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Marinefliegergeschwader 3
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RIAT 2023
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Attack Helicopter Part III
From Tiger to Havoc

Boeing F-15 EAGLE
Air Superiority Fighter

Coverstory:
RNLAF F-16 DemoTeam

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Contact

Burggaillenreuth 116
D-91320 Ebermannstadt
Germany
phone: +49 (0)177 4867937
mailto: chiefeditor@checksix.de
home: www.checksix-journal.com

Layout & Design

Team CHK6

Publisher

Robert Kysela

Managing editor

Robert Kysela

Contributors

Will Moore / UK
Danilo Bof / Italy
Marc Muick / Austria
Shawn Clish / Canada
Rob Hynes / Australia
Howard German / USA
Bjoern Engelke / Germany
Joris van Boven / Belgium

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CONTENT

BRIEFING

A lot has happened since the release of our first issue in January 2023. We received much encouragement but also much advice for which I would like to thank you at this point. With this help we are able to improve - a little bit of it you can already see in this issue. Our layout has been revised and appears not only much more clear but also a little bit cooler! The quality of our articles is also increasing and the acceptance of our journal as a military aviation magazine has been confirmed by all sides. This makes me personally proud, of course, but at the same time it is an incentive to continue to live up to the high standards we have set ourselves. With issue IV/2023, we are therefore following up once again - enjoy reading!

Robert Kysela

PS.: I always look forward to receive your feedback:

chiefeditor@checksix-journal.com

MARINEFLIEGERGESCHWADER 3 "GRAF ZEPPELIN"

Naval Air Station Nordholz / Germany

Lockheed P-3C CUP ORION / *image by: Robert Kysela*

After the founding of the Federal Republic of Germany in 1956, the Navy was reorganized to accommodate its own aviation units. From the very beginning, it was planned to create its own naval aviation units. Their primary task was to supress amphibious landing operations of the Warsaw Pact in the Baltic Sea area and to combat Soviet naval units in the North and Baltic Sea regions. To this end, five naval air wings (NAW) were established for the Bundesmarine* (Federal Navy), including two helicopter wings (NAW 4 and NAW 5). After the collapse of the Soviet Union and the resulting elimination of the threat in the Baltic Sea area, the naval aviation forces were drastically reduced and their tasks adapted to the changed situation. Only two of the five squadrons remained - Naval Air Wing 5 and Naval Air Wing 3 "Graf Zeppelin".

story & all images by: Robert Kysela

*Unofficial designation. After reunification (1990) this was changed to DEUTSCHE MARINE (German Navy).

MILITARY UNIT

Naval Air Station Nordholz

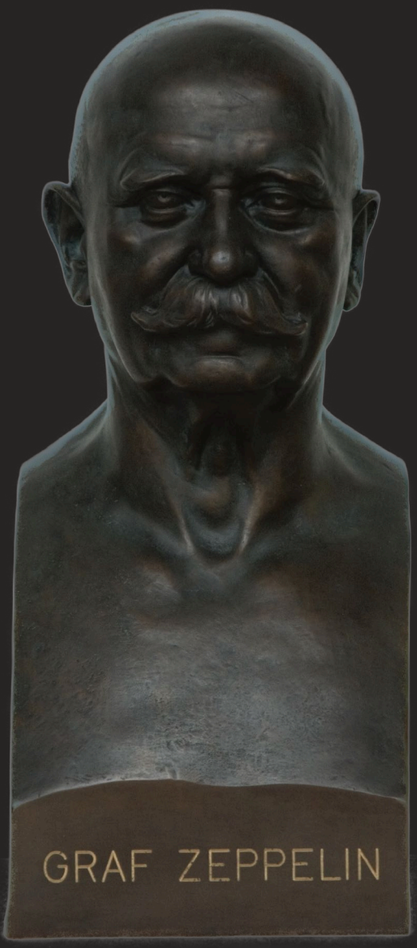
Naval aviation has a long tradition in Germany. By imperial decree (with a so-called A.K.O - Allerhoechste Kabinettsorder = Order-in-Council) of May 3rd, 1913, the establishment of a naval aviation department as well as a naval airship department was started. The port town of Putzig (today: Puck/ Poland) served as the first location for the aviation department, and the small town of Nordholz, not far from the port town of Cuxhaven, was selected as the location for naval airships. At that time, airships still had a very high (strategic) value. A total of six huge hangars (four double hangars and two single hangars) could accommodate up to ten (!) airships. These huge hangars had a length of almost 200 m and a height of 30 m. Primarily, attacks on the British mainland were flown from Nordholz with Zeppelin and Schuette-Lanz airships. One important task of the naval airships, however, was maritime reconnaissance. After the war, not only were all the remaining airships destroyed, but the huge hangars were also dismantled. In the period from 1937 to 1945 the air base was used militarily by various Luftwaffe units.

After the war, the U.S. Army Air Force took over the airfield in Nordholz and stationed Republic P-47 THUNDERBOLT fighter-bombers of the 406th Fighter Group there, but only for a relatively short time (until August 1947). After that, the site was used for civilian purposes. It was not until the mid-1950s that the newly created Bundeswehr (Federal Army) began to consider reactivating the air base and using it as a NATO naval airfield. Construction work on this began in 1959, and when it was completed in 1963, the first unit, Naval Air Wing 2, was able to begin preparations for flight operations. With the formation of the Naval Air Wing 3 in 1964/1965, new owners moved into the accommodations and barracks of Nordholz once again.

The airfield (ICAO code: ETMN) has a single concrete runway with a length of 2 438 m. Today, the whole remaining naval aviation units of the german navy are stationed at NAS Nordholz, including the higher-level Naval Air Command as well as the two air wings - Naval Air Wing 3 (MFG 3) and Naval Air Wing 5 (MFG 5). The latter is a helicopter Wing flying Westland SEA LYNX Mk.88 as well as Westland SEA KING Mk. 41, which currently is to be replaced by the new NH-90 (NTH) SEA LION. The LYNX Mk.88 is primarily used as an onboard-helicopter on frigates of the German Navy.

With a staff of nearly 2 500 men and women (military personnel and civilian employees), NAS Nordholz is one of the largest employers in the region.

Naval Air Station Nordholz / image by: Robert Kysela



Ferdinand Graf v. Zeppelin (1838-1917)
Aeronauticum Museum Nordholz

Breguet Br.1150M ATLANTIC (SIGINT-Signals Intelligence) / image by: Robert Kysela

Official patch of the Naval Air Wing 3 "Graf Zeppelin"

The era of the ATLANTIC

The order to establish the new squadron was issued on July 1st, 1964, and the Nordholz Air Base was handed over to the first Commanding officer, Commander (Fregattenkapitaen) Paul Kriebel, very promptly in January of the following year. The initial equipment included ASW-aircraft of the British type Fairey A.S.4 GANNET. This single-engine turboprop was quickly replaced by the then brand-new Breguet Br.1150 ATLANTIC, an aircraft type which remained in service with NAW 3 until 2010. The ATLANTIC was a twin-engine maritime patrol aircraft (MPA) that was explicitly designed for this purpose from the outset and was not derived based on a commercial aircraft. The German Navy flew the Br.1150 in the maritime reconnaissance variant as well as in the SIGINT version (SIGINT = SIGnal INTellegence). In total, Naval Air Wing 3 had 15 aircraft for maritime reconnaissance and five for electronic reconnaissance/communications surveillance.

For a maritime patrol aircraft, the technology of the aircraft is less important than the sensors and electronics installed in the aircraft. The Br.1150 ATLANTIC was a conventional aircraft powered by two Rolls Royce RTy.20 Mk.21 TYNE engines. It was based on the aviation technology of the 1960s. For this reason, Dornier was commissioned in 1978 to upgrade all ATLANTIC maritime reconnaissance aircraft by means of a combat effectiveness program (KWS = Kampf-Wert-Steigerung). For this purpose, a pulse Doppler radar (AN/APS-134) and an acoustic signal processing system of the type AN/AQA-5 from Emerson were integrated. The AN/APS-134 operated in the X-band range (8-12 GHz) and could detect up to 32 surface targets.

Each aircraft can complete a certain number of flight hours (based on the airframe) before it reaches the end of its life cycle. After more than 30 years of continuous operation over the North Sea and the Baltic Sea, the airframes of the Br.1150 had reached the end of their service life. Because maritime reconnaissance aircraft sometimes operate at very low altitudes (a mission usually runs in a range from 100 feet to a maximum of 5 000 feet), they are subjected to considerably greater stress than a civilian airliner, which spends most of its flying time at high altitudes in relatively calm air. In maritime operations, the salinity of the air is an additional factor, affecting the airframe and various components. For this reason, the Br.1150s were withdrawn from service with NAW 3 as early as 2005, with only two Br.1150M SIGINT aircraft remaining in service until June 2010 in the absence of a successor.

The search for a successor for the Breguet Br.1150 was not that easy. The ATLANTIQUE II (or NG - Nouvelle Generation) version of the Br.1150 offered by the manufacturer Dassault-Breguet was out of the question for Germany, among other things, because this aircraft was still based on the old airframe. The development of such a highly complex weapon system as a maritime patrol aircraft is very cost-intensive. What further drives up the unit price of the individual aircraft is the fact that the expected sales figures for this category of aircraft are, by their very nature, relatively low. It is not for nothing that most long-range naval aircraft of the last 50 years have been based on civil aircraft types. In the 1990s, there were not particularly many alternatives on the (Western) market; above all, there was hardly any modern aircraft available. In addition, in the case of Germany, after the Warsaw Pact threat was removed, there was a political unwillingness to commission a new armaments project. What was the point of buying expensive military technology if it was no longer needed? There were even considerations of having other NATO partners perform maritime reconnaissance. After evaluating various options, the German Ministry of Defense under then Minister Peter Struck (SPD) opted for a pragmatic solution by procuring eight used Lockheed P-3C ORION aircraft from the Dutch Navy at a purchase price of just under 271 million euros. What at first seemed like a bargain unfortunately turned out to be a cost trap. The Dutch P-3Cs already had more than 20 years of service life under their belts (all the aircraft were built between 1981 and 1984) and were not in the best of technical condition. Extensive maintenance and modernization work, especially in the area of the wings, was necessary to ensure that NAW 3 could continue to fulfill its mission. For NAW 3, the Lockheed P-3C ORION was a great challenge on the one hand, but also a quantum leap in mission technology and operational capabilities on the other.

CRT-Console / Br.1150 / image by: Robert Kysela

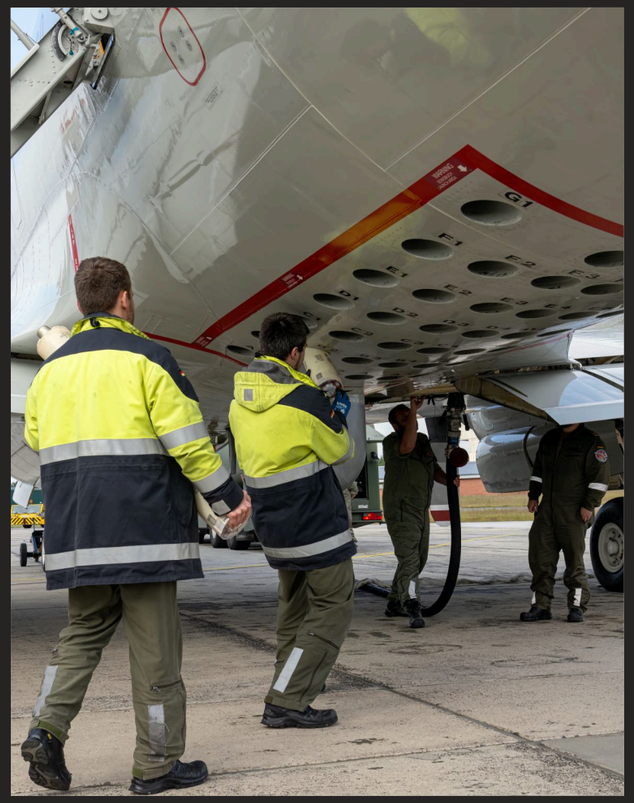
MILITARY UNIT

Lockheed P-3C ORION

With 734 units built, the P-3 ORION is the most successful maritime patrol aircraft in history. Based on the civilian Lockheed Model 188 ELECTRA, the first series-produced four-engine turboprop airliner in the U.S., the new Navy long-range maritime reconnaissance aircraft, designated YP-3A, had its maiden flight on August 19th, 1958. The special feature of this aircraft is its relatively short wings, which are equipped with large Fowler flaps, four oversized engines and powerful four-blade propellers. In contrast to the civilian ELECTRA, which was a commercial loss-maker for Lockheed (just 170 L-188s were built, including prototypes), the P-3 was an enormous success for the U.S. manufacturer. For the U.S. Navy alone, a total of 647 units were produced until production was discontinued in April 1990.

The German government's decision to replace an aircraft from the 1960s with another type from that period seems illogical at first glance. Since the Dutch P-3Cs are still relatively new, there were still enough remaining flight hours on all aircraft. In addition, the complete mission avionics of the Dutch aircraft were brought up to the very latest level with a Capabilities Upkeep Program (CUP) shortly before they were handed over to NAW 3. The Texas Instruments AN/APS-115 radar originally used on the P-3C was replaced by the more powerful AN/APS-137[V]5 from Raytheon. This synthetic aperture broadband radar is also used in a modernized variant (AN/APY-10) in the P-3s designated successor, the Boeing P-8A POSEIDON.

Lockheed P-3C CUP ORION / image by: Robert Kysela



Loading a sonobuoy in one of the launchers

Flight-ready P-3C towed from the maintenance hangar

MILITARY UNIT

Magnetic Anomaly Detector (MAD)

The mission of NAW 3 consists of the following areas:

- Submarine hunting, independently as well as in cooperation with surface units and/or own submarines
- Surveillance and reconnaissance of enemy naval forces (including target data transmission to NATO units).
- Acquisition of electromagnetic signals and creation of an "Electronic Order of Battle (EOB)"
- SAR / search and rescue operations

Direct engagement of surface units is not envisaged. German naval aviators do not carry anti-ship missiles, such as the AGM-84D HARPOON, in their ORION. The only offensive armament used is the ATK Mk.46 lightweight torpedo. A maximum of eight of these 234 kg torpedoes can be carried. The Mk.46, in its current Mod 5A(S) version, carries a 43.9 kg combat charge consisting of a plastic-bonded explosive (PBXN-103). This enables the ORION to effectively engage tracked-down submarines. The range of these torpedoes is reported to be just over 10 000 meters, and the speed of the Mk.46 is up to 45 knots (83.3 km/h).

The decisive factor in detecting enemy submarines is the sensor technology used and the processing electronics. The P-3C has a fixed launcher for up to 52 sonobuoys, and can carry more internally. The sonobuoys are divided into passive (AN/SSQ-53F DIFAR) and active (AN/SSQ-62F DICASS) devices. Both variants are programmable (for example, the depth setting, transmission/life time of the buoy or even the frequency range used). The fall of the sonobuoy is slowed down by a small parachute after dropping, the battery and thus the power supply is activated by contact with salt water. With the help of a float filled with CO2, the sonobuoy will sink to the preset depth and be held in suspension there. The maximum lifetime (transmission time) of these buoys is eight hours.

Passive sonobuoys detect sounds caused by ship propellers, propulsion systems or other non-natural sources. Water (especially salt water) conducts acoustic sounds very well and over long distances. The advantage of passive sonar is primarily the fact that the targeted submarine is unaware that it is being tracked. This is different with active sonar buoys. Here, a sound wave pulse is emitted (PING), which is reflected by the metal surface of the submarine. In the case of both passive and active sonobuoys, this acoustic energy is detected by highly sensitive hydrophones (a type of underwater microphone). In the case of the active sonobuoy, the hydrophone is also used to generate the PING. The greatest danger, especially in offshore waters, comes from diesel-electric submarines. These are extremely quiet and therefore much harder to detect than most nuclear-powered submarines. Active sonobuoys are better suited for rapid detection, but they also give the submarine commander a warning that his boat is being located. Before active or passive sonobuoys are dropped, an additional buoy (for example: AN/SSQ-36B) can be used to determine the water temperature and salinity. These have a significant influence on the propagation of the sound waves and are therefore essential for locating a submarine. All signal processing is performed in Lockheed Martin's AN/USQ-78B Acoustic Processing and Display System.

Another passive method of detecting submarines is the Magnetic Anomaly Detector (MAD). This reacts to the change in the earth's magnetic field caused by a submerged submarine. Since this is an extremely sensitive device, it is mounted as far away as possible from other aircraft avionics. In most maritime patrol aircraft, this is why it is located in a boom at the end of the aircraft fuselage. Technically, a MAD is a magnetometer that continuously measures the magnetic strength of the earth's magnetic field and can localize changes. In fact, there are three elements (helium gas detectors) in the MAD that are oriented to measure the magnetic strength along the longitudinal, transverse, and vertical axes and thus, at least in theory, can provide a very accurate determination of a submerged submarine to the central computer. The disadvantage of this method is the small range due to the very small measurable deviation caused by a submerged submarine. Therefore, only submarines that are not too deep can be located. Also the altitude has a big influence. Therefore, when using MAD detection, the aircraft must operate at a very low altitude. Detection in shallow waters such as the Baltic Sea is also difficult (the maximum depth of the Baltic Sea is 459 m, the average depth is just 52 m), since sunken ships interfere with the situation picture. On the plus side of MAD is its insensitivity to the prevailing weather conditions or sea state. In the case of the P-3C, an AN/ASQ-81 MAD system from Texas Instruments is used. The designated successor to the P-3C, the Boeing P-8 POSEIDON does not use a MAD sensor but a device for detecting diesel exhaust gases (hydrocarbon detector).

MILITARY UNIT

Lockheed P-3C CUP ORION / image by: Robert Kysela

Tech Sheet (Lockheed P-3C ORION):

Length:	116 ft 10 in (35,61 m)
Height:	33 ft 8 in (10,27 m)
Wingspan:	99 ft 8 in (30,38 m)
Take-off weight:	142 000 lbs (64 410 kg)
Max speed:	473 mph (760 km/h)
Ceiling:	28 300 ft (8 600 m)
Rate of climb:	1 950 ft/min (9,9 m/s)
Combat range:	1 345 nm (2 491 km)
Power plant:	4 x Allison T-56-A-14 Turboprops
Performance:	4 910 SHP each
Armament:	8 x Torpedoes Mk.46

For maritime surveillance and reconnaissance, the German Naval Aviation´s P-3C has a full suite of sensors, most notably the MX-20HD electro-optical camera system developed by L3Harris/Wescam. This enables the P-3Cs crew to generate high-resolution video footage or images even from high altitudes, allowing real-time situational awareness. The system consists of two optical cameras (one wide-angle and one telephoto) an infrared camera and a laser rangefinder. The entire system is installed in a five-axis stabilized turret that is recessed, located in the forward section below the cockpit of the P-3C, and deployed only in flight (when needed).

Another important part of any maritime patrol aircraft's avionics suite is its radar, in the case of the P-3C the aforementioned Raytheon AN/APS-137[V)5, which allows the crew to detect, identify/classify and track targets at long range (up to 370km). The AN/APS-137 is capable of detecting and identifying objects as small as a deployed periscope or the antenna of a submarine on the surface of the water.

The P-3C ORION is powered by four Allison T-56-A-14 turboprops, each rated at 4,910 SHP, acting on a 4.11 m Hamilton Standard 54H60-77 four-blade propellers. This enables a formidable top speed of 760 km/h (473 mph). Missions are usually flown at a relatively moderate speed of about 380 km/h (236 mph).

Boarding for the next mission / *image by: Robert Kysela*

The Mission

A mission begins long before the aircraft leaves the hangar. The preparation of the P-3C alone requires a great deal of effort from the maintenance crew. Depending on the planned mission, it can take up to four hours to complete all pre-flight inspection checks and adjustments (GVI = General and Visual Inspection). When the aircraft is then released from maintenance, it is towed by a tug to the apron, where it is refueled and the armament carried (torpedoes, practice torpedoes, sonobuoys, etc.) is loaded. During a full refueling, 34 800 liters of kerosene flow into a P-3C. This gives it a range of a little bit less than 9 000 km, which corresponds to an operational radius of about 2 500 km. However, the ORION does not have an air refueling capability.
In peacetime, torpedoes are not carried on every mission. The use of live Mk.46 torpedoes is practiced at irregular intervals, and practice torpedoes must be dropped by each crew at least once a year. After being dropped, these torpedoes are recovered by Navy ships and can thus be reused. After refueling and loading, the P-3C is towed to a parking position near the runway, where the crew then begins boarding. Since a mission can last up to eleven hours, the crew must carry not only technical equipment but also food.

