

MiG-21bis – top of MiG-21 aircraft evolution



MiG-21bis – background and history of creation, defining features

■ **By the late 1960s it was clear that further improvement of MiG-21 combat performance was possible only after equipping with more powerful power plant and more advanced radar.**

■ **Air Force's general operational requirements:** high performance achievement first of all on low altitude and high indicated air speed.

■ **Power plant requirements:** Sergey K. Tumanskiy experimental-design bureau OKB-300 was to design for MiG-21 a new engine delivering 7,100 kgp take-off thrust and having a contingency rating briefly (up to 3 min) increasing the thrust to 9,600 kgp during emergency rates. In fact, the engine had already existed, the document merely gave it official status.

■ **Airframe and systems improvement:** A.I. Mikoyan experimental-design bureau OKB continued aircraft improvement. When it became clear that MiG-21SMT's huge saddle tank was unacceptable, fuselage spine fairing construction was again changed reducing fuel tanks volume to 2880 l.

■ **Thus, after more than 15 years of search, mistakes and successes optimal combination of aircraft aerodynamics, fuel system capacity and engine thrust was reached.**

■ In addition MiG-21bis featured:

1. More advanced "Sapfir-21M" fire control radar (S-21M or RP-22M);

2. Modified ASP-PFD optical sight allowing certain restrictions on using cannon fire during high-G maneuvers to be lifted.;

3. New aircraft and power plant health and usage monitoring system that allowed routine maintenance to be performed much quicker;

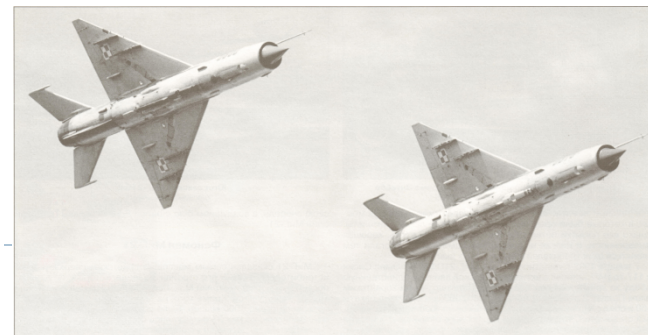
4. The number of missiles was increased to six, remaining R-3 on inner hardpoints and installing paired launch rails on the outer wing pylons for R-60 missiles. Provision was made for using R-55 missiles, yet it didn't become serial being superseded by the R-60.;

5. The weapons options included the R-13M IR-homing air-to-air missile which had twice the launch range of the R-3S and was able to engage targets making high-G evasive maneuvers.

■ **That is the origin of MiG-21bis – the most perfect fighter among all huge "Twenty-one family" produced in the USSR.**

■ The air defense version of the aircraft was equipped with "Lazur-M" GCI guidance system, and the Air Force version had a "Polyot-OI" instrument landing system permitting landing approach with a cloud base not lower than 100 m and a horizontal visibility of up to 1,000 m. Outwardly the MiG-21bis equipped with "Polyot-M" system was readily identifiable by two small 'devil's pitchfork' aerials protruding forward beneath the air intake and aft from the fin tip. MiG-21bis entered flight testing in 1971. since 1972 to 1974 the aircraft was manufactured in Gorkiy in three main versions – "izdeliye 75" (for Soviet Air Force and Air Defense only), "izdeliye 75A" and "izdeliye 75B" (for friendly countries).

■ **MiG-21bis** saw service with nearly all Warsaw Pact nations and many developing countries, as well as India manufactured it by license since 1980 to 1987. The MiG-21bis was offered at much lower price than the American F-16 the entered market in the mid 1970s, besides, the US government imposed considerable restrictions on its sales. Air International Magazine in its December 1979 issue pointed out that the MiG-21bis was a very redoubtable aircraft, and despite limited combat radius remained its Achilles' heel, the fighter was **quite a match for the F-16 as far as vertical and horizontal acceleration, speed and turn radius were concerned** which were of paramount importance in a close-in.



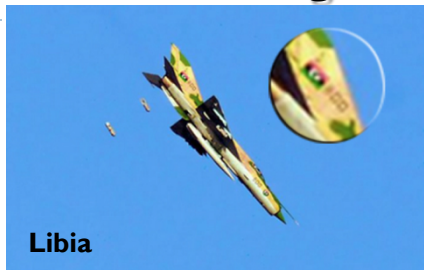
Countries in which MiG-21bis and “Jaguar” are in service



Croatia



In 2013-2014 in SE “OAP” were repaired and modified 12 MiG-21bis and MiG-21UM aircrafts for the Air Forces of the Republic of Croatia + MiG-21bis supply.



