Russian Federation's 5th Generation Fighter:
PAK-FA (T-50) Program

First Flight of PAK-FA (T-50-1) on 29 JAN 10

02 MAR 10

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UNCLASSIFIED

Sukhoi's PAK-FA/I-21/T-50 Program

Overview PAK-FA/I-21/T-50 Program

- Overview of PAK-FA facts and figures:
  - Cost of development $8-10 billion USDs
  - Russia's requirement 250 fighters
  - India's requirement 250 fighters
  - Cost per aircraft $87-100 million USDs
  - Production run 500 aircraft
  - Russian name PAK-FA requirement/Sukhoi T-50/Service name Su-50 service 2015
  - Indian name FGFA service 2017
- T-50-1, first flight worthy air vehicle, first taxi test runs were on 24 DEC 09 with two taxi test runs (T-50-0 static test vehicle and T-50-2 avionics test vehicle)
- Performed low and high-speed taxi tests at Dzemgi airfield on 21-22 JAN 10 with “one of the best test pilots” at the controls
  - Dzemgi air force base shares airfield with KnAAPO at Komsomolsk-na-Amure
  - Aircraft performed FLG rotation and release of brake parachute
  - Plane lifted off the forward landing gear wheel and deployed the parachute
  - Aircraft looks “unusual”
  - Plane looks flat, as other sources have said
    - Months ago it was said that it was flat like a toad
    - Only the canopy area looks humped
  - Vertical stabilizers are trapezoidal and all-movable
  - Nose looks canted downward, with the tail being elevated
  - IR stealth with an axis symmetrical nozzle; may use some form of passive or active cooling
- During taxi tests photos and video was taken
- “First flight is soon” next week at KnAAPO, but An-124 is awaiting at Dzemgi on 25th, so intrigue was evident on whether it would be at Zhukovsky or KnAAPO field
  - Rumor first flight last week of JAN 10 and official media day also rumored on 1 FEB 10
  - First flight was on 29 JAN 10

PAK-FA (T-50) to Start Testing in April 2010

- T-50 will start a standard flight test program in April, a source at the Sukhoi aircraft maker said on Monday, 1 MAR 10
  - He said it would take "several years" to complete the testing program
  - Current prototype was designed by the Sukhoi design bureau
  - Built at a plant in Komsomolsk-on-Amur, in Russia's Far East
  - It will be delivered to the Russian Air Force from 2015 onwards
  - Russian officials have already hailed the fighter as "a unique warplane" that combines the capabilities of an air superiority fighter and attack aircraft
- T-50 is to undergo more than 2,000 flight tests before full-scale production starts, Prime Minister Vladimir Putin said Monday, 1 MAR 10
- He also said now that Russia had a fifth-generation prototype fighter, it should start working on a new-generation long-range strategic bomber (PAK-DA) that he described as “an airborne missile-carrier”
  - Tupolev aircraft maker said last year that a new-generation strategic bomber would be developed by 2017, while production should start in 2020 to 2025
  - However, Maj. Gen. Anatoly Zhikharev, commander of Russia's strategic aviation said a new strategic bomber, which would use stealth technology, was expected to enter service in 2025 to 2030
  - New bomber will replace three aircraft currently in service with Russia's strategic aviation, the Tu-95MC Bear and Tu-160 Blackjack strategic bombers, introduced in 1956 and 1980, respectively, and Tu-22M3 Backfire long-range bombers, which first flew in 1972

Source: MOSCOW, March 1 (RIA Novosti)

PAK-FA T-50-0 (Completed in Summer 2009)

First Flight Preparations of PAK-FA (T-50-1) on 29 JAN 10

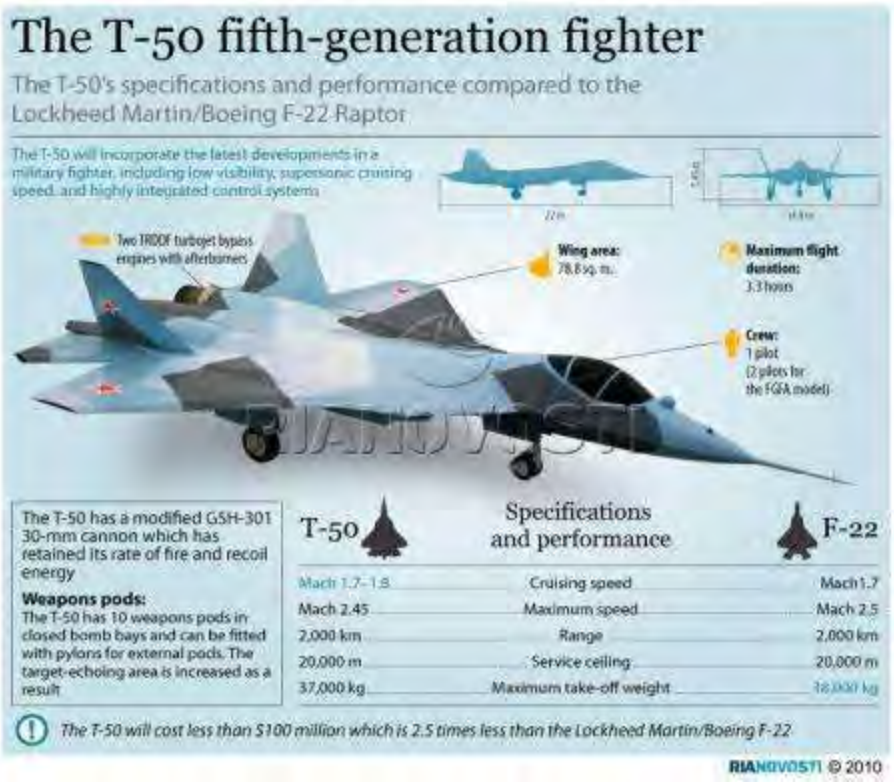
PAK-FA's (T-50-1) First Flight on 29 JAN 10

"Today we've embarked on an extensive flight test program of the 5th generation fighter. This is a great success of both Russian science and design school. This achievement rests upon a cooperation team comprised of more than a hundred of our suppliers and strategic partners. PAK FA program advances Russian aeronautics together with allied industries to an entirely new technological level. These aircraft, together with upgraded 4th generation fighters will define Russian Air Force potential for the next decades. Sukhoi plans to further elaborate on the PAK FA program which will involve our Indian partners. I am strongly convinced that our joint project will excel its Western rivals in cost-effectiveness and will not only allow strengthening the defense power of Russian and Indian Air Forces, but also gain a significant share of the world market", - said Mikhail Pogosyan, Sukhoi Company Director General commenting on the launch of the flight test program.

- 47 minutes in the air and then landed on the aircraft factory runway
- 5th generation fighter is equipped with brand-new avionics suite integrating "electronic pilot" functionality, as well as advanced phased-array antenna radar
- This significantly decreases pilot load and allows him to focus upon completion of tactical missions
- New aircraft on-board equipment allows real-time data exchange not only with ground based control systems, but also within the flight group
- Composites application and innovative technologies, aerodynamics of the aircraft, measures applied to decrease the engine signature provide for the unprecedented small radar cross section in radar, optical and infrared range
- This significantly improves combat effectiveness against air and ground targets at any time of the day in both visible and instrument meteorological conditions

Sukhoi's T-50 Threeview

Preliminary Technical Characteristics of PAK-FA



MTOW	81,600 lb
Maximum Speed	1,400 KTAS (Mach 2.44 ~36kft, ISA)[1]
Supercruise Envelope	700 KTAS to 920 KTAS (1.22M to 1.6M >36kft, ISA), through analysis suggests a likely higher top end point of ~1.9M.
Maximum Initial Climb Rate	69,000 fpm
Climb Ceiling	65,000 ft[2]

Sources: Sukhoi via Russian media, preliminary APA analysis

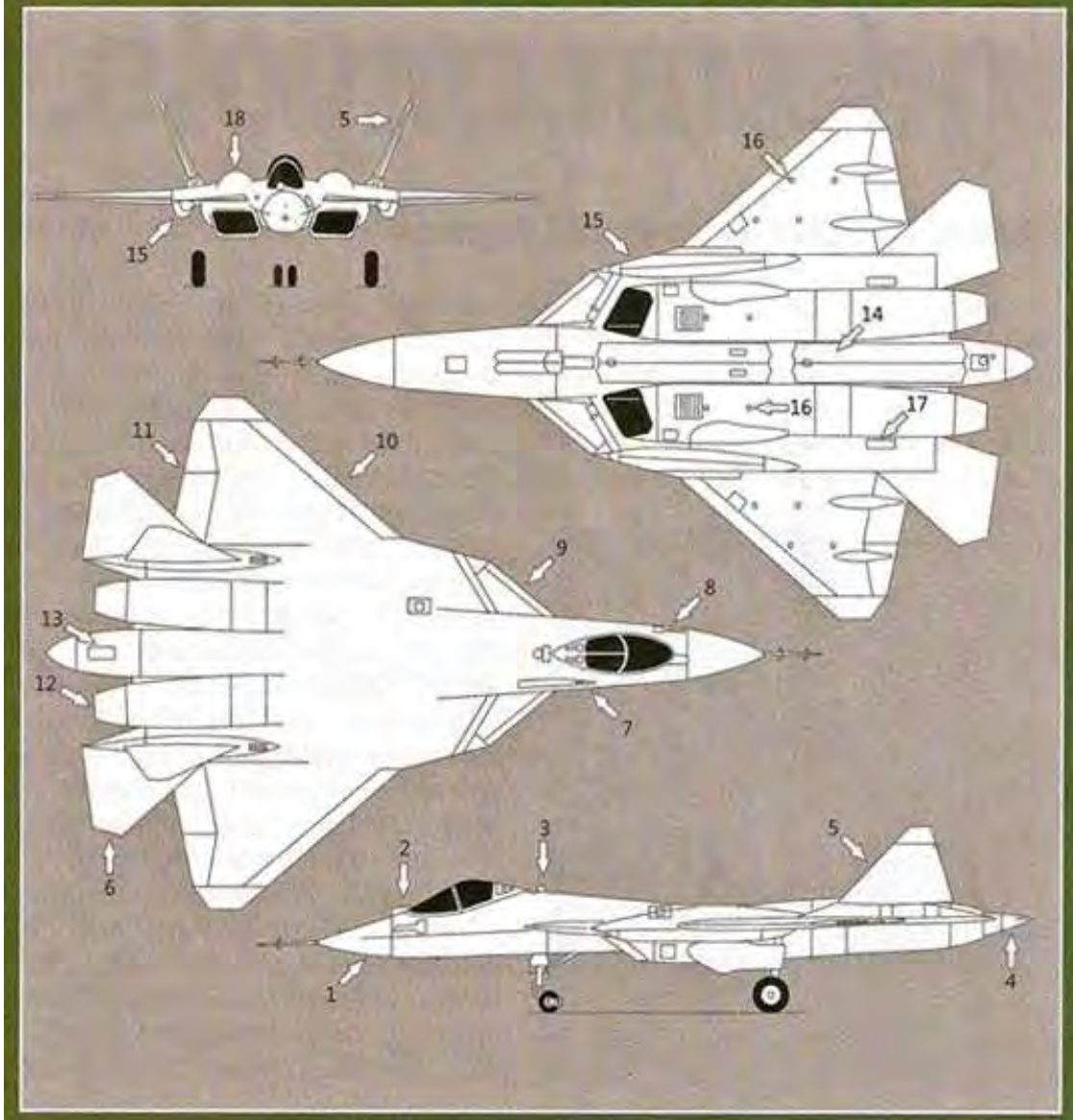
1 - supersonic flight duration not specified

2 - ceiling constraints not specified

PAK-FA (T-50) Program Highlights

PAK-FA (T-50) Program Highlights

LE T-50 SOUS TOUS LES ANGLES



1 Radar Sh121 avec une antenne frontale à balayage électronique à modules actifs (bande X) et quatre autres réparties sur les flancs.

2 Optronique secteur frontal (maquette).

3 Détecteur d'émissions infrarouges.

4 Appendice caudal, typique des Su-30, susceptible d'abriter un radar arrière.

5 Dérive d'empennage monobloc inclinée à 25°.

6 Empennage horizontal monobloc sur support en titane.

7 Emplacement du canon (un 30 mm monotube).

8 Réserve pour une perche de ravitaillement en vol escamotable.

9 Partie mobile de l'apex.

10 Volet de bord d'attaque supposé contenir une antenne (bande L) du radar.

11 Flaperon à deux sections.

12 Réacteur Saturn AL-41F1 (117) avec tuyère mobile dans le plan vertical.

13 Soute des deux parachutes de freinage.

14 Soutes à armements en tandem avec trappes "furtives".

15 Capotage de 4,5 m de long susceptible d'abriter un missile de combat air-air, un radar à balayage latéral ou d'autres systèmes électroniques. La partie avant cache le mécanisme des volets de l'apex.

