK-1 Compass Slave **(ГИК-1 СОГЛАСОВ КСИ)**
15. Indicator - KUS-2000 Airspeed IAS/TAS (km/h) **(КУС-2000 УКАЗАТЕЛЬ СКОРОСТИ)**
16. Indicator - EUP-53 Electric Rate of Turn **(ЭУП-53 УКАЗАТЕЛЬ ПОВОРОТА)**
17. Lamp – Turn Off Radar **(ВЫКЛЮЧИ РП-5 ИЗУМРУД-2 РЛС)**
18. Indicator - UV-57 RV-5 Radar Altimeter **(ИНДИКАТОР УВ-57 - РВ-5 РАДИОВЫСОТОМЕР)**
19. Indicator - AChS-1 Clock **(ЧАСЫ)**
20. Lamp – LH Engine Air Re-Light System On **(ЛЕВЫЙ ЗАПУСК В ВОЗДУХЕ ВКЛ.)**
21. Lamp – RH Engine Air Re-Light System On **(ПРАВЫЙ ЗАПУСК В ВОЗДУХЕ ВКЛ.)**
22. Indicator - ARU-2V Stabilizer Lever Arm Position **(АВТОМАТИЧЕСКАЯ РЕГУЛИРОВКА УСИЛЕНИЯ АРУ-2В)**
23. Button Lamp Test - ARU-2V Take-off/Landing Position **(КОНТР. ЛАМП АРУ-2В ВЗЛЕТ ПОСАДКА)**
24. Lamp – ARU-2V Take-off/Landing Position **(АРУ-2В ВЗЛЕТ ПОСАДКА)**
25. Indicator - 2TVG-411 Exhaust Gas Temperature **(2ТВГ-411 ТЕМПЕРАТУРА ОТХОДЯЩЕГО ГАЗА)**
26. Lamp – LH Engine at Military Power **(ЛЕВ ДВИГАТЕЛЬ МАКСИМАЛ)**
27. Lamp – RH Engine at Military Power **(ПРАВ ДВИГАТЕЛЬ МАКСИМАЛ)**
28. Lamp – LH DC Generator Failure **(ЛЕВЫЙ ГЕНЕРАТОР ВЫКЛЮЧЕН)**
29. Lamp – RH DC Generator Failure **(ПРАВЫЙ ГЕНЕРАТОР ВЫКЛЮЧЕН)**
30. Indicator - VAR-150 Vertical Speed (Variometer) **(ВАР-150 ВАРИОМЕТР)**
31. Indicator - 2TE15-1 Engine Speed (Tachometer) **(2ТЭ15-1 ТАХОМЕТР)**
32. Indicator - T-6 Warning Light Panel
33. Indicator - MS-1.5 Machmeter
34. Indicator - TR3-52 Fuel Meter **(ТР-352 ТОПЛИВОМЕР РАСХОДОМЕР)**
35. Lamp - Main Hydraulic System Low Pressure **(ПАДЕНИЕ ДАВЛЕНИЯ В ГИДРОСИСТЕМЕ)**
36. Indicator - V-1 Voltmeter **(В-1 ВОЛЬТМЕТР)**
37. Indicator - UVPD-15 Cockpit Altitude and Differential Pressure **(ВЫСОТОМЕР УПВД-15 И ПЕРЕПАД ДАВЛЕНИЯ В КАБИНЕ)**
38. Indicator - M-2000 Oxygen System Altitude
39. Lamp - Bomb Fuse Armed **(ТАКТИЧЕСК СБРОС ВКЛЮЧ НА ВЗРЫВ)**

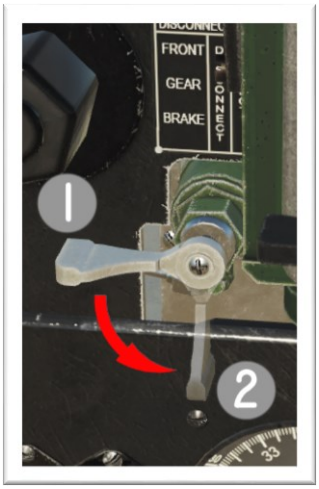
40. Lamp - Left Cannon Armed **(ЛЕВОЕ ПИСТОЛЕТ ГОТОВ)**
41. Lamp - Right Cannon Armed **(ПРАВОЕ ПИСТОЛЕТ ГОТОВ)**
42. Lamp - External Drop Tanks Empty **(СИГНАЛИЗАЦИЯ ПОДВЕСКА БАКОВ)**
43. Switch - Bomb Arming Circuit **(ТАКТИЧЕСК СБРОС ВКЛЮЧ НА ВЗРЫВ)**
44. Indicator - USB-1 Left Cannon Ammo Counter **(УСБ-1 ОСТАТОК ПАТРОНОВ)**
45. Indicator - USB-1 Right Cannon Ammo Counter **(УСБ-1 ОСТАТОК ПАТРОНОВ)**
46. Lamp - Load Suspended on the LH Wing Pylon **(ЛЕВОЕ ПОДВЕСКИ БОМБ)**
47. Lamp - Load Suspended on the RH Wing Pylon **(ПРАВОЕ ПОДВЕСКИ БОМБ)**
48. Indicator - MA-12 Dual Brake Pressure **(ДВУХ-СТРЕЛОЧНЫЙ МАНОМЕТР ТОРМОЗОВ)**
49. Indicator - MA-250 Booster Hydraulic System Pressure **(ГИДРОСИСТЕМА БУСТЕРНАЯ МАНОМЕТР)**

AM-10 3-POINTER G-METER

AM-10 3-POINTER G-METER

Incorporating 3 Pointers (1 Indicating and 2 Recording). The Main Pointer indicates the current Acceleration while the two Recording Pointers record the highest positive and negative G loads experienced by the Aircraft during Flight. The Recording Pointers follow the Main Pointer to its maximum travel. They then remain at the respective maximum travel position, thus providing a record of maximum G Loads encountered during Flight. To return the Recording Pointers to the normal (1G) position, it is necessary to press the Accelerometer Reset Button, located on the lower right corner of the Instrument Bezel. The MiG-19P has a Structural Limit of +8 G.

EXTERNAL LIGHT SWITCHES & NOSE WHEEL BRAKE
АНО, ПОСАДОЧНАЯ И ТОРМОЗ ПЕРЕДНЕГО КОЛЕСА



EXTERNAL LIGHTING AND NOSE WHEEL BRAKE CONTROL

Navigation Lights Switch **(АНО)** – 4 Position

- 10% - Up
- OFF - Centre
- 30% - Down Left
- 100% - Down Right

Taxi/Landing Light Position Switch **(ПОСАДОЧНАЯ)**

- Landing **(ФАРА)** - Up
- Off - Centre
- Taxi **(РУЛЕЖНАЯ)** – Down

Nose Wheel Brake Control **(ТОРМОЗ ПЕРЕДНЕГО КОЛЕСА)**

- Position 1 - ON **(ПОСАДКА ВКЛЮЧЕН)**
- Position 2 - OFF **(ВЫКЛЮЧЕН РУЛЕЖКА)**

Nose Wheel Braking is selected Off for Taxiing to allow the use of Differential Braking and is selected On for Take-Off and Landing to allow for maximum braking.

LANDING GEAR HANDLE & PPS-1 INDICATION PANEL
ШАССИ

LANDING GEAR SYSTEM CONTROLS AND INDICATIONS

1. Lamp – Gear in Transit **(ВЫПУСТИ ШАССИ)**
2. Lamp – Flaps Deployed **(ЗАКРЫЛКИ ВЫПУЩЕНЫ)**
3. Lamp – Airbrakes Deployed **(ЩИТКИ ВЫПУЩЕНЫ)**
4. Lamp Test Button – **(КОНТР ЛАМП)** tests all the PPS-1 Panel Lamps
5. Landing Gear Lever Lock Handle.
6. Lamp - Aileron Trim in Neutral Position **(ТРИММЕР ЭЛЕРОНА НЕЙТРАЛЬНО)**
7. Lamp Test Button – **(КНОПКА КОНТРОЛЬ ЛАМПЫ)** illuminates the Aileron Trim Neutral Lamp
8. Landing Gear Handle***** **(ШАССИ)**

   - UP – Landing Gear Retracted **(УБРАНО)**
   - Centered – Neutral position
   - DOWN – Landing Gear Extended **(ВЫПУЩЕНО)**

   ***** The correct use of the Landing Gear Handle is to place it into the Centered position every time the Landing Gear has reached its requested position and the associated lamps are illuminated.

This is done because of two reasons: firstly, because the Pneumatic System will activate the Brakes once the Handle is moved up, so that the Wheels don´t retract into the Landing Gear Bays whilst rotating at high speed, putting the Handle into the Centered Position releases the Brake Pressure and secondly, because part of the Landing Gear Retraction/Extension System will remain energized and may be damaged by overheating if it stays energized for more than 20 minutes.

The correct procedure is to ensure the Landing Gear Handle is in the Down Position **(ВЫПУЩЕНО)** and secure it with the Lock once the Battery Switch has been Switched Off. That way, unwary Ground Crew or other Pilot's won´t Retract the Landing Gear accidentally as the Hydraulic Pressure can remain for a long time after the Engines are stopped.

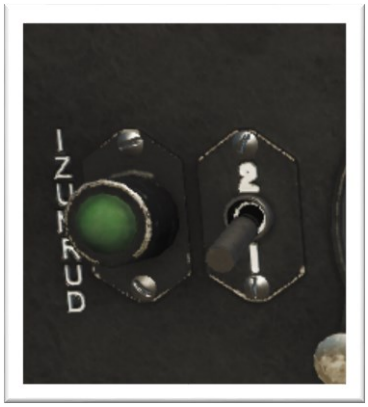
IK-18 OXYGEN PRESSURE & FLOW INDICATOR
ИК-18 ИНДИКАТОР КИСЛОРОДА

IK-18 OXYGEN PRESSURE & FLOW INDICATOR

The IK-18 Oxygen Pressure and Flow Indicator consists of two independent instruments:

- An Oxygen Manometer in the upper part, indicating Oxygen Pressure in the Main Feed Supply, with a Pointer.
- A White/Black "Lung-Shaped" Oxygen Breathing Indicator in the lower part, indicating the supply of oxygen. The "Lung-Shaped" Indicator blinks White and Black alternately as the Pilot breathes.

RP-5 RADAR
РП-5 ИЗУМРУД-2



RP-5 RADAR EMITTING LAMP & ALTITUDE MODE SWITCH

Lamp - When On, it indicates that the Radar RP-5 IZUMRUD is emitting and working correctly. **(РП-5 ИЗУМРУД-2 РЛС ИЗЛУЧЕНИЯ)**

Switch - RP-5 Radar Altitude Mode (See Chapter 4 for more details)

- **Position 1:** For use at Altitudes below 2,000 meters. The Radar Search Antenna is disabled, and the AR-18-16 Tracking Antenna reduces its Lock distance to 1,200 meters.
- **Position 2:** For use at Altitudes above 2,000 meters. Both the Search and Track Antennas are operational.

LAMP - PITCH TRIM IN NEUTRAL POSITION
ТРИММЕР ЭФФЕКТ НЕЙТРАЛЬНО

PITCH TRIM NEUTRAL LIGHT

This lamp is illuminated whenever the Pitch Trim is in its Neutral Position.

GIK-1 COMPASS RADIO-NAVIGATION INSTRUMENT
ГИК-1 УКАЗАТЕЛЬ КУРСА

GIK-1 COMPASS SYSTEM & SYNCHRONIZATION BUTTON

The GIK-1 System uses a Flux Valve and A Directional Gyro to update the Aircraft Magnetic Heading on the Compass Card relative to the Index Mark. It also displays the bearing to an NDB station (Thin Pointer) and allows the Pilot to set a desired Course/Heading (Wider – Divided Pointer) using the Knob in the lower left of the Instrument Bezel.

Before Engine Start, the GIK-1 Compass System should be aligned magnetically by pressing the GIK-1 **(ГИК-1)** alignment button for 2-3 Seconds. The instrument will then display the correct Aircraft Heading after approximately 2-3 minutes.

LAMP – MARKER BEACON RECEIVER
МАРКЕР

MARKER LAMP

The lamp is linked to the MRP-56 Marker Beacon Receiver and will illuminate as the Aircraft overflies a Marker Beacon near a co-located Airport NDB. Illumination of the lamp is accompanied by a Buzzer, located on the RH Side Panel of the Cockpit. In DCS Word as in real life the higher the Frequency the closer to the Airfield the Marker Beacon is located (Outer Marker – 400 Hz, Middle Marker – 1020 Hz, Inner Marker 3000 Hz).

AGI-1 ARTIFICIAL HORIZON
АГИ-1 АВИАГОРИЗОНТ

AGI-1 ARTIFICIAL HORIZON

This is a Soviet type Artificial Horizon, the "Blue-Sky" and "Black-Ground" parts of the Attitude Ball are inverted in relation to the world. The display of Aircraft Pitch Attitude is the reverse of a modern Western Artificial Horizon. The Instrument displays the Aircraft Position with respect to the Horizon in Pitch and Roll and includes a Slip Indicator at the bottom of the Instrument.

The Left Knob is used to correct the static Pitch Angle once the Gyro is erected, while the Right Knob cages the Gyro on Aircraft power up.

NOTE: For the system to show the correct attitude of the Aircraft, after the Aircraft electric system has been energized via the Battery Switch, operate the align knob (right of instrument) for 5 seconds if the exterior temperature is below 30 °C. If the temperature is above 30 °C, operate the button for 3 seconds. The instrument will display the correct Aircraft Attitude after 3 minutes. The instrument measured errors accrued during operation are 3° (degrees) in pitch and 1° (degree) in bank after 2 hours.

VD-20 BAROMETRIC ALTIMETER(M)
ВД-20 УКАЗАТЕЛЬ ВЫСОТЫ

VD-20 BAROMETRIC ALTIMETER

The Outer Scale indicates the current Altitude in the Hundreds of Meters and is indicated by the Longer Thinner Pointer, the Inner Scale indicates the current Altitude in the Thousands of Meters and is indicated by the Shorter Fatter Pointer.

In the lower part there´s a scale to indicate the selected Barometric Pressure, which can be changed from 670 to 790 mmHg.

Rotating the knob will change the selected Barometric Pressure so that the Pilot can set an Airfield Pressure (QFE) to indicate 0m on the Ground, a local pressure above See Level (QNH)to indicate the Airfield Height in meters above the Sea or Standard Atmospheric Pressure of 760 mmHg.

KUS-2000 AIRSPEED IAS/TAS INDICATOR (KM/H)
КУС-2000 УКАЗАТЕЛЬ СКОРОСТИ

KUS-2000 AIRSPEED/TAS INDICATOR

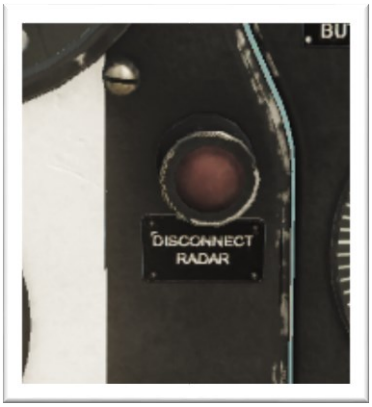
This instrument indicates the Aircraft Airspeed (IAS) in Kilometers per hour (km/h) on the Thicker Pointer. The TAS is displayed by the Thinner Pointer. There is a Red Line at 1,300 km/h which is the Airframe Max Structural Dynamic Pressure Limit.

EUP-53 RATE OF TURN & SLIP INDICATOR
ЭУП-53 УКАЗАТЕЛЬ ПОВОРОТА

EUP-53 ELECTRIC RATE OF TURN & SLIP INDICATOR

The EUP-53 Electric Turn Indicator includes two separate instruments within the one housing; a Pointer indicating the Roll Rate of the Aircraft between ±45° with index marks at 15° positions, calibrated for an Airspeed of 500 km/h. It also has a curved slip ball tube (Inclinometer) for indicating the sideslip.

LAMP "TURN OFF RADAR"
ВЫКЛЮЧИ РП-5 ИЗУМРУД-2 РЛС



"TURN OFF RADAR" LAMP

"Turn Off Radar" **ВЫКЛЮЧИ РП-5 ИЗУМРУД-2 РЛС** warning lamp. This lamp illuminates when the electrical elements of the Radar start to Overheat due to prolonged use. Once the lamp lights up, turn the Radar Off. Otherwise, the Radar may be damaged and fail.

UV-57 RV-5 RADAR ALTIMETER
ИНДИКАТОР УВ-57 - РВ-5 РАДИОВЫСОТОМЕР

UV-57 RADAR ALTIMETER

The UV-57 Altitude Indicator of the RV-5 Low-Altitude Radar Altimeter indicates Radar Altitude up to 600 meters. The Dangerous Altitude can be selected by the Pilot with the RV-5 Radio Altimeter Minimum Altitude Selector on the LH Side panel.

ACHS-1 CLOCK
ЧАСЫ

ACHS-1 CLOCK

The AChS-1 Clock indicates Time of Day and Flight Duration and serves as a Chronometer. The main Clock uses the outer dial and displays the time. To set the time, first turn the right knob fully clockwise to stop the clockwork. Then, pull the left knob and by rotating it, set the correct time. Once finished, press the left knob back and turn the right knob counterclockwise again to start the clockwork.

The smaller Clock in the top half is used to measure Flight Time and the small circular window in the upper small Clock indicates the current Flight Time Clock Mode. To start the Flight Time Counter, press the left knob. The circular window will show a red color to indicate running Flight Time. To stop the Flight Time clock, press the left knob again. The circular window will show half red, half white to indicate stopped Flight Time. To reset the Flight Time Counter, press the left knob a third time. The circular window will then show a full white color to indicate that the Clock has been reset.

To start the Chronometer, press the right knob. This will start both the stopwatch needle in the bottom small dial and the main Clock second hand. To stop, press the right knob a second time and a third to reset the stopwatch.

LAMPS – LH/RH ENGINE "AIR RE-LIGHT" SYSTEM
ЛАМПЫ – ЛЕВЫЙ/ ПРАВЫЙ ЗАПУСК В ВОЗДУХЕ ВКЛ.

ENGINE AIR RE-LIGHT SYSTEM LAMPS

Illumination of the Lamp indicates that the respective Engine Air Re-Light System is active.

ARU-2V STABILIZER LEVER ARM POSITION
АВТОМАТИЧЕСКАЯ РЕГУЛИРОВКА УСИЛЕНИЯ АРУ-2В

ARU-2V STABILIZER LEVER ARM POSITION INDICATOR

This instrument is an ordinary Voltmeter, calibrated in both Speed and Altitude units. It indicates the status of the ARU-2V Flight Control Governing System, which controls Stabilizer Deflection as a function of the Aircraft's Speed and Altitude. The current position of the ARU arm is indicated on the combined speed-altitude scale. The upper speed scale indicates IAS in hundreds of km/h, the lower altitude scale Altitude in kilometers. If the Indicator Pointer is in its leftmost position, the ARU is in "Long Lever Arm" and maximum Stabilizer deflection is available. The rightmost position indicates "Short Lever Arm" where only partial Stabilizer Deflection is available.

LEFT STABILIZER			
PITCH TRIM NEUTRAL			
HYDRAULIC BOOSTER		**NORMAL PRESSURE**	
ARU GAUGE INDICATION		**STAB LEADING EDGE POSITION**	
IAS	ALTITUDE	MAX DOWN	MAX UP
Km/h	Km	Degrees	Degrees
480	10	26°	11°
610	8.5	22°	9°
750	7	18°	6°
900	5	15°	4°
900	0	15°	4°
HYDRAULIC BOOSTER DISCONNECTED			
0	0	26°	11°
900	0	15°	4°

2TVG-411 DUAL ENGINE EGT GAUGE
2ТВГ-411 ТЕМПЕРАТУРА ОТХОДЯЩЕГО ГАЗА

DUAL ENGINE EGT GAUGE

Indicates the LH and RH Engine Exhaust Gas Temperature (EGT) from 300-900°C. The instrument does not need Aircraft Electrical Power in order to display the Engine Temperatures as it relies on Voltages generated by Thermocouples.

LAMP – LH/RH ENGINE AT "MILITARY POWER"
ЛЕВ/ПРАВ ДВИГАТЕЛЬ МАКСИМАЛ

LH/RH ENGINE AT "MILITARY POWER" LAMPS

These lamps illuminate when the Engines are operating at Military Power.

LAMP – LH/RH DC GENERATOR FAILURE
ЛЕВЫЙ/ ПРАВЫЙ ГЕНЕРАТОР ВЫКЛЮЧЕН

LH/RH DC GENERATOR FAILURE LAMPS

These Lamps illuminate to indicate that the respective Engine DC Starter-Generator is not Operating or has Failed.

VAR-150 VERTICAL SPEED (VARIOMETER)
ВАР-150 ВАРИОМЕТР

VAR-150 VARIOMETER

Indicates the Aircrafts Vertical Speed in meters per second (m/s) from 0 to 150. This instrument senses the Rate of Static Air Pressure to indicate the Rate of Climb or Descent.

2TE15-1 ENGINE SPEED (TACHOMETER)
2ТЭ15-1 ТАХОМЕТР

2TE15-1 ENGINE SPEED (TACHOMETER)

Indicates the LH and RH Engine, High Pressure Compressor Rotor (N2) RPMs in the range from 0 to 15,000.

Л – **ЛЕВЫЙ** LH Engine

П – **ПРАВЫЙ** RH Engine

T-6 WARNING LIGHT PANEL

T-6 WARNING PANEL

1. LH Engine Afterburner active **(ФОРСАЖ)**
2. RH Engine Afterburner active **(ФОРСАЖ)**
3. Low oil pressure in LH Engine **(НЕТ МАСЛО)**
4. Low oil pressure in RH Engine **(НЕТ МАСЛО)**
5. Main Fuel Tank No.1 is Empty. All Fuel has been used. **(1 БАК)**
6. 550 Liters Remaining in Fuel Tank No.1 **(ОСТАЛОСЬ 550)**

The T-6 Warning Light Panel contains 6 Warning Lights, a Day/Night Mode Selector Switch (labelled Day - **ДЕНЬ** and Night - **НОЧЬ**) and a Lamp Test Button (labelled Control Lamp - **КОНТРОЛЬ ЛАМП**).

WARNING: During prolonged Negative G's maneuvers, the Tank 1 **(1 БАК)** Lamp may illuminate, indicating a reduction in Fuel Pressure. If this happens, stop the maneuver and generate Positive G's, otherwise the Engines may Flame Out.

MS-1.5 MACHMETER

MS-1.5 MACHMETER

A Machmeter is an Aircraft Pitot-Static system flight instrument that shows the ratio of the true airspeed to the speed of sound, called Mach number. This is shown on a Machmeter as a decimal fraction. The Thick Pointer indicates the Mach number. The Red Line indicates the Transonic Region.

TR3-52 FUEL METER
ТР3-52 ТОПЛИВОМЕР РАСХОДОМЕР

TR3-52 FUEL METER

The TR3-52 Fuel Meter has two separate instruments in one housing. The upper part is the Fuel Quantity Indicator that indicates remaining Fuel Quantity in Tank No. 1 from 0 up to 1,400 liters. The (interior) scale in the lower part is a Fuel Flow Meter indicating Fuel Flow to the Engines from 400 to 8,000 Liters per hour (L/h). The current Fuel Flow is indicated by the triangular index marker.
The Knob in the lower left corner is used to manually place the Totalizer Needle at the correct position after every Refuel.

LAMP - MAIN HYDRAULIC SYSTEM "LOW PRESSURE"
ПАДЕНИЕ ДАВЛЕНИЯ В ГИДРОСИСТЕМЕ

MAIN HYDRAULIC SYSTEM LOW PRESSURE LAMP

The Lamp is illuminated when the Main Hydraulic System is at Low Pressure either due to the Left Engine not operating or System Failure.

V-1 VOLTMETER
В-1 ВОЛЬТМЕТР

V-1 VOLTMETER

The V-1 voltmeter indicates Volts DC from 0 to 30 V. It will indicate 28-29 V when a Ground Power Source is connected and 24-26 V when the Battery is being used.

UVPD-15 COCKPIT ALTIMETER & DIFFERENTIAL PRESSURE
ВЫСОТОМЕР УПВД-15 И ПЕРЕПАД ДАВЛЕНИЯ В КАБИНЕ

UPVD-15 COCKPIT ALTIMETER & DIFFERENTIAL PRESSURE INDICATOR

This Instrument indicates the Cabin Altitude on the top half (Cyan)and the Differential Pressure of the Pressurized Cockpit relative to the Ambient Outside Altitude.

The Top Altimeter Labelled Cockpit Altitude (**ВЫСОТА В КАБИНЕ)** and indicates the Cockpit Altitude in km (from 0 to 15). The bottom Differential Pressure (**ПЕРЕПАД ДАВЛЕНИЙ**) indicates the pressure difference between inside the cockpit and the atmosphere outside the aircraft in kg/cm² (from -0.04 to +0.6). The Pointers reach their respective stops when the Cabin Altitude exceeds 15 km and the Positive Differential Pressure exceeds +0.6 kg/cm². This type of instrument is present in all Pressurized Cockpits as part of the system to maintain Cockpit Pressure within safe limits. Cockpit Pressurization follows a table which lowers the pressure to safest lower values as the Aircraft increases Altitude. This is done to minimize the impact on the Pilot in case of Cockpit Depressurization. The RD-2IA System Regulator will maintain Cockpit Pressure between 0.32-0.24 kg/cm² Differential Pressure, decreasing as the Aircraft gains Altitude. At an Altitude of 12,000 meters and above, the instrument will be at its limits which are 12 for Altitude and 0.24 kg/cm² for Differential Pressure.

M-2000 OXYGEN SYSTEM ALTITUDE INDICATOR

M-2000 OXYGEN SYSTEM ALTITUDE

It indicates that the Oxygen is being Diluted correctly with the Oxygen Selector in the "Mix" **(СМЕСЬ)** setting.

At Altitudes under 1.5 km the Pointer will remain at 0 km, because the Oxygen Mask is not used. From 1.5 km to 2 km, the Pointer will move to 1. The N Pointer will start moving from 2 km and up till 8 km, when it should be between 8 km and 10 km. At the Altitude of 11 km it must be at the 12 km Mark. Above 11km (from 11km to 13 km) it will go to the 18 km Mark and remain there all the time until the Aircraft Service Ceiling.

LAMP – BOMB FUSE ARMED
ТАКТИЧЕСК СБРОС ВКЛЮЧ НА ВЗРЫВ

LAMP – BOMB FUSE ARMED

The Lamp indicates the Bombs are Armed and will explode when dropped.

LAMP – LH/RH CANNON ARMED
ЛЕВОЕ/ ПРАВОЕ ПИСТОЛЕТ ГОТОВ

LAMPS - LH/RH CANNON ARMED

The illumination of the Lamps indicates that the Cannons are loaded and Ready to Fire.

LAMP - EXTERNAL FUEL DROP TANKS EMPTY
СИГНАЛИЗАЦИЯ ПОДВЕСКА БАКОВ

LAMP – EXTERNAL DROP TANKS EMPTY

The illumination of the Lamp indicates that the External Fuel Drop Tanks are Empty.

SWITCH - BOMB ARMING CIRCUIT
ТАКТИЧЕСК СБРОС ВКЛЮЧ НА ВЗРЫВ

Fig 2.25 Switch - Bomb Fuse Arming

Turning this Switch on will Arm the Bomb Fuses, if they are dropped with this Switch Off, they will be Inert.

USB-1 LH/RH CANNON AMMO COUNTER
УСБ-1 ОСТАТОК ПАТРОНОВ

LH&RH CANNON AMMO COUNTERS

Both Ammunition Counters have a Knob to reset the Counters after the Aircraft Cannons have been Rearmed. Normal Loaded Quantity is 70 Cartridges per Cannon, but the Maximum Capacity is 90 Cartridges per Cannon.

LAMP - LOAD SUSPENDED ON LH/RH WING PYLON
ЛЕВОЕ/ПРАВОЕ ПОДВЕСКИ БОМБ

LAMPS – SUSPENDED LOADS

The respective Lamp indicted the presence of either External Drop Tanks, Free Fall Bombs or ORO-57K Rocket Pods are attached to the Pylon.

МА-12 DUAL BRAKE PRESSURE GAUGE
ДВУХ-СТРЕЛОЧНЫЙ МАНОМЕТР ТОРМОЗОВ

МА-12 DUAL BRAKE PRESSURE INDICATOR

The Dual Pointer Brake Pressure Indicator, labelled **ВОЗДУХ**, indicates the Braking Air Pressure for both LH and RH Main Landing Gear Wheel Brakes, from 0 to 12Kg/cm^2.

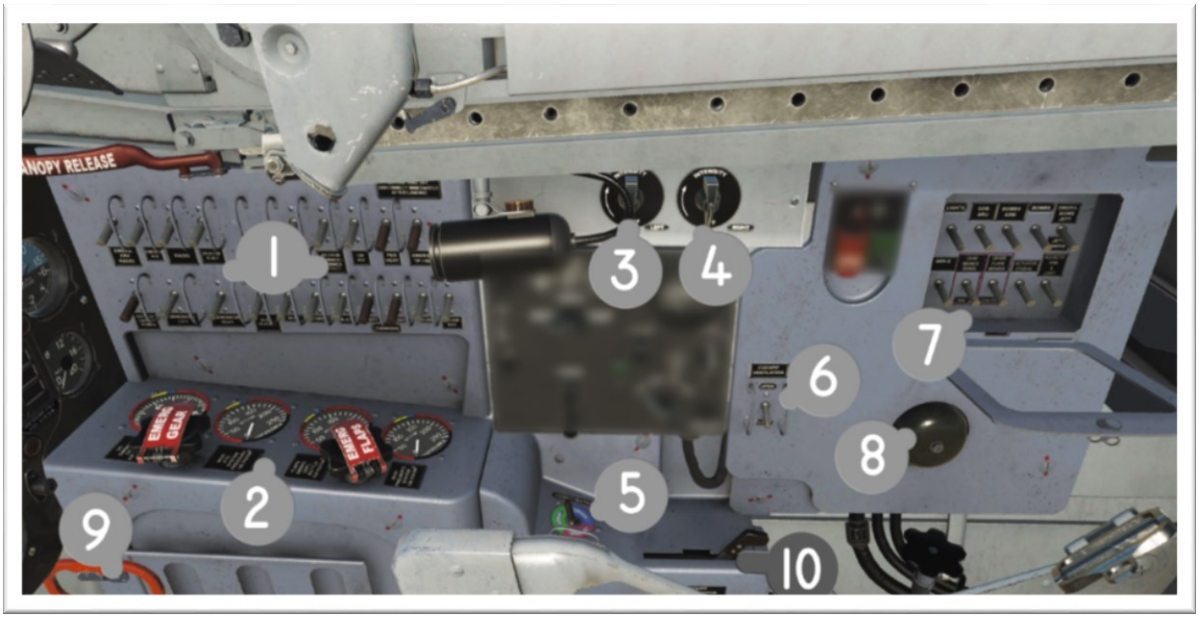
The Pointers move to a Maximum of 11.5Kg/cm^2 when Braking with the Main System and to 12Kg/cm^2 when Braking with the Emergency Brake System.

МА-250 EMERGENCY HYDRAULIC SYSTEM PRESSURE GAUGE
ГИДРОСИСТЕМА БУСТЕРНАЯ МАНОМЕТР

BOOSTER HYDRAULIC SYSTEM PRESSURE GAUGE

Indicates the Booster Hydraulic System Pressure, which should be the same as the Main Hydraulic System Pressure: 142 Kg/cm^2.