Libia



Syria



Yemen



Egypt



In 1995-2010 in SE “OAP” were repaired 137 MiG-21 aircrafts (MF, UM, US, R modifications) and over 200 R11 and R13 aircraft engines.



The Air Force of India remains the only operators of attack fighter **Sepecat Jaguar**, informs **Jane's**. on 16 October 2014 aircraft of this type are phased out of service in the Royal Air Force of Oman.

Today in service with the Air Force of India are 148 fighter bomber. In 2009 Ministry of Defense of India invited bids for modernization of this type aircrafts. Particularly, it was planned to replace outer wings, engines and update onboard radar equipment. Contract for aircrafts modification hasn't been concluded yet. In February 2011 **British company Rolls-Royce refused to bid for Jaguar modernization.**

According to Flightglobal MiliCAS information in service with Oman until recently were ten fighter bomber Jaguar S/B2/T. In 2011it was reported that Oman Ministry of Defense decided to extend service life of 20 aircrafts of this type by **replacing outer wings**. This work never started. Possibly, the aircraft face problems with fatigue stress of wing primary structures that are not paraded.

On 22.01.2014 and 03.06.2015 in India 2 Jaguar type aircraft accidents took place, both by reason of aircraft failure.

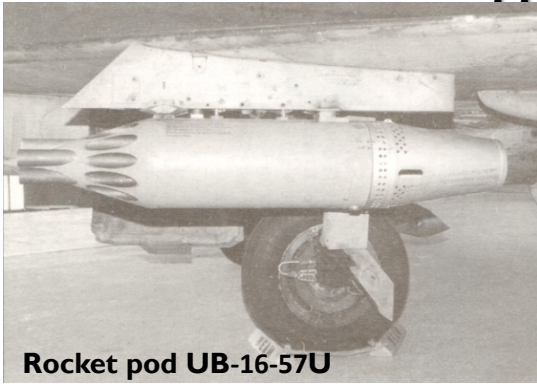


India



Cuba, Uganda, Tanzania...

MiG-21bis – application specific aspects for waging of anti-guerilla war



Rocket pod UB-16-57U



500-kg aerial bomb, photo 1983 r.



Heavy rockets S-24 fire, 2014

Application during ground missions support: MiG-21bis during application for the benefit of ground forces is capable to reconnaissance and attack different targets. Hereat onboard guns GSh-23, aerial bombs 250 and 500 kg caliber, rocket pods (aircraft-launched rockets) UB-16-57 and UB-32-57 with S-5 rockets as well as heavy rockets S-24 are used. Depending on home airfield altitude and ambient temperature combat load mass is 500 to 1000 kg.

Disadvantages during waging of counter-guerilla warfare:

High speed and constrained vision complicate detection of low-sized and often well disguised targets that lowers operational effectiveness;
Limited combat load;
Lack of guided “air-to-ground” missiles and protection from air defense fire.

Positive features: Thanks to high speed and good maneuverability to strike MiG-21 with small arms is difficult, and if adversary doesn't have effective portable anti-aircraft missile system it is possible to operate on middle and low altitude without using heat flares. High speed minimizes time of being under adversary's air defense fire.

Later, before forwarding MiG-21bis to conflict zones the aircraft was equipped with IR decoy dispensers ASO-2I that were installed on the places for JATO boosters (Jet Assisted Take Off).