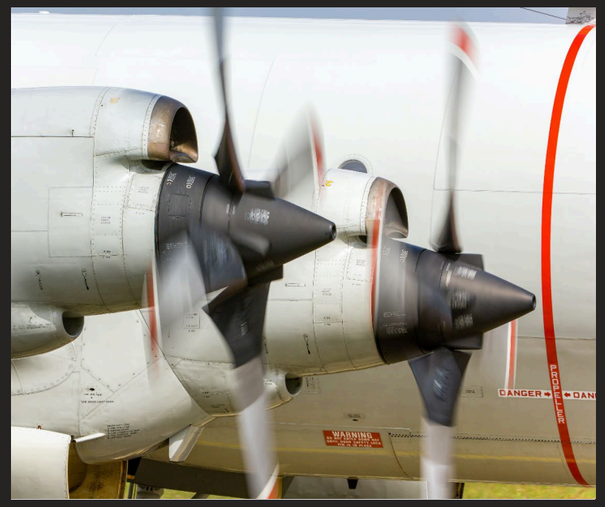
The crew normally consists of eleven men and women, but in individual cases it can grow to as many as 21 crew members. In relation to their area of responsibility, a crew is made up as follows:

- Pilot (Aircraft Commander)
- Copilot
- Flight engineer
- Flight technician (avionics)
- Tactical coordinator (TACCO)
- Navigator/Comm-specialist (NAV/COM)
- 3 x Surface vessel operator
- 2 × ASW-operator

In addition to daily operations over the North and Baltic Seas, NAW 3 has been very active outside its own territory. Missions were conducted in the Horn of Africa (Djibouti) as part of Operation ATALANTA, to combat piracy (from 2008 to 2022). NAW 3 has also been involved in the EUNAVFOR MED Irini mission since May 2020. This involves the implementation of a UN arms embargo in Libya. The operational area roughly covers the triangle of Sicily in the North and the entire Libyan coast from the border of Tunisia (West) and Egypt (East). In all these missions, the men and women of NAW 3 have repeatedly shown their high level of professionalism and thus also sustainably demonstrated how important a maritime reconnaissance squadron is for a country like Germany.

On patrol towards the North Sea!

Low-level flying (min. height: 100 ft)



The mighty Hamilton Standard 54H60-77

The reign of the POSEIDON

The procurement of the P-3C ORION was a necessary step in order to be able to guarantee the tasks of maritime reconnaissance and anti-submarine warfare. The first P-3C from the Netherlands landed in Nordholz on March 17th, 2006. Unfortunately, it quickly became clear to the Navy that the technical condition of the aircraft did not meet expectations. For example, hairline cracks and corrosion were discovered in the wing area. To increase operational readiness and extend service life, a costly upgrade program called MLU (Mid-Life Upgrade) was initiated, which included replacing entire sections of the wings. The entire program was delayed for a variety of reasons, and the cost of it was getting more and more out of control. Meanwhile, maintenance at NAW 3 was constantly struggling to maintain operational readiness as best they could. However, the technical difficulties did not diminish and it became more and more difficult to ensure the service status. Originally, the P-3C was to continue its service until a newly developed solution became available. According to plans, a joint Franco-German project based on the Airbus A320neo called Maritime Airborne Warfare System (MAWS) was to replace the current maritime patrol aircraft of both countries from 2035.

Due to the difficulties mentioned above and the fact that the constantly rising costs were simply no longer politically justifiable, the Ministry of Defense pulled the ripcord. Under then Defense Minister Annegret Kramp-Karrenbauer, the decision was taken to decommission the Lockheed P-3C ORION weapon system by 2025 at the latest, to discontinue all further modernization measures and to procure new Boeing P-8A POSEIDON as a replacement as quickly as possible. On June 30th, 2021, the Bundestag's budget committee approved the procurement of five aircraft of this type, which will start to replace the P-3C as early as the end of 2024. Full operational readiness of the P-8A is thus to be ensured from 2026.

The P-8A is based on the civilian Boeing 737NG. In fact, the P-8A has about 86% commonality with the civilian variant. The differences are, in addition to the installed sensors/avionics, a reinforced airframe, an internal (4.7 m long) weapons bay in the rear fuselage section and a wingspan increased by almost two meters. Instead of the winglets typical for the 737-800 series, so-called raked wingtips were used in the military version, as they are also used in the Boeing 767-400 series. In addition, the P-8A has air-to-air refueling capability, giving it, at least theoretically, an almost unlimited range. Of course, the avionics and sensor systems are state of the art. Compared to its predecessor, the AN/APS-137 used in the P-3C, the AN/APY-10 synthetic broadband airborne radar is considerably smaller and yet more powerful.

Along with the modern sensor system, the POSEIDON can also carry a large amount of different armament. There is room for up to five Mk.54 MAKO torpedoes in the spacious weapons bay. Whether the German Navy will opt for this torpedo type or go for another solution, for example the MU90 Impact from EuroTorp, is not yet clear. Also in the weapons bay, up to five Boeing AGM-84L HARPOON II sea target missiles can be carried. A total of four external load stations can carry additional guided missiles for sea targets and/or air-to-ground missiles to engage targets on land. Self-protection is given special importance in the P-8A. Together with an AN/ANR 54 radar warning receiver, numerous systems for self-protection or countermeasures are integrated, such as an AN/ALE-47 chaff/flare dispenser from BAe Systems. All self-protection and countermeasures are coordinated and controlled by the central ALQ-213(V) Electronic Warfare Management Unit.

BOEING

Tech Sheet (Boeing P-8A POSEIDON):

Length:	129 ft 6 in (39,50 m)
Height:	42 ft 1 in (12,83 m)
Wingspan:	123 ft 6 in (37,64 m)
Take-off weight:	189 200 lb (85 820 kg)
Max speed:	564 mph (907 km/h)
Ceiling:	41 000 ft (12 496 m)
Crew:	9 (2 x pilots; 7 system operators)
Combat range:	1 200 nm (2 225 km)
Performance:	2 x CFM-56-7BE rated at 121,4 kN
Armament:	5 x Torpedoes (Mk.54 MAKO) or 5 x AGM-84L HARPOON II missiles 129 x Sonobuoys

Boeing P-8A POSEIDON / *image: Robert Kysela*

MILITARY UNIT

Lockheed P-3C CUP ORION / image by: Robert Kysela

With the Boeing P-8A POSEIDON, the NAVAL AIR WING 3 "Graf Zeppelin" finally gets the aircraft that will ensure the execution of its mission for a long time to come!
The state-of-the-art technology coupled with a solid and, above all, proven platform also ensures that the decision makers can relax for the time being with regard to the successor - even if the MAWS is not available in 2035 as planned. The first crews are already in the U.S. for training, and the wing is eagerly awaiting the new type. The mission profile will change in some respects. The P-8 is faster and flies higher than the P-3C, and its sensors are much more powerful. The P-8A also represents a quantum leap for pilots. The modern glass cockpit and the elimination of the flight engineer are just two of the things that catch the eye. Flying the P-3C was manual work and anything but easy. In contrast, P-8 has all the aids that are built into a modern airliner, including multi-function displays and a powerful on-board computer/flight management system that reduces the pilot's workload. With each new aircraft, changes are inevitable, but one thing will remain: the high level of professionalism with which the men and women of NAW 3 perform their duties. The competent maintenance crew, who with almost stoic composure, ensure that a serviceable aircraft is handed over to the crew. And then the men and women of the flying unit, who for more than six decades have worked to ensure that their home is a lot safer!

Robert Kysela

AIRSHOW

THUNDER OVER MICHIGAN AIR SHOW 2023

Mikoyan MiG-17F (NATO Code: FRESCO) - Pilot: Randy W. Ball / image by: Robert Kysela

On August 12 and 13, 2023, the Yankee Air Museum (YAM) hosted their annual Thunder Over Michigan air show at the Willow Run Airport just west of Detroit. The show followed the same format as the two previous events with a drive-in style arrangement that featured separate morning and afternoon shows each day. This year marked a special milestone for the event as they celebrated their 25th anniversary. The first show was held in 1999 and was called “Mustangs & Mustangs” so it was very fitting that the North American P-51 MUSTANG was once again the highlight aircraft in 2023. Heavy bombers have always played a major role as theme aircraft throughout the show’s history, including in 2003 when the name “Thunder Over Michigan” was first used. All three of the heavy bombers used by the United States Army Air Corps in World War Two were on display.

Text: Shawn Clish / Images: Shawn Clish & Robert Kysela

Douglas C-47 DAKOTA "Hairless Joe"/ image by: Robert Kysela

Willow Run Airport / Michigan

The Commemorative Air Force (CAF) made a stop on their AirPower History Tour with their Boeing B-29A SUPERFORTRESS "FIFI" and Consolidated B-24 LIBERATOR "Diamond Lil" to sell rides and participate in the afternoon flying demonstration. This organization is the world's largest operator of classic military aircraft. At present, the CAF owns 175 aircraft, including such rarities as the Boeing B-29A or an original Mitsubishi A6M3 "ZERO". The organization was founded by a Texan pilot named Lloyd Parker Nolens under the name Confederate Air Force. This name was changed to Commemorative Air Force for various reasons (2002). The individual member organizations are distributed among 26 states of the USA as well as four countries (New Zealand, Switzerland, France and United Kingdom). With their huge amount of airworthy aircraft plus 11,000 members, the CAF is larger than various air forces of many countries. There were four other aircraft from the CAF that joined the bombers on the AirPower Tour to celebrate the 25th anniversary in Michigan. A Vought FG-1D CORSAIR flew each morning in the show and three trainers, a Boeing PT-13 KAYDET, a Fairchild PT-26 CORNELL and a North American T-6G TEXAN were parked together in the static.

Yankee Air Museum's Boeing B-17G FLYING FORTRESS "Yankee Lady" was also busy conducting rides to ensure the museum can continue its goal of educating individuals about the history of American aeronautics while inspiring generations through personal experiences. This aircraft was built by the Vega Division of Lockheed Aircraft Corporation at Burbank, California. Since it was delivered to the United States Army Air Force (USAAF) at the very end of the war it was almost immediately placed into storage. The aircraft was soon transferred to the Coast Guard and underwent modifications to remove all of the guns and turrets and was re-designated as a PB-1G, with the "P" standing for Patrol, the "B" for Boeing and the "G" for Coast Guard. It was purchased by the museum in 1986 and flew for the first time after a lengthy restoration in 1995, wearing its new markings to honour Joseph Slavic of the 381st Bomb Group who made significant financial contributions which allowed the museum to acquire the aircraft. "Yankee Lady" was joined in this mission by most of the museum's other airworthy aircraft: North American B-25D MITCHELL "Rosie's Reply", Douglas C-47D SKYTRAIN "Hairless Joe" and Bell UH-1H IROQUOIS (HUEY GREYHOUND). All four repeatedly took to the sky throughout the day when the airspace wasn't busy with displaying aircraft to conduct Air Adventures for guests who wanted to experience the thrill of flying in a special piece of history. The museum also had its beautifully restored Ford 4-AT-B TRI-MOTOR parked in the static area over the weekend, which will hopefully soon be available for pleasure flights as well.

The Yankee Air Museum has been a resident of the Willow Run Airport since it was founded in 1981. A lot has changed for the museum since this time. A devastating fire in October 2004 destroyed the original World War Two building the museum was housed in along with artifacts, tools, parts and a collection of aircraft that included the original prototype North American Rockwell YOV-10A BRONCO, a former USAF Thunderbirds Republic F-105 THUNDERCHIEF and an Aero L-39 ALBATROS. After reopening in 2010, the museum started the "Save the Bomber Plant Campaign" and with the help of thousands of "Rosie the Riverter´s" they managed to raise enough money to purchase a portion of the famous facility that built Consolidated B-24 LIBERATORS which now is home to some of the museum's large aircraft acquisitions like a Martin RB-57A CANBERRA, a Consolidated PB4Y-2 PRIVATEER, Lockheed EC-121 WARNING STAR and a Lockheed P2V-7 NEPTUNE. There are also 20 aircraft on static display in the primary museum building available for tours including a Douglas SBD DAUNTLESS that flew off the USS Ranger during Operation Torch in November of 1942 while with VS-41, then later crashed in Lake Michigan while with the Carrier Qualification Training Unit and stayed there for 53 years until it was recovered in 1996. Also part of the static display but located outside is a Boeing B-52D STRATOFORTRESS that was deployed to Southeast Asia and flew over 600 combat missions during the Vietnam war. Fortunately, the airworthy collection of aircraft was saved during the 2004 fire and recently moved to a brand new Roush Aeronautics Center building that was completed in 2022.

Bell UH-1H HUEY "Greyhound" / image by: Robert Kysela

Lockheed Martin F-22A RAPTOR / *image by: Shawn Clish*

Thunder & Lightning

While Thunder Over Michigan has always maintained a strong focus on piston and rotary warbirds, over the years vintage jets and modern military acts have played major roles in the show. While the event was moved back close to its traditional date at the beginning of August it has been held in July, late August and even September in recent years. (Thunder Over Michigan was typically held the first weekend in August but has moved its dates around through the years to allow the United States Air Force Thunderbirds and United States Navy Blue Angels to participate. The show was supposed to be held the first weekend in August again in 2023 but was moved to accommodate a NASCAR race at the nearby Michigan International Speedway also scheduled that weekend). This year the United States Air Force sent the Lockheed Martin F-22 RAPTOR Demonstration Team to the show to demonstrate the unique capabilities of the world's premier fifth-generation fighter aircraft. The RAPTOR's performance was contrasted nicely by a display from Gregory "Wired" Colyer in his Lockheed CT-133 SILVER STAR "ACE MAKER III", the twin-seat training sibling of the Lockheed P-80 SHOOTING STAR, the first fighter jet used operationally by the United States Army Air Force. Greg Colyer is a native Californian and former Air Traffic Controller of the USAF who switch from the control tower into the cockpit.

There were also a pair of Mikoyan-Gurevich designs on display as Randy W. Ball displayed in his Mikoyan-Gurevich MiG-17F (NATO Code: FRESCO) and Dan Filer brought the world's only privately owned example of a Mikoyan-Gurevich MiG-23UB (NATO Code: FLOGGER).
Randy Ball is the only jet demonstration pilot in the United States to be granted an unlimited aerobatic waiver rating (allowing maneuvers to be conducted just above the ground) for both day and night flight by the Federal Aviation Administration. Randy showed off his ability to fly low and fast each afternoon during the show, reaching speeds close to 700 miles per hour while operating below 100 feel above the ground, then pulling up and showing off the incredible maneuverability of the nimble jet and pulling up to 8 G's (a g-force is a measure of acceleration due to gravity. 8 G's is equivalent to Randy's body weighing eight times its normal amount). While Randy's jet is painted in Soviet markings, the MiG-17 was made famous for its service in the Vietnam People's Air Force during the Vietnam War as the primary enemy fighting against American aircraft, especially the McDonnell Douglas F-4 PHANTOM II. Along with the MiG-17F that flew at the show, Randy's collection also includes a former Polish MiG-17PF (NATO Code: FRESCO D), a Canadian CT-133 SILVER STAR and a Cessna T-37 TWEET.

Lockheed Martin F-22A RAPTOR / *image by Robert Kysela*

Lockheed CT-133 SILVER STAR / *image by Shawn Clish*

Mikoyan & Gurevich MiG-17F / image by: Robert Kysela

AIRSHOW

North American P-51D MUSTANG "Swamp Fox"

image by: Robert Kysela

357th Fighter Group

The theme this year focused on the P-51 Mustang and more specifically the 357th Fighter Group. The 357th was activated at Hamilton Field, California on December 16, 1942, and initially trained on the Bell P-39 (D, L, N and Q models) AIRACOBRA at Tonopah, Nevada. The group transitioned to early B models of the Mustang and first saw combat in the European Theatre of Operations on February 11, 1944, conducting bomber support as part of the famous Eighth Air Force. A total of 313 missions were flown by the 357th against the Luftwaffe with the last occurring on April 25, 1945. Two Distinguished Unit Citations were awarded, the first for a pair of missions over Berlin and Leipzig in defense of bombers in 1944 and the second for action on a mission over Derben on January 14, 1945, in which the Group's pilots shot down 55 ½ enemy aircraft during a mission over Berlin, the highest single day total by a Fighter Group during the war. At the end of World War Two, the Group had 43 aces, the highest number in the Eighth Air Force, with five triple aces and four double aces. The 357th is credited with 595 ½ air victories, which is second only to Colonel Hubert "Hub" Zemke's 56th Fighter Group which was in combat for significantly longer (first operation April 13, 1943.

North American P-51D "Swamp Fox"/ *image by: Robert Kysela*

North American P-51B MUSTANG / image by: Shawn Clish

North American P-51B/D "Old Crow" / image by: Robert Kysela

Old horses

The famous red-yellow-red bands on the spinner and two rows of red and yellow checkers aft of that started appearing on aircraft soon after they arrived in England and started flying combat operations from the home at RAF Leiston. There were six Mustangs in attendance at Thunder Over Michigan with four wearing these historic and vibrant colours: "Mormon Mustang", "Swamp Fox" and two aircraft with "Old Crow". "Mormon Mustang" is a late model F-51D built in 1967 and painted in the colours worn by retired Brigadier General Roland R. Wright who not only served in World War Two but also the Korean War and Vietnam. His aircraft always carried the same name in an effort to continue the missionary work he was engaged in before the war and representing qualities such as strength, stamina and endurance. "Swamp Fox" is a P-51D that was built in 1944 and delivered to the USAAF on May 7, 1945, one day before Victory in Europe Day. The plane changed hands many times within the military until 1957 when it was declared surplus and became a civilian. After a five year restoration between 2007 and 2012 it received the EAA Airventure Best Fighter award at Oshkosh in 2013. Painted to honour Retired Lieutenant Colonel Will Foard, who grew up in the Carolinas and since he was flying and fighting out of England, thought it would be funny to name his plane after the famous American Revolutionary from South Carolina, Colonel Francis Marion, who was apparently hated by the British.

Finally, there were P-51B and P-51D examples painted up as "Old Crow". "Old Crow" honours Triple Ace Colonel Clarence E "Bud" Anderson who flew multiple "Old Crows" during his thirty years of military service. It comes from the cheapest bourbon whiskey available at the time and was first painted on a Bell P-39Q Airacobra. "Bud" scored 12 1/4 victories in the P-51B and another four in the P-51D. During Vietnam, the name returned when "Old Crow II" was painted on a Republic F-105D THUNDERCHIEF flying combat operations with the 355th Tactical Fighter Wing stationed at Takhli Air Base in Thailand. Both examples of "Old Crow" that attended Thunder Over Michigan flew in formation each morning and all four aircraft flew together on Saturday afternoon. The P-51B was also part of the Saturday Night photography event which has become one of the major highlights at Thunder Over Michigan since its first occurrence in 2018.
Also parked in the hot zone with the other Mustangs was P-51D "Nervous Energy V". Although this aircraft was not part of the 357th tribute, the Mustang flew in the show and has a stunning paint scheme with a red spinner and black and yellow checkers on its wing tips and empennage.

North American P-51D MUSTANG / image: Robert Kysela

Commemorative Air Force

The Commemorative Air Force AirPower History Tour runs from February to November to bring the sights, sounds and smells of World War II aviation history to audiences across the United States. While other personnel and aircraft from some of the CAF's 70 units joins the tour at various stops, at least one of the Boeing B-29A "FIFI" or Consolidated B-24A "Diamond Lil" is always in attendance. This B-29/B-24 Squadron was started in 1970 and introduced the concept of warbird barnstorming by bringing these special aircraft to cities across the country and conducting tours and rides to honour the memories of the past while continuing the legacy and inspiring future generations. The Squadron is based in Dallas, Texas and consists of about three hundred members and makes as many as twenty stops on tour each year with the mission to protect these rare flying monuments to freedom for future generations through preservation, education, exhibition and airshows.

