PROGRAMME NEWS & FEATURES 1/2011

EUROFIGHTER WORLD

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SINGLE vs. TWIN

WHICH COMES OUT ON TOP ?

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THE EVOLUTION OF THE SINGLE SEAT SWING-ROLE FIGHTER

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A single and twin seat Eurofighter Typhoon breaking away over the Spanish coastline

Photography: Eurofighter - Geoffrey Lee

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January 2011

EDITORIAL

Enzo Casolini
CEO Eurofighter GmbH

Amongst the cuts and fears for the future of many aircraft programmes, Eurofighter Typhoon has emerged strong from 2010.
With so much going on and so much still to look forward to, I am proud to say I am part of such a successful programme. We have seen many achievements in the last year including the recent delivery of our 250th aircraft to the customer. Now is a time to reflect on how 2010 looks from my perspective and what 2011 will bring.
In January 2011, the programme reached a huge milestone when the operational fleets reached the massive 100,000 flying hours total. This achievement for Eurofighter demonstrates the maturity reached by the platform and the reliability of it as a defence system. In addition, this key event shows in clear terms what can be achieved through international cooperation and partnership. With over 250 aircraft in service with six air forces across 16 worldwide based units, the Typhoon is the perfect example of a new generation fighter. With more aircraft in service than any other, the aircraft is trusted to deliver in terms of performance and operational reliability with well above average results when compared to the most mature aircraft in service across the customer nation's fleets.
Designed with an established technology insertion programme in place, Eurofighter Typhoon is beginning to deliver on the promise to develop in line with evolving threats. We have always stressed that new technologies would be integrated on the aircraft, but only when they are mature enough and it is affordable to do so. 2010 saw the launch and introduction of many new capabilities, highlighting how Eurofighter remains a cutting edge aircraft that will be at the forefront of fighter technology for years to come. This year will not be any different. With export being a primary focus for the Eurofighter programme in 2011, it was great to see the governments from the four core nations being so active and offering a significantly higher level of support with our campaigns in 2010. With ministers and Secretaries of State visiting potential export nations in the past months few months and with more planned in 2011, we are now getting the support we need to promote the aircraft internationally.
2011 will be an important year for the programme in order to demonstrate how Eurofighter Typhoon is the world's best multi-role combat aircraft. With a large presence at many key air shows throughout 2011, Eurofighter has increased the number of exhibitions and defence events we will attend in the coming year. With Aero India just around the corner, Abu Dhabi, Paris Le Bourget and Dubai as the main focal points, Eurofighter will be present at the most important exhibitions around the world to show the capabilities of the Typhoon, its affordability and to demonstrate the benefits of investing in such a capable aircraft.

Enzo Casolini
CEO Eurofighter GmbH

NEWS

SWITZERLAND EVALUATES THE TYPHOON´S FOOTPRINT

EUROFIGHTER LESS NOISE IMPACT THAN ITS COMPETITORS

■ The Swiss procurement organisation for military armaments, Armasuisse, has been evaluating the Typhoon and its two competitors involved in the F-5 Tiger II replacement bid (TTE) for sound levels. The noise pollution criteria (only accounting for three per cent of the overall evaluation) was a main concern in Switzerland.

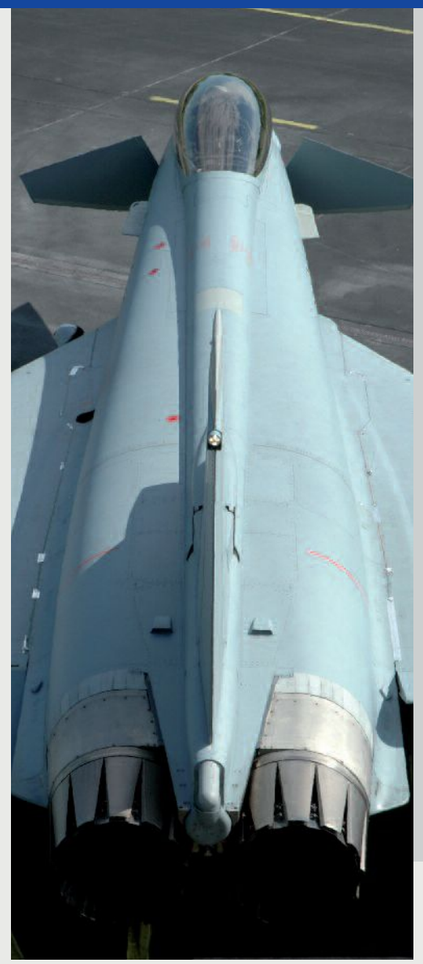
The criteria for the evaluation was split into two groups: 'Light' aircraft simulating air policing missions and equipped with one fuel tank as well as two infrared and radar missiles, and 'Heavy' aircraft with the same armament but with a second fuel tank and a recon pod. The missions also differentiated between use of maximum dry power and the use of afterburners during take-off, flight and landing manoeuvres.

The findings, published recently in the Swiss media some time after the tests were completed, were reassuring for Eurofighter Typhoon. Even though the candidates (Eurofighter Typhoon, Rafale and Gripen NG) were nearly twice as loud in comparison to the older Tiger II, all three aircraft were listed under the same noise category. With a minimal noise difference offered by Saab's Gripen - not traceable to the human ear – the results were a testament to the power and efficiency of the Eurojet EJ200 engines.