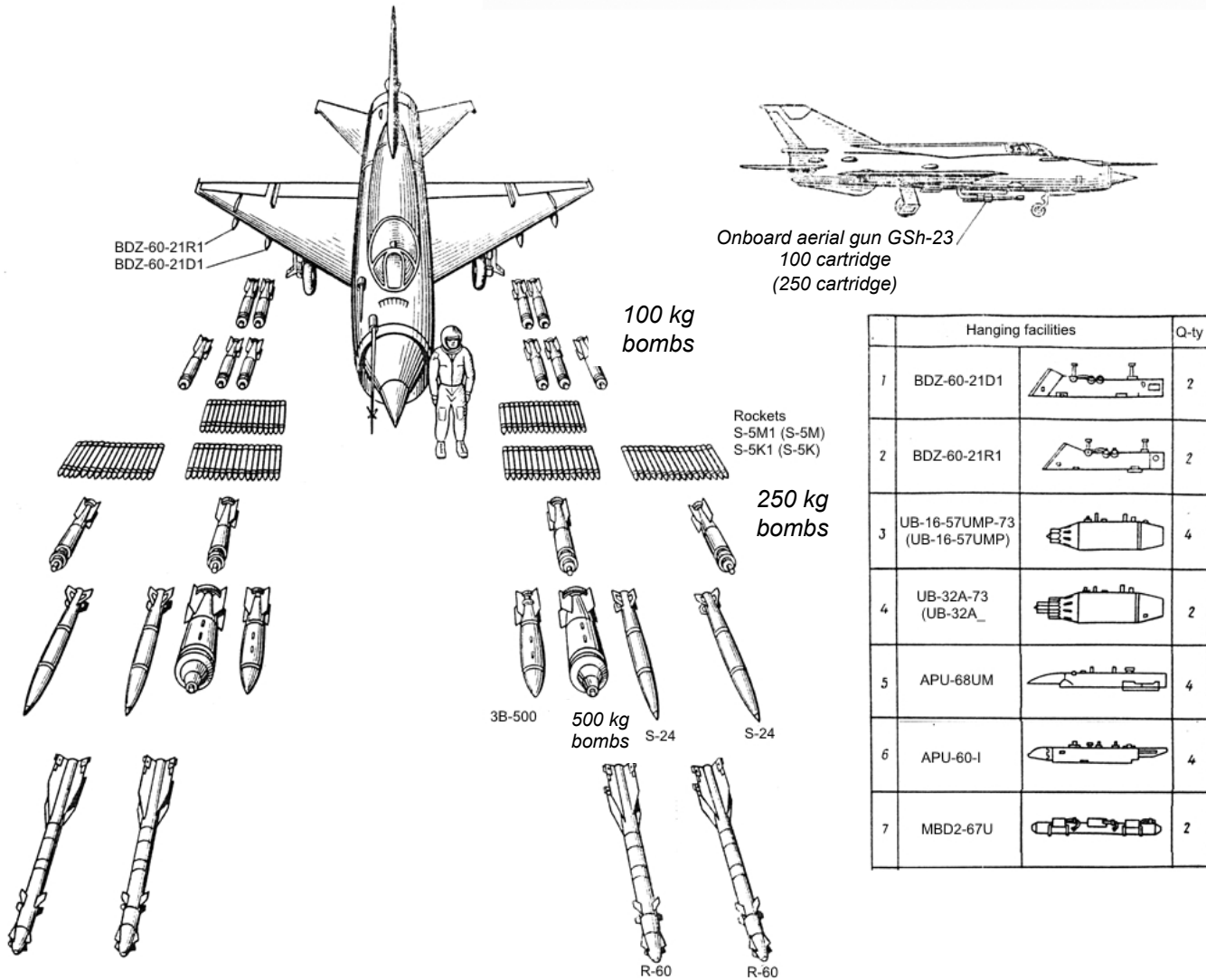


■ Variants of air-launched weapon brackets by MiG-21bis tactical employment

No.	Hanging facilities	Q-ty	Weapons	Outer hardpoint (point No.3)	Inner hardpoint (point No.1)	Inner hardpoint (point No.2)	Outer hardpoint (point No.4)	Weapon Class
1	Outer rack BDZ-60-21-D1	2	Bombs 100 kg		+	+		air-to- ground
			250 kg		+	+		
			500 kg		+	+		
2	Outer rack BDZ-60-21-R1	2	Bombs 100 кг	+			+	air-to- ground
			250 кг	+			+	air-to- ground
3	MBD2-67U	2	Bombs 100 кг (4x100 кг)		+	+		air-to- ground
4	Universal unit UB-16-57U	4	16 rockets S-5	+	+	+	+	air-to- ground
5	Universal unit UB-32A-73	2	32 rockets S-5		+	+		air-to- ground
6	Aircraft launcher APU-68UM	4	Rockets S-24	+	+	+	+	air-to- ground
7	Aircraft launcher APU-60-1	4	Missiles R-60	+	+	+	+	air-to-air



■ Variants of air-launched weapon brackets by MiG-21bis tactical employment



Hanging facilities		Q-ty
1	BDZ-60-21D1	2
2	BDZ-60-21R1	2
3	UB-16-57UMP-73 (UB-16-57UMP)	4
4	UB-32A-73 (UB-32A_)	2
5	APU-68UM	4
6	APU-60-I	4
7	MBD2-67U	2

MiG-21 phenomenon and SE “OAP” capabilities

Taking into account reliability level and widespread occurrence MiG-21 is akin to Kalashnikov assault rifle brand.