Right Side Instrument Panel
ПРАВОЕ ПУЛЬТ

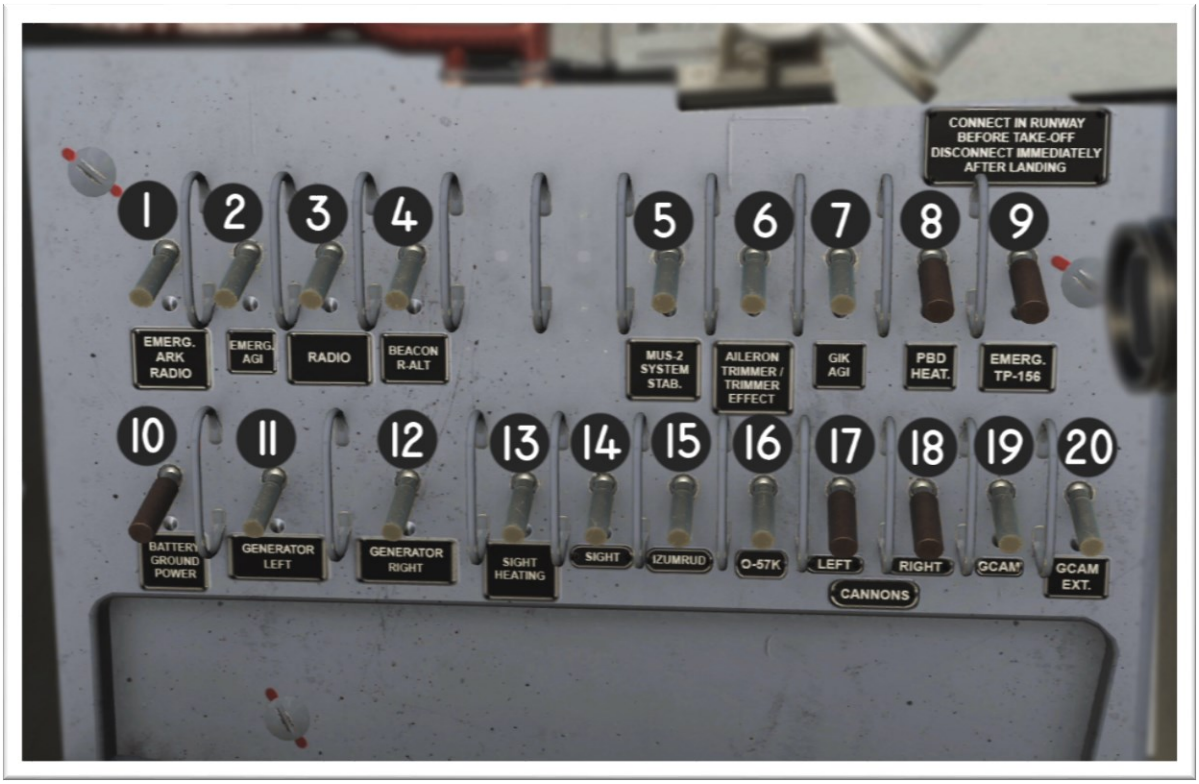


RH SIDE INSTRUMENT PANEL

1. Avionics and Armament Switch Panel
2. Hydraulic and Pneumatic System Pressure Gauges and Emergency Deployment Valves
3. RUFO-45 LH Side Lamp Rheostat
4. RUFO-45 RH Side Lamp Rheostat
5. Cockpit Air Conditioning Temperature Control Switch **(ОБОГРЕВ КАБИНЫ)**
6. Cockpit Ventilation Control Switch **(ВЕНТИЛЯЦИЯ КАБИНЫ)**
7. Circuit Breaker Panel
8. Marker Receiver Buzzer
9. Landing Gear Emergency Deployment Handle **(АВАРИЙНОЙ ШАССИ)**
10. Cockpit Air Supply and Pressurization Handle

    This Handle closes of all the compressor air from the engines thereby controlling cockpit pressurization and temperature control systems.

AVIONICS AND ARMAMENT SWITCH PANEL



AVIONIC AND ARMAMENT SWICTH PANEL

1. Emergency Power to **ARK-5** and **RSIU-4V** Radios **(АВАРИЙН АРК РАЦИЯ)**
2. Emergency Power to **AGI-1** Artificial Horizon System **(АВАР АГИ)**
3. **RSIU-4V** Radio **(РАЦИЯ РАСХОДОМ)**
4. **MRP-56P** Marker Beacon Receiver and **RV-5** Radar Altimeter **(МАРКЕР РВ)**
5. **MUS-2** Stabilizer Electric Control System **(УПРАВЛ. МУС-2 СТАБИЛ)**
6. Aileron and Pitch Trim **(ТРИММЕР ЭЛЕРОНА ТРИММЕР ЭФФЕКТ)**
7. **GIK-1** and **AGI-1** Directional and Attitude Gyroscope Systems **(ГИК АГИ)**
8. Heating Main **PVD** Air Data Probe and Clock **(ПВД ЧАСЫ)**
9. Heating Standby **TP-156** Air Data Probe **(АВАР. ТП-156)**
10. Battery Power **(АККУМУЛ БОРТОВОЙ АЭРОДР)**
11. LH DC Generator **(ГЕНЕРАТОР ЛЕВЫЙ)**
12. RH DC Generator **(ГЕНЕРАТОР ПРАВЫЙ)**
13. **ASP-5N** Gunsight Heating **(ОБОГРЕВ ПРИЦЕЛА ПРИЦЕЛ)**
14. **ASP-5N** Gunsight Power **(ПРИЦЕЛ)**
15. **RP-5** Radar Power **(ИЗУМРУД)**
16. **ORO-57K** Rocket Pods Power **(Р.С.)**
17. LH **NR-30** Cannon Power **(ЛЕВАЯ ПУШКИ)**
18. RH **NR-30** Cannon Power **(ПРАВАЯ ПУШКИ)**
19. Cockpit Gun Camera Power **(ФКИ)**
20. Aircraft Gun Camera Power **(ФКИ ОРУЖИЕ**

HYDRAULIC AND PNEUMATIC SYSTEM GAUGES

HYDRAULIC AND PNEUMATIC SYSTEM GAUGES

1. MA-80 Gauge. Pneumatic Air Pressure Available for Emergency Landing Gear Deployment, which must be 50 kg/cm². **(ДАВЛЕНИЕ В АВАРИЙНОЙ БАЛЛОНЕ ШАССИ)**
2. MA-250 Gauge. It shows Main Hydraulic System Pressure. Normal operating pressure is 142 kg/cm². **(МАКСИМ. ДАВЛЕНИЕ В ОСНОВНОМ ГИДРО-СИСТЕМЕ)**
3. MA-250 Gauge. Pneumatic System Air pressure for Emergency Flaps Deployment. 130 kg/cm². **(ДАВЛЕНИЕ В АВАРИЙНОЙ БАЛЛОНЕ ЗАКРЫЛКОВ)**
4. MA-250 gauge. Pneumatic System Air pressure in the Pneumatic System. Value must be 150 kg/cm². **(МАКСИМ. ДАВЛЕНИЕ В ОСНОВНОМ БАЛЛОНЕ)**
5. Emergency Landing Gear Deployment **(АВАРИЙНОЙ ШАССИ)** in case of Hydraulic System failure. Rotating this valve will introduce air pressure into the Landing Gear Retraction Hydraulic Actuators.
6. Emergency Flaps Deployment (Flaps will move to the 25° Takeoff Position) in case of Hydraulic System failure. Opening this Valve will introduce air pressure into the Flap Hydraulic Actuators.

WARNING: After Deploying the Gear and/or Flaps using the Emergency Pneumatic System, they cannot be Retracted again until a repair has been performed, otherwise the hydraulic lines may burst due to overpressure.

COCKPIT AIR TEMPERATURE CONTROL SWITCH
ОБОГРЕВ КАБИНЫ

COCKPIT AIR TEMPERATURE CONTROL

1. GREEN: AUTO **(АВТОМАТ)**. It will maintain the last Manually set Temperature.
2. RED: HOT **(ГОРЯЧИЙ)**. Increases Cockpit Temperature by adding hot air from the last Engine Compressor Stage.
3. BLUE: COLD **(ХОЛОДНЫЙ)**. Decreases Cockpit Temperature by adding cooler air from the First Compressor Stage.

The Pilot places the Switch in COLD or HOT as desired and when a comfortable temperature is reached, the switch is moved to AUTO. The System will then retain the last temperature setting.

NOTE: Too low temperatures can cause the Canopy to freeze, especially if the ambient temperature is close to or below 0°C.

RH CIRCUIT BREAKER PANEL

RH CIRCUIT BREAKER PANEL

1. Disables the Landing/Taxi Lighting System **(ФАРЫ)**
2. Disables the **ARU-2V** flight control system **(УПРАВЛ. АРУ)**
3. Disables Bomb Arming System **(ВЗРЫВ НЕ ВЗРЫВ)**
4. Disables Bomb Release System **(БОМБЫ)**
5. Disables Emergency Jettison of Bombs and Jettisoning of Drop Tanks **(АВАР СБРОС БОМБ/ СБРОС БАКОВ)**
6. Disables **ARK-5P** Radio Navigation System **(АРК РАСХОДОМ)**
7. Disables Gear, Flaps, Airbrake Position Indication Systems and Navigation Lights **(СИГН ШАССИ ТОРМ. ЩИТ/ АНО)**
8. Disables Gear, Flaps, Airbrake, and Drag Chute deployment **(ШАССИ ЗАКРЫЛ ТОРМОЗ/ ПАРАШ.)**
9. Disables **BU-13M** and **BU-14M** Aileron and Stabilizer Hydraulic Boosters **(БУ СТАБИЛ. ЭЛЕРОНОВ)**
10. Disables Cockpit Lighting and Rocket Launching Systems **(АРУФОШ ПЕРЕНОС ЛАМПЫ РАКЕТЫ)**

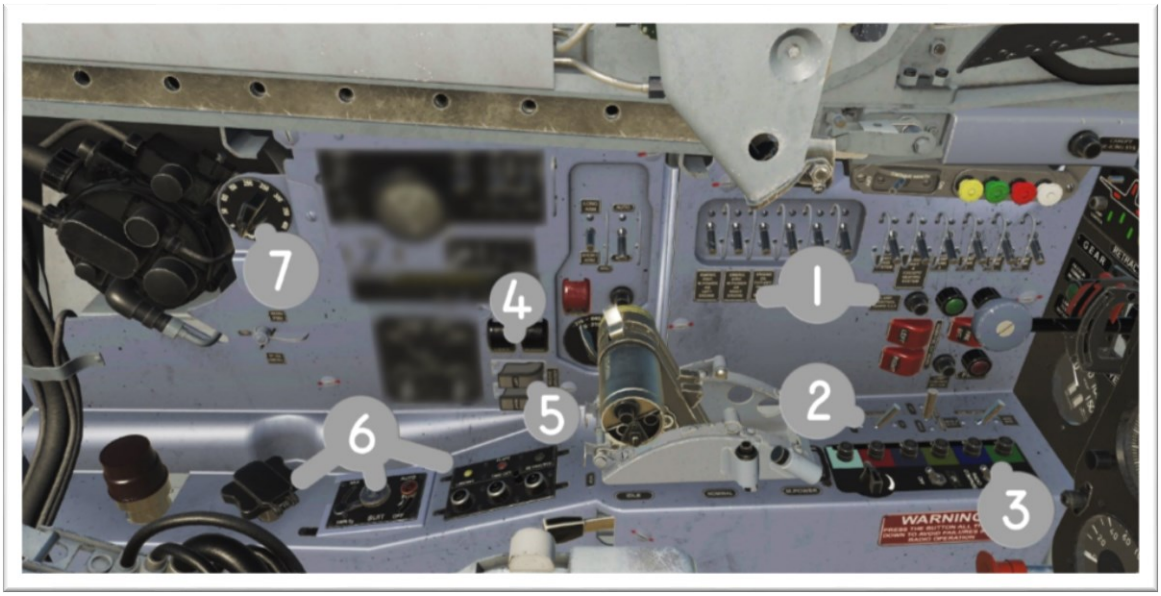
LANDING GEAR EMERGENCY DEPLOYMENT HANDLE
АВАРИЙНОЙ ШАССИ

LANDING GEAR EMERGENCY DEPLOYMENT HANDLE

With the Landing Gear Handle in its Neutral Position, this Emergency Deployment Handle for the Landing Gear can be used in case the of Hydraulic System Failure. Pulling this Handle releases the Landing Gear Uplocks by a Cable System, allowing the Landing Gear to Free Fall and allowing the use of the Emergency Landing Gear Deployment Pneumatic Air Pressure to Lock the Landing Gear Down, illuminating the Green Gear Position Indication lights on the PPS-1 panel.

Left Side Panel

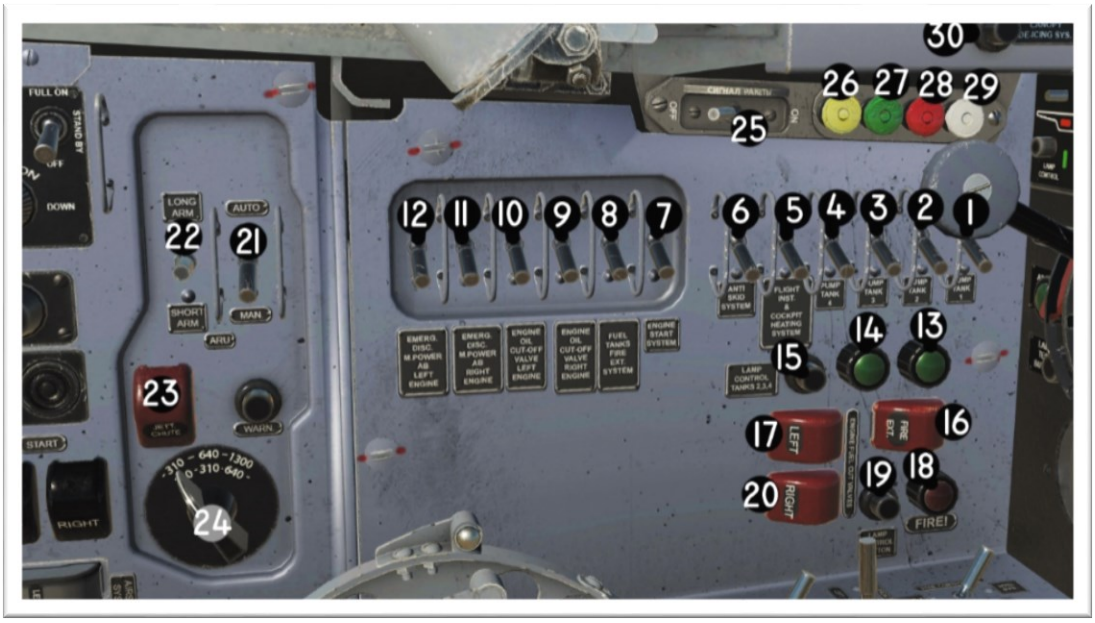
ЛЕВОЕ ПУЛЬТ



LH SIDE INSTRUMENT PANEL

1. Fuel and Engine System Switches, Fire Extinguisher and Emergency systems, ARU-2V Control Panel
2. Trim, Aileron and Stabilizer Control
3. RSIU-4V radio
4. Engine Start Buttons
5. Engine Air-Start System Switches
6. Flap Control Panel, Oxygen System
7. RV-5 Radar Altimeter Minimum Altitude Selector

FUEL & ENGINE SYSTEM SWITCHES, FIRE EXTINGUISHER & EMERGENCY SYSTEMS, ARU-2V CONTROL PANEL



FUEL & FIRE SYSTEM, FIRE EXTINGUISHER & EMERGENCY SYSTEMS

1. Switch - Fuel Pump Tank 1 **(НАСОС 1. ГО БАКА)**
2. Switch - Fuel Pump Tank 2 **(НАСОС 2. ГО БАКА)**
3. Switch - Fuel Pump Tank 3 **(НАСОС 3. ГО БАКА)**
4. Switch - Fuel Pump Tank 4 **(НАСОС 4. ГО БАКА)**
5. Switch - Flight Instruments Heating System **(ЗУПНЛЦ-РН ПРОТИВООЬЛ КОЗЫРЬКА ОБОГРЕВ КАБИНЫ КАБ ЛАМПЫ)**
6. Switch - Anti-Skid System **(АВТОМАТ ТОРМОЖ КОЛЕС)**
7. Switch - Engine Start System **(АГРЕГАТЫ ЗАПУСК)**
8. Switch - Fire Detection System **(ПРИБОРЫ ДВИГ ПРОТИВОПОЖАРН ОБОРУД СИГНАЛ ПОМПЫ)**
9. Switch - RH Engine Oil Cut-Off Valve **(ПЕРЕКР КРАН ДАВЛЕН МАСЛА ПРАВОГО ДВИГ)**
10. Switch - LH Engine Oil Cut-Off Valve **(ПЕРЕКР КРАН ДАВЛЕН МАСЛА ЛЕВОГО ДВИГ)**
11. Switch - RH Engine MILITARY POWER and AFTERBURNER Disconnect **(АВАРИЙН ОТКЛЮЧЕН ФОРСАЖА МАИСИМАЛ ПРАВ ДВИГ)**
12. Switch - LH Engine MILITARY POWER and AFTERBURNER Disconnect **(АВАРИЙН ОТКЛЮЧЕН ФОРСАЖА МАИСИМАЛ ЛЕВ ДВИГ)**
13. Light - "Fuel Tank No.2 Empty"
14. Light - "Fuel Tanks 3 and 4 Empty"
15. Button - Lamp Test Tanks 2, 3 and 4 lamps (Items 13, 14)

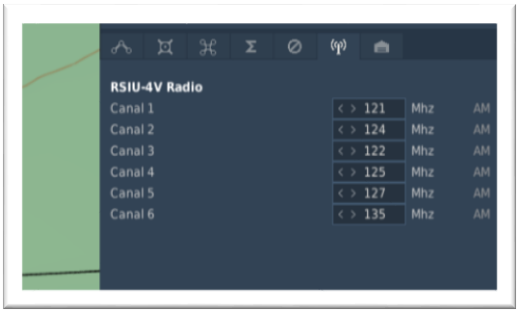
16. Button - Fire Extinguisher Activation **(ОГНЕТУ-ШИТЕЛЬ)**
17. Button - LH Engine Fuel Cut-Off Valve **(ПЕРЕКРЫВНОЙ КРАН ЛЕВ.)**
18. Lamp - Engine Fire **(ПОЖАР)**
19. Button - Lamp Test Engine Fire **(КОНТРОЛЬ ЛАМП ПОЖАР)**
20. Button - RH Engine Fuel Cut-Off Valve **(ПЕРЕКРЫВНОЙ КРАН ПРАВ)**
21. Switch - ARU-2V AUTO/MANUAL mode selection **(АРУ-2В АВТОМ/РУЧНОЕ)**
22. Switch - ARU-2V Long Arm/Short Arm setting **(БОЛЬШ ПЛЕЧО/ МАЛОЕ ПЛЕЧО)**
23. Switch - TP-19 Drag Chute Jettison **(СБРОС ПАРАШЮТА)**
24. Selector - ARK-5P "Far" Frequency
25. Switch - Signal Flare Dispenser Power **(СИГНАЛ РАКЕТЫ - ВКЛ./ ВЫКЛ.)**
26. Button - Yellow Flare
27. Button - Green Flare
28. Button - Red Flare
29. Button - White Flare
30. Button - Windshield De-Icing **(ПРОТИВООБЛЕДЕНИТЕЛЬ)**

TRIM, AILERON AND STABILIZER CONTROL

TRIM, AILERON AND STABILIZER CONTROL

1. Switch - BU-13M Aileron Hydraulic Booster Power. In the Off Position the Aileron Hydraulic Actuator is Disabled, and the Ailerons will revert to Mechanical Control and so will appear sluggish at higher speeds.
2. Switch - Aileron Trim
3. Switch - Elevator Actuator Control. Selects the stabilizer method of control.
    - HYD. SYS. Position for the BU-14M Hydraulic Booster
    - MUS-2 ELEC. Position for the MUS-2 Electric Control System.

RSIU-4V RADIO



RSIU-4V RADIO CONTROLS

1. Preset Radio Channel Buttons
2. ARK-5 Morse Identifier for NDBs Enable Switch
   Radio (Up): Radio Audio Only
   Radio Compass (Down): Radio and ARK-5P NDB Morse Identifier Audio.
3. Squelch Disable Switch. Based on received signal strength, if the signal is too weak or filled with noise, the radio will suppress that frequency until an improvement of the signal strength occurs. Disabling this feature allows hearing of distant radio transmissions at the expense of an increase in background noise.
4. Radio volume control knob

The RSIU-4V radio operates in the frequency range of 100-150 MHz (2-3 meters) and in this specific aircraft version it can store up to 6 pre-defined frequencies. It is connected to the ARK-5P radio navigation system to allow for the reception of Morse codes transmitted from NDBs.

RSIU-4V Preset Radio Channels Settings can be set in the Radio Tab of the DCS Mission Editor.

ENGINE START BUTTONS & AIR RE-LIGHT SYSTEM

ENGINE START BUTTONS & AIR RE-LIGHT SYSTEM SWITCHES

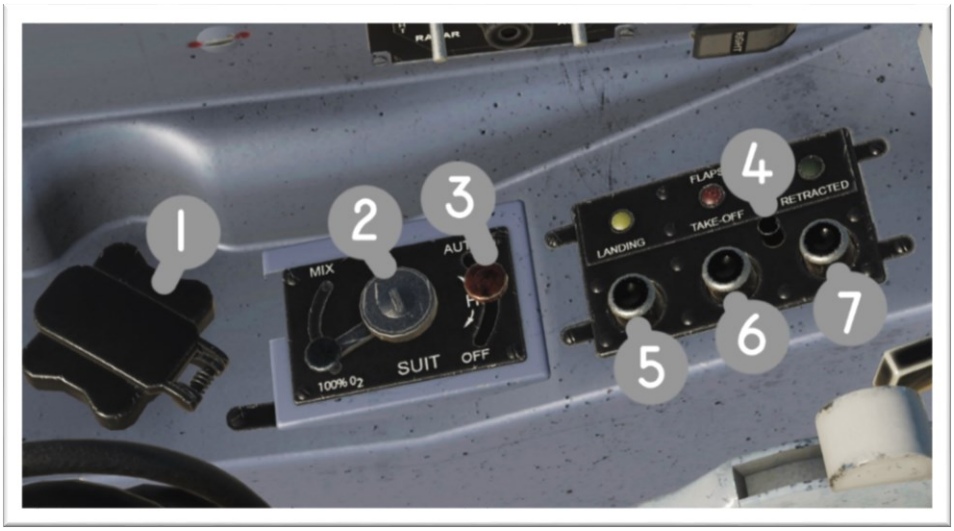
1. Left Engine Start Button **(ЛЕВЫЙ ЗАПУСТИТЬ ДВИГАТЕЛЬ)**
2. Right Engine Start Button **(ПРАВЫЙ ЗАПУСТИТЬ ДВИГАТЕЛЬ)**
3. Left Engine Air Re-Light System Switch **(ЛЕВЫЙ ЗАПУСК В ВОЗДУХЕ ВКЛ.)**
4. Right Engine Air Re-Light System Switch **(ПРАВЫЙ ЗАПУСК В ВОЗДУХЕ ВКЛ.)**

RV-5 RADAR ALTIMETER MINIMUM ALTITUDE SELECTOR

RV-5 RADAR ALTIMETER MINIMUM ALTITUDE SELECTOR

The "K" position operates the Built-In Test for the Radar Altimeter. The Indicator Pointer moves to 100 meters and starts moving back to zero over 10 seconds. When the Pointer arrives at the 10-meter mark, a high pitch sound should be heard in the Helmet Earphones indicating that the Radar Altimeter is working properly.

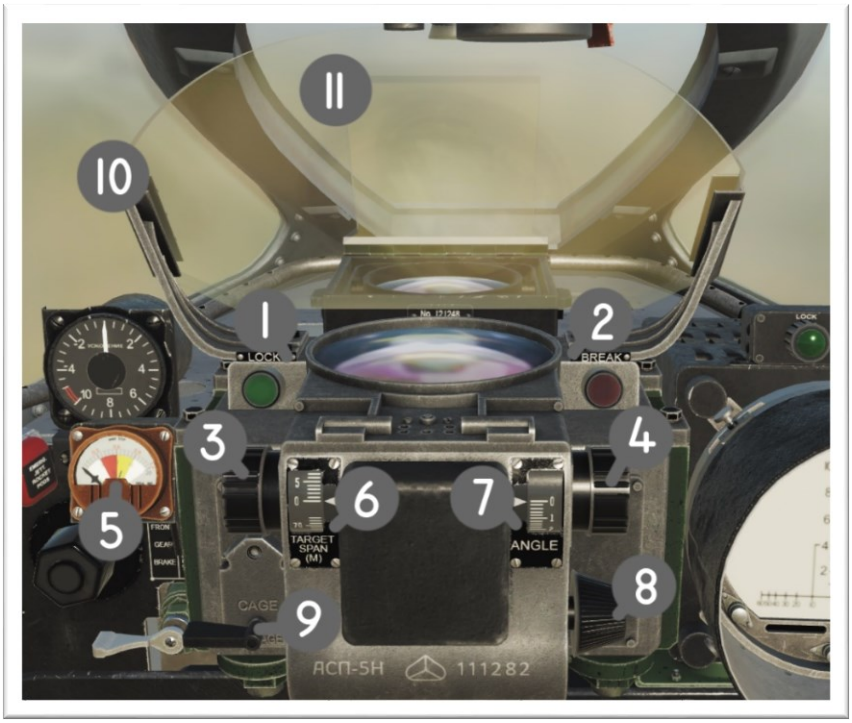
FLAP CONTROL PANEL & OXYGEN SYSTEM CONTROLS



FLAP CONTROL PANEL & OXYGEN SYSTEM CONTROLS

1. Oxygen System Shut-Off Valve. Shuts Off the Oxygen Supply to the Cockpit.
2. Oxygen System Mode Selector Control Panel.
    - **MIX:** Automatic Operation of the Oxygen System, diluted Oxygen Supply dependent on Aircraft Altitude.
    - **100% O_2:** 100% oxygen supply to the Pilot. Normally only used in Emergency Situations.
3. Altitude Pressure Suit Mode Selector.
    - **AUTO:** Automatic Operation of the Suit Oxygen/Air Supply dependent on Aircraft Altitude.
    - **N:** neutral mode of operation, keeps the last auto setting.
    - **OFF:** Altitude Suit is De-Pressurized; the Oxygen Supply is turned Off.
4. Flaps Panel Reset Button. Used to deselect the previous Flap Position Selector Button that was selected. This does not deactivate the last Flap Setting only the Button pressed.
5. Button – Extends the Flaps to the Landing Position
6. Button – Moves the Flaps to the Take-Off Position
7. Button – Retracts the Flaps to the Fully Retracted Position

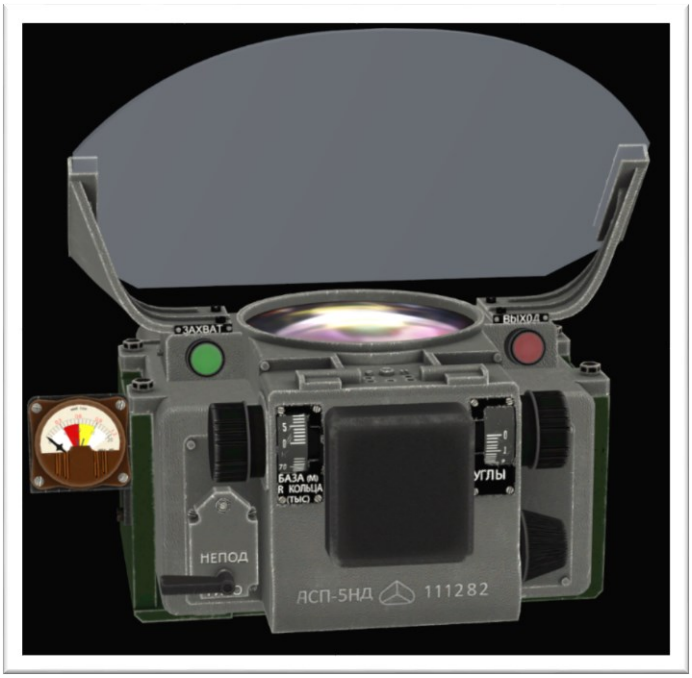
ASP-5N Gunsight, AR-18-8 Radar Sight & ASP-5N Control Panel



ASP-5N GUNSIGHT (FRONT) AND AR-18-8 RADAR SIGHT (BACK)

1. Lamp - ”Lock”
2. Lamp - ”Break”
3. Target Wing Span/Base Selector Knob
4. Dive Angle Selector Knob for Bombs and Rockets use
5. Target Distance. Displayed automatically when the Sight is in “Radar” Mode
6. Target Span Selection Scale
7. Dive Angle Selection Scale
8. Sight Reticle Brightness Knob
9. Sight Cage/Uncage Lever
10. ASP-5N Glass
11. AR-18-8 Glass

ASP-5N GUNSIGHT



ASP-5N GUNSIGHT

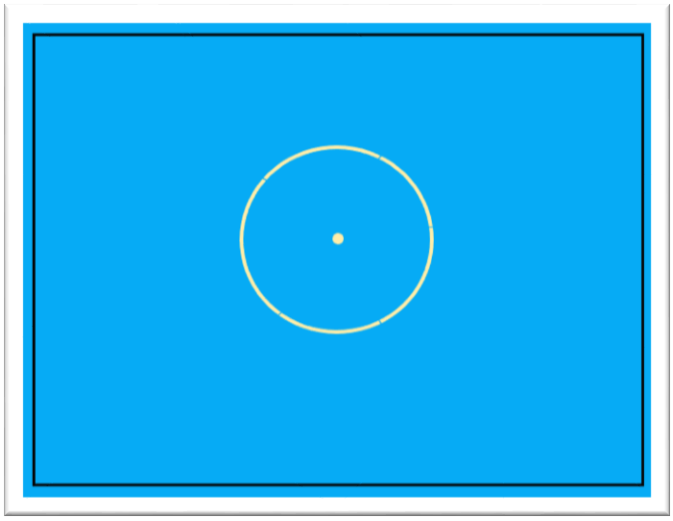
The ASP-5ND Gunsight is used to provide aiming solutions for Air Combat and Ground Attack. It uses both Collimator-Type Optics and is also Synchronized to the RP-5 Radar System. For Air Combat it can be used in conjunction with the RP-5 AR-18-16 Tracking Antenna to provide for the Lead to hit the Target or it can be used to aim by Optical means, using the Sight's 3-axis Gyro System. In Optical Mode, Target Wing Span is introduced by the "Target Wing Span/Base" Selector and Distance to Target is introduced by the rotation of the Throttle Grip. The Sight receives Barometric Altitude data automatically.