The Boeing B-29 SUPERFORTRESS first flew in 1942 and was the single most expensive weapons project undertaken by the United States in World War II, exceeding the cost of the Manhattan Project. Although designed with a pressurized cabin for high-altitude strategic bombing missions, the B-29 conducted many low-altitude night missions in the spring of 1945, then of course the two famous missions in August, making it the only aircraft to drop a nuclear weapon in combat. Even with this important role in aviation and American history, "Fifi" is one of only two airworthy B-29s. "Fifi" was built in 1944 and almost immediately modified to a training aircraft before being placed in storage in 1953. In 1958 the aircraft was retired and placed in the U.S. Navy Proving Ground at China Lake, California where it was being used as a missile target. In 1971, it was rescued and restored by the CAF and registered as a civilian aircraft.

Consolidated B-24 LIBERATOR "Diamond Lil" (AM927) owns serial number 18 and was the 25th B-24 built out of a total that ranges 18,482 to 19,267. Initially built for France in 1940, then changed to Great Britain, it ended up being operated by Trans World Airlines and used for flight crew training in Albuquerque, New Mexico. After a brake and gear accident caused the aircraft to be unusable as a bomber AM927 was used as a C-87 Liberator Express prototype to ferry personnel and equipment between the five B-24 production plants. The CAF took full ownership of the plane in 1968 and in 1972, AM927 was painted in the colours of the 98th Bomb Group of the Ploesti Raid and given the name "Diamond Lil". After a six year stint as "Ol' 927", the "Diamond Lil" name was restored in 2012.

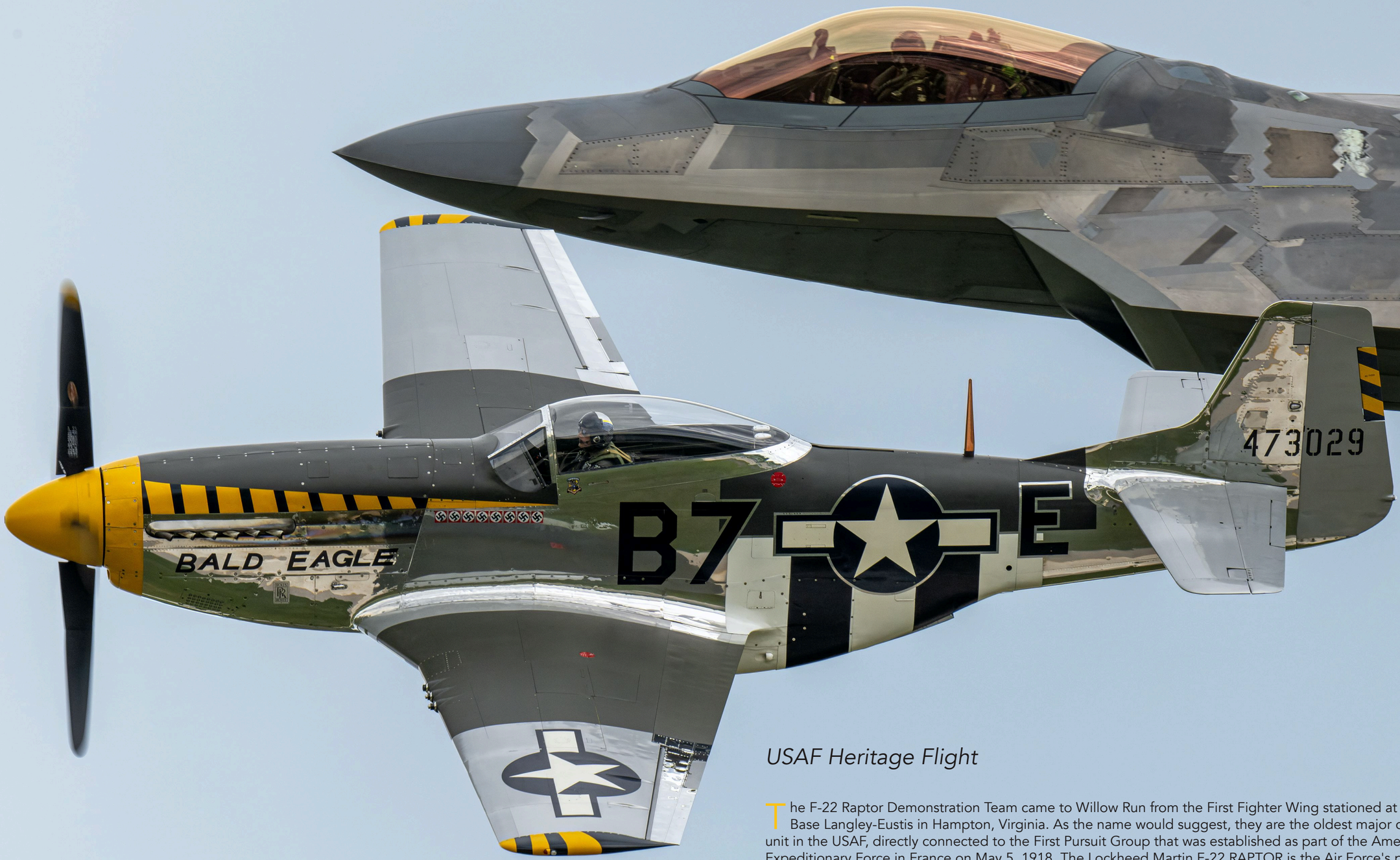
The Willow Run Airport (KYIP) near Ypsilanti, Michigan has been the home of the air show since the first event in 1999. The airport currently serves freight, corporate and general aviation, but played a significant historical role as part of US President Franklin D. Roosevelt's "Arsenal of Democracy". Constructed by the Ford Motor Company, the Willow Run Bomber Plant started producing B-24 Liberator Bombers in 1942, under license from the plane's designer Consolidated Aircraft. More than 8600 Liberators were built at Willow Run during the war. The first B-24E rolled off the production line in September 1942 while the final B-24M was completed in May 1945. Officially known as Air Force Plant 31, at peak production one airplane was being completed every 63 minutes.

Consolidated B-24 "Diamond Lil" / image: Robert Kysela

Boeing B-29A SUPERFORTRESS "FIFI" / image by: Robert Kysela

AIRSHOW

Lockheed Martin F-22A RAPTOR & North American P-51D MUSTANG / *image by: Robert Kysela*



USAF Heritage Flight

The F-22 Raptor Demonstration Team came to Willow Run from the First Fighter Wing stationed at Joint Base Langley-Eustis in Hampton, Virginia. As the name would suggest, they are the oldest major combat unit in the USAF, directly connected to the First Pursuit Group that was established as part of the American Expeditionary Force in France on May 5, 1918. The Lockheed Martin F-22 RAPTOR is the Air Force's premier fifth-generation fighter aircraft combining stealth technology, supercruise capability, extreme maneuverability and integrated avionics that represent an exponential leap in military capabilities and are vital on the modern battlefield. While there are four single-ship Air Combat Command Tactical Demonstration Teams that perform at air shows all over the world, the F-22 performance is the most spectacular of the group due to its incredibly diverse flight envelope. The Raptor's pair of Pratt & Whitney F119-PW-100 turbofan afterburning engines with two dimensional thrust vectoring nozzles combine with the aircraft's aero design, advanced flight controls and high thrust-to-weight ratio to enable the plane to perform a sequence that cannot be duplicated by any other western fighter. Pilot Captain Samuel "RaZZ" Larson is able to perform maneuvers such as the Cobra J-Turn Repo, Pedal Turn and Tail Slide that would cause other jets to fall out of the sky. "RaZZ" showcased this incredible piece of technology twice on Saturday and again on Sunday morning, forming up after each of the morning performances with Jim Beasley in the P-51D "Bald Eagle" for the Heritage Flight.

Lockheed Martin F-35B LIGHTNING II / *image by: Robert Kysela*

Lockheed Martin F-35B LIGHTNING II / *image by: Robert Kysela*

MiG-23UB & F-35B / image by: Robert Kysela

U.S. Marine Corps

The Raptor's fifth-generation cousin from the United States Marine Corps was also in town. Four Lockheed Martin F-35B LIGHTNING II from VMFA-225 made the trip from Marine Corps Air Station Yuma, Arizona. Marine Fighting Squadron (VMF) 225 was established in California in January 1943 flying Vought F4U-1 CORSAIRS. The "Death Dealers" saw combat in August 1944 over the Marianas Islands flying close air support missions as part of Operation Forager. Additional strike missions were flown later in the war against Rota and Pagan Island and in January 1945 the squadron was credited with its only air-to-air victory, the downing of a Nakajima B6N JILL bomber. The squadron continued its air-to-ground mission in Vietnam flying the Grumman A-6A INTRUDER and re-designated VMA(AW)-225 (Marine All-Weather Attack Squadron). The "Vagabonds" provided close air and deep air support for allied ground forces against Viet Cong forces in 1965 and then again in 1969-1971. In January 2021 the "Vikings" were again re-designated as VMFA-225 and transitioned from the McDonnell Douglas F/A-18D HORNET to their current aircraft, the F-35B.

The F-35B is the Marine Corps variant of the Joint Strike Fighter program that was first started in 1993 and included a competition between Lockheed Martin design and the Boeing X-32. The main difference between the F-35B and the Air Force and Navy versions is its unique Pratt & Whitney F135 engine that features a three-bearing swivel duct nozzle. This short takeoff and vertical landing capability provides the jet with the means to operate from forward based expeditionary airfields and amphibious assault ships to meet the diverse mission spectrum of the Marine Corps. A vertical landing can generate exhaust temperatures of up to 1700 degrees Fahrenheit and would have caused the movement surfaces at Willow Run to melt and the nearby grass to catch fire. Therefore when the pilots from the pair of F-35Bs that launched at the beginning of each of the four shows to conduct local training returned to the airport and transitioned the aircraft from normal to vertical flight they were only able to swivel their engine exhausts to a 45 degree angle and demonstrate a short field landing. The other two of these modern fighter jets were parked in the static display and were the focal aircraft for photographers at the end of the Saturday Night photography event. The Marines have ordered 353 F-35Bs from Lockheed Martin but also plan to operate 67 of the F-35C variant which features improved low speed handling, strengthened landing gear and a tail hook to be operated off of the Navy's fleet of nuclear-powered supercarriers. Italy, Japan, South Korea, Singapore and the United Kingdom are also customers of the F-35B.

Lockheed Martin F-35B LIGHTNING II / *image: Shawn Clish*

AIRSHOW

Consolidated B-24A LIBERATOR / image: Robert Kysela

To celebrate Thunder Over Michigan's 25th anniversary, the Yankee Air Museum assembled an impressive collection of warbirds, vintage jets and modern fighters. P-51 Mustangs, especially those wearing the red and yellow of the 357th Fighter Group and Commemorative Air Force aircraft that included the B-29 "Fifi" and B-24 "Diamond Lil" were joined in the air and on the ground by a trio of impressive vintage jets and both of the United States fifth-generation stealth fighters. Friends that only see each other once per year gathered on familiar and historic ground and watched a pair of air shows each day that finally enjoyed sunshine and blue sky, an element that had been elusive during recent events. The weekend progressed wonderfully until just after 4pm on Sunday afternoon when the MiG-23 crashed into an apartment building parking lot. While both pilots ejected safely and no one was injured on the ground, it was a truly unfortunate way to end the weekend. Investigations will be conducted and recommendations made but hopefully none of them will impact our ability to gather once again next year at Willow Run Airport to enjoy one of North America's premier aviation events and support the Yankee Air Museum.

Shawn Clish & Robert Kysela

AIRSHOW

Special Feature

MiKOYAN & GUREViCH MiG-23

When a Mikoyan & Gurevich MiG-23UB (NATO code: FLOGGER) appeared at the Sun 'n Fun Airshow in Lakeland, Florida earlier this year, it caused quite a sensation. Few people could have ever expected to see an airworthy example of this Soviet swing-wing aircraft. Retired Lieutenant Commander Daniel “Files” Filer’s second appearance with the world’s only privately owned MiG-23 was at the world’s largest air show, EAA AirVenture Oshkosh in July. Shortly after that, the former United States Navy A-6 INTRUDER pilot confirmed he was going to participate in the 25th Anniversary celebration at Thunder Over Michigan. The demonstration by Dan Filer was definitely one of the highlights of the event, especially the three-ship formation that returned to Willow Run on Sunday morning after the FLOGGER concluded some training with a pair of F-35B Lightning II. The MiG-23 also took part in the Saturday afternoon show, the Saturday Night photography event and launched for their display Sunday evening ahead of the Mustang Finale.

Mikoyan & Gurevich MiG-23UB / *image by: Robert Kysela*

Special Feature

Mikoyan & Gurevich MiG-23UB / image by: Shawn Clish

Development of the MiG-23 dates back to the early 1960s, with its maiden flight taking place on June 10, 1967. Originally intended as a replacement for the obsolete MiG-17/19/21, this type was produced in large numbers. Around 5,000 aircraft rolled off the production line in total. Compared to its predecessors, such as the MiG-21 (NATO code: FISHBED) or the Sukhoi Su-15 (NATO code: FLAGON), the MiG-23 was able to demonstrate significantly better performance parameters which made it the standard fighter aircraft of the Warsaw Pact countries in the 1970s and early 1980s. The largest foreign operators of the MiG-23 were India (154 aircraft) and Iraq (187 aircraft of various types). The MiG-23 was mainly used in the conflict between Iran and Iraq (First Gulf War:1980 to 1988). The Iraqi MiG-23s performed very poorly against the Iranian McDonnell Douglas F-4 PHANTOM II and especially against the Grumman F-14A TOMCAT, but this was not only due to the quality of the MiG-23, but also to the poor training of the Iraqi pilots and their rigid Soviet-style tactical approach. Today, most nations have retired their MiG-23s, with only a handful of countries listed as operating the type, but whether these aircraft are still in airworthy condition remains in doubt. Thus, North Korea seems to be the only country where the FLOGGER is still in active service.

Dan Filer's MiG-23UB had a so-called Experimental Category certification, which allowed limited operation of the aircraft at air shows. The aircraft was manufactured in Irkutsk in 1981 with serial number 1038107 and served in the Czechoslovak Air Force until 1992. Together with his mechanic Dobrin Dobrov (a former Bulgarian Air Force technician) Dan painstakingly restored the UB to airworthy condition years ago and acquired all the necessary certificates.
In total, Dan acquired 18 aircraft of this type, as well as a large quantity of spare parts. Some of his MiGs were given to museums (seven airframes) while a few are planned to be restored to airworthy condition, with the rest being used for spare parts.

The MiG-23 was scheduled as the penultimate act during the afternoon show on Sunday. After the first flyby, the pilot made a radio call about a loss of power and shortly after, both crew members ejected from the jet. The Flogger banked to the left and contacted the ground in an apartment parking lot south of the field and was quickly engulfed in flames. Fortunately, both crew members suffered only minor injuries and nobody was injured on the ground. The accident brought an immediate end to the show and a closure of the airport.

Mikoyan & Gurevich MiG-23UB / image by: Robert Kysela

The engine of the MiG-23 has a special feature, which is strongly pointed out in the manual. If the thrust nozzle is not fully open, the afterburner cannot be activated. The entire engine control (position of the diffuser in the engine intakes, supply of fuel, as well as the position of the thrust nozzle) is set to afterburner operation, but without actually igniting it. As a result, the engine progressively loses power. To eliminate this problem, the pilot is advised to shut down the engine completely and restart it. In the event that the altitude is below 3000 feet (app.1000 m), the pilot is instructed to eject. Whether this scenario was the reason for the loss of power to the MiG-23's engine is pure speculation at this time, but in any case the ejection of the two pilots was almost certainly unavoidable.
Both KM-1M ejection seats functioned without fuss and pulled the crew to safety. The ejection sequence proceeded exactly as specified; after jettisoning the canopy, the ejection cylinder was actuated and shortly thereafter the rocket motor ignited. Separation of the pilots from the ejection seat also occurred immediately after ejection and both parachutes opened as instructed. The ejection occurred at an altitude of about 1000 feet (just under 300m), well below the minimum altitude at which a safe restart of the turbine would have been possible.

MiG-23UB Cockpit / image by: Shawn Clish

AIRSHOW

Special Feature

Mikoyan & Gurevich MiG-23UB / image by: Robert Kysela

What exactly caused the MiG-23UB engine to fail is unknown at this time and this is not the place to advance any speculation as we await the outcome of the air accident investigation. In the meantime some information has been given by the NTSB (National Transportation Safety Board) in a preliminary report, stating that it was the co-pilot who (probably) has pulled the ejection seat handle. At this time the pilot was still doing his troubleshoot procedure and was not prepared for ejection. At the time of the accident, the aircraft was in very good condition in terms of maintenance and had only flown a few hours since obtaining its certification. The engine, a Tumansky R-27 F2M-300, is generally considered to be very reliable, although some bad experiences the US Air Force had with some MiG-23s during the secret CONSTANT PEG program have claimed otherwise. In this secret operation, aimed at familiarizing American pilots with the performance parameters of the FLOGGER, a large number of Soviet fighters were obtained and used as the enemy for air combat exercises. The USAF received the first MiG-23s from Egyptian Air Force stocks (according to unconfirmed sources, there were twelve MiG-23MS (NATO code: FLOGGER E) and one MiG-23BM (NATO code: FLOGGER F) fighter-bomber). After the collapse of the Soviet Union and the reunification of Germany, more were added from the stocks of the former East-German Air Force (NVA). The operation and maintenance of the fleet proved to be very difficult initially, especially since the Egyptian aircraft had previously stood unused in the open for years and were therefore in poor technical condition. The performance of the MiG-23 was rated rather negatively by this program compared to Western technology.

The crash of the MiG-23UB in Belleville, Michigan is a great loss for Dan Filer, but also an enormous loss for all aviation enthusiasts, and not only in America. We can only hope that Dan will continue with his plans to make other aircraft of this type airworthy. The opportunity to admire a FLOGGER in flight was an amazing opportunity thanks to Dan, and hopefully it will happen again for many years to come.

Robert Kysela

AIRSHOW

THE ROYAL INTERNATIONAL AIR TATTOO 2023

Messerschmitt Me-262 Replica / image by: Will Moore

The United Kingdom (UK) Airshow season reaches its peak in July when British aviation enthusiasts turn their heads towards RAF (Royal Air Force) Fairford in the picturesque county of Gloucestershire. RAF Fairford is actually a United States Air Force (USAF) facility and the new home of the 501st Combat Support Wing Headquarters. The residents in and around Fairford are well acquainted with the American visitors and regularly witness the movements of Rockwell B-1B LANCER and Boeing B-52 STRATOFORTRESS bombers as well as Lockheed U-2 DRAGON LADY reconnaissance aircraft.
For one week each year the largest military airshow in the world comes to town, The Royal International Air Tattoo (RIAT), where dozens of air arms gather to display their aircraft. A truly international event that was held from July 12 to 17, 2023 and included three days of arrivals, three days of performances and one day of departures (Friday features both arrivals and flying displays). Roughly 150,000 visitors attended the event with thousands more watching from private viewing sites outside the base perimeter.

Text & images: Shawn Clish and Will Moore

Messerschmitt Me 262 Replica / image by: Will Moore

The highlight for many this year was the replica Messerschmitt Me 262 SCHWALBE, the first jet fighter in operational service. Much can be written about the development of this incredible aircraft, its participation in World War II and the influence it had on many jets developed after the war. But what is important here is that for almost five decades after the war, nobody would have imagined they'd ever see an Me 262 fly at an airshow. Then in 1993, the Me 262 project was founded in Texas with the objective of producing five airworthy replicas based on an original Me 262B-1. The first replica flew from Paine Field near Seattle in 2002 and the final aircraft was delivered in 2012. Four of the five are airworthy with three of those residing in the United States and the fourth in Germany. The fifth aircraft is on permanent static display at the impressive Evergreen Aviation Museum in Oregon (home of the Hughes H-4 HERCULES, the Spruce Goose). The replicas are nearly identical to the original Me 262 aircraft of World War II but feature a strengthened landing gear and are powered by a pair of General Electric CJ610 Turbojet engines instead of the original (and unreliable) Junkers Jumo 004B powerplant. It was the German registered D-IMTT which is an Me 262A/B-1c that made its UK debut at the show. The jet is operated by the Flugmuseum Messerschmitt and supported by the Airbus Heritage Flight. While bad weather prevented the Me 262 from flying on Friday and Saturday, the aircraft took part in the flying program on Sunday to the delight of all in attendance.

