Boeing/McDonnell Douglas F-15 Eagle and F-15E Strike Eagle

David James provides a brief outline of the Eagle programme, before bringing the story up to date, with a bias towards American operations.

The Boeing (McDonnell Douglas) F-15 Eagle represents one of the most potent and capable warplanes produced in modern times. Originally conceived as an all-weather air superiority fighter capable of out-flying and outfighting any aircraft of the time, through a perfect blend of superb manoeuvrability, speed, range, advanced avionics and powerful weaponry, the F-15 has since evolved (as the F-15E Strike Eagle) into a hard-hitting, low-level strike aircraft that can not only attack the most heavily defended of targets deep behind enemy lines with pinpoint accuracy, but can also fight its way out of most air-to-air combat situations. Proven in combat on several occasions, the F-15 remains in widespread service and is still, 31 years after it first took to the air, one of the most feared and respected warplanes in service.

F-X air superiority fighter

The Eagle came about as a direct result of a 1965 USAF feasibility study for a new air superiority fighter, known as the F-X. Much political fighting and rejigging of requirements ensued, before the USAF announced, during December 1969, that McDonnell Douglas was the winner of the F-X programme.

In January 1970 the USAF ordered 20 pre-series F-15 Eagles, two of which were to be two-seat TF-15 operational trainers. The first F-15A completed its maiden flight on 27 July 1972, the first TF-15A following it into the air one year later. Testing ran so smoothly that the first of the production-standard Eagles flew during November 1974 and the first deliveries of TF-15As to the 58th Tactical Training Wing (TTW) at Luke AFB began. Initial Operational Capability (IOC) was awarded in July 1975 and from the beginning of 1976, the 1st Tactical Fighter Wing (TFW), at Langley AFB, began receiving the first front-line F-15As.

These four Tyndall-based F-15As were photographed in October 1984. Note that the three closest machines have ACMI (Air Combat Manoeuvring Instrumentation) pods on their outer starboard Sidewinder rails. (Boeing via David James)

Greater capabilities

By 1978 the USAF had received 355 F-15As and 57 F-15Bs (as the TF-15A had been re-designated in December 1977), before McDonnell Douglas switched production to the improved F-15C and its two-seater equivalent, the F-15D. The first F-15C took to the air on 26 February 1979 and deliveries to the USAF commenced later that same year.

For America's Bicentennial celebrations in 1976, the first TF-15A prototype wore this dazzling colour scheme. (Boeing via David James)

Photographed over the famous St Louis arch, this F-15A, like all other USAF Eagles, was built in the city. The aircraft was on the strength of the 110th FS, Missouri ANG, in September 1991. (Boeing via David James)

The F-15C/D offered greater internal fuel capacity, a higher gross take-off weight and an improved avionics package compared to the F-15A/B. To increase the aircraft's range further, the F-15C/D could employ Conformal Fuel Tanks (CFTs, originally known as Fuel And Sensor Tactical (FAST) packs) on the fuselage sides, but these were never used operationally by the USAF.

The F-15C/D also introduced upgrades for the AN/APG-63 radar and other avionics improvements. Externally it was very difficult to tell the F-15A/B from the C/D, the most reliable way being by their serial number. USAF F-15As were numbered in the series 73-xxxx to 77-xxxx, while the F-15Cs are 78-xxxx to 81-xxxx.

Multi-Stage Improvement Program II

In February 1983, the USAF initiated the Multi-Stage Improvement Program II (MSIP II) for its F-15A/C fleet. The first MSIP II F-15C flew in 1985 and all Eagles (from 84-001 on) were to MSIP standard. The core elements of the MSIP involved upgrading the performance of the F-15's Central Digital Computer and the addition of a new Programmable Armament Control Set (PACS). In existing aircraft the AN/APG-63 radar was modified to AN/APG-63(V)1 standard, while new-build machines received AN/APG-70. Another major component of the MSIP was the introduction of an expanded Tactical Electronic Warfare System (TEWS).

From 1986 onwards, some USAF F-15s were delivered with new 23,830-lb (105.97-kN) thrust F100-PW-220 engines. These returned the increasingly heavy aircraft's performance to previous levels, but were never widespread in service.

Further improvements in the Eagle's performance have been achieved with the installation of Active Electronically-Scanned Array (AESA) AN/APG-63(V)2 radar. The new radar was introduced from 1999, but has not been adopted fleetwide.

USAF Eagles in combat

The first real test for the USAF's F-15 force in combat came during the 1991 Gulf War (see January 2000, *SAM* 21/11).

When the Gulf War ended, two No-Fly Zones were imposed across Northern and Southern Iraq by the victorious Coalition. To enforce them, USAF F-15s were deployed on Operations Northern Watch and Southern Watch, respectively and these two operations have often seen Eagles intercept Iraqi aircraft.

A similar enforcement policy was conducted over Bosnia during 1994 as Operation Deny Flight. The following year NATO launched Operation Deliberate Force. This campaign saw NATO warplanes strike Serbian forces throughout Bosnia, with USAF F-15s providing round-the-clock fighter cover. The next action came in 1998 with Operation Desert Fox against Iraq.

In March 1999 NATO began Operation Allied Force against Yugoslavia. Again, USAF F-15C/D squadrons were called upon to provide cover. The Serbian air force attempted a number of interceptions during the early stages of Allied Force and on the first night of the campaign at least two MiG-29s were shot down by USAF F-15Cs. The following day a pair of Eagles from the USAF's 493rd FS shot down two more MiG-29s.

Recently, the USAF's F-15A/B/C/D force has been involved in the ongoing war against terrorism. Following the shocking attacks of 11 September 2001 in New York and Washington, DC, Operation Noble Eagle came into force to provide increased air cover over key American cities.

To hit back at Al Qaeda, the USA and other nations launched an air and land campaign against Afghanistan where the terrorists had their main bases under the protection of the ruling Taliban fundamentalist regime. As part of this mission the USAF began Operation Enduring Freedom, in October 2001. Again, F-15Cs, operating from the Gulf region, provided fighter support.

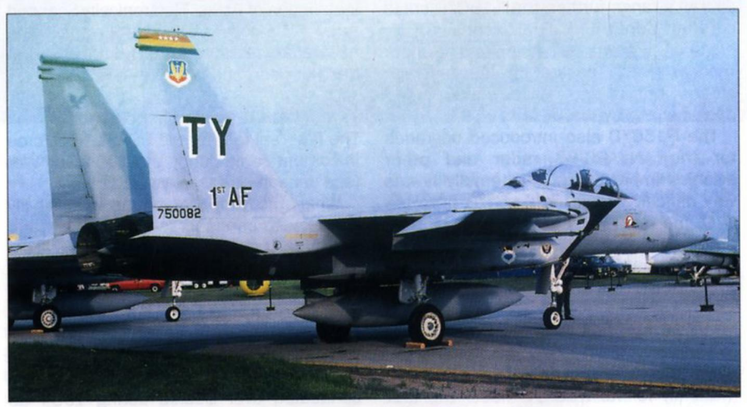
Most recently, the F-15 has been in action over Iraq once more, as part of Operation Iraqi Freedom.