However, choosing an aircraft based solely on the levels of noise efficiency is not sufficient. It is the performance of the aircraft that plays a key role in the noise output. The thrust-to-weight ratio of the tested aircraft was for instance a very important part of the evaluations, affecting the landing and take-off procedures and importantly the use of afterburners. The faster the take-off, the quicker the noise will reduce on the ground and so the noise footprint is less than the competitors.

The Eurofighter Typhoon, although being the most powerful of the three aircraft in the competition, showed a very good thrust to weight ratio, enabling the aircraft to take-off in all Swiss military airports fully loaded and without the use of afterburners. The other tested competitors did not reach the same high standards as the Typhoon.

The Swiss Government have put the decision of the competition on hold, but Eurofighter looks forward to working closely with Armasuisse as the competition evolves in the future.



PERFECT, HIGHLY DETAILED, SMALL EUROFIGHTERS

■ Small, but highly detailed models of the Eurofighter are becoming increasingly popular among the modeller community. Revell, the leading German model manufacturer has just released a 1/144 scale version of the Typhoon, only 10 cm long, made of intricate parts as well as a bigger, 1/48 scale reproduction of the twin seat Eurofighter.

Just a few months ago the kit producer released a 1/32 scale model of the single seat version. This model, 498 mm long and with a wingspan of 349 mm, is made of 391 parts and is a perfect reproduction of the real Eurofighter designed with the aid of original Eurofighter drawings and data. The model includes a detailed EJ200 engine and displays a very high level of detail: the ejector seat made from 11-pieces, movable canards, a detailed air intake area, jet nozzles in two configurations, detailed air brake and landing gear, separate ailerons, flaps and rudder. In addition, the model has been fitted with Meteor, AMRAAM, Sidewinder, IRIS-T and ASRAAM missiles. All this makes it the best reproduction of the real aircraft available for the model kit enthusiast.

FIVE TYPHOONS DELIVERED TO THE ITALIAN AIR FORCE IN ONE DAY

THE PROGRAMME THAT NEVER SLEEPS

With most companies on Christmas break between Christmas and New Year, it was a welcome surprise to learn that Alenia Aeronautica was busy completing their final aircraft deliveries for the year, exceeding the total planned for 2010. These last deliveries came in the form of five Eurofighter Typhoon jets that were handed over to the Italian customer on one day.

On the 28th December 2010, Eurofighter Partner Company Alenia Aeronautica signed over IS037, IS039, IS040, IS041, IT011 to the Italian Air Force, bringing the total number of deliveries for the programme in 2010 to 51 – far higher than had been predicted.

This success is yet another impressive indication of the hard work and commitment of the partner companies to meeting and exceeding customer requirements. Throughout the year, the highly skilled Typhoon staff work tirelessly to ensure that each aircraft is safely delivered on time and on schedule. A nice way to end the year.

NEWS

EUROFIGHTER DEVELOPED ON THE FAST TRACK

■ On 22nd November 2010, Partner Company Cassidian Air Systems in Manching delivered Eurofighter GT016 (German Twin-seater no. 16) to the Luftwaffe as the first aircraft in the final Tranche 2 configuration. "This means the Luftwaffe is receiving Eurofighters of the final Tranche 2 standard earlier than planned," explains Cassidian project manager Nils Michael.

As a general rule in the Eurofighter programme, aircraft are delivered in contractually defined configurations. In parallel, the partner companies continue developing the aircraft and then install the upgrades to the aircraft already delivered. That is why, for every tranche of aircraft deliveries, there is a starting standard at the outset and eventually a final configuration to which the aircraft from the first part of the tranche are subsequently upgraded. In the case of the German Tranche 2 deliveries, the first 34 aircraft were to be provided in the starting standard and the following 45 in the final version. Later on, the aircraft from the first batch delivered to the various units were to be upgraded to this final version.

So much for theory. In practice, the final Tranche 2 standard was already available for the production of German Eurofighter number 30, earlier than contractually agreed. The Luftwaffe had asked to receive Tranche 2 final configuration aircraft as early as possible, and Cassidian Air Systems reacted immediately by integrating the upgrades during production instead of later on. Cassidian Air Systems will now also deliver the five remaining aircraft of the first batch to the Luftwaffe in the final Tranche 2 configuration.

The complex tasks involved and the certification of the aircraft in the new standard was a success thanks to the close collaboration between Cassidian Air Systems, the other three Eurofighter partner companies and the Luftwaffe as the customer with its associated quality assurance offices.

EUROFIGHTER IPA 7 TEST AIRCRAFT MAKES ITS 100TH FLIGHT

■ The Eurofighter Instrumented Production aircraft IPA 7 reached a round milestone in late November 2010 when it landed in Manching, in Bavaria after its 100th flight carrying a new flight software version. During the flight which lasted an hour and 25 minutes, pilot Heinz Spölgen, a Cassidian test pilot, checked the new software's autopilot functions - in particular the one for automatic landing approaches.

In addition, Cassidian test pilot Chris Worning flew IPA 7 with this new software version in mid-November. IPA7 forms part of the four-nation test fleet and is used with the appropriate software standard for tests of the plane's enhanced capabilities. It will serve in particular to test air-to-ground capabilities at a later date.