MiG-21 are inferior to modern aircrafts in combat load, flight endurance and several other factors, nevertheless facing enormous prices for up-to-date materiel these factors overshadows in case of military budget limitations.

MiG-21 provides usage of aircraft weapons (100 kg, 250 kg, 500 kg free-falling aerial bombs), aircraft-launched rockets S-5 and S-24, onboard aerial gun GSh-23 on MiG-21bis, “air-to-air” missiles;

MiG-21 can be applied both for fight with air adversary and for air assault strikes;

MiG-21, in case of navigation-communication equipment upgrade, allows to remain piloting skills on modern requirements level, interact affectively with other branches of troops, as if necessary – make resistance to real enemy.

That is the reason of interest in experience of Croatia which joined NATO, the one that under budget deficit condition followed a course of its MoG-21 repair and modernization on SE “OAP”. Thereby it became possible to raise fighter combat efficiency, save budget money and have an aircraft applicable to both combat operations and remaining fighter pilots’ skills on appropriate level. In the course of the Contract there was supply of 5 MiG-21bis aircrafts after modernization.

Having similar to F-7 (China) aerodynamics and speed capabilities, MiG-21 assures succession and minimizes probability of flight accident during pilots’ operation of aircrafts of this type;

SE “OAP” has continuous experience and is ready to perform MiG-21bis and MiG-21UM repair and modernization, as well as to supply if necessary 3 MiG-21BiSi and 2 MiG-21UM aircrafts;

SE “OAP” can offer logistics support of repaired and supplied aircrafts: supply ground equipment, spare parts, etc.



MiG-21 phenomenon and SE “OAP” capabilities



R25-300



R13-300



R11-300



MiG-21

Overhaul all types of turbojet boost engines for MiG-21 aircrafts

The only enterprise in Ukraine that overhaul MiG-21 and L-39 airframes and engines without subcontractors

MiG-21 phenomenon and SE “OAP” capabilities

Summarizing the abovementioned it can be stated that MiG21-bis remains powerful combat platform that has considerable potential for tactical employment and modernization.

There is no doubt that radar equipment needs upgrade, specifically navigation and radio communication equipment, that is necessary for:

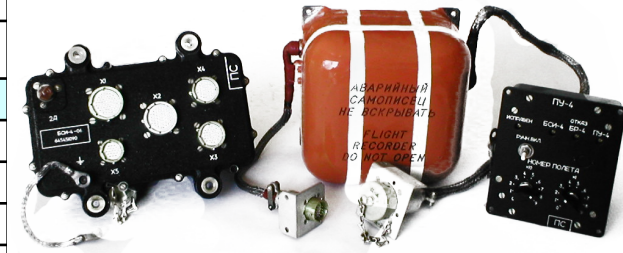
- More precise and comfort navigation using satellite navigation source including forwarding to ground target area having known geographical coordinates;**
- Aircraft operation from civil airports that meet ICAO requirements;**
- On the whole radar system reliability improvement due to usage of a new circuitry;**
- Non-interference of the aircraft control system (autopilot, radio, control laws) during modernization to prevent aircraft accidents.**

For this purpose three variants of MiG-21bis onboard radar equipment modernization are offered.



Onboard equipment configuration

No.	Designation	Marking	Version			
			Condensed	Primary	Basic	Navigated bombing
1	Flight data recording system	BUR-4	-	-	+	+
1.1	Onboard flight data recorder	BR-4T	-	-	+	+
1.2	Control panel	PU-4	-	-	+	+
1.3	Synchronizer unit	BSI-4	-	-	+	+
1.4	Additional equipment set	Sensors & modules	-	-	+	+
2	Radio communication equipment		-	-	+	+
2.1	V/UHF receiver	MR 6000R	-	-	+	+
2.2	Radio station control panel	GB 6500	-	-	+	+
2.3	Audio interface unit	AIU	-	-	+	+
2.4	Antenna V/UHF COM	S65-8282-34	-	-	+	+
3	Aircraft responder (S-mode)	GTX-33	-	+	+	+
3.1	Altitude coder (responder and GPS)	SSD120-62NE	-	+	+	+
3.2	L-band antenna	S65-5366-10L	-	+	+	+
4	Navigation equipment		-	+	+	+
4.1	DME system		-	+	+	+
4.1.1	DME receiver	KDM 706A	-	+	+	+
4.1.2	L-band antenna for DME system	S65-5366-10L	-	+	+	+
4.2	VOR/ILS system		-	+	+	+
4.2.1	VOR/LOC/GS/MB receiver	KNR 634A	-	+	+	+
4.2.2	VOR/ILS control/display unit	KFS 564A	-	+	+	+
4.2.3	VOR/LOG/GS antenna	S65-247-22	-	+	+	+
4.2.4	VOR/ILS splitter	SSPD-113-12	-	+	+	+
4.2.5	MB antenna	S35-1000-02	-	+	+	+