ASP-5N CHARACTERISTICS

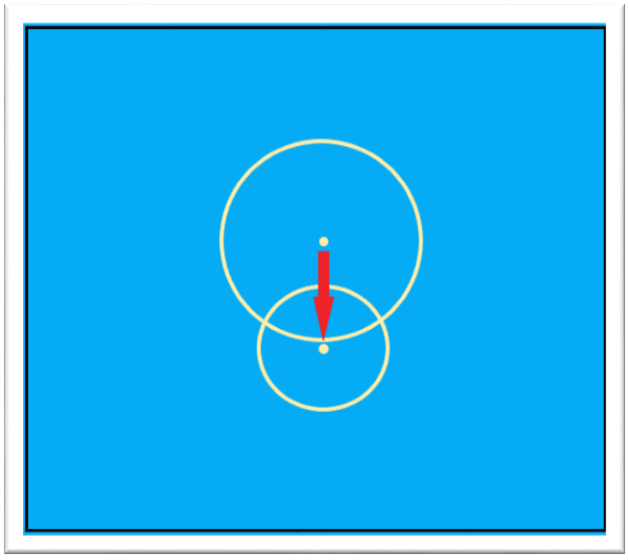
PARAMETER	VALUE
AIR to AIR	
Range to Target, m	200 – 2,000
Target Wingspan, m	7 - 70
Altitude of Operation, m	500 – 25,000
Ambient Temperature	-60 to +50°C
Target Speed, Km/h	500 – 2,250
Own Aircraft Speed, Km/h	500 – 2,500
GROUND ATTACK	
Diving angle	20 - 50°
Range to Target, m	200 – 2,000
Altitude, m	500 – 1,500
Speed, Km/h	600 - 900
Target speed, Km/h	0 - 90

The Sight indication consists of a Central Dot and an Outer Circle. The Central Dot indicates the Aiming Point of the Cannons. The Sight Outer Circle changes its Diameter (in Optical mode) from 11 to 70 mils (1°15´ to 8°) dependent upon the Target Wing Span and Target Distance. This can be done by rotating the Wing Span/Base Knob on the Sight and rotating the Engine Throttle Grip.

ASP-5N SIGHT INDICATIONS



When in Caged Mode, the Sight will maintain the indication centered at the correct Aiming Point based on Distance for a Static Aircraft. When the Distance is changed in the Caged Mode, by rotating the Throttle Grip, the Reticle will move up or down to compensate for bullet drop.



The Image above is an example of the Sight Indication when increasing the Distance to Target. The Larger Circle is the initial position and the Smaller Circle is the final position. Note the Diameter Decreases and the Cannon Aiming point moves Down, compensating for bullet drop.

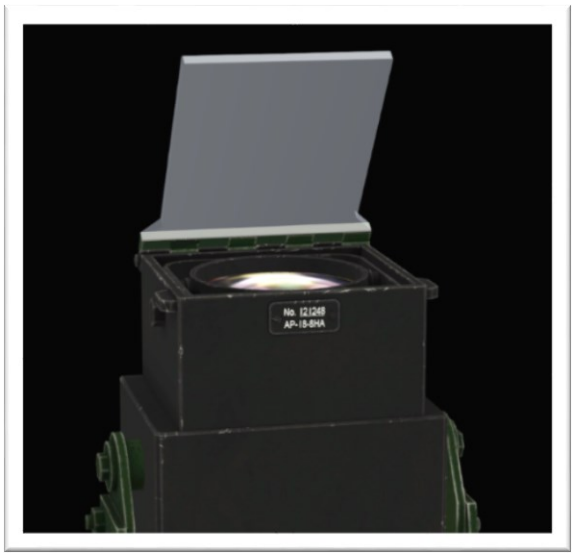
The Caged Position does not allow the sight to use the Gyro to calculate the Target Lead Angle.

Moving the lever to the Uncage Position allows the Sight to use its Gyros to start Calculating the Cannon Aiming Point based on Angular Velocity, Target Wing Span and the Distance to Target that has been selected. In this Mode, the Reticle will move on the Sight Glass, displaying the correct bullet arc for a preselected Distance. Air Density, which is sampled continuously, and bullet flight time are known values that are considered for the calculations. On the MiG-19, a set of special cartridges with Ballistic Data about the type of Armament to be used is installed before the Flight. This includes FAB-100/250 bombs, ARS-57M/S-5M rockets and 30-mm ammunition for the NR-30 Cannons.

In Radar mode, the Target Distance is received automatically. After the Target has been Locked by the Radar, the ASP-5N "Lock" Lamp is illuminated at 2,000 meters, which is the range for Cannon Armament. When the Target Distance approaches 300 meters, the "Break" Lamp will be illuminated, and all the Aiming Data will be reset after 3 seconds. These Lamps only work when in "Radar" mode.

WARNING: During Taxi, Take-Off and Landing, the sight must be in Caged Mode. Otherwise the Gyros may be damaged by bouncing during Taxiing or with the Aircraft's contact with the Runway during Landing.

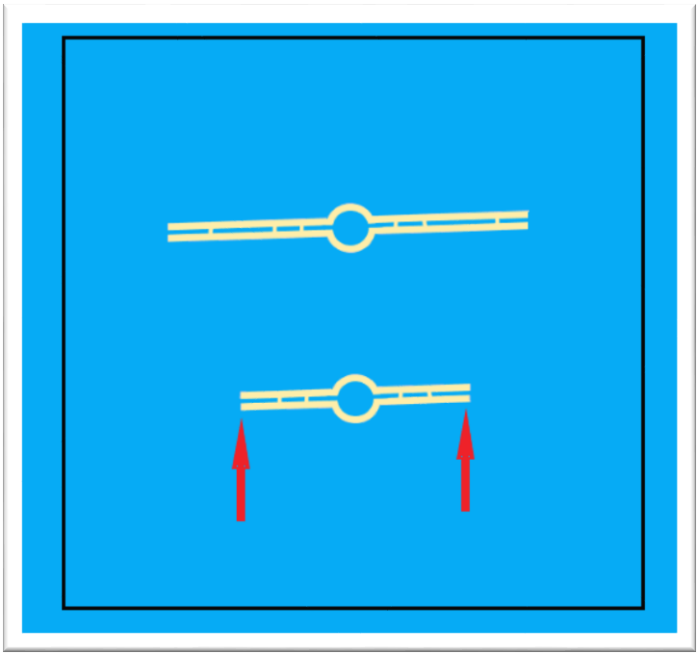
AR-18-8 RADAR SIGHT



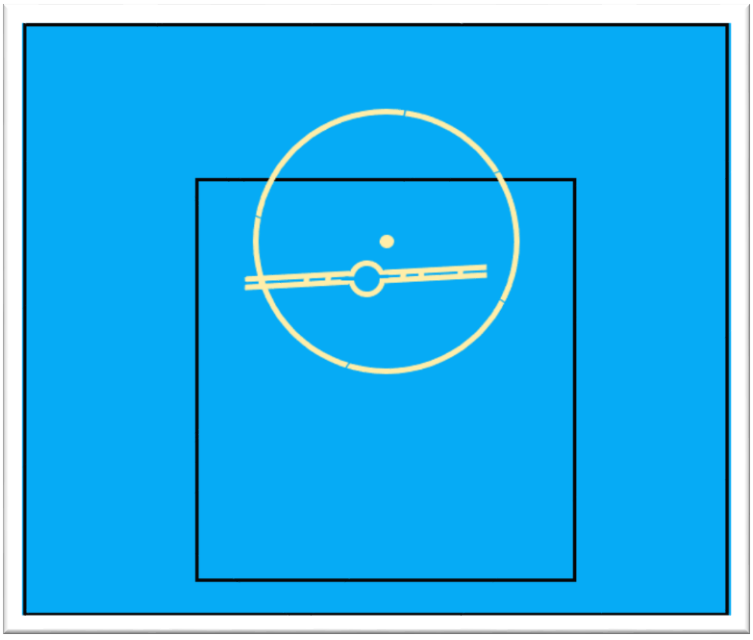
AR-18-8 RADAR SIGHT

The AR-18-8 Radar Sight shows the direction where the AR-18-16 Tracking Antenna is pointed at in the Sky, thereby displaying the Target Position in Relation to the Aircraft. Target indication, also known as "Bird", is the representation of an Aircraft and indicates the Target Position. The Wingspan of the Indication changes in relation to Distance to Target (the Indication's Wing Span increases as the Distance to the Target reduces). The Sight will start displaying the Target Indication as soon as a Target is Locked by the Radar.

NOTE: The Target Indication is only representative of Target Aircraft Position and Distance in Relation to the Interceptor. The Indication does not Roll to reflect the Target's Roll Angle relative to the Horizon, it is fixed in the Horizontal Position.



RADAR SIGHT INDICATING DISTANCE CHANGES



COMBINED INDICATION FROM THE RADAR AND GUNSIGHTS

ASP-5N CONTROL PANEL

ASP-5N Control Panel

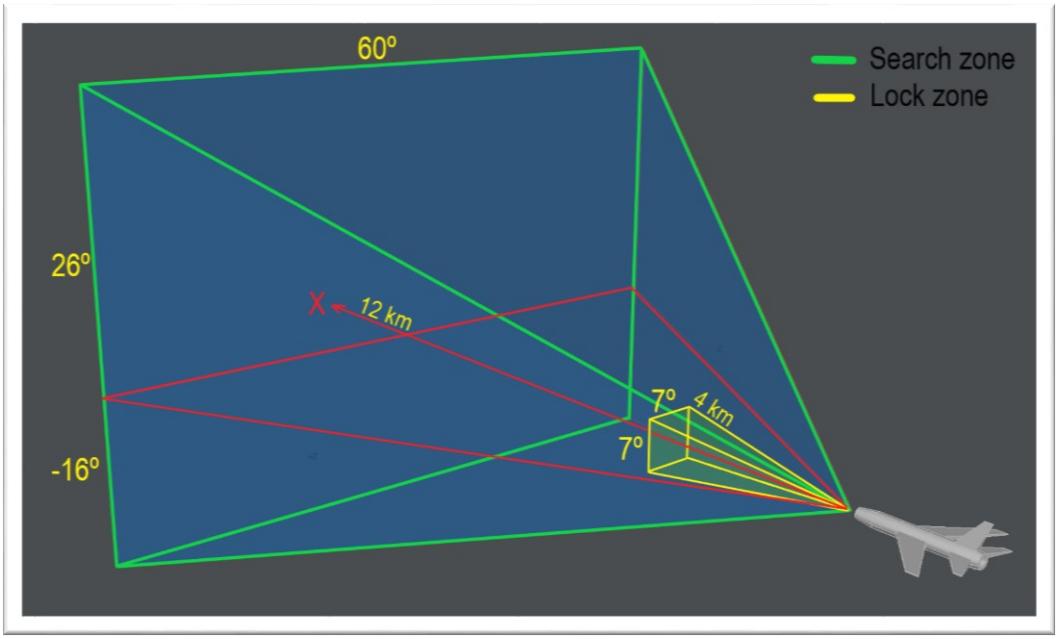
1. Sight Armament Employment Mode. From Left to Right:
   - ARS-57M/S-5M Rockets
   - FAB-100/250 Bombs
   - NR-30 30-mm Cannons
   - R-3S IR Guided Missiles
2. Sight Aiming Mode.
   - OPTIC: Manual introduction of the Target Wing Span and Distance.
   - RADAR: Aiming Calculations are provided by the RP-5 Radar.
3. Bomb Release Mode.
   - MANUAL: Bombs are released at every press of the Armament Trigger Switch.
   - AUTO: Both Bombs are released together.

RP-5 Radar & Radar Screen, RP-5 Radar Control Panel

The RP-5 Izumrud (Emerald) is an update of the RP-1, installed in the MiG-17PF and early production MiG-19P Aircraft. It increased the Detection Range from 10 to 12Km and the Lock Range from 2 to 4Km. It is used to Search and Track Air Targets and provide a firing solution to destroy them if necessary. The Radar cannot be used in the Air-to-Ground role. Because it uses two different antennas to Search and Track, it can Lock onto a Target while still displaying Search Data on the Radar Screen, (could be argues it's a very primitive sort of a Track-While-Scan (TWS) Capability). However, the early Radar capabilities are very limited, as it´s only capable of displaying as much as 10 Contacts and can only Lock one Target.

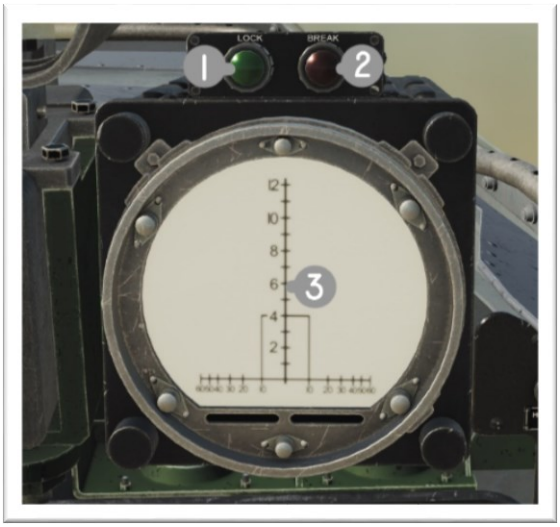
RP-5 RADAR CHARACTERISTICS

PARAMETER	VALUE
Max Search Range, Km	12
Max Lock Range, Km	4
Detection Range for a Tu-16 Bomber, Km	10 - 11
Detection Range for a MiG-21 Fighter, Km	8 - 9
Lock range for Tu-16, Km	4
Lock range for MiG-21, Km	3 - 3.5
Altitude of operation, m	Above 2,000
Time to complete a full scan	1.3 seconds
Coverage in Azimuth	60°
Coverage in Elevation	+26°/-16°
Max time of continuous operation	15 minutes



The RP-5 is heavily affected by Ground returns at Low Altitude, making it impossible to use at Altitudes below 2,000 meters. The Radar has an Altitude Mode Switch, on the Main Instrument Panel, which disconnects the Search Antenna and reduces the Track Antenna Range from 4,000 to 1,200 meters. This allows for Automatic Aiming Solutions from 2,000 meters down to 1,000 meters in Daylight Conditions. This transforms the RP-5 into a Radio-Rangefinder.

RP-5 RADAR SCREEN

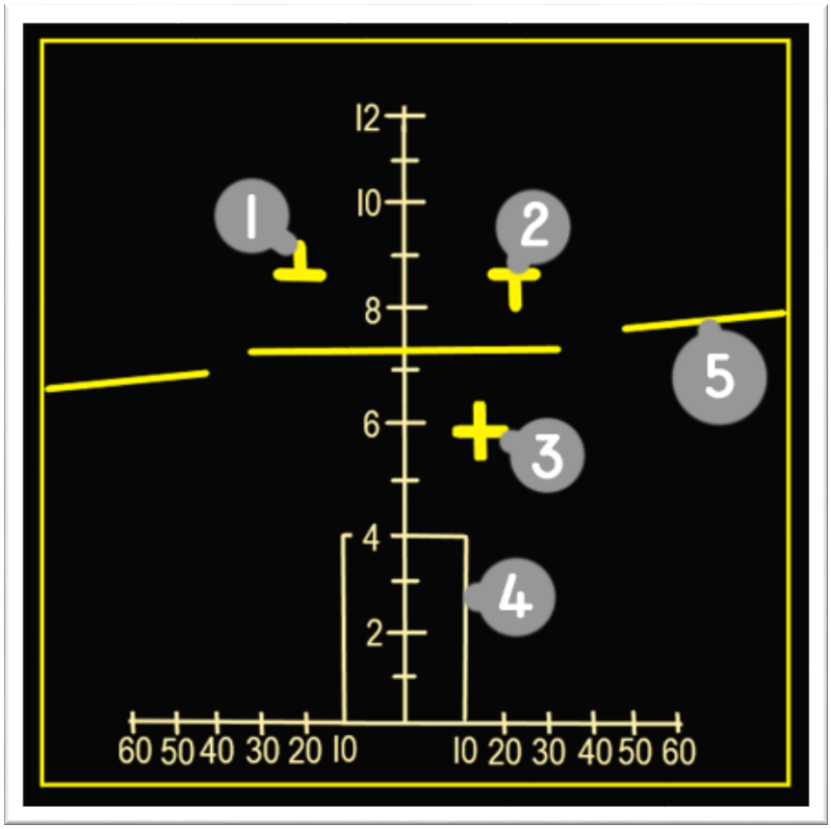


RP-5 CRT RADAR SCREEN

In the MiG-19P, the Radar Data is displayed on a Cathode Ray Tube (CRT) Screen which has the Radar Scale marked into a Glass Panel that is in Front of the Main Screen. This Scale is backlit by a Red light. The Main Radar Screen is Yellow when On, displaying the Contacts and the Electronic Horizon in White. A Metal and Leather Hood is used during Daytime to allow the Screen to be seen in bright daylight.

1. "Lock" Lamp (Target Locked)
2. "Break" Lamp (Leave the Attack)
3. Radar Distance Scale

RADAR SCREEN INDICATION



RADAR SCREEN INDICATION

1. Radar Contact at a greater Altitude than the Interceptor
2. Radar Contact at a lower Altitude than the Interceptor
3. Radar Contact at approximately the same altitude as the Interceptor
   NOTE: This is the correct Altitude in relation to the Interceptor that is needed in order to Acquire a Target Lock
4. RP-5 Radar "Lock" Range Window
5. Electronic Horizon (ADI)

NOTE: The wings represent the Horizon, the Center Line represents the Aircraft.

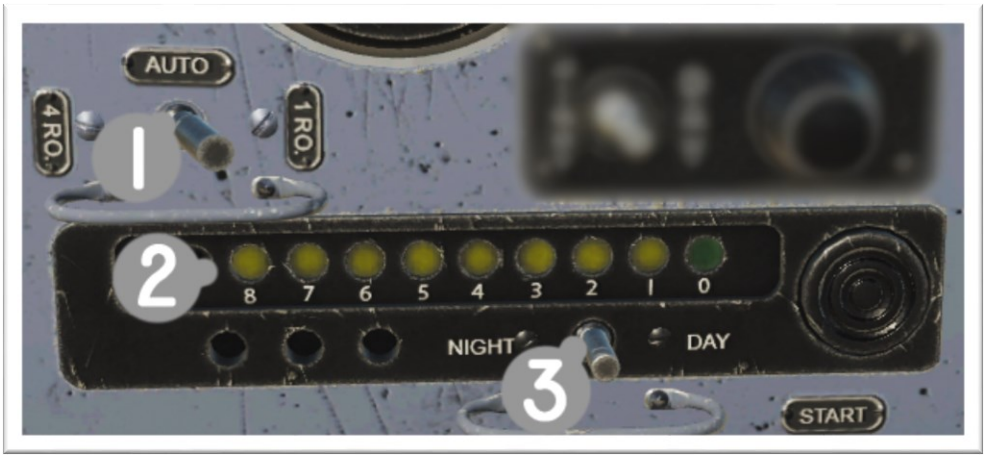
RP-5 CONTROL PANEL

RP-5 CONTROL PANEL

1. Radar Anti-Jamming (ECCM) Mode Switch
   Reduces Antenna Sensitivity, converting the Jamming Cloud into a Line.
2. Radar Built-in Test (BIT) Button
   By pressing the BIT button for 2 seconds the Radar starts checking that all elements are working correctly. This is done by generating a Target signal that appears on the Screen at about 6Km and to the Left of the Screen. The Target starts moving towards the Center of the Lock Zone at 4Km and then, staying in the Center, starts moving towards the Aircraft. The Radar should Lock on to Target (the Green "Lock" **(ЗАХВАТ)** Lamp over the Radar Screen illuminates) and then start to display Target Position information on the AR-18-8 Radar Sight. At 2,000m the ASP-5N Sight should start displaying Aiming Indications and the green Lock **(ЗАХВАТ)** Lamp to the left illuminates. At 300m, the red "Break" **(ВЫХОД)** **L**amp will illuminate and after 3 seconds the Aiming Indication is Reset (the Target Mark on the Radar Sight disappears, and the ASP-5 Sight displays a Fixed Reticle) and the Target is rejected by the Radar.
3. Radar Gauge Display Mode Switch. This switch controls the information displayed in the Panel Gauge. In the Up – "Crystal" Position, the Gauge displays the Main Radar Voltage. In the Down – "Press." (for Pressure) Position, the Gauge displays the Air Pressure in the Wave Guides (Kg/cm²).
   Crystal: 210 V
   Pressure: 130 kg/cm²

4. Radar Target Lock (AR-18-16 Tracking Antenna) Switch. The Radar will not Lock any Contacts if selected Off.
5. Radar Mode Control Switch. This Switch has 3 positions: Off, Standby and Full On. The Standby Position allows the Radar to warm up in preparation for use. Full On initiates Radar Transmitting. A safety mechanism won´t allow the Radar to transmit if the Landing Gear is Deployed.
6. Radar Electronic Horizon Elevation Adjustment Knob
7. Radar Screen Mode Switch. Adjusts the Night and Day Brightness Settings for the Radar Screen
8. Radar Screen Brightness Control Knob
9. Combined Voltmeter/Manometer Gauge indicating Main Radar Voltage or Wave Guide Air Pressure.

ORO-57K Unguided Rocket Pod Control Panel



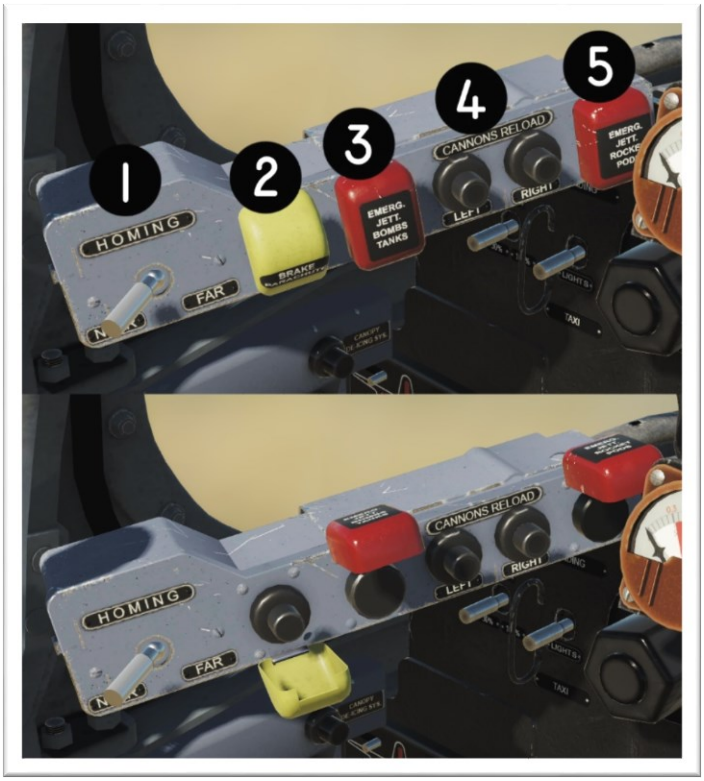
ORO-57K ROCKET POD CONTROL PANEL

1. Rocket Salvo Selection Switch
   - **4 RO:** Releases 4 Rockets per Pod with every press of the Trigger.
   - **1 RO:** Releases 1 Rocket per Pod with every press of the Trigger.
   - **AUTO:** All rockets launch in succession from both Pods at the press of the Trigger.

2. Rocket Counter
   - **Green (0)** Light indicates ORO-57K pods are installed on the Pylons and working correctly.
   - **Yellow (1-8)** Lights are the available Rockets per Pod, up to 8 Rockets, which is the capability of the ORO-57K Rocket Pods.

3. Day and Night Lighting Brightness Setting for the Panel

Upper Left Control Panel



1. Homing Switch. It switches the ARK-5P NDB Receiver to the FAR or NEAR Pre-Set Beacon/Freq Selector.
2. Drag Chute Deployment Button
3. External Fuel Drop Tanks or Bombs Emergency Jettison Button
4. Left and Right NR-30 Cannon initial reload Buttons. These must be pressed for more than 2 seconds for the Cannons to be Armed. After being pressed, their respective Armed Indication Red Lights will illuminate on the Lower Main Instrument Panel.
5. ORO-57K Rocket Pods Emergency Jettison Button

ARK-5P Control Panel

ARK-5P NDB RECEIVER CONTROL PANEL

1. Frequency Range Indicator with rotating Scale
2. Frequency Scale backlight Brightness Control Knob
3. Received Signal Strength Meter
4. Receiver Mode Switch. TLG: Telegraphy; TLF: Telephony. TLG is for reception of un-modulated signals, while TLF is for the reception of modulated ones. Usually, all radio stations work in TLF mode.
5. Frequency Band Selector Switch. It selects between 150-310kHz, 310-640kHz and 640-1300kHz Frequency Ranges.
6. ARK-5P On/Off Lamp
7. Volume Knob. Sets the Volume of the NDB Morse Identifier Audio.
8. Loop Antenna Rotation Switch, spring-loaded to centre. Used to manually move the Directional Loop Antenna when the Mode Selector Switch is in the Loop setting.
9. Frequency Fine Tuning Handle is only used when in ANT. Mode in conjunction with the Signal Strength Meter.
10. ARK-5P Mode Selector Switch.

ARK-5P MODE SELECTOR SWITCH (10)

The Mode Selector Switch has the following settings.

- OFF: ARK-5P is switched Off.
- COMP: Direction finder Mode. The ARK-5P will use the pre-set or manually tuned Frequencies to automatically indicate the NDB Bearing.
- ANT: (Antenna)Enables the Audio of the NDB Morse Identifiers (using the Non-Directional Sense Antenna). In this Mode, the Morse Identifiers are heard more clearly than in COMP. Mode.
- LOOP: Used to manually Rotate the Directional Loop Antenna Frame to the Null Signal Position.

ARK-5P MANUAL TUNING PROCEDURE

For manual tuning to a radio station from inside the cockpit, the following steps are necessary:

1. Put the ARK-5P in Non-Directional Antenna Mode by rotating the ARK-5P Mode Selector Switch (10) to the ANT. Position.
2. Set the TLG-TLF receiver mode switch (4) to the position which corresponds to the NDB operation mode. Normally, all NDBs in DCS World operate in Telephony (TLF) mode.
3. Turn the Volume Knob (7) to Maximum Volume.
4. Set the Homing Switch to the "Near" Position.
5. Select the desired Frequency Range on the ARK-5P Frequency Band Selector Switch (5).
6. Use the Frequency Fine Tuning Handle (9) to rotate the Frequency Scale until the desired Frequency is indicated over the vertical index. Listen to the Audio of the NDB Morse Identifier (ensure the RSIU-4V is set to Radio Comp Mode) and ensure Maximum Deflection on the Signal Strength Meter (3).
7. Select Automatic Direction Finder Mode by setting the ARK-5P Mode Selector Switch (10) to the COMP. Position. The thin solid Needle on the GIK-1 Compass Indicator will display NDB relative bearing.
8. To check setup quality, switch the ARK-5P Mode Selector Switch (10) to the LOOP mode and rotate the spring-loaded Loop Antenna Rotation Switch (8) in any direction and keep it in this position for several seconds. The Needle on the GIK-1 Compass Instrument will deflect at an angle. Release the Loop Rotation Knob and return the Mode Selector Switch to the COMP. Mode. The Needle on the GIK-1 Compass should return to its initial bearing.

USE OF PRE-SET FREQUENCIES

1. Set the "Homing" (Near-Far NDB) Switch to the "Near" position.
2. Follow the Manual Tuning Procedure.
3. Set the "Homing" Switch to the "Far" Position
4. On the "Far" NDB Frequency Range Selector on the LH Side Panel, select the desired Frequency Range.
5. Follow the Manual Tuning Procedure

This system allows the changeover of between 2 Pre-Set NDB Frequencies using the "Homing" Switch.

WARNING: Trying to manually move the Frequency Fine Tuning Handle, when Automatic Compass Mode is selected, is forbidden. This is due to high risk of malfunction of the electrical motor, which is controlling the Frequency Range Selection.

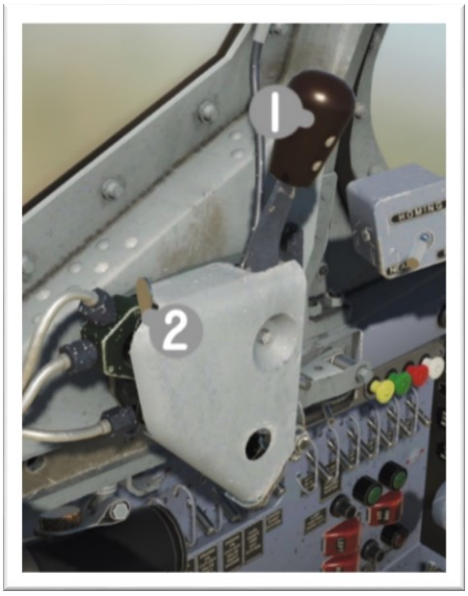
SRO-2 IFF Control Panel

SRO-2 IFF CONTROL PANEL

The SRO-2 Khrom (Chrome) is one of the Identification Friend-or-Foe (IFF) systems used on early Cold War Era Soviet Aircraft. In the case of the MiG-19P, the system is quite simple, having only an On/Off switch and a self-destruction device, in case the Aircraft was forced down over an enemy country. On the MiG-19S and MiG-19PM the same system allowed the use of different modes and the input of several codes as well.

1. SRO-2 IFF Power Switch
2. SRO-2 Self-destruct Button
3. SRO-2 "Self-destruction Activated" Lamp

Canopy Control Mechanism



CANOPY CONTROLS

The MiG-19P has a Pressurized Bubble Canopy. The fixed part is divided into three sections, with the Center piece being a Bulletproof Windshield. The Movable part is opened by sliding it backwards.

1. Canopy Open/Close Handle. These Handles, one on the Left and the other on the Right, actuate the Canopy Locks.
2. Canopy Pressurization Valve. In the Up position the Valve is Closed and moving it backwards Opens the Valve. Opening the Valve allows the Pneumatic Air pressure to pressurize and so seal the Canopy Rubber Seals.
3. On the RH Glareshield Area is an Emergency Canopy Release Handle – operating this will Jettison the Canopy. In preparation for a Crash Landing this can be operated to aid evacuation.

SPO-2B Radar Warning Receiver

SRO-2B RWR

The MiG-19 was retrofitted with an early Radar Warning Receiver, the SRO-2B. It was only capable of detecting a Radar Signal in the Rear Hemisphere and as such its capabilities were very limited.

The Controls and Indications consisted of a Switch – On/Off, A Red Light adjacent to the On/Off Switch which indicated the System was activated and another Red Light that indicated that the Aircraft was locked by a Radar.

The Sensor was mounted on the top of the Tail Fin assembly.

Chapter 3 – Standard Operating Procedures

ГЛАВА 3 – СТАНДАРТНЫЙ ПОРЯДОК ДЕЙСТВИЙ

PILOTING TECHNIQUES AND AERIAL NAVIGATION

All flights above an altitude of 10,000 meters are to be performed with the BKK-2/BKK-2M/BKK-3M pressure suit.

Aircraft Inspection
ОБСЛЕДОВАНИЕ САМОЛЕТА

1) Carry out a General Visual Inspection of the Aircraft Fuselage, Landing Gears, Air Data Probes and Antennas to ensure they are in a serviceable condition.
2) Check that all the Engine Blanking Covers and Control or Landing Gear Locks have been removed.
3) Check the Aircraft to ensure there are no Oil, Hydraulic Fluid or Fuel leaks.
4) Check the Ailerons, Stabilizer and Rudder including the Trim Tabs for security of attachment and that there is no visible damage.
5) Check that the Stabilizer and Flaps are not in an asymmetric position with the Control Stick in the neutral position.
6) Check that the Engine Afterburner Nozzle petals are open.