It seems almost redundant to use the words nasty British weather as it's an unfortunate feature of the island. Last year was an intense heatwave during the Air Tattoo that had visitors battling heat haze while trying to stay hydrated and shaded under scorching 30-40 degree Celsius heat. This year's conditions were less dangerous but more challenging to the show, as the weather on Friday featured torrential rain throughout the day, forcing many to stay home or at least remain under shelter. The flying program proceeded with spirited displays from the Royal Danish Air Force's stunning Red and White 'Dannebrog 800' Lockheed Martin F-16AM FIGHTING FALCON in truly atrocious conditions and Swedish performances by their Air Force's Saab SK.60 trainer and Saab Aeronautics JAS 39E GRIPEN demonstrator. While the Danish were rewarded for their effort with an unserviceable jet that didn't fly again for the rest of the weekend, the Swedes each received Flying Display Awards at the Sunday Evening Awards Ceremony. André Brännström, pilot of the GRIPEN E, was awarded the The Paul Bowen Trophy, in memory of RIAT's co-founder, for the Best Solo Jet Demonstration, while Captain Nils Schylström in the SK.60, received the

Saab JAS 39E GRIPEN / image by: Will Moore

The King Hussein Memorial Sword for the Most Polished & Precise Flying Display.

The Saab 105 first flew on June 29, 1963 and entered service with the Swedish Air Force as the Sk.60 in 1967. Over its almost 60 years of service, the Swedes have operated the high-wing twin turbofan multirole aircraft mainly as a trainer but it can also perform light attack and reconnaissance roles. There are currently 46 Sk.60 in active use with the Swedish Air Force that have functioned as both the basic and advanced trainers since 1986. This dual mission is coming to an end as the type gets phased out with a planned retirement by 2026. In 2021 an order was placed for the Grob G 120 TP turboprop which will take care of the basic trainer needs, while GRIPEN C/D fighters will function as stop-gap advanced trainers as the new generation GRIPEN E is introduced. There were two colourfully painted examples at RAF Fairford. The static aircraft paid tribute to the 60th anniversary of the aircraft's first flight with a yellow and red livery similar to the one worn in the Swedish Air Force Flight School in the 1930s. While the aircraft in the flying program wore the traditional Swedish blue and yellow belonging to the service's aerobatic demonstration team, Team 60, that traces its history back to 1976.

Saab Sk.60 / image by: Will Moore

Theme: SKYTANKER23

Large military airshows have been on the decline in the United Kingdom over the past 25 years as the US Air Force withdrew some operations from the UK and the Royal Air Force contracted dramatically in size. Gone are the popular events at RAF Mildenhall, RAF Leuchars, RAF Waddington and more recently Royal Naval Air Station Yeovilton, making the Royal International Air Tattoo at RAF Fairford that much more meaningful for UK aviation enthusiasts.

The operational theme for this year's Air Tattoo was SKYTANKER23, which highlighted the vital role of air-to-air refueling throughout the history of military aviation. The first successful aerial refueling took place on June 27, 1923, when an Airco DH-4B of the United States Army Air Service passed gasoline through a hose to another DH-4B flying beneath it. The Airco company´s chief engineer was Geoffrey de Havilland (this is what the DH in the designation stands for).The development of aerial refueling through hoses and fittings was furthered in the 1930s by Britain's Alan Cobham and his firm Flight Refueling Limited into one of the main methods used by military aircraft today, the probe-and-drogue system. The first use of the probe-and-drogue system took place on August 7, 1949, when the RAF used an Avro LANCASTER tanker to pass 2,352 imperial gallons of fuel over ten separate refueling connections to a Gloster METEOR F.3 which allowed the fighter to stay airborne for 12 hours and 3 minutes. A LANCASTER B.Mk I belonging to the RAF's Battle of Britain Memorial Flight and a Gloster METEOR T.Mk 7 operated by the Martin Baker Company were part of this year's SKYTANKER23 theme to honor that first successful refueling. This method of aerial refueling was displayed during the flying program by a pair of aircraft from the United States Air Force Special Operations Command and a trio from the German Luftwaffe. The American duo consisted of a Lockheed Martin MC-130J COMMANDO II leading a Bell Boeing CV-22 OSPREY, both from the 352nd Special Operations Wing based at RAF Mildenhall. This was later followed by the Luftwaffe aircraft as an Airbus A400M flew simulated refueling passes with hoses lowered beneath each wing to a pair of thirsty Panavia TORNADO (one ECR and one IDS) from the Taktisches Luftwaffengeschwader 33 (TaktLwG 33) based at Buechel Air Base.

An evolution of the probe-and-drogue system is the buddy-stores system, which consists of a fuel tank that can trail a hose and drogue and allow a small aircraft, such as a fighter, to refuel another without the requirement of a dedicated tanker. This

Gloster METEOR T.Mk 7 / image by: Shawn Clish

Lockheed Martin MH-130J COMMANDO II & Boeing CV-22 OSPREY / image by: Will Moore

system allows fighter aircraft to operate independently from the more cumbersome tankers while flying at higher speeds and lower altitudes. After separating from the Airbus A400M, the pair of TORNADOS returned with multiple passes in the buddy refueling configuration, as the lead TORNADO ECR trailed a hose from its under-slung fuel tank and the receiver TORNADO IDS had its refueling probe extended.

An alternative system was developed by the Boeing Aircraft Company in 1948 called the "Boeing Boom" in which a large diameter pipe with wings is lowered and flown by a Boom Operator from the rear of a tanker aircraft into a waiting receiver aircraft. This system, now known as the flying boom, can operate at significantly higher speeds and deliver fuel flow rates that are five-to-six times higher while also being safer as it can be disconnected more efficiently in case of an emergency. RIAT showcased an international flavour for this example during the show as an RAF Airbus VOYAGER KC3 flew an overhead formation with a Finnish Air Force McDonnell Douglas F/A-18C HORNET.

Looking ahead, there are a lot of different ideas for what the tanker of the future will look like. Since 2006, the United States Navy has been the developing the concept of a carrier-based Unmanned Aerial Vehicle (UAV) to refuel its strike fighters. The Boeing MQ-25 STINGRAY is what has resulted and combines autonomy with stealth technology and a robustness for carrier deck operations. Meanwhile the US Air Force has changed their mind numerous times and are now focusing on a program known as Next-Generation Aerial Refueling System (NGAS) that will be able to survive in future battlefields should adversaries choose to target larger aircraft such as tankers. Regardless of the equipment chosen, thirsty aircraft will rely on the two-options of hardware that were developed in the first-half of the 20th Century to receive fuel and extend their ability to remain airborne.

There were also multiple examples of the SKYTANKER theme on static display across the airfield, including a privately owned Metrea Boeing KC-135R STRATOTANKER, an Airbus A330 MRTT (Multi Role Tanker Transport) from the Royal Saudi Air Force and a Boeing KC-767A from the Italian Air Force that was not only part of the SKYTANKER theme but was also part of the celebration of the Italian Air Force's 100th Anniversary.

Leonardo HH-139B / image by: Will Moore

Aeronautica Militare Italiana

On March 28th, 1923, the Regia Aeronautica (Royal Airforce) was officially established as an independent air force upon its separation from the Italian Army. During WWII as Italy fell to the Allies the country's air force divided into the Aeronautica Nazionale in the North and the Italian Co-Belligerant Air Force in the South which was aligned with the Allies. At the end of the war as Italy reunited, the Regia Aeronautica reunited too. When Italy became a Republic in 1946 the Royal prefix was dropped and the Aeronautica Militare Italiana (AMI) became the new Italian Air Force.

The Aeronautica Militare has spent much of 2023 marking its centenary with large celebrations and open houses, including a 72 aircraft flypast over Rome on March 28th, that included an audience of the Italian President Sergio Mattarella, the Italian Air Force Chief of Staff Gen. Luca Goretti and other high ranking government authorities and military officials from all services. Then there was the large air show at the Pratica di Mare military airport from June 16 to 18 that was beautifully covered in our previous Issue (Issue III released on June 30, 2023). As RIAT is the largest military air show in the world, it was only fitting that a substantial Italian Air Force contingent was present to continue the celebration of their first hundred years of history. Flying program participants included a Eurofighter EF-2000A TYPHOON, an AMX A-11 GHIBLI and a Leonardo M346T MASTER, all wearing special 100th Anniversary tail art that featured the official logo of the centenary. Unfortunately the Leonardo C-27J SPARTAN that was scheduled to perform suffered a technical issue relegating it to the static display for the weekend. Another pair of notable aircraft that were part of the Italian 100th Anniversary area were the Panavia TORNADO IDS from 6° Stormo / Ghedi Air Base. The Aeronautica Militare still operates some 35+ aircraft of this type but will retire in the forseeable future (the replacement will be the Lockheed Martin F-35 LIGHTNING II).

Finally, there was a second AMX A-11 GHIBLI that wore a colorful livery to celebrate the 80th anniversary of the 103° Gruppo (Squadron) from Istrana Air Base. This is significant and interesting as the 103° Gruppo was deactivated in September 2016, but since their heritage and traditions are still strong within the 51° Stormo (Wing) at Istrana, an A-11B received the vibrant yellow markings of the former operational squadron. It was especially meaningful to have the AMX represented in the air and on the ground as these aircraft are in the process of being retired and therefore have almost certainly participated at the Air Tattoo for the very last time!

Eurofighter EF-2000 TYPHOON / *image by Will Moore*

Leonardo C-27J SPARTAN / *image by Will Moore*

AMX A-11 GHIBLI / image by: Shawn Clish

From the security lines, to the merchandise booths and certainly in the FRIAT (Friends of the Royal International Air Tattoo) enclosure, a hot topic all week was the participation by three iconic British fighters. Since the first Air Tattoo at North Weald Airfield in 1971 until 2019 when the last of the Tornados was retired, the RAF and Fleet Air Arm were always well represented at the Air Tattoo with plenty of PHANTOMS, HARRIERS and TORNADOS on the ground and in the air. These cold war warriors could number in the double digits and although beloved by British aviation enthusiasts, it may have been taken for granted to see *another* PHANTOM in the 1980s or *another* TORNADO in the 2000s. As all three have been retired from British service, it was certainly not taken for granted this year to see the four previously mentioned Tornados from Germany and Italy. Nor was it taken for granted to have a pair of Spanish Navy EAV-8B MATADORS back in the flying display along with a pair of Italian Navy AV-8B+ Harriers on static. Last but certainly not least was the appearance of an F-4E PHANTOM II from the Hellenic Air Force's 338 "Ares" Squadron. These participants brought back found memories for many in attendance and the RIAT organizers deserve a lot of credit for being able to bring all three rare types together for this event.

McDonnell Douglas EAV-8B MATADOR II / image by : Will Moore

The Spanish contingent to the flying display included the one of the McDonnell Douglas EAV-8B+ MATADOR II of the Armada Espanola (Spanish Navy) in close formation with a Lockheed Martin F-35B LIGHTNING of No 617 Squadron (The Dambusters) from RAF Marham. Then undertaking its own individual display, on the Sunday this display including the hover section was performed flawlessly in torrential rain!! The other Spanish contribution to the flying display was the Ejército del Aire y del Espacio (Spanish Air and Space Force) PATRULLA AGUILA (Eagle Patrol) flying their CASA C-101 AVIOJETS opening the show on the Saturday and by good luck alone managed to display in breaks in the weather on Saturday and Sunday!

AIRSHOW

Boeing B-52H STRATOFORTRESS / image: Will Moore

Elements of the Royal Air Force that were able to present on Friday were their Airbus VOYAGER KC3, 617 Squadron Lockheed Martin F-35B LIGHTNING II and the Typhoon Display Team in their sharp Eurofighter TYPHOON FGR4 "Black Jack". Its pilot, Flight Lieutenant Matt Brighty also received an award at the Sunday banquet, taking home The Steedman Display Sword as the British participant with the most notable contribution to RIAT. It was certainly a valiant effort from the team at RIAT and the contributing displays but the overriding poor conditions were the main story of the day.

Saturday was also supposed to feature harsh conditions that not only included rain but also significant winds gusting over 40 mph during the afternoon. While these conditions were enough to cancel the Battle of Britain Memorial Flight and sent the Me 262 into a hangar, the majority of the show went as planned producing some intense crosswind crab angles and providing further evidence of the exceptional professionalism and flying ability from the crews involved, especially the formation aerobatic teams. Finally, while Sunday wasn't a blue bird day, it allowed the Avro LANCASTER, the Messerschmitt Me 262 and the Boeing B-52H STRATOFORTRESS to display for the only time all weekend, with the B-52H showing off it's unusual rotating landing gear as it taxied back at the end of the show.

الصقور السعودية - *Saudi Hawks / image by: Shawn Clish*

الفرسان - *Al Fursan / image by: Will Moore*

Patrulla Aguila - Ejercito del Aire / image by: Shawn Clish

Aerobatic Teams

The famous representatives of the Royal Air Force, the RED ARROWS, were of course one of the aerobatic teams at the show in their red, white and blue BAe Systems HAWK TMk.1A trainers. While the team has been thrilling crowds since 1965, the last few years have featured plenty of turmoil and changes. In 2022 their trademark Diamond Nine shape was reduced to seven after inquiries about the conduct of team members necessitated the transition of two team members to others roles within the RAF. In 2023 the team is displaying as an eight-ship, a significant step after the challenging period of the previous two years, while major flypasts, such as the ones performed in honour of the coronation celebrations, King Charles III's birthday and Wales National Armed Forces Day were made with nine jets. The team also changed bases, moving to RAF Waddington in October 2022, from their previous home at RAF Scrampton, the base that launched nineteen Avro LANCASTERS on May 16, 1943, on the famous dambusters mission known as Operation Chastise.

The SAUDI HAWKS were also in attendance with their BAe Systems HAWK, but their seven green and white jets are a slightly modernized Mk.65 variant of the trainer. The team was formally established as the Saudi Falcons Aerobatic Team on June 6, 1998 and performed their first official show in January 1999 over Riyadh. The Saudi team made their first appearance at the Royal International Air Tattoo in 2011. The FURSAN Al Emirat Squadron from the United Arab Emirates were also back in the UK after just over ten years since their first appearance at RIAT in 2012. The team flies an impressive routine with seven black and gold Aermacchi MB-339NAT twin seaters that were developed for the Italian Air Force as advanced trainers with light attack capability.

The PATRULLA AGUILA (Eagle Patrol) was the opening act of the flying display representing Spain and its Air and Space Force by proudly displaying the colours of their national flag. The team has been active since 1954 and currently fly six sharply painted red, yellow and silver CASA C-101 AVIOJETS. These trainer/light attack jets were developed indigenously in the late 1970s and have also served in limited numbers in Chile, Honduras and Jordan.

Finally, the ROYAL JORDANIAN FALCONS are the national aerobatic team of the Hashemite Kingdom of Jordan, formed in 1976. A regular visitor to RIAT, the team is a joint civil-military operation that selects its pilots from the Royal Jordanian Air Force while its fleet of Extra-330 LX aerobatic aircraft are owned and maintained by Royal Jordanian Airlines.

RAF Red Arrows / image: Shawn Clish

AIRSHOW

Airbus A400M / image: Shawn Clish

The Royal International Air Tattoo is the top aviation event in the United Kingdom, the biggest military air show in the world and a familiar gathering place for a global audience of aviation enthusiasts. There is no other show that can compete with the quantity and quality of military aircraft presented while also featuring the expertise of those involved with the show's organization. Even though there are fewer aircraft available in the present than at the 'great' shows of the past, there are still special opportunities to be enjoyed as was apparent this year with a first-of-its-kind appearance by the replica Me 262. For six days each July at RAF Fairford friendships are renewed, memory cards are filled and weather conditions are flouted all in support of the Royal Air Force's Charitable Trust…and we wouldn't have it any other way.

Special thanks goes to the RIAT Media Team for their great support during our visit!

Will Moore & Shawn Clish

EXERCISE

ANATOLIAN EAGLE 2023

Konya Air Base / Turkey

From May 2nd to12th, 2023, aircraft and personnel from Azerbaijan, Pakistan, Qatar, the United Arab Emirates (UAE), the United Kingdom (UK) and NATO gathered at Konya Air Base in Turkey for Exercise Anatolian Eagle 23-2. The goal of the event was to increase the level of experience among participating pilots to boost their chance of survival in a hostile operational environment while promoting interoperability and the exchange of ideas and tactics among allied nations. The base opened its doors to members of the press on May 8th for Media Day and to photographers and enthusiasts on May 9th/10th for Spotters Days.

story & all images by: Shawn Clish/CHK6

McDonnell Douglas F-4E PHANTOM II / 111 Filo "PANTER" / *image: Shawn Clish*

Anatolian Eagle Training Center

The 3rd Main Jet Base in Konya is home of the Anatolian Eagle Training Center (AETC). The AETC is one of four tactical training centers in the world and the only one in Europe. The other three are Maple Flag at CFB Cold Lake in Canada, Red Flag at Nellis AFB in the US and the Pakistan Air Force Airpower Centre of Excellence at PAF Base Mushaf in Pakistan. Konya is home to two Turkish Air Force Squadrons, 131 Filo "Elder" (131 Squadron "Dragon") and 132 Filo "Hançer" (Dagger). 131 Filo fly the Boeing E-7T PEACE EAGLE Airborne Early Warning and Control aircraft which is based on the Boeing 737-700 commercial airliner and is responsible for command and control battle management. 132 Filo is a weapons and tactics training squadron that flies Block 50 Lockheed Martin F-16C/D Fighting Falcons and operate as the hostile nation (Red Force) during Anatolian Eagle.. Also located at Konya are the two Turkish Air Force demo teams. SOLOTURK performs single-ship routines in one of their beautifully painted Lockheed Martin F-16C/Block 40 FIGHTING FALCONS while 133 Akrotim Filo (Aerobatic Squadron) TURKISH STARS fly precision team aerobatics in their Red and White Canadair NF-5A/B FREEDOM FIGHTER.

The first Anatolian Eagle (AE-01) took place in 2001. This exercise was preceded by Turkish Air Force participation in Exercise Red Flag in 1997 to learn from the best about organizing large scale training events. Since then, Anatolian Eagle has welcomed 16 Nations (including NATO), 3135 aircraft and 38,969 personnel. 25,692 sorties have been flown in the those previous 49 editions in the tactical air space over central Turkey that spans over 50,000 square miles and extends up to 50,000 feet. The Anatolian Eagle facilities on the east side of Konya AB have expanded greatly since AE-01 and now include operations centers for mission planning, briefing, maintenance and headquarters, with the goal of becoming the most prestigious tactical training center in the world!

Visiting aircrew are responsible for planning, briefing and executing air-to-air and air-to-ground missions for the Blue Force based on realistic scenarios of operational environments developed by the White Headquaters. The Blue Force's goal is to survive against the hostile Red Force that are trained to replicate the tactics of aircraft such as the Su-27/30 FLANKER and MiG-29 FULCRUM as well as a fictional aircraft known as the FX-07. Mission objectives include Composite Air Operations, Time Sensitive Targeting, Dynamic Targeting, High Value Airborne Asset Protection and Anti-Surface Forces Air Operation. The success of each mission is determined by the mission assessment program using modern technology to reconstruct and validate each element of the Blue Force's tactics then presented in a debriefing session. The team at Anatolian Eagle stress that their exercise is not a competition but rather an opportunity to compare and improve capabilities and tactics through a tactical live fight training exercise.

Joining the locally based aggressor F-16's were six other squadrons that operate the type within the Turkish Air Force. 113 Filo "Ceylan" (Gazelle), 152 Filo "Akinci" (Raider), 161 Filo "Yarasa" (Bat), 181 Filo "Pars" (Panther) and 191 Filo "Kobra" (Cobra) flew from their bases in Turkey to operate out of Konya for two weeks and perform multirole missions, while 151 Filo "Kurt" (Wolf) is responsible for the Suppression of Enemy Air Defence. Aerial refueling duties were conducted by the 101st Tanker Squadron (Tanker Filo "Asena") in the Boeing KC-135R STRATOTANKER from Incirlik Air Force Base. Aerial surveillance and reconnaissance missions were flown by a pair of unmanned aerial vehicles, the Turkish Aerospace Industries ANKA-S and the Baykar BAYRAKTAR AKINCI, although unlike last year neither was present during the public time on base. Finally, one of the main highlights of the event was the opportunity to watch some of the last McDonnell Douglas F-4 PHANTOM II aircraft that are still in operation. There are only three other nations still using the Phantom, Greece, South Korea and Iran, and although the Turkish F-4E TERMINATOR 2020 variants have been significantly upgraded and no replacement or retirement date has yet been announced, their service life will soon come to a close. 111 Filo "Panter" (Panther) from the 1st Main Jet Base Eskişehir is the last unit operating the PHANTOM in Turkey. In the early 2000s, Israeli Aircraft Industries upgraded the Turkish F-4E to the TERMINATOR 2020, based on similar work it had already done to the KURNAS 2000 (Upgraded Israeli F-4E). The TERMINATOR received an extended airframe life and upgrades that included a Global Positioning System, a Multi-Functional Display, an advanced radar, modernized wiring and improved weapons carrying capabilities including the AGM-142 POPEYE missile.

EXERCISE

Boeing E-7T PEACE EAGLE

EXERCISE

Sukhoi Su-25 (NATO Code: FROGFOOT)

The other major attraction at Konya was the Sukhoi Su-25 (NATO Code: FROGFOOT) from the Azerbaijan Air Force. The south Caucasus nation has regularly participated in Anatolian Eagle with the FROGFOOT and even sent Mikoyan-Gurevich MiG-29 (NATO Code: FULCRUM) to participate in 2021. After the fall of the Soviet Union, Azerbaijan did not inherit any of these aircraft, rather they have come through sales from Belarus, Georgia and Ukraine, as well as at least one defection from Russia. While Azerbaijan has had approximately 40 of these aircraft in service since the early 1990s, there may only be a dozen that are currently serviceable. Turkey and Azerbaijan have seen an increased partnership in the last few years starting with the increased export of Turkish arms ahead of the 2020 Nagorno-Karabakh War. The Turkish assistance helped Azerbaijan win the 44 day conflict against Armenia and lead to the signing of the Shusha Declaration on June 15, 2021, strengthening the allied relations between the Republic of Azerbaijan and the Republic of Turkey. Two Su-25s took part in the exercise, both wearing mission markings from operations flown during the Nagorno-Karabakh War, while a third Su-25 was on base and flew during the spotters day on May 9, possibly for training with one of the 132 Filo "Hançer" weapons school aircraft that was painted in a very impressive digital-camouflaged livery.

Lockheed Martin F-16C/Block 52 / image by: Shawn Clish

Lockheed Martin F-16E DESERT FALCON / image by: Shawn Clish

Boeing E-3A SENTRY / image by: Shawn Clish

Participants

Pakistan has also been a regular participant at Konya, although this year was the first time with their Block 52 F-16C/D FIGHTING FALCON. The jets belong to the 5 Squadron "Falcons" out of Shahbaz Air Base, one of five active units operating the F-16 for the Pakistan Air Force. While many of the upgrades to the advanced Block 52 variant are internal, the five PAF jets featured Conformal Fuel Tanks (CFT) that were attached to the upper surface of the F-16s fuselage. While the obvious advantage is an extra 3000 pounds of fuel, the CFTs also provide operational flexibility by reducing the need for drop tanks, thereby increasing weapons capacity. A set of CFTs can carry 50 percent more fuel than a centreline tank, but only suffers twelve percent of the drag. The design can handle the full flight envelop of the F-16, allowing the nimble jet to retain its full 9-g capability and flight envelope with the CFTs installed.

The United Arab Emirates brought further advanced Block 60 F-16s that were also equipped with CFTs. Their sharply camouflaged F-16E/F DESERT FALCONS belong to the 2nd Shaheen Squadron based at Al Dhafra Air Base ("Shaheen" being Persian for "Falcon"). The Block 60 can accommodate all of the weapons available to the Block 52, while also adding the AIM-132 Advanced Short Range Air-to-Air Missile (ASRAAM) and the AGM-84E Standoff Land Attack Missile (SLAM), which is a subsonic air-launched cruise missile.

Finally, there were a pair of NATO Boeing E-3A SENTRY Airborne Warning and Control System (AWACS) aircraft parked opposite the Eagle Ramp. The E-3A Component is one of two flying units operated by NATO from their air base in Geilenkirchen AB, Germany. It holds a special place in history as the first multinational flying unit established by the Alliance and currently features crews from 19 of the 31 NATO member nations. The jets are part of the original order for eighteen that were first delivered in January 1982 and have not received any major updates. They are still powered by four Pratt and Whitney TF-33-PW-100A turbofans while featuring the Westinghouse Corporation AN/APY-1 or AN/APY-2 passive electronically scanned array radar system above the fuselage in the plane's distinctive rotodome. The age and lack of modernization has led to the AWACS fleet being challenged with maintainability and capability issues, party due to parts shortages and poor availability rates. With the aircraft scheduled to be retired in 2035, a team was recently established to explore replacement options, with the E-7 WEDGETAIL expected to be the leading candidate.

Lockheed Martin F-16C FIGHTING FALCON / image: Shawn Clish

EXERCISE

Eurofighter EF-2000 TYPHOON S / image: Shawn Clish

In 2017, Qatar signed a 5 billion pound deal with BAeSystems to purchase 24 Eurofighter EF-2000 TYPHOON and 9 BAe HAWK Mk. 167 advanced trainers. The deal also included a support and training package, creating a strong link between the Qatar Emiri Air Force (QEAF) and the Royal Air Force (RAF). In August 2022, the first four jets which were produced at facilities in Warton and Brough in the United Kingdom, arrived at their new home, Dukhan Airbase. QEAF pilots had been training at RAF Coningsby in the UK ahead of the arrival of their new jets and the two nations provided air security during the 2022 FIFA World Cup. Both air forces were present in Turkey with their Eurofighter EF-2000 TYPHOON, with four of the brand new and lightly camouflaged QEAF jets wearing their Maroon and Yellow roundels parked next to a pair of unmarked No 6 Squadron jets from the RAF.

Lockheed Martin F-16C Block 40 / image: Shawn Clish

McDonnell Douglas F-4E PHANTOM II / TERMINATOR 2020 / image by: Shawn Clish

The Media Day started with a welcome briefing from Lieutenant Colonel Hakan Girgin, the AETC Commander, before heading to the Eagle Ramp where the visiting aircraft were all parked. Partly cloudy skies and ample locations along the ramp, taxiway and runway provided excellent photographic opportunities. Over the course of an hour, aircraft from Turkey, Azerbaijan, Pakistan, the UAE and a lone Qatari Typhoon, exited the ramp and launched off Runway 01R, the closest of the two runways to where media were positioned. The highlight was being on the edge of the runway for the departure of the two PHANTOM. Although this location wasn't ideal for photography as it was actually too close to the action, photographers kept shuffling ahead of each other which resulted in an unforgettable experience as the jets went roaring by at just a short distance. While the organizers did their best the following day to keep photographers further back and in line, a rope would have greatly helped reduce all of the pushing and leaning that regularly occurs at these events. Unfortunately, members of the Press were unable to remain on the field for the return of the jets and were instead bused to the mess hall for lunch. After lunch and a group photo in front of the AETC, the buses returned to the Eagle Ramp for a static walk among the jets to end the day.

The Spotters Days featured four times as many people as Media Day, but a lot more time for picture taking. Spotters were allowed to watch the entire morning wave and were treated to a performance by SOLOTURK between the launch and recovery. For the afternoon mission, spotters were bused to the west side of the field with the plan of taking advantage of the afternoon light. Unfortunately, multiple layers of thick clouds obscured the sun which was a shame as the proximity to Runway 01L was excellent and the afternoon featured a second performance by SOLOTURK, as well as the TURKISH STARS and multiple large dissimilar formations.

EXERCISE

The Anatolian Eagle Training Center provides air-centric joint training to Turkish and allied armed forces personnel through a realistic live simulation of an operational environment while fostering an opportunity to strength relationships and share ideas. Turkish associations with nations like Azerbaijan, Pakistan, Qatar and the United Arab Emirates combine for a list of participating nations that does not occur anywhere else in Europe. Most importantly, the willingness of the 3rd Main Jet Base to provide members of the media and aviation enthusiasts with an opportunity to view a military training exercise from incredible vantage points while also presenting a show full of national pride that included aerobatic teams and impressive formations made for an unforgettable experience. Thank you Türk Hava Kuvvetleri for allowing CHECKSIX to be part of this incredible event and hope to see you next year!

Shawn Clish / CHK6

Lockheed Martin F-16C FIGHTING FALCON / image: Shawn Clish

HISTORY

ROYAL NETHERLANDS AIR FORCE

F-16 DEMO TEAM

Lockheed F-16AM FIGHTING FALCON J-055/306 Sqn / image by: Robert Kysela

The Lockheed Martin F-16 FIGHTING FALCON is one of the most successful fighter aircraft of our time. Although this aircraft made its first flight in 1974, it has been in continuous production to this day (in the Block 70/72 version). The F-16 proved to be a bestseller, with more than 2,000 aircraft currently in active service with 25 air forces. In addition to the USAF, the F-16 was supplied to numerous allies and was (and still is) the standard multi-role fighter aircraft for many NATO countries. One of the first customers of the machine originally developed by General Dynamics was the Netherlands. A total of 213 aircraft were procured by the Royal Netherlands Air Force from 1979 to 1992, including 177 single-seaters (F-16A) and 36 double-seaters (F-16B). The F-16 replaced the Lockheed F-104 STARFIGHTER and (later) the Northrop NF-5. Of course, they wanted to proudly present the very latest asset in the RNLAF arsenal and its flight envelope to the Dutch people. The very first solo display of a Dutch F-16 took place on 15 September 1979 at Vliegbasis Twenthe at an open house. At the controls was the first display pilot, Capt. Wim Sneek. He had also transferred the very first F-16B from the USA to the Netherlands (Vliegbasis Leeuwarden, June 07, 1979).

story & all images by: Robert Kysela

J-364/314 Sqn - Pilot: Capt. Patrick "Spout" Tuit / Meeting Aérien 1997 - Base Aérienne 102 Dijon/France

Patch RNLAF F-16 Demo Team (one of many)

Purpose of a Demo Team

When Capt. Sneek landed his F-16A (J-213) in Twenthe, he was certainly unaware that his display was the first in a long proud tradition of Dutch F-16 demonstrations. For more than 35 years, the Dutch solo demo was an integral part of the European airshow scene. No fewer than 18 pilots (including Capt. Sneek) showed their skills as the official display pilot for the team. While formation aerobatic teams and solo demonstration teams present an opportunity for air forces to showcase the capabilities of their equipment and the professionalism of their fighter pilots, one of their primary functions is recruitment. Many current pilots when asked about what influenced their interest in aviation will respond with a specific air show their parents took them to when they were a child and an aircraft they saw that guided their choice to want to become a pilot. The RNLAF demo team was extremely successful in this area and certainly there are many pilots who decided to pursue a career as a military pilot with the Koninklijke Luchtmacht over the past 40 years that were inspired by the RNLAF F-16 Demo Team!

The aircraft operated by the RNLAF F-16 Demo Team over the years were provided by the squadrons and therefore numerous different machines were used for the flying displays. The first (as well as the last) displays were all flown with machines that had the traditional tactical grey finish with no special paint schemes. The 1983 season was the first time a specially painted aircraft was used, but this particular paint scheme was related to the 40th anniversary of 322 Sqn and had less to do with the demo team. Nevertheless, the machines became more and more colorful. In the beginning only the tail unit was painted in a special color, but in the course of time they became more and more courageous. For the 1995 season, a 311 Sqn (J-508) was attractively painted in the Dutch national colors (red-white-blue), covering about a quarter of the aircraft. Two years later, almost half of the aircraft's surface was covered in the national colors (314 Sqn / J-364).
Then, in the 2001 season, the Dutch hit the nail on the head. The display aircraft of the 312 Sqn (J-016) was completely painted with a special livery consisting of several shades of grey and black stripes, with the front underside in a silver tone. The wing leading edges featured the inscription "TEAMWORK". By March 2005, the next special paint scheme was introduced (306 Sqn/J-055). Here the silver content was increased and the stripes became rings which were supposed to represent a shock wave. The front part was in glossy black. Underpinning this great design were some narrow orange stripes (on the wing leading edges).

By far the most striking (and beautiful) paint job was used from 2009 to 2013. Aircraft J-015 was painted with the coat of arms animal (lion) and the color of the Dutch royal house (Oranje-Nassau). Of course, aircraft paint schemes are always a matter of taste, but in this case I personally believe this to be the most beautiful paint scheme ever applied to a fighter aircraft!

Unfortunately, all of the specially painted aircraft were returned to their original condition after the end of their last season in order to remain in service. As a result, not a single one of these beautiful exhibits has been preserved.
The Royal Netherlands Air Force had nine operational F-16 squadrons. These were distributed over five different air bases (Vliegbasis):

I. Vliegbasis Volkel

- 306 Sqn "Hawk" (disbanded December 2010)
- 311 Sqn "Eagle" (disbanded May 2011)
- 312 Sqn "Bonzo" last active F-16 unit (until 2024)
- 313 Sqn "Tiger" (F-35A since December 2020)

II. Vliegbasis Leeuwarden

- 322 Sqn "Polly Grey" (F-35A since July 2021)
- 323 Sqn "Diana" (F-35A since October 2014)

III. Vliegbasis Twenthe (closed 2007)

- 315 Sqn "Lion" (disbanded April 2004)

IV. Vliegbasis Gilze-Rijen

- 314 Sqn "Redskins" (disbanded July 1995)

V. Vliegbasis Eindhoven

- 316 Sqn "Falcon" (disbanded April 1994)

J-016/312 Sqn - Pilot: Capt. Richard "Tomba" Buijs / Royal International Air Tattoo 2001 - RAF Cottesmore/UK

J-055/306 Sqn - Royal International Air Tattoo 2005 - RAF Fairford / image by: Robert Kysela

The Pilot(s)

To become a demo pilot, the candidate required at least 1000 flight hours on the F-16 and be recommended for the job by his commanding officer. Great attention was also paid to mental strength. There is a difference between flying a fighter jet operationally versus performing in front of hundreds of thousands of people! Even outside of the cockpit, the display pilot had to represent his position with the best interests of the Air Force. Safe handling of the media was another point that was valued. The demo pilot was primarily a fighter pilot of the Koninklijke Luchtmacht, meaning he had to maintain his readiness status. In order to be able to continue to fulfill his military mission, he also (partially) took part in normal service operations in his squadron. Of course, that means a very high double burden, especially during the season, which usually lasted six months. During this time there was almost no weekend when the demo team didn't fly a display somewhere. Up to 60 individual displays were not uncommon in one year! The stress level was correspondingly high, which is one of the reasons why the pilot was assigned one or two coaches. These were often former display pilots who were familiar with the rigors of the job and could lend assistance as needed. The RNLAF F-16 Demo Team usually consisted of only one demo pilot, a spare pilot was not provided.

List of all Demo-Pilots from 1979 until 2014:

1979	Capt. Willem Sneek
1980-1983	Capt. Gert "Barney" Booij
1984-1985	Capt. Hans "Midas" Weber
1986	Maj. Gert "Barney" Booij
1987-1988	Capt. Henri "Basco" Schevers
1989-1990	Lt. Maarten "Puke" Pladet
1991-1992	Capt. Reinder "Dagger" Zwaart
1993	Capt. Gerhard "Garlic" Went
1994	Capt. Peter "Finger" Janssen
1995-1996	Capt. Ries "Champ" Kamperman
1997-1998	Capt. Patrick "Spout" Tuit
1999-2000	Capt. Robert-Jan "Woods" Bosch
2001-2002	Capt. Richard "Tomba" Buijs
2003-2004	Capt. Christian "Louis" van Gestel
2005-2006	Capt. Gert-Jan "Goofy" Vooren
2007-2009	Capt. Ralph "Sheik" Aarts
2010-2011	Capt. Tobias "Hitec" Schutte
2012-2013	Capt. Stefan "Stitch" Hutten
2014	Capt. Jeroen "Slick" Dickens

The rotation of a demo pilot usually lasted two years, after which not only the pilot changed, but usually also the squadron. The only exceptions were Maj. Gert "Barney" Booij and Capt. Ralph "Sheik" Aarts, each holding the position of demo pilot for three years.

Touch-n-go

High-G turn with Smokewinder on

High-G turn

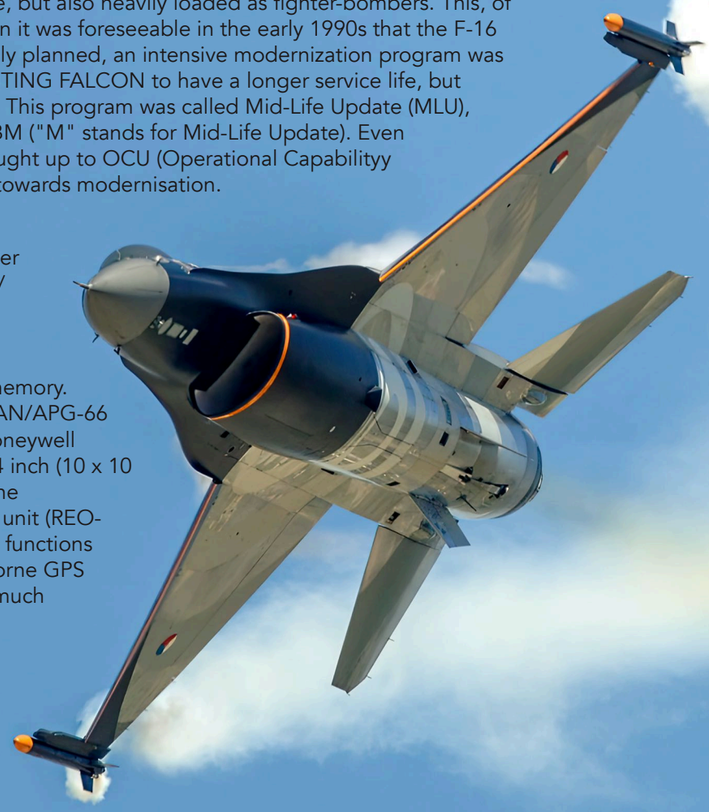
Lockheed Martin F-16AM FIGHTING FALCON

The F-16 arose from a tender for a new air superiority fighter based on a program called the Lightweight Fighter (LWF). In it, the experiences of the Vietnam War were implemented and a light, extremely manoeuvrable machine was developed. This development was also driven forward with the prospect that numerous NATO members would need a replacement for their Lockheed F-104 STARFIGHTERS in the foreseeable future and were therefore available as potential customers. Originally, five competing companies were commissioned to develop the design, of which two were ultimately selected to build prototypes: Northrop (YF-17) and General Dynamics (YF-16). The YF-16 made its first flight on February 2, 1974. The prototype from General Dynamics was ultimately chosen as the winner by the Air Force and a contract was signed in January 1975 to build 650 machines. This started negotiations with the NATO partners Belgium, Denmark, Norway and the Netherlands. The decision to purchase the F-16 by the four nations was made in July 1975. These also included the license construction of the F-16 in Europe (at Fokker in Amsterdam-Schiphol and at SABCA in Belgium).

The basis for the outstanding maneuverability of the F-16 was an analogue fly-by-wire system (a digital one was used from the C/D variant onwards) in conjunction with slight aerodynamic instability. This is controlled by a quadruple redundant flight control computer, which not only implements the pilot's control inputs precisely, but also limits various flight attitudes/manoeuvres (e.g. the maximum g-load is limited to 9g, and the angle of attack cannot be exceeded either, which would result in an uncontrolled stall). Together with the powerful Pratt & Whitney F100 turbofan engine, the ergonomic design of the cockpit, the modern avionics and the ability to add new stores and weapons, the F-16 turned out to be a great hit and, in the case of the Netherlands, a 45-year long success story!

As already mentioned, the Royal Netherlands Air Force was one of the launch customers of the F-16. At that time, the Air Force staff assumed that the aircraft would have a maximum service life of 20 years. This also roughly corresponded to the service life of the F-16's predecessor, the Lockheed F-104G STARFIGHTER, which was in service with the RNLAF for a full 22 years. General Dynamics stated that the airframe had a service life of 8000 flight hours, which would have corresponded to a useful life of almost 35 years (provided the aircraft is only ever flown by a single pilot and he does not achieve more than 220 flight hours per year). However, actual airframe life depends on more factors than just the number of flight hours. The Dutch not only used their F-16s in the air combat role, but also heavily loaded as fighter-bombers. This, of course, affects the airframe structure. When it was foreseeable in the early 1990s that the F-16 would be in operation longer than originally planned, an intensive modernization program was initiated, which not only enabled the FIGHTING FALCON to have a longer service life, but also brought all of the avionics up to date. This program was called Mid-Life Update (MLU), hence the abbreviation F-16AM and F-16BM ("M" stands for Mid-Life Update). Even before the MLU the Dutch F-16s were brought up to OCU (Operational Capabilityy Upgrade) standard, which was a first step towards modernisation.

At the heart of the update was a Texas Instruments Modular Mission Computer (MMC). In addition, the Westinghouse AN/APG-66 radar was equipped with a new signal and data processor, which not only works considerably faster than the original processor, but also has a 20 times larger memory. The designation for the modified radar is AN/APG-66 (V)2. Two multi-functional displays from Honeywell were installed in the cockpit. The two 4 x 4 inch (10 x 10 cm) color liquid crystal displays replaced the monochrome radar electro/optical display unit (REO-IU). A new sidestick with various advanced functions was also included, as was a miniature airborne GPS receiver, which not only made navigation much more precise, but also the use of weapon systems. The entire update/conversion measures took almost half a year per machine.



Tech Sheet (Lockheed F-16AM FIGHTING FALCON):

Length:	49 ft 6 in (15,08 m)
Height:	16 ft 5 in (5,00 m)
Wingspan:	32 ft 10 in (10,00 m)
Take-off weight:	29 896 lbs (13 560 kg)
Max speed:	1 345 mph (2 164 km/h)
Ceiling:	55 300 ft (16 764 m)
Rate of climb:	62000 ft/min (315 m/s)
Combat range:	1 407 nm (2 600 km)
Power plant:	P&W F100-PW-220E rated at 23 830 lbf
Armament:	1 x 20mm M61A1 Vulcan AIM-9N/M/L Sidewinder AIM-120 AMRAAM Mk.82/84 bombs AGM-65G Maverick

Preparation for display

Once a year, before the start of the air show season, the Chief of the Air Staff has to review and sign off the display routine for the year. Preparation for a display often begin before or shortly after arrival at the airfield. The demo pilot first familiarized himself with the respective terrain and the distinctive points of the environment. Several briefings are held before any display takes place within the team, as well as with flight safety, the local Met Office (weather service) and the organizer. The decision as to what, how, where and in what form was flown was not made by the demo pilot alone, but was decided together with his coach(es). The first point was of course the weather. There were three different display profiles depending on the weather conditions to be expected or the cloud base: a high-level, a medium-level and a low-level profile. The minimum cloud base for a display was 1500 feet.
Once the type of demonstration had been agreed upon, each individual maneuver was discussed in detail, but safety-related matters were also clarified. For example, an alternative airfield had to be defined where the demo pilot could land his aircraft safely if this was not possible at the event's airfield. In the case of a flying display, the aircraft is usually not fully filled up with jet fuel or does not carry any additional tanks. The onboard fuel carried must be calculated in such a way that the alternative airfield can be reached in any case while leaving a reserve in the tanks. Any action in the event of a technical malfunction was also discussed and defined in the briefings.

J-015/311 Sqn / RNAS Yeovilton 2009

The display

In contrast to many of the US F-16 displays, where the focus of the demonstration was primarily on the performance parameters of the FIGHTING FALCON, such as speed and climb rate, the Dutch pilots prefer to show off the impressive maneuverability of their machines. Extremely tight curves generated contrails on the strakes, especially in high humidity, which soon became a kind of trademark of the RNLAF F-16 solo displays. A display usually lasted eight to ten minutes and could hardly be surpassed in terms of dynamics. After being cleared by air traffic control, the first thing the demo pilot did was demonstrate the enormous power of his aircraft by applying full afterburner which lead to a take-off roll of only 300 m. A special trademark was the break that the demo pilot performed immediately after lifting off. The tail unit or the exhaust nozzle with full afterburner almost touched the concrete of the runway. This maneuver was defused around the 2005/2006 season, much to the chagrin of the photographers. After that, the start was rather unspectacular. All attitudes flown were standard maneuvers that every fighter pilot must be able to master. The only difference to regular flight operations was the quick succession with which one profile transferred into another and of course, the fact that they took place at very low altitude. The load on the demo pilot was substantial, reaching g-forces of up to 8g+ several times during a flight. Since the 1985 season, so-called "Smokewinders" have been fitted or used on the F-16. These are smoke generators, which have the shape and size of an AIM-9 Sidewinder missile and visually underpin the demonstration with white smoke. If the respective situation allows it (or those responsible do), flares were also used during a demonstration. While this has become a standard for most fast-jet displays, the Dutch were the originators that made it really socially acceptable with their F-16 Demo Team!

After take-off, a tight full circle was usually flown and (depending on the flight profile/weather conditions) the F-16 then went vertical. High-speed maneuvers were alternated with slow ones like that high-alpha pass, with rolls and loops also being part of the standard repertoire of the demo. A high-alpha pass demonstrates the F-16's slow speed characteristics, while a high-speed, low pass gives the spectator a feel for the power of the FIGHTING FALCON. One maneuver that was always welcome, at least for photographers, was performed before the final landing – a so-called touch-n-go followed by a roll with the landing gear down. The landing was also precisely choreographed and always used the brake chute. As a result, the aircraft usually came to a standstill in the middle of the runway (directly in front of the spectator stands) in order to turn around there, blow off the brake chute and then taxi to the intended parking position.

After the engine of the F-16 was shut down by the pilot the whole job was far from being over. While the maintenance crew carried out the post-flight checks and very often removed the flies and mosquitoes from the windscreen, the cockpit glazing and the radar dome, the pilot and the coaches sat down for an intensive debriefing. In most cases, the entire display was recorded on video so that the crew could view and assess every maneuver in detail. In the evening they usually were invited to an official event or a dinner, where all participants of the F-16 Demo Team presented themselves as worthy ambassadors of their country and their air force.

Capt. Tobias "Hitec" Schutte / Demo Pilot 2010 - 2011

Pratt & Whitney P&W F100-PW-220E

Capt. Ralph "Sheik" Aarts / Demo Pilot 2007 - 2009

The Team

As the name suggests, the demo team consisted not only of the demo pilot and his coaches, but of a number of selected experts. Several (usually four) technicians known as crew chiefs were responsible for the maintenance of the aircraft. Their work was coordinated by a technical manager. An important part was the external impact of the team, especially when dealing with the media. A dedicated PR manager was responsible for this. After the internet became more and more important at the end of the 1990s the demo team also maintained their own website, a dedicated webmaster was in charge for it.

The crew chiefs were all experienced technicians who also enlisted for two years. Here, too, not only did professional competence serve as the basis for becoming a member of this elite team, but each member also had to be a good team player to fit perfectly into the team. The same applies to all members of the F-16 Demo Team during the season: spare time was rare or hardly available at all! Dealing with VIPs and the media was trained. In general, the training determined the course of the team during the week. When a pilot wasn't in his F-16 or engaged in the other activities mentioned before, he was found in the simulator. The simulator was also the first step for new manoeuver. Only when the pilot and his coaches have practiced a new maneuver in the simulator several times is the new maneuver was flown in a real F-16 on a training flight (first at high altitude). During the season no new manoeuver was introduced, as the whole display routine had to be signed off before the beginning of the display season.

During this time, the coaches not only support the demo pilot with advice or relieve him of a lot of work, but also ensure that the can concentrate exclusively on the upcoming display, especially before a display was performed. Even the PR manager was anything but bored. Not only is the handling of numerous journalists and media people one of his tasks, he was also jointly responsible for marketing. A small stand with information material was part of every event. Interested parties could also buy patches and various promotional items from the demo team there. Last but not least, he was also responsible for the troop's travel management. While one of the coaches usually traveled to the events in a replacement aircraft, the rest of the team came by car (at least within Europe). Two Mercedes vans painted in the colors of the respective display machine served as means of transport for the team.

Lockheed Martin F-16AM FIGHTING FALCON / image: Robert Kysela

HISTORY

J-015/311 Sqn / RIAT 2010 / image by: Robert Kysela

For 35 years the Dutch F-16 pilots proudly represented their air force and thus their country, but also inspired millions of spectators and, of course, tens of thousands of enthusiasts. No matter where they showed up and flew their display, whether in the Netherlands or beyond their national borders, they were always the main attraction of an event. With their stunning looking aircraft, the balanced and dynamic display, and the use of flares and smoke, they set the bar for what a fast-jet display should look like. Due to cuts in the defense budget and above all the constantly decreasing number of aircraft and the availability of personnel, the last display was flown at the end of the 2014 season (Athens Flying Week 2014/Capt. Jeroen "Slick" Dickens at the controls).
The Royal Netherlands Air Force is in the process of phasing out the last F-16s and replacing them with the Lockheed Martin F-35A LIGHTNING II. It remains to be seen whether there will be a F-35 Demo Team, but it is rather unlikely. A Dutch F-35 will certainly appear in the flight program at an event from time to time, but the Koninklijke Luchtmacht will probably not be able to afford a permanent demo team. That's why only the memory of a great team remains!

We miss you!

Robert Kysela

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ATTACK HELICOPTER
Part III

Eurocopter TIGER ARH / image by: Robert Kysela

The German Heeresflieger (Army Aviation) pilots, just like their Swedish counterparts, were fully aware of their small chance of survival in a full-scale war and therefore developed a special hit & run tactic. They trained to fly their attacks in extreme low-level flight partly below 3 m (!) above ground. The small helicopters were flown with maximum use of terrain and maneuverability in order to provide the enemy air defense with the smallest possible target just for the moment when their guided missiles were fired. The extreme low-level flight demanded absolute concentration from the pilots, but this was the only way to avoid being detected by enemy radar, or at least much too late. A kind of "free chase" over enemy territory, as practiced by the Soviets in the early stages of the Afghanistan war and, at least it seems, revived in Ukraine, was considered sheer suicide by Army pilots.

story & images by Robert Kysela

The next generation

The Western alliance faced huge numerical superiority in the event of an attack by armored units in cooperation with motorized infantry units. These Warsaw Pact attack armies, also known as shock armies, were protected by a large number of mobile anti-aircraft systems. Especially the anti-aircraft tanks of the type ZSU-23-4 "SHILKA" or their successor, the 2K22 TUNGUSKA (NATO code: SA-19 GRISON) with their radar-guided guns caused the NATO planners considerable headaches. These were integrated in large numbers directly into the motorized infantry units and were intended to combat attacking fighter-bombers and attack helicopters, in other words to protect their own tank units from attacks from the air. In combination with the increasingly precise guided missiles mounted on combat vehicles, such as the 2K12 "KUB" (NATO code: SA-6 GAINFUL) or the 9K33 "OSA" system (NATO code: SA-8 GECKO) on the Soviet side and the ROLAND anti-aircraft missile system on the Western side, not to mention the Manpads that were being produced in ever greater numbers, the threat to the combat helicopter increased steadily. In the first days of the Yom Kippur War, the Israeli Air Force had to learn how lethal a combination of radar-guided triple-A artillery in combination with surface-to-air missiles can be, when they suffered heavy losses at the hands of Egyptian air defenses.

The best weapon system is of no use if operated in the wrong way. This was clearly demonstrated by the high losses of Russian combat helicopters at the beginning of the Ukraine conflict. These flew directly over enemy territory in almost peacetime formation (as well as altitude) and relied (apparently) on their technical and numerical superiority - a huge mistake that costed the lives of numerous crews. The survivability of any attack helicopter on the battlefield depends first and foremost on the correct tactical approach. This includes:

- comprehensive knowledge of the situation, respectively the position, strength and type of armament of the enemy forces
- interaction with friendly forces in any form, from communication to data exchange to the coordinated use of all weapons involved.
- ability to approach the enemy undetected or, by taking advantage of the terrain and all available cover, to give the enemy little or better no time for countermeasures.
- to engage the enemy effectively from cover and using adequate weapon systems
- ability to carry out the task in any weather condition and especially in complete darkness
- efficient range, precision and penetrating power of one's own weapon systems
- and last but not least, its active as well as passive self-protection systems.

Other points concerned the helicopter itself. For example, a narrow silhouette not only reduces the visibility of the aircraft (at least from the front view), it also provides a considerably smaller target. A mast sight allows the helicopter to remain in cover for as long as possible while still being able to observe the enemy environment. Redundant systems ensure that a hit, especially with small-caliber infantry weapons, does not become a total failure. This applies not only to the technology of the machine. The most important system in a combat helicopter is (still) the pilot. As inhuman as it may sound, one reason for a two-man crew is, among other things, the ability to carry out the mission or at least get the valuable machine to safety, even if one pilot is wounded or, in the worst case, even killed.

In contrast to the Americans and the Russians, who relied on a heavy high-tech machine with the Boeing AH-64 APACHE or the Mil Mi-28 (NATO code: HAVOC), the Germans and French preferred one solution, which relied on speed and, above all, maneuverability. In order to be able to carry the required weapons and the built-in mission avionics and still have the maneuverability of the B0-105, the Europeans planned a machine of the 6t class. This should be powered by two engines, each rated at some 1,000 sHP, having a two-man cockpit and an extremely narrow front silhouette. The designation of the new design was EC 665 TIGER built by a newly formed company called Eurocopter. The newly developed PARS3 LR fire-and-forget missile was to be used as the main armament. Armor was initially completely dispensed with due to weight restrictions.

At first glance, the tandem configuration of the crew resembles that of the AH-64, but has a few important differences. Contrary to the APACHE, the pilot of the new helicopter sits in the front seat, still the aircraft can be flown from the rear seat as well. Since the pilot sits much lower and also at the very front, he has a much better feeling for the altitude and attitude of his aircraft when flying extremely low than if he were sitting in an elevated position in the upper rear cockpit. Both cockpits have the same instrumentation, which means that while the TIGER can be flown from either cockpit position, the only real difference is in the use of the wire-guided HOT missiles. These can only be fired and controlled from rear cockpit, the commander's seat.

Eurocopter TIGER KHT / image: Robert Kysela

Eurocopter TIGER PT5 (5th Prototype) / ILA 1998 - image by: Robert Kysela

Eurocopter EC665 TIGER

As with many multi-national projects, the development of the Franco-German anti-tank helicopter 2 (PAH2 = Panzer-Abwehr-Hubschrauber 2) was a lengthy process until the different points of view and concepts could be brought to a common denominator. While the German side opted for a pure anti-tank helicopter, the French side wanted a multi-functional combat and scout helicopter for close air support. Government representatives from both countries signed a memorandum of understanding as early as 1976, but it took until 1984 before some kind of development even started. This delay (and others were to follow) had a significant impact on the success of the Franco-German project. When the Soviet Union and the Warsaw Pact collapsed in 1991, the procurement of a pure anti-tank helicopter for the German Bundeswehr was up for debate. The specification was then changed again and the PAH2 became the UHT (Tiger Support Helicopter). Of the 300+ machines originally hoped for, only 180 helicopters were ultimately built. Export success was also limited. In addition to Australia (22 ARH - Army Reconnaissance Helicopters) only the Spanish Army bought a contingent of 24 machines.

From the outside, the differences between the French variant HAP (Hélicoptère d'appui et protection) and HAD (Helicoptere d'Appui Destruction) and the German version UHT are clearly visible. While the German TIGER has a mast sight (Osiris) on the rotor head, the French variants are equipped with a sight mounted behind the second cockpit with a gyro-stabilized platform and triple sensors (Strix). The most important difference, however, is that the UHT does not have a cannon armament. This is not necessary for pure anti-tank combat, which is why the cannon was not included in the German version. However, since the range of applications has changed considerably in the meantime, the lack of a built-in cannon is a shortcoming of the German TIGER. This cannot be compensated for by the 12.7mm MG container either, since the .50 caliber weapon has neither the penetration power nor the range of a 20 or 30mm cannon. All other versions have an integrated 30mm GIAT M 781 cannon with a theoretical rate of fire of 750 rounds/min.

Much of the airframe was made of composite materials to meet weight specifications. According to the manufacturer, the EC665 TIGER consists of 80% carbon fiber reinforced plastic. This not only brought the required weight savings, but also has the advantage that the radar signature is

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significantly reduced. The TIGER is not a stealth helicopter, but great care has been taken in its design to significantly reduce the radar signature compared to other helicopters. In addition to the use of composite materials, attention was paid to a low RCS (Radar Cross Section). The disadvantage of this design is the very narrow cockpit. This is also the reason why (only in the Bundeswehr) deployment above sea is not permitted. Getting in and out of a TIGER is considerably more difficult than in comparable helicopters. Large pilots in particular need almost a "shoehorn" to get in, and the same is true the other way round: a quick exit in the event of an emergency landing in water could be critical.

For a long time survivability of attack helicopters on a modern battlefield has been questioned, especially in terms of its chance against a high-performance fighter. However, various exercises and tests have proven that it is virtually impossible for even the most sophisticated fighter jet radar systems to detect a combat helicopter whose crew knows their trade. Of course, a fighter whose pilot does sight an attack helicopter can effectively engage it, especially if the crew of the attack helicopter is unaware of the danger. That is why combat helicopters have radar warning devices installed, which warn the crew of the danger. Active defenses, such as chaff and flare dispensers, are part of a combat helicopter's standard repertoire. The TIGER uses an AN/AAR-60 Missile Launch Detection System (MILDS), which uses UV sensors to detect the hot exhaust gases of approaching guided weapons and can take appropriate countermeasures. This is done by launching flares and/or chaff. These are decoys consisting of aluminum strips that deflect a radar-guided seeker from its target. The system used in the TIGER is manufactured by MBDA and is named Saphir-M. The pilot can choose between Automatic, Semi-Automatic and Manual mode. In total there are up to 72 cartridges in two dispensers located at the bottom of the fuselage (underneath the engines).

An important part of the survivability is its ability to deploy its weapon system out of range of enemy air defenses. For this reason, the PARS3 LR guided missile was developed, which was intended to have a theoretical range of nearly seven kilometers. The PARS3 LR was designed as a fire-and-forget weapon. This meant that the crew only needed to expose their Tiger for target acquisition and the moment the guided missile was fired, again providing an additional safety aspect. Unfortunately, the PARS3 LR in no way lived up to the expectations placed in it. A very low hit rate coupled with a high degree of unreliability ensured that the Bundeswehr once again deployed its Tigers with the old but proven HOT guided missile.

Eurocopter EC665 TIGER HAP (Hélicoptère d'appui et protection)

MiL Mi-28NM Night Hunter (NATO code: HAVOC-C)

MiL Mi-28N (NATO Code: HAVOC-B)

MiL Mi-28N (NATO Code: HAVOC-B)

On the other side of the fence

While different concepts for a combat helicopter were followed in the West, there was also disagreement in the Soviet Union about the exact design and tactical use of armed helicopters. The MiL Mi-24 was received with joy, but the strategists in the Soviet General Staff were undecided as to whether its concept met all the requirements of a future battlefield. This was one reason why the Soviet High Command created a catalog of requirements in 1972 that specified the new development of an attack helicopter. These specs were so unspecific in many parts that it was completely left to the design bureaus (OKB) of MiL and Kamov as to what the design of the aircraft would ultimately look like. Mil's first design looked like a further development of the German Focke-Achgelis FA 223 DRACHE, which instead of a tail rotor had two counter-rotating rotors mounted side by side on extended wings. The reason for the twin-rotor design was the desire to equip the cockpit with ejection seats to increase crew survivability. At that time, it was the only possible technical solution to ensure safe ejection from a helicopter. Blowing off the rotors shortly before igniting the propellant of the ejection seat was not considered safe at this time. Great attention was paid to the survivability of the crew. After long trials and considerations, the designers at MiL came to the conclusion that it was not the use of ejection seats that improved the chances of survival of the crew, but rather the ability of the airframe to absorb the high G-forces when the machine hits the ground. Ejection seats are useful when the helicopter crew has to bail out at relatively high altitude. However, this would only be necessary in the event of a total failure of the rotor system (or if the aircraft is on fire or totally uncontrollable). If the rotor still rotates (even if the engine fails), the helicopter can at least be brought to the ground relatively safely through controlled autorotation. If there is lethal damage at low altitude, it is maybe not enough time left to eject safely. The solution from MiL designers is unique. Instead of an ejection seat, the rotor blades, the side doors and the stub wings are blown away together with the weapon load at a higher altitude so that the crew can leave the helicopter relatively safely by using a parachute. This is stored in the Zvezda Pamir-K seat. If the flight altitude is less than 300ft, an emergency landing is carried out fully automatically. In order to reduce the risk of injury to the crew the seats, landing gear and the entire front area including a flexible cockpit floor were designed to withstand sink rates of up to 12m/s. This corresponds to a free fall from more than 20m height. Internally, the new aircraft was named Project (Izdeliye) 280, the official name was then Mi-28. In the West, the Mi-28 is known under the NATO designation: HAVOC.

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MiL Mi-28NM (NATO Code: HAVOC-C) / *image: Robert Kysela*

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MiL Mi-28N (NATO Code: HAVOC-B) / *image by: Robert Kysela*

The layout of the final version of the Mi-28 was similar to that of the AH-64 in many ways, but the Mi-28 is anything but a cheap copy of the APACHE (even if the US often likes to claim this). Similar specifications sometimes lead to the same solutions, even if it is sometimes easier to take a close look at an existing competing product in order to implement the knowledge gained in your own development. An example: both helicopter models were required to be air-deployable without major modifications, which in the case of the Mi-28 means that it fits into the fuselage of an Iljushin IL-76. This ensured the low design of the landing gear and tail wheel, making the AH64 and the Mi-28 very similar.

There is hardly any big difference between the two attack helicopters on the outside. While the AH-64 only has space for the two-man crew, up to four people can fit in an albeit narrow space in the fuselage area behind the Mi-28's engines (some sources say two people). Whether these are soldiers for a commando unit or the space is used to rescue a downed crew is irrelevant. The Mi-28 is particularly ideal for so-called CSAR missions (CSAR = Combat Search & Rescue) - it not only offers enough firepower to suppress enemy forces, it can also pick up the people to be extracted. An additional (usually unprotected) transport helicopter is therefore not necessary. Another, not entirely unimportant, part distinguishes the Mi-28 from its US counterpart. While the latter is a highly complex weapon system that can only be flown and maintained by highly qualified crews and well-trained specialists, the Russians aimed to make the technology as simple and easy to use as possible.

The Mi-28's additional armor and self-protection also come at a price. Compared to the APACHE, the NOCHNOY OCHOTNIK (Russian for Night Hunter) is around 30% heavier than its American counterpart, which is not exactly light.

MiL Mi-28N (NATO Code: HAVOC-B) / image by: Robert Kysela

The use of attack helicopters in a full scale wars will rarely start from their Home base, but the helicopter unit will be relocated to the rear of the front line (approx. 30 to max. 50 km from the operational area) in order to be in a protected and well-camouflaged area to operate from. Only the most necessary spare parts, tools and equipment are taken, so that the ground crew can only carry out the most necessary maintenance work. Ideally, the helicopter can be operated maintenance-free for a defined period of time. This criterion is not relevant if the front line is stable and the infrastructure in the hinterland is intact. In the event of a massive first strike from a superior opponent, this can be the decisive defense factor. The best high-tech system is completely useless if it is grounded after just one use due to necessary maintenance work.
The Mi-28 can also score points in this direction – at least on paper. Information about a short TBO (Time Between Overhaul) gives the HAVOC a poor rating in terms of reliability and availability: the next maintenance is due after just over eight hours of flight.

The Mi-28's armament is impressive. In addition to the 30mm type 2A42 cannon, which is installed in an NPPU-28 turret, it is the guided and unguided rockets that give the Mi-28 enormous firepower. The on-board cannon is the same gun used in Russian armored personnel carriers such as the BMP-3. Although this cannon is twice as heavy as the US M230 chain gun, it fires ammunition with significantly greater penetration power (30 x 165mm).

When it comes to guided missiles, there are several systems available, most notably the 9M120 ATAKA and the laser-guided 9K121 VIKHR anti-tank guided missile. Up to sixteen of them can be carried on the pylons of the Mi-28. The range of both guided missiles is stated to be around 10 km, but the probability of hitting a target the size of a vehicle or tank decreases drastically at distances of more than four km. One reason is the increasing dispersion of the laser beam at large distances (in the case of the VIKHR). Another difficulty is keeping the target in sight and aim at long distances.The gunner/WSO has to keep the guided missile during the approach with his aiming device. That applies to the ATAKA model, as this guided missile is controlled to the target via radio signals. The latest variant, the Mi-28NM, can also carry the 9M123M KHRIZANTEMA and the Izdeliye 305 or LMUR (Light Multi-role Unified Missile) missile. The Latter is a modern fire-and-forget guided missile that continues to pursue its target independently after firing. The maximum range of this anti-tank guided missile is 14.5 kilometers. What makes this missile so

MiL Mi-28N (NATO Code: HAVOC-B) / image by: Robert Kysela

dangerous is, on the one hand, its enormous range and on the other hand the fact that it has a bi-directional communication system, which enables the weapons system officer to give control commands to the weapon even after it has been fired and the target approach control has been activated.

An important point in the development of the MiL Mi-28 is its ability to operate in all weather conditions and especially at night. This was (and is) one of the biggest weaknesses of the Mi-24 series. The Mi-28 was then designed to be fully night combat capable, which included the use of night vision devices for the crew, night vision capable instrumentation and an efficient radar and sensor system. Like various western models, the latest version has a gyro-stabilized mast sight. The Fazotron-NIIR N-025M ARBALET radar operates in both L- and Ka-band. As part of the fully digital BLRK-28 avionics system the millimeter-wave pulse Doppler radar has a range of 37 km (23 miles) and enables the Mi-28NM to be the only attack helicopter using a terrain following system. This can be used at a stunning minimum altitude of just five meters above ground!

Fazotron-NIIR N-025M ARBALET / image by: Robert Kysela

ROTARY AVIATION

MiL Mi-28N (NATO Code: HAVOC-B) / image by: Robert Kysela

The use of drones, especially combat drones (and so-called killer drones) has reached a new dimension in the conflict between Russia and Ukraine. These unmanned aerial vehicles pose an ever-growing threat to any armed force, which neither side has yet been able to properly control. On August 30, 2023, an approaching Ukrainian drone was shot down by a Mi-28NM attack helicopter. What makes it special is the cooperation of the crew of the Mi-28NM with the ground forces and the ground control center. The latter transmitted radar data of the approaching missile via data link to the helicopter, which was thus able to locate the drone and destroy it with its on-board gun (with a short burst of five rounds). This shootdown was analyzed with great interest by the military (especially on the part of NATO allies), as it clearly showed another important use of the attack helicopter on a battlefield.

In our next issue, we will look at two other notable combat helicopters, the South African Denel AH-2 ROOIVALK and the Russian Kamov Ka-52 (NATO code: HOKUM).

Robert Kysela

PLANES OF FAME

McDonnell Douglas F-15C EAGLE / image by: Shawn Clish

MCDONNELL DOUGLAS

F-15 EAGLE

It is hard to believe the McDonnell Douglas F-15 EAGLE is over 50 years old. Since it entered service with the United States Air Force (USAF) in 1974, the EAGLE has ruled the skies and been the perfect definition of air superiority with an aerial combat record of over 100 victories versus zero loses. The development of the F-15 EAGLE was a significant milestone in the history of military aviation, resulting in one of the most successful and iconic fighter aircraft ever built. The F-15 was designed to be a high-performance air superiority fighter capable of gaining and maintaining control of the skies. There has consistently been a rivalry among fighter aircraft in every generation. In World War Two the Supermarine SPITFIRE duelled with the Messerschmitt Bf 109 in the Battle of Britain while later in the war the North American P-51 MUSTANG tangled the Focke-Wulf Fw 190 over Germany. During the Korean War, the North American F-86 SABRE clashed against the Mikoyan-Gurevich MiG-15 (NATO Code: FAGOT) in MiG Alley above the Yalu River. In Vietnam, the McDonnell Douglas F-4 PHANTOM II had to contend with both the MiG-17 (NATO Code: FRESCO) and MiG-21 (NATO Code: FISHBED). Even the Lockheed Martin F-22 RAPTOR that is replacing the F-15 as America's premier fighter has theoretical competition from the Russian Sukhoi Su-57 (NATO Code: FELON) and the Chinese Chengdu J-20 MIGHTY DRAGON. Yet throughout its operational history, an F-15 Eagle has never met an equal during an aerial engagement, maintaining a perfect record while serving with Japan, Israel, Saudi Arabia and the United States.

Text: Shawn Clish
Images: S. Clish, H. German, B. Engelke & R. Kysela

F-X Program

At the beginning of World War Two, American military planners were convinced that precision bombing through intelligent target selection was the best use of air power to win a war. Successful use of tactical air power by the Germans at the beginning of the war, then the vulnerability of German bombers during the Battle of Britain and finally the losses incurred by the US Army Air Forces during raids over Schweinfurt, Regensburg and Kiel in 1943 challenged this belief. Fortunately, the tactics were evolved to prioritize air dominance in the spring of 1944 which cleared the airspace above Normandy, France to help secure the five invasion beaches on D-Day. The lessons learned in World War Two were then applied to the Korean War where North American F-86 SABRES faced an evenly matched opponent in the Mikoyan & Gurevich MiG-15 but used superior training and tactics which resulted in a 10:1 kill ratio. But when the war in Southeast Asia escalated and particularly after air-to-air combat operations over North Vietnam increased in intensity it became evident to the Air Force that it lacked a true air superiority fighter.

In April 1965 the earliest concepts of the the new F-X (Fighter Experimental) aircraft envisioned a fighter that possessed superior air-to-air capabilities and stressed maneuverability over speed. But within a few months a multirole aircraft that could accomplish both air-to-air and air-to-ground missions was being suggested to replace the McDonnell Douglas F-4 PHANTOM II, which would significantly jeopardize the aircraft's aerial combat capabilities. An initiative lead by the Commander of Tactical Air Command, General Gabriel P. Disosway, a World War Two fighter pilot, argued that the only way the Air Force could meet the challenge posed by the lightweight maneuverable Soviet fighter was to design a superior aircraft. Yet by December 1965, aerospace manufacturing companies were asked to submit initial design proposals for a multirole aircraft that closely resembled an improved General Dynamics F-111 AARDVARK as opposed to an air superiority fighter.

Fortunately, veteran fighter pilot and author of the air combat training manual used by the Fighter Weapons School at Nellis Air Force Base (AFB), Nevada, Major John R Boyd, joined the Tactical Division of the Air Staff Directorate of Requirements in October 1966. Major Boyd, with the help of a mathematician named Thomas Christie, had developed the Energy Management (EM) Theory, a revolutionary equation that simplified air combat and enabled fighter pilots to communicate their wishes effectively with aircraft engineers to aide in the design of fighter aircraft.

Even with Boyd's assistance and the EM Theory being applied to the F-X Program, politicians and Air Force officials were still insisting on a fighter that would have to be rather large in size to accommodate the fuel, weapons and avionics required to complete the desired mission profiles. While there was no preference specified for fixed or swing-wing designs and turbojet or turbofan engines could be proposed as long as they were smokeless, the Air Force still insisted on an all-weather aircraft that could be reconfigured for ground support missions once air superiority had been established. By August 1968 the F-X had evolved into a single-place, twin-engine design featuring excellent pilot visibility with a combination of standoff missiles for beyond visual range combat and a built-in cannon for close-in combat. While heavy items such as the radar and avionics were discretionary, other items such as a tail hook, drag chute, self-sealing or foamed fuel tanks, armour and bullet-proof glass were all deemed essential features for aircraft and pilot survivability.

In July 1967, the Soviet Union unveiled a new fighter at an air show near Moscow, the Mikoyan & Gurevich MiG-25 (NATO Code: FOXBAT). The twin-engine supersonic interceptor concerned American Air Force planners and helped highlight the urgency for an advanced, highly capable air superiority platform, a role that had not been fulfilled since the F-86 SABRE. While the F-4 PHANTOM II was a very capable interceptor and fighter-bomber, its multi-role design lacked the agility and dedicated aerial combat capabilities to be superior to the current and emerging fleet of enemy fighters. While Soviet fighter development certainly influenced the Air Force, there was also domestic pressure from the Navy's VFX fighter program which ultimately became the Grumman F-14 TOMCAT. Finally, there was internal pressure within the USAF as a group of like-minded innovators lead by Major Boyd and known as the "Lightweight Fighter Mafia" believed that the fighter should be a small, low-drag, low-weight aircraft that would be difficult for the enemy to detect as opposed to the larger proposed F-X design. These factors forced the Air Force to expedite the F-X program instead of adding time and incurring the additional costs associated with evaluating a new fighter design.

McDonnell Douglas F-15B EAGLE / image: Robert Kysela

PLANES OF FAME

McDonnell Douglas F-15C EAGLE / image by: Shawn Clish

McDonnell Douglas F-15 EAGLE (A/B-Model)

On September 30, 1968, eight aircraft companies were asked to submit bids for a high thrust-to-weight ratio aircraft with advanced avionics and a weapons system capable of excelling in a wide range of mission profiles. By December, proposals from General Dynamics, Fairchild Republic, McDonnell Douglas and North American were being evaluated with the latter three companies receiving $15.4 million dollars to submit technical proposals and projected cost schedules for development. On December 23, 1969, in an effort to further reduce development time and costs, the air force chose to skip the traditional competitive fly-off and instead declared the winner of the F-X program, now known as the F-15, to McDonnell Douglas. The initial order was for twenty development and operational evaluation aircraft including a pair of tandem seat models.

Although Major John Boyd helped save the direction of the F-X program, he was unhappy with its outcome and the eventual winner. He maintained his belief in a small, agile fighter and would go on to influence two designs that flew against each other a few years later in the Lightweight Fighter/Air Combat Program. In 1975, the General Dynamics YF-16 FIGHTING FALCON was named the winner and awarded the Air Force contract, while the Northrop YF-17 COBRA was chosen by the Navy a few months later and would serve as the basis for the McDonnell Douglas F/A-18 HORNET.

The development process of the F-15 was swift and the first F-15A rolled out of the McDonnell Douglas assembly plant in St Louis on June 26, 1972. Just over a month later, on July 27, 1972, McDonnell Douglas Chief Test Pilot, Irving Burrows, performed the first flight, lifting off from the famous home of flight testing, Edwards AFB, California. The first flight of what would later be known as the F-15B took place on July 7, 1973. The F-15A was powered by a pair of Pratt & Whitney F100-PW-100 afterburning bypass turbojets that are separated by titanium in the hopes of preventing a damaged engine from harming the other. The engines are mounted side by side in the fuselage which reduces handling problems due to asymmetric thrust in the event of an engine failure and are fed by rectangular wedge-style inlets with variable intake ramps to optimize airflow. The engines can produce a maximum continuous power rating of 12,410 lbf (55.2 kN), military power of 14,690 lbf (65.3 kN) and afterburning thrust of 23,930 lbf (106.4 kN) limited to five minutes of use. The engines could power the F-15A/B up to 30,000 feet in 60 seconds and a service ceiling of 60,000 feet with a maximum speed of 1650 miles per hour and a range of 2880 miles with external fuel tanks. The design features a large shoulder-mounted wing which is unofficially referred to as a tennis court and contributes to low-speed performance negating the need for additional lift devices such as leading edge slats. The sleek aerodynamic wing has a cropped delta shape and is swept back at a 45 degree angle. The trailing edge of each wing has a two-position flap and ailerons. The hydraulically-operated spine mounted air brake was increased in size during initial flight tests to help with slowing the aircraft both in the air and for rollout after landing. The empennage includes twin vertical stabilizers and all-moving horizontal stabilizers which received a notch during testing to reduce flutter problems and provide assisted roll control in certain flight attitudes.

Tech Sheet (McDonnell Douglas F-15C EAGLE):

Length:	63 ft 9 in (19,43 m)
Height:	18 ft 6 in (5,64 m)
Wingspan:	42 ft 10 in (13,06 m)
Take-off weight:	68 000 lbs (30 844 kg)
Max speed:	1 650 mph (2 655 km/h)
Ceiling:	65 000 ft (20 000 m)
Rate of climb:	67 050 ft/min (341 m/s)
Combat range:	1 061 nm (1 965 km)
Power plant:	P&W F100-PW-220 rated at 23 770 lbf
Armament:	1 x 20mm M61A1 Vulcan 4 x AIM-9N/M/L Sidewinder 8 x AIM-120 AMRAAM 4 x AIM-7 Sparrow

McDonnell Douglas F-15C EAGLE / image by: Robert Kysela

F-15C/D

Rapid advancements in technology lead to an upgraded variant of the F-15 within a few years. Although they are almost indistinguishable on the outside, the upgraded C/D models featured Production Eagle Package 2000 (PEP 2000) improvements. Internal fuel capacity was increased by 2000 pounds (900 kilograms) with the new fuel being placed in the leading and trailing edges of the wings. Additional fuel capacity was also available in optional conformal fuel tanks (CFTs) that could be attached to the side of the engines nacelles by two bolts and carried an extra 3215 litres (850 US Gallons). While these CFTs were/are seldomly used by the F-15C/D, they did become standard on the F-15E STRIKE EAGLE and it's international variants. All of this additional fuel necessitated an increase in the maximum takeoff weight to 68,000 pounds (30,600 kilograms) and a strengthened undercarriage to handle the weight. The engines and avionics were also updated with new Pratt & Whitney F100-PW-220 engines capable of providing 14,670 lbf (65.3 kN) maximum dry thrust and 23,830 lbf (106 kN) afterburning thrust and an improved Hughes AN/APG-63PSP radar.

The first F-15C flew on February 27, 1979 while the F-15D performed its first flight a few months later on June 19, 1979. 482 F-15Cs were produced between 1978 and 1986 while 93 D models were built during that time. 409 F-15C and 61 F-15D served with the USAF starting in September 1979 at Kadena AFB in Japan.

In February 1983, the Multistage Improvement Program (MSIP) was conceived to modernize the fighters as technology improved. MSIP I was planned for the F-15A/B but wasn't followed through due to the costs involved, although some of the early variants received upgraded engines, landing gear and radar. MSIP II for the F-15C/D was evaluated in December 1984 and became standard for aircraft manufactured after June 1985, with older models eventually receiving the MSIP retrofit at Robbins AFB, Georgia. Improvements included a new colour display built by Honeywell, an upgraded central computer and a Programmable Armament Control Set with modernized wiring for compatibility with the latest versions of Sidewinder, Sparrow and eventually the AMRAAM (Advanced Medium Range Air-to-Air Missile). There was also an expanded Tactical Electronic Warfare System that provided improvements to the ALR-56C RWR and ALQ-135 countermeasures set.