Flight data recording system set
BUR-4



Комплект навигационного оборудования
(навигационный приемник, дальномер, пульт управления,
индикатор, преобразователь и комплект антенн)
Navigation equipment set
(navigation receiver, DME system, control panel, indicator, converter
and set of antennas)



Set of IR decoy dispenser system and radar chaffs



Onboard equipment configuration

Navigation system receiver **GTN-650**



Engine operating parameters display **MVP-50** (optional)



Air data unit **MVP-1** for aircraft weapon control system upgrade



Ballistic computer set **VDK-558** for aircraft weapon control system upgrade

No.	Designation	Marking	Version			
			Condensed	Primary	Basic	Navigated bombing
4.3	Satellite navigation system	GTN650	+	+	+	-
4.3.1	Antenna	GA-35	+	+	+	-
5	Weapons control system upgrade		-	-	-	+
5.1	Additional channel computer	VDK-558	-	-	-	+
5.1.1	Ballistic computer	BTsVM25A	-	-	-	+
5.1.2	Mission input unit	BII	-	-	-	+
5.2	Satellite navigation specialized system	SN-4315	-	-	-	+
5.2.1	Antenna	A101P	-	-	-	+
5.2.2	Unit	UMHs-RFS	-	-	-	+
5.2.3	Multifunctional recorder	MFI	-	-	-	+
5.2.4	Computer	BV	-	-	-	+
5.2.6	Switching unit	BK-SAU	-	-	-	+
6	Air data unit	MVP-1	-	-	-	+
7	International Linear Collider	SKV	-	-	-	+
8	Engine operating parameters combined display	MVP-50T	-	-	-	+
8.1	Engine Data Converter	EDC-33T	-	-	-	+
9	Flight data backup display	MD302 SAM	-	-	-	+
10	Navigation data backup display	SN3500	-	+	+	+
11	Mechanical aircraft clock	V18-956.22.28.3 A	-	+	+	+
12	Set of IR decoy dispenser system and radar chaffs	ASO-2I	-	-	+	+



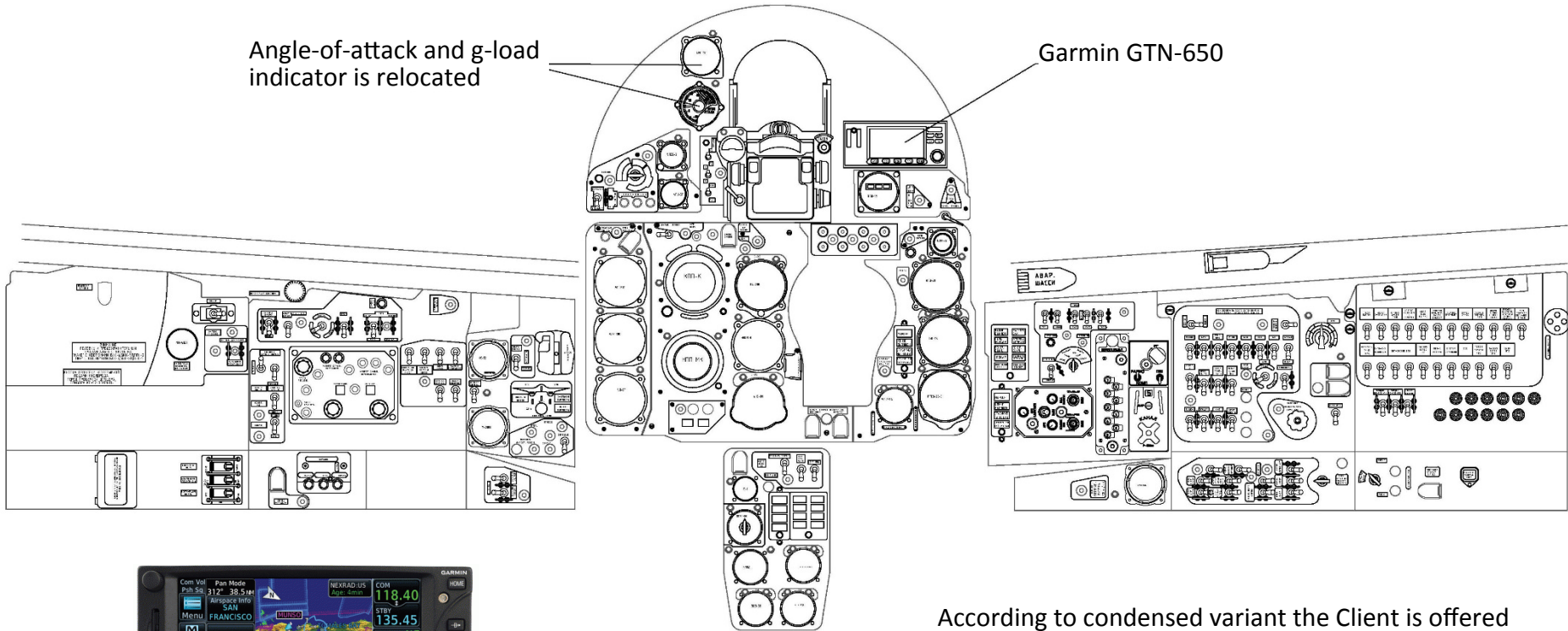
Navigation equipment set **SN-4315** for aircraft weapon control system upgrade