Cockpit Inspection
ОБСЛЕДОВАНИЕ КАБИНЫ

1) Check that the Landing Gear Handle is in the Neutral Position and with the Latch Locked to prevent inadvertent operation.
2) Check that all the Circuit Breaker Switches (on the rear RH Side Panel) are in the on position and all the Safety Covers, where fitted to Switches, are Closed.
3) Check that the Control Stick, Fire Control Trigger is in it's Safe Position.
4) Check that all the Switches for powering the Flight Control Instruments and Avionics on the RH Side Panel are in the Off position.
5) Check that the RH Side Panel Switches "LH/RH Engines Military Power and Afterburner" **(АВАРИЙН ОТКЛЮЧЕН ФОРСАЖА МАИСИМАЛ ЛЕВ/ПРАВ ДВИГ)** are On.
6) Check that the RH Side Panel Switches "LH/RH Engines Oil Cut-Off Valves" **(ПЕРЕКР КРАН ДАВЛЕН МАСЛА ЛЕВОГО/ ПРАВОГО ДВИГ)** are On.

7) Check that the LH Side Panel "Cockpit Pressurization" Lever and "Cockpit Ventilation" (**ВЕНТИЛЯЦИЯ КАБИНЫ**) Switch are in the Open position.
8) Verify there are no Foreign Objects, Water or Ice in the Cockpit.
9) On the Main Instrument Panel, the IK-18 Oxygen Pressure and Flow Indicator **(ИК-18 ИНДИКАТОР КИСЛОРОДА)** is indicating a pressure of 130-150 kg/cm².
10) Check the Pneumatic Systems Gauges on the LH Side Panel. The nominal pressures should be:
    - Main Pneumatic System
      МАКСИМ. ДАВЛЕНИЕ В ОСНОВНОМ БАЛЛОНЕ 130-150 kg/cm²
    - Landing Gear Emergency Deployment System
      ДАВЛЕНИЕ В АВАРИЙНОЙ БАЛЛОНЕ ШАССИ 50 kg/cm²
    - Flaps Emergency Deployment System
      ДАВЛЕНИЕ В АВАРИЙНОЙ БАЛЛОНЕ ЗАКРЫЛКОВ 110-130 kg/cm²
    - Canopy Pressurization System 50 kg/cm²
11) Check the Clock **(ЧАСЫ)** time is set correctly, and the Chronometer is zeroed ready for Engine starts.
12) Check that the Barometric Altimeter **(ВД-20 УКАЗАТЕЛЬ ВЫСОТЫ)** is set to 0m and make sure that it corresponds to the QFE Barometric Pressure given by the Tower.
13) Operate the Engine Throttles over their full operating range to check for free movement and that their respective locks in the "Stop" **(СТОП)** and "Idle" **(МАЛЫЙ ГАЗ)** positions are operating correctly.
14) Check for the correct functioning of the Braking System by operating the Brake Lever on the Control Stick and observing the MA-12 Dual Brake Pressure Indicator **(ДВУХ-СТРЕЛОЧНЫЙ МАНОМЕТР ТОРМОЗОВ)** located on the lower part of the Main Instrument Panel. It should read 5 kg/cm² when you start to operate the Brake Lever and 10+0.5 kg/cm² when the Braking Lever is fully operated. Check the MA-12 Dual Brake Pressure Indicator for accurate and simultaneous braking/un-braking when operating the respective foot pedals.
15) The ARU-2V **(АРУ-2В АВТОМ/РУЧНОЕ)** Switch should be in the **"AUTO" (АВТОМ)** position.
16) The "Aileron Booster" **(ГИДРОУС ЭЛЕРОНОВ)** Switch located on the horizontal LH Side Panel should be in the On position.
17) On the RH Side Panel, check that the Oxygen Main Feed Valve is Fully Open.
18) On the RH Side Panel, check that the Oxygen System Control Panel Selectors are set to "Mix" (**СМЕСЬ**) and "Auto" **(АВТ)** respectively.

19) If the Aircraft has External Fuel Drop Tanks or Bombs fitted, check that both of the "Suspended Loads" **ЛЕВОЕ/ПРАВОЕ ПОДВЕСКИ БОМБ** lamps, located on the lower part of the Main Instrument Panel are illuminated.

Engine Start Procedure

PREPARING FOR THE ENGINE START PROCEDURE

1) Contact the ground crew to connect the External Ground Power.
2) On the RH Side Panel, Turn On the "Battery" switch. Check the Voltmeter, on the Main Instrument Panel, is reading 28 V (if the Aircraft Batteries are the only power source, it will indicate 24 V).
   The Warning Lamps "Oil" for both the LH and RH Engines, "Right Generator" and "Left Generator", "Low Hydraulic Pressure", located on the Main Instrument Panel and Lamps "Fuel Tank 2" and "Fuel Tanks 3, 4", located on the RH Side Panel should be illuminated.
3) Check the Landing Gear, Flaps and Airbrake PPS-1 Position Indication Panel and confirm that the three Green Landing Gear Down lights are illuminated.
4) Press the "Lamp Control Test" button on the PPS-1 Panel and confirm that all the PPS-1 Panel lights are illuminated whilst button is pressed.
5) Press the LH Side panel "Lamp Control Test" Buttons. The Green Lamps for Fuel Tanks 2, 3, 4 and the Red "Fire" Lamp should illuminate.
6) On the Main Instrument Panel, check that the Fuel Quantity Indicator is showing the correct quantity for the Aircraft Fuel Status. The Indicator must be at 1,400 Liters and none of the Green Fuel Tank Lamps should be ON.
   The Red Warning Lamps "Tank 1" and "Rest 550" on the Warning Panel should be not be illuminated.

7) Carry out a Systems Check of the Engine Relight System used for restarting the Engines in-flight.

- Operate the "Air Re-Light" Start Switches for 2-3 seconds.
- The Red Air Re-Light System Lamps, on the Main Instrument Panel, should illuminate and the sound of the Engine Ignition System should be heard.

NOTE: Make sure to turn Off both "Air Re-Light" Start Switches afterwards and close their protective caps.

8) Turn On the "Emerg. ARK Radio" and "Emerg. Radio" Switches, located on the RH Side Panel.
9) Turn On the "Radio Power" Switch.
   Press the Control Tower Frequency selector button and request permission for Engine Start.
10) Turn On the "Beacon R-Alt." Switch, located on the RH Side Panel.
    Select the desired Radio Altimeter Minimum Height setting with the selector knob on the LH Side Vertical Panel.
11) Turn On the "MUS-2 System Stab.", "Aileron Trim/Pitch Trim" and "GIK AGI" switches, located on the RH Side Panel.
12) Operate the "AGI-1" Artificial Horizon "Caging" Knob and press the "GIK-1" Compass Alignment Button on the Main Instrument Panel for 3 seconds if ambient temperature is above 30 °C, or for 5 seconds if it is below 30 °C.
    After 2-3 minutes both Instruments will show the correct aircraft heading and attitude.

NOTE: If the Engines are to be started using the Aircraft Battery, do not connect any electrical consumers apart from Fuel Tank No. 1 Pump and Generators until both Engines are at Idle RPM.
The Battery allows for 3 consecutive Engine starts.

ENGINE START PROCEDURE

Only when Control Tower clearance is approved to start the engines:

1) Confirm that the "Battery" Switch, located on the RH Side Panel, is On.
2) On the LH Side Panel, Turn On "Fuel Tank Pump 1", "Fuel Tank Pump 2", "Fuel Tank Pump 3" and "Fuel Tank Pump 4". The Green Lamps "Fuel Tank 2" and "Fuel Tank 3, 4" adjacent to the Fuel Tank Pump Switches will turn Off.
3) On the LH Side Panel, Turn On "Flight Inst. & Cockpit Heating System" and "Anti-Skid System" switches.
4) On the LH Side Panel, Turn On the "Engine Start System" and "Fire Extinguisher System" switches.
5) On the LH Side Panel, Turn On both "Right Generator" and "Left Generator" Switches.
6) Put the Left Throttle into the "Idle" position.

WARNING: Check that the Throttle is in the "Idle" position (resting on the "Stop" locks) when starting the Engine and not moved a little forward in between the Idle and Nominal positions to avoid a False Start or an excess of Fuel being dumped into the Combustion Chamber that can generate a Fire.

7) Press the Left Engine "Start" button for 2-3 seconds.

DURING THE ENGINE START CYCLE THE FOLLOWING MUST BE CHECKED:

- The Engine EGT may reach 750°C during the start cycle but should stabilize under 650°C as Idle RPM is reached.
- Engine EGT rise should not exceed a rate of 350 °C/second.
- The "Oil" Warning Lamp should turn Off as soon as the engine reaches 4,000 RPM, but it could flash sometimes when the Engine is below 6,000 RPM. Above 6,000 RPM, the Warning Lamp should remain Off.
- The "Left Generator Disconnected" Lamp, on the Main Instrument Panel, should turn Off when the Engine reaches Idle RPM.
- The Main System Hydraulic Pressure Gauge, on the RH Side Horizontal Panel, should indicate 142 kg/cm².
- The "Low Pressure Hyd. System" Lamp, on the Main Instrument Panel, should turn Off.
- The Engine should take no more than 80 seconds to reach Idle RPM.
- Idle for the RD-9B engine is 4100 +200 RPM.
- "Idle" speed is dependent on Outside Air Temperature. At -30°C the Engine Idle RPM should be not be less than 4,100 and above 30°C the RPM should not exceed 4,300.

WARNING: If The "Oil" Lamp does not turn off when the Engine reaches Idle RPM, immediately move the Throttle to the "Stop" Position.

If the Engine EGT remains above 750°C when the engine is at Idle, there are 2 Options:

- First, an excess of fuel in the combustion chamber may be causing the temperature to rise, so moving the throttle to the Nominal position may dump the fuel and the EGT should reduce below 650 °C. If the temperature does not reduce after 20 seconds, shut down the Engine.
- Second, shut down the engine and inform the Ground Crew.

8) Once the LH Engine has reached Idle RPM, tell the ground crew to disconnect the External Ground Power.
9) Place the RH Engine Throttle into the "Idle" position.
10) Press the RH Engine "Start" button for 2-3 seconds.
11) Follow the same steps and checks as with the Left Engine.
    The Booster Hydraulic System Pressure located on the Main Instrument Panel should reach 142 kg/cm².
12) Once both Engines have stabilized at Idle, connect both the Throttle Handles together using the Locking Mechanism.
13) The Engines should only remain at Idle RPM for less than 10 minutes. If you plan to stay at Idle RPM for longer, increase the Engine RPM to 10,000 RPM every 5-7 minutes.
    When the Ambient Temperature is below -5 °C, Engine operation below 9,000 RPM should be for as short as possible in order to avoid ice formation in the Compressor Stages.

NOTE: To make a Cranking start of the Engines, the corresponding Engine Throttle is moved forward four degrees (4°) of the Idle position where it makes a clicking sound indicating the activation of the rotation start-up switch. Then operate the respective Engine "Start" Button for 2 seconds, the Starter-Generator will accelerate the Engine to 3,700-3,800 RPM for 30 seconds. This is useful after false starts where fuel which has not been burnt in the Combustion Chamber is expelled out the Jet Pipe in order to avoid an Engine Fire on next Start.

The simultaneous starting of both Engines is not permitted by the Engine Start System. Starting of the opposite Engine is only allowed after the first Engine stabilizes at Idle RPM.

WARNING: The Aircraft Starter-Generators allow for 5 consecutive Engine starts followed by a 30-minute cooling period. Exceeding this limitation can cause damage to the Starter-Generators.

Preparation for Taxi and Take-Off

PRE-FLIGHT ENGINE CHECKS

1) Ensure that the Ground Crew have installed the wheel chocks.
2) Increase the thrust on both engines to 10,000 RPM for around 40 seconds to warm up the engines.

   NOTE: When testing the Engines on the Ramp, it is only permitted to increase the thrust at the same time on both Engines to a limit of 10,000 RPM.

   When doing the following tests, the Engines are tested in turns. During all the Engine Tests the Pilot must be aware of any Vibrations and Oscillations of the Engines or Tachometer Indications and any sudden EGT rise.
3) Connect the Nose Gear Brake and increase the RPM to the Nominal Position.
   - The Tachometer should indicate 11,150+50 RPM.
   - Engine EGT should be less than 550 °C.
   - The Oil Pressure Warning Lamps should remain Off.
4) Operate the Throttle to the Military Power Position.
   - The Tachometer should indicate 11,150+50 RPM.
   - Engine EGT should be less than 650°C.
   - Both the Green Military Power Lamps should illuminate.
   - The Oil Pressure Warning Lamps should remain Off.
5) To check the Afterburner function, operate the Afterburner Button on the Throttle Quadrant and take a single engine at a time to the Afterburner Regime Position.
   - The "Afterburner" Lamp for the respective Engine should turn illuminate.
   - The Engine EGT temperature should remain below 680 °C.

   WARNING: The Afterburner Test should not exceed the limit of 10 seconds per Engine.

6) You can check the Power Responsiveness of the Engines by moving the throttles from Idle to the Military Power Position within 1.2-2 seconds.
    - During this test the EGT increase up to 750 °C and the RPM can rise to 11,600 for a short period of time (3-5 seconds).
    - After this, the EGT should stabilize under 650 °C and the RPM at 11,150+50.
    - Check the Engine Description above to check the correct power response time.

FLIGHT CONTROL AND HYDRAULIC SYSTEMS CHECK

AILERON CONTROL CHECKS

AILERON BOOSTER OFF CHECK:

1) Turn Off the Aileron Boosters and move the Control Stick from the Left to Right and check that the Ailerons move smoothly. When the Aircraft is on the ground and there is no dynamic air pressure flowing over the Ailerons, the Control Stick should remain in the position selected.
2) Take the Control Stick to the extreme Left Position and then Switch On the Aileron Booster.
3) The Control Stick should return to the Neutral Position.
4) Repeat the same procedure for the extreme Right Position.

AILERON BOOSTER ON CHECK:

1) Switch On the Aileron Booster.
2) Move the Control Stick to the extreme Left and Right. The movement should be smooth without jamming and sticking. The Pilot should feel the resistance of the spring feel mechanism.

   During testing, the indication in the Booster Pressure System Gauge may oscillate a small amount.

STABILIZER CONTROL CHECKS

1) Ensure the Stabilizer Switch is in the Hydraulic Control Mode. Check the Stabilizers by moving the Control Stick forwards and backwards to the extreme positions. There should be no jamming, rubbing or knocks when moving the Control Stick moves.
   The Main Hydraulic System Pressure Gauge may oscillate a small amount during testing.
2) Turn On the Stabilizer Electric Control Mode and check that the stick moves smoothly.
   The Stabilizer should move at the speed of 4°/second in this Backup Mode.
3) Operate the Stabilizer Hydraulic Mode and check that it works correctly.
4) ARU-2V check:

WARNING: To check the ARU-2V there must be pressure in the hydraulic system, or the MUS-2 stabilizer electric control must be activated. Trying to test the ARU system without any of these conditions will result in serious damage of itself.

- Put the ARU Auto/Manual Mode Selector Switch in the Manual position.
- Move the Control Stick to the extreme rearward position.
- Using the "Long Lever Arm" and "Short Lever Arm" Switch, increase and decrease the ARU-2V arm to the maximum and minimum values. Confirm this by looking at the ARU Arm Control Indicator, located on the Main Instrument Panel. The Needle on the Indicator should move to the Max. and Min. limits on the Indicator.
- Check the change in the Stabilizer Deflection Angle visually.
- Release the Control Stick and put the ARU Auto/Manual Mode Selector Switch back to the AUTO position.
- The ARU gauge should move to the longest arm setting and the "ARU System in Take-Off and Landing Position" Lamp should illuminate.

CHECK THE TRIM TABS

1) Move the Aileron Trim Tab by operating the "Aileron Trim" switch, check the "Aileron Trim Neutral" Lamp every time the trim tab moves through the neutral position. Verify the Aileron Trim Tab position with the Ground Crew.

2) Using the Control Stick Pitch Trim Switch, move the Stabilizer Trim forwards and backwards to the extreme positions. The rearward trim should move the Control Stick all the way to the back of its travel and about 90% forward in travel. Check the "Pitch Trim Neutral" Lamp illuminates every time the Control Stick goes through the Neutral position. Verify the Stabilizer positions with the Ground Crew.

NOTE: Neutral Stabilizer Trim Position is dependent on the Landing Gear Position. When the Landing Gear is Down, the Aircraft adopts the Ground Neutral Position and in flight when the Landing Gear is up it adopts the In-Flight Neutral Position. This is to ensure that when the Aircraft is on the ground the Stabilizers are parallel to the ground considering the slightly Nose Up Static Attitude of the Aircraft on to the ground.

CHECK THE FLAPS

1) Cycle through the Flap Positions. Check that the green "Flaps Deployed" indication on the PPS-1 panel illuminates when the flaps cycle through the Take-Off and Landing positions. A Ground Crew Technician will verify the position. Flaps should move symmetrically.

2) Extend and Retract the Airbrakes. Check that the Green "Airbrake Extended" signal on the PPS-1 panel illuminates when the Airbrakes are Extended.
   Main System Hydraulic pressure could fluctuate but should quickly return to 142 kg/cm².

FINAL PREPARATIONS BEFORE FLIGHT

- Close the Canopy, Lock and Pressurize it. Check that the indicator of the Cockpit Pressure Indicator remains at 0. Check that both the "Cockpit Pressurization" lever and "Cockpit Ventilation" switch are in the Open position.
- Contact the Control Tower and request permission to taxi to the active runway.
- When authorized, give the Ground Crew the "Chocks Away" signal and confirm that Chocks have been removed.

PREPARATIONS OF THE ARMAMENT & RADAR SYSTEMS

1) Turn On the "Sight Heating" Switch.
   While the ASP-5 Gunsight and AR-18-8 Radar Sight indications appear instantly, the Sight Heating assures correct sight operation at Low Temperatures.
2) Turn On the "Sight" Switch.
   The Yellow Circle with the Center Dot Cannon Aiming Point should appear on the Glass of the ASP-5N Gunsight.
3) Turn On the "Izumrud" Switch.
   The RP-5 "Izumrud" radar should take 2-3 minutes to warm up and be ready for use.
4) Turn On the "O-57K" Power Switch.
5) Turn On both "Left" And "Right" Cannon Power Switches.

Taxi and Take-Off

TAXI

1) Ensure that all Gauge indications are correct, Control Boosters are selected On and the Stabilizer Mode Selector is set to Hydraulic Control, verify all System switches are set to the correct positions and the that the Cockpit is pressurized.
2) Check that the "ARU System in Take-Off and Landing Position" Lamp is illuminated.
3) Extend the Flaps to the 15° "Take-Off" position. The signal lamp "Flaps Deployed" will illuminate on the PPS-1 panel.
4) Check that the ASP-5N gunsight is in its "Caged" mode. Otherwise damage may occur to the sight mechanisms while taxiing due to the sensitivity of the Gyroscopes.
5) With Ground Crew assistance, ensure there are no other taxiing aircraft or obstacles nearby.
6) Disconnect the Nose Wheel Brake.
7) Increase the Engine Power settings to approximately 10,050 RPM.
8) As the Aircraft begins to move, operate the brake lever to check the Brakes for correct operation.
9) Release the brakes and start to taxi towards the designated Active Runway. Speed should be no more than 30 km/h.

   WARNING: When more than one aircraft has been cleared to taxi to the Active Runway, maintain a separation distance between Aircraft of not less than 60 meters to avoid engine ingestion of debris and FOD dislodged from the ground by the jet efflux of the preceding aircraft.

10) Enter the Active Runway only when authorized and taxi straight for 10-15 meters to make sure the Aircraft is aligned with the center line.
11) Connect the "PVD Heat." and "Emerg. TP-156" switches on the RH Side panel.
    This will activate the heating of both Main and Standby Air Data Probes. This must be done on the runway and disconnected again immediately after landing to avoid Ground Crew injuries from contact with hot Air Data Probes.

TAKE-OFF

1) Connect the Nose Wheel Brake.
2) Remove the Landing Gear Lever Lock.
3) Operate the Brakes and increase the Throttles to 9,000-10,000 RPM.
4) Release the Brakes and start increasing the Throttle Setting to Military Power Setting or to Afterburner Setting as necessary.
   - When taking off from a concrete runway at the Military Power Setting and the Flaps in the 15° Take-Off Position, the take-off run will be around 600-650 meters.*
   - When taking off from a concrete runway at the Afterburner Setting with no Flaps deployed, the take-off run is reduced to around 515-520 meters.*

   * For a clean aircraft

   NOTE: When taking off with 760-liter drop tanks, the take-off run increases by 250 meters.

5) Maintain the Control Stick in the Neutral Position at the beginning of the take-off run. Correct any initial yaw by applying differential braking. As the IAS increases, the Rudder becomes effective to correct any Yawing motion.
6) During the take-off run, the aircraft has no inherent tendency to Ground-Loop. A crosswind of 15 m/s at a 90° angle does not considerably affect the take-off run.
7) As the speed reaches 200 km/h, move the Control Stick backwards to about 2/3 of its travel.
8) At a speed between 230 and 250 km/h, the aircraft will gradually lift the nose wheel off the ground.
   The pilot needs only to maintain the upper contour of the nose projected against the natural horizon.

   NOTE: When taking off in Afterburner, the Control Stick should be moved slightly more backward than in Military Power to lift the Nose Wheel.

9) The aircraft will easily come off the ground at a speed of 280 +20 km/h with no tendency to ballooning or stalling.

10) In the air, the Armored Windshield will hamper judging the distance from the ground, so use the left side of the Canopy to observe the ground.
11) Retract the landing gear at an altitude of 15 meters.
    The Landing Gear should be retracted below a speed of 550 km/h, in excess of this speed the retraction process will be too slow, or the Landing Gear may fail to retract.
    Normal retraction time must be less than 8 seconds.
12) Check the Retraction of the Landing Gear by the three illuminated Red lights and the "Retract Gear" signal going Off on the PPS-1 Panel. The Pilot can also check the three Mechanical Indicators in the upper part of the wing for the Main Landing Gear and to the Left of the Canopy for the Nose Landing Gear.
13) Move the Landing Gear Selector Lever to the Neutral position.
14) Retract the flaps at an altitude of 100 meters after the Landing Gear has been retracted.
    With flaps at the 15° position, the aircraft will be a little tail heavy. At the start of the retraction, the Pilot will hardly feel the aircraft sinking.

    WARNING: With flaps in 15°, the aircraft should not exceed an IAS of 800 km/h.

15) If one of the afterburners fails, indicated by the "AB" Green Lamp Off and an associated EGT below 500 °C, the Aircraft will Yaw towards the failed afterburner engine. However, this should not complicate the take-off run. The tendency to Yaw to this side should be counteracted with Rudder and differential braking.
    Once in the airborne, circle the Airbase and land immediately.
16) If one of the Red Landing Gear Position indication lights on the PPS-1 fails to illuminate, disconnect the Afterburner and repeat the Extension and Retraction process while maintaining a speed below 500 km/h. If the light still fails to illuminate, return and land immediately.

CLIMB

1) Climb should be performed at Maximum Engine Power, in order to save Time and Fuel.
2) The best Climb Speed with Afterburners engaged is M = 0.88-0.9.
3) The best Altitude for Afterburner engagement is 7,000-8,000 meters. When engaging the afterburner at this Altitude, the climb will require less Time and Fuel than with Military Power selected.

General Operating Conditions of Flight

1) The extension of the Airbrakes is allowed at all permissible airspeeds but may cause a slight vibration of the aircraft.
2) While flying at speeds above M = 1.2, the extension of the airbrakes may generate momentary Longitudinal Oscillations.
3) When flying at speeds close to the permissible limits, the following may happen:
   - If rudder pedals begin to pulse, stop accelerating.
   - If the Aircraft starts to Oscillate about the Longitudinal Axis, decrease thrust and smoothly pitch up in to a climb to decrease the speed. Extension of the Airbrakes instance may cause an increase in the severity of the Oscillations.
4) The minimum indicated evolution speed is 350 km/h, at this speed the aircraft is stable and controllable.
5) During Training Circuits, Flights with the Landing Gear Extended or Retracted, maintain an IAS of 500 km/h.
6) Level Flight at Altitudes between 5,000 and 7,000 meters and with Afterburners engaged will require a considerable Nose Down Trim position.
7) When the Aircraft reaches Transonic Speeds in level flight, between M = 0.97-1.02, the Altimeter will display an increase in Altitude of about 600 meters and the Variometer might display as much as a 100 m/s climb. After the aircraft transits this speed zone, the Altimeter will decrease and display an Altitude about 100 meters above the actual and the Variometer will return to zero.
8) At Altitudes above 16,000m, the Throttles should not be moved below Military Power, or the Engines will shut down.

9) At altitudes from 14,000 to 16,000 meters, the Throttles should be moved slowly, taking a time of no less than 5 seconds to move from the Idle to Military Power positions.
10) Flight time under negative G Conditions must be limited to 10 seconds if the engines are operating in Military power or Afterburner, or 15 seconds in any other Engine Throttle Setting.

Fuel Supply to the Engines

On an Aircraft with no External Drop Tanks installed:

- 100 Liters will be consumed from Fuel Tank No. 1
- Fuel Tanks No. 3, 4 and 2 will be Emptied concurrently
- Remaining Fuel in Tank No. 1.

On an aircraft with External Drop Tanks fitted:

- 100 liters will be consumed from Fuel Tank No. 1
- All the Fuel from the External Drop Tanks will be consumed
- Another 100 liters will be consumed from fuel tank No. 1
- Fuel Tanks No. 3, 4 and 2 will be Emptied concurrently
- Remaining Fuel in Tank No. 1.

When the External Fuel Drop Tanks are Empty, the Green "EXT.TANKS EMPTY" Lamp will illuminate.
When Fuel Tanks No. 3 and 4 are Empty, the Green Lamp below the "PUMP TANK 3" and "PUMP TANK 4" Switches will turn illuminate.
When Fuel Tank No. 2 is Empty, the Green Lamp below the "PUMP TANK 2" switch will illuminate.
When the "REST 550L" Red Lamp illuminates on the T-6 Warning Panel, the Aircraft should enough Fuel for a Flight Time of approximately 20 Minutes at an Altitude of 500 meters and a Speed of 500 Km/h.
When the "TANK 1" Red Lamp illuminates on the T-6 Warning Panel, the Fuel remaining in the Fuel Supply System may still be enough for a Flight Time of 5 Minutes depending on the Altitude and the Engine Throttle Settings.

Cockpit Pressurisation

1) At Altitudes above 2,000 meters, the UVPD-15 Cockpit Altitude & Differential Pressure Dual Instrument must show a Cockpit Differential Pressure of about 0.28-0.32 kg/cm². As the Altitude increases above 8,000 meters, the cockpit pressure should be no less than 0.24 kg/cm².

   Cockpit Altitude must be the same as the Altimeter up to 4,000 meters, when it should increase at half the speed of the Altimeter reaching a maximum value of 12,000 meters at the Aircraft Service Ceiling.

2) If the Canopy freezes while descending from High Altitudes, check the following:
   - Check that the Cockpit Air Supply Lever is Open.
   - Check that the Canopy is Pressurized.
   - Select the Cockpit Temperature Switch to "Hot" and increase the Engine RPM.

Flight with Drop Tanks

1) Maximum permissible IAS during with External Fuel Drop Tanks installed is 1,000 km/h.
2) 760-liter External Fuel Drop Tanks should be Jettisoned in the speed range of 400-800 km/h.
3) When Jettisoning the External Fuel Drop Tanks, check that the Green "Suspended Loads" Lamps are no longer illuminated.

Preparation for Landing

The MiG-19P can Land with a Remaining Fuel load of 1,500 liters or less. In case of an Emergency, an Aircraft with External Fuel Drop Tanks can land with less than 2,500 liters of Fuel. If the Fuel Quantity is above 2,500 liters, Jettison the External Fuel Drop Tanks. The Approach Speed must be 15 Km/h greater.

1) Check that the Switches "O-57K"; "Left" and "Right" Cannons; "GCAM" and "GCAM Ext." on the RH Side Panel are selected Off.
2) Turn Off the Radar by putting the Radar Mode Control Switch on the Radar Control Panel to "Off".
3) The Gun Trigger must be in the Safe Position.
4) Check the Main Hydraulic System Pressure.
5) The "Anti-Skid" Switch should be switched On.
6) Decrease the speed to 500 km/h. Use the Airbrakes if necessary.
7) Enter the Landing Circuit of the airfield at an altitude of 500 meters.
8) The Landing Gear should be lowered in the Downwind Leg before the third turn at a maximum speed of 500 km/h.
9) Landing Gear Extension is checked by the three Green Position lights on the PPS-1 panel. Keep the Gear Lever in its Down Position. The Red "Retract Gear" Lamp on the PPS-1 must be Off after the Landing Gear is Extended.
10) Before the final turn, put the Flaps in the "Take-Off" Position and then into the "Landing" position. Check this by verifying the illumination of the "Flaps Deployed" lamp on the PPS-1 panel. When the Flaps are deployed, the Aircraft becomes a little tail heavy. This is easily corrected by pushing the stick forward.

WARNING: If after Flap Deployment there is a sudden induced Roll, Retract the Flaps immediately.

11) Approach the Base Leg after Flaps Deployment at a speed of 400 km/h.
12) Check that the ARU-2V "ARU System In Take-Off And Landing Position" Lamp is illuminated and that the Indicator Pointer is in the leftmost position, indicating a "Long Lever Arm" Position of the System.

NOTE: The Lamp may not illuminate at speeds above 420 km/h.

13) The final turn must be performed at a speed above 380 km/h. The recovery from this turn should be completed at an altitude of 250 meters.
14) After the final turn, decrease the speed to 300-310 km/h.

LANDING

1) On final approach, the aircraft loses its speed rather slowly and has a shallow Approach Angle.
   The Aircraft Nose at that Angle nearly intersects the Horizon.
2) At an altitude of 20-30 meters till Touchdown, look down to the ground, forward left at an angle of 15-20°, checking the Altimeter and Variometer periodically.
3) At an Altitude of 7-8 meters, pull the Control Stick slightly back and stop the descent around an Altitude of 1 meter. After this, close the Throttles to IDLE and proceed with levelling-off.
4) While floating, apply the necessary back stick as to touch the runway with two wheels (the Control Stick is pulled completely back normally).
5) Normal landing speed with Flaps Extended is around 235 km/h.
   If the Control Stick is not pulled back enough, the Landing Speed will be greater. Use of the Airbrakes during Landing does not generate any negative effect.
6) Once the Nose Wheel is in contact with the ground, retract the Flaps and release the Drag Chute by pressing the "Brake Parachute" button on the upper LH Panel.

   WARNING: The Drag Chute must be deployed below a speed of 290 km/h.

7) To avoid overheating of the brakes, start to brake when the speed decreases to 200 km/h.
   If the pilot needs to stop the aircraft quick in case of an Emergency or short runway, the brakes could be pressed as soon as the Aircraft touches the ground. In this condition, braking is rather effective, but will require a Wheel/Tire Inspection by the Ground Crew after Landing.
8) Landing Distance with all three Wheel Brakes is about 890 meters.
9) Landing distance with all three Wheel Brakes and the Drag Chute is 610 meters.

TAXI TO PARKING STAND & ENGINE SHUTDOWN

1) After the Landing Roll-out, disconnect the Nose Wheel Brake and un-pressurize the Cockpit. The Canopy can be opened if necessary.
2) Ensure all Armament and Radar Switches are Off and the Trigger is in its Safe Position.
3) Taxi to the Parking Stand and, once Parked, increase Engine RPM to 10,000 for 1 minute.
4) After this, put both Throttles in the "Stop" position.

   NOTE: If the Pilot wants to shut down one Engine while Taxiing to the Parking Stand, the LH Engine must be stopped first. This is because the Hydraulic Pump that controls the Afterburner Nozzle Petals is powered by the RH Engine.