16 Emplacements pour emports d'armements extérieurs (deux sous chaque aile, un sous chaque fuseau moteur).

17 Réserves pour éjecteurs de leurres optiques et électromagnétiques.

18 Enveloppe extérieure des conduits d'air (en "S" vertical) entourant les parties chaudes du moteur.

PAK-FA's Radar Complex SH121

NIIP L-band AESA Radar for PAK-FA and Su-35

- NIIP displayed a full-scale model for the first time of an X-band nose-mounted Active Electronic Scanned Array (AESA) for the new PAK-FA (T-50) 5th generation multirole fighter program
  - Designed for PAK-FA and Indian FGFA
  - Offered for the mid-life upgrades of existing Su-35BMs, Su-30MKIs and Su-30MK2s
  - Ready to equip up to 50 aircraft per year with radars
- This will "no longer be just radar, but the integrated radio-electronic system, which includes radars in several wave bands, an identification system, electronic warfare (EW) and electronic intelligence (ELINT)", stated NIIP's director Yuri Belyy in a media report on the system

F-22 ASEA Radar

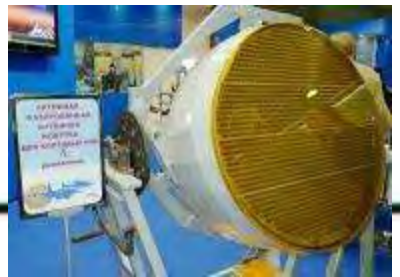
PAK-FA NIIP X-Band Radar

Tikhomirov's Scientific Research Institute for Instruments (NIIP) X-band AESA Radar for PAK-FA

PAK-FA's Radar Complex SH121

121

1 Antenne frontale en bande X
2 Antennes latérales en bande X
3 Antennes de bords d'attaque en bande L



P. BUTOWSKI

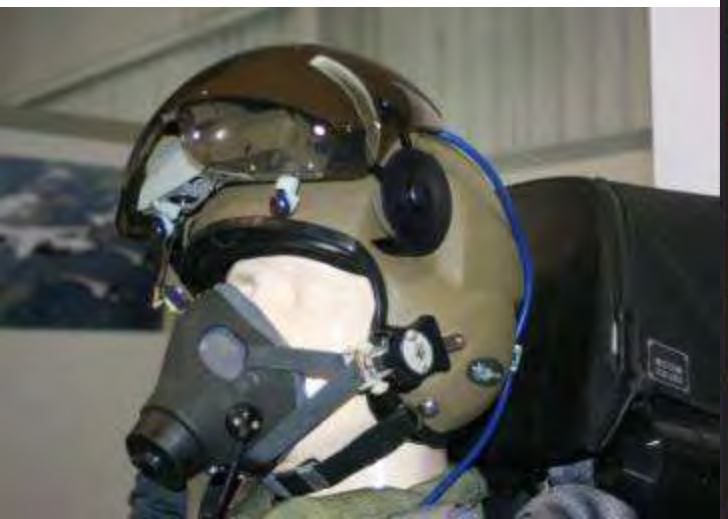
PAK-FA's Radar Complex SH121 : Russian TV Report Shows Radar Coverage

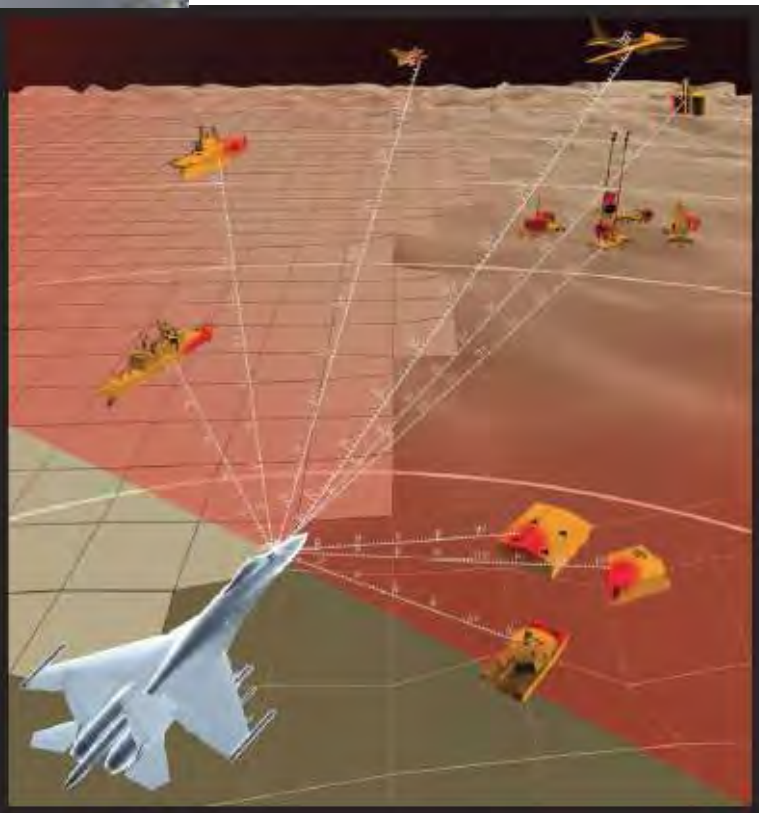
Note that the L-band radar seem to be on the LERX side and not the leading edge slats as on the Su-35 and also seems to indicate side-band X-band antenna as well.

PAK-FA and Su-35's Optical Location System

- OLS-35 according to web source can detect F-22-like aircraft at 100 km distance
  - –OLS with 360 deg
  - –Using thermal detectors from a European supplier

Zsh-10 Helmet Mounted Sight System





Performance

Detection range of an aerial target (head-on/pursuit detection range), km	50/90
measurement range to a ground target, km	30
measurement range to an aerial target, km	20
number of aerial targets simultaneously followed in IR-range	4

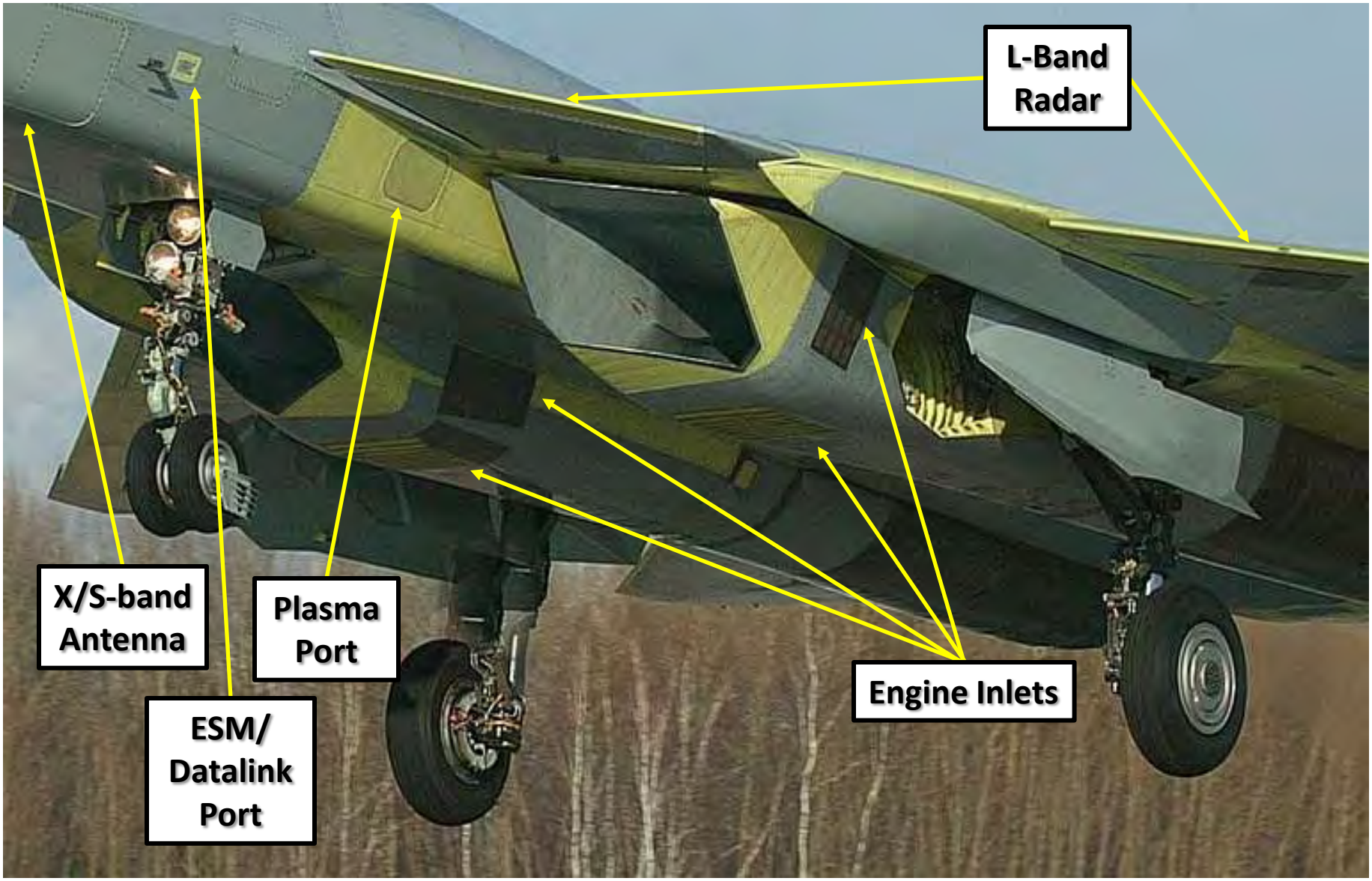
PAK-FA (T-50-0)
Wide-angle HUD

Avionics closer in layout and performance to the French Rafale

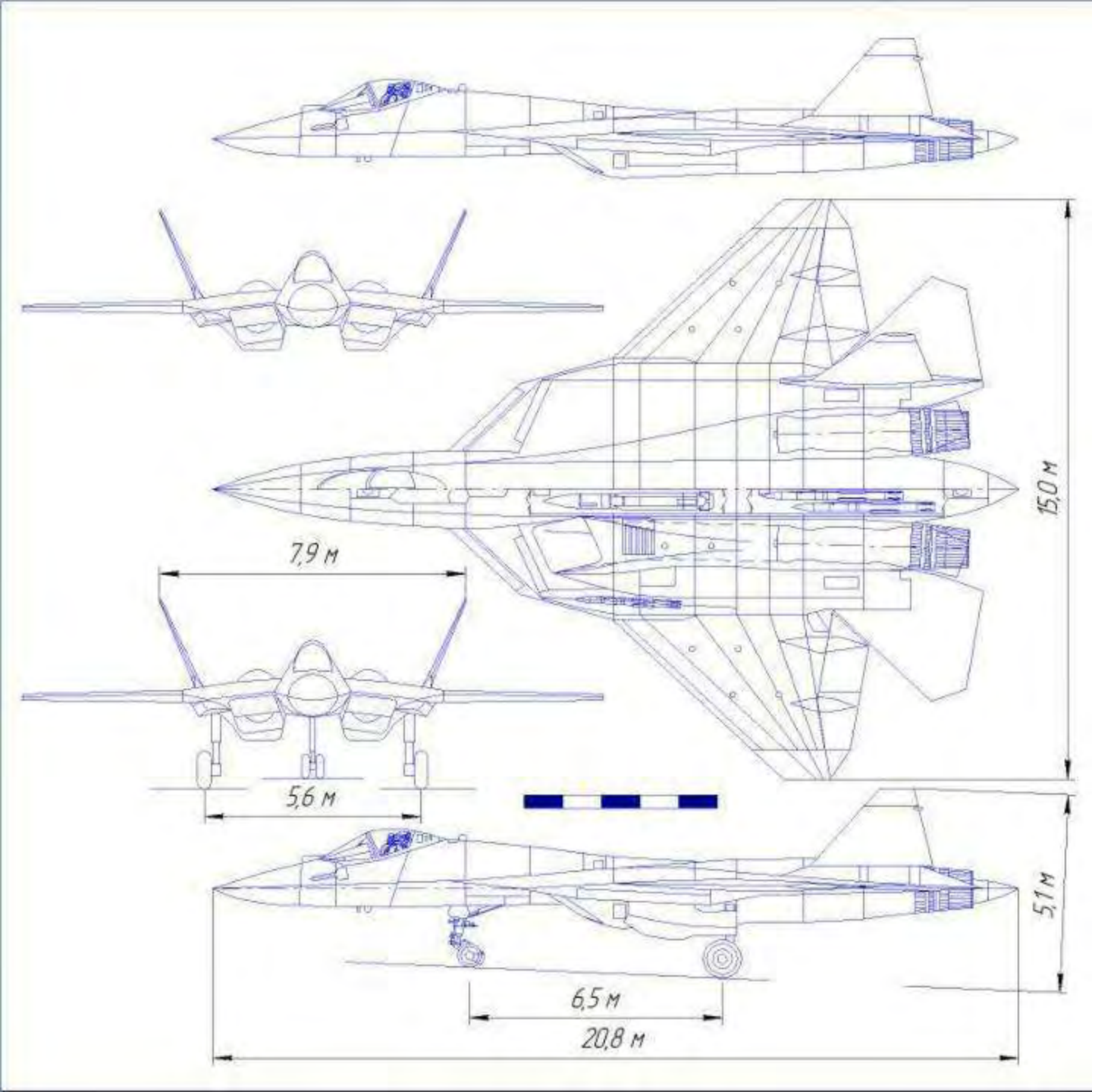
New HOTAS and Throttle Controls

Russian sources claim that the new OKB Aviaavtomatika HOTAS control set is likely to be used in the PAK-FA, but no formal disclosures by manufacturers have been made to date.