IPA 7 was commissioned in January 2008 as the first series aircraft of the Tranche 2 standard. The main difference between Tranche 2 and Tranche 1 production Typhoons is their new avionics computers, which are distinguished by their higher processing speed and memory capacity. This superior computer performance is needed among other things for the enhanced aerial combat capabilities of the Tranche 2 aircraft, for air-to-ground operations and for the use of long-range guided weapons.

NEWS

UK FOR EUROFIGHTER CAMPAIGN IN INDIA

■ The UK's Secretary of State for Defence Liam Fox visited the Eurofighter Typhoon Office in New Delhi on the 23rd November, meeting a group of high-level company officials during his stay. Bernhard Gerwert, CEO of Cassidian Air Systems and Chairman of the Supervisory Board of Eurofighter GmbH, briefed Liam Fox on the current status of the Eurofighter Typhoon campaign to win India's tender for 126 Medium Multi-Role Combat Aircraft (MMRCA).

Gerwert said of the visit: "Our governments in the United Kingdom, Germany, Spain and Italy are strongly supporting the Eurofighter Typhoon campaign in India. Europe's leading aerospace and defence companies are ready to enhance their industrial cooperation with India's advanced defence industry for the benefit of all parties. Our goal is to integrate India into the global supply chain of the Eurofighter Typhoon by developing a strong and diverse supplier base in India which will also cater to this global programme." The consortium members will also provide India access to key technologies in a unique industrial partnership designed to further catalyze India's indigenous defence sector.

During last November's meeting of the Eurofighter Supervisory Board in New Delhi, senior representatives of Cassidian (Germany and Spain), BAE Systems (United Kingdom) and Finmeccanica (Italy) highlighted their combined commitment to develop a long-term strategic relationship with India and establish a new benchmark for Europe's defence and industrial cooperation with Indian defence and aerospace companies.

Bernhard Gerwert (left) and Dr. Liam Fox (right) in India

THE FOAM AIRCRAFT THAT FLIES AT 75 MPH

■ There is no greater joy for a pilot than being able to fly a reliable, cutting edge aircraft that offers exceptional manoeuvrability and performs impressive acrobatic stunts with ease. Luckily that's possible for non fighter pilots too as the Eurofighter Typhoon remote controlled models offer all of the above.

Just like the original aircraft, radio controlled (RC) Eurofighter Typhoon models have been designed perfectly - aesthetically pleasing yet with the capability to perform challenging aerobatic tricks and manoeuvres. The original delta wing design gives the model plane a great range in speed and flexibility, which permits any experienced RC pilot to fly these wonderful Typhoon models at maximum capacity.

The plane is a scale model of the original Typhoon aircraft built out of hard foam. The 'Impeller' version made by Carson Model Sport in Germany is one of many different versions available across the world. The engine integrated into the model is a 2040 Inrunner Brushless motor, giving the aircraft a top speed of 120 km/h (75 mph).

A similar RC Typhoon model is the 'HC-Hobby Eurofighter EF2000' from Nitro Planes. It comes as 'ready to fly' straight from the manufactures box and is easy to assemble. The foam aircraft is painted in black with the 4 nation's emblem on each side of the plane. It includes a brushless motor as well as landing gear which is able to steer just like the original, making the taxiing, take-off and landing simpler.

These models are perfectly designed for Eurofighter fans who want to experience the feeling of flying a great aircraft, even if it is just the little brother of today's most capable multi-role combat aircraft, the astonishing Eurofighter Typhoon.

AHC

EUROFIGHTER TYPHOON AMATEUR PHOTO CONTEST 2011

■ The 2011 Eurofighter Typhoon calendar was launched in December 2010. On the front cover is a stunning image taken by amateur photographer Neil Bury from the end of the runway at BAE System's Warton site in the UK. This fantastic photograph highlights that we don't just use the work of our professional photographers but we appreciate and will use the best photos we can find of the aircraft. As such, we are introducing to the public the chance to enter our 2011 Eurofighter Typhoon Amateur Photographer of the Year competition.

As part of the competition, we will accept pictures from any amateur photographer with original images of the Typhoon.

Please send all entries either via email to communications@eurofighter.com or in the post: Eurofighter Communications, Am Söldnermoos 17, 85399 Hallbergmoos, Germany.

Good Luck!

TERMS AND CONDITIONS

The 2011 Eurofighter Typhoon Amateur Photographer of the Year Competition will run from the 1st February 2011 to the 31st August 2011.

The winner must be an amateur photographer which by definition means: "A person who engages in photography as a pastime rather than as a profession". Images must be at a minimum, 300dpi in quality.

The winner will have their image featured in the 2012 Eurofighter Calendar and will receive a 100,000 flying hours commemorative Typhoon 1:48 model.

The judging panel for the competition will be Geoffrey Lee from Plane Focus - Eurofighter's leading Typhoon photographer, Bob Hayes, - Managing Director of Impact Image, Marco Valerio Bonelli, - Head of Communications and PR for Eurofighter GmbH and Neil Bury - amateur aviation photographer and author of the 2011 Eurofighter calendar front cover. The winner of the 2011 competition will sit on next year's panel.

Entries should arrive in Eurofighter GmbH no later than the 31st August 2011. All other entries will be put forward for the 2012 competition.