MiG21bis modernization condensed version

MiG-21bis izdeliye 75B aircraft cockpit equipment
(condensed version)

Angle-of-attack and g-load indicator is relocated

Garmin GTN-650

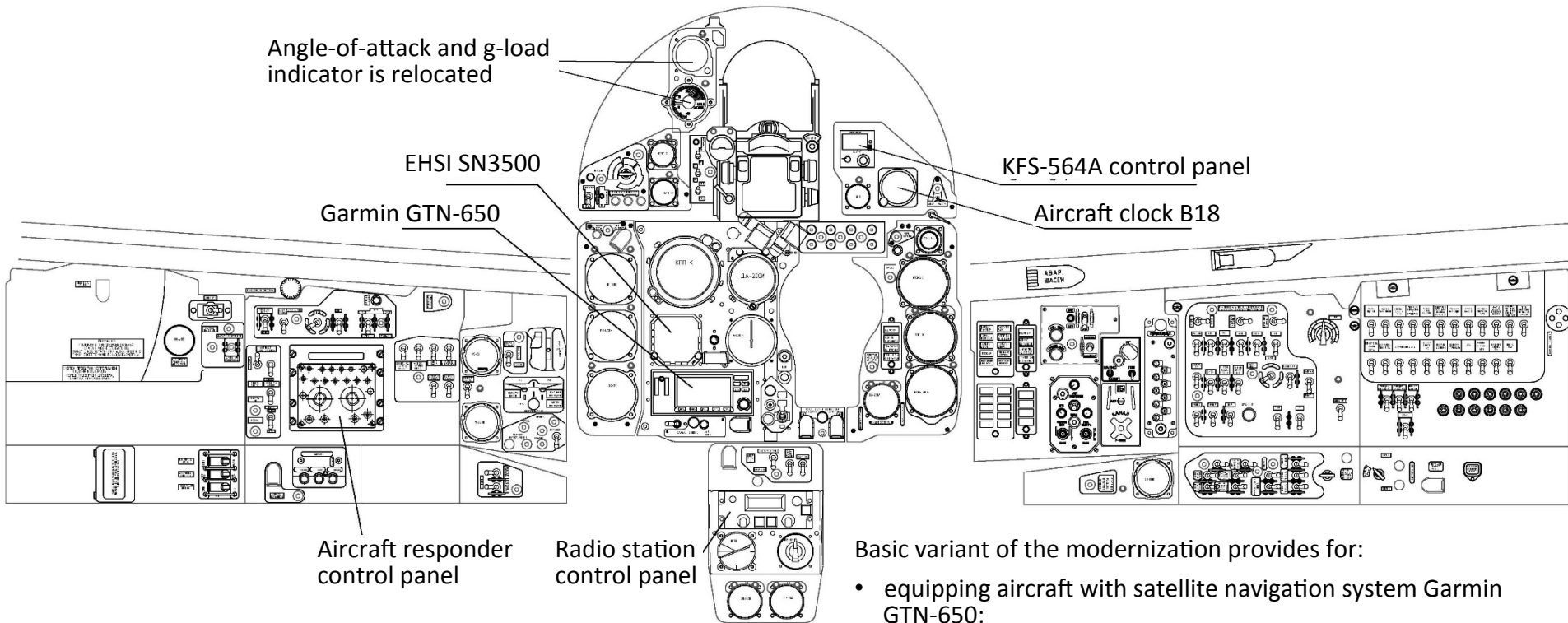


Navigation system receiver **GTN-650**

According to condensed variant the Client is offered to install combined navigation equipment Garmin GTN-650 in addition to original onboard equipment. Installation of Garmin GTN-650 allows to use resourced of the GPS navigation system to the full, simplifies navigation tasks accomplishment and provides the pilot with backup radar source.

MiG21bis modernization basic version