Various Sensor Ports for T-50-1



Notional PAK-FA Paint Scheme

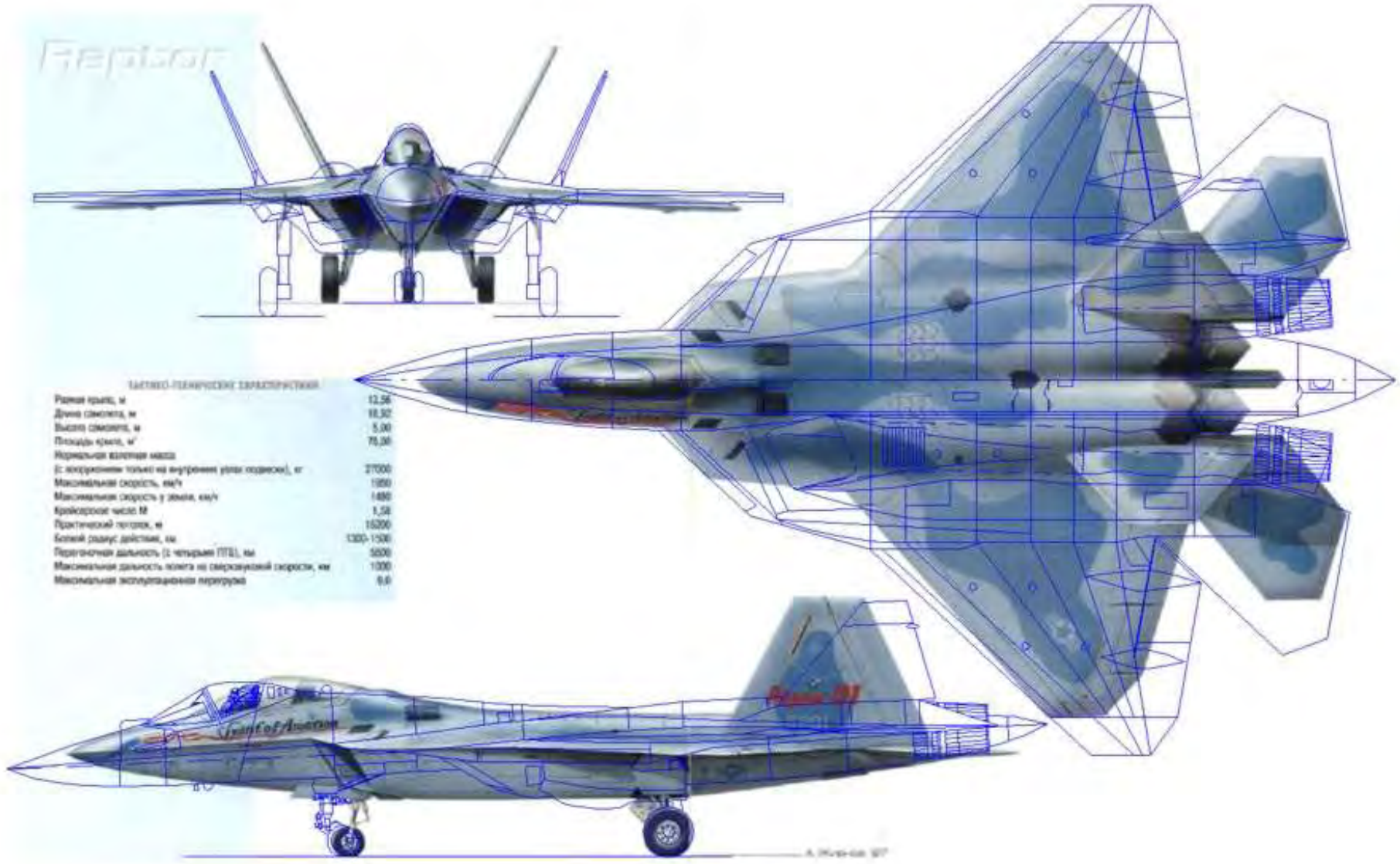


PAK-FA Line Drawing

Comparison of Su-35 and PAK-FA

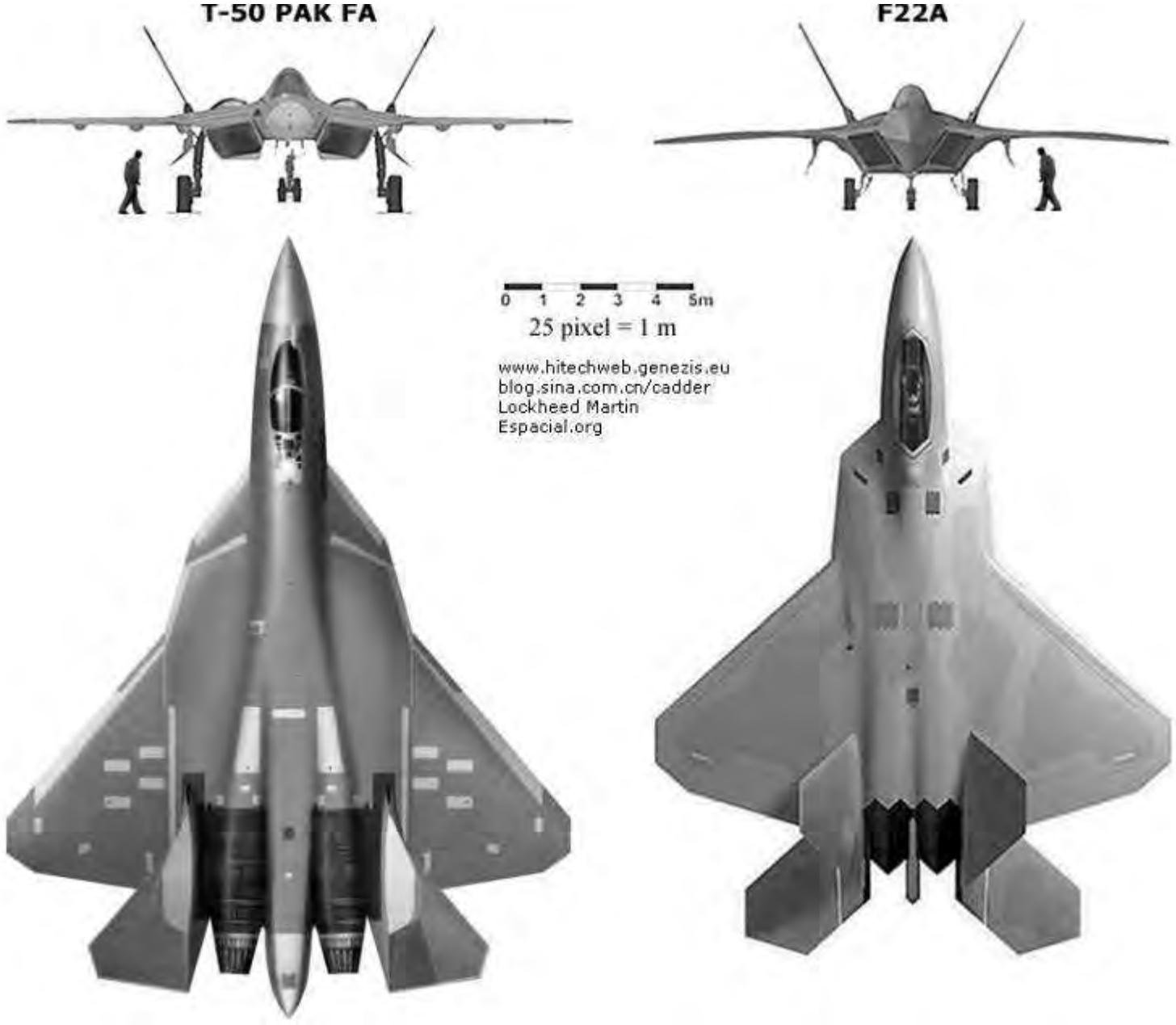
LOCKHEED MARTIN/BOEING F-22 RAPTOR
VS
SUKHOI SU-50 FIREFOX

Comparison of PAK-FA vs. F-22

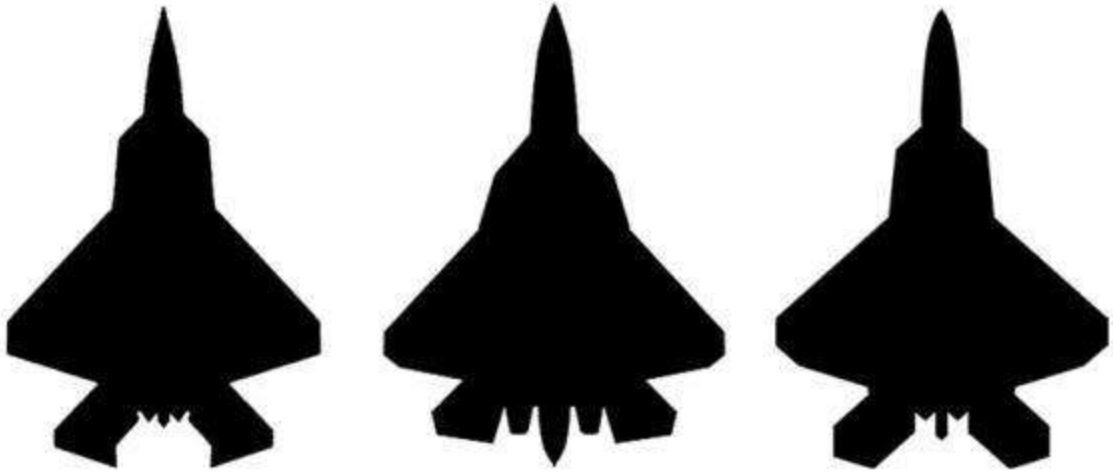


Размах крыла, м	12,56
Длина самолета, м	18,92
Высота самолета, м	5,00
Площадь крыла, м²	78,80
Нормальная взлетная масса	
(с вооружением только на внутренних узлах подвески), кг	27000
Максимальная скорость, км/ч	1950
Максимальная скорость у земли, км/ч	1400
Крейсерское число М	1,58
Практический потолок, м	19200
Боевой радиус действия, км	1300-1500
Перегоночная дальность (с четырьмя ПТБ), км	5500
Максимальная дальность полета на сверхзвуковой скорости, км	1000
Максимальная эксплуатационная перегрузка	9,0

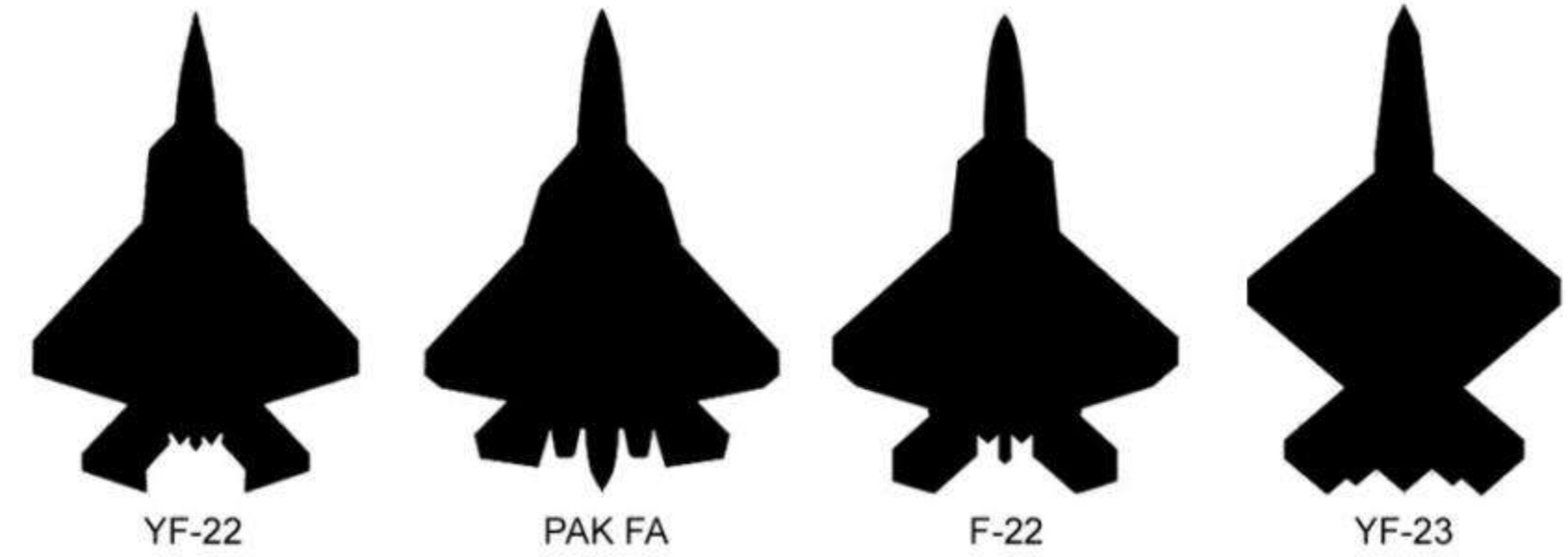
Comparison of PAK-FA vs. F-22



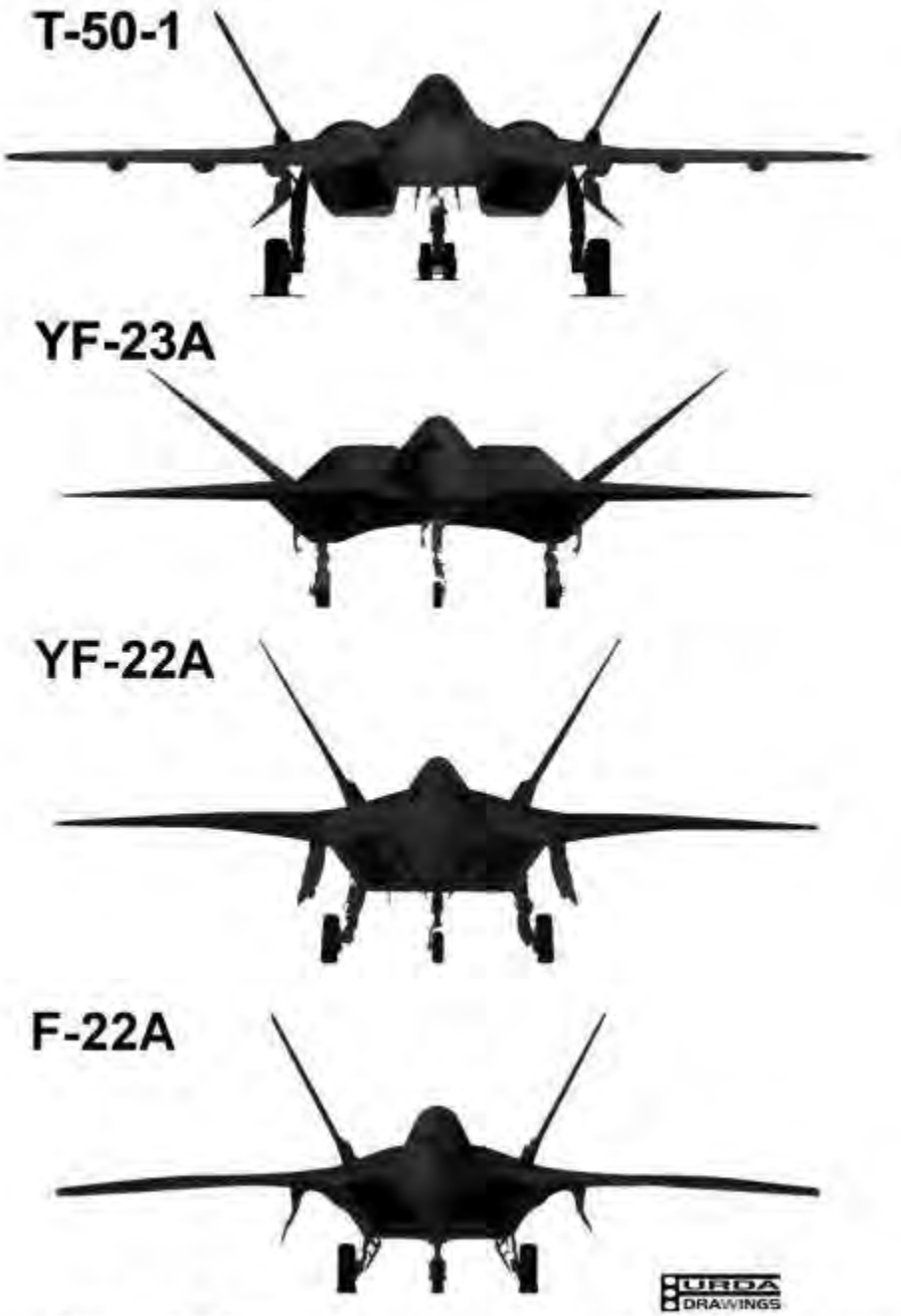
Comparison of PAK-FA vs. F-22



Comparison of T-50, F-22, YF-23 and F-35



Comparison of T-50-1, YF-23A, YF-22A and F-22A



PAK-FA's (T-50-1) First Flight Imagery

PAK-FA's (T-50-1) First Imagery

- http://sukhoi.org/news/company/?id=3142
- http://www.youtube.com/watch?v=mp0yd6no7B4
- http://www.youtube.com/watch?v=6XqwDEU0fus