EUROFIGHTER TYPHOON ON AIR

■ European and international television channels have recently shown increased interested in the Eurofighter Typhoon as the aircraft's profile thrives and the programme matures. In November, Italy's national TV news programme TG3 Leonardo covered the technological and economic impact of the Eurofighter programme in a six minute long report. The show was filmed across Eurofighter's Italian manufacturing and assembly sites, highlighting the spin-off technologies developed for this high performance combat aircraft. The show focused heavily on the technology that has been applied to other industrial sectors such as civil aviation, medicine, automotive as well as energy generation industries. The report also looked at the Italian production of the Eurofighter and covered technical details from a pilot's perspective with an interview from Alenia Aeronautica test pilot Marco Venanzetti.

In Germany, n-tv, a national cable and satellite news channel, filmed a 25 minute special report entitled "Business with the Eurofighter", which was first broadcasted on December 14th 2010. The report was filmed at three Eurofighter sites across Germany with interviews from Eurofighter experts. Filming started at partner company Cassidian's final assembly site in Manching, Southern Germany and covered the industrial, economic as well as the military impact of the Eurofighter programme. After a stop in Munich at the Eurofighter headquarters, n-tv concluded their report with a visit to Laage Air Base, Rostock, to film daily operations at the home of the Luftwaffe's Jagdgeschwader 73 "Steinhoff" in Northern Germany.

In addition to these European programmes, National Geographic contacted Eurofighter towards the end of 2010 to film an hour long show as part of their 'Mega Factories' series. The show, which will focus on the unique manufacturing on the Eurofighter aircraft, will be aired in excess of 240 countries worldwide in April 2011. The National Geographic team began filming in mid-November at Alenia Aeronautica's final assembly plant in Caselle, Italy. The tour continued in Germany, where National Geographic spoke with Eurofighter CEO Enzo Casolini before interviewing Eurofighter specialists at Museum Flugwerft Schleissheim near Munich in front of the first Typhoon prototype DA1. To conclude the German tour, the team went to the Luftwaffe's air base in Laage for footage of the operational jets emerging through the atmospheric conditions of northern Germany and filmed great interviews with pilots and engineers who explained the diverse capabilities of the aircraft.

Shortly after their filming in Italy and Germany the production team travelled to Spain's Getafe plant to film the manufacture of the right-wing and spent time at BAE Systems' Warton and Samlesbury sites in the UK to see the sub and final assembly of the aircraft.

Eurofighter would like to thank everyone who supported the filming which will underline the manufacturing excellence of the Typhoon programme.

MS

EUROFIGHTER AT GREECE´S DEFENSYS EXHIBITION 2010

■ Eurofighter Typhoon participated in the first edition of the Greek defence and equipment exhibition DEFENSYS which took place between the 28th and 31st October 2010 in Thessaloniki.

The exhibition was under the auspices of the Ministry of National Defence and the quality of the whole show was impressive with exceptional organisation and effort put in to the details of the event.

The Eurofighter Typhoon stand, positioned directly in front of Finmeccanica and key supplier MBDA, was one of the most visited by delegations, politicians, embassy representatives and journalists from all around the world.

As predicted, one of the main visitors was the Hellenic Air Force who showed a keen interest in the Eurofighter Typhoon. The Hellenic Military visitors included the Chief of Staff of the Hellenic National Defence Ioannis Giagkos, Deputy Chief of Staff of the Hellenic National Defence Ilias Venetis and the Chief of Staff of the Hellenic Air Force Vassilios Klokozas.

The Greek Minister of Defence Evangelos Venizelos (second to left) visits the Eurofighter stand

In addition to the host nation visitors, other international official delegations from India, Bulgaria, Oman, Saudi Arabia, Tunisia, Jordan and the UAE passed by the Typhoon stand to receive an update on the present and future of the programme.

SS

100,000 FLYING HOURS FOR THE EUROFIGHTER TYPHOON

Every so often an aircraft programme achieves a significant milestone during its lifetime and Eurofighter Typhoon has done just that with the achievement of 100,000 flying hours. This incredible total came hand in hand with the celebration of the sixth operational year of the Eurofighter and was celebrated during an event on the 25th January in Munich. These milestones were reached at the beginning of 2011 by the 16 units equipped with the Typhoon across the six air forces of the UK, Germany, Italy, Spain, Austria and the Kingdom of Saudi Arabia.

The 100,000 hours were achieved flying in the bitter cold weather of the Baltic Sea, in the temperate climate of the Tyrrhenian Coast, in the torrid heat of the Arabic Peninsula and over the rough South Atlantic Sea. A range of operational scenarios have tested the Typhoon to its limits and is testament to the reliability, operational readiness and the durability of the platform and systems under operational conditions.

16 units, of which six come from the UK (four in Coningsby, one in Leuchars and one in Mount Pleasant, Falkland Islands); four in Italy (two in Grosseto and two in Gioia del Colle); three in Germany (Laage, Neuburg and Nörvenich), as well as one each in Spain, Austria and in the Kingdom of Saudi Arabia make a total of more than 260 aircraft in service - the largest number among the new generation fighters available in the world today.

With Tranche 2 production in full swing, all 148 Tranche 1 aircraft delivered and the retrofit programme bringing them all to their latest block configuration, the Typhoon is establishing its footprint in the air forces as the backbone of operations both in air dominance and ground support roles. With an average of 3000 flying hours per month through the six operators – a figure that will increase progressively with more aircraft delivered - the Eurofighter programme has reached full maturity and is ready to offer to the air forces all the benefits of a mature fleet: affordability; reducing logistics support and through-life cost savings coupled with top-end performances.