5) Turn Off all the Cockpit Switches except "Pump Tank 1" and "Battery".
   Once both Engines have completely stopped rotating, turn these Off.

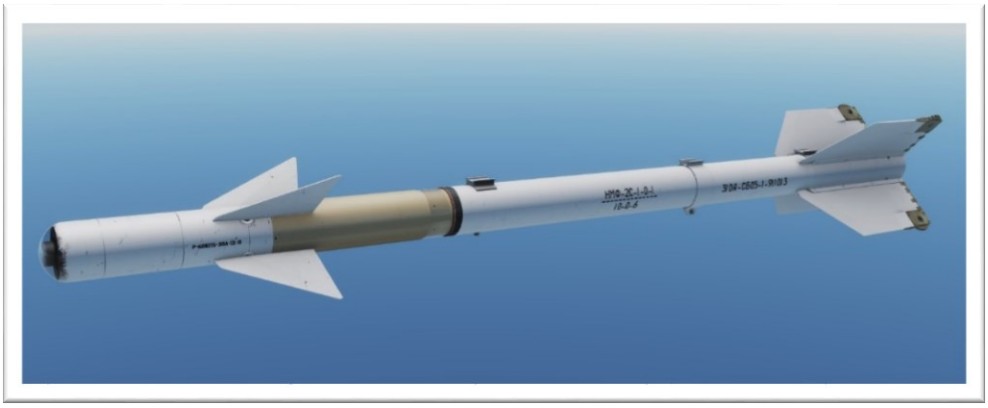
ABORTED LANDING

1) Another Landing Circuit is possible from any Altitude down to Touchdown. If the Pilot decides to Go-Around, the Engine RPM must be increased to Nominal or Military Power.
2) At a speed of 350-370 km/h bring the Aircraft into a Climb, Retract the Landing Gear and put the Flaps in the Take-Off (15°) Position.
3) At an Altitude of no less than 100 meters and a speed up to 500 km/h, Retract the Flaps and Go Around for another Landing attempt.

Chapter 4 – Combat Mission

Aircraft Armament

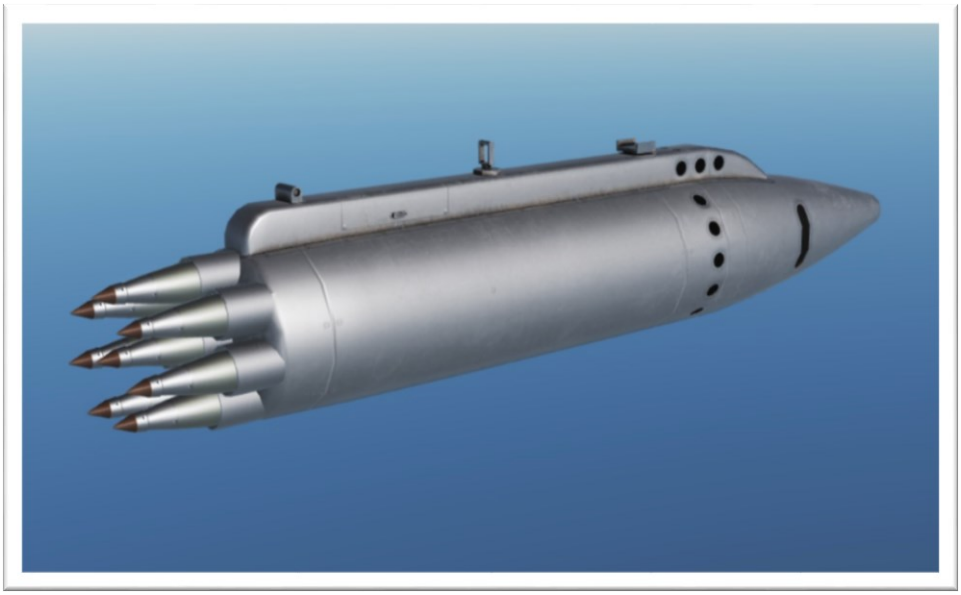
R-3S AIR-TO-AIR IR GUIDED MISSILE



PARAMETER	VALUE
Operational altitude, km	0 – 21.5
Maximum Range, km	8
Minimum Range, m	900
Maximum Speed, M	M 2.5
Maximum G at the time of launch	2
Seeker Head Field of View	28°
Duration of Controlled Flight	21 seconds
Warhead Type	Fragmentation
Warhead Weight, kg	11.3
Self-destruction Time	21 seconds

The R-3S (NATO reporting name AA-2A "Atoll") is a Rear-Aspect IR Guided Air-to-Air missile. The American AIM-9B Sidewinder Copy started to be added to Soviet Fighter Aircraft from 1960 onwards. The MiG-19P was developed as a Radar Equipped Gunfighter, but when the Missile became available, several were updated to use the R-3S. The update incorporated a new removable Pylon capable of holding the R-3S Missile on the APU-13M Rack. One per wing were installed, outboard of the existing External Fuel Tank Pylon. This made the MiG-19P capable of carrying two R-3S missiles.

ORO-57K UNGUIDED ROCKET POD



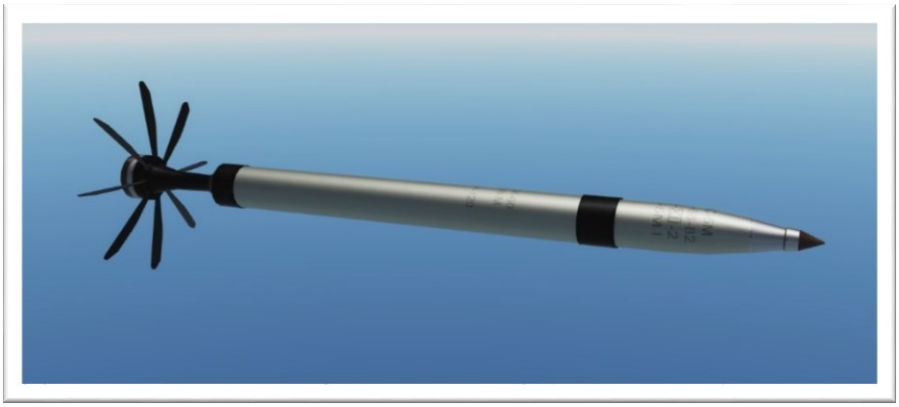
ORO-57K ROCKET POD

The ORO-57K underwing eight-round Rocket Pod is a container for eight 57mm. ARS-57M/S-5M Unguided Rockets.
The MiG-19P can carry four ORO-57K launchers:

- Two on the Inboard pylons on the rear section of the wings, ahead of the wing flaps.
- Two on the Universal Pylons with BD-3-36 Ejector Racks in lieu of External Fuel Drop Tanks.

In early service, it had a streamlined cover on the nose which was jettisoned when the Rocket Pods were selected for firing. This was later removed from service.

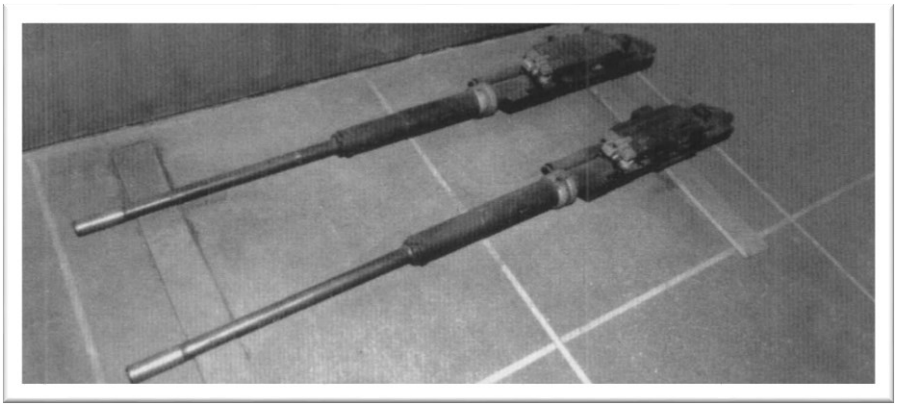
ARS-57M/S-5M UNGUIDED ROCKET



PARAMETER	VALUE
Caliber, mm	57
Effective Range, m	1,800
Maximum Speed, m/s	725
Circular error probability (CEP)	0.35% of Range
Warhead type	Fragmentation
Weight, kg	3.86
Warhead Weight, kg	0.815

The S-5M, first designated ARS-57M, is an Unguided High-Explosive (HE) Fragmentation Rocket. It can be employed both against Soft Ground Targets and as an Anti-Aircraft weapon against Medium to Large size Aircraft. The Rocket is carried in ORO-57K Rocket Pods with a capacity of 8 Rockets.

NR-30 30-MM AUTO-CANNON



PARAMETER	VALUE
Year	1955
Caliber, mm	30
Shell Mass, kg	0.41
Shell initial speed (muzzle velocity), m/s	780
Rate of Fire, Rounds per Minute	900
Weight, kg	66

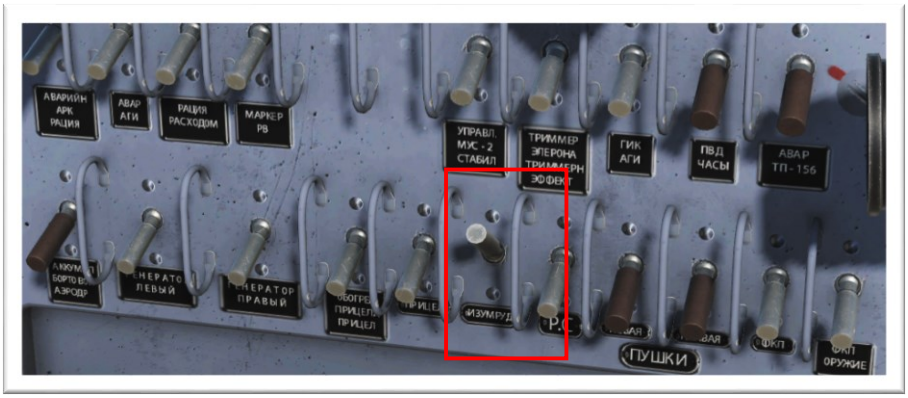
The MiG-19P has two Nudelman-Rikhter NR-30 30mm cannons, mounted in the Wing Leading Edge close to the Wing Root. The Cannon has 73 rounds of Ammunition, a Rate of Fire of 900 Rounds per Minute and an effective firing distance of 1,500 meters based on Shell Dispersion. Initial Gun Charging is Pneumatic, with Recharging by recoil action. Firing is controlled Electrically. Spent Rounds are counted by the USB-1 Ammunition Counters on the Lower, Main Instrument Panel, one for each Cannon.

RP-5 IZUMRUD (EMERALD) Radar Employment Instructions

The RP-5 is an Airborne Fighter Aircraft Radar, capable of searching the airspace for Contacts up to 12 km Distance and Tracking a single Contact automatically from 4 km. It is an update of the RP-1, used on MiG-17PF aircraft and early series MiG-19Ps.

To Operate the Radar, you need to do the following:

1. Turn ON the "IZUMRUD" switch on the RH Side Panel to power all the Radar Systems.



2. On the RP-5 control panel, located on the left panel, put the radar mode control switch in the Standby Position.

   NOTE: After this switch is turned On, the Radar needs about 2-3 minutes to Warm Up. If you set the switch to On before the warm up time has completed, the Radar Screen will turn on, but there will be no Transmission.

RAZBAM

3. After the warm up time has expired, put the switch in the On position.

WARNING: Transmitting is Forbidden when the Aircraft is on the ground. The aircraft has a safety mechanism that will not allow the Radar to Transmit if the Landing Gear is Deployed, however, Pilots are not allowed to put the switch in this position when on the Ground.

4. Check the Radar Screen. Rolling the Aircraft slightly, check that the Electronic Horizon is working correctly. The Radar Search should be visible in the form of a Faint Line and a Dot at the bottom, sweeping the Search Area from the Left. Some Noise from Ground Reflection or Clouds could be seen on the Screen.

NOTE: The Radar can only be used continuously for about 15 minutes, then it needs a 1-minute Cooling down time.

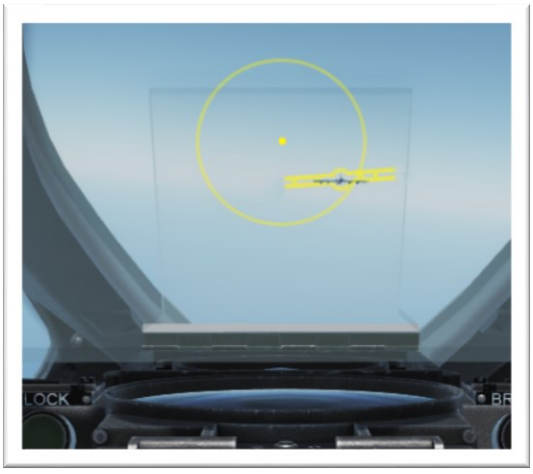
LOCKING A RADAR CONTACT FOR ENGAGEMENT

1. Check that the Radar Target Lock (AR-18-16 Tracking Antenna) Switch is turned On.

2. Maneuver the Aircraft to position the Radar Contact in the Scale Center Line.
3. Initiate a Climb or Dive, so the Contact Icon changes into a (**+**) Sign.

4. Close the Distance to the Target to make the Contact enter the Locking Window Zone.
   When this happens, the green LOCK lamp above the radar screen will illuminate.

5. Also, the Target Indicator will appear on the AR-18-8 Radar Sight.



6. As the Distance to Target approaches 300 meters, the Red Break lamp will illuminate, instructing the Pilot to Turn away and leave the attack run to avoid a collision. After 3 seconds the Lock will be dropped, as well as all Aiming Solution.

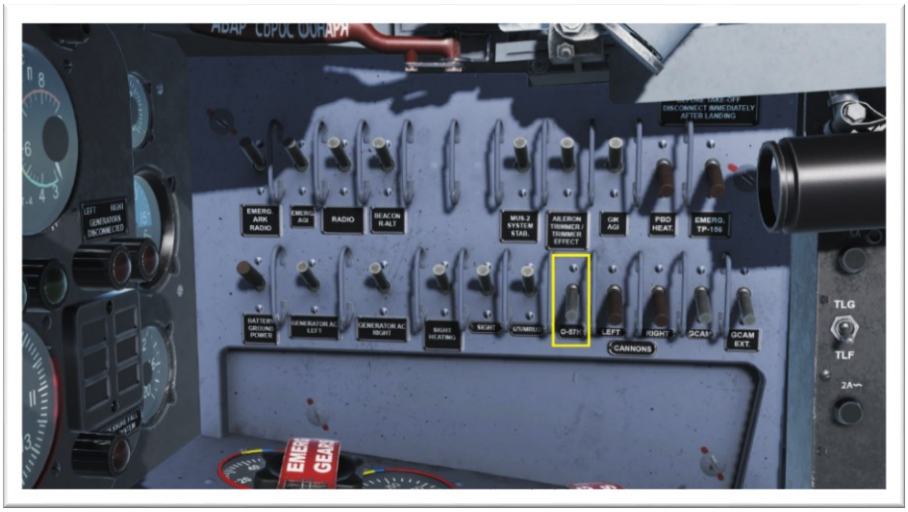
NOTE: This is a collision avoidance system, as there is a good probability that the Interceptor might collide with the target it is attacking, even more if it´s a Large Bomber Aircraft.

Armament Employment Instructions

NOTE: This instruction assumes that the aircraft is airborne with all main flight and electrical systems switched ON and operative.

R-3S AIR-TO-AIR MISSILE EMPLOYMENT

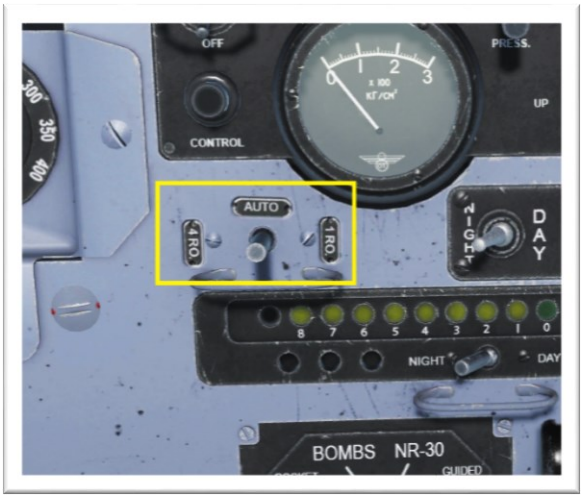
1. Ensure the Rocket Armament Power Switch, labeled **"O-57K" (P.C)** is switched On.



2. On the ASP-5N control panel, select "Guided Missiles" **(УР)** After this, the tracking Audio of the R-3S Seeker Head is heard on in the Helmet Earphones.

RAZBAM

3. You can select Missile Salvo by using the three-position Salvo switch above the ORO-57K Control Panel.
   AUTO: Both Missiles will be fired in an interval of 1.2 seconds.
   1RO: A single Missile will be fired with every press of the Trigger.
   4RO: Not operational when employing **R-3S.**

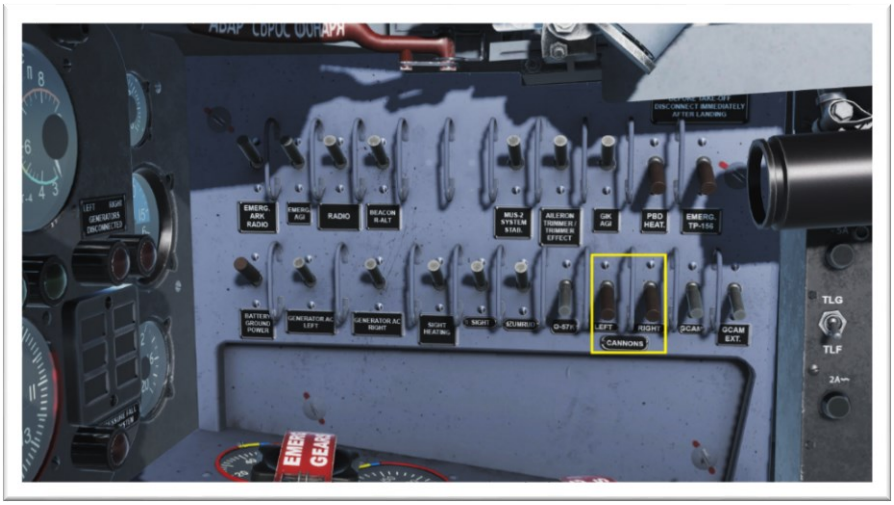


4. Approach the Target from behind and position it in the center of the ASP-5N reticle.
5. When the Distance to the Target decreases to Missile Tracking Range, the Tracking Tone increases in Volume and Pitch, indicating a correct Seeker Lock.
6. Fire the Missile.
   You can also use the Radar for exact measure of Missile Employment ranges.

   NOTE: The R-3S missile can only be fired at in a Maneuver of 2 Gs or less.

EMPLOYMENT OF CANNON ARMAMENT IN AIR COMBAT

1. Switch On both Cannon power switches on the RH Side Panel.



2. Press the Cannon Reload Buttons on the Upper LH Side panel for more than 2 seconds per Button.

3. After every press, check that the corresponding Red Lamp, indicating an armed cannon, is illuminated on the lower Main Instrument Panel above the Ammunition Counters.

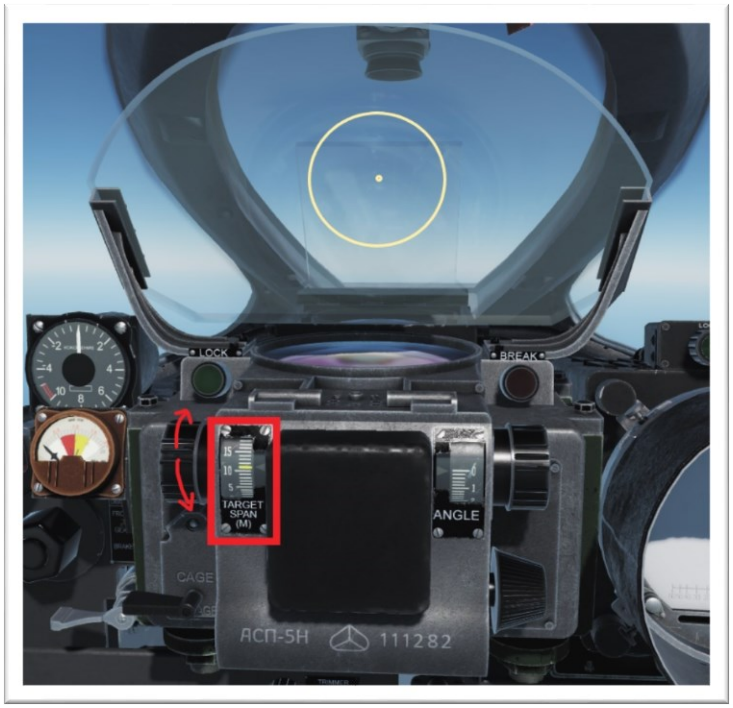
4. Put the ASP-5N Mode Selector in the NR-30 Position, this arms the cannons ready for use. Depending on the situation, the Pilot can choose to Aim the Cannons using Optic or Radar Mode.

EMPLOYMENT OF THE ASP-5N GUNSIGHT IN OPTIC MODE CANNON ARMAMENT

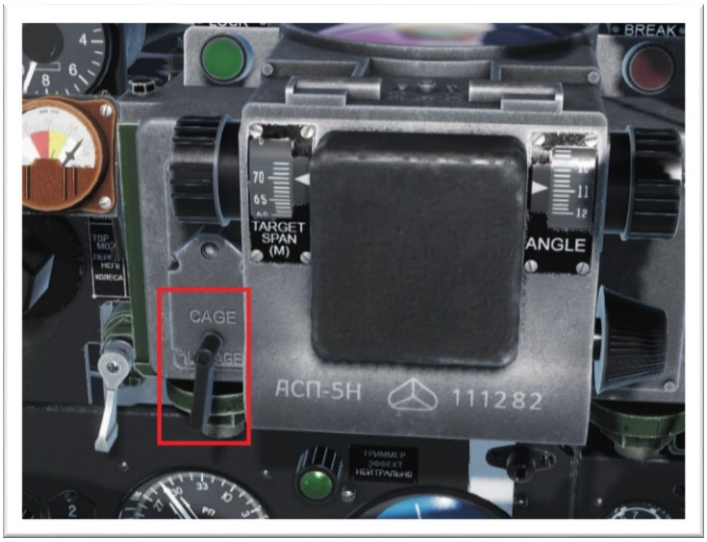
After completing the preceding steps, the Cannons are now ready to use. The ASP-5N gunsight is capable of being used as a Collimator-based Sight in which Target Span and Distance are introduced manually by the Pilot or can receive Distance Data from the RP-5 Radar, for a generally improved Aiming Solution, and for use in low visibility conditions. However, Radar Malfunctions or Low Altitude Combat (due to Ground Clutter and the Radar tracking the Ground as a Target) can make the Radar ineffective and in these cases, the Optic method should be used.
The ASP-5N already has Bullet Flight Time, Bullet Path Curvature for Angular Speeds and Barometric Altitude Data for its calculations. The manual introduction of Distance by the Pilot is the last parameter needed to provide a Aiming Solution.

1. In the ASP-5N Control Panel, put the Aiming Mode Switch in the Optic Position.
   This will remove the Radar Data from the ASP-5N and make it start to receive Target Wing Span and Distance Data that is manually introduced by the Pilot.

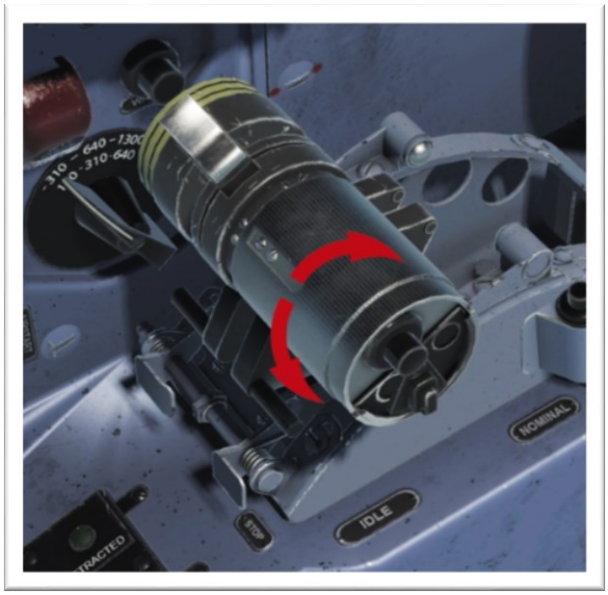
2. For this example, an F-4 Phantom Fighter Aircraft, which has a Wingspan of 11 meters, is used as a Target. In this case, a value of 11 meters must be entered on the TARGET BASE/WING SPAN selector on the Sight.



3. Uncage the Sight Gyro by turning the Cage/Uncage Lever. This allows the Aiming Reticle to move freely allowing Gunsight Gyro Precession.



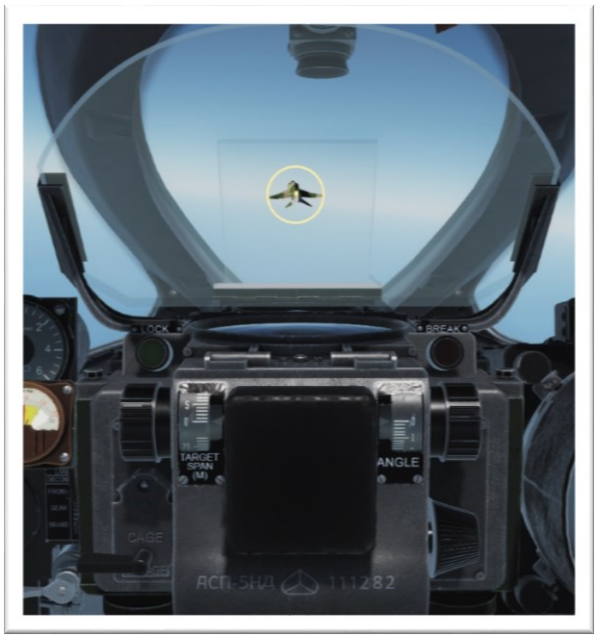
4. Having selected the Target Wing Span, change the Aiming Reticle Distance by rotating the Throttle Handle backwards and forwards, check the change in the Diameter of the Outer Circle.



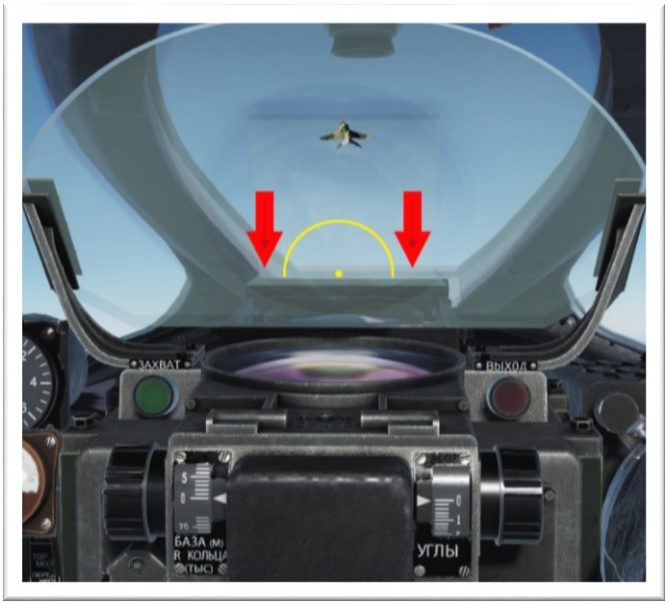
5. The Distance introduced manually can be checked on the Target Distance Indicator to the left of the ASP-5N Sight.

6. When pursuing the target, rotate the Throttle Handle, so the wingtips of the Phantom touch the borders of the Outer Circle. This ensures the correct distance to target is introduced into the Sight. As the Distance to Target changes, this value can be adjusted, the Sight will calculate the Angular Velocity value and project an Aiming Solution. Open fire while maintaining the Center Dot over the Target.

   NOTE: Keep in mind that in an Uncaged sight, the Reticle will move further down in an climbing maneuver as the introduced distance is increased.



During this process, as the Gunsight Gyros are Uncaged, it may be possible that during high G maneuvers, the reticle moves too far down, disappearing from the Sight Field of View. While this may not be an issue at Short Range, because Bullet deflection is not relevant, it may prevent effective engagement of Targets at Medium to Far Distances as in this case it will be impossible to introduce the correct Distance for a good Aiming Solution.



Standard solutions are to maintain the sight Caged until the Distance Measurement, then Uncage and Fire over the established aiming point, or use a Caged Sight and aim by the Pilot´s own predictions.

However, in the MiG-19, a Technical solution was provided for these cases: the ASP-5N Aiming Reticle dampening Button on the Control Stick.

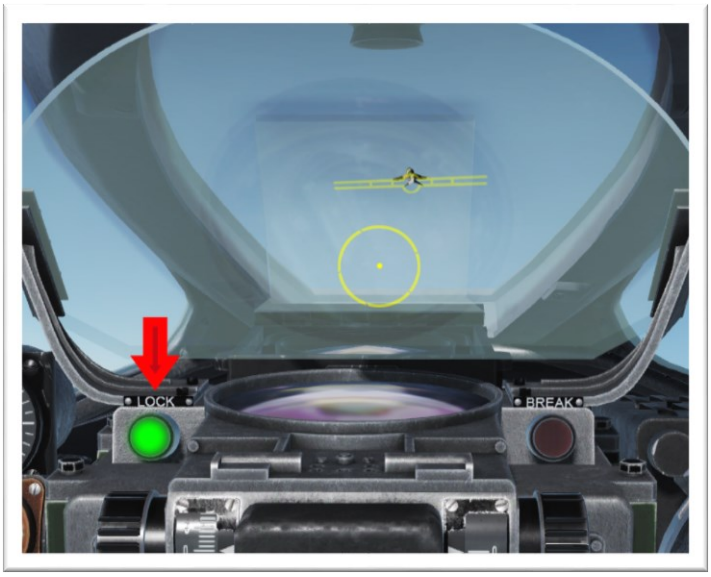
This Button is an electrical Caging, Centering the Gunsight Reticle when pressed. This way, the Pilot can introduce the correct Distance into the Sight during intense maneuvering while the Lead Angle Calculations for the selected Distance are still made. When the button is released, the Reticle returns to the Calculated Impact Point Position (CIIP).

EMPLOYMENT OF THE ASP-5N GUNSIGHT IN RADAR MODE CANNON ARMAMENT

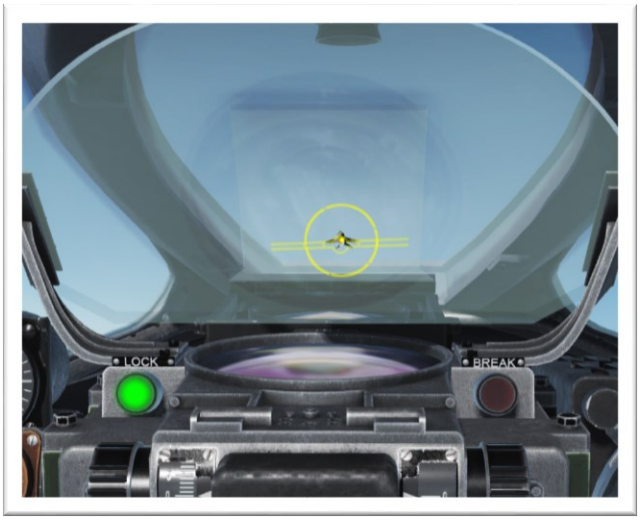
Working in a similar fashion as the Optic mode, in Radar mode, the Distance to Target is introduced automatically by the RP-5 Radar. In this mode, the manual distance introduction by means of the rotating Throttle Handle is overridden and the target distance indicator shows that provided by the radar.

