

= CAC / PAC JF @-@ 17 Thunder =

The PAC JF @-@ 17 Thunder (Urdu : ?? ??? @-@ ?? ???) , or CAC FC @-@ 1 Xiaolong (Fierce Dragon ; Chinese : ?? ; pinyin : Xi?o Lóng) , is a lightweight , single @-@ engine , multi @-@ role combat aircraft developed jointly by the Pakistan Aeronautical Complex (PAC) and the Chengdu Aircraft Corporation (CAC) of China . The JF @-@ 17 can be used for aerial reconnaissance , ground attack and aircraft interception . Its designation " JF @-@ 17 " by Pakistan is short for " Joint Fighter @-@ 17 " , while the designation and name " FC @-@ 1 Xiaolong " by China means " Fighter China @-@ 1 Fierce Dragon " .

The JF @-@ 17 can deploy diverse ordnance , including air @-@ to @-@ air and air @-@ to @-@ surface missiles , and a 23 mm GSh @-@ 23 @-@ 2 twin @-@ barrel autocannon . Powered by a Guizhou WS @-@ 13 or Klimov RD @-@ 93 afterburning turbofan it has a top speed of Mach 1 @. @ 6 . The JF @-@ 17 is to become the backbone of the Pakistan Air Force (PAF) , complementing the General Dynamics F @-@ 16 Fighting Falcon whose performance it roughly matches , at half the cost . The PAF inducted its first JF @-@ 17 squadron in February 2010 and as of December 2015 , 49 JF @-@ 17 Thunder Aircraft were in service with 50 additional airframes ordered , of which 17 have been delivered . The Pakistan Air Force plans to induct a twin @-@ seater version for training and enhanced operational capability , known as the JF @-@ 17B by 2017 .

= = Development = =

= = = Background = = =

The JF @-@ 17 was primarily developed to meet the PAF 's requirement for an affordable , modern , multi @-@ role combat aircraft as a replacement for its large fleet of Dassault Mirage III / 5 fighters , Nanchang A @-@ 5 bombers , and Chengdu F @-@ 7 interceptors , with a cost of US \$ 500 million , divided equally between China and Pakistan . The aircraft was also intended to have export potential as a cost @-@ effective and competitive alternative to more expensive Western fighters . The development of this aircraft was headed by Yang Wei (aircraft designer) , who is considered China 's " ace designer " . Wei also designed the Chengdu J @-@ 20 .

By 1989 , because of economic sanctions by the US , Pakistan had abandoned Project Sabre II , a design study involving US aircraft manufacturer Grumman and China , and had decided to redesign and upgrade the Chengdu F @-@ 7 . In the same year , China and Grumman started a new design study to develop the Super 7 , another redesigned Chengdu F @-@ 7 . Grumman left the project when sanctions were placed on China following the political fallout from the 1989 Tiananmen Square protests . After Grumman left the Chengdu Super 7 project , the Fighter China project was launched in 1991 . In 1995 , Pakistan and China signed a memorandum of understanding (MoU) for joint design and development of a new fighter , and over the next few years worked out the project details . In June 1995 , Mikoyan had joined the project to provide " design support " , this also involved the secondment of several engineers by CAC .

= = = Launch of FC @-@ 1 project = = =

In October 1995 , Pakistan was reportedly to select a Western company by the end of the year to provide and integrate the FC @-@ 1 's avionics , which was expected to go into production by 1999 . The avionics were said to include radar , Inertial navigation system , Head @-@ up display , and Multi @-@ function displays . Competing bids came from Thomson @-@ CSF with a variant of the Radar Doppler Multitarget (RDY) , SAGEM with a similar avionics package to those used in the ROSE upgrade project , and Marconi Electronic Systems with its Blue Hawk radar . FIAR 's (now SELEX Galileo) Grifo S7 radar was expected to be selected due to the company 's ties with the PAF . In February 1998 , Pakistan and China signed a letter of intent covering airframe development

. Russia 's Klimov offered a variant of the RD @-@ 33 turbofan engine to power the fighter . In April 1999 , South Africa 's Denel offered to arm the Super 7 with the T @-@ darter beyond @-@ visual @-@ range (BVR) air @-@ to @-@ air missile (AAM) , rather than the previously reported R @-@ Darter . Previously in 1987 , Pratt & Whitney offered the Super @-@ 7 project three engine options ; PW1212 , F404 , and PW1216 , with local manufacturing in either China or Pakistan . Rolls Royce offered its RB199 @-@ 127 / 128 turbofan engine ; this plan was scrapped in 1989 .

In June 1999 , the contract to jointly develop and produce the Chengdu FC @-@ 1 / Super 7 was signed . The project was to be a 50 : 50 partnership ; the air forces of both countries would be committed to ordering the fighter . After GEC @-@ Marconi had abandoned the bidding to supply an integrated avionics suite , FIAR and Thomson @-@ CSF proposed a number of avionics suites based on the Grifo S7 and RC400 radars respectively , despite previously hoping to use the PAF 's Super 7 to launch its new Blue Hawk radar . Because of sanctions placed on Pakistan after the country 's 1998 nuclear weapons tests , design work progressed very slowly over the next 18 months , preventing delivery of the Western avionics to the PAF . In early 2001 , the PAF decided to decouple the airframe from the avionics , enabling design work on the aircraft to continue . As the airframe was developed , any new avionics requirements by the PAF could be more easily integrated into the airframe .

Prototype production began in September 2002 ; a full @-@ size mock @-@ up of the FC @-@ 1 / Super 7 was displayed at Airshow China in November 2002 . The first batch of Klimov RD @-@ 93 turbofan engines that would power the prototypes was also delivered in 2002 . According to a China National Aero @-@ Technology Import & Export Corporation (CATIC) official , the JF @-@ 17 's low cost is due to some of the on @-@ board systems having been adapted from those of the Chengdu J @-@ 10 . The official said , " This transfer of technology ? transposing the aircraft systems from the J @-@ 10 to the JF @-@ 17 ? is what makes the JF @-@ 17 so cost @-@ effective " . The use of computer @-@ aided design software shortened the design phase of the JF @-@ 17 .

= = = Flight testing and redesigning = = =

The first prototype , PT @-@ 01 , was rolled out on 31 May 2003 and transferred to the Chengdu Flight Test Centre to be prepared for its maiden flight . This was initially planned to take place in June , but was delayed due to concerns about the SARS outbreak . The designation Super @-@ 7 was replaced by " JF @-@ 17 " (Joint Fighter @-@ 17) around this point . Low speed taxiing trials began at Wenjiang Airport , Chengdu , on 27 June 2003 . The maiden flight was made in late August 2003 ; an official maiden flight of the prototype took place in early September . The prototype was marked with the new PAF designation JF @-@ 17 . By March 2004 , CAC had made around 20 test flights of the first prototype . On 7 April 2004 , PAF test pilots Rashid Habib and Mohammad Ehsan ul @-@ Haq flew PT @-@ 01 for the first time . The maiden flight of the third prototype , PT @-@ 03 , took place on 9 April 2004 . In March 2004 , Pakistan was planning to induct around 200 aircraft .

Following the third prototype , several design improvements were developed and incorporated into further aircraft . Because of excessive smoke emissions by the RD @-@ 93 engine , the air intakes were widened . Reported control problems found in testing resulted in alterations to the wing leading edge root extensions (LERX) . The vertical tail fin was enlarged to house an expanded electronic warfare equipment bay in the tip . The redesigned aircraft had a slightly increased maximum take @-@ off weight and incorporated an increased quantity of Chinese @-@ sourced avionics ; however PAF had selected Western avionics for their aircraft , postponing PAF deliveries from late 2005 until 2007 . Pakistan evaluated British , French , and Italian avionics suites , the winner of which was expected to be finalised in 2006 . PT @-@ 04 , the fourth prototype and the first to incorporate the design changes , was rolled out in April 2006 and made its first flight on 28 April 2006 .

The modified air intakes replaced conventional intake ramps ? whose function is to divert turbulent boundary layer airflow away from the inlet and prevent it entering the engine ? with a diverterless

supersonic inlet (DSI) design . The DSI uses a combination of forward @-@ swept inlet cowls and a three @-@ dimensional compression surface to divert the boundary layer airflow at high sub @-@ sonic and supersonic speeds . According to Lockheed Martin , the DSI design prevents most of the boundary layer air from entering the engine at speeds up to two times the speed of sound , reduces weight by removing the need for complex mechanical intake mechanisms , and is stealthier than a conventional intake . In 1999 , developmental work on the DSI with the aim of improving aircraft performance commenced . The JF @-@ 17 design was finalised in 2001 . Multiple models underwent wind tunnel tests ; it was found that the DSI reduced weight , cost , and complexity while improving performance .

For the avionics and weapons qualification phase of the flight testing , PT @-@ 04 was fitted with a fourth @-@ generation avionics suite that incorporates sensor fusion , an electronic warfare suite , enhanced man @-@ machine interface , Digital Electronic Engine Control (DEEC) for the RD @-@ 93 turbofan engine , FBW flight controls , day / night precision surface attack capability , and multi @-@ mode , pulse @-@ Doppler radar for BVR air @-@ to @-@ air attack capability . The sixth prototype , PT @-@ 06 , made its maiden flight on 10 September 2006 . Following a competition in 2008 , Martin @-@ Baker was selected over a Chinese firm for the supply of fifty PK16LE ejection seats .

= = = Production = = =

On 2 March 2007 , the first consignment of two small @-@ batch @-@ production (SBP) aircraft arrived in a dismantled state in Pakistan . They flew for the first time on 10 March 2007 and took part in a public aerial demonstration during a Pakistan Day parade on 23 March 2007 . The PAF intended to induct 200 JF @-@ 17 by 2015 to replace all its Chengdu F @-@ 7 , Nanchang A @-@ 5 , and Dassault Mirage III / 5 aircraft . In preparation for the in @-@ flight refuelling of JF @-@ 17s , the PAF has upgraded several Mirage IIIs with IFR probes for training purposes . A dual @-@ seat , combat @-@ capable trainer was originally scheduled to begin flight testing in 2006 ; in 2009 Pakistan reportedly decided to develop the training model into a specialised attack variant .

In November 2007 , the PAF and PAC conducted flight evaluations of aircraft fitted with a variant of the NRIET KLJ @-@ 10 radar developed by China 's Nanjing Research Institute for Electronic Technology (NRIET) , and the LETRI SD @-@ 10 active radar homing AAM . In 2005 , PAC began manufacturing JF @-@ 17 components ; production of sub @-@ assemblies commenced on 22 January 2008 . The PAF was to receive a further six pre @-@ production aircraft in 2005 , for a total of 8 out of an initial production run of 16 aircraft . Initial operating capability was to be achieved by the end of 2008 . Final assembly of the JF @-@ 17 in Pakistan began on 30 June 2009 ; PAC expected to complete production of four to six aircraft that year . They planned to produce twelve aircraft in 2010 and fifteen to sixteen aircraft per year from 2011 ; this could increase to twenty @-@ five aircraft per year . On December 29 , 2015 , Pakistan Aeronautical Complex (PAC) announced the rollout of 16th JF @-@ 17 Thunder fighter manufactured in the calendar year 2015 , taking total number of manufactured aircraft to more than 66 . Later , a PAF spokesperson said that in light of the interest shown by various countries , it has been decided that production capacity of JF @-@ 17 Thunder at PAC Kamra will be expanded .

Russia signed an agreement in August 2007 for re @-@ export of 150 RD @-@ 93 engines from China to Pakistan for the JF @-@ 17 . In 2008 , the PAF was reportedly not fully satisfied with the RD @-@ 93 engine and that it would only power the first 50 aircraft ; it was alleged that arrangements for a new engine , reportedly the Snecma M53 @-@ P2 , may have been made . Mikhail Pogosyan , head of the MiG and Sukhoi design bureaus , recommended the Russian defence export agency Rosoboronexport block RD @-@ 92 engine sales to China to prevent export competition from the JF @-@ 17 against the MiG @-@ 29 . At the 2010 Farnborough Airshow , the JF @-@ 17 was displayed internationally for the first time ; aerial displays at the show were intended but were cancelled due to a late attendance decision as well as license and insurance costs . According to a Rosoboronexport official at the Airshow China 2010 , held on November 16 ? 21 , 2005 in Zhuhai , China , Russia and China had signed a contract worth \$ 238 million for 100 RD

@-@ 93 engines with options for another 400 engines developed for the FC @-@ 1 .

According to media reports , Pakistan plans to increase production of JF @-@ 17s by 25 % in 2016

= = = Further development = = =

Pakistan negotiated with British and Italian defence firms regarding avionics and radars for the JF @-@ 17 development . Radar options include the Italian Galileo Avionica 's Grifo S7 , the French Thomson @-@ CSF 's RC400 (a variant of the RDY @-@ 2) , and the British company SELEX Galileo 's Vixen 500E active electronically scanned array (AESA) radar . In 2010 , the PAF had reportedly selected ATE Aerospace Group to integrate French @-@ built avionics and weapons systems over rival bids from Astrac , Finmeccanica and a Thales @-@ Sagem joint venture . Fifty JF @-@ 17s were to be upgraded and an optional fifty from 2013 onwards , at a cost of up to US \$ 1 @-@ 36 billion . The RC @-@ 400 radar , MICA AAMs , and several air @-@ to @-@ surface weapons are believed to be in the contract . The PAF also held talks with South Africa for the supply of Denel A @-@ darter AAMs .

In April 2010 , after eighteen months of negotiations , the deal was reportedly suspended ; reports cited French concerns about Pakistan 's financial situation , the protection of sensitive French technology , and lobbying by the Indian government , which operates many French @-@ built aircraft . France wanted the PAF to purchase several Mirage 2000 @-@ 9 fighters from the United Arab Emirates Air Force , which would overlap with the upgraded JF @-@ 17 . In July 2010 , the PAF 's Chief of Air Staff , Air Chief Marshal Rao Qamar Suleman , said these reports were false . He said , " I have had discussions with French Government officials who have assured me that this is not the position of their government " . Suleman also speculated that " someone was trying to cause mischief ? to put pressure on France not to supply the avionics we want " .

On 18 December 2013 , production of Block 2 JF @-@ 17s began at PAC 's Kamra facility . These aircraft have air @-@ to @-@ air refuelling capability , improved avionics , enhanced load carrying capacity , data link , and electronic warfare capabilities . Block 2 construction activity is planned to run until 2016 , after which the manufacturing of further developed Block 3 aircraft is planned . In December 2015 , it was announced that the 16th Block II aircraft had been handed over resulting in standing up of the 4th squadron .

Usman Shabbir of the Pakistan Military Consortium has said that Block 3 aircraft might include AESA radar , HMD , avionics improvements , and perhaps some reworking of the airframe . Local media has indicated that a 2 @-@ seat version will also be part of Block III package Unconfirmed reports says that Block III will also have better flight management system / software On 17 June 2015 , Jane 's Defence Weekly confirmed this that Block 3 will have an AESA radar and will also include a helmet @-@ mounted display (HMD) and possibly an internal infrared search and tracking (IRST) system .

Selex ES next @-@ generation cockpit includes a new mission computer , an enhanced head @-@ up display and contemporary multi @-@ function displays , plus the capability for the pilot to instead use a single , large @-@ area display . Selex is positioning the cockpit as a possible upgrade of JF @-@ 17 Block III .

= = Design = =

= = = Airframe and cockpit = = =

The airframe is of semi @-@ monocoque structure constructed primarily of aluminium alloys . High strength steel and titanium alloys are partially adopted in some critical areas . The airframe is designed for a service life of 4 @-@ 000 flight hours or 25 years , the first overhaul being due at 1 @-@ 200 flight hours . Block 2 JF @-@ 17s incorporate greater use of composite materials in the airframe to reduce weight . The retractable undercarriage has a tricycle arrangement with a single

steerable nose @-@ wheel and two main undercarriages . The hydraulic brakes have an automatic anti @-@ skid system . The position and shape of the inlets is designed to give the required airflow to the jet engine during manoeuvres involving high angles of attack .

The mid @-@ mounted wings are of cropped @-@ delta configuration . Near the wing root are the LERX , which generate a vortex that provides extra lift to the wing at high angles of attack encountered during combat manoeuvres . A conventional tri @-@ plane empennage arrangement is incorporated , with all @-@ moving stabilators , single vertical stabiliser , rudder , and twin ventral fins . The flight control surfaces are operated by a computerised flight control system (FCS) , which also adjusts the slats / flaps for improved manoeuvrability . Up to 3 @, @ 629 kg (8 @, @ 001 lb) of ordnance , equipment , and fuel can be mounted under the hardpoints , two of which are on the wing @-@ tips , four are under the wings and one is under the fuselage .

The glass cockpit is covered by a transparent , acrylic canopy that provides the pilot with a good , all @-@ round field of view . A centre stick is used for pitch and roll control while rudder pedals control yaw . A throttle is located to the left of the pilot . The cockpit incorporates hands @-@ on @-@ throttle @-@ and @-@ stick (HOTAS) controls . The pilot sits on a Martin @-@ Baker Mk @-@ 16LE zero @-@ zero ejection seat . The cockpit incorporates an electronic flight instrument system (EFIS) and a wide @-@ angle , holographic head @-@ up display (HUD) , which has a minimum total field of view of 25 degrees . The EFIS comprises three colour multi @-@ function displays , providing basic flight information , tactical information , and information on the engine , fuel , electrical , hydraulics , flight control , and environment control systems . The HUD and MFD can be configured to show any available information . Each MFD is 20 @. @ 3 cm (8 @. @ 0 in) and 30 @. @ 5 cm (12 @. @ 0 in) tall and is arranged side @-@ by @-@ side in portrait orientation . The central MFD is placed lowest to accommodate a control panel between it and the HUD .

= = = Avionics = = =

The avionics software incorporates the concept of open architecture . Instead of the military @-@ optimised Ada programming language , the software is written using the popular C + + programming language , enabling the use of the numerous civilian programmers available . The aircraft also includes a health and usage monitoring system , and automatic test equipment . The flight control system (FCS) comprises conventional controls with stability augmentation in the yaw and roll axis and a digital fly @-@ by @-@ wire (FBW) system in the pitch axis . The leading edge slats / flaps and trailing edge flaps are automatically adjusted during manoeuvring to increase turning performance . The FCS of serial production aircraft reportedly have a digital quadruplex (quad @-@ redundant) FBW system in the pitch axis and a duplex (dual @-@ redundant) FBW system in the roll and yaw axis .

The JF @-@ 17 has a defensive aids system (DAS) composed of various integrated sub @-@ systems . A radar warning receiver (RWR) provides data such as direction and proximity of enemy radars , and an electronic warfare (EW) suite housed in a fairing at the tip of the tail fin interferes with enemy radars . The EW suite is also linked to a Missile Approach Warning (MAW) system to defend against radar @-@ guided missiles . The MAW system uses several optical sensors across the airframe to detect the rocket motors of missiles across a 360 @-@ degree coverage . Data from the MAW system , such as direction of inbound missiles and the time to impact , is shown on cockpit displays and the HUD . A countermeasures dispensing system releases decoy flares and chaff to help evade hostile radar and missiles . The DAS systems will also be enhanced by integration of a self @-@ protection radar @-@ jamming pod that will be carried externally on a hardpoint .

The first forty @-@ two PAF production aircraft are equipped with the NRIET KLJ @-@ 7 radar , a variant of the KLJ @-@ 10 radar developed by China 's Nanjing Research Institute of Electronic Technology (NRIET) and also used on the Chengdu J @-@ 10 . Multiple modes can manage the surveillance and engagement of up to forty air , ground , and sea targets ; the track @-@ while @-@ scan mode can track up to ten targets at BVR and can engage two simultaneously with radar @-@ homing AAMs . The operation range for targets with a radar cross @-@ section (RCS) of 5 m² (54 sq ft) is stated to be ? 105 km (65 mi) in look @-@ up mode and ? 85 km (53 mi) in look

@-@ down mode . A forward looking infrared (FLIR) pod for low @-@ level navigation and infra @-@ red search and track (IRST) system for passive targeting can also be integrated ; the JF @-@ 17 Block 2 is believed to incorporate an IRST .

A helmet @-@ mounted sight (HMS) developed by Luoyang Electro @-@ Optics Technology Development Centre of AVIC was developed in parallel with the JF @-@ 17 ; it was first tested on Prototype 04 in 2006 . It was dubbed as EO HMS , (Electro @-@ Optical Helmet Mounted Sight) and was first revealed to the public in 2008 at the 7th Zhuhai Airshow , where a partial mock @-@ up was on display . The HMS tracks the pilot 's head and eye movements to guide missiles towards the pilot 's visual target . An externally carried day / night laser designator targeting pod may be integrated with the avionics to guide laser @-@ guided bombs (LGBs) . An extra hardpoint may be added under the starboard air intake , opposite the cannon , for such pods . To reduce the numbers of targeting pods required , the aircraft 's tactical data link can transmit target data to other aircraft not equipped with targeting pods . The communication systems comprise two VHF / UHF radios ; the VHF radio has the capacity for data linking for communication with ground control centres , airborne early warning and control aircraft and combat aircraft with compatible data links for network @-@ centric warfare , and improved situation awareness .

In April 2016 , Air Marshal Muhammad Ashfaq Arain said that , " JF @-@ 17 needs a targeting pod , as the jets ? usefulness in current operations was limited due to lack of precision targeting . To fulfill this gap the Air Force was interested in buying the Thales @-@ made Damocles , a third @-@ generation targeting pod ; which was a priority .

= = = Propulsion and fuel system = = =

The first two blocks of JF @-@ 17 is powered by a single Russian RD @-@ 93 turbofan engine , which is a variant of the RD @-@ 33 engine used on the MiG @-@ 29 fighter . The engine gives more thrust and significantly lower specific fuel consumption than turbojet engines fitted to older combat aircraft being replaced by the JF @-@ 17 . The advantages of using a single engine are a reduction in maintenance time and cost when compared to twin @-@ engined fighters . A thrust @-@ to @-@ weight ratio of 0 @. @ 99 can be achieved with full internal fuel tanks and no external payload . The engine 's air supply is provided by two bifurcated air inlets (see airframe section) .

The RD @-@ 93 is known to produce smoke trails . The Guizhou Aero Engine Group has been developing a new turbofan engine , the WS @-@ 13 Taishan , since 2000 to replace the RD @-@ 93 . It is based on the Klimov RD @-@ 33 and incorporates new technologies to boost performance and reliability . A thrust output of 80 to 86 @. @ 36 kN (17 @, @ 980 to 19 @, @ 410 lbf) , a lifespan of 2 @, @ 200 hours , and a thrust @-@ to @-@ weight ratio of 8 @. @ 7 are expected . An improved version of the WS @-@ 13 , developing a thrust of around 100 kN (22 @, @ 000 lbf) (22 @, @ 450 lb) , is also reportedly under development . During the 2015 Paris Air Show , it was announced that flight testing of a JF @-@ 17 equipped with the WS @-@ 13 engine had begun . In 2015 , a representative of Pakistan Aeronautical Complex said that Pakistan would continue to use the RD @-@ 93 engine on their fighters . Local media reports in Jan 2016 say that , Russia is planning to sell engines for JF @-@ 17 directly to Pakistan . According to a PAC representative , Pakistan is looking to collaborate with Russia in developing and repairing engines

The fuel system comprises internal fuel tanks located in the wings and fuselage with a capacity of 2 @, @ 330 kg (5 @, @ 140 lb) ; they are refuelled through a single point pressure refuelling system (see turbine fuel systems) . Internal fuel storage can be supplemented by external fuel tanks . One 800 @-@ litre (180 imp gal) drop tank can be mounted on the aircraft 's centerline hardpoint under the fuselage and two 800 @-@ litre or 1 @, @ 110 @-@ litre (240 imp gal) drop tanks can be mounted on the two inboard under @-@ wing hardpoints . The fuel system is compatible with in @-@ flight refuelling (IFR) , allowing tanker aircraft to refuel inflight , and increasing its range and loitering time significantly . All production aircraft for the PAF are to be fitted with IFR probes . In June 2013 , PAF Air Chief Marshal Tahir Rafique Butt said ground tests on the JF @-@ 17 's refuelling probes had been successfully completed and the first mid @-@ air refuelling operations would commence that summer .

== Weaponry ==

The JF 17 can be armed with up to 3 @ 629 kg (8 @ 001 lb) of air to air and air to ground weaponry , and other equipment mounted externally on the aircraft 's seven hardpoints . One hardpoint is located under the fuselage between the main landing gear , two are underneath each wing , and one is at each wing tip . All seven hardpoints communicate via a MIL STD 1760 data bus architecture with the Stores Management System , which is stated to be capable of integration with weaponry of any origin . Internal armament comprises one 23 mm (0.91 in) GSh 23 2 twin barrel cannon mounted under the port side air intake , which can be replaced with a 30 mm (1.2 in) GSh 30 2 twin barrel cannon .

The wing tip hardpoints are typically occupied by short range infra red homing AAMs . Many combinations of ordnance and equipment such as targeting pods can be carried on the under wing and under fuselage hardpoints . Underwing hardpoints can be fitted with multiple ejector racks , allowing each hardpoint to carry two 500 lb (230 kg) unguided bombs or LGBs ? Mk.82 or GBU 12 . It is unknown whether multiple ejector racks can be used for ordnance such as beyond visual range (BVR) AAMs . Active radar homing BVR AAMs can be integrated with the radar and data link for mid course updates . The Chinese PL 12 / SD 10 is expected to be the aircraft 's primary BVR air to air weapon , although this may change if radars of other origin are fitted . Short range , infra red homing missiles include the Chinese PL 5E and PL 9C , and the AIM 9L . The PAF is also seeking to arm the JF 17 with a fifth generation close combat missile such as the IRIS T or A darter . These will be integrated with the HMS / D and the radar for targeting .

Unguided air to ground weaponry includes rocket pods , gravity bombs and Matra Durandal anti runway munitions . Precision guided munitions such as LGBs and satellite guided bombs are also compatible with the JF 17 , as are other guided weapons such as anti ship missiles and anti radiation missiles . Pakistan planned to bring the Brazilian MAR 1 anti radiation missile into service on its JF 17 fleet in 2014 .

== Operational history ==

== Initial delivery , evaluation , and induction ==

Small batch production of the single seat , single engine JF 17s began in China in June 2006 . The first two small batch produced aircraft were delivered on 2 March 2007 and first flew in Pakistan on 10 March . They took part in an aerial display on 23 March 2007 as part of the Pakistan Day Joint Services Parade in Islamabad . Another six small batch produced aircraft were delivered by March 2008 . These were extensively flight tested and evaluated by the PAF . Two serial production aircraft were delivered from China in 2009 and the first Pakistani manufactured aircraft was delivered to the PAF in a ceremony on 23 November 2009 .

On 18 February 2010 , the first JF 17 squadron , No. 26 Black Spiders , was officially inducted into the PAF with an initial strength of 14 fighter planes . These aircraft first saw service in the anti terrorist operation in South Waziristan , during which various types of weapons were evaluated . They took part in the PAF 's High Mark 2010 exercise from 29 April , where they were used by the Blue Force to attack Red Land surface targets with precision air to surface weapons . A re equipment ceremony for No. 26 Black Spiders Squadron took place on 11 April 2011 , during which it was stated that the JF 17 had " revolutionised the PAF 's operational concepts " . The then Chief of the Air Staff , Air Chief Marshal Rao Qamar Suleman said : " Today as we re equip No 26 squadron , we have also raised No. 16 Squadron with the JF 17 Thunder aircraft . I would like to mention and appreciate the contribution and support of the

Chinese in helping us acquire a technological breakthrough in the shape of this aircraft . " According to Pakistani forums , No 27 Squadron " Zarrars " replaced its Mirage 5EF with JF @-@ 17 in 2013 . No 2 Squadron currently tasked with sea strikes reequipped with JF @-@ 17s in Sept 2015 replacing the F7s . No 16 Squadron " Black Panthers " has already stood up . The next squadron is supposed to be No 7 Squadron .

= = = Potential operators = = =

Various countries including Algeria , Argentina , Bangladesh , Myanmar , Egypt , Iran , Lebanon , Malaysia , Morocco , Nigeria , Sri Lanka , and Uruguay have shown interest in the JF @-@ 17 .

The Azerbaijani Air Forces has negotiated with China for several dozen JF @-@ 17s worth approximately US \$ 16 to 18 million each . The Sudanese Air Force was reportedly negotiating to buy twelve aircraft . The Air Force of Zimbabwe reportedly had plans to purchase twelve JF @-@ 17s in 2004 , as part of the \$ 240 million deal with China . But none of the aircraft sales have been materialized . In 2010 , China was reportedly in talks about the JF @-@ 17 with five or six countries , some of which had sent pilots to China to undergo test flights .

Argentine officials at the 2013 Paris Air Show said they had discussed JF @-@ 17 co @-@ production with Chinese officials , calling it the first formal effort potentially leading to the co @-@ production of a modern Chinese fighter in Latin America . Fábrica Argentina de Aviones (FAdA) officials said the co @-@ produced FC @-@ 1 could be called the " Pulqui @-@ III " , recalling FAdA 's Pulqui @-@ II , Latin America 's first swept wing jet fighter . On 15 February 2015 , after a three @-@ day visit to Beijing by Argentine president Cristina Fernández de Kirchner , Argentina completed negotiations to purchase twenty FC @-@ 1s from Chengdu Aircraft Corporation . In January 2014 , the Royal Saudi Air Force was reportedly examining potential technology transfer and co @-@ production opportunities for the JF @-@ 17 . Saudi Defence Minister Prince Salman bin Sultan toured the JF @-@ 17 project during a visit to Pakistan .

The Burma Times reported on 15 June 2014 that Myanmar was considering local production of the JF @-@ 17 with China and Pakistan assistance .

In December 2014 , during the International Defence Exhibition and Seminar in Karachi , Nigeria was reportedly buying between 25 and 40 JF @-@ 17s from Pakistan . Nigerian Air Force chief Air Marshal Adesola Nunayon Amosu had visited Pakistan earlier in October 2014 . Nigeria became the second customer in 2016 by placing an order for 3 planes . However , as the news reports value the deal at US \$ 25 million , so it is not clear if the item is misreported . June 2016 article in Jane 's re @-@ affirmed NAF budget for 3 JF @-@ 17 , 10 Super Mushshak , and 2 Mi @-@ 35M aircraft in 2016 .

In June 2015 , Pakistani media reports suggested that export orders have also been confirmed and signed with the Sri Lanka Air Force , according to Pakistan @-@ based 92 News while some other sources claim that Myanmar is the first buyer of Pakistani JF @-@ 17 Thunder jets . The article goes on to say that deliveries are likely to begin in 2017 . According to the report , the order will be for around 18 @-@ 24 aircraft , potentially confirming claims made at the 51st Paris Air Show that the first contract for the sale of the JF @-@ 17 had been signed with the Sri Lanka Air Force .

Though there are reports that Sri Lanka signed an agreement to buy eight JF @-@ 17 Thunders from Pakistan during a state visit by Nawaz Sharif in January 2016 , but Sri Lankan government denies that any such deal happened . The deal was cancelled after Indian pressure . The deal would have been for 10 @-@ 12 planes , valuing each plane at US \$ 35 million for a total of US \$ 400 million

Moroccan media has revealed that the country is interested in buying JF @-@ 17 and has invited the sales team to showcase the aircraft in the Marrakech Air Show 2016 According to a local analyst , the deal might be difficult to come to fruition , as the JF @-@ 17 Block I and Block II do not match the on @-@ board electronics suites and air @-@ to @-@ air / air @-@ to @-@ surface munitions inventories of Morocco 's current western avionics equipped Mirage F @-@ 1 (MF2000) , F @-@ 5E / F Tiger II and Alpha Jets

Egypt in 2015 reportedly expressed an interest again in the JF @-@ 17 despite buying French and

Russian planes earlier that year . This has come as a surprise to analysts who had considered the possibility of Egypt acquiring the JF @-@ 17 to be lost .

= = Notable accidents and incidents = =

A JF @-@ 17 Thunder crashed in Attock , Pakistan on 14 November 2011 killing its pilot .

= = Variants = =

= = = Prototypes = = =

Two airframe configurations were tested during the prototype stage . The first configuration was tested on the first three prototype aircraft ; PT @-@ 01 , PT @-@ 02 , and PT @-@ 03 . The next three prototypes PT @-@ 04 , PT @-@ 05 , and PT @-@ 06 were of the second configuration , incorporating modifications such as DSI , wider LERX , extended ventral fins , and a taller , less swept vertical stabiliser with a rectangular fairing at the tip containing electronic warfare equipment and small blister fairings at the base containing Missile Approach Warning sensors . The PT @-@ 04 prototype was primarily used for avionics and weapon qualification tests . Prototype @-@ 01 first flew in August 2003 ; Prototype @-@ 03 followed in April 2004 . On 10 May 2006 , Prototype 04 made its maiden flight .

In 2007 , a dual @-@ seat version for training and strike roles was proposed and due to the customer interests the development started in 2015 .

According to local media , the newly launched JF @-@ 17B dual seat fighter jet will be inducted in the Air Force by April 2017 with the maiden flight by the end of the year .

= = = Production versions = = =

JF @-@ 17 Block 1 ? Production in China began in June 2006 . The first three Chinese weapons to be integrated are the PL @-@ 5E II AAM , the SD @-@ 10 AAM , and the C @-@ 802A anti @-@ shipping missile . Block 1 aircraft had performed " better than expected " according to PAF Air Commodore Junaid . Production of Block 1 was completed on 18 December when the fiftieth aircraft ? 58 % of which was produced in Pakistan ? was delivered . A Block 1 JF @-@ 17 had cost approximately US \$ 15 million per unit .

JF @-@ 17 Block 2 ? Production began on 18 December 2013 and initial testing began on 9 February 2015 . These aircraft have air @-@ to @-@ air refuelling capability , improved avionics , enhanced load carrying capacity , data link , and electronic warfare capabilities . The construction will continue until 2016 , after which the manufacture of Block 3 is planned . A Block 2 JF @-@ 17 costs approximately US \$ 25 million per unit . Chairman of PAC , Air Marshal Javaid Ahmed said : " We will hand over 16 Block @-@ II JF @-@ 17s to the PAF every year " , and that the manufacturing plant has the capacity to produce 25 units in a year . According to local media , PAC rolled out the 16th Block 2 aircraft in December 2015 enabling the 4th JF17 squadron to be stood up . The JF @-@ 17B two seat version would start testing in September 2016 .

JF @-@ 17 Block 3 ? Projected to feature further avionics advancements such as an AESA radar , more use of composites , a new engine , helmet mounted display , and a two @-@ seater cockpit option , with a top speed of 2 @. @ 0 + Mach . Pakistani Air Force officials have described it as a " fourth generation plus " fighter jet . According to unconfirmed media reports the induction is expected to start around 2019 . As of January 2016 , the design of the JF @-@ 17 Block III has not been finalized .

JF @-@ 17B - is a twin seater variant and is to be inducted into the Pakistan Air Force by 2017 , it 's multi @-@ roles include use for training and for enhanced surveillance and support capability

= = Operators = =

Pakistan

Pakistan Air Force : 66 units in service PAF Base Minhas

JF @-@ 17 TEF (Test and Evaluation Flight) (2007 ? 2010)

PAF Base Peshawar No . 26 Squadron Black Spiders (2010)

No. 16 Squadron Black Panthers (2011)

PAF Base Masroor

No. 2 Squadron Minhas (2015)

PAF Base Mushaf

Combat Commanders School (2015)

= = Specifications (Block 1) = =

Data from Pakistan Aeronautical Complex

General characteristics

Crew : 1

Length : 14 @. @ 93 m (49 ft)

Wingspan : 9 @. @ 45 m (31 ft , including 2 wingtip missiles)

Height : 4 @. @ 72 m (15 ft 6 in)

Wing area : 24 @. @ 4 m ² (263 ft ²)

Empty weight : 6 @, @ 586 kg (14 @, @ 520 lb)

Loaded weight : 9 @, @ 100 kg (20 @, @ 062 lb)

Useful load : 3600kg (Block 1) ()

Max. takeoff weight : 12 @, @ 500 kg (28 @, @ 000 lb)

Powerplant : 1 x Klimov RD @-@ 93 or Guizhou WS @-@ 13 Dry thrust : 49 @. @ 7 kN / 51 @. @ 2 kN (11 @, @ 106 lbf / 11 @, @ 510 lbf)

Thrust with afterburner : 84 @. @ 6 kN (19 @, @ 000 lbf)

G @-@ limit : + 8 g / -3 g

Internal Fuel Capacity : 2 @, @ 350 kg (5 @, @ 130 lb)

Performance

Maximum speed : Mach 1 @. @ 6 (1 @, @ 217 @. @ 9 mph ; 1 @, @ 960 @. @ 1 km / h)

Combat radius : 1 @, @ 352 km (840 mi)

Ferry range : 3 @, @ 482 km (1 @, @ 880 NM)

Service ceiling : 16 @, @ 920 m (55 @, @ 500 ft)

Thrust / weight : 0 @. @ 95

Armament

Guns : 1 x 23 mm GSh @-@ 23 @-@ 2 twin @-@ barrel cannon or 1x 30 mm GSh @-@ 30 @-@ 2

Hardpoints : 7 in total (4 x under @-@ wing , 2 x wing @-@ tip , 1 x under @-@ fuselage (Joint Hardpoint) ; pylon stations number 3 , 4 and 5 are wet @-@ plumb capable) with a capacity of 8 @, @ 001 lb (3 @, @ 629 kg) for external fuel and ordnance

Missiles : Air @-@ to @-@ air missiles :

MAA @-@ 1 Piranha (Short @-@ range)

AIM @-@ 9L / M (Short @-@ range)

PL @-@ 5EII (Short @-@ range)

PL @-@ 9C (Short @-@ range)

PL @-@ 12 / SD @-@ 10 (Beyond visual range)

Air @-@ to @-@ surface missiles :

MAR @-@ 1 (Anti @-@ radiation missile)

Ra 'ad ALCM (Nuclear @-@ capable Subsonic Cruise missile)

CM @-@ 400AKG supersonic anti @-@ shipping missile , export version of YJ @-@ 12

C @-@ 802A Anti @-@ ship missile

CM 102 supersonic Anti radiation missile

GB @-@ 6 Air @-@ Launched Standoff Submunition Dispenser Precision Guided Weapon Bombs :

Unguided bombs :

Mk @-@ 82 (general purpose bomb)

Mk @-@ 84 (general purpose bomb)

Matra Durandal (anti @-@ runway bomb)

CBU @-@ 100 / Mk @-@ 20 Rockeye (anti @-@ armour cluster bomb)

Precision guided munitions (PGM) :

GBU @-@ 10 (Laser @-@ guided)

GBU @-@ 12 (Laser @-@ guided)

LT @-@ 2 (Laser @-@ guided)

H @-@ 2 (electro @-@ optically guided)

H @-@ 4 (electro @-@ optically guided)

LS @-@ 6 (satellite @-@ guided glide bombs)

Satellite @-@ guided bombs

Others :

Rocket Pods

Countermeasures (Flares , Chaff)

Up to 3 external drop tanks (2 x under @-@ wing 1 @-@ 100 litres (240 imp gal ; 290 US gal) , 1 x under @-@ fuselage 800 litres (180 imp gal ; 210 US gal)) for extended range / loitering time

Avionics

DEEC electronic warfare suite

NRIET KLJ @-@ 7 multi @-@ mode fire @-@ control radar

Night vision goggles (NVG) compatible glass cockpit

Externally mounted avionics pods :

KG @-@ 300G self @-@ protection radar jamming pod

WMD @-@ 7 day / night targeting pod