Current situation

By 2003, the number of USAF F-15 Eagles has fallen. Late in 2002, Air Combat Command could call upon 126 F-15C/Ds which were designated as Primary Aircraft, ready for immediate combat. These were assigned to the 1st FW, Langley AFB; 33rd FW; Eglin AFB; 53rd Wing; Tyndall AFB; 57th Wing; Nellis AFB and 366th Wing; Mountain Home AFB. In addition, the Air Education and

84-0014 and 84-0026, both F-15Cs, make a formation approach at Eglin AFB, Florida in 1987. The aircraft hailed from the 60th TFS 'Fighting Crows' of the 33rd TFW. (David James)

F-15C 84-027, of the 493rd FS, 48th FW, is credited with a pair of MiG kills, as denoted by the flags on its nose. (FJ Photography/Steve Davies)



F-15B 75-0082 was marked for the Commanding Officer of the 325th FW at Tyndall in 1992. The 325th was part of AETC, serving as a conversion and tactical training unit. (David James)

Training Command's 325th FW also flew F-15s for training purposes. PACAF maintained a mix of 90 F-15A/B/C/D aircraft with the 3rd Wing, Elmendorf AFB; 18th Wing, Kadena and the 154th Wing, Hickam AFB, this last being part of the Hawaiian ANG. USAFE could call upon the 36 F-15C/Ds of the 48th FW, RAF Lakenheath, England.

Apart from the 154th Wing in Hawaii, the ANG operated the F-15 in the Massachusetts, Oregon, Florida, Missouri and New Orleans Guard, plus squadrons of its Air Defence Force which have responsibility for the protection of US airspace. In total the ANG had around 116 operational Eagles.

The new F/A-22 Raptor is unlikely to fully replace the Eagle until at least 2010. However, once enough F/A-22s are in service, the USAF will have the option of converting surplus F-15s into dedicated Suppression of Enemy Air Defences (SEAD) aircraft. Originally known as F-15 HARM when first proposed (due to a primary armament of AGM-88 HARMs) this concept has since been renamed as the F-15 PDF (Precision Direction Finder).

Flight trials of the concept commenced in August 1996 using the F-15D Advanced Fighter Technology Demonstrator (AFTD) test aircraft as a prototype. This was fitted with HARMs and a Litton-Amecon/TRW Precision Direction Finder system which was able to detect and pinpoint hostile radar sites. However, the advanced system proved difficult to develop and it remains to be seen whether or not the F-15 PDF will ever see operational service.

Of course, the fighter Eagle has also achieved limited export success, aircraft being sold to Israel, Japan and Saudi Arabia. Those of Israel and Saudi Arabia have seen combat and both countries have scored kills with the type.

F-15E Strike Eagle

Convinced that the USAF would need to replace its General Dynamics F-111s and that an Eagle development could fill the void, McDonnell Douglas began work on the Strike Eagle during the 1980s. To produce a concept demonstrator, it converted the second F-15B, 71-0291, as a Dual Role Fighter or DRF. Among other things, the conversion added a pair of larger CFTs. Penetrating enemy air defences and actively being able to engage hostile fighters at long ranges was seen as a key element in the promotion of the Strike Eagle.

To suit the aircraft to high speed missions at low levels, McDonnell Douglas considerably strengthened the basic F-15 airframe. The resultant weight increase, added to the weight of the CFTs, required the use of more powerful engines, the F100-PW-220 being installed as standard.

The AN/APG-70 radar, with a synthetic aperture radar (SAR) mode, was produced, with the air-to-air qualities of the AN/APG-63 radar and also able to give extremely high resolution images of ground targets.

Linked to the AN/APG-70 was a newly developed Low Altitude Navigation and Targeting Infra-Red for Night (LANTIRN) system. Originally devised by Martin-Marietta (now Lockheed-Martin), LANTIRN consists of two pods carried on the Strike Eagle's air intake stores pylons. One pod houses an AAQ-13 terrain avoidance and following navigation unit, which relies on a FLIR to allow high-speed, low altitude flying in poor weather or by night. The second pod contains an AAQ-14 targeting unit. This uses a FLIR tracking device and a laser designator to seek out and 'illuminate' ground targets. Fully integrated with the AN/APG-70's mapping mode, the AAQ-14 can be slaved to individual targets by the Strike Eagle's crew, via their radar display screens.

A fully digital, triple-redundant Lear-Siegler Astronics flight control system which incorporates an automatic terrain following mode linked to the LANTIRN pods, gives the Strike Eagle an impressive low-level flying capability. This was further enhanced by the use of a Honeywell ring-laser gyro Inertial Navigation System (INS) while night flying was made easier through making the aircraft fully compatible with AN/AVS-9 Night Vision Goggles (NVGs).

McDonnell Douglas recognised that if the Strike Eagle was to penetrate deep into enemy airspace, then it would need a highly effective self-protection capability. To this end it was fitted with a range of advanced systems, linked and co-ordinated by a TEWS.

USAF interest

The USAF began to have second thoughts about the Strike Eagle once the design's capabilities and potential became clear. In 1978 it issued its Tactical All-Weather Requirements Study (TAWRS) to evaluate various contenders as a replacement for the F-111. McDonnell Douglas submitted the Strike Eagle while arch rival General Dynamics proposed the F-16XL. Panavia offered Tornado IDS, which had already been selected as a low-level strike aircraft by Britain, Germany and Italy.

Tornado IDS was quickly rejected due to its lack of air-to-air capabilities, leaving the Strike Eagle and F-16XL to slug it out. Since both possessed outstanding air combat performance, the USAF was forced to redefine its requirements under the Enhanced Tactical Fighter (ETF) project. This sought to assess both proposals in respect of their own air-to-ground capabilities and against those of the F-111.

It came as no surprise when the USAF declared the Strike Eagle the winning ETF contender during 1984, the Strike Eagle, among other things, being cheaper in terms of development costs.

A contract for 200 production aircraft, known to the USAF as F-15E Eagles, was awarded to McDonnell Douglas. The first F-15E entered service with the 461st Tactical Fighter Training Squadron (TFTS) of the 405th TTW at Luke AFB on 12 April 1988. The following year the 366th TFS, 4th TFW was declared as the first fully operational, front-line F-15E unit.