1. Put the gunsight switch in the Radar Position.

2. Uncage the Sight Gyros.
3. When the Contact locked by the Radar closes to 2,000 meters, the Lock Lamp on the ASP-5N sight will illuminate, indicating that the Target has entered the Sight Operational Range and the Radar has started to provide Distance Data. Distance to Target is also presented on the Sight Distance Indicator.

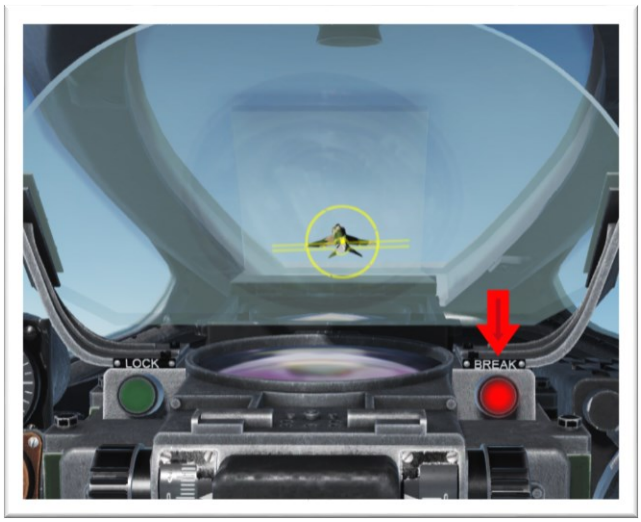


4. Maneuver the aircraft to position the Reticle Center Dot over the Target and Fire.

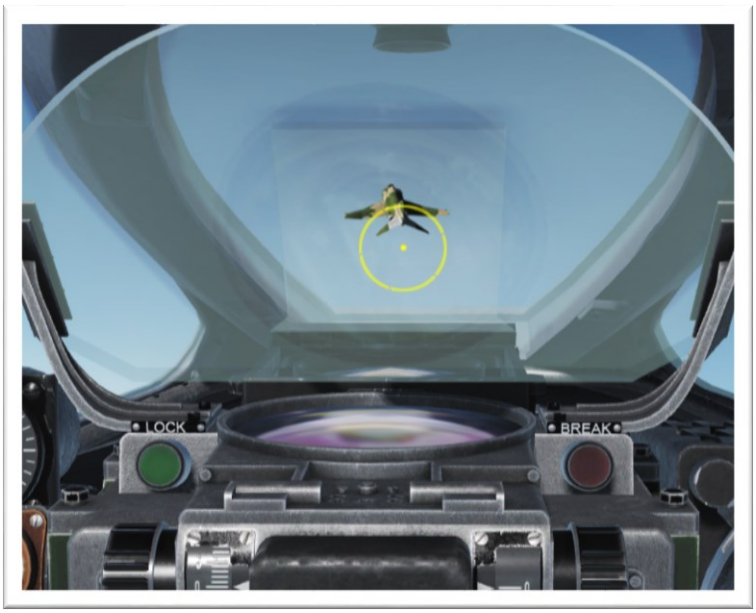


5. If you hold you Fire to get close on the Target Aircraft, keep in mind that, like the Radar, the Sight also displays a Proximity Alert, represented by the Red Break Lamp. As the distance to the Aircraft approaches 300 meters, the Break Lamp will illuminate.

NOTE: If the closing rate is too great, the Lamp will illuminate earlier.



6. The Lamp will illuminate for around 3 seconds, then the Aiming Solution and Radar Lock will be dropped, and the Sight will automatically switch to Optical Mode.



This does not mean that the Cannons will be disabled as well. If the Pilot decides so, the Target can still be Engaged using the standard Optical method.

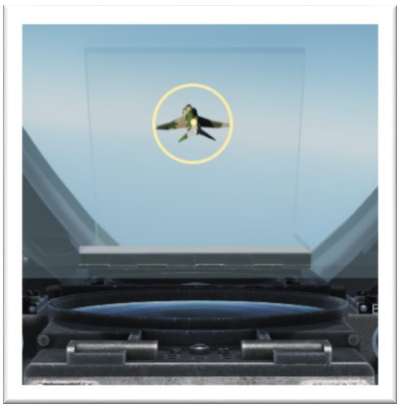
EMPLOYMENT OF RADAR MODE WHEN THE RP-5 HAS BEEN SWITCHED TO MODE 1

When flying below 2,500-2,000 meters, the Ground Reflections received by the Radar are too strong and cover the entire Radar Screen. Because of this, the Radar cannot be used to Search or to provide an accurate aiming prediction. For the RP-5 a special mode was introduced to deal with this situation and aid in the aiming process in Altitudes as low as 900-1,000 meters.

This is done by turning off the AR-18-1 Search Antenna and reducing the AR-18-16 Antenna Tracking Range to 1,200 meters. To use this mode, you need to do the following:

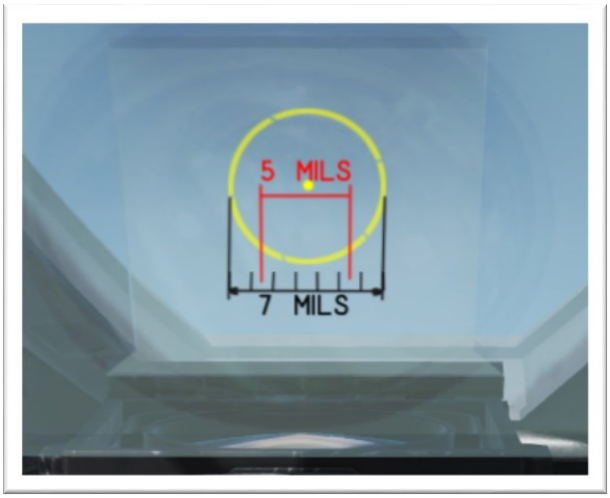
1. Put the RP-5 Altitude Mode Switch in the 1 Position.

2. This turns off the AR-18-1 Search Antenna of the Radar and any Target within 1,200 meters of the Aircraft will be Locked. The Radar will then work identically to a Radio Range-Finder, like the one installed in the MiG-19S.
3. The process to attack is identical: as the Distance is being introduced automatically into the Gunsight, you only need to place the Reticle Center Dot over the Target and fire.



EMPLOYMENT OF CANNON ARMAMENT IN GROUND ATTACK

As the Radar of the MiG-19P cannot be used for Ground Attack, the Optic method can be used for this purpose in the same manner it is used for Air combat. However, the minimum span that can be introduced into the Sight is 7 meters, which may prove insufficient when attacking small targets like Cars or small Armored Units. One solution is to introduce a distance of 1,000 meters into the Sight (or whichever the Pilot decides as Optimal Range) and estimate how much a 5-meter target (for example) would fill the Reticle Outer Circle in the 7-meter setting, then open fire when the Target fills that space.

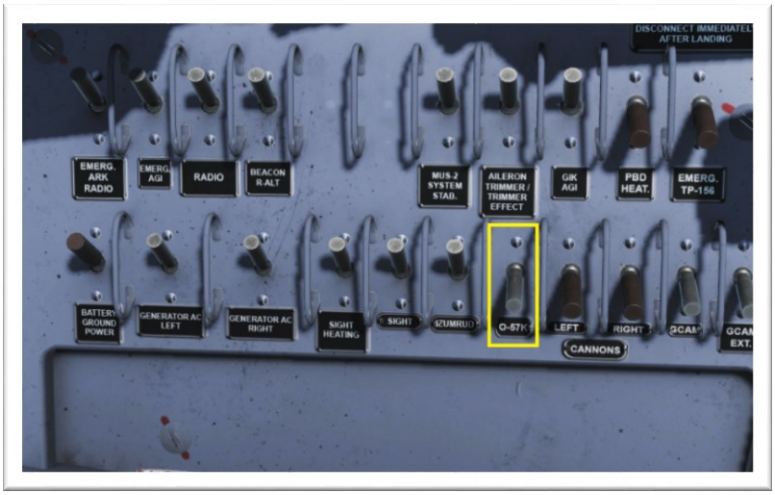


A fixed sight can also be used, but that requires a lot of training to prefect. For targets larger than 7 meters, the method of operation remains unchanged.

The Cannons are best employed at Dive Angles from 20° to 50° and at distances between 1,500 and 800 meters from the Target. Remember that as the Dive Angle and Speed increases, so does the exit Altitude. When attacking at 20-30°, the recovery maneuver should start before reaching 800 meters, but for 40-50°, the recovery should start at 1,000 meters.

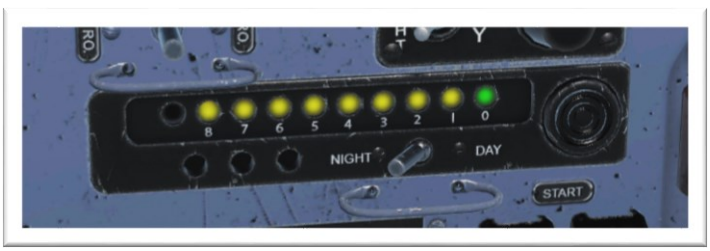
EMPLOYMENT OF ARS-57M/S-5M UNGUIDED ROCKETS

1. Turn On the O-57K (P.C) Switch on the RH Side Panel.



2. On the ASP-5N Control Panel, put the Armament Mode Selector in Rocket Pods (P.C).

3. On the ORO-57K Control Panel, check that the Green light above the "0" is illuminated, indicating the suspension of both Rocket Pods, and that the correct remaining quantity of Rockets per Pod (8) is indicated by Yellow lights.



4. Select the desired Salvo setting with the Salvo Switch above the ORO-57K Control Panel.

AUTO: All Rockets will be fired in succession if the Trigger remains pressed.
1RO: A single Rocket will be launched for every Trigger press.
4RO: Four Rockets will be fired on every press of the Trigger.

EMPLOYMENT OF ARS-57M/S-5M ROCKETS IN AIR COMBAT

The ARS-57M Unguided Rockets can be used to attack Large Aircraft, like bombers, where they could be more effective than Cannons. The method of employment is the same as the Cannon, while using the Optical method or the Radar one. When the ASP-5N Armament Mode is changed to Rocket Pods, the Ballistic Data entered for calculations will be that of the ARS-57M Rockets. The Sight will display the correct impact point.

EMPLOYMENT OF ARS-57M/S-5M ROCKETS IN GROUND ATTACK

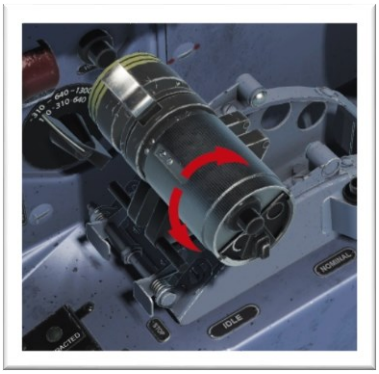
As explained previously for Air Combat, the method of operating the ARS-57M rockets for Ground Attack is the same as the Cannon. However, an example will be provided, as attacking targets on the ground has its own characteristics.

Unguided Rockets are best used at Distances of between 1,500 – 2,000 meters and in Dive Angles from 20 to 60 Degrees. The Aircraft should Break Off the Attack at a Minimum Distance of 600 meters to avoid damage from shrapnel and explosions.

In this example, a 15-meter-long rail wagon at 1,500 meters will be attacked:

1. Introduce the span of 15 meters into the Sight.

2. Introduce the Distance of 1,500 meters by rotating the Throttle Handle.



3. Put the gunsight mode in Optic and Uncage the Gyros.
4. Dive towards the Target and maintain the Reticle Center Dot over it. Ensure there´s no yaw.
5. When both edges of the Wagon touch the Sight´s Reticle Ring, open fire.

EMPLOYMENT OF FREE-FALL BOMBS

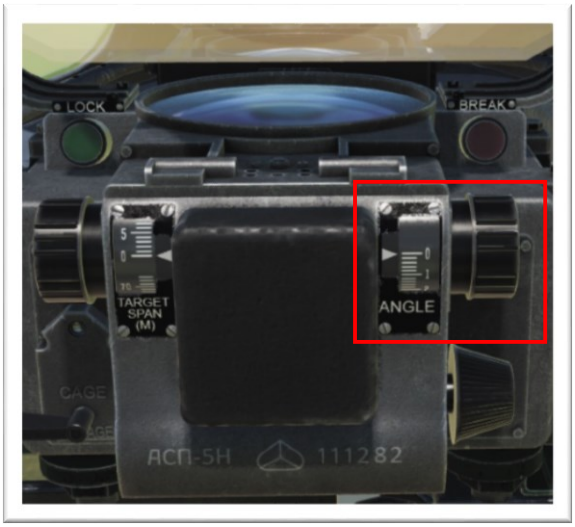
The MiG-19P can use Free-Fall Bombs up to 250 kg, which includes FAB-100, 150 and 250 High-Explosive General-Purpose Bombs. For this, the ASP-5N Gunsight is loaded with special cartridges with the Ballistic Data of the Bombs that are going to be used.
Perform the following steps to get the bombs ready for use:

1. Put the ASP-5N Armament Mode Switch in Bombs and select the Release Setting (Auto-Manual).

2. Check that the two Green Lamps that indicate Suspended Loads on the Pylons are illuminated

3. Turn On the "Arm Bombs Fuse" Switch. The Red "Exp" (explosion) Lamp should illuminate.

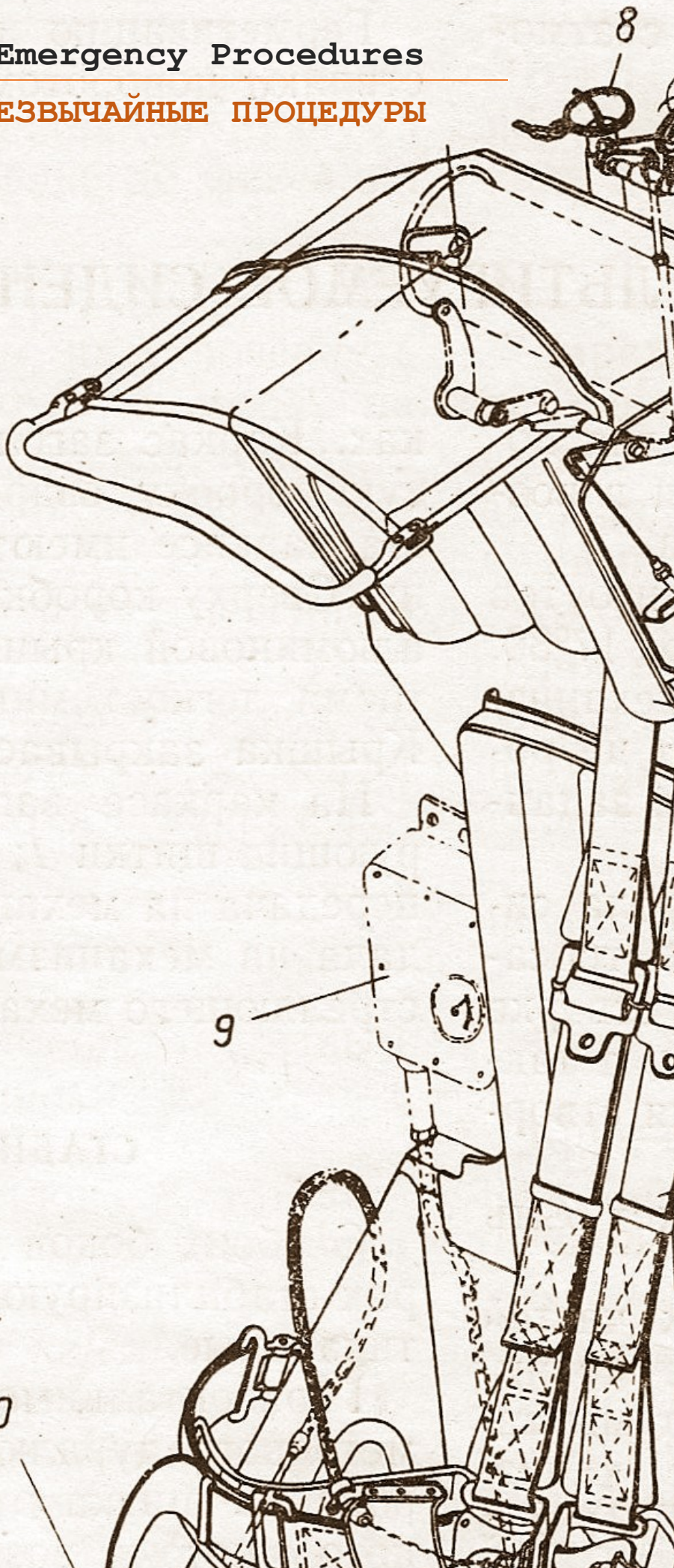
4. Select a dive angle from the Sight Angle Selector. The Angles are limited to values between 20 to 50 degrees. Best Angles for Bombing are from 30 to 50 degrees (the Reticle will move down out of the view in Level Flight).



5. The same as Cannon or Rockets use, select a Target Span (if between 7-70 meters) and desired Distance for Bombing (depending on the target, the best bombing distance is from 1,500 to 2,000 meters).
6. Dive and put the Reticle Dot in the center of the Target, eliminate all yaw.
   The best dive speed is between 600 and 800 km/h. Use airbrakes if necessary.

7. When the Target edges touch the Sight´s Ring, release the Bombs and perform a 4-G pullout.
   Both the Green Lamps for "Suspended Loads" should extinguish.

   WARNING: When using 250 kg bombs, be sure to pull out of the dive before reaching an altitude of 700 meters, otherwise the Aircraft may be damaged by the explosion.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Emergency Procedures in Flight

ENGINE(S)IN-FLIGHT SHUTDOWN

Ensure the following conditions are met before attempting an in-flight engine relight:

- Altitude 9,000 m or lower
- Min IAS of 400 km/h.
- Engine RPM 1,600RPM or more.

NOTE: The lower the Altitude and the greater the speed the IAS then the greater reliability of the Engine re-start will be successful.

1. Put the Throttle of the shutdown Engine in the IDLE (**МАЛЫЙ ГАЗ**) position.

2. On the LH Side Panel, open the cover of the Engine Air Re-Light Start (**ЗАЖИГАНИЕ В ВОЗДУХЕ**) switch for the Engine you want to Re-Light and operate the Switch.

3. The respective "Engine Air Re-Light Start System" (**ЗАПУСК В ВОЗДУХЕ ВКЛ)** Lamp for the respective engine will illuminate on the front panel and the starting sound should be heard continuously.

4. Within 20-25 seconds, the engine should reach IDLE of 4,100 +200 RPM.

5. When the Engine has stabilized at the IDLE RPM, turn off the respective Engine Air Re-Light Start (**ЗАПУСК В ВОЗДУХЕ ВКЛ)** Switch.

6. After a successful In-Flight relight ensure that you wait 30 seconds after the engine has stabilized at IDLE RPM before moving the Throttle to the desired Thrust Position. Making sure to avoid Afterburner and Military Power settings until 1 min after reaching IDLE RPM.

7. If the Engine Air Re-Light Start procedure fails, ensure that you wait at least 40 seconds before reattempting the start procedure.

8. If both Engines shutdown whilst under 2,000 m try to start them one after the other if they are at the normal speed of autorotation of 1,600RPM. If they fail to re-light, choose a good location and eject. If the both Engine are less than 1,600RPM, eject or try an emergency landing immediately.

9. Flight with one Engine can be easily counteracted using the Rudder. If the remaining Engine will not re-start where possible cancel the mission and return to the Airbase.

FAILURE OF THE STABILIZERS HYDRAULIC BOOSTER

- The failure will be indicated by the one or all the following symptoms; the inability to move the stick in the pitch axis, the "Low Hydraulic Pressure" (**ПАДЕНИЕ ДАВЛЕНИЯ В ГИДРОСИСТЕМЕ**) warning lamp or an un-commanded pitch without operation of the control stick in the pitch axis.

1. If either the Main or Booster Hydraulic System fails or the BU-14M Hydraulic Booster fails in flight, switch to the backup MUS-2 Electric Stabilizer Control using the switch in the Left Side Panel.

2. While operating with the backup Electric Stabilizer Control System bear in mind that the Stabilizer Control is not as responsive as the Hydraulic Stabilizer Control System. Continuation of the Mission under these conditions is Forbidden, return immediately to the airbase. You should attempt to maintain an IAS of 700 kph or below and perform wide turns making sure to avoid high bank angles.

GENERATOR FAILURE

- DC Generator Failure is indicated by the illumination of the Generator Off Red Warning lights (**ГЕНЕРАТОР ВЫКЛЮЧЕН**) on the Main Instrument Panel.

- If both DC Generators fail at the same time, the V-1 Voltmeter, located on the Main Instrument Panel, will display approximately 24V indicating the Battery is now powering the DC Busses.

- If a single DC Generator fails, the power generated by the remaining one is capable of powering all the Aircraft electrical power consumers.

DOUBLE DC GENERATORS FAIL DURING FLIGHT

1. Contact the ATC/Control Tower and immediately return to land at your Airbase.

2. Turn off all Electric consumer power switches. This includes both DC Generators (**ГЕНЕРАТОР ЛЕВЫЙ, ГЕНЕРАТОР ПРАВЫЙ**) RP-5 Radar (**ИЗУМРУД**), RV-5 Radar Altimeter (**МАРКЕР РВ**), RSIU-4V Radio (**РАЦИЯ РАСХОДОМ**), SRO-2 IFF, ARK-5P (**АВАРИЙН АРК РАЦИЯ**) Radio Navigation System and all Fuel Tank Pumps (**НАСОС 1., 2., 3. & 4. ГО БАКА**) (if flying above 7,000 meters, keep the Fuel Tank Pump 1 (**НАСОС 1. ГО БАКА**) ON.

3. Turn the Radio Power ON (**РАЦИЯ РАСХОДОМ**) only when it is necessary to communicate with the Airbase Tower in order to conserve power.

4. Engine Throttle movement should be slow. On Landing Approach, deploy both the Landing Gear and Flaps using the Emergency Procedures.

5. The safe time the Batteries can last powering the systems is:
   - 8 minutes, if the Engines were started using the Batteries.
   - 12 minutes, if the Engines were started using Ground Power.

   If all the consumers are left ON:

   - 3 minutes, if the engines were started using the batteries.
   - 7 minutes, if the engines were started using ground power.

ENGINE LOW OIL PRESSURE

1. Illumination of the "Oil" (**МАСЛО**) Lamp during flight, stop any maneuver and return to straight and level flight.

2. Increase the Throttle setting to the MILITARY POWER (**МАКСИМАЛ**) position and check if the lamp remains illuminated.

3. If the lamp remains illuminated for greater than 15 seconds, carry out a manual engine shutdown, by placing the respective throttle into the STOP (**СТОП**) position, and carry out an expedited return to the airbase.

4. In case of a Double Engine OIL low pressure warning, return to the airbase if possible or search for place to land or eject as required.

   WARNING: To keep the engine working for more than 1 minute with low oil pressure can generate an engine fire on the engine destruction in the worst case.

ENGINE FIRE

- The presence of Fire in one or both Engines will be indicated by the illumination of the "Fire" (**ПОЖАР**) Warning Lamp, located on the LH Side Panel. You may also observe a smoke trail that can be seen during turns or reported by your Wingman.

1. Immediately move the Throttle(s) of the affected Engine(s) to the STOP (**СТОП**)position and close the Fuel Shut-Off Valve(s) (**ПЕРЕКРЫВНОЙ КРАН**) by using the respective Switch in the same LH Side panel.

2. Turn OFF all Fuel Tanks Pumps 2,3 and 4 (**НАСОС 2., 3. & 4. ГО БАКА**). Fuel tank pump 1 (**НАСОС 1. ГО БАКА**) should remain on unless both Engines are on Fire.

3. If the Fire is not extinguished with these measures, decrease IAS 400 kph or lower and operate the "Fire Extinguisher" (**ОГНЕТУ-ШИТЕЛЬ**) Button. The Engines can´t be re-started after this. If the Fire remains after this then eject.

4. If the fire warning ceases and it's confirmed the fire is extinguished, then immediately return to the airbase where possible.

   NOTE: If there is smoke in the cockpit, jettison the canopy (**АВАР. СБРОС ФОНАРЯ**) while flying below 2,000 meters and at speed below 450 kph.

5. On landing approach, deploy both the Landing Gear and Flaps (**АВАР. ШАССИ И АВАР. ЗАКР**) using the emergency procedures and jettison the Canopy (**АВАР. СБРОС ФОНАРЯ**). If you plan to land without the Landing Gear, ensure that you jettison all external stores (**АВАР. СБРОС ПОДВЕСОК**).

PITOT TUBE FAILURE

- Failure of the Main, Starboard Wing mounted, PVD Air Data Probe is indicated by erratic operation of the Air Data Instruments; Airspeed Indicator, Machmeter and Altimeter and also by the ARU-2V gauge showing incorrect position for the current Airspeed and Altitude.

1. In cold weather it is important to check that the both the Main PVD Pitot Probe (**ПВД ЧАСЫ**) and TP-156 Emergency Pitot Probe (**АВАР. ТП-156**) Heating Switches on the RH Side Panel are switched on prior to departure. If you detect erratic readings in the Air Data Instruments, check that the two Probe Heating switches are turned On.

2. In case the main PVD Pitot fails, switch over to the Standby TP-156 by switching the lever in the LH Side Panel to the TP-156 position and reduce IAS to 700 kph or lower.

3. The Standby TP-156 is only allowed to allow for the Aircraft to return and land safely.

4. On Approach, switch the ARU-2V control to Manual (**АРУ-2В – РУЧНОЕ**) and move the lever arm length to long lever arm (**БОЛЬШ ПЛЕЧО**) setting.

OXYGEN SYSTEM FAILURE IN FLIGHT

1. In case of an Oxygen System failure while at high altitude (symptoms of hypoxia and wrong M-2000 and IK-18 instruments readings) operate the DU-2 oxygen control panel and put the oxygen mixture setting in the 100% position.

2. Descend the aircraft below 2,000 meters altitude and depressurize the canopy.

3. Return the oxygen level switch to the MIX (**СМЕСЬ**) position.

EMERGENCY LANDING GEAR & FLAP DEPLOYMENT

- If both the Main and Booster Hydraulic Systems fail during flight, it will be not be possible to lower the flaps or the Landing Gear. For this situation, an Emergency Pneumatic System is used.

1. To lower the Landing Gear, put the Landing Gear Handle (**ШАССИ**) in the Down (**ВЫПУЩЕНО**) position.

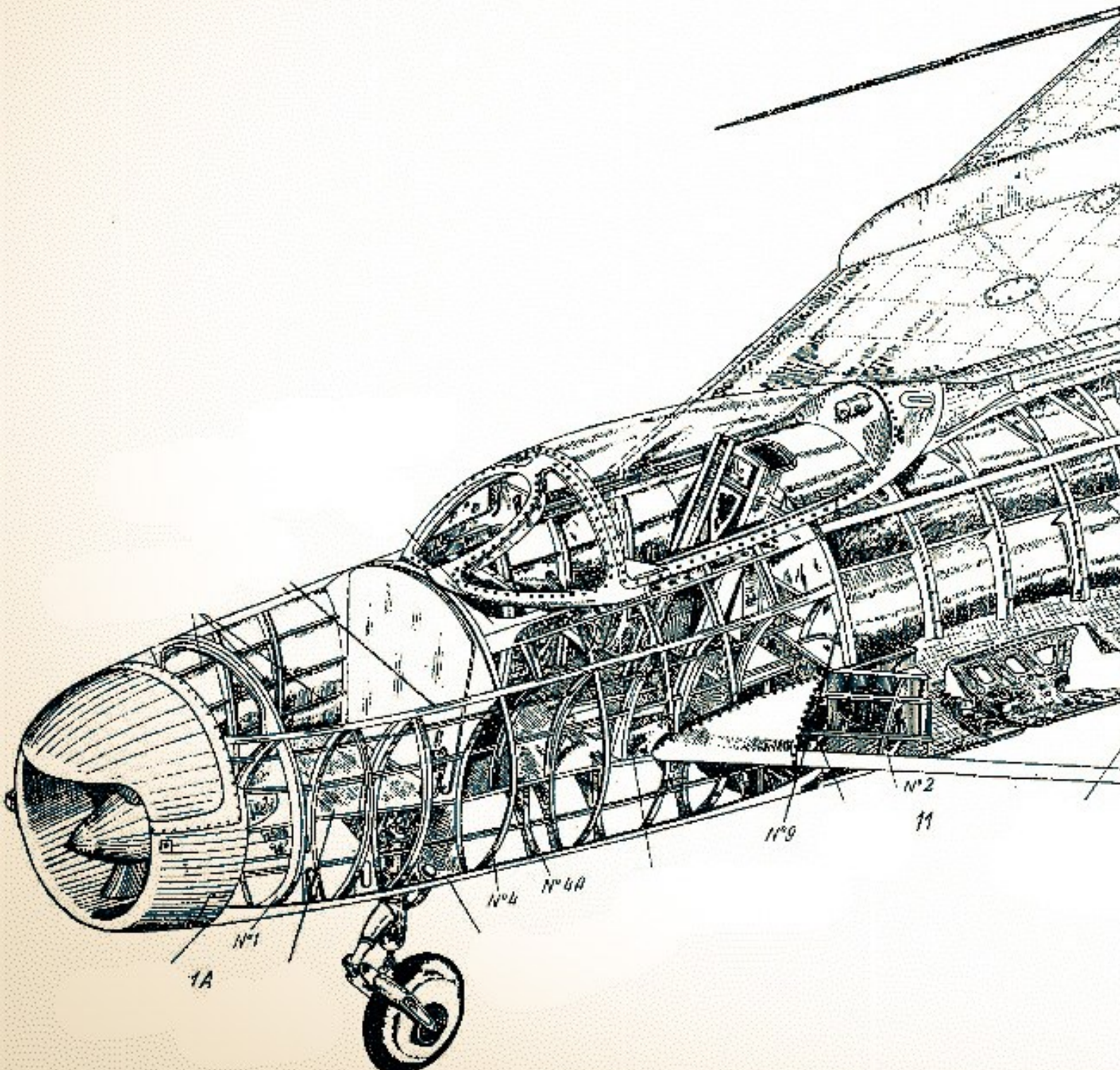
2. Pull the Landing Gear Emergency Deployment Handle, Red Handle to release the Hydraulic Uplocks mechanically by a cable and pulley system, the Handle is located next the pilot right leg near the RH Side Panel.

3. Fully rotate the Landing Gears Emergency Deployment Valve (**АВАР. ШАССИ**) on the RH Side Panel. Check that all three Landing Gear Down and Locked Green lights are illuminated on the PPS-1 Landing Gear, Flaps and Airbrake Position Indicator panel.

4. After the Landing Gear is fully deployed, fully rotate the Flaps Emergency Deployment Valve (**АВАР. ЗАКР**), this will deploy the Flaps to the Landing Position. Check the "Flaps Deployed" (**ЗАКРЫЛКИ ВЫПУЩЕНЫ**) lamp on the PPS-1 Landing Gear, Flaps and Airbrake Position Indicator Panel is illuminated.