MiG-21bis izdeliye 75B aircraft cockpit equipment
(basic version)



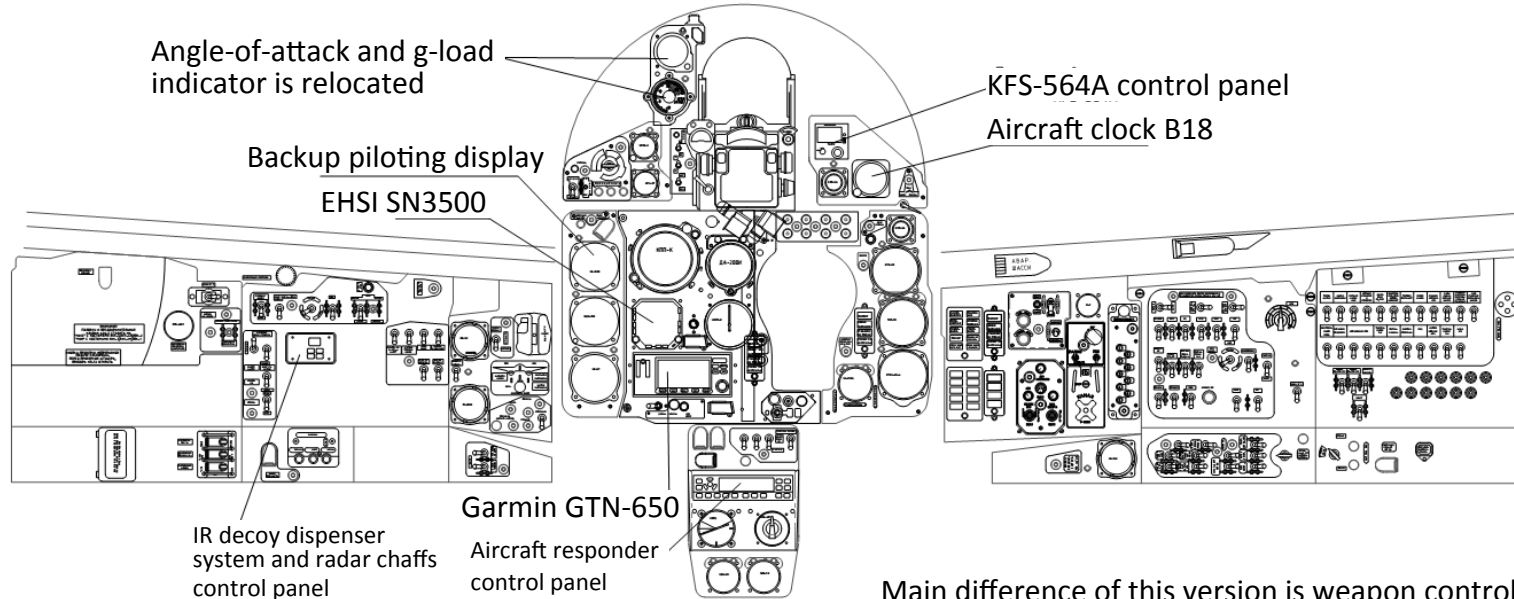
Navigation equipment set

Basic variant of the modernization provides for:

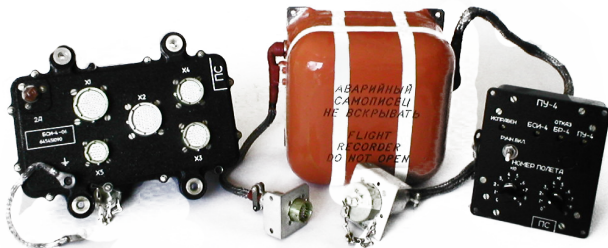
- equipping aircraft with satellite navigation system Garmin GTN-650;
- modification of original aircraft navigation system by Sandel SN3500 Primary Navigation Display installing;
- Installing advanced aircraft responder;
- providing the pilot with backup radar source;
- All necessary modification and relocation of the original equipment are due to installation of new equipment.