PAK-FA (T-50-1) Front View

PAK-FA (T-50-1) Front View

PAK-FA (T-50-1) Top Section

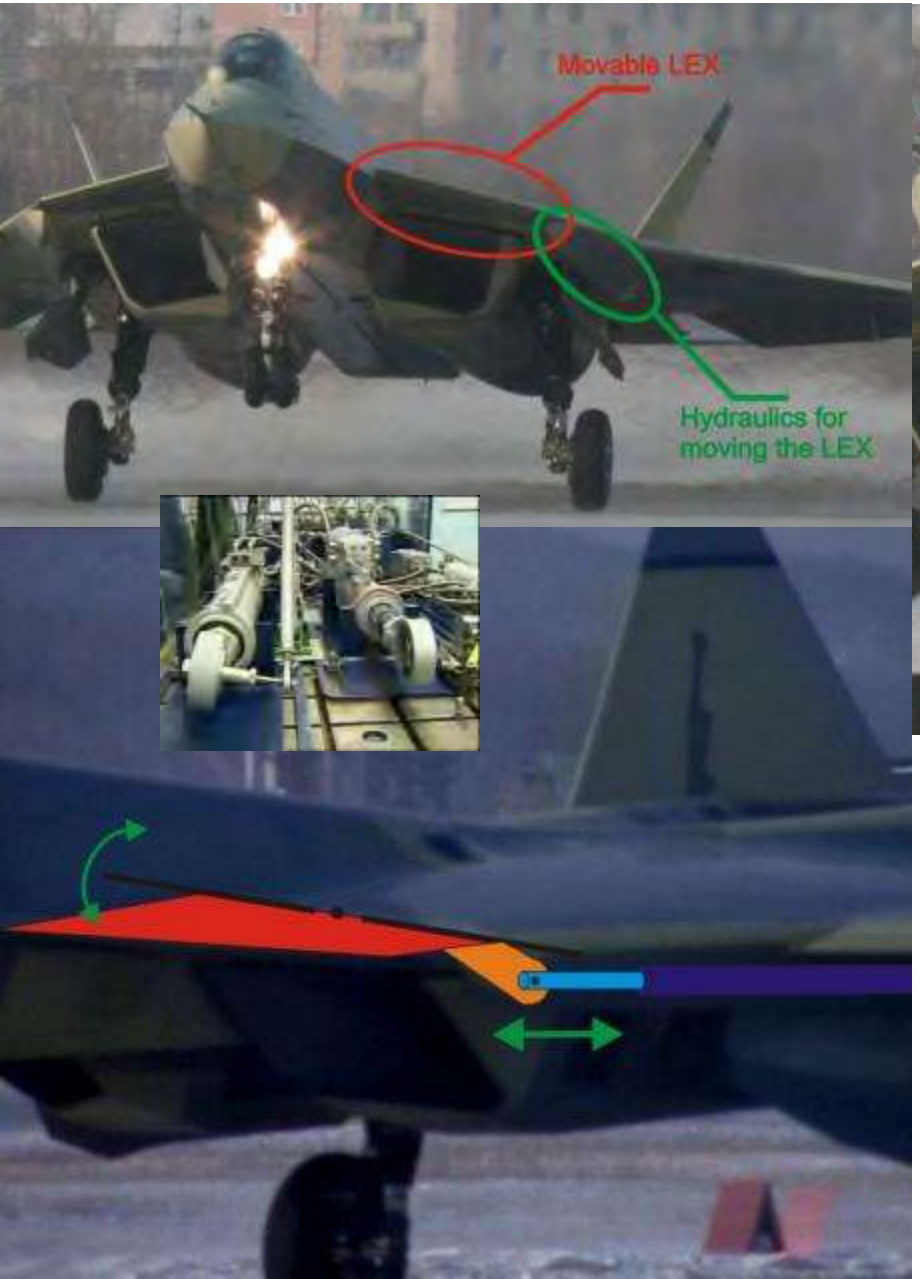
PAK-FA (T-50-1) Canopy Top view

PAK-FA's (T-50-1) First Flight Imagery

Features Noted on the PAK-FA's (T-50-1) First Flight

1. Cockpit-canopy reminds one of the YF-23 -but there seems to be a strange middle frame
2. For a Russian aircraft it has a very large wide-angle HUD (hologram)
3. Interesting strakes or fairings on the wing's roots
4. Front part of the LERX seems movable
5. Overall fuselage - especially the inner section between the engines - is very wide and one can see at least two weapons bays
6. Again in typical Sukhoi or Flanker fashion there's one gun on the right side of the T-50 (some say it is now officially called the Su-50)
7. Has an all-moving vertical tail

Movable LEX on PAK-FA (T-50-1)



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Russia's Fighter Engine Development for PAK-FA

- **NPO Saturn Engines**
  - NPO Saturn AL-31F @ 12.5t (thrust) for Su-27
  - NPO Saturn AL-41F at 18t+
    - Defunct MiG MFI/1.42/1.44 program
  - NPO Saturn 117C/ AL-41F-1A (117S) at ~14.5t for Su-35BM
    - 96 engines already ordered for Su-35BM
  - **NPO Saturn 117 at 15t+ for prototype PAK-FA**

- **MMPP Salyut Engines**
  - MMPP Salyut AL-31FM1 at 13.5t for Su-27SM, Su-30, Su-33 and Su-34
  - MMPP Salyut AL-31FM2 at 14.2t (R&D only)
  - MMPP Salyut AL-31FM3-1 at 14.5t (nominal), 15.3t (claimed max. achieved, R&D)
  - **MMPP Salyut AL-31FM3-2 at 15t (nominal) has new hp compressor with 6 stages instead of AL-31F's 9 (R&D)**
  - **PAK-FA definitive 5G engine at 16 to 16.5t (projected)**
    - **MMPP Salyut is now the lead developer (also referred to as the Iz. 217 or 127)**

Russia's T-10M-10 '710' (old Su-35) Testbed with Article 117 Engines First Flight 21 JAN 10

Russia's T-10M-10 '710'(old Su-35) Testbed with Article 117 Engines First Flight 21 JAN 10

- Image above shows the T-10M-10 Flanker with the 117 engine in the left nacelle, on the left which is larger than the standard AL-31 which is the one on the right
- Image on the right is the Su-35 Flanker with two AL-31 engines

Aircraft engine development gets a boost from PLM

Widespread use of NX and Teamcenter has cut six to 10 years off the development cycle for a new engine and reduced production costs to one-tenth the previous amount

MMPP SALUT

Siemens PLM Software

www.siemens.com/plm

Business initiatives

New product development

Business challenges

Establish R & D and design divisions equipped with the latest CAD/CAM/CAE software

Ensure innovation

Reduce design and manufacturing times and costs

Keys to success

Solutions from Siemens PLM Software at all stages of design and production

3D digital models

Digital simulation

Use of design geometry for NC programs

Product data management

Results

Engines developed in only 2 to 4 years vs. 10 years previously

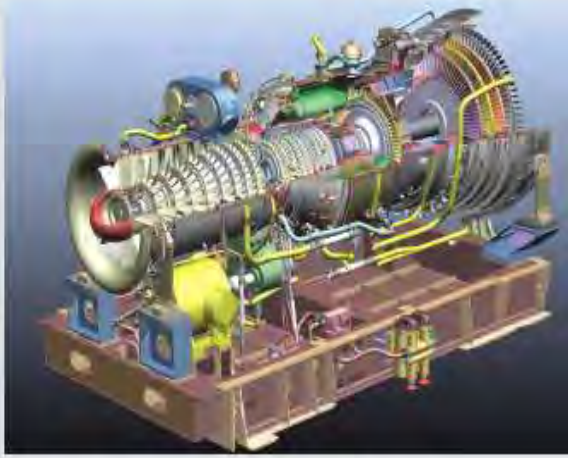
Cost of PLM investment paid for in reduced physical testing

Engine production costs one-tenth as much as previously

A stable and growing economic position for the company

Building aircraft engines for nearly 100 years

The history of Moscow Machine-building Production Plant (MMPP), "Salut," began in 1912 when a French company built its workshops near the location of the present plant and began producing the first serial aircraft engines in Russia. Those first engines, referred to as "Gnome" engines, were installed on such popular aircraft as Moskva, Newpore-4, Farman-16 and Moran-Zh.



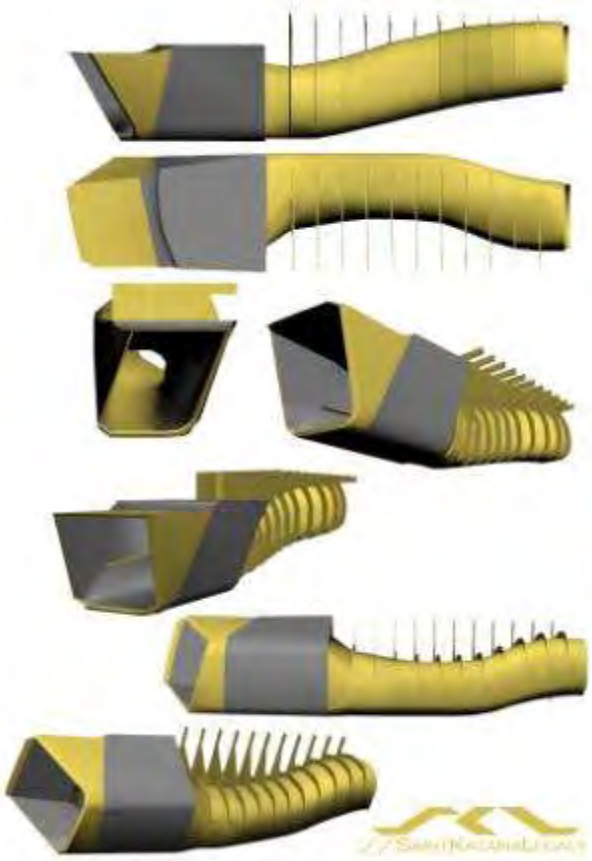
The plant soon started its own development activities. In the pre-war period the company produced a variety of aircraft engines, including those installed on the largest plane in the world at the time, the Maxim Gorky. Salut engines also powered the first non-stop flight from Moscow to America via the North Pole. During the war the plant produced more than 10,000 AM-38F engines for the legendary IL-2 armored battle plane. In 1947 the plant mastered the production of the first Soviet turbojet TR-1 engine. From then on, it has continued making aircraft engines for well-known production airplanes. In 1984, new engineering procedures were introduced with the AL-31F engine. Su-27 planes with AL-31F engines hold about 30 world records.

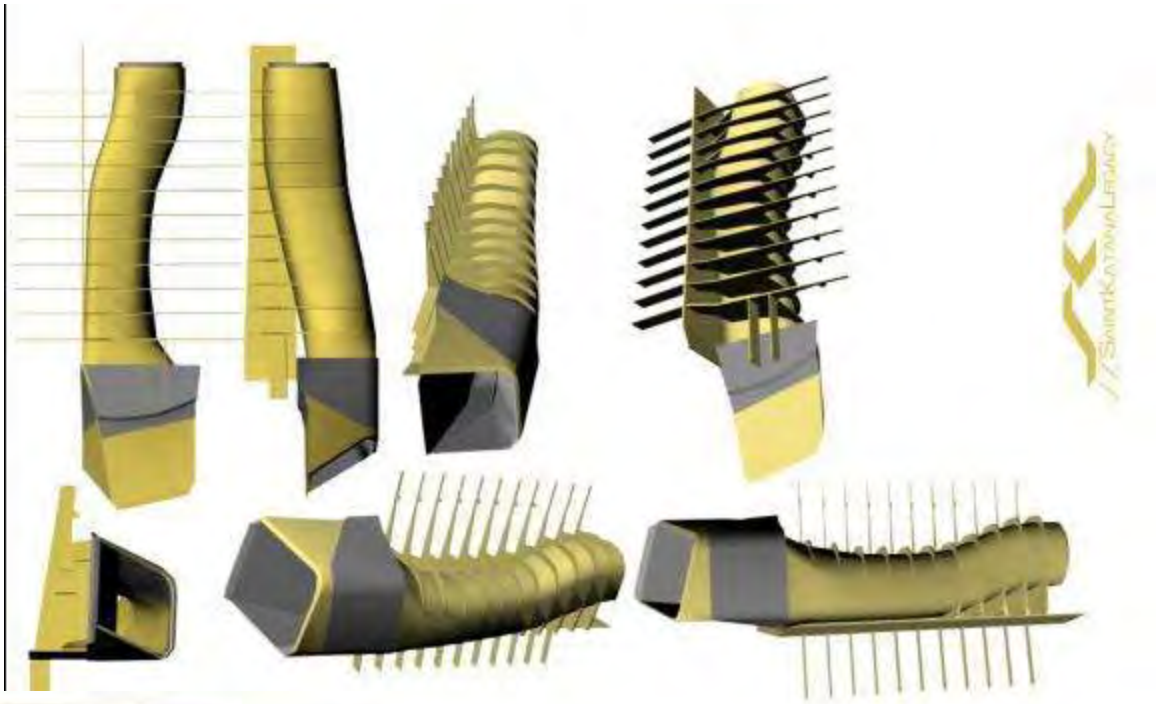
Today Salut is the largest Russian trading company involved in the design, production and after-sales service of aircraft engines. Its roster includes: AL-31F engines (for planes of "Su" family); engine repair for Su-22 and MiG-25 aircraft; assembly and component production for engines on Be-200, Tu-334, An-74TK-200, Tu-230, An-70, An-180 and Yak-130 planes; and the electric power plant GTE-20S. Currently the total number of employees is 23,000 with 14,000 working in the parent enterprise.