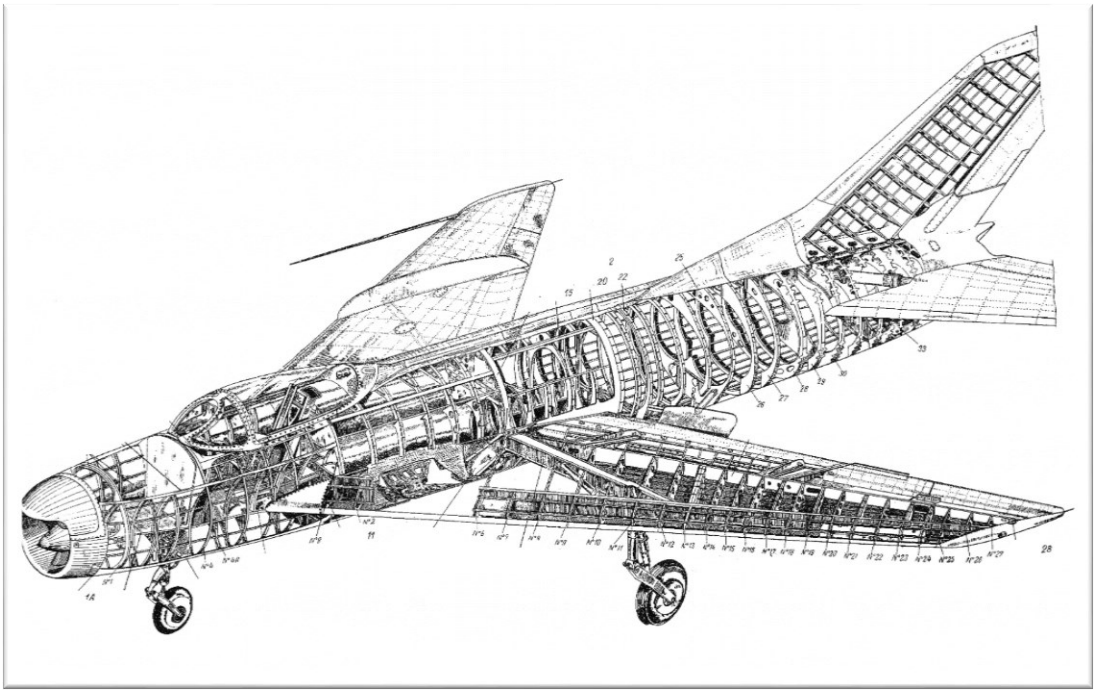
   WARNING: After both the Landing Gear and Flaps Emergency Deployment Systems have been operated, the aircraft Hydraulic and Emergency Pneumatic Deployment Systems will require repair/service before being to use these systems again in order to prevent Hydraulic System Overpressure and supply pipe ruptures.

Chapter 6 – System Technical Descriptions



Fuselage

The Fuselage is a Semi-Monocoque construction made from D16 Aluminum Skin, with the use of V-95 Aluminum Alloys, 30KhGSA and 30KhGSNA Steel for the Frames, Longerons, Spars and Stringer construction, with the cross section being circular over the Nose Section and gradually changing to oval over the Engines. The Fuselage, with a max. diameter of 1.45 m is divided into two main Sections comprising 40 Frames. The Front Section consists of an intake duct divided by a vertical splitter that flows into a bifurcated duct around the Cockpit and the nose wheel bay. The central splitter and the upper nose ring lip incorporate Radar Transmitter and Receiver Antennae. A Gun Camera is housed in a fairing on the Starboard side of the Nose. The upper Nose Section houses Radar Equipment and is enclosed by a detachable cover. The lower center Fuselage, behind the Nose Landing Gear Bay, is occupied by the Radio and Navigation Equipment and the Batteries, while a retractable Landing Light is housed on the Port side. The Fuselage center section carries the Wing Attachments (at Frames No's. 9 and 15) and engine mounts. The Rear Section, attached by four quick-release locks at Frame No. 20, can be quickly detached for Engine and Systems maintenance. The Aft Fuselage contains Engine Jet Pipes, Control System Linkages and Fuel and Hydraulics Systems Equipment.



A spine on the top of the center Fuselage covers the linkage of the ARU Automatic Flight Governor Control unit. Below the Rear Fuselage a liquid-sprung bumper is fitted to prevent damage during Take-off and Landing. Two Lateral Airbrakes, of an area of 1.04 m^2 in total, and a Ventral perforated Airbrake, with an area of 0.45 m^2, are incorporated in the Rear Section and below the center fuselage. A pneumatically operated and jettisoned TP-19 Drag Chute with an area of (15 m^2), is in a ventral bay between the engine pipes, accessed via 2 doors offset to port. The Fuselage skin thickness varies between 0.6 and 1.2 mm (0.024 and 0.047"). The endmost Fuselage part, in the form of a Forked Fairing, is made of steel; its shape differs on the 'P' and 'PM' versions. Several air scoops around the rear fuselage are fitted to cool the Engines and associated systems.

Wing

The Wing is of a cantilever construction and swept-back design, using D-16T Electron magnesium alloy castings and V95 aluminum alloy panels. The airfoil section is TsAGI S-12 at the root and SR-7S at the wingtip, while the wing aspect ratio is 3.24 and taper ratio is 3.04. Each wing consists of a main, front and rear, and an auxiliary spar implementing a total of 30 ribs and a wing tip. A single 320-mm high boundary layer fence is fitted to the upper wing's surface. The trailing edge inboard of the fence is occupied by a single-section Fowler Flap which can be set at 12° for combat maneuvering at speeds of up to 797 km/h, while outboard of the fence is a two-piece aileron; the Trim Tab is fitted to the Left Side only. The Spoilers, which improve flight characteristics at high speeds, are installed on the lower wing surface forward of the Flaps and are mechanically interconnected with the Ailerons. The MiG-19P wing leading edge also incorporates an ammunition magazine for the NR-30 Cannons, while the 'PM' is fitted with four pylons for AAMs on the wing leading edge. A pitot boom is fitted to the starboard wing tip leading edge.

Empennage

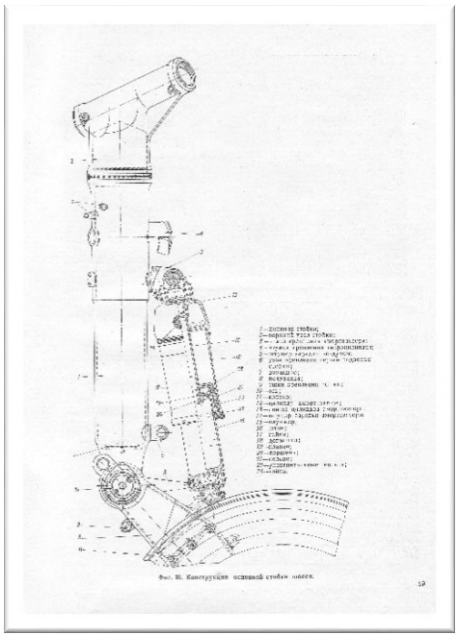
The Empennage is of a Cantilever all-metal stressed-skin construction. A Stabilizer is fitted, with a TsAGI-M airfoil section, 55° sweep at quarter chord and 7 % thickness/chord ratio. The stabilizers rotate around a beam axis attached to the rear Fuselage. An Anti-Flutter Mass Balance Weight is fitted to each Stabilizer tip. The Vertical Tail unit, of a Conventional Design, utilizes a TsAGI S-11 Section.
MiG-19P and early MiG-19PM fighters were fitted with a short Fin leading edge extension while on later 'PM' aircraft a long Fin Fillet was installed to cover the ARU-2V Control Unit. A long Ventral Fin, of an area of 0.54 m^2, is installed to improve stability at high angles of attack.

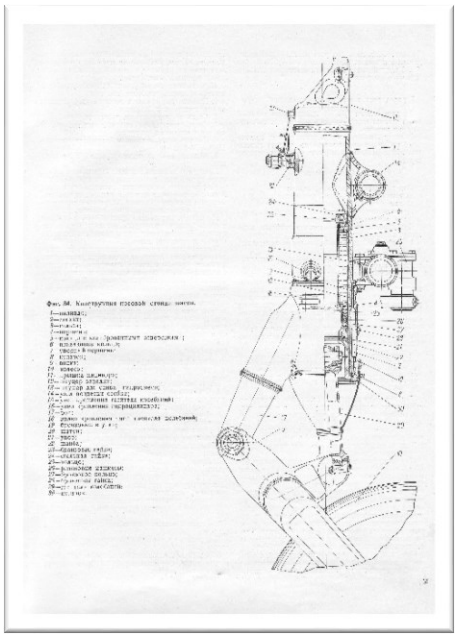
Cockpit

The cockpit (slightly wider than that of the MiG-19S), which is located within pressure bulkheads at Frames No. 4 and 9, is enclosed by a bubble canopy, with 64-mm bulletproof glass front panel, and a sliding Perspex canopy. The windscreen can be de-iced using pneumatically-sprayed alcohol. The cockpit tub is surrounded by a 10-mm (0.39") thick armor plate at the front, a 16-mm (0.63") plate at the rear and a 25-mm (0.98") sheet behind the pilot's head. It is pressurized by the engine bleed air and is equipped with an automatic temperature control system. The pilot's emergency rescue system comprises a pyrotechnical canopy jettisoning system. The Mikoyan-designed KK-2 ejection seat incorporates a face screen/firing handle and stabilizing fins in its headrest and mounts a canopy glass penetrator in case of the canopy jettison failure.

Landing Gear

The Landing Gear consists of a tricycle-type Hydraulically Retractable Undercarriage with Lever Suspension. The Nose Gear, incorporating a Shock Absorber and Anti-Shimmy Damper, retracts forward. A free-castering KT-38 wheel, with a 500x180mm tire, is fitted, and a Taxiing Lamp is mounted on the Nose Leg. The Main Landing Gear assemblies retract inwards into the Landing Gear Bays located within the Front and Main Wing Spar. Both Main Legs comprise a hollow Cylinder, with a 4.3-liter (0.95 gal) Pressure Air Bottle, and a Telescopic Hydraulic Shock Absorber. KT-37 wheels (660x200mm) with Drum Brakes are fitted, and two Wheel Doors and a Landing Gear Leg Fairing are fitted. Gear Retraction and Extension is actuated Hydraulically with Pneumatic Emergency Release as a Backup.





Powerplant

Two Mikulin RD-9B single-shaft axial-flow afterburning turbojets are installed side-by-side in the center fuselage, attached to Frames No's. 15 and 20. Each engine has a two-stage turbine driving a nine-stage compressor via a single shaft. The afterburner has 10 adjustable nozzle flaps. In full afterburner, the nozzle diameter is 498 mm, at max. thrust it is 442 mm. The engines and their accessories are accessible via panels in the upper central fuselage. For engine starting an external power source is used. Normally, the left engine is started first, but in case of cross winds the one on the right side can be started first.

RD-9B ENGINE CHARACTERISTICS

Engine Regime	RPM	Thrust (Kg)	Fuel Consumption (Kg/h)	Specific Fuel Consumption (SFC)	Time limits
Afterburner	11,150+50	3250	5200	1.6	<6,000 m = 6 min >6,000 m = 10 min
Military Power	11,150+50	2600	2420	0.93	<6,000 m = 6 min >6,000 m = 10 min
Nominal	11,150+50	2150	1910	0.89	Not limited
Idle	4,100+200	100	300	-	10 min

MAIN OPERATING CONDITIONS

PARAMETER	LIMIT
MILITARY POWER AND AFTERBURNER	
Exhaust Gas Temperature (ambient temperature <15 °C)	650 °C
Exhaust Gas Temperature (ambient temperature >15 °C)	680 °C
In flight at all altitudes	680 °C
NOMINAL	
Exhaust Gas Temperature	550 °C
RPM at 0.8 of Nominal	10,400 ±50
IDLE	
Exhaust Gas Temperature	650 °C

ACCELERATION CHARACTERISTICS

PARAMETER	LIMIT
From IDLE to NOMINAL	9 – 12 s
From IDLE to MILITARY POWER	9 – 13 s
From IDLE to AFTERBURNER	Not more than 15 s
From automatic regulation start to NOMINAL	9 – 12 s
Permissible EGT rise after acceleration check	750 °C
Permissible surge in RPM (3-5 s) after AB is turned ON/OFF	11,600 RPM
From Military Power to AFTERBURNER (AB connection)	Not over 6 s

NOTE: When checking engine RPM acceleration or in flight, the engine throttles should be shifted/moved within 1.5 to 2 seconds through all its path. Otherwise the engine may surge and shut down.

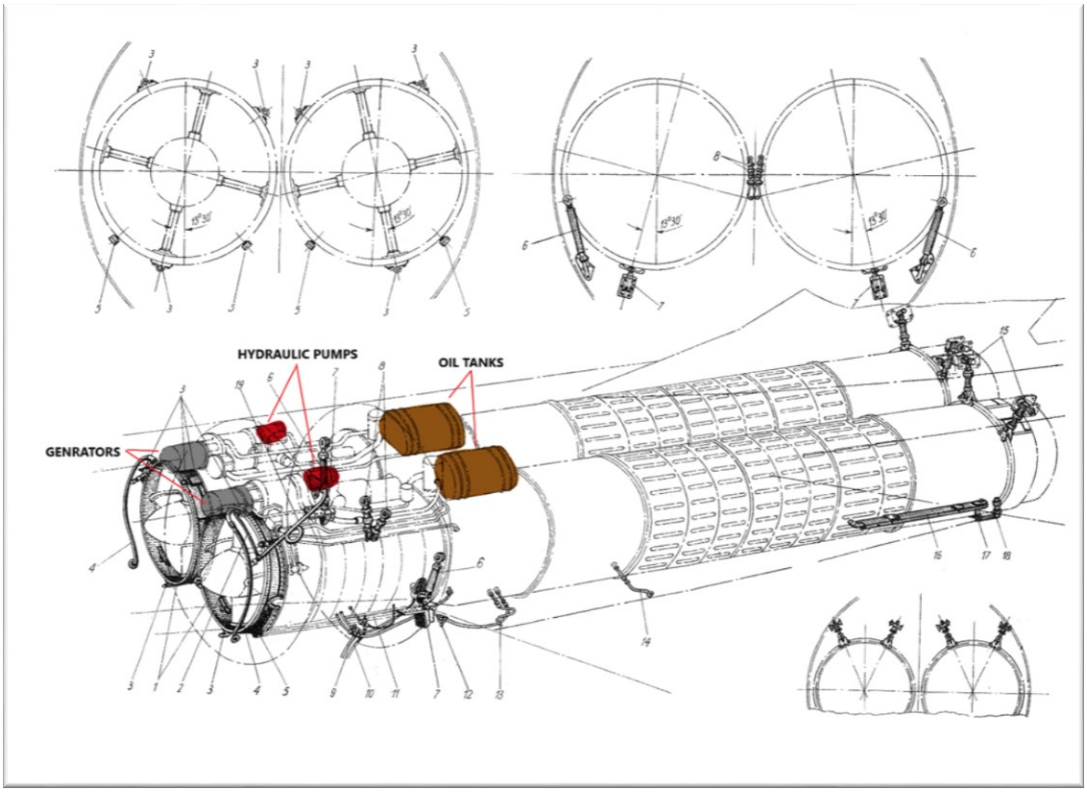
ENGINE SYSTEMS CHARACTERISTICS

PARAMETER	VALUE
Beginning of automatic RPM regulation	8,200 ±100 RPM
Fuel pressure in engine main pump	2.6 kg/cm²
Fuel pressure in main combustion chamber	<80 kg/cm²
Fuel pressure in AB chamber	<90 kg/cm²
Oil consumption	<0.5 kg/h
Oil pressure at IDLE	>1 kg/cm²
Oil pressure at MILITARY POWER	4 – 4.5 kg/cm²
Min/Max permissible oil temperature at all regimes	-40 °C/+85 °C
Oil output under NOMINAL and P = 4 kg/cm²	25 L/min
Oil warning lamps activation pressure:	
IDLE	<1.3 Kg/cm²
OTHER	<3 Kg/cm²
Max oil tank capacity	7.5 L
Min at which engine operation is allowed	5 L

GSR-ST-6000A STARTER-GENERATORS

PARAMETER	VALUE
Power developed at starting	3,5 H.P (U = 21 V, I = 200 A)
Power developed as generator	6000 W (30 V)
Period of operation at start procedure	45 s
Max number of successive starts (with ground power)	5 (then 30 min of cooling)
Max number of successive starts with aircraft batteries	3
Fuel used during one start	Around 0.5 kg
Permissible temperature raise after start	<850 °C
Time to IDLE at starting	<80 s

NOTE: When using ground power boosted providers (48 V), the engine may reach IDLE RPM in less than 60 seconds. This applies to aircraft on alert duties and can´t be used too much as it may damage the generators.



Electrical System

The Electrical System consists of DC and AC systems, supplied by two engine-driven GSR-ST-6000A Starter-Generators and backed up by 2 x 12SAM-28 Batteries. The system caters for starting the Engines, and the functioning of controls and other on-board equipment. The DC voltage is 28.5±1.5 V, maintained by R-27 regulators, while for AC supply (115 V, 400 Hz) PO-750, PT-125 and PAG-1F Inverters are used. An RU-11AM DC converter supplies 220 Volts to operate the Radio Altimeter.

The electrical system consumers are:

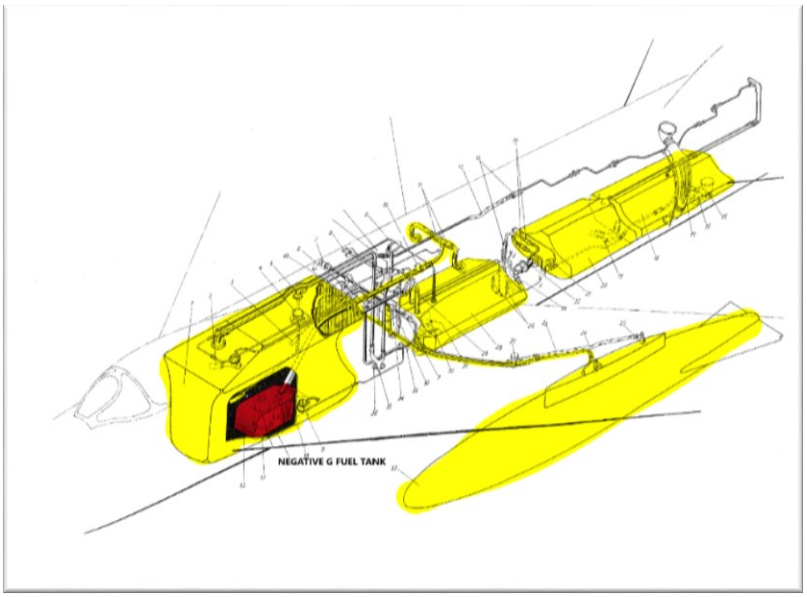
1) Starter-Generators
2) Starter box
3) 435B Fuel Pumps
4) Two Starter reels
5) Two Fuel Starter Pumps
6) Cockpit Lamps
7) GA-21 Valves, Engine Nozzles Control
8) RSIU-4V Radio
9) RV-5 Radio Altimeter
10) ASP-5ND and AR-18-8 Sighting Systems
11) NR-30 Cannons Firing System
12) Bomb Release System
13) Rocket Armament System
14) Gun Cameras
15) Fire Detection and Extinguishing System
16) Hydraulic System Valves
17) MUS-2 Stabs Electric Control System
18) Cockpit Acclimatization Controls
19) Cockpit Night Lighting
20) Flight and Navigation Instruments
21) Fuel Quantity Indicator
22) Engine Control System
23) Aircraft External Lighting System
24) Signal Flare System
25) Clock and Pitot Tube Heating
26) RP-5 Radar System
27) UT-6D Trim Motors and Trim System
28) ARU-2V Flight Control System
29) SPO-2 RWR (late aircraft.

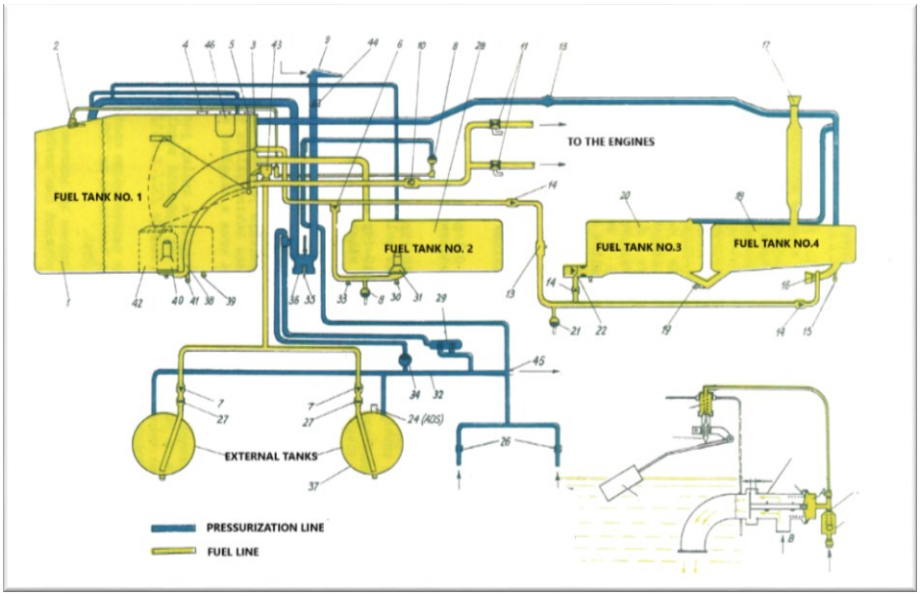
The Generators start to provide Current when their Voltage is from 0.3 to 0.7 higher than that provided by the Batteries or External Ground Power. There´s an interlock system that prevents both Engines from starting at the same time.
The 12SAM-28 Batteries allows for three Engine Starts and provides power for approximately 20 minutes in case of Double Generator Failure to the 27 VDC Consumers.

Fuel System

The fuel system consists of four fuselage tanks, piping, valves, fuel pumps, filters, sensors and a signaling system. Two rubber-bag type main tanks (No's. 1 and 2) are situated behind the cockpit and under the engines respectively (No. 1 between Frames No. 9 and 15; No. 2 between Frames No. 15 and 20; while two smaller aluminum integral-type tanks are positioned under the front end of the jet pipes.

The MiG-19P has a total internal fuel capacity of 2,170 liters (1,700 kg) divided in 4 tanks. It can also use Wing Pylon External Drop Tanks of either 400 or 760 liters capacity. Tank No. 1 is the main fuel tank and the one that provides fuel to the engines. Tanks No. 1 and 2 both have a **435B** electric pump, tanks No. 3, No. 4 and external tanks are drained by air pressure drawn from the engines.





The fuel is consumed in the following order:

1) 100 liters are consumed from fuel tank No. 1.
2) External tanks are emptied
   (the "External Tanks" lamp will light up when the external tanks are empty).
3) 100 more liters are consumed from fuel tank No. 1.
4) Tanks No. 4 and No. 3 are emptied
   (the "Fuel Tanks No.3,4" lamp lights up when tanks 3 and 4 are empty).
5) Tank No. 2 is emptied
   (the "Fuel Tank No.2" lamp lights up when tank 2 is empty).
6) Tank No. 1 start to be emptied.
7) When fuel left is 550 liters, the lamp "Rest 550L" will light up.
8) When fuel tank No. 1 is emptied, the lamp "Tank No. 1" will light up.

When the "Tank No.1" lamp illuminates, depending on the engine power setting, the engines may continue working for as much as another 5-10 minutes. This is because of the fuel that remains in the fuel supply pipes.

Flight Control System

The Aircraft Flight Control system is a conventional mechanical type, with push-pull rods, cranks and levers. The Ailerons and Stabilizers are moved by irreversible Hydraulic Boosters while the Rudder is moved manually. The Ailerons are powered by a single BU-13M Booster located in the Right Wing, close to the wing root. The Stabilizers are powered by a single BU-14M booster, located in the base of the Vertical Tail or by the MUS-2 electrical system.

The aircraft uses Ailerons and Roll Spoilers for Roll, the latter to improve lateral control at high Mach numbers. For Pitch, it has all moving Stabilizers with a counter Flutter Weight in the Stabilizer tips and for yaw a mechanically operated Rudder. The Aircraft has a trim mechanism for Pitch and a dedicated trimmer (UT-6D) for Roll. To counter the span-wise airflow phenomenon, both wings have large Boundary Layer Fences.

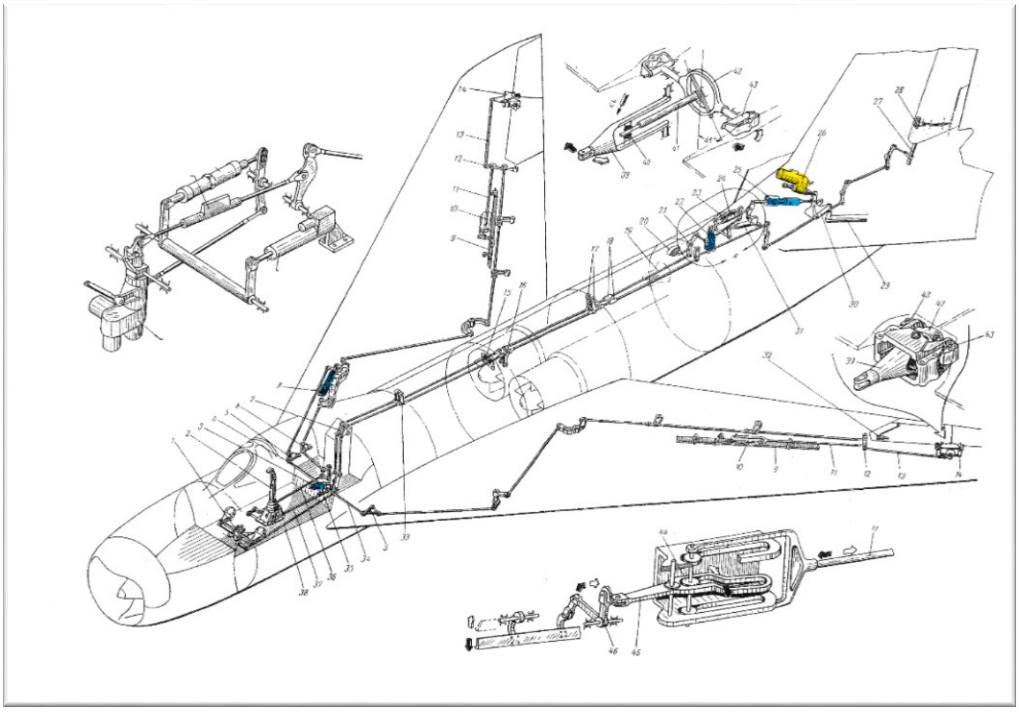
The ARU-2V flight control system is provided to control the ratio between control stick movement and stabilizer angles, so the aircraft can maneuver within safe limits over a wide range of airspeeds and altitudes. This system provides automatic adjustment (manual backup) of control stick-to-stabilizer gearing and stick forces depending on the aircraft's speed and altitude. The system samples dynamic and static air pressure and changes the transmission relation between the control stick and BU-14M booster by means of a device that increases or decreases the arm between them. The ARU can be controlled manually with controls in the cockpit in case of a failure of the automatic system. A table is provided to the pilot, so they know the correct position for every speed and altitude. The ARU-2V was an update of the ARU-2A mounted in the MiG-19S that improves aircraft controllability up to 15,000 meters.

The ARU will work only for speed under the altitude of 5,000 meters. It will be in long arm from take-off to the speed of 480 km/h and start regulating until the speed of 900 km/h, when it will be at the shortest arm. Starting at 5,000 meters to the altitude of 10,000 meters it will start increasing the arm.
Long arm = bigger stabilizer deflection angle
Short arm = smaller stabilizer deflection angle

The MP-100M Trim and Artificial Load system is provided to Trim the Stabilizers and generate additional Stick loading as the Aircraft approaches Maximum G Loads when maneuvering. The system is calibrated to generate increased resistance by the Control Stick once Ny approaches 8 units, which is the Aircraft Structural Safety limit (during service, some Aircraft surpassed 12 G without this generating any important Structural Damage and continued flying afterwards).

The BU-13M Aileron Boosters can be disconnected by a Switch in the Cockpit and can be moved Manually. However, this comes with the characteristic disadvantages of direct control surfaces.

In case the Hydraulic Systems fail, the aircraft can use the MUS-2/APS-4M Stabilizer Electric Actuator that can move both Stabilizers Electrically by using the Control Stick. When this system is in use, the Stabilizers move at about the same speed that when using the Hydraulic System.



Hydraulic Systems

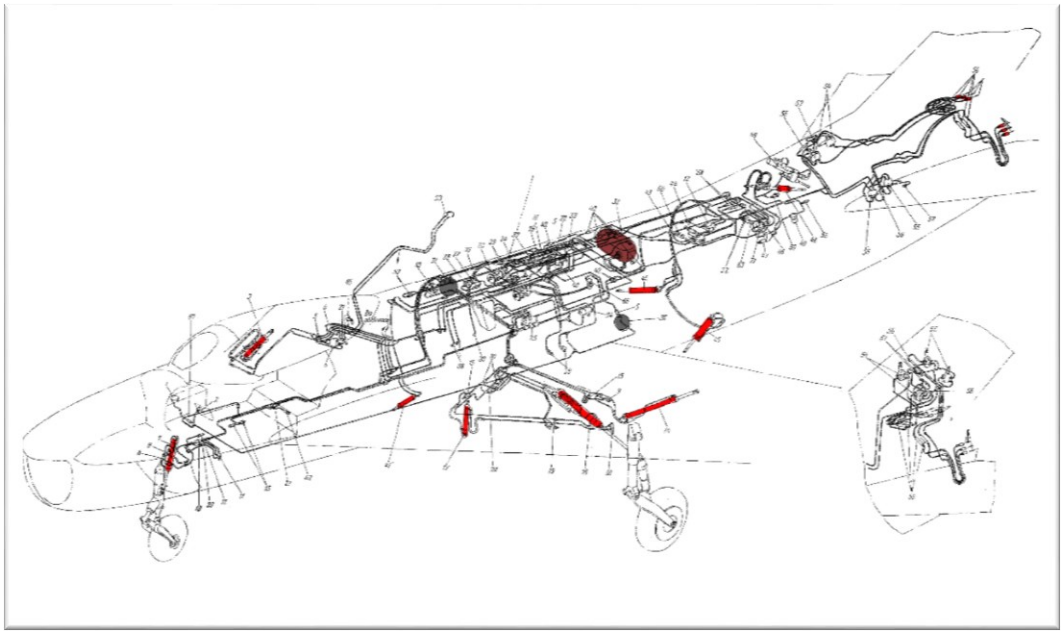
The aircraft has two Hydraulic Systems, the Main Hydraulic System (MHS) and the Emergency Hydraulic System (EHS), known also as the Booster System, because it operates Control Surfaces Boosters. The MHS pump is connected to the Left Engine, and the EHS pump to the Right Engine Accessory Gearboxes respectively. Total capacity of the system is 40 liters.
Both systems use the 435VM pumps, which generate a pressure of 142 kg/cm² (1,920 PSI).

The Main Hydraulic System operates:

- Landing Gear Retraction/Extension
- Flap System
- Airbrakes Deployment
- Engine Afterburner Nozzles
- Backup for the Booster System

The Emergency Hydraulic System (Booster) operates:

- Flight Control Actuators – Aileron and Stabilizer
- Backup for the Main System



Both systems are independent and operate all the Hydraulic consumers by separate chambers and Check Valves. So, in case any of them fails, the other will take over the functions.