MiG21bis modernization primary version

MiG-21bis izdeliye 75B aircraft cockpit equipment
(primary version)



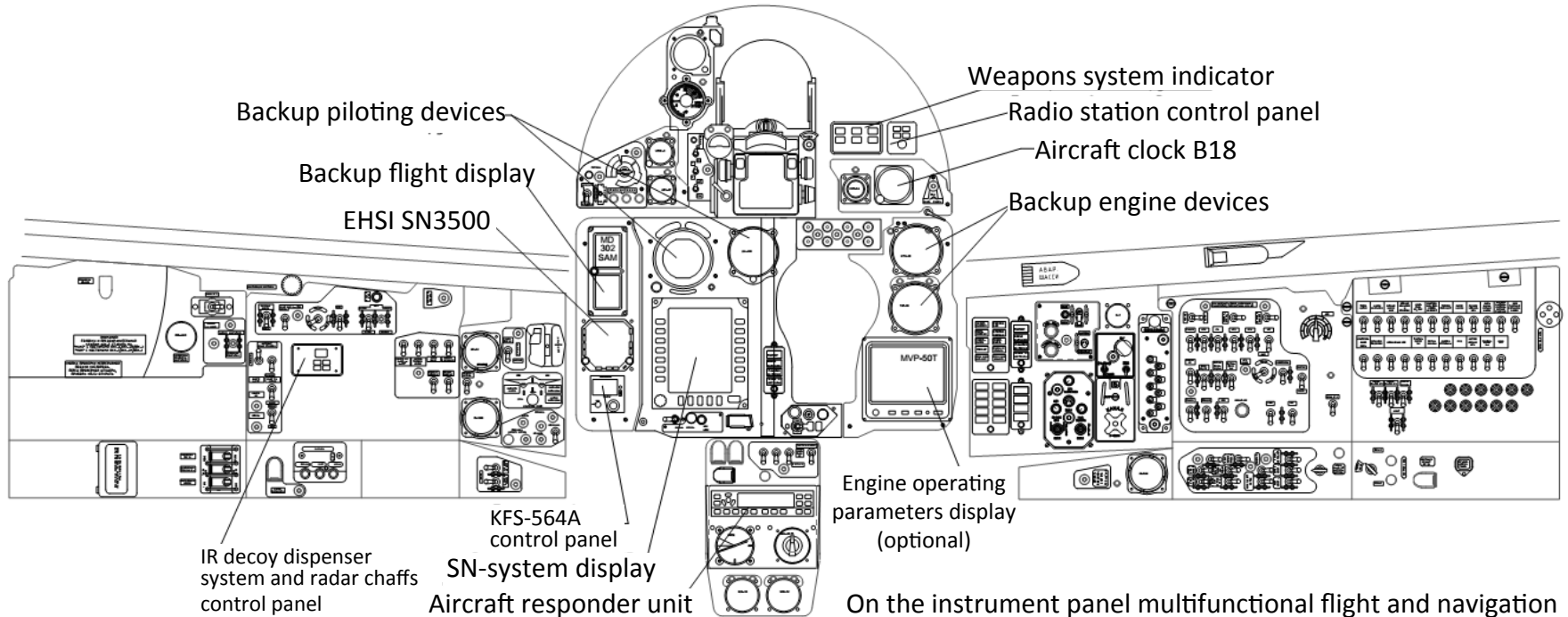
Main difference of this version is weapon control system upgrade. The aircraft is equipped with new recorder and all necessary coupling devices with original systems.



Flight data recording system set BUR-4

MiG21bis modernization navigated bombing version

MiG-21bis izdeliye 75B aircraft cockpit equipment
(navigated bombing version)



Navigation equipment set for aircraft weapon control system upgrade

On the instrument panel multifunctional flight and navigation data digital display and satellite navigation system receiver are located. To onboard equipment are added: onboard weapons system computer, engine operating parameters display, backup data displays: flight data - MD302SAM) and navigation data – Sandel SN3500. The aircraft is equipped with a new recorder and all necessary coupling devices with original systems.