The 100,000th hour was achieved in collaboration with all core nation air forces and export customers who split the symbolic hour between their operational fleets. At the celebratory event held only a handful of days after the milestone was reached were management representatives from the Eurofighter Programme, Eurofighter Management Agency NETMA alongside senior staff from all six customer nations including those from the programme's export customers Austria and the Kingdom of Saudi Arabia.

This new milestone for the Eurofighter programme reinforces the credibility of the programme and highlights the benefits of investing in such a capable aircraft. In addition, this key event shows in clear terms what can be achieved through international cooperation and partnership. Here's to the next 100,000 hours...

No. 3 Sqn and XI Sqn Typhoons fly in formation with the IAF's Su-30MKIs during Exercise Indra Dhanush

EXERCISE INDRA DHANUSH '10

RAF TYPHOONS AND INDIAN AIR FORCE SU-30MKI WORKING TOGETHER

In October 2010, the Royal Air Force began putting Eurofighter Typhoon through its paces again, when it kicked off a series of back to back international exercises spanning the breadth of the globe and testing the aircraft's deployed operational readiness to the full. Flying from their UK bases, six Typhoon's from both 3 and XI Fighter Squadrons deployed first to Indian Air Force (IAF) Base Kalaikunda, West Bengal as part of exercise Indra Dhanush 2010, one of a series of bi-lateral training exercises between the RAF and IAF. Immediately after this exercise was completed, the aircraft were re-deployed to Doha, UAE to participate in Exercise Air Khanjar in November. All in all, the same six RAF Typhoons operated on a deployed operational basis, away from home for close to three months!

Meaning the 'archers bow' of the Hindu God of thunder and lightning - Indra, the Indra Dhanush exercise focussed primarily on air-to-air warfare operations to further develop the understanding of both RAF and IAF doctrines and tactics. The arrows to Indra's bow were provided by a potent mix of fighters comprising of six Su 30MKIs, six Mirage 2000s and six MiG-27 Floggers from the IAF as well as the RAF Typhoons. The RAF and IAF pilots flew more than 200 sorties during the two week exercise, building in complexity and culminating in Mixed Fighter Force (MFFO) Combined Air Operations (COMAO) scenarios involving up to 16 fighters. These jets were supported by RAF E-3D AWACS and a VC.10 tanker aircraft as well as the latest IAF AWACS, the A-50EhI.

Deployed and operating some 4500 miles from home presented a stern challenge to the RAF Typhoon team which was compounded by the punishing conditions of Kalaikunda AFB. With daily temperatures touching over 40°C, humidity levels of 90% or greater and snakes and spiders around every corner, the RAF demonstrated that Typhoon delivers capability in all-weathers, achieving operational readiness statistics in excess of 90%. With a minimal footprint of maintenance personnel and limited availability of spares, Typhoon once again proved that it is capable of sustaining operations throughout the most challenging of operational environments thanks to its intelligent health monitoring and preventative maintenance design philosophy.

During the first week of the exercise, both IAF and RAF crews had the opportunity to familiarise themselves with the capabilities of each others aircraft, conducting visual dog-fighting manoeuvres against one or two jets. Thanks to the combination of superb agility and the immensely powerful EJ200 engines, Typhoon was able to demonstrate its exceptional performance capabilities in this arena even when facing the latest, thrust vectored, Su-30MKI.

Week two witnessed scenarios of ever increasing complexity and Typhoon successfully operating with all the IAF fighters on both 'BLUE' and 'RED' sides in Offensive and Defensive Counter Air roles (OCA/DCA). Utilising its full range of sensors - including MIDS - Typhoon was able to demonstrate outstanding levels of tactical situational awareness gleaned from the 'fused' information clearly displayed within the cockpit, a point that impressed the IAF front line pilots who had the opportunity to fly with the Typhoons during the exercise. Although airspace and exercise constraints restricted Typhoon from unleashing its full potential in the beyond Visual Range (BVR) arena, exercise staff and pilots from both the IAF and RAF were thrilled with the opportunity to train and learn together.

All good things must come to an end and all involved are looking forward to the next Indra Dhanush which should see the return of the IAF to the UK. Indra Dhanush gave Typhoon the opportunity to demonstrate its deployed operational robustness yet again, and prove that it is capable of operating together with Su-30MKI and other IAF fighters to great effect, a powerful deterrent should India choose to become the next member of the Eurofighter Typhoon family.

The combined operation team at Indra Dhanush '10

Bernhard Gerwert
Chairman of the Supervisory Board
of Eurofighter GmbH and
CEO Cassidian Air Systems

"NO OTHER AIRCRAFT IN THE MMRCA COMPETITION CAN DELIVER COMPARABLE VALUE TO INDIA"