- If pressure in any system drops below 95 kg/cm², the "Hydraulic Pressure Drop" lamp will light up.
- Sometimes, if Landing Gears, Airbrakes and Flaps are deployed at the same time, pressure will drop below 95-100 kg/cm² and the Lamp will light up, pressure must raise quickly after.
- If pressure in the EHS drops below 65 kg/cm², Control Surface Boosters are passed to the MHS.
- If both hydraulic systems fail, afterburner operation is disabled.
- If hydraulic pressure drops below 70 kg/cm², Airbrakes will be locked at set position but close Aerodynamically

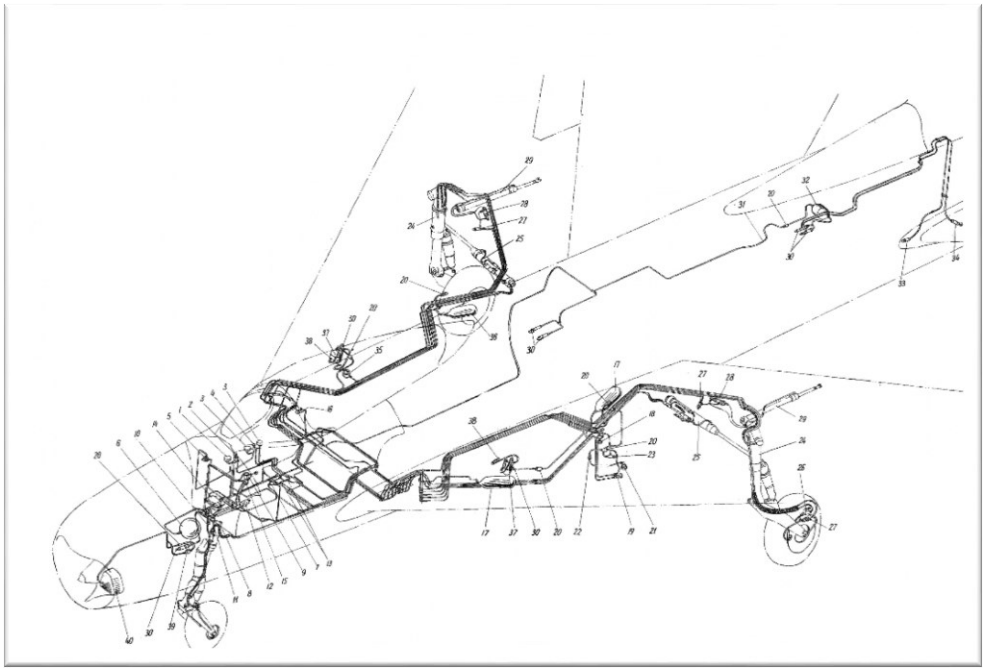
Pneumatic Systems

The Aircraft Pneumatic System consists of 6 air bottles. The Main Pneumatic System bottles are in the Nose Landing Gear Bay and are charged with a pressure of 150 kg/cm², with a capacity of 10 liters. The Emergency Pneumatic System uses two air bottles of 4.3 liters each that are in the main landing gear bays, with a pressure of 50 kg/cm². The remaining bottle, charged with a pressure of 130 kg/cm², is used for flaps emergency extension, 2 liters. One bottle, used for canopy sealing, is in the rear of the cockpit and can be seen externally.

The pneumatic system operates:

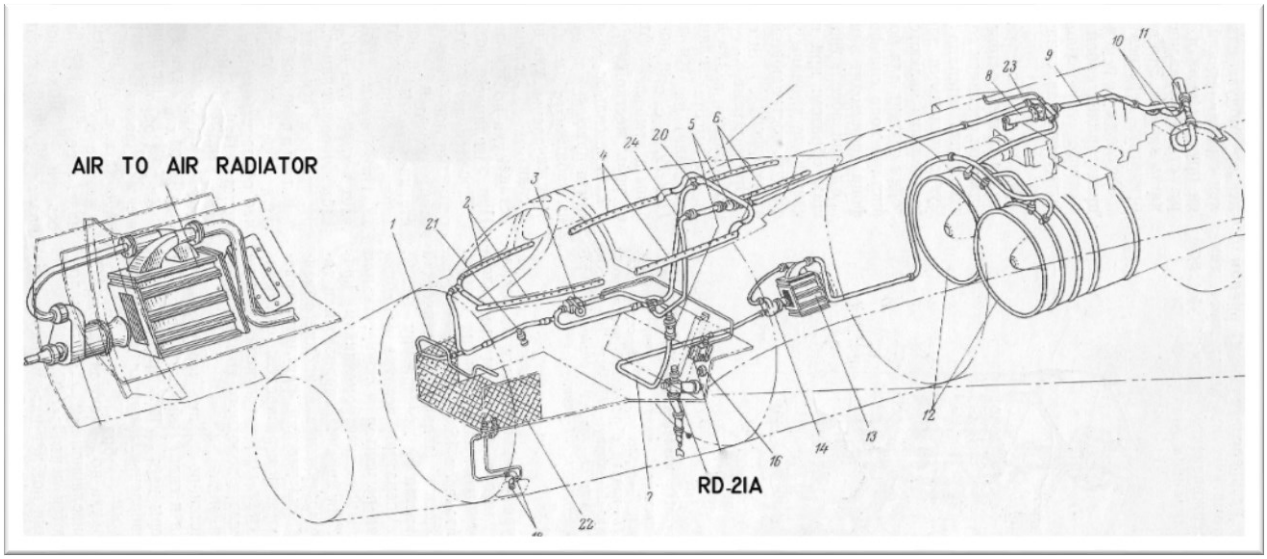
- Landing Gear Brakes (Air Pressure is Automatically controlled by Anti-Skid System)
- Landing Gear Emergency Brakes (air goes directly to the Wheel Brakes)
- Emergency Extension of the Landing Gear and Flaps
- Radar Wave Guides Pressurization
- Cannon Loading
- Drag Chute Release and Jettison
- Windshield De-Icing System

- The pneumatic system must remain sealed for more than a day.
- Use of the gear brakes must generate a waste of 2-5 kg/cm².
- Use of the emergency pneumatic system for the deployment of flaps and airbrakes will generate an expense of 60 kg/cm² of air.



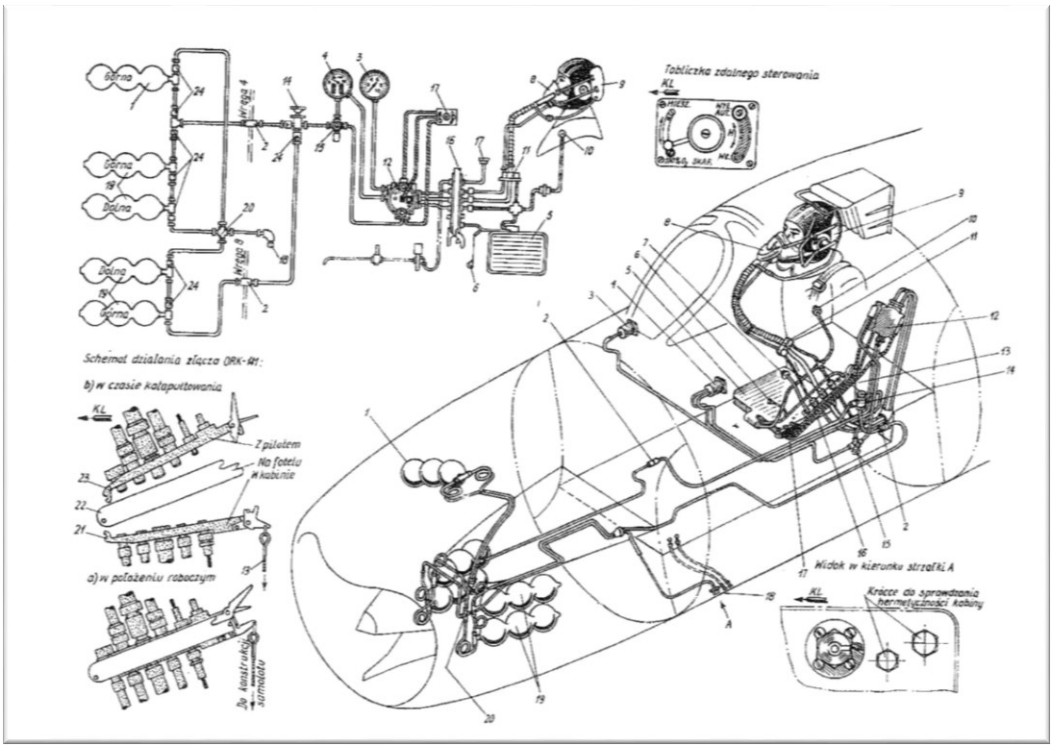
Air Conditioning & Pressurisation

The air conditioning system maintains overpressure and optimizes the temperature in the cockpit (15 - 26 °C) using air from the engine compressor. The pressure is maintained at ambient pressure up to 2,000 meters (6,560 ft). Up to 10,000 m (32,810 ft) it is evenly increased by an RD-2IA regulator to 29.435 kPa (4.3 psi), while above this level the differential pressure is constant. An auxiliary ventilation system is also provided.

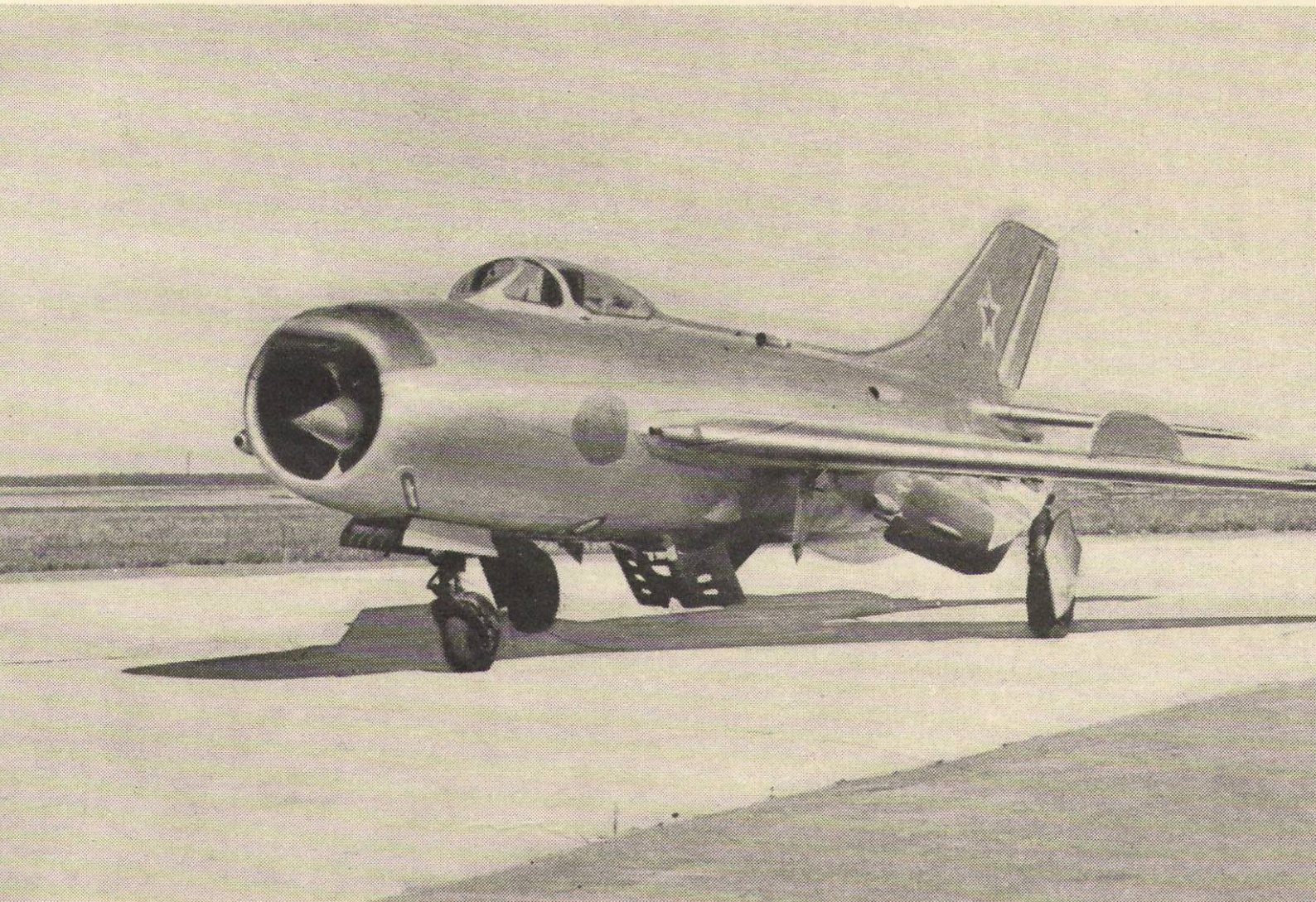


Oxygen System

A KKO-1 set comprises the KP-30D oxygen distribution unit and five pressure cylinders with a total volume of 10 liters (2.20 gal), stowed in the nose wheel well and behind the pilot's seat. Oxygen is supplied to the KM-30 pilot's mask, PPK-1 anti-G suit and VKK-2 or VKK-3M altitude suits and to the KP-27M parachute oxygen apparatus.



Chapter 7 - History & Development of the MiG-19P



Aircraft History

On the 15th August 1953, the Ministry of Aviation Industry assigned to OKB MiG the development of a tactical supersonic fighter, requests were made supersonic interceptors – one was to be a day fighter and the other capable of operating in all-weather or night conditions. Unlike other types, the radar variants were not evolved as a step-by-step development of the initial aircraft structure, but both the MiG-19S day fighter version and the MiG-19P Radar equipped aircraft were developed and introduced into military service concurrently.

Development & Production in the USSR

PROTOTYPES

The MiG-19 variants initial designs stemmed from the prototype I-340 (SM-1), a MiG-17F airframe modified for installation of two new Mikulin AM-5 engines (these were designed as scaled down versions of the Mikulin AM-3 engines fitted to the Myasishchev M-4 and Tupolev Tu-16). Design and construction work on the aircraft continued throughout the whole of 1951, but due to the unavailability of the new AM-5 engines, the first flight was only performed at the in March 1952.

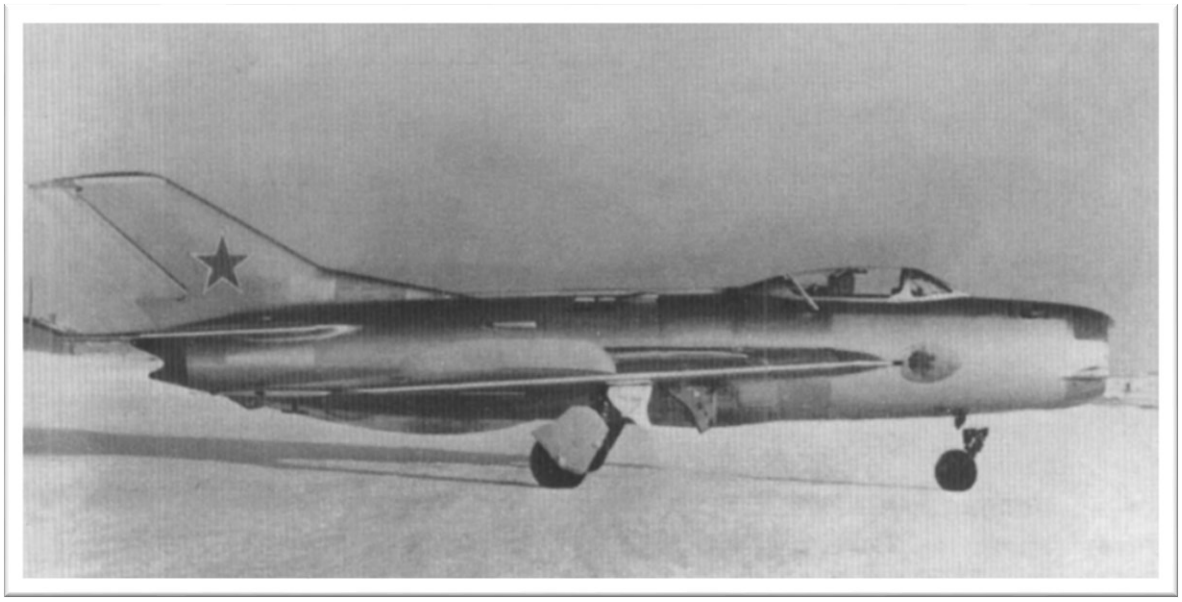
The SM-2 prototype was a MiG-17F airframe modified to use two AM-5 engines, with an enlarged fuselage and a new wing design

The I-360 (SM-2/1 and SM-2/2) differed substantially from the I-340 prototype. It was quite a new design, with a longer fuselage and a new anhedral swept back wings equipped with boundary layer fences. The armament consisted of two N-37D (the D indicated it was fitted with Muzzle Brakes) Nudelman 37-mm cannons located in the wing roots. The SM-2/1 was completed in April 1952 and a month later it flew for the first time. The SM-2/2 differed from the SM-2/1 in having larger air brakes (increased by 13 %) and small protective heat resistant gun blast panels close to the gun barrels in the wing roots. The empennage, originally T-shaped, was replaced with a more conventional design due to spin recovery problems that were identified in flight testing. At the same time other aerodynamic improvements were made. The flight tests of the SM-2 were successfully completed in October 1953.

The SM-7, the prototype of the MiG-19P

The next step in the design of the MiG-19P was the SM-7/1, which took to the air on 28 August 1954. It differed from the I-360/SM-2 by having larger vertical tail surfaces and a longer and wider nose structure. At Frame 7 at the aft of the cockpit the Fuselage was extended by 2 Frames, adding 0.36m to the length. The Nose Fuselage structure was redesigned, and skin stiffened with additional transverse rings, which allowed the engine air ducts to be moved further apart creating the extra width in the cockpit. This new increased dimensioned Nose Section housed the RP-1 Izumrud (Emerald) 1 Radar.

The AR-18-16 Radar Tracking Dish Antenna was in the central hemispherical cone of the air intake while the AR-18-1 Search Antenna was fitted in the extended upper nose intake lip, this required the gun camera to be moved to the starboard side. The widened cockpit equipment was supplemented with a radar screen with a sun hood, situated on the right hand of the main instrument panel. The nose landing gear, mounted in the modified nose, was shifted forward, thus increasing the wheel base. The aircraft was powered by two afterburning RD-9B engines, of 25.6 kN static thrust, which increased to 31.87 kN in full afterburner. Installation of the improved engines necessitated widening of the rear fuselage. The armament originally consisted of two NR-23 23-mm guns which were replaced by NR-30 30mm cannons for the State Acceptance Trails, located in the wing roots. The aircraft could be equipped with two ORO-57K FFAR Rocket Pods, with their removable pylons situated behind the Main Landing Gear bays. The other underwing pylons could carry two fuel tanks or two 250 kg bombs. Two pitot tubes were fitted to the wing tips. This prototype was later used to test the K-5M (RS-2U) missiles in January 1956, with its designation changed to SM-7/1M.



The SM-7/2 prototype

Following on from the SM-7/1, two more prototypes were developed the SM-7/2 and SM-7/3, which had the original horizontal tail surfaces, consisting of a fixed horizontal stabilizer and elevators, replaced by an all-movable stabilizer in order to improve the aircraft's maneuverability at transonic and supersonic speeds. A third air brake and underwing spoilers were also introduced under the fuselage. The aircraft were equipped with an improved RP-5 Izumrud-2 Radar. Like the SM-7/1, the second prototype also took part

in tests with K-5M (RS-2U) Missiles and was called the SM-7/2M. The SM-7/3 prototype became the specification for serial MiG-19P production.

PRODUCTION

The MiG-19P (Izdeliye 62) became the first serial version of the MiG-19 aircraft equipped with a radar. Production commenced in 1955 at the State Aircraft Factory at Gorky (GAZ No.21). The production aircraft differed from the SM-7/3 prototype by having a sharper aerodynamic cover of the tracking radar antenna and in relocating the auxiliary pitot tube from the port wing to the right side of the fuselage nose. During production other changes and improvements were implemented. Initial aircraft were equipped with the original RP-1 Izumrud 1, while later machines were fitted with the more advanced RP-5 Izumrud 2. The rudder trim, which was not fitted on early machines, was re-introduced to later production aircraft. Other changes included the cannon installation which originally consisted of two NR-23 23mm Cannons, with 120 rounds per gun but later this armament was replaced by NR-30 30mm Cannons; the ammunition was reduced to 70 rounds per gun. The fuselage, in the vicinity of the gun muzzles, was protected by small steel blast panels. The aircraft was equipped with the SRO-1 IFF system, later replaced by SRO-2 Khrom (Nato Code: Odd Rods). The MiG-19P was equipped with the ARU-2V Artificial Feel System, which automatically varied the gearing between the Control Stick and the Pitch Control Surfaces according to Mach Number. It incorporated a q-feel input to make control stick force proportional to Dynamic Pressure.

Some aircraft were upgraded with the installation of pylons for carrying R-3S/K-13A (NATO Reporting Name: **AA-2A 'Atoll'**) Air-to-Air IR Guided Missiles. The pylons were fitted to the outer sections of the wings and the missiles were carried on APU-3S launch rails. Sometimes these airplanes were referred to as MiG-19PTs. A limited number of aircraft were also modified to carry RS-2U missiles. In this case, two pylons, which protruded forward of the wing leading edge, were situated on the inner wings.

MiG-19P Variants

MiG-19PG

Early MiG-19Ps were equipped with a "Gorizont-1" system, used for guiding the aircraft to the target area by means of ground control. This system processed the target flight data supplied from the ground radar system.

MiG-19PV

The "Vysotnyy" denoting high-altitude was equipped with a more powerful RD-9BF engine and its weight was reduced by removal of redundant on-board equipment. Contrary to the analog MiG-19SV day model, this type was not mass produced.

MiG-19PM

The Izedilye 65 was a modified MiG-19P interceptor equipped only with missiles. In the latter half of the 1950s it was generally accepted (not only in the USSR) that fighter combat would only be performed by launching missiles at a relatively distant target, thus making gun armament redundant. At the end of 1956 and in the first half of 1957, another five aircraft modified to SM-7/2M standard joined the tests using guided missiles. After successfully completing the trials, serial production of the new model was launched at the Gorky plant. The armament consisted of four K-5M/RS-2U air-to-air radio-guided missiles, installed on APU-4 launch rails on the wing leading edge pylons. The cannon armament was removed, and the aircraft did not have the capability to carry any Rocket Pods. For the Beam Guidance of the K-5M/RS-2U missiles an RP-2U Izumrud-2 radar. The RP-2U Radar had Antennas giving a search area over a flattened cone measuring ±60° left/right and from +26° to -14° vertically. The Inlet was made deeper, and the ranging antenna had a larger dielectric area in the upper lip. Tracking range was almost doubled at 3.5km, however the missile had an effective range of 6km. The ASP-5N-V5 (5U??) gunsight was fitted, it was fed with the target range and coordinates in azimuth and elevation. Some aircraft that were manufactured later for export were fitted with a RR-20 radar unit. The MiG-19PMs were characterized by a long fin extension, corresponding with the late series MiG-19S fighters. The installation of relatively large pylons caused aerodynamic drag increase and a corresponding reduction in flight performance.

MiG-19PML

A modification of the "PM" version equipped with the "Lazur" guidance system enabling the aircraft to be guided to the target by means of the onboard avionics/instruments.

Operational History

USSR

The MiG-19P and PM aircraft were assigned to Soviet Air Force VVS (Voyenno-Vozdushnye Sily) and Air Defense Forces PVO (Protivo-Vozdushnoy Oborony) units, but both types of aircraft were not favoured by the pilots, mainly due to unreliable radar equipment causing frequent in-service failures. Unlike the MiG-19S, the radar-equipped MiG-19 airplanes were not largely exported to other countries. The Soviet Union supplied them only to reliable states, where the capabilities existed for keeping the required new equipment confidential and, at the same time, conditions for maintenance and application of relatively complicated weapons could be fulfilled. After the disintegration of the Soviet Union, some of the successor states, now linked via the Commonwealth of Independent States, also became users of the MiG-19 radar version aircraft. Azerbaijan used several dozen such aircraft in the period 1991-95, while some machines were also reported to be on the strength of the Armenian Air Force.

ALBANIA

Albania received 12 MiG-19PM from the USSR in October 1959. These aircraft served with the Albanian Airforce (Forca Ajrore e Republikës së Shqipërisë) 7594th Aviation Regiment, 1st Fighter Squadron based at Tirana-Rinas Airbase. In 1965 they exchanged them for twelve Chinese Shenyang F-6s.

BULGARIA

In the summer of 1957, a group of pilots, headed by Squadron Leader Captain Razsolkov, took an operational conversion course on MiG-19. The Bulgarian Air Force received 12 MiG-19Ps in 1959 from that USSR. These equipped the 1st Squadron of the 19th Fighter Avaition Regiment, only to be exchanged for 12 "PM"s a year later. In 1961, the 19th FAR became part of the newly formed 10th Composite Aviation Corps. I the 1970s the 19th Air Regiment comprised 2 Squadrons, with the 1st Squadron being equipped with MiG-19PM/Ss. Bulgaria purchased other "P" and "PM" aircraft were purchased from Poland in 1966-67. They were in service with the 11th IAP - Iztrebitelen Aviopolk (Fighter Regiment) and later also with the 19th and 21st IAP. Bulgaria retired their radar-equipped MiG-19s in 1977 and by 1978 all MiG-19 Aircraft had been retired.

CUBA 

The MiG-19Ps were also put in service in the western hemisphere. The Cuban Air Force received 12 machines in total, of which the first eight machines were delivered in crates in the course of 1961. After their completion, assisted by Soviet technicians, they were assigned to the 1st Escuadron de Caza at San Antonio Air Base. Worthy of note is the fact that some of the personnel were trained in former Czechoslovakia. In 1966 those aircraft were withdrawn from service. The Cuban MiG-19Ps were the first supersonic aircraft in Latin America.

CZECHOSLOVAKIA 

Within the Warsaw Pact, the largest user of MiG-19P and PMs was Czechoslovakia. In the second half of 1957, this country received a total of 27 MiG-19P aircraft which were delivered dismantled in crates. After their assembly at the Prague-Kbely Airfield and their flight tests in the course of the first quarter of 1958 they were subsequently transferred to squadrons. The supply of MiG-19PMs (44 aircraft) was arranged in the period 1959-60. The radar variants of the MiG-19 were in service with the 1. Zvolensky SLP (Fighter Regiment) based at Ceske Budejovice, 4 SLP (Pardubice), 5th SLP (Line), 8th SLP (Mosnov) and 11st SLP (Zatec). The Czechoslovak Air Force withdrew their last MiG-19Ps in 1965 while the very last MiG-19PMs were taken out of service in 1972.

EAST GERMANY 

In August 1959, the East German Air Force also received a batch of 12 MiG-19PMs. They were used machines from the Soviet inventory. The aircraft were introduced to JG-3 (fighter squadron) in Preschen. These aircraft were all decommissioned by May 1969.

HUNGARY 

The Hungarian Air Force was supplied by a dozen MiG-19PMs in March and April 1959. They were taken under the charge of the 31st Honi Vadászrepülő Ezred (Fighter Regiment) based in Taszár. The aircraft stayed in service until 1973. 1 Squadron 31st Fighter Regiment (1st század 31st HVE), Hungarian Air Force (Magyar Honvédség Repülö Csapatai) Taszár base.

POLAND

Poland received their first nine MiG-19Ps in December 1957 and the next 10 aircraft were delivered in May the following year. In total, the Polish Air Force acquired 24 'P' models. In 1958, another 14 aircraft, of the 'PM' version, were supplied. The Polish MiG-19s were in service with No. 62 PLM (Pulk Lotnictwa Mysliwskiego - fighter regiment), and with the 28th (28th Fighter Regiment Air Defense (28th PLM OPK), the Polish Air Force (Polskie Lotnictwo Wojskowy), base Slupsk-Redzikowo, 1964) and 39th PLMs. In 1966-67, some aircraft were sold to Bulgaria while the last of these aircraft were decommissioned as late as December 1974. The engines from these aircraft were delivered back to the USSR and used to power La-17 drones.

ROMANIA

The other significant user of MiG-19P and PMs was Romania. Its Air Force took delivery of a total of 15 MiG-19P and 45 MiG-19PM aircraft during 1959-60. All the airplanes were put on the strength of Divizia 66 Aviatie Vanatoare (Fighter Division). The aircraft were in service until the 1970s.

MIG-19P and MIG-19PM Licensed Production

USSR

Designation	*Factory*	*1956*	*1957*	*1958*	*1959*	*1960*
MiG-19P, PG	No.21 Gorky	144	185	104		
MiG-19PM, PML		7	5	187	145	25
SUBTOTAL		151	190	291	145	25
TOTAL		802				

Chinese Development and Production

In the 1950s, the USSR and China were co-operating after signing a Sino-Soviet Treaty of Friendship. China already produced both the MiG-15UTI and MiG-17F aircraft under License (Chinese Designations JJ-2 and J-5). In 1957, China obtained the Licensing Rights to build MiG-19P and RD-9B Engines, this was shortly followed by Permission to produce the MiG-19PM and later in 1959, the MiG-19S. The relationship soured in the late 1950s and early 1960s, with the Sino-Soviet Split.

SHENYANG J-6A (JIANJIJI-6 JIA)

The Shenyang Jianjiji-6 Jia, aka J-6A was the Chinese counterpart of the original MiG-19P. The Shenyang Aircraft Factory received Five MiG-19P Kits from the USSR in March 1958 and full-scale production began in April 1959. Initial Production Aircraft suffered from the same Quality Control Issues as the MiG-19S Models also being produced at the time and as such, the PLAAF (People's Liberation Army Air Force) refused to accept the Aircraft into service. These original Aircraft were disposed of and the Shenyang works were reopened only in 1961 after delivery of new jigs and with Soviet assistance. The MiG-19S, was produced under similar designation, the J-6 continued Production at Shenyang but the Production of J-6A Aircraft was transferred to Nanchang in Kiangsi (Jiangxi). These new Production Aircraft were armed with Type 23-2 (23mm Cannons) instead of the NR-30 (30mm Cannons).

SHENYANG J-6A

NANCHANG J-6B (JIANJIJI-6 YI)

Nanchang Jianjiji-6 Yi, aka J-6B was the Chinese designation for the MiG-19PM. The Plant encountered the same Production problems as the preceding J-6A and as such Production was stopped after completion of only 7 Aircraft in 2 Years. In 1974, following the receipt of 12 MiG-19PM from Albania in 1965, the Project was reborn. In 1976 the J-6B Flight Tests were completed and entered Limited Production in 1977. As with the J-6C Day-Fighter, the Drag Chute housing was relocated from its original offset Ventral position to a new bullet-shaped fairing at the base of the fin. This new design aided the Aircraft Pitch Stability during Drag Chute deployment and shortened the Landing Distance.

NANCHANG J-6B

GUIZHOU J-6 IV

In 1974 the Guizhou Aircraft Production Plant undertook an Improvement Program of the J-6B. The Nose Section shape was altered significantly to improve the Aerodynamics also the Air Intake had a Sharp Lip, in order to maximize the Inlet Duct Cross Section. The Upper Tracking Antenna was sharpened and extended forwards. The standard centrebody Radome was changed to a blunt conical Radome. The cockpit canopy was flatter, thus decreasing drag and improving the flight characteristics. Other improvements included the provision of JATO Rockets, Disc Braked Main Wheels and the relocated Tail Fin Drag Chute of the J-6B. Unlike the J-6C, which were delivered to many foreign countries under the F-6C designation, the Chinese Radar-equipped MiG-19 Variants were never exported.

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