Strike Eagle's first blood

F-15E deliveries were in full swing when Iraq invaded neighbouring Kuwait in August 1990. The US-led Coalition commenced Operation Desert Shield days after Kuwait had fallen, to provide military protection for the Saudis. As part of this mission the USAF rushed several units to the Gulf region and two F-15E squadrons were deployed.

The aircraft performed well in the subsequent hostilities of Desert Storm in 1991, but was somewhat hampered by the lack of LANTIRN pods and the limited range of stores that had been cleared for it. Nevertheless, the F-15E became deeply engrossed in the anti-'Scud'. Two of the jets were lost in combat, while an airborne Iraqi 'Hind' was destroyed by a GBU-10 LGB.

Since the Gulf War, the F-15E has seen further combat during Operation Deliberate Force, over Iraq during Operation Desert Fox, in Operation Allied Force, against Al Qaeda terrorists and their Taliban protectors in Operation Enduring Freedom and during Operation Iraqi Freedom in 2003.

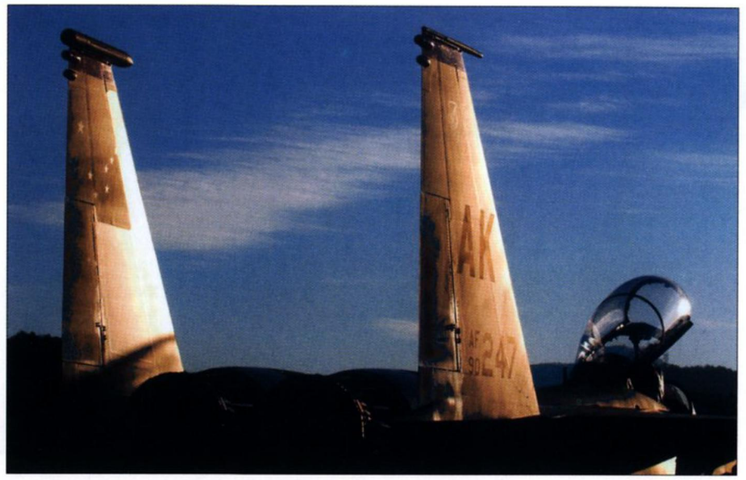
USAF service today

To replace combat and attrition losses, the USAF ordered a further nine aircraft and after these had been delivered the F-15E production line was closed down. However, the USAF began to realise that its resources were over-stretched; by its own estimates, it really required as many as 392 F-15Es. The US Government refused to sanction such a large buy, but did agree to let the USAF purchase a further 17 new-build aircraft.

Production of the Strike Eagle duly restarted at St.Louis where the new aircraft were referred to as E-210s, after they were allocated the McDonnell Douglas construction numbers 210 to 226, although they were built by Boeing after its 1995 take over of McDonnell Douglas. When they entered service, most of the E-210s were assigned to the 48th FW at Lakenheath, except 96-0200, which went to Nellis AFB, Nevada for test purposes.

On display at Bitburg in 1981, F-15C 79-0062 wore this large stars and stripes marking for the display season. (David James)

These F-15Js were part of the Japan Air Self Defence Force's 204 Hiko-tai in 1984. Japan is the largest F-15 operator outside the US, having licence-built the type and upgraded it with indigenous systems. (David James)



Later, the USAF placed an order for a further ten F-15Es. Known as E-227s, these Strike Eagles started joining the USAF in June 2002 with the 48th FW again the initial recipient. Final deliveries are planned to take place in December 2004. In service the E-227 batch has been assigned the serial codes 00-3000 to 00-3004 and 01-2000 to 01-2004.

Of the F-15Es produced so far, 134 were fitted with F100-PW-220 engines. The remainder (including the E-210 and 227 aircraft) have 29,000-lb (128.97-kN) thrust F100-PW-229 Improved Performance Engines (IPEs).

To maintain the F-15E's effectiveness through the early years of the 21st century, the USAF has invested in a number of upgrade packages. The first of these, known as the Band 1.5 Modification, began in 1999 and was aimed at improving the existing TEWS suite. In the Strike Eagle's cockpit a newer, more accurate Honeywell digital map display has been retrofitted, while a Joint Tactical Information Distribution System (JTIDS)/datalink has been added to allow the Strike Eagle to send or receive target data and other key information to or from other aircraft.

For all its capabilities, the F-15E is not a stealthy machine. Any efforts at masking parts of the airframe can do little to detract from the radar-reflecting qualities of the aircraft's fins. (Boeing via David James)

For the future the USAF has been considering a replacement for the F-15E's AN/APG-70 radar which will feature a far more advanced synthetic aperture function. New generation FLIR targeting sensors are also being discussed as is the integration of an Advanced Display Core Processor (ADCP).

New generation weapons are also on offer to boost the F-15E's hitting power. Already the Strike Eagle can deploy some of the USAF's most advanced conventional munitions including the AGM-130 TV-guided stand-off weapon, the GBU-32/33 JDAM and the AGM-154A JSOW. However, the Lockheed-Martin Joint Air-to-Surface Stand-Off Missile (JASSM), the Wind Corrected Munitions Dispenser (WCMD) and the AIM-9X Sidewinder are among the weapons likely to come into the aircraft's inventory in the near future.

The USAF intends to maintain the F-15E in service until at least 2030, with a dedicated strike variant of the F/A-22 Raptor, based upon the cancelled F-22B two-seat operational trainer, a likely candidate as its replacement.

Export Strike Eagles

Israel was the lead export customer for the Strike Eagle, taking the F-15I Ra'am (Thunder), which is closely based on the PW-229-powered F-15E. The first two of 25 aircraft were handed over to the IDF/AF during January 1998 with the final examples arriving by the close of the following year.

After operations during Enduring Freedom, this 391st FS, 366th Air Expeditionary Wing F-15E gained distinctive nose art and a sizeable mission scoreboard. Note that one mission involved the use of the GBU-28 penetrating bomb. The aircraft is home based at Mountain Home. (FJ Photography/Steve Davies)

This pair of F-15Es nicely demonstrates the asymmetric loadouts commonly associated with the type. Both aircraft have an AIM-120 to one side and an AIM-9 to the other. Their underwing pylons are carrying SUU-20 practice bomb carriers, while the pod visible below the port intake trunking is the AAQ-14 component of the LANTIRN system. (Boeing via David James)

The second overseas Strike Eagle customer was also an existing F-15 operator. The Royal Saudi Air Force (RSAF) was initially offered the Strike Eagle as the F-15XP, which was later re-designated as the F-15F. This was a single-seat variant of the USAF's F-15E and at first the Saudis considered buying 24 examples, together with 48 of a two-seat, combat-capable trainer derivative.

However, the F-15F was not built and instead the RSAF purchased a downgraded version of the F-15E known as the F-15S. The first aircraft was delivered in 1995 and all 72 ordered had entered service by November 1999.

After much debate and many test evaluations, South Korea announced in April 2002 that the Strike Eagle had been selected to fulfil the Republic of Korea Air Force's (RoKAF's) F-X Fighter Programme as a replacement for its F-4 Phantom II and F-5E Tiger II fighter-bombers. The RoKAF ordered 40 aircraft under the designation F-15K for delivery between 2005 and 2008. The F-15K is the first Strike Eagle variant with the General Electric F110-GE-129 engines that had first been tested by the USAF in the late 1990s.

Among the very advanced features fitted to the F-15K will be the new Joint Helmet-Mounted Cueing System (JHMCS), while weapons will include JDAM, AGM-130, AGM-84 Harpoon and SLAM-ER.

Even though the basic design features of the Strike Eagle and its Eagle forebears stretch back over 30 years, the aircraft is still a formidable foe. The low-level, long-range Strike Eagle represents the zenith of this design process. Still in production and still a match for even the latest generation of potential rivals, the Strike Eagle truly represents the supreme fighter-bomber in use today. Repeatedly proven in combat, the Strike Eagle will remain a feature of the world's aviation scene for many years to come.

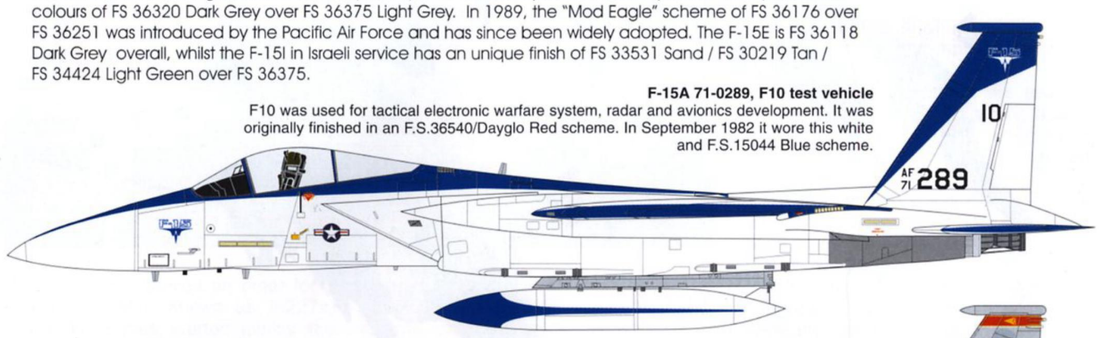
David James

Photographed during pre-delivery testing in the US, this Ra'am is shrouded in a sonic shockwave. The F-15I joined te IDF/AF's No. 69 Sqn in 1998 and the aircraft was soon in combat. It has continued with an active combat role ever since. (Boeing via David James)

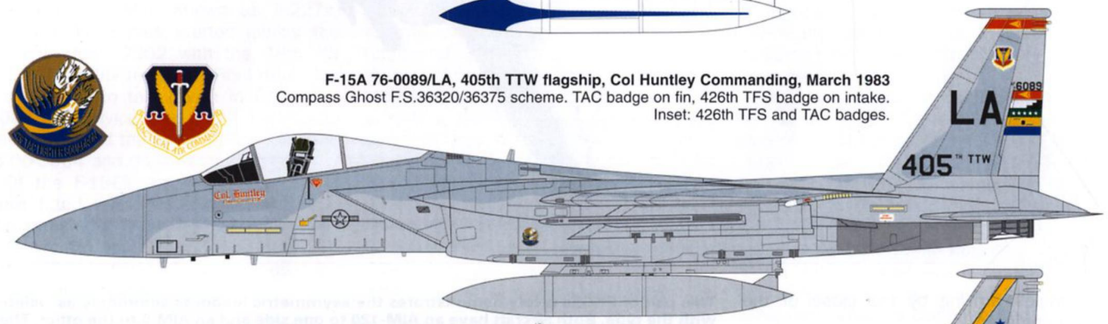
Boeing F-15 Eagle drawings by David Howley

Black	White	Yellow	R. Red	R. Blue	FS 36320 (Compass Ghost)	FS 36375 (Compass Ghost)	FS 36176 (Mod Eagle)	FS 36251 (Mod Eagle)	FS 36118

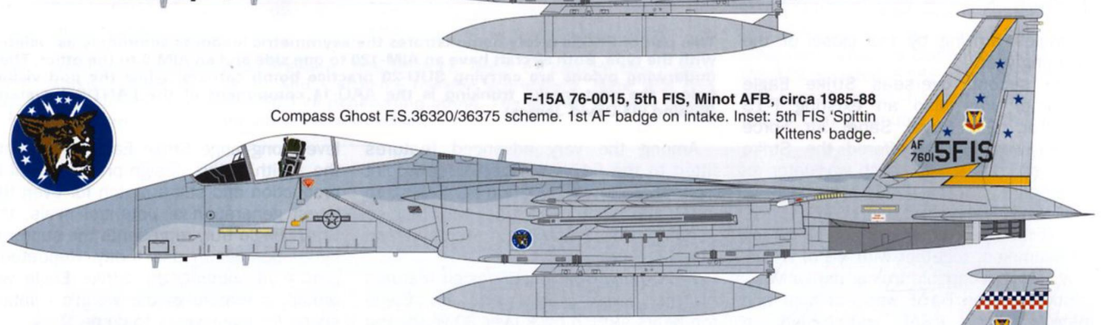
In 1975 the USAF changed from the "Air Superiority Blue" scheme (FS 35450/15450) to the "Compass Ghost" colours of FS 36320 Dark Grey over FS 36375 Light Grey. In 1989, the "Mod Eagle" scheme of FS 36176 over FS 36251 was introduced by the Pacific Air Force and has since been widely adopted. The F-15E is FS 36118 Dark Grey overall, whilst the F-15I in Israeli service has an unique finish of FS 33531 Sand / FS 30219 Tan / FS 34424 Light Green over FS 36375.



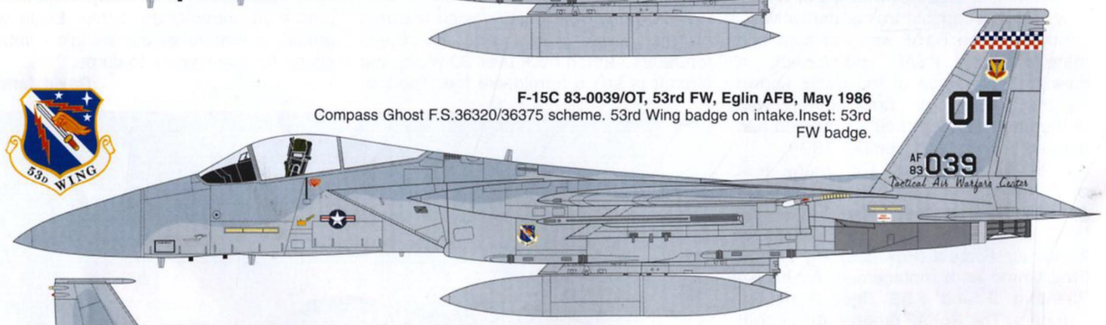
F-15A 71-0289, F10 test vehicle
F10 was used for tactical electronic warfare system, radar and avionics development. It was originally finished in an F.S.36540/Dayglo Red scheme. In September 1982 it wore this white and F.S.15044 Blue scheme.



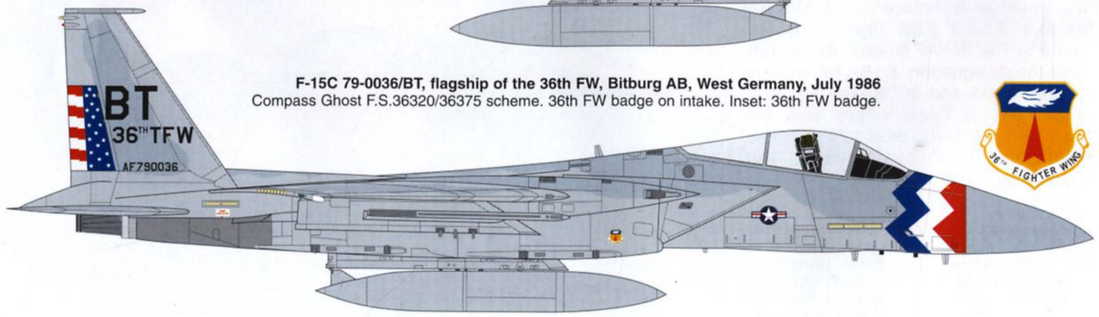
F-15A 76-0089/LA, 405th TTW flagship, Col Huntley Commanding, March 1983
Compass Ghost F.S.36320/36375 scheme. TAC badge on fin, 426th TFS badge on intake. Inset: 426th TFS and TAC badges.



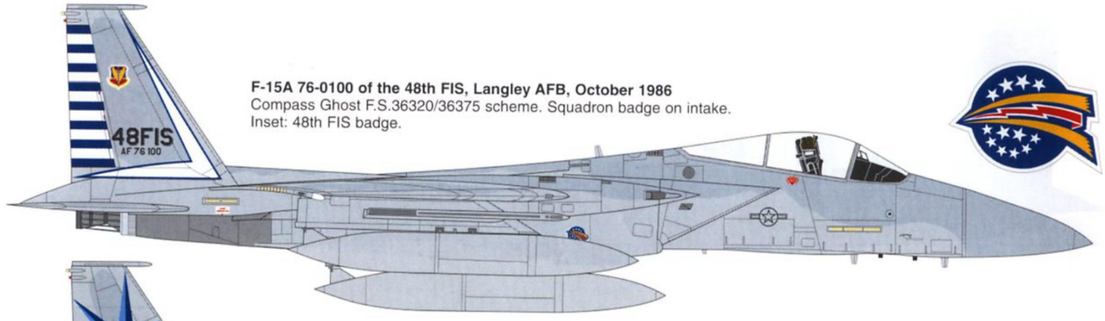
F-15A 76-0015, 5th FIS, Minot AFB, circa 1985-88
Compass Ghost F.S.36320/36375 scheme. 1st AF badge on intake. Inset: 5th FIS 'Spittin Kittens' badge.



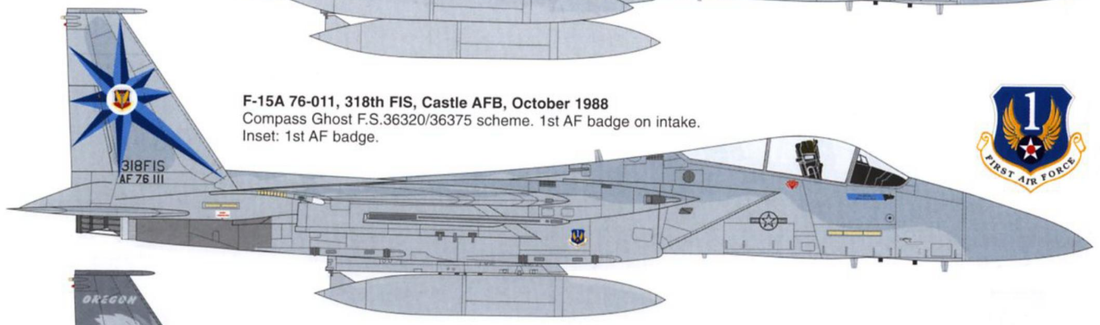
F-15C 83-0039/OT, 53rd FW, Eglin AFB, May 1986
Compass Ghost F.S.36320/36375 scheme. 53rd Wing badge on intake.Inset: 53rd FW badge.



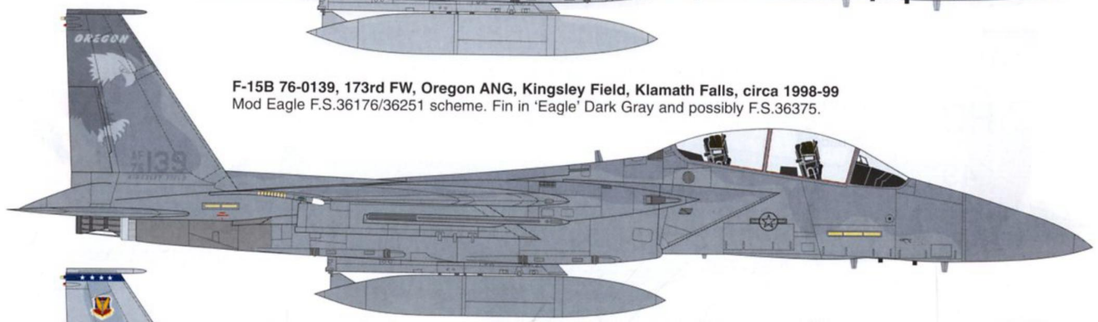
F-15C 79-0036/BT, flagship of the 36th FW, Bitburg AB, West Germany, July 1986
Compass Ghost F.S.36320/36375 scheme. 36th FW badge on intake. Inset: 36th FW badge.



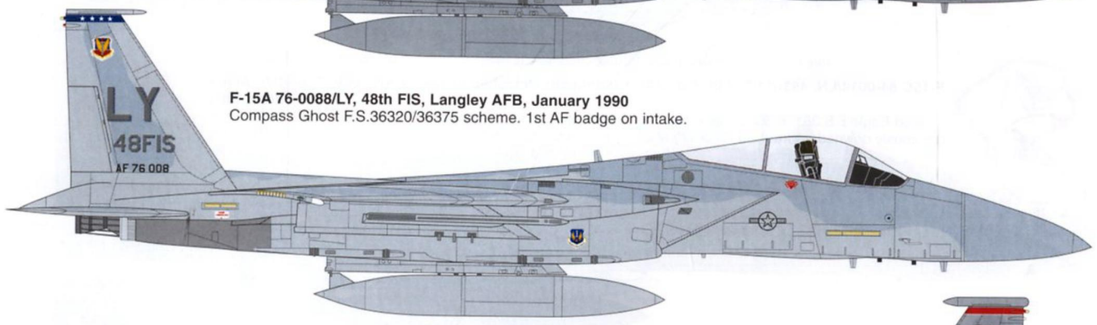
F-15A 76-0100 of the 48th FIS, Langley AFB, October 1986
Compass Ghost F.S.36320/36375 scheme. Squadron badge on intake. Inset: 48th FIS badge.



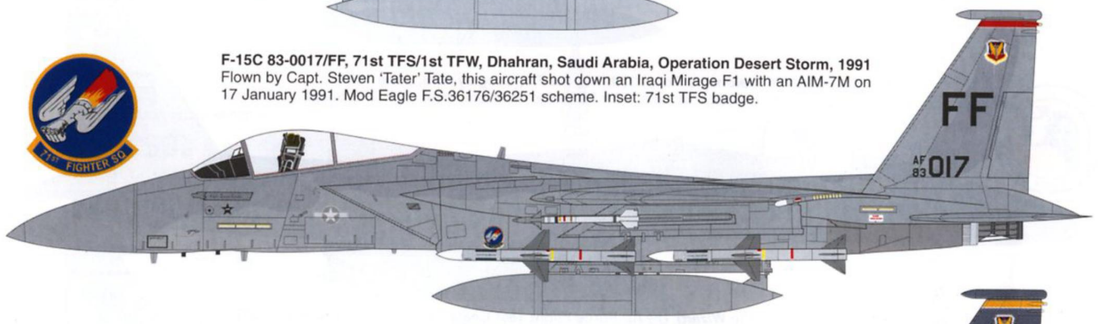
F-15A 76-011, 318th FIS, Castle AFB, October 1988
Compass Ghost F.S.36320/36375 scheme. 1st AF badge on intake. Inset: 1st AF badge.



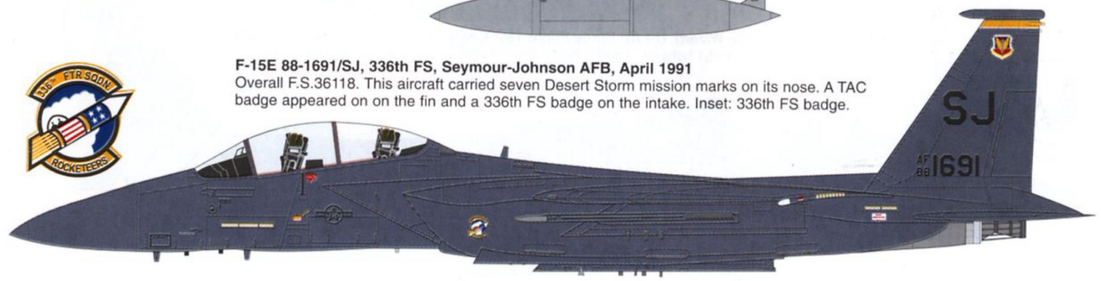
F-15B 76-0139, 173rd FW, Oregon ANG, Kingsley Field, Klamath Falls, circa 1998-99
Mod Eagle F.S.36176/36251 scheme. Fin in 'Eagle' Dark Gray and possibly F.S.36375.



F-15A 76-0088/LY, 48th FIS, Langley AFB, January 1990
Compass Ghost F.S.36320/36375 scheme. 1st AF badge on intake.

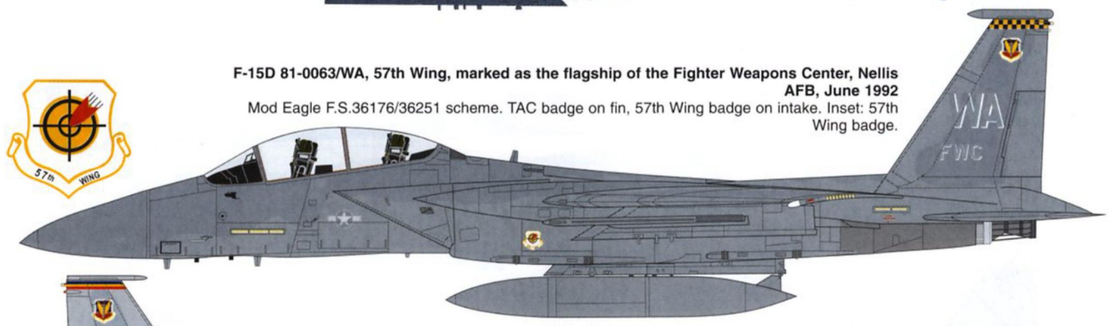


F-15C 83-0017/FF, 71st TFS/1st TFW, Dhahran, Saudi Arabia, Operation Desert Storm, 1991
Flown by Capt. Steven 'Tater' Tate, this aircraft shot down an Iraqi Mirage F1 with an AIM-7M on 17 January 1991. Mod Eagle F.S.36176/36251 scheme. Inset: 71st TFS badge.

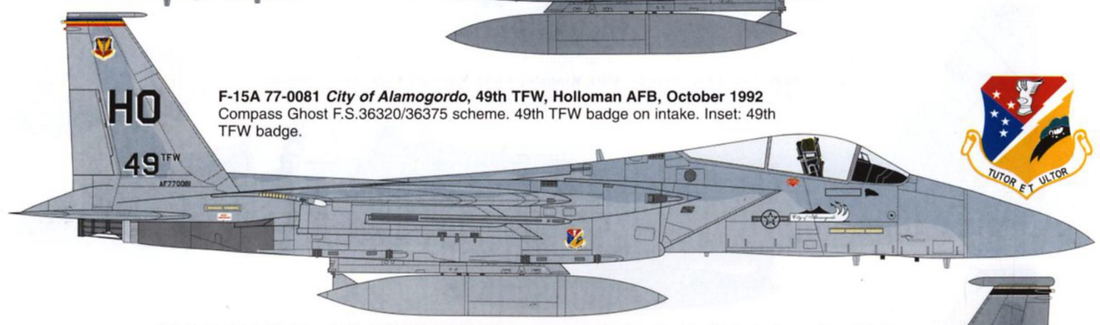


F-15E 88-1691/SJ, 336th FS, Seymour-Johnson AFB, April 1991
Overall F.S.36118. This aircraft carried seven Desert Storm mission marks on its nose. A TAC badge appeared on on the fin and a 336th FS badge on the intake. Inset: 336th FS badge.

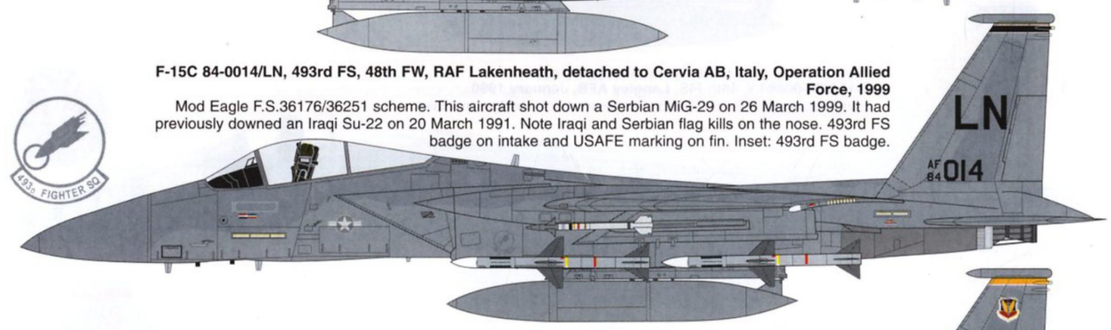
F-15E 87-0185/LF, 56th FW, Luke AFB, May 1992
Overall F.S.36118. 56th FW badge on intake, Training Command badge on fin. Inset: 56th FW badge.



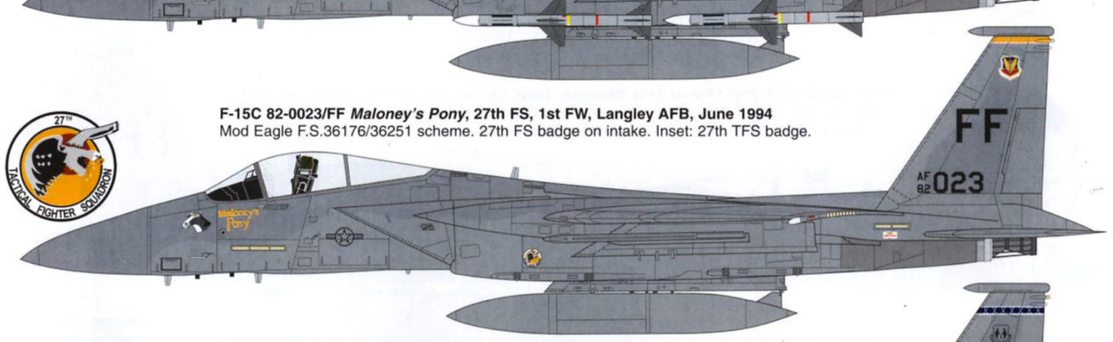
F-15D 81-0063/WA, 57th Wing, marked as the flagship of the Fighter Weapons Center, Nellis AFB, June 1992
Mod Eagle F.S.36176/36251 scheme. TAC badge on fin, 57th Wing badge on intake. Inset: 57th Wing badge.



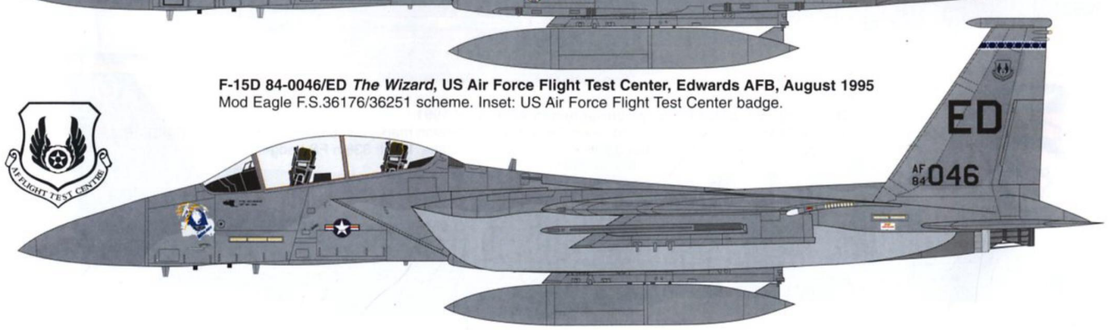
F-15A 77-0081 *City of Alamogordo*, 49th TFW, Holloman AFB, October 1992
Compass Ghost F.S.36320/36375 scheme. 49th TFW badge on intake. Inset: 49th TFW badge.



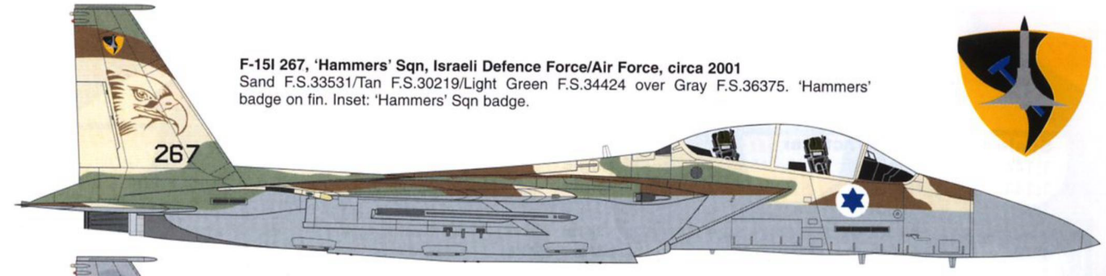
F-15C 84-0014/LN, 493rd FS, 48th FW, RAF Lakenheath, detached to Cervia AB, Italy, Operation Allied Force, 1999
Mod Eagle F.S.36176/36251 scheme. This aircraft shot down a Serbian MiG-29 on 26 March 1999. It had previously downed an Iraqi Su-22 on 20 March 1991. Note Iraqi and Serbian flag kills on the nose. 493rd FS badge on intake and USAFE marking on fin. Inset: 493rd FS badge.



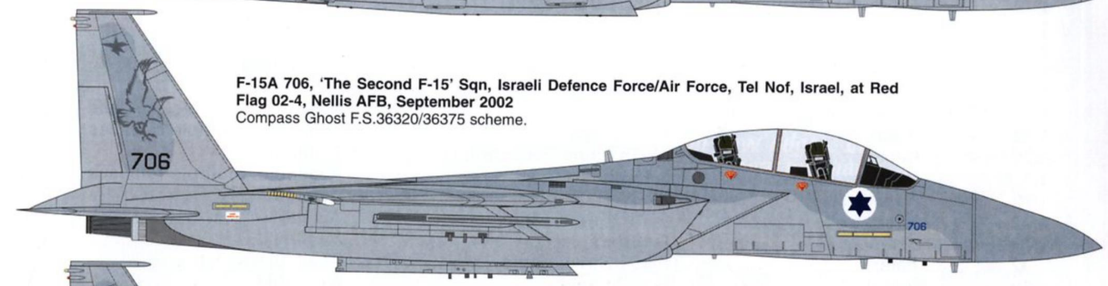
F-15C 82-0023/FF *Maloney's Pony*, 27th FS, 1st FW, Langley AFB, June 1994
Mod Eagle F.S.36176/36251 scheme. 27th FS badge on intake. Inset: 27th TFS badge.



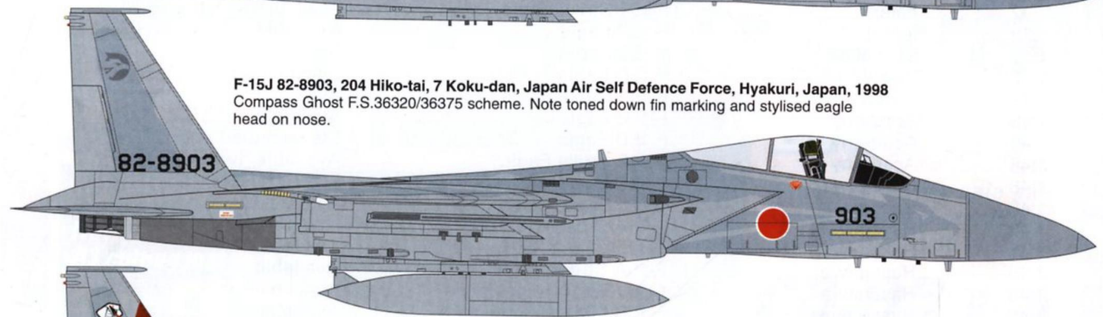
F-15D 84-0046/ED *The Wizard*, US Air Force Flight Test Center, Edwards AFB, August 1995
Mod Eagle F.S.36176/36251 scheme. Inset: US Air Force Flight Test Center badge.



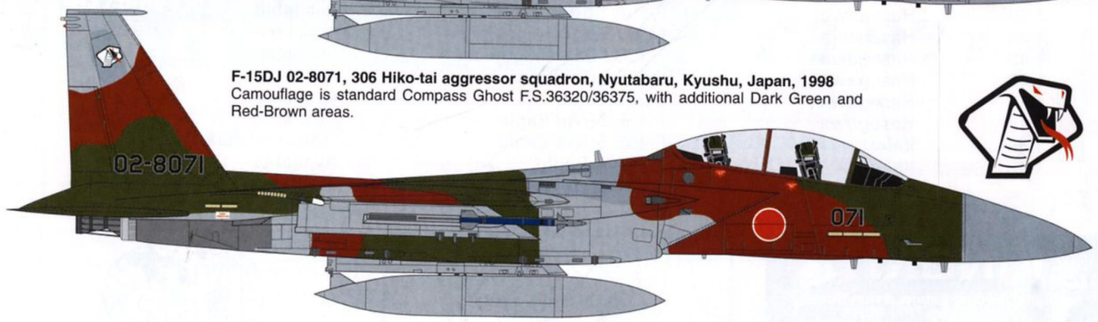
F-15I 267, 'Hammers' Sqn, Israeli Defence Force/Air Force, circa 2001
Sand F.S.33531/Tan F.S.30219/Light Green F.S.34424 over Gray F.S.36375. 'Hammers' badge on fin. Inset: 'Hammers' Sqn badge.



F-15A 706, 'The Second F-15' Sqn, Israeli Defence Force/Air Force, Tel Nof, Israel, at Red Flag 02-4, Nellis AFB, September 2002
Compass Ghost F.S.36320/36375 scheme.

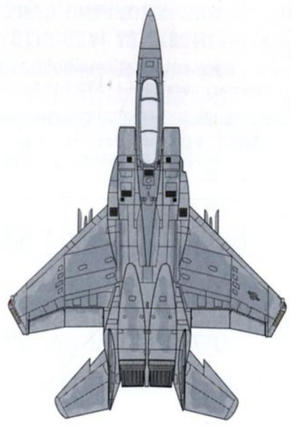


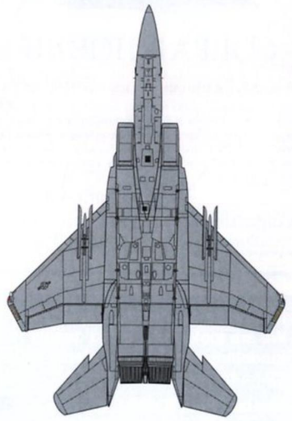
F-15J 82-8903, 204 Hiko-tai, 7 Koku-dan, Japan Air Self Defence Force, Hyakuri, Japan, 1998
Compass Ghost F.S.36320/36375 scheme. Note toned down fin marking and stylised eagle head on nose.



F-15DJ 02-8071, 306 Hiko-tai aggressor squadron, Nyutabaru, Kyushu, Japan, 1998
Camouflage is standard Compass Ghost F.S.36320/36375, with additional Dark Green and Red-Brown areas.

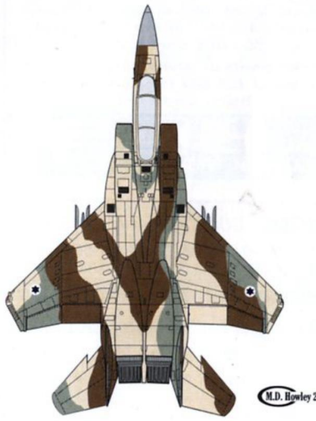
Upper surfaces of Compass Ghost and Mod Eagle scheme.





Lower surfaces of Compass Ghost/ Mod Eagle scheme.

Upper surfaces F-15I scheme.



M.D. Rowley 2003