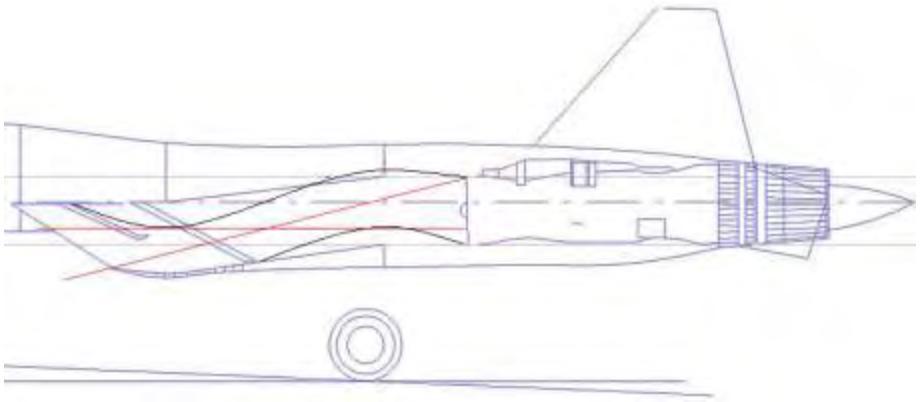
SIEMENS

Germany's SIEMENS Support to Salyut Moscow Machine-building Production Plant (MMPP)

PAK-FA Inlet Geometry

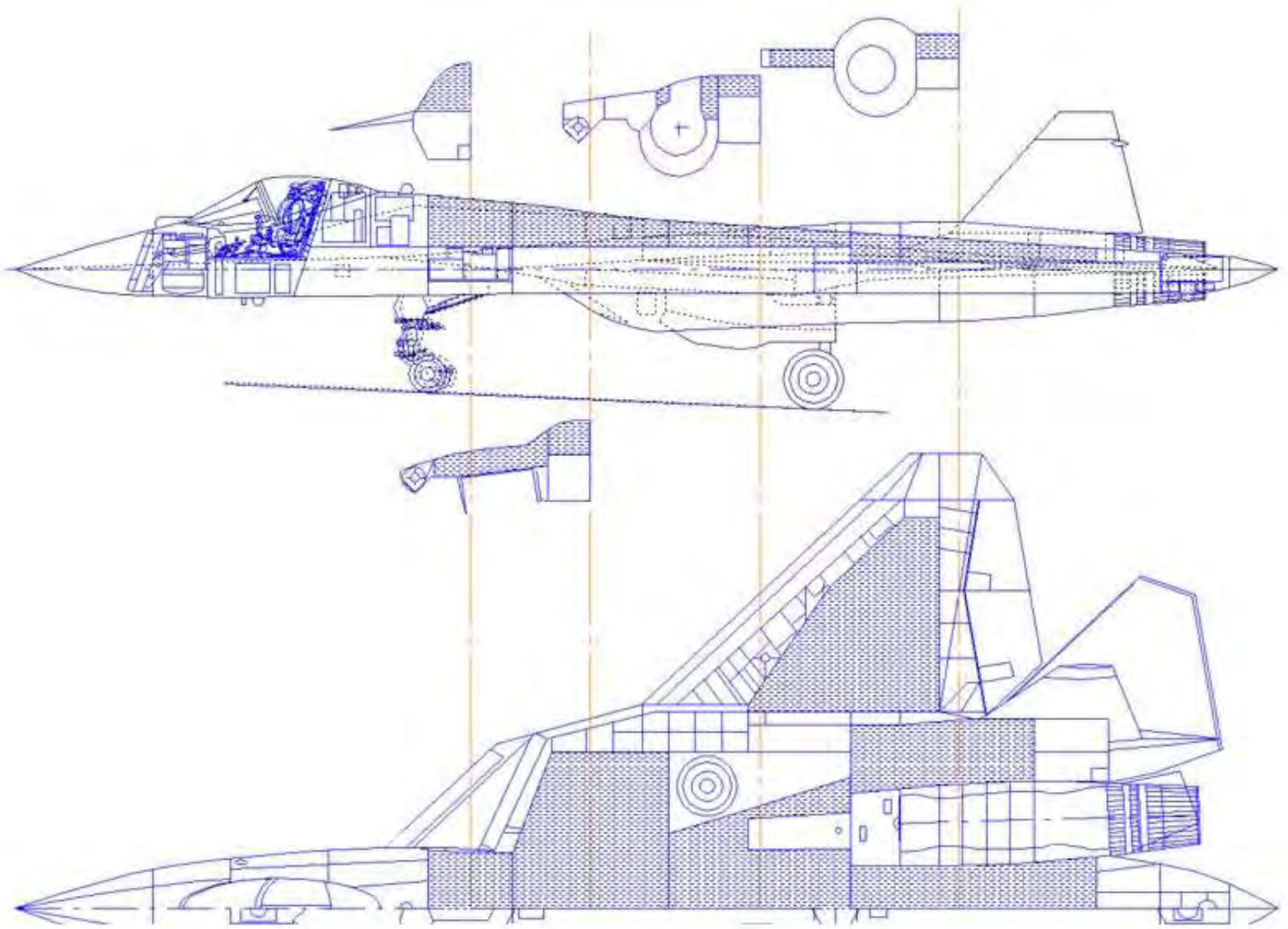






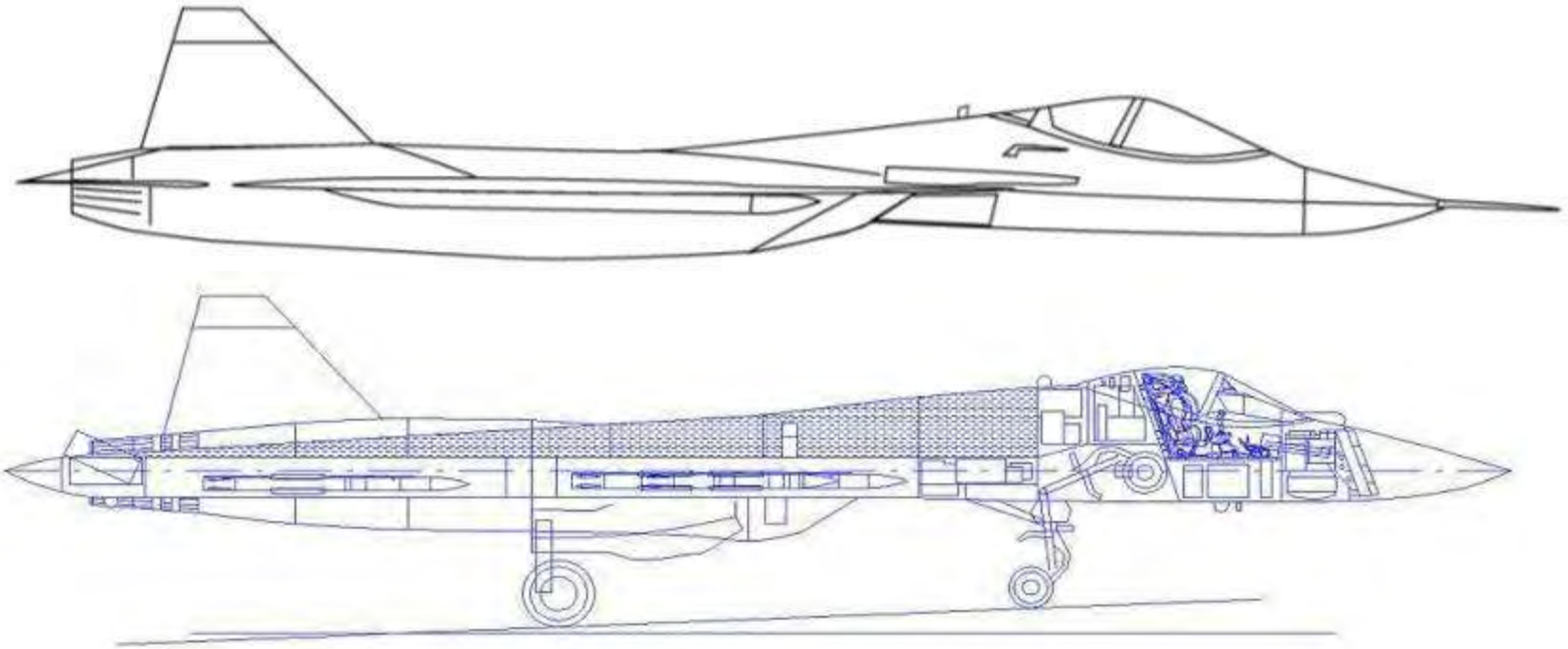
T-50-1 Inlet and Wing Layout

Possible Fuel Tank Configuration for the PAK-FA



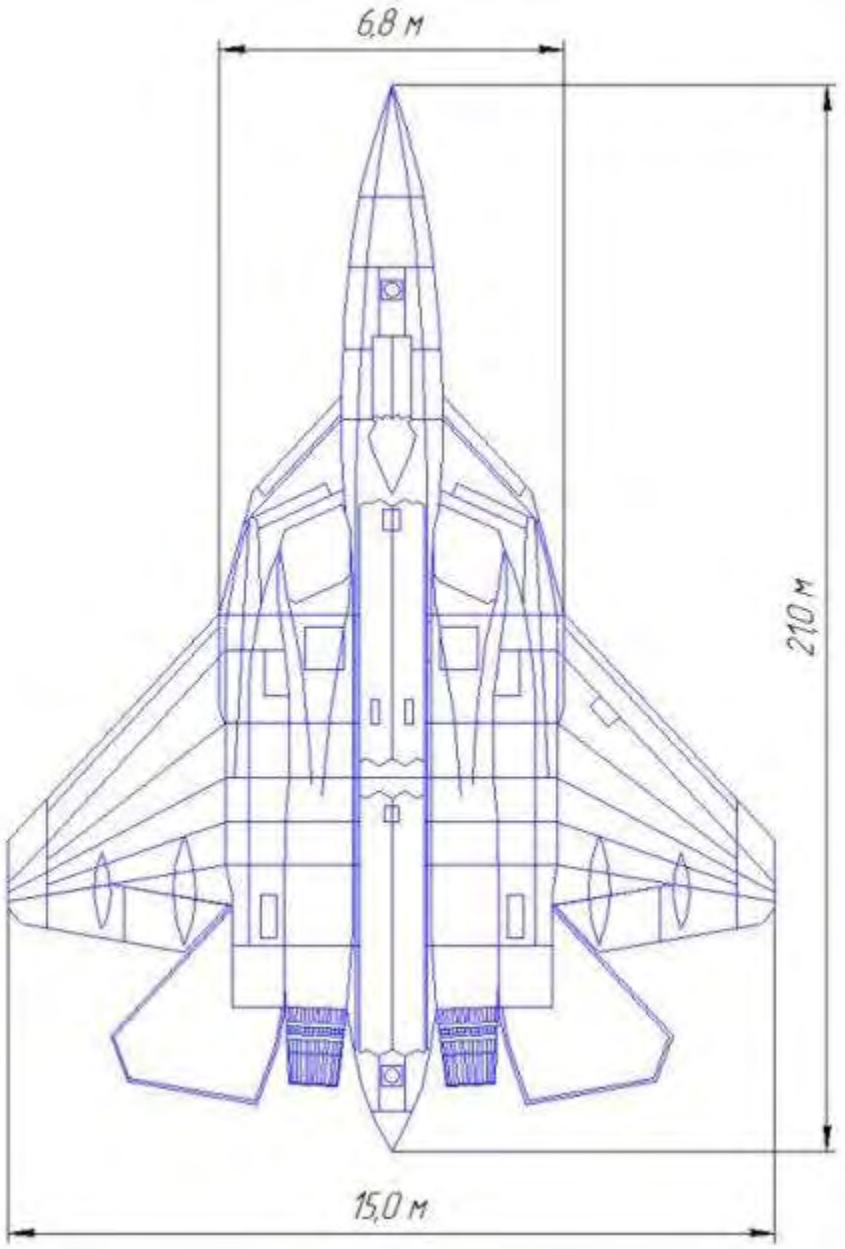
PAK-FA (T-50-1) Sideviews

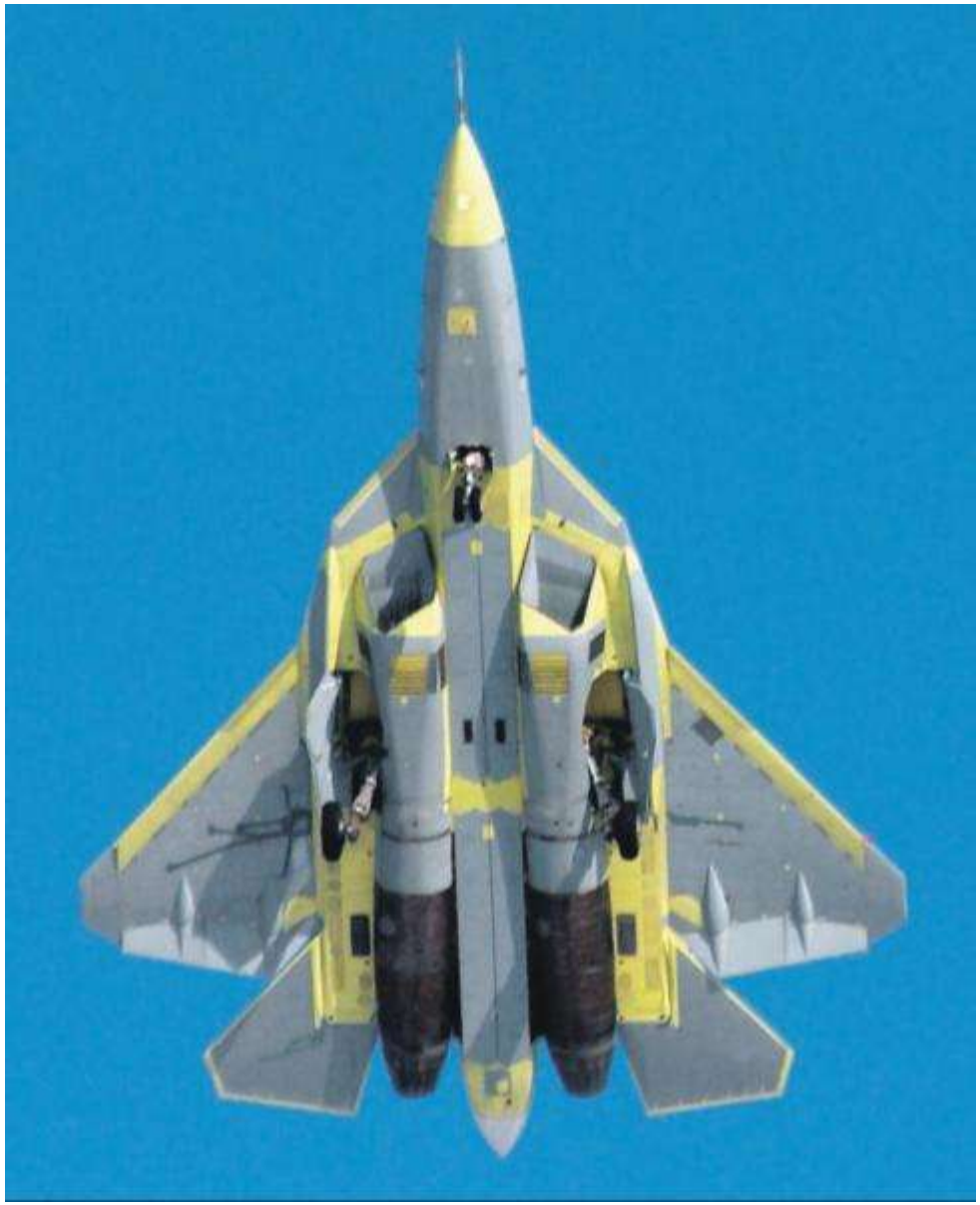
PAK-FA's (T-50-1) Sideview



Posited Russia's PAK-FA Evolution

PAK-FA (T-50-1) Bottom Section





PAK-FA (T-50-1) Tail Section

PAK-FA (T-50-1) and Su-30 Chase Plane

PAK-FA (T-50-1) Post-Flight

PAK-FA (T-50-1) Post-Flight

T-50-1 Painted with Bort Number 51 with a 2nd on 12 FEB 10 and 3rd Flight on 13 FEB 10 at KnAPPO

Pre-flight Speculation on PAKS-FA T-50

Recent Russian Edition of Popular Mechanics Images

Indian Newspaper 5th GEN Picture

Sukhoi Lapel Pin at MAKS

Saturn Engine Brochure

Paralay.com Rendering of Sukhoi's T-50-1 (PAK-FA)

Possible Model of Sukhoi's T-50-1 (PAK-FA)

Pre-flight PAK-FA Speculation and Actual First Flight Aircraft Comparisons

Features of the Sukhoi T-50/PAK-FA Seen on Russian Web Sites Since DEC 09

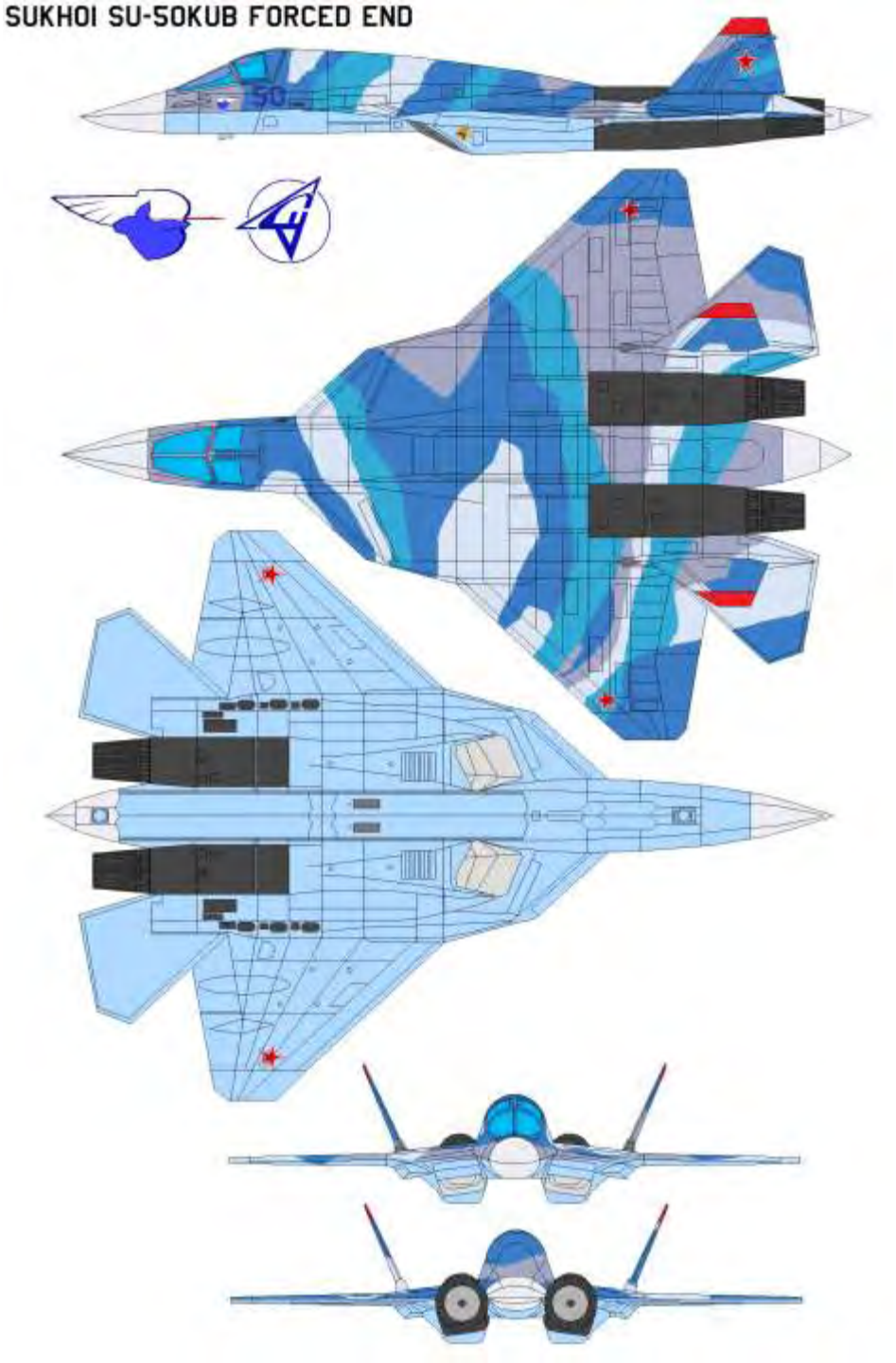
- Hope for 10-15% PAK-FA advantage over F-22 Raptor due to two decades of technology development
- F-22 Raptor detects Su-35 from the distance of 150-180 km but can open fire from 110 km, while becomes visible for Su-35's radar by itself and on R-77 range of attack
- OLS-35 probably detects F-22 Raptor on 100 km distance
  - OLS with 360 deg
- PAK-FA's AESA radar has probably 1,526 modules with overall power 18 KWt
  - Range for a big air target – 400 (TWS/A = 60/16)
- Active antennas in the wings and tail are probable
- Backward attacking missiles
- Has up to 12 air-to-air missiles (if compact) in internal placement
- Two internal bays for WLRAAMs and LRAAMs up to 700 kg each + 2 bays for short range missiles
- While F-22 Raptor can have up to 8 missiles in the internal bays
- WLRAAM 'Izdelie 810' is MiG-31 R-33 derivative with range of 400 km
- LRAAM 'Izdelie-180PD' is air-breath R-77 derivative with a range of 250 km
- 'Izdelie-180' – solid-fuel R-77 derivative with a range of 110-140 km with active/passive radar and homing on jammer
- Short range AAM – 'Izdelie-300' or K-MD IR matrix, double range of homing
- Kh-58UShKE internal weapon bay ARM and Kh-35 internal weapon bay ASM can be carried
- 500 kg guided and unguided bombs and/or sub-munition payloads
- Intra-fuselage catapults
  - UVKU-50L – up to 300 kg; UVKU-50U – up to 700 kg.
- Internal bays total carry weight is 2,000 kg
- With + external hardpoints carry weight is 6,000 kg
- GSh-30 30 mm autocannon.
- According to the plans – 430 planes must be built for Russian Air Force
- Will replace 339 Su-27 and 300 MiG-31 fighters

India/Russia Close to Pact on PAK-FA Fighter

- Late last year, a defense ministry delegation to Sukhoi's flagship aircraft facility in Siberia became the first Indians to set eyes upon the next-generation fighter that is slated to form the backbone of the future Indian Air Force (IAF)
- In that first meeting, carefully choreographed by Sukhoi, the new fighter, standing on the tarmac waved a welcome to the Indians, moving all its control fins simultaneously
  - The effect, recounts one member of that delegation, was electric
  - The senior IAF officer there walked silently up to the aircraft and touched it almost incredulously
- This was the Sukhoi T-50, the first technology demonstrator of what India terms the Fifth Generation Fighter Aircraft (FGFA)
- Senior defense ministry sources tell Business Standard that — after five years of haggling over the FGFA's form, capabilities and work-share — a detailed contract on joint development is just around the corner
- Contract, which Bangalore-based Hindustan Aeronautics Ltd (HAL) will sign with Russia's United Aircraft Corporation (UAC), will commit to building 250 fighter (50 single-seat and 200 twin-seat) for the IAF and an equal number for Russia
  - Option for further orders will be kept open; HAL and UAC will be equal partners in a joint venture company
- Cost of developing the FGFA, which would be shared between both countries, will be $8-10 billion (Rs 37,000-45,000 crore)
  - Over and above that, say IAF and defense ministry sources, each FGFA will cost 86 to 108 million (Rs 400-500 crore)
- Sukhoi's FGFA prototype, which is expected to make its first flight within weeks, is a true stealth aircraft, almost invisible to enemy radar
  - According to a defense ministry official, "It is an amazing looking aircraft. It has a Radar Cross Section (RCS) of just 0.5 square meters as compared to the Su-30MKI's RCS of about 20 square meters“
- Ajai Shukla/New Delhi – 05 JAN 10

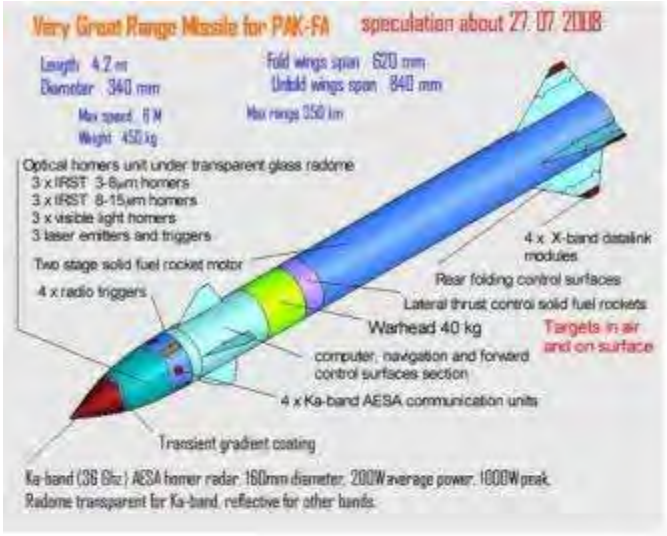
Naval PAK-FA (T-50/Su-50): Possible Carrier Configuration

NAVAL PAK-FA SU50
READY TO SERVE IAC2,3 OF INDIAN NAVY



T-50KUB Variant Similar to the Su-32/34

PAK-FA Internal Arrangement Speculation



PAK-FA speculation about 28.08.2009

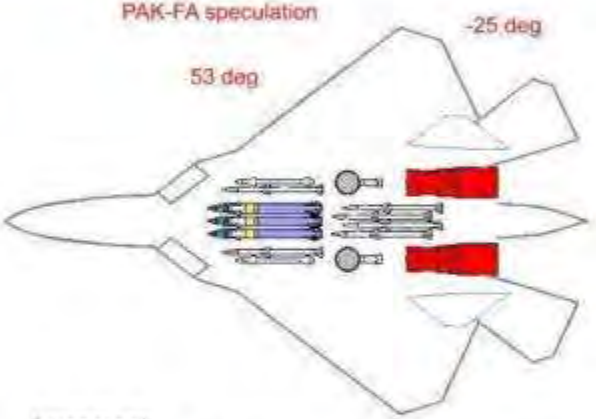
empty weight	17200 kg	length	21,4 m
internal fuel	10200 kg	wingspan	14,3 m
afterburner thrust	2 x 17000 kgf	max operative ceiling	21 km
max nonafterburner speed	M = 2	12 g structural limit	
max speed	M = 2,35		

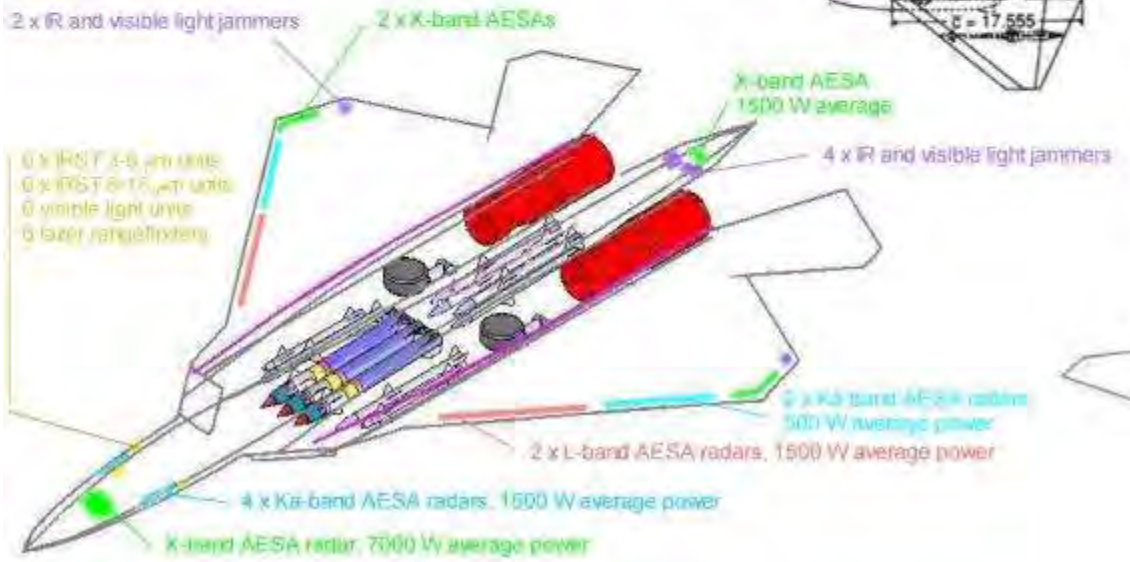
3D thrust vector control

Images approximately scaled!

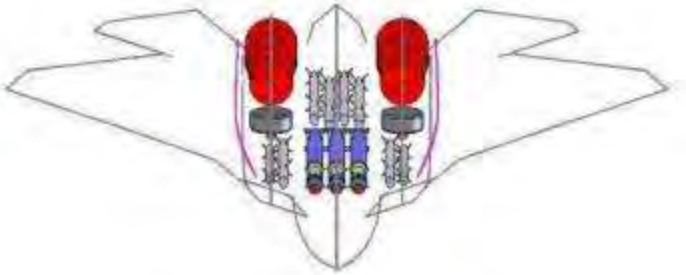
F-16 "Falcon 21" concept

PAK-FA speculation

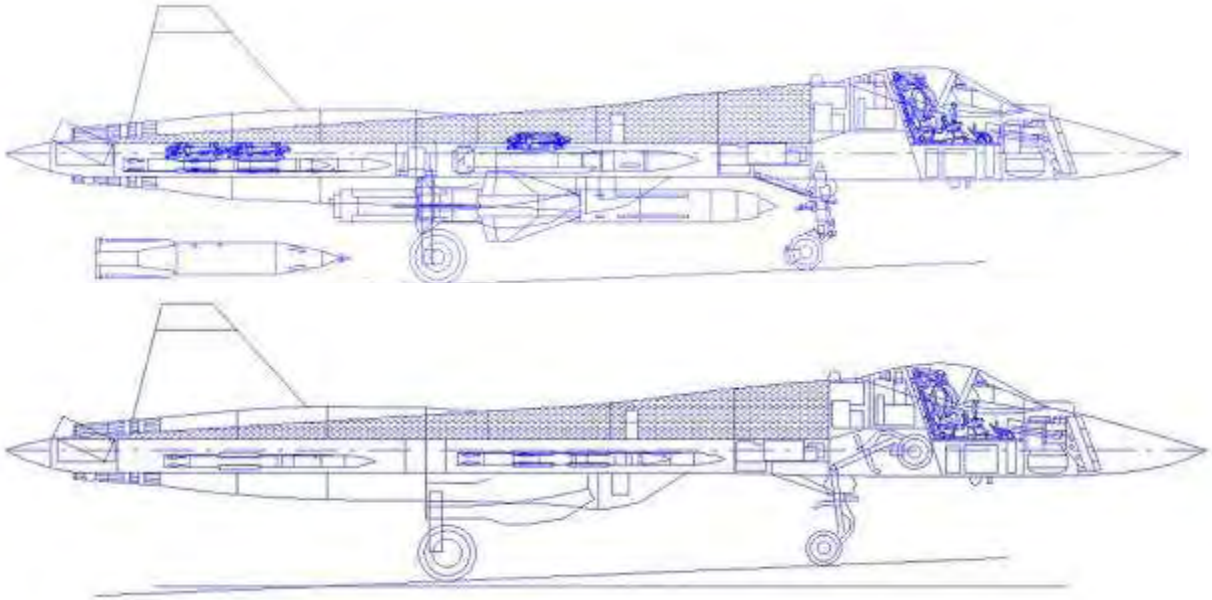


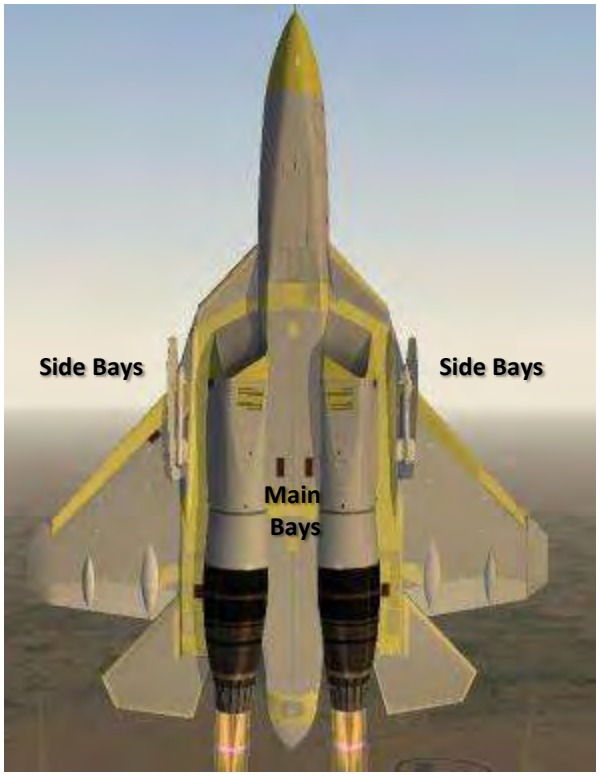


Armament:
- up to 6 Very Great Range missiles internally
- up to 10 Middle Range missiles internally
- up to 4 (12) Short Range missiles internally

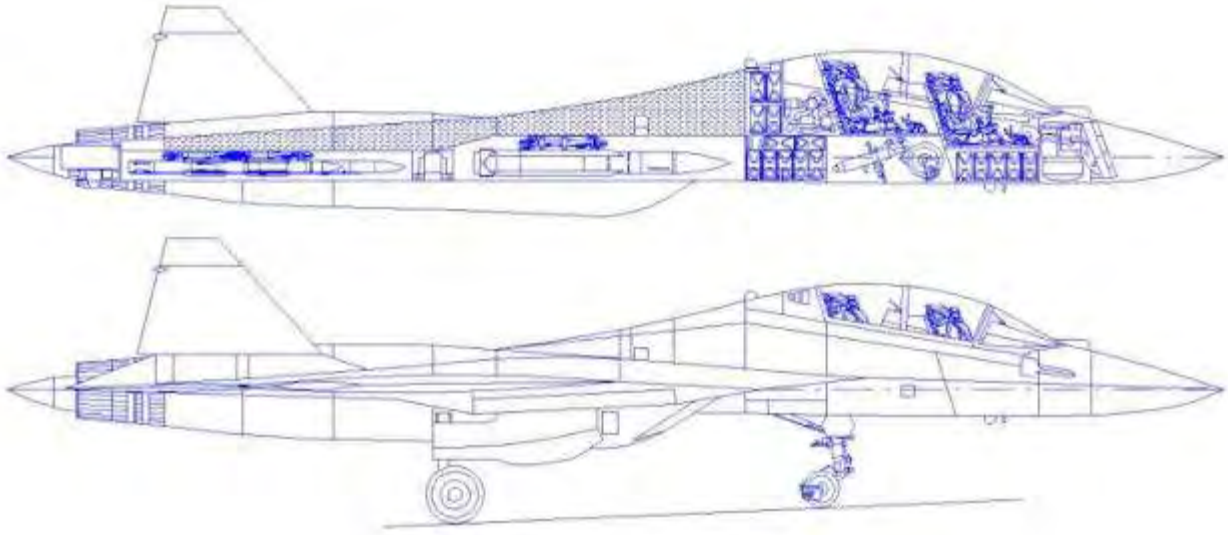


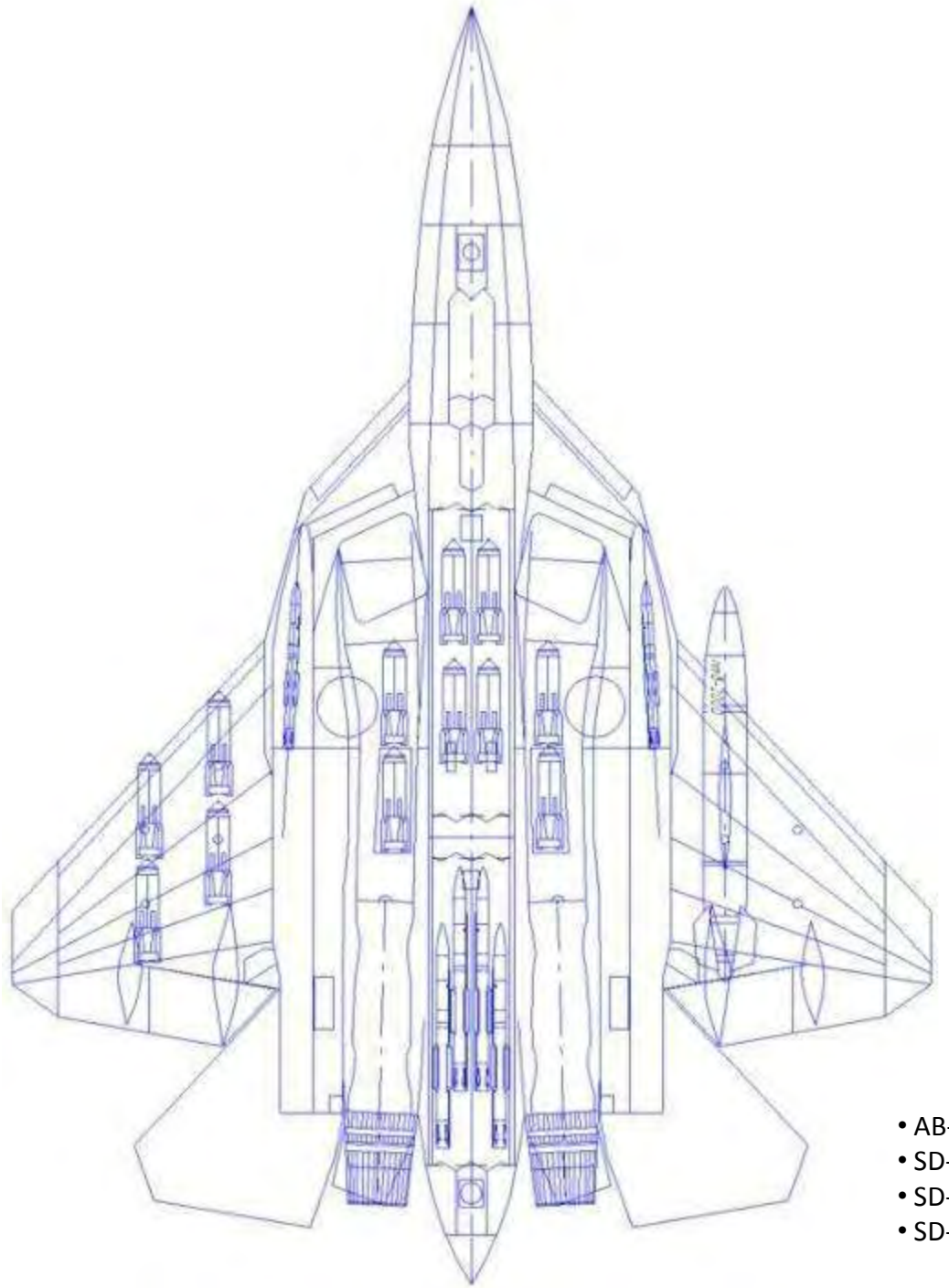
Notional PAK-FA Single-Seat Weapon Loadout





Notional PAK-FA Twin-Seat Weapon Loadout

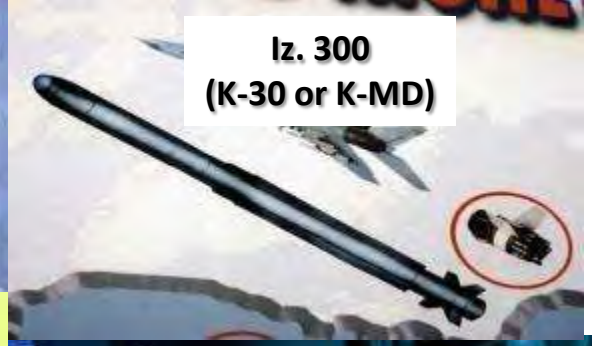


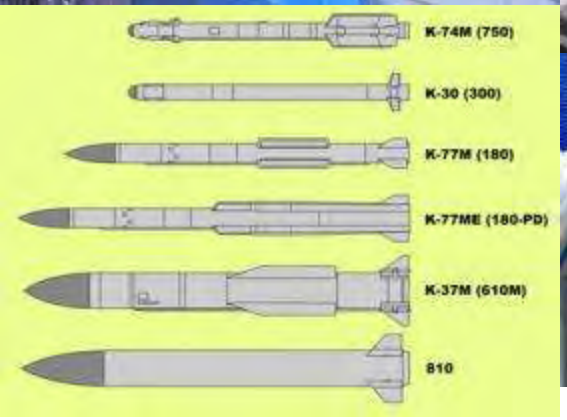


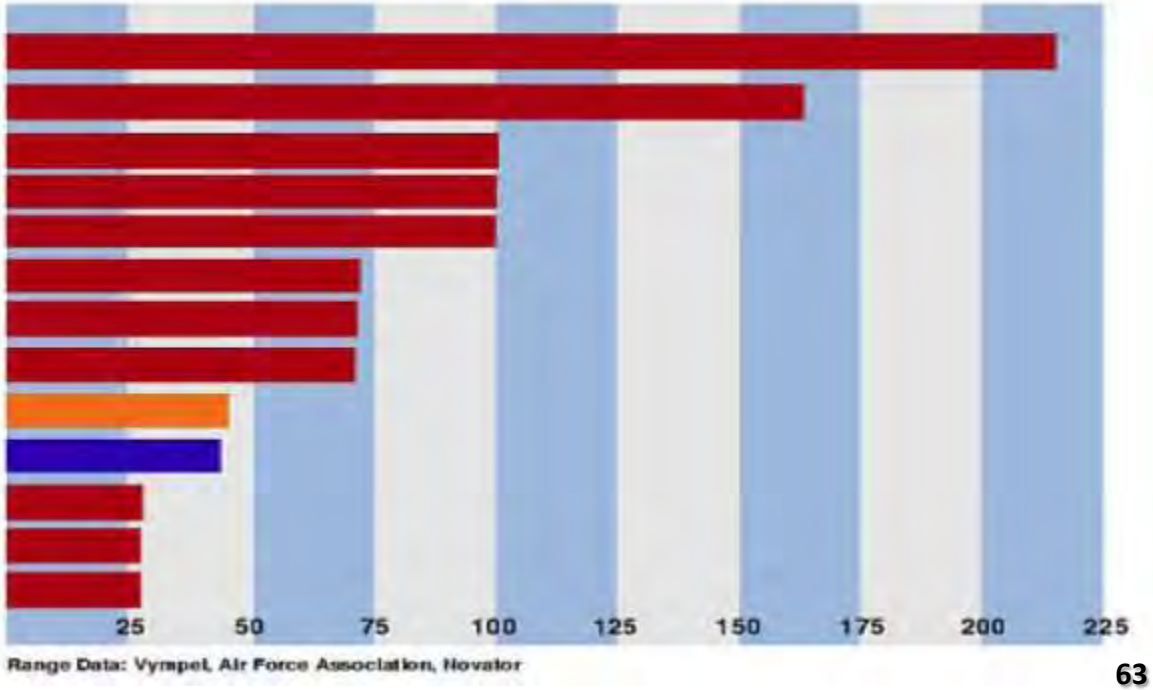
Notional PAK-FA External/Internal Carry Weapon Loadout

- AB-500-air bombs
- SD-DB-driven long-range missile
- SD-SD-guided medium-range missiles
- SD-MD-guided short-range missiles

Future Air-to-Air Missile Programs for PAK-FA







Internal Carriage Air-to-Ground Missile for PAK-FA

Kh-58UshKE (AS-11 Kilter) Long-range Anti-radiation Missile

Kh-31PD extended-range version Anti-Radar Missile

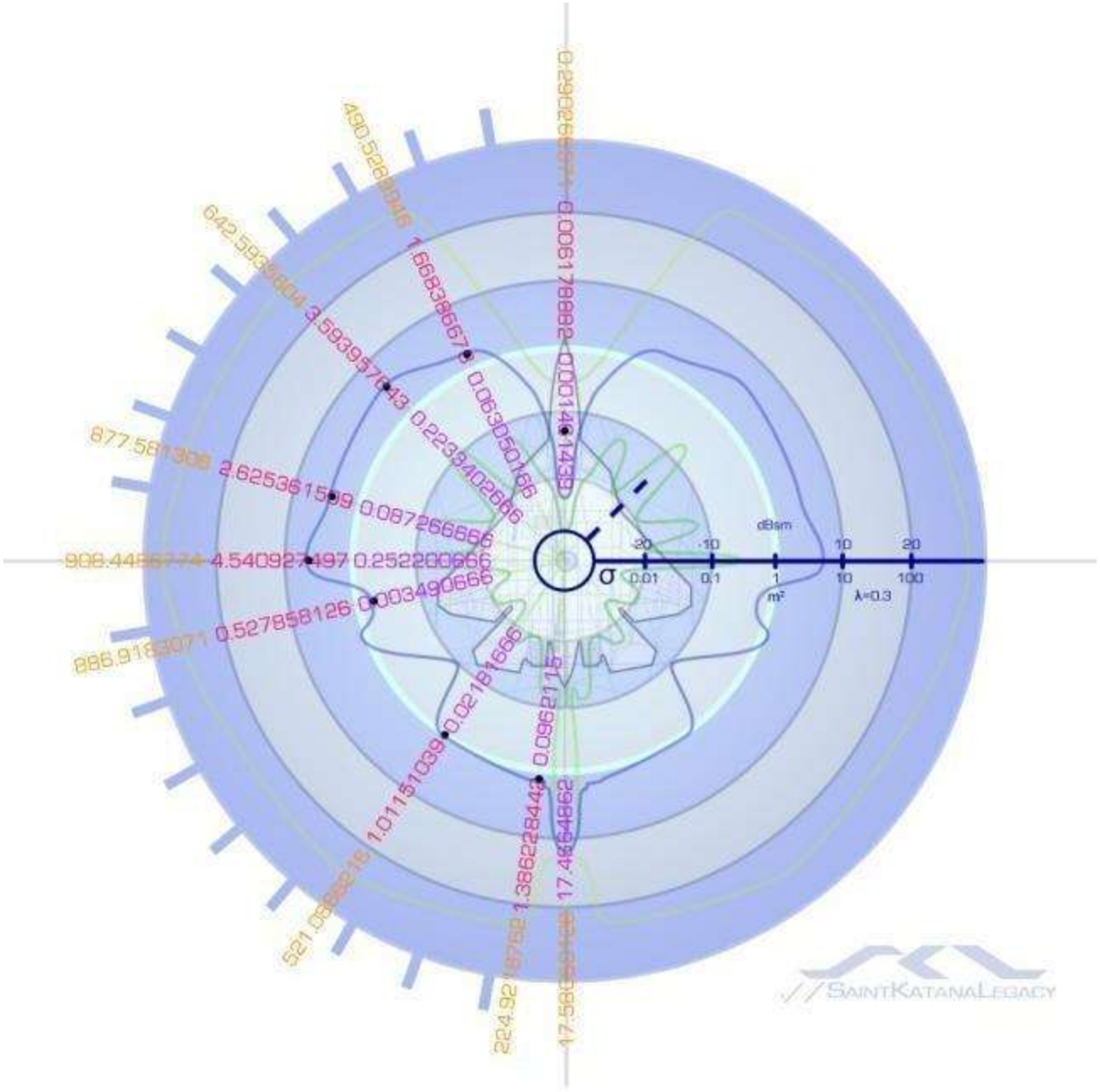
Kh-38ME Guided Air-to-Surface Missile Family

- Kh-39ML uses semi-active laser
- Kh-38MA uses active radar
- Kh-38MT uses IIR
- Kh-38MK uses GLOSNAAS/GPS

Kh-35UE Air-launched Anti-ship Cruise Missile

Improved range from 130 to 260 km and increases launch weight by 50 kg

Notional PAK-FA RCS from Web Sources



Открытое акционерное общество
НИИ "Феррит-Домен"

50

СВЕРХЛЕГКИЕ НАНОСТРУКТУРИРОВАННЫЕ РАДИОПОГЛОЩАЮЩИЕ МАТЕРИАЛЫ

В ОАО «НИИ «Феррит–Домен» с 2003 года проводятся разработки по созданию сверхлегких радиопоглощающих покрытий (РПП) нового поколения с использованием нанотехнологий.

Основой метода получения тонкопленочных РПП является вакуумное напыление ферромагнитных наночастиц и магнитодиэлектриков размерами от 2 до 80 нм на гибкие подложки больших размеров (600 х 750 мм) из термостойких тканей.

В диапазоне от 8 до 80 ГГц поглощение электромагнитного излучения составляет более 10 дБ для РПП толщиной до 1 мм.

Основными преимуществами тонкопленочных наноструктурированных материалов в сравнении с традиционными (резины и краски с ферромагнитными наполнителями) являются:

- высокие поглощающие свойства, более 10 дБ в широком диапазоне частот;
- малая приведенная удельная масса - от 1,0 до 1,5 кг/м^2;
- предельно высокая термостойкость;
- высокая прочность, устойчивость к климатическим воздействиям и агрессивным средам;
- использование одного вида покрытий (вместо 5-6) с высоким уровнем поглощения в широком диапазоне частот.

Разрабатываемые РПП предназначены для решения на новом уровне таких проблем как:

- снижение радиозаметности наземной, морской, авиационной и космической техники,
- электромагнитная совместимость антенн и фазированных антенных решеток и подавление их боковых лепестков излучения,
- обеспечение защиты многофункциональных радиотехнических комплексов и компьютерных систем от несанкционированного доступа,
- уменьшение уровня интенсивности облучения биологических объектов в широком диапазоне сверхвысоких частот.

Разработана технология создания РПП для диапазона частот от 1 до 300 ГГц.

Проводятся исследования по созданию окон прозрачности в заданных диапазонах частот и поляризаций, а также РПП для смежных диапазонов частот от 30 МГц до 1 ГГц с целью расширения спектра поглощения электромагнитных волн.

В настоящий момент Институт завершил подготовку линии опытного производства поглощающих материалов на тканевой основе в объеме до 5000 кв. метров в год.

Характеристики сверхлегких РПП толщиной 1 мм

Потребители приглашаются к апробации материалов для оптимизации поглощения в конкретных рабочих диапазонах частот.

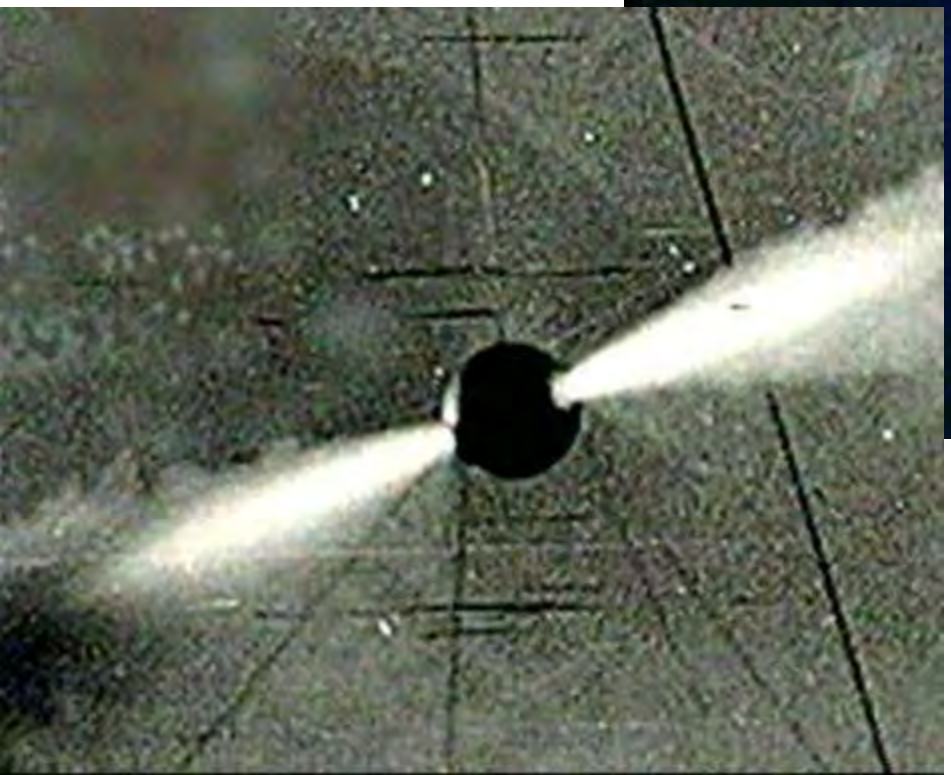
196084 С.-Петербург, Цветочная ул., д. 25, e-mail: info@domen.ru
www.ferrite-domen.com

New Russian Anti-Radar Material

- Russian researchers are developing more advance compounds and technologies for an anti-radar covering
  - Airframe and the ship frame stealth geometry gives only a partial answer to contemporary radar developments
  - Only the centimeter and millimeter long radar waves are effectively deflected by such method while the L-band radars progress remains a growing threat for military devices
  - Other complimentary methods are the use of composite and coverings
- Anti-radar materials are usually resins and paints with ferromagnetic materials
  - New nano-metric anti-radar covering is much lighter and more stable
  - It's made with magneto-dielectric layering 2-80nm thick on a high temperature-steady material
  - Radar-absorption is about 10 Db in 8-80 GHz diapason
  - lg (P1/P2) = 1, while P1 – is the incoming radar power and P2 – the reflected
  - By that formula with these materials the RCS can be reduced 10 times
  - Its relative mass is as 1 to 1.5 kg/m2
  - Material has a high resistance against climatic factors
  - They have a one-layer structure instead of usually 5 or 6
- This new technology can be used not only for RCS reduction, but for side-lobe radiation reduction for radars, raising their effectiveness
  - Military electronics can be defended from radio splashes and an unsanctioned communication access by this means
  - Personal isolation from the dangerous radar microwaves can be provided too by this method
- Potential of this technology allows creating ant-radar materials with working diapason of 1 – 300 GHz.
- Implementation of it on the 4^{th+} generation fighter fleets could prolong their service while 5th generation planes are yet to be produced or are too costly for some customers

Russian Plasma Stealth on Test Article at Eric-1 RCS Test Range

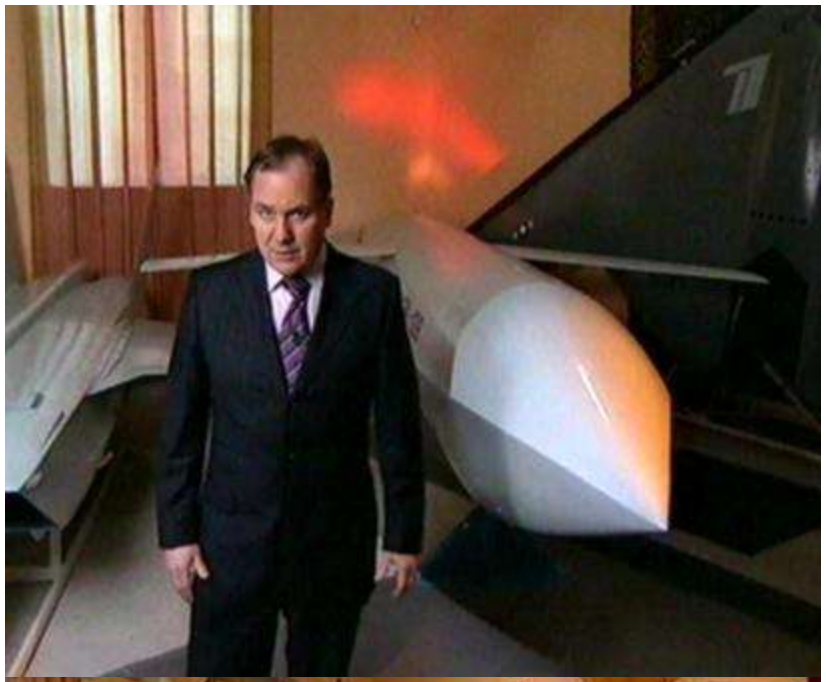
- Recently, Russian declassified images showing testing of test article
- Sphere carrying two rocket motors at Eric-1 RCS test range
- Test designed to give ability to understand how plasma looks on and to radars when activated



- Used on inlets, radomes and rear-engine areas(being investigated for Su-35's radar dome as a plasma screen like plasma TV)
- Requires a lot of space, heavy shielding of on-board systems, are heavy and consumes a large amount of power
  - New claim is that the plasma only operates for micro-seconds
- Produces visual glow, IR effects, material wear, and a detectable EM field
- Designed to break AIM-120 AMRAAM lock-on

2nd Central Scientific & Research Institute of the Ministry of Defense Russian Federation (2 TzNII MO RF) Measurement Facility

2nd Central Scientific & Research Institute of the Ministry of Defense Russian Federation (2 TzNII MO RF) Measurement Facility



Russian RCS Measurement and Reduction Programs

Blue sectors show platforms where 2 TzNII MO RF provided RCS expertise too but not attempting to lower their RCS while the White sectors are vehicles they did lower the platforms RCS.

Russian Measurements of RCS for F-22

НАПРАВЛЕНИЕ СНИЖЕНИЯ РАДИОЛОКАЦИОННОЙ ЗАМЕТНОСТИ ЛЕТАТЕЛЬНЫХ АППАРАТОВ

Возможное снижение ЭПР летательных аппаратов (разы)

	ПЛАНЕР						АНТЕННЫ				ВОЗДУХОЗАБОРНИКИ		
см	10	20	50	40	—	100	100	100	50	50	100	50	50
дм	10	10	30	20	—	100	100	—	100	100	50	50	30
м	5	—	10	10	20	—	—	—	—	—	—	—	5
	1	2	3	4	5	6	7	8	9	10	11	12	13

Implications of the Debut of PAK-FA

- Clearly the PAK-FA aircraft has been designed with a clear understanding of the effects of low-observability on air combat when both sides have such aircraft
- PAK-FA houses a large internal weapon bay:
  - Larger internal carriage of LRAAMs and MRAAMs
  - Up to eight R-77s and two R-74 AAMs
  - Air-to-surface missile carriage for the ARMs, ASMs and ASMs
- Obviously, the combatants will be closer when their radar sensors detect the other side, so close in fact that the Infra-Red Scan and Track (IRST) might be the first sensor to detect the presence of an enemy aircraft
  - PAK-FA has IRST capability while the F-22A does not
- Extreme agility of the PAK-FA could in a 'knife fight' potentially out-maneuver the F-22A in such an engagement
  - Sukhoi has extensive experience in designing aircraft that operate at high angles of attack (AoA) as demonstrated by various members of the Su-27/-35 family

Interesting Questions about PAK-FA?

- Can Russia produce in numbers such an expensive aircraft?
  - Do the Russians have an understanding of producing, manufacturing and maintaining an low-observable aircraft?
  - Can Russia's emerging composites industry keep up with production?
  - Will the PAK-FA engine be ready on time? Can the Russians produce it in quality and with the required reliability?
  - Will the program's avionics and datalinks (noted by various websources to be a laser communications/datalink system) be ready by 2015?
  - How different will the production aircraft be from the development one?
  - What differences can be expected in the twin-seater as well as the carrier variants? What other variants could be expected?
    - Will PAK-FA lead to a UCAV variant?
- Will Russian funding endure long enough to get the aircraft from development to production?
  - What impact, if any will India have on the development and production timeline?
  - What happens if Indian funding is withdrawn?
- What "lessons learned" from PAK-FA will be applied to PAK-DA?
  - Will PAK-DA (strategic bomber replace for the Tu-160) be ready as stated by 2020 to 2030? Will delays in PAK-FA, delay PAK-DA?

Questions?