McDonnell Douglas F-15C EAGLE / image by: Shawn Clish

McDonnell Douglas F-15C EAGLE / image by: Robert Kysela

Mitsubishi F-15J EAGLE / image by: Bjoern Engelke

McDonnell Douglas F-15C EAGLE / David-Monthan AFB - image by: Shawn Clish

In service

It took almost two decades from its entry into service with the USAF until the F-15 was used in combat by the Americans and although it was against the Soviet designed fighters envision by planners in the 1960s, these aerial battles took place over the Middle East and not Europe. On the first night of Operation Desert Storm, January 17, 1991, F-15C pilot Captain Jon K. "J.B." Kelk scored the first aerial victory of the war when he destroyed a Mikoyan & Gurevich MiG-29 (NATO Code: FULCRUM) near Mudaysis, Iraq, using an AIM-7M Sparrow. F-15Cs scored aerial victories against five Iraqi aircraft on the first night, three MiG-29s and two Mirage F-1EQs, all with Sparrows. By the end of the war, the F-15C accounted for 34 of the 37 Iraqi aircraft credited to the USAF.

While the successes in the skies over Iraq showcased the capabilities of the F-15 against the MiG and Sukhoi aircraft it was designed to fight, the end of the Cold War saw a restructuring of the USAF and a reduction of its fighter force. In 1997, the first F-15A/B arrived for storage at the Aerospace Maintenance and Regeneration Center at Davis-Monthan AFB, Arizona. Subsequent deployments included Operation Southern Watch to enforce the no-fly zone over Southern Iraq, Provide Comfort in Turkey, Allied Force in Bosnia where F-15Cs shot down four Yugoslavian MiG-29s using AMRAAMs, Enduring Freedom in Afghanistan and Iraqi Freedom in Iraq. The F-15 EAGLE served as the USAF's primary air superiority fighter for over three decades until the F-22 RAPTOR received Full Operational Capability in December 2007. Eagles were based in the Pacific, Europe and served with the Air National Guard and Air Force Reserve alongside active duty units in the US. One-way flights to the Boneyard continued as the F-22 assumed the role of the Air Force's premier air superiority fighter with the remaining F-15s relegated to the role of support for this mission due to the limited number of F-22s produced. As of September 2023, F-15C/D aircraft are still in service in Air National Guard units in California, Florida, Louisiana, Massachusetts and Oregon.

Foreign customers: Israel

Following the Yom Kippur War between Israel and Egypt in October 1973, a need arose for 50 fourth-generation fighters for the Israeli Air Force (IAF). The IAF sent some very experienced pilots to the United States, the evaluation group had 24 aerial victories among them, to compare the Grumman F-14A TOMCAT and the F-15A/B EAGLE. The EAGLE's primary mission as an air superiority fighter appealed greatly to the group of pilots, as did exceptional visibility, user-friendly weapons system and overall aircraft performance, especially the power and maneuverability. They conducted ten flights in the F-15B and found the EAGLE could easily outmatch the Douglas A-4 SKYHAWK and F-4 PHANTOM II that were used as aggressors. This was contrasted by their experience in the F-14A which featured the impressive AIM-54 PHOENIX missile in its arsenal but wasn't a missile dogfighter and had a tendency for its Pratt & Whitney TF30-P-414A Turbofans to suffer complications during air combat maneuvering. The F-15 was also less expensive than the F-14. In September 1975, the Peace Fox I agreement was signed between the US and Israel and lead to the delivery of four early production aircraft. Peace Fox II transferred 19 F-15A and 2 F-15B BAZ (Hebrew for Falcon) while Peace Fox III involved 18 F-15C and 8 F-15D AKEF (Hebrew for Buzzard). After Operation Desert Storm, to show their appreciation for Israel not becoming involved even while being struck by Iraqi Scud missiles, the US sent ten F-15A/B as a thank you present.

On June 27, 1979, during an air strike being conducted by the Israeli Defence Force on bases in southern Lebanon, six F-15s intercepted a flight of Syrian MiG-21s, shooting down five of the MiGs in the first combat engagement involving the F-15. The two sides met again a few months later in September 1979 with similar results, as Israeli F-15 pilots claimed four Syrian MiG-21s on the 19th and again on the 24th. Of the 100+ claimed victories by the F-15, Israeli pilots are responsible for the majority of the them with many of these claims occurring during Operation Drugstore in June 1982. In late May and June, 1982, the Palestine Liberation Organization (PLO) in Lebanon conducted a twelve-day artillery and rocket bombardment of Northern Israel, resulting in 60 civilian casualties and making living in the area extremely hazardous. After an unsuccessful assassination attempt by the PLO of the Israeli Ambassador in London, Israel responded with a full-scale ground invasion to remove the threat posed to their citizens. Aerial engagements between Israel and Syria occurred from June 5-12 and heavily favoured the Israelis. Officially, Israeli pilots claimed 88 Syrian aircraft destroyed with F-15s accounting for 33 of those victories, while it is believed that Israeli losses totalled 13 aircraft. While it wasn't shot down, an Eagle was badly damaged on June 8 by a MiG-21bis using a Vympel R-60 (NATO Code: AA-8 (Aphid) infrared air-to-air missile.

Boeing F-15C EAGLE - image by: Howard German

PLANES OF FAME

McDonnell Douglas F-15C EAGLE / image by: Robert Kysela

Foreign customers: Royal Saudi Arabia & Japan

In 1983, the Al Quwwat al Jawwiya as Saudiya (Royal Saudi Air Force or RSAF) purchased 46 F-15C and 16 F-15D under the Foreign Military Sales project Peace Sun to replace their aging British Aircraft Corporation Lightning interceptors. The delivery of EAGLES to Saudi Arabia had its share of controversy as the US Congress was unhappy about a potential adversary operating the jet while Israel was cautious about being within the aircraft's combat radius. Congress did approve the sale but included a provision limiting the number of jets that could be in one place at one time. Initial training was conducted at Luke AFB, Arizona and upon reaching Initial Operational Capability, F-15C/Ds started to arrive at No 5 Squadron at King Fahad AFB in Taif, No 6 Squadron at King Khaled AFB in Khamis Mushayt and No 13 Squadron at King Abdul Aziz AFB at Dharan. On June 5, 1984, RSAF Eagles from No 6 Squadron were involved in an air battle with Iranian F-4E PHANTOM II during a border confrontation involving Saudi oil fields. Two of the PHANTOMS were shot down in the only known engagement between McDonnell Douglas products. In 1989 Saudi Arabia tried to expand their fleet of F-15s with the purchase of a further 12 aircraft but the deal was was not supported by the US. Operation Desert Shield/Storm did a lot to strengthen relations between the two countries resulting in the jet limitation being removed and 24 F-15C/D being transferred from USAF units in Europe to the RSAF to form No 42 Squadron at Dhahran. During the conflict, RSAF F-15Cs flew combat air patrols alongside American Eagles and on January 24, 1991, Captain Ayehid Salah al-Shamrani of No 13 Squadron shot down a pair of Iraqi Dassault Aviation MIRAGE F-1EQs with AIM-9P SIDEWINDERS for the only non-American aerial victories of the war. After the war, the 1989 order for twelve jets received approval and consisted of 9 F-15Cs and 3 F-15Ds.

Japan showed early interest in the F-15 and evaluated the F-15A and B at Edwards AFB in 1975. Japan's proximity to potential threats on mainland Asia paired nicely with the F-15s ability to counter air space intrusions with its impressive climb rate and maximum speed. This combination lead to the Japanese Air Self-Defense Force (JASDF) eventually becoming the only license-builder of the type. In 1978, a contract was awarded to Mitsubishi for license construction of the F-15J and DJ EAGLE which were based on early F-15C and D aircraft but included some Japanese technology. The electronic warfare package was changed to a Japanese J/APR-4 and from the threat warning and countermeasures system to a Japanese J/ALQ-8. Although the engines of the J/DJ are the same as the C/D, they were manufactured by Ishikawajima-Harima Heavy Industries under license from Pratt & Whitney and are designated F100-IHI-100. The engines have since been updated with the more reliable F100-IHI-220E. The first 2 F-15J and 12 F-15DJ were produced in St Louis by McDonnell Douglas but the remaining 163 single-seat and 36 twin-seat jets were built in Japan by Mitsubishi. More upgrades through the years have focussed on weapons capability as a new AN/APG-63(V)1 radar was added to support AAM-4 missile, the Japanese version to the AMRAAM and a helmet-mounted sight that supports the AAM-5 missile. Outer wing pylons have also been added to accommodate up to 12 air-to-air missiles, a significant increase for a jet used for air defense. Although many intercepts of Chinese, North Korean and Russian aircraft have been conducted, the JASDF EAGLES have yet to be involved in an aerial engagement.

Different variants

STREAK EAGLE

In April 1974, the Air Force ordered the modification of the 17th F-15A built to the STREAK EAGLE configuration in an effort to reclaim world time-to-climb records. In an effort to reduce weight, all non-essential systems and paint were removed, resulting in a reduction of 815 kilograms (1800 pounds) and it only flew with the amount of fuel required for each specific flight profile. The STREAK EAGLE went on to break eight time-to-climb records between January 16 and February 1, 1975, many of which had been recently set by the Mikoyan & Gurevich MiG-25 (NATO Code: FOXBAT). With its mission complete, the Streak Eagle was transferred to the National Museum of the United States Air Force at Wright-Patterson AFB in Dayton, Ohio, where it remains on display.

AGILE EAGLE

In 1984, NASA begun a modification of the first F-15B after McDonnell Douglas was awarded a contract to explore advanced Short Take-Off and Landing (STOL) capabilities. The goal of the project, known as AGILE EAGLE, was to develop an aircraft that could take off and land from battle damaged runways while also demonstrating improved maneuverability. The Maneuvering Technology Demonstrator (MTD) experimental aircraft was fitted with canards which were actually modified horizontal stabilizers from an McDonnell Douglas F/A-18 HORNET and were mounted at a dihedral of 20 degrees. The plane received two-dimensional thrust vectoring exhaust nozzles and reversing engines along with some avionics and landing gear alterations. The AGILE EAGLE program ended in August 1991 after successfully meeting all of its objectives. Although none of the AGILE EAGLE technology was used in operational EAGLES, data from the program was used for the Lockheed Martin F-35 LIGHTNING II and Lockheed Martin F-22 RAPTOR, including engine technology that was used in the development of the F-22s Pratt & Whitney F119-PW-100 thrust vectored engines. The AGILE EAGLE F-15B wasn't the only EAGLE used by NASA, as F-15A and B models have been used in a variety of tests for programs that include the Space Shuttle by the aeronautics research agency.

F-15 Anti-Satellite (ASAT)

The F-15 ASAT program was envisioned as an anti-satellite interceptor, able to destroy an orbiting satellite by launching a missile from an F-15 at the upper reaches of the aircraft's flight envelope. During the early 1980s, an F-15A was heavily modified with a special centerline pylon for carrying the 2,700-pound weapon and a cryogenic tank for carrying liquid helium in the ammunition bay. The missile was based on the Boeing AGM-69 Short Range Attack Missile and consisted of a two-stage rocket that used a liquid helium cooled infrared seeker to guide it toward the target satellite. The F-15 was regarded as a good launch platform because its excellent climb rate enabled it to launch the kinetic-energy vehicle to intercept satellites up to altitudes of 965 kilometers (600 miles). Following a series of live fire flight tests to evaluate aircraft and missile compatibility and overall system performance, an ASAT-armed F-15A took off from Vandenburg AFB, California on September 13, 1985 and climbed to 80,0000 feet. The jet and missile performed flawlessly, engaging and destroying the Solwind P78-1 satellite which had been launched by the US in February 1979, much to the dismay of the satellite's scientists as it was still functioning and returning project data. The program was terminated by US Congress in 1988 after it was seen as a violation of a US-Soviet treaty forbidding the development and testing of anti-satellite weapons.

F-15EX EAGLE II

The Boeing F-15EX EAGLE II is an advanced and upgraded variant based off the F-15E STRIKE EAGLE designed for the USAF to replace the F-15C/D. It boasts a suite of modernized avionics, mission systems and sensors, providing improved situational awareness and combat effectiveness for the modern battlefield. The aircraft is equipped with the latest electronic warfare systems, radar and communications equipment, ensuring compatibility with the most advanced weapons in the Air Force's inventory. Notably, the EAGLE II retains its formidable air-to-air combat capabilities while expanding its role to include air-to-ground missions. It features conformal fuel tanks to extend its range, making it a versatile platform for a wide range of mission profiles. While the F-15EX fills an air superiority role, it is not intended to replace fifth-generation aircraft like the F-22 RAPTOR and F-35 LIGHTNING II. Instead, it complements these advanced platforms by providing additional capacity for air superiority and strike missions. On March 11, 2021, the U.S. Air Force took delivery of its first F-15EX EAGLE II fighter. The original EAGLE II program was intended to deliver 144 aircraft however the FY2023 President's budget request adjusted the intended fleet size to just 80 aircraft.

PLANES OF FAME

McDonnell Douglas F-15C EAGLE / image: Robert Kysela

PLANES OF FAME

McDonnell Douglas F-15D EAGLE / image by: Shawn Clish

The history of the McDonnell Douglas / Boeing F-15 EAGLE is a testament to the remarkable evolution of military aviation. Born out of the USAF's quest for air superiority, the F-15 emerged as a formidable fighter aircraft, embodying speed, agility and advanced technology. Its development in the 1970s marked a significant leap forward in the capabilities of aerial combat platforms and it quickly established itself as a dominant force in the skies. While still in service with all four nations that have operated it, the F-15s legacy is one of excellence due to its unblemished air-to-air combat record. The F-15 EAGLE is an iconic symbol of air power and a testament to the ingenuity, innovation and dedication of the those who contributed to its storied history.

Shawn Clish / CHK6

image by: Marc Muick

... behind the image

by Robert Kysela

This section is for you - our readers! We often get asked many questions regarding what camera gear and settings we use. While there are no real secrets to this, this section is dedicated to sharing our experience with you. Every issue will feature valuable information regarding aviation photography, from the absolute beginner right up to the seasoned professional, so stay tuned!

SHUTTER SPEED

***Statement**: in aviation photography there are different opinions on what a great shot should look like, what is right and what is wrong. Personal taste plays a big role, so all the information and statements in this tutorial naturally reflect my personal opinion and preference!*

The exposure for a photo is optically controlled by two components: the lens aperture and the shutter speed. Only when both are set correctly to each other is your photo perfectly exposed. In addition, there is the ISO setting, which in simple terms is the sensitivity of the sensor. You also control the depth of field of a shot via the aperture as well as the appropriate time (we'll take a look at this area in an upcoming issue). Today we'll focus exclusively on shutter speed and its influence in aviation photography.

The minimum shutter speed with which you achieve sharp images always depends a little on the focal length of your lens. As a rule of thumb: with a 500 mm lens you should take your photos at least with 1/500s, with an 800 mm it should be minimum 1/800s. For modern jets, especially if they are extremely agile aircraft of the 4th generation and higher (e.g.: Lockheed Martin F-16 VIPER or a Dassault Aviation RAFALE, just to name a few), your shutter speed should be at least 1/1600 sec if you want to get a point-sharp image of this aircraft while performing a high-speed pass. If you take photos from propeller aircraft or helicopters it becomes a bit more difficult. To make sure that the propeller/rotor is not sharp and completely stationary, the shutter speed must be at least less than 1/400s, if you want to see the propeller circle completely, then we are talking about a maximum of 1/80s or even longer. It goes without saying that this will generate a high output of blurred images! Modern cameras and lenses have a stabilizer (VR - Vibration Reduction at Nikon and IS - Image Stabilizer at Canon). With this, they gain, according to the manufacturer, up to three full f-stops (theoretically). While Canon's IS seems to deliver good results, I'm personally not convinced by Nikon's VR. This is completely useless, especially in the three-dimensional area (when the lens is directed against the sky and thus no longer has a reference point). All that is left is a steady hand and a lot of practice in pulling along evenly to prevent blurred and shaky shots. The advantage today is that most cameras have a high frame rate. For example, Nikon's current top model, the Z9 can generate up to 20 images per second in RAW mode. The chance that there will always be a few razor-sharp photos is quite high. However, they also produce a lot of data waste.

Let's get back to the propeller aircraft. If you want to photograph an aircraft with a fast turning prop, like a World War II fighter or a modern turboprop (for example an Airbus A400M), you can do it with a 1/320s or even a 1/400s and you still have a slight wiping effect on the propeller. With aircraft from the early years of aviation, like a Fokker Dr.1 triplane, this time is a bit too short, because their two-blade propeller usually turns relatively slowly. Here you should use 1/250s or less at most. The same applies to all rotorcraft. To achieve a wiping effect on a rotor, you should also use 1/250s or less. To get a full circle of rotor blades on a helicopter, the shutter speed has to be in the range of seconds - sharp shots of a helicopter in flight with a full rotor circle are therefore pure coincidence and not really possible. If the helicopter is on the ground or in a hover, the chances that they will succeed in a full circle increase.

Image taken with 1/320 sec

Image taken with 1/125 sec

With fast-jets, the shutter speed cannot be short enough. The maximum available time depends very much on the lens used and its quality. A high-quality (and expensive) lens has a large starting aperture (f-number f2.8 or f4). We remember: the greater the incidence of light, the shorter the exposure time has to be. This means you have a faster shutter speed with these lenses without increasing the ISO value. Lenses that are not quite as high-quality (especially zoom lenses) have a smaller starting aperture (f-number f5.6 or f6.3). In addition, the imaging performance with a fully open aperture is often not really good, i.e. you have to step down to f8 or even f11 to achieve an acceptable image quality, especially in the peripheral areas of your photo. Conversely, you lose shutter speed again. If it is so long that you run the risk of getting a blurry photo, you can compensate for this by changing the ISO setting. Here the options depend somewhat on the quality of the camera or the image sensor built into the camera. The standard ISO setting is usually between ISO100 and ISO200 in good light. If the light conditions decrease, for example when the sky is cloudy or in the late afternoon, you either have to supply more light to the sensor (by increasing the shutter speed - bad idea) or (if possible) use a larger aperture. If neither works, you have the option of changing the sensitivity of the sensor by adjusting the ISO value. This in turn gives you shutter speed again.
Modern high-end cameras can be set up to ISO 1600 (and higher) without the photo losing its (visible) quality (due to image noise or clearly visible grain). You simply have to try out first how far you can go here. With fast-jets I generally work with ISO400 (minimum value) and have set the camera settings to ISO automatic. That works fine with me and my camera!

In our next issue, our digital imaging expert Marc Muick will discuss the topic of crop factor and especially the misconception that it is equivalent to extending the focal length.

Preview

Issue 1/2024

Image by: Joris van Boven

1. MILITARY UNITS: KHR 36 "KURHESSEN"

There is only one single unit in Germany operating the Eurocopter TIGER: the Kampfhubschrauber Regiment 36 "Kurhessen" based at Fritzlar Army Base.

2. AIRSHOW: NATO Days 2023

Since 2001, the airport in Ostrava/Czech Republic has been the venue for NATO Days - a large-scale spectacle in which beside aircraft, tanks, artillery and special forces present their skills.

3. AIRSHOW: SIAF 2023

The Slovak International Air Fest (SIAF) was now held for the second time at the Kuchyňa/Malacky Air Base. This fantastic show is organised by the Slovak Aviation Agency.

4. COVERSTORY: USS Gerald R. Ford

The USS Gerald R. Ford (CVN-78) officially entered U.S. Navy service in July 2017. This super-carrier replaced the USS Enterprice (CVN-65) We were on board for you and took a look around!

5. AIRSHOW: ATHENS FLYING WEEK

The Athens Flying Week at Tanagra AB has become one of the best European events attracting not only thousands of visitors but many enthusiast from all over the world!!

6. ATTACK HELICOPTER: PART IV

In the last part of our story on attack helicopters, we look at the further development of this genre - from the Kamov Ka-50/52 HOKUM to the Denel AH-2 ROOIVALK.

7. PLANES of FAME: Boeing F-15E

We continue our big story about one of the most powerful aircraft of our times - the mighty McDonnell/Boeing F-15. After presenting the A-D models we now have a look on the STRIKE EAGLE.

8. AIRSHOW: AIRSHOW LONDON 2023

Airshow London, voted the number one air show in North America, returned in 2023 with the Lockheed Martin F-22 and the Canadian Armed Forces SNOWBIRDS as headliners.

9. AIRSHOW: JESOLO AIRSHOW 2023

The Jesolo Airshow was held this year for the 25th time. It is not only one of the biggest Italian events but also one of the best airshows in Italy.

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