EUROFIGHTER IN INDIA

BERNHARD GERWERT INTERVIEW

How do you see Eurofighter Typhoon positioned in India's MMRCA competition?
We are convinced that we are very well positioned because all the strengths and advantages of our offer are well recognised by India's decision makers. No other aircraft in the MMRCA competition can deliver comparable value to India, both in terms of operational capabilities and economic as well as industrial benefits.
Eurofighter Typhoon is clearly the most technologically advanced combat aircraft on offer for the MMRCA tender. My impression is that its superior combat performance is well understood in India. It is encouraging that the flight trials went very well for us and according to plan - in particular the weapons testing by Indian Air Force (IAF) pilots in both Germany and the United Kingdom.
In addition to being the most modern combat aircraft available on the world market, we offer an unrivalled industrial and technological partnership which meets India's strategic goals. Choosing Eurofighter Typhoon will catalyze the development of India's domestic defence and aerospace industry, thereby considerably reducing its current dependence on imports.
Instead of remaining a mere buyer of aircraft and its parts, we envision India as a future key supplier to the global Eurofighter Typhoon programme and thus as an integrated part of its global value chain. As a true, new industrial partner, we would like India to co-develop and co-produce future capabilities for the Eurofighter Typhoon.
So you are confident that Eurofighter Typhoon is well placed to win?
Absolutely. Getting the best and most advanced combat aircraft technology on offer and partnering its further development is an opportunity for India which no competitor can match. Our value proposition is increasingly recognised in India, and our campaign is making constant progress. We are excited at the prospect of winning India as our next partner.
What industrial benefits can India expect from the Eurofighter partner companies?
Our proposal includes industrial benefits that no competitor will be able to match. We have maintained from the very beginning that we are keen to win India as a new industrial partner for the Eurofighter consortium. Our ultimate objective is to win India as a key supplier, co-developing and co-producing future upgrades and enhancements, new sub-systems and software for the world-wide Eurofighter Typhoon fleet.
To enable India to fully manufacture the Eurofighter Typhoon itself and to become a globally important production and R&D partner, we are willing to offer a comprehensive Transfer of Technology package.
What makes you so sure you can deliver on this ambitious industrial partnership promise?
Eurofighter Typhoon is the only truly international combat aircraft in the world: Europe's leading defence companies – EADS, BAE Systems, Finmeccanica/Alenia Aeronautica - and more than 400 suppliers have pooled their core competences to create it. Our success is based on cross-border cooperation, by sharing sensitive technologies and know-how to a level that our competitors would not contemplate. It is precisely this spirit of mutual trust and technology sharing that we will extend to India, if they accept our offer.
Even before the MMRCA tender is awarded and independent of a type selection, Cassidian, the Security and Defence division of EADS, has opened an Engineering Centre in Bangalore (see another article in this issue of EF World). The fact that we are the first major defence and security company to transfer high value defence R&D to India, including Eurofighter Typhoon related engineering tasks, underlines our trust in and our commitment to India as a partner.
Cassidian plans to ramp up the headcount at its Indian defence Engineering Centre to over 200 engineers by the end of the year. This is just the beginning. The economic benefits of our industrial partnership approach are substantial: We estimate that choosing the Eurofighter Typhoon would create more than 20,000 highly skilled jobs in India, boosting its domestic defence and aerospace industry.
What political and strategic benefits can the Eurofighter partner companies offer India?
India's MMRCA tender is of high strategic importance for its government. It intends to use this large tender to boost India's long term security. On this count, too, we deliver outstanding value: Our four European partner governments do not demand end-user monitoring, site-inspections or any other agreements which compromise India's sovereignty. Neither do our governments have implicit diplomatic demands linked to purchasing this truly multi-role combat aircraft. India is free to use the Eurofighter Typhoon as it sees fit. It can even develop India-specific features.
Several other reasons make the Eurofighter Typhoon the best choice for safeguarding India's strategic independence and its sovereignty: It will defend the nation more effectively than any competitor. Its choice will elevate India's strategic relationship with the partner nations and their armed forces to a completely new level. And it will strengthen India's domestic defence industry through Transfer of Technology, boosting India's capability to protect itself with its own technologies.
Why do you think Eurofighter Typhoon is the right aircraft for the Indian Air Force?
I have no doubt that we will deliver un-matched value to the IAF, those which are uniquely suited to meet their requirements. It is the most advanced multi-role fighter India can buy. The aircraft entered service a few years ago and has a life span of a further 40 years. Therefore, no other aircraft on offer is better able to meet India's current and future defence challenges. Eurofighter Typhoons delivered to the IAF will be the latest Tranche 3 aircraft with state-of-the-art electronic warfare sensors and communication systems. With its proven multi-role combat capability, this aircraft will provide the IAF with unrivalled air superiority and with sophisticated ground attack capabilities. Eurofighter Typhoon comes with a comprehensive weapons payload, high armament flexibility and the capability to effectively respond in a wide variety of combat missions.
Another key reason the IAF will benefit from Eurofighter Typhoon is cost: maintenance, servicing and operating costs can easily exceed the initial purchase price of an aircraft over time; this may make a seemingly economical aircraft a very expensive one in the long run. Eurofighter Typhoon was designed for low-life cycle costs. Its airframe is made of over 80% composites, incorporating new-generation materials like carbon fibre composites (CFC), glass-reinforced plastic and special alloys to name a few, deploying cutting edge component design to boost performance while at the same time maximising life. Longer component life makes the aircraft less maintenance intensive which results in significant cost savings.
What are the next steps of the MMRCA selection process?
The field evaluation trials in which our aircraft demonstrated its multi-role prowess to the IAF concluded earlier this year. They were first conducted in Bangalore, Jaisalmer and Leh. Weapon trials were then held in Germany and in the United Kingdom. Now the Indian Ministry of Defence has to analyse the IAF's flight trials report. It is also studying offset proposals submitted by all vendors. After this exercise, we expect the opening of the commercial bids followed by price negotiations with those vendors which will be short-listed.

"We have a mature weapon system that boasts the potential for plenty of growth in capability."

ENZO CASOLINI INTERVIEW

How do you see the Eurofighter Typhoon currently positioned in the world market? *First of all let me remind you that the Typhoon is today the best selling new generation aircraft in the fighter market. We are very proud of our 707 aircraft order, of which 583 aircraft have already been covered by a production contract. With over 250 aircraft in service and 16 units across six air forces, the Typhoon is also the perfect example of a new generation aircraft with more fighter jets in service than any other. This very modern machine is reaching maturity and delivering a stunning service in terms of both performance and operational readiness. Taking this into consideration and also considering that the total fighter market in the next 20 years could reach in excess of 800 aircraft, we really believe that the potential for the Typhoon could be around 250 of those examples. This forecast is based on the fact that we are enjoying a positive combination of factors: we have the best multi-role aircraft available on the global market in terms of performance; we are affordable in both acquisition costs – that, contrary to general perception, is less than our comparable competitors – and in logistic support; we have a mature weapon system that boasts the potential for plenty of growth in capability.*
What are the political and industrial key benefits that Eurofighter can offer to a potential customer nation? *As I said before, the Typhoon is a mature system today, which is a benefit in itself, but the aircraft is still able to be developed as a platform; in its main systems and secondary components. That makes for a strong selling point when we speak to potential customers in both political and industrial terms. There is no other programme in the world more open to industrial partnership than Eurofighter. In addition, being European means that the access to technology is free from the usual constraints that we see when US made products are marketed. The history of our partner companies in working with customer nations is the best testimony of what we can promise. Moreover, for a customer industry working with the Eurofighter's four partner companies, this means opening the doors to a potential collaboration with a complex set of industries that total more than 120 billion dollars revenue and that have a product range that varies from the smallest of UAV's to the world's largest passenger aircraft as well as from satellites to submarines.*
Why do you think Eurofighter Typhoon is the right aircraft for the world fighter market? *The Typhoon is a state-of-the-art aircraft designed from the beginning with an intrinsic growth path. Forget slogans like 5th generation, etc... that's only marketing. What really matters are the capabilities. Capabilities that enable the air forces and industry to improve and develop are important as well as being beneficial to the nations. Being superior to any potential threat, the Eurofighter is able to offer deterrence – and that's the primary goal for any air force in the world – and also offers access to new technology and advanced capabilities for the programme – and that is, I think, the priority for any industry in the world. Combined, these effects make a Typhoon acquisition not a cost for a nation, but an investment.*
What are the next steps for the Eurofighter marketing in the World? *The Typhoon is a perfect aircraft for today's requirements but we are working on further developments to the aircraft in order to keep it updated with future requirements. One of the main drivers set by the original designers of the Eurofighter was to have a platform that can evolve in line with the threats and capable to insert new technologies when it is mature enough and when it is affordable to do so. That's what we are doing. It is not by chance that Eurofighter will soon have the best AESA radar available in the world - the Captor-E - and the best air-to-air missile on the market - the Meteor - but that is not our final target. The weapon system is continually evolving and a large package of updates and upgrades is under evaluation, integration or definition. This is an aircraft that will be in service for the next 30 years, probably more. That is why we are now looking to the future in order to address the world market in the short, medium and long term.*
How important is Aero India 2011 for the marketing of Typhoon worldwide? *Aero India is not only the pride of Indian aerospace but it is also internationally recognised as a key global air show for the aerospace and defence community. With a large presence of foreign military and political delegations visiting, this year's show is set to be bigger than ever. For us it is very important to be here and show our capabilities to any potential customer. Asia will be an important market for fighters in the short term. All nations are watching closely to see how India is running this tough MMRCA competition and will closely evaluate the final result.*

CASSIDIAN TRAINS FIRST INDIAN ENGINEERS IN MANCHING

The Cassidian Engineering Centre in Bangalore has been created to provide engineering services to both Cassidian in Europe as well as Indian customers whilst first establishing a local footprint in the country. The presence of the Engineering Centre in Bangalore is part of the overall industrialization strategy that will encourage and support India in developing the capabilities and skills to become a fifth partner in the Eurofighter programme.

Since early September 2010, the first 15 Indian engineers from the Engineering Centre in Bangalore have been at Cassidian's Manching site in southern Germany, to attend a technical and intercultural training course. The training was specifically organised by engineers and experts from the Cassidian Air Systems Engineering Department to provide an insight into the company, its products and its working culture.

During these weeks, both the Indian and European engineers have had the opportunity to create close relationships and gain experience working in a unique international environment. This is the first step to establishing a successful partnership and building on Indian-European cooperation in the future.

"It is a great experience and I am highly impressed with their depth of knowledge, openness and the extensive capabilities here in Germany. Our European colleagues are very helpful and friendly", said Rohit Jain, currently working as Systems Engineer for Cassidian in Bangalore.

The Indian engineers returned home in November where they began roles on their first work packages in close collaboration with their German colleagues in Manching. The work packages selected were related to aircraft systems, avionics and engineering IT.

Shadman Andleeb, Head of Cassidian Air Systems Engineering in India, stated the vision and mission: *"We are working towards being a fully integrated Cassidian Air Systems Centre of Engineering Excellence in India, we must ensure the delivery of high quality and cost effective solutions leveraging on local presence to establish indigenous capability in the country".*

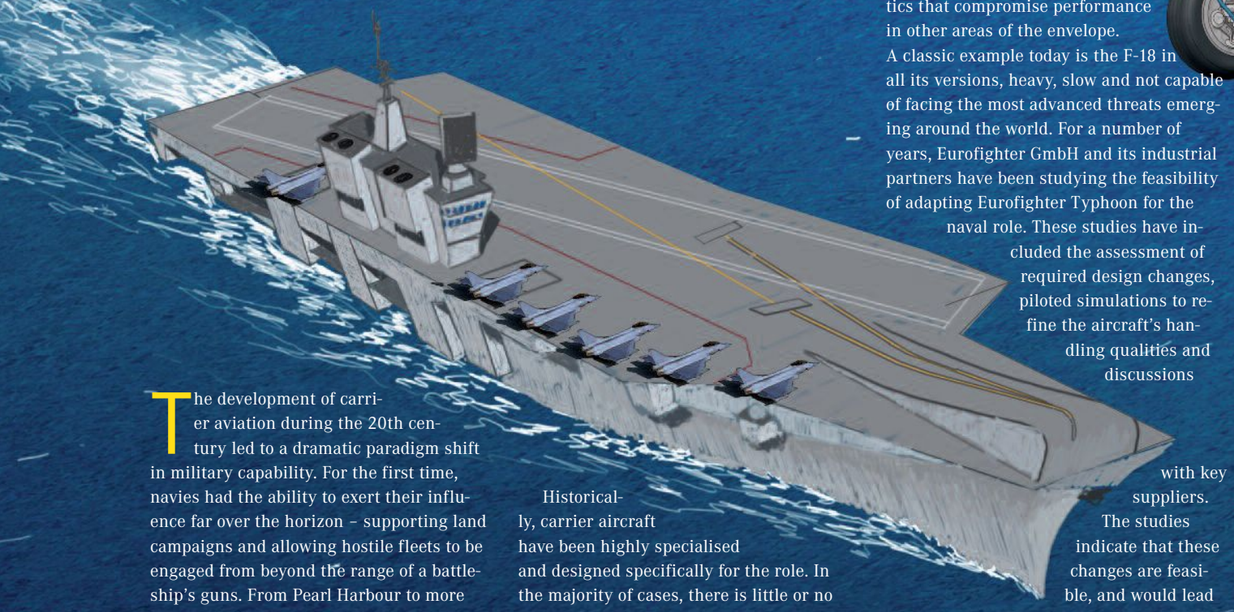
Progress on the Engineering Centre, details of its official opening and the benefits it will bring to local and national industry will be focused on in a future edition of Eurofighter World.

The aircraft involved in the Indra Dhanush '10 Exercise.
From left to right: MiG-27, Mirage 2000, Typhoon, Su-30MKI, Typhoon, Mirage 2000, MiG-27

Artist impression of a naval Typhoon in Indian Navy colours carrying two RBS 15 anti-ship missiles

AN AIRCRAFT CARRIER VERSION UNDER DEVELOPMENT

NAVAL TYPHOON
A GAME CHANGER



The development of carrier aviation during the 20th century led to a dramatic paradigm shift in military capability. For the first time, navies had the ability to exert their influence far over the horizon – supporting land campaigns and allowing hostile fleets to be engaged from beyond the range of a battleship's guns. From Pearl Harbour to more recent conflicts in the Falklands and the Middle East, the carrier and its aircraft provide commanders with an unrivalled ability to project military and political influence; several acres of sovereign territory which can be moved close to potential trouble spots at short notice.

Historically, carrier aircraft have been highly specialised and designed specifically for the role. In the majority of cases, there is little or no commonality between the aircraft operated by a nation's air force, and the different aircraft performing the same role in the Navy. Design decisions taken in order to optimise an aircraft for carrier operations can lead to trade-offs elsewhere – such as additional weight and low-speed handling characteristics that compromise performance in other areas of the envelope.

A classic example today is the F-18 in all its versions, heavy, slow and not capable of facing the most advanced threats emerging around the world. For a number of years, Eurofighter GmbH and its industrial partners have been studying the feasibility of adapting Eurofighter Typhoon for the naval role. These studies have included the assessment of required design changes, piloted simulations to refine the aircraft's handling qualities and discussions with key suppliers. The studies indicate that these changes are feasible, and would lead to the development of a world-beating, carrier-based fighter aircraft.

READY FOR LAUNCH

Modern carrier aircraft typically take off with the use of a catapult that attaches to the nose gear. These catapults are expensive to procure, maintain and operate. Catapult launch also leads to a heavier aircraft as a result of the additional weight on the aircraft's structure.

Typhoon is well known for its exceptional thrust-to-weight ratio which has been regularly demonstrated at air shows and in customer flight trials. It also allows the aircraft to take off from a carrier using a "ski-jump". Detailed simulations have shown that the aircraft will be able to take off in this way with a full weapon and fuel load – providing a nation with a truly potent naval aviation capability.

LANDINGS

Clearly one of the major challenges for any carrier-based aircraft is the arrested landing. Carrier aircraft fly a steep approach path and are brought to a halt rapidly by the arrestor gear. This leads to much higher loads being generated than would be the case for a land-based aircraft. Navalised Typhoon tackles this problem in two ways.

1. The introduction of a thrust-vectored variant of the Eurojet EJ200 engