Chinese stealth and other fighters

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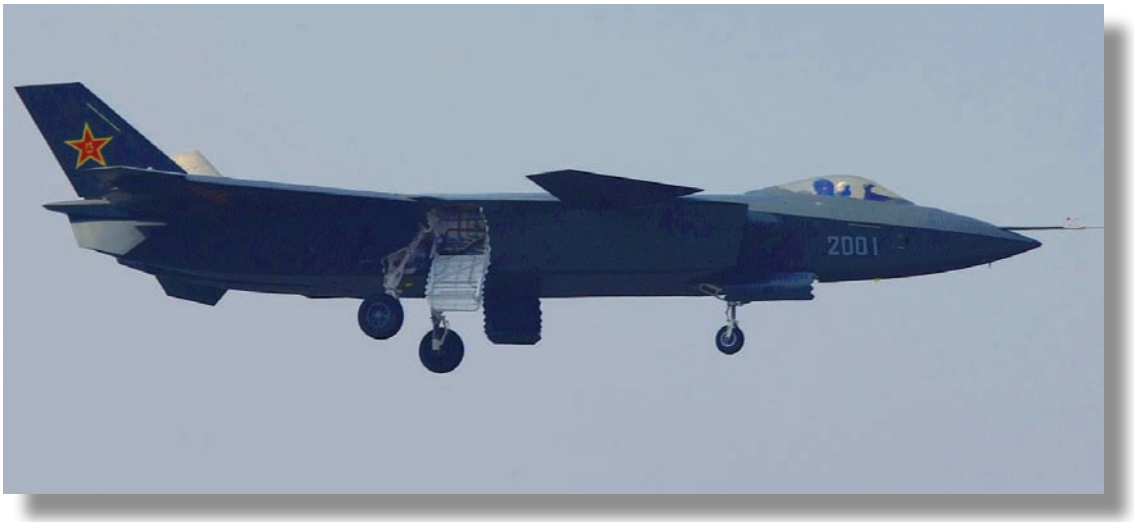


First flight of the J-20 prototype in January, 2011.

THE public unveiling in late December 2010 of China's new Chengdu J-20 stealth fighter was an important milestone in China's Long March toward parity in military technology with Russia and the West.

While the J-20 was a shock for many Western observers, analysts immersed in the study of Chinese activity in aircraft development were much less surprised. While the J-20 is an indigenous design and entirely new, it is also another incremental step forward in a much larger and broader national campaign by the Chinese to catch up with its Western and Russian rivals.

China's military aviation industry has been the beneficiary of generous funding, on the scale of that seen in the West at the peak of the Cold War when maintaining parity or gaining an advantage over the Soviets and their Warsaw Pact allies was seen as vital to collective survival. Moreover, China has maintained over the last decade a very effective policy for research funding in the defence industry and related academic research institutes, or 'Military Academies'. The result observed includes intensive prototyping, technology demonstration and development activities, with an intensity not seen in the West since the golden era of aerospace during the 1960s. Exploring the diversity of new products, prototypes or product proposals displayed at Zhuhai airshows and CIDEX military electronics exhibitions over recent years shows activity levels unseen in the West for many decades. While many of the products are copies, clones or analogues of existing Russian and Western products, many are uniquely Chinese, and displaying the kind of original engineering creativity seen in the best Western and Russian products.

China is now producing annually at least 300,000 engineering and science university graduates. Even if their university education is not as good as that in the West, the sheer numbers mean that some very good talent will emerge to populate the design offices of manufacturers or research labs of the Military Academies. In contrast, the West has had a steady exodus of talent from increasingly moribund and stagnant defence contractors, and increasing losses in technical expertise in procurement bureaucracies. The result is the sad reality that very few major projects in Western nations now meet operational needs, let alone specifications, timelines or intended budgets.

The long term outlook, if current Western policy remains unchanged, is that as the West continues to stagnate China's industry will transition from reverse engineering and copying, increasingly to creative indigenous designs, which will be used to arm the PLA, and China's export clientele.

A delusion still commonly believed by many Western analysts is that the PLA-AF largely comprises thousands of J-6 Farmer and Q-5 Fantan fighters. The last J-6 retired some years ago, and the Q-5 is being rapidly replaced by the JH-7 Flounder.

J-20 Stealth Fighter

That the J-20 is China's first stealthy design to be seen publicly. It owes much to the aerodynamic design of the earlier J-10 Sinocanard.

The most notable feature of the J-20 is its stealth shaping, mostly 'borrowed' from the F-22A Raptor, but for the Diverterless Supersonic Inlet (DSI) design, common to the F-35 Joint Strike Fighter.

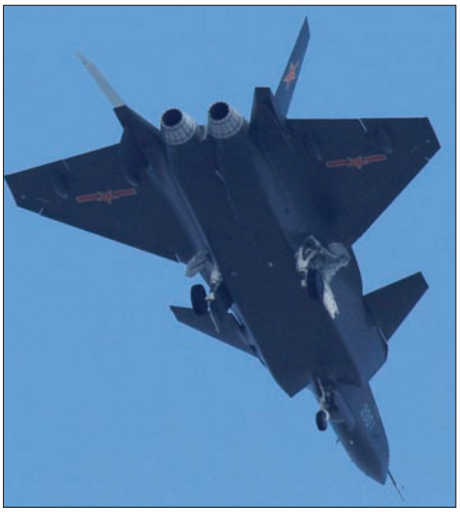
The J-20 is a large aircraft, similar in size to the F-111, and built for similar subsonic combat radius, and large supersonic cruise persistence. The aircraft's delta-canard configuration will provide both good supersonic cruise performance, and if sufficient engine thrust is installed, excellent supersonic, transonic and subsonic agility. There can be no doubt that the J-20 is intended to compete against the F-22A Raptor, although it is closer to the proposed FB-22 in size and range/persistence.

The detailed stealth shaping on the J-20 is based on the design rules for the F-22, which remains the stealthiest fighter design to be fully developed to date. The nose and forward fuselage chining is almost identical to the F-22, with chine angles difficult to differentiate. The engine inlet design is edge aligned trapezoidal, and similar to that in the F-22, other than the F-35 style DSI and upper/lower edges.

The delta wing and canards are edge aligned, as are the fully movable canted tails. The trailing edges of the delta wing and opposing canards exactly align.

The bottom of the fuselage, important for all-aspect wideband stealth, is flat and modelled on the F-22 as are the flat facet fuselage sides and fuselage wing join. The blended convex upper fuselage carapace has a similar curvature to the F-22.

The aft fuselage like that of the Russian PAK-FA departs from the disciplined stealth shaping of the rest of the airframe, which begs the question of whether it is the intended production arrangement or an expedient stop gap to expedite flight testing with off-the-shelf AL-41F or WS-10 engines. This may be while the intended production engine claimed to be the WS-15 is in development, possibly with F-22 style nozzles.



The two prototypes photographed have circular axisymmetric nozzles, which are very poor in terms of stealth performance, a vice shared with the F-35 and the PAK-FA. These will spoil aft hemisphere RCS severely. The two ventral strakes on the aft fuselage are also unhelpful to aft sector stealth, and produce large broadside reflections from the sides, which spoil much of the excellent shaping effect of the lower fuselage design.

What is unknown at this time is the state of Chinese stealth materials technology, and the extent to which China may have gained access to classified US technology through cyber penetrations of US contractor computer networks. The mostly very sound stealth shaping of the J-20 would permit competitive stealth performance against the F-22 if the right materials technology was used, and used correctly, in a mature production aircraft.

The aerodynamic design of the J-20 is a good compromise in the sense that with advanced digital flight controls and a suitable engine the aircraft should be able to achieve better aerodynamic performance and agility than the current benchmark, the F-22 Raptor.

The Chinese have claimed an Initial Operational Capability for the J-20, in 2017-2018. Given the rate at which China has produced prototypes and new designs in recent years, this should not be arbitrarily dismissed, as many United States observers have done. Importantly, even an immature J-20 fitted with lower thrust engines such as the AL-41F or WS-10 would still make a very effective strike aircraft or air defence interceptor, even if it lacked as a result the agility to compete in fighter-fighter combat against the F-22.

Once a mature J-20 enters production it will have an enormous strategic impact across the Pacific rim. Its supersonic cruise capability will place it kinematically out of the reach of most Surface to Air Missile systems in the region, as well as all fighters other than the F-22. The notion that the F-35 JSF or F/A-18E/F can compete with the J-20 is clearly off the mark, as both lack the performance to evade let alone credibly intercept an F-22-class supercruiser.

Even if the Chinese cannot match the high stealth performance of the F-22, the J-20 will still be highly effective against the small aperture AESA radars in the F-35 JSF or F/A-18E/F, both of which were designed for conventional unstealthy fighter targets.

Chengdu J-20 stealth fighter.

Shenyang J-11B "Sino-Flanker"

Shenyang J-11B Flanker B

The Shenyang J-11B Flanker B has been repeatedly described in the Russian media as an "exact copy" of the Su-27SK Flanker B licensed to China during the 1990s. This claim by a multiplicity of Russian sources is not entirely true. The airframe of the J-11B is indeed an almost exact copy of the Su-27SK, as its WS-10 engine is an almost exact copy of the Russian Lyulka AI-31F. The avionic suite and many of the systems in the J-11B are indigenous Chinese designs, making the aircraft superior in many respects to the Su-27SK and much closer to the uprated Russian built Su-27SMK variant.

The origins of the J-11B lie in disagreements between the Chinese and Russians over the terms of the contract negotiated during the mid 1990s, for Shenyang to licence-build 200 Su-27SK or J-11A Flankers. The initial deal was for all aircraft to be built to the late-1980s Su-27SK configuration, with a progressively transition from Russian supplied kits to Chinese built parts. The Chinese liked the Flanker but were unhappy with the 1980s technology avionics and systems. After fruitless attempts to renegotiate the contract, the Chinese prototyped the J-11B and bailed out of the licence deal at 100 aircraft. They transitioned production to the J-11B instead, with cloned WS-10 engines – prototypes and early production J-11Bs being powered by imported AI-31F engines. The Russians have since then been reluctant to supply small quantities of any military equipment without binding commitments for volume buys, for fear of reverse engineering.

While the J-11B is aerodynamically an Su-27SK, its Chinese digital avionic suite includes a glass cockpit and a Chinese IRST set located in the centreline position, as with the OLS-27 in early Su-27S; a planar array multimode radar that resembles the Phazotron Zhuk-27 series, with an embedded L-band IFF interrogator array; and an optical Missile Approach Warning System (MAWS). The systems include a Chinese OBOGS, a feature seen only in the latest Russian Flanker subtypes. Weapons carried on the J-11B include the PL-12/SD-10 'Sino-AMRAAM' and the indigenous PL-8, based on the early Israeli Rafael Python 3 series.

The J-11B will be substantially more combat effective than first generation Russian built Su-27SK variants, and should not be equated with the latter due to better avionics and defensive systems.

Shenyang J-15 Flanker D

The J-15 is a Chinese derivative of the Russian Su-27K/Su-33 Flanker D, the shipborne variant of the Flanker designed for ski-jump launches and arrested tailhook recoveries. A number of sources claim that China procured one or more derelict T-10K/Su-27K prototypes from a former Soviet naval air arm base in the Ukraine, around 2001. The aircraft first flew in 2009.

There have been few official disclosures on the J-15, and only a handful of images. The only images of good quality support the claims that the airframe is based upon the Su-27K. Chinese sources claim the use of reverse engineered WS-10 engines and Chinese J-11B avionics.

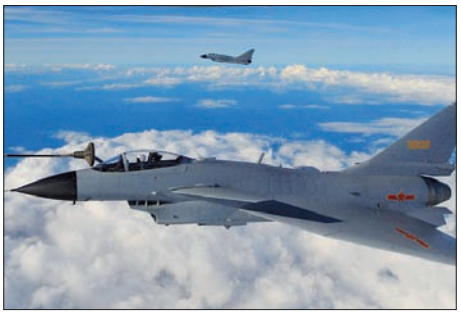
The emergence of the J-15 comes after several years of stalled negotiations between Russia and China, for the purchase of a wing of 48 Russian built Su-33 Flanker D fighters to equip a PLAN aircraft carrier, expected to be the former Soviet Varyag bought in the Ukraine. The carrier is currently in a Dalian shipyard being rebuilt after years of decay in a Ukrainian shipyard, and unrestrained pillaging of internal hardware for scrap metal yards. There has been ongoing speculation recently about China constructing three aircraft carriers, but little in the way of substantive evidence.

The Chinese are claimed to have sought a pair of Su-33 before committing to the full order, which the Russians refused following the J-11B debacle.

From an engineering perspective, the Chinese should be in the position to put the J-15 into production as early as two years hence, as the structural design is based on the proven Russian Su-27K, and the J-11B avionics and systems are well established in production. Therefore, much of the effort on the J-15 will involve flight testing, validation of the flight control system software, and testing of any avionics unique to shipboard operation. A land based dummy carrier flight deck, including a ski-jump, has been constructed at a new PLANAF airfield south of Huludao on the eastern coast of China.

Timelines for operational deployment on a carrier are less clear, since the status of the Varyag rebuild remains unknown, as is the status of claimed new hulls under construction.

J-15 Flanker D naval fighter prototype.



Chengdu J-10 Sinocanard

The J-10 is frequently labelled in the West, especially the United States, as a "cloned Lavi", yet careful examination shows that it is a completely indigenous Chinese design which owes more to the evolved Chengdu J-7E/G Fishbed than it does to the cancelled United States funded Israeli delta canard fighter.

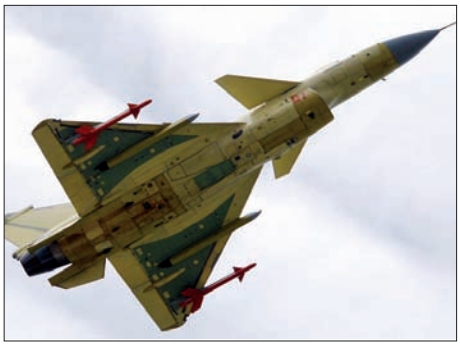
In the pantheon of contemporary fighters the J-10 occupies a similar niche to the agile European lightweights, the Dassault Rafale, Eurofighter Typhoon, and SAAB Gripen. It is however a unique design with a delta planform derived from evolved J-7 variants, an imported Russian AI-31F engine from early model Flankers and unique chin inlets and fuselage design.

The J-10 was China's first modern fighter, and first indigenous fighter not be be almost completely based on imported technology. With an unstable airframe and quadruplex digital flight-by-wire the basic flight system is of the same generation of basic technology as its EU built peers.

The first version to be built in numbers was the J-10A, soon followed by the dual J-10S. More recently imagery has emerged of the improved J-10B prototypes. The most prominent change is a much larger, higher massflow engine inlet which appears to be a fusion of the 1960s LTV XF-8U3 Crusader III and the F-16DSI demonstrator, used to prove the inlet design for the F-35 JSF.

The J-10 has yet to be exported, due to its dependency on imported AI-31F engines. This will change as the WS-10, a reverse engineered AI-31F, matures. The J-10B will provide respectable performance against its EU peers and the F-16, while soundly outperforming the F/A-18 series. All J-10 variants use an indigenous glass cockpit design, and the J-10B is evidently intended to carry an AESA of respectable size, as well as a nose mounted Infrared Search/Track turret modelled on the Russian OLS-30 series.

The J-10A/S currently equips several PLAAF regiments. Public statements indicate the intent to field around 1,000 J-10s as replacements for the obsolescent day VFR J-6 Farmer and J-7 Fishbed. The J-10 is small enough to fit into all of the PLAAF and PLANAF's 17 'J-6 sized' underground tunnel hangars, unlike imported Russian Flankers.



Clockwise from top left:
Chengdu J-10A, J-10S, J-10B.

Xian JH-7 Flounder

The JH-7 Flounder or FBC-1 'Flying Leopard' is a wholly indigenous Chinese strike fighter visually resembling an enlarged SEPECAT Jaguar, but much closer to the Panavia Tornado IDS in size, weight and intended role. The aircraft is powered by a reverse engineered Rolls Royce Spey engine, designated the WS-9.

The Flounder was initially developed as a maritime strike fighter, built to attack shipping with a payload of up to four subsonic Anti-Ship Cruise Missiles, typically variants of the C-802 series which are Chinese equivalents to the Exocet and Harpoon. The aircraft was initially deployed with PLANAF strike regiments, replacing the Harbin H-5 Beagle, a Canberra / B-66 analogue, and the NAMC Q-5 Fantan, an enlarged strike derivative of the J-6 itself a reverse engineered MiG-19 Farmer.

More recently the JH-7 has been adopted by PLAAF regiments, and the weapons mix has evolved, now including Chinese built laser guided bombs and satellite/inertial guided bombs, as well as the reverse engineered Kh-31P heavy anti-radiation missile, often designated the YJ-91.

The current production JH-7A variant is equipped with a glass cockpit, one piece windshield, digital avionics, and a LETRI JL-10A planar array radar, which appears to be derivative of the Russian Phazotron Zhuk M, licenced to China for use on the J-8 Finback.

While the Flounder is regarded poorly in the West, and inferior to the imported Su-30MKK/MK2 Flanker G, it can be manufactured in China with no dependencies upon imported components. It is an enormous improvement upon the obsolescent H-5 Beagles and Q-5 Fantans it is replacing.

Xian JH-7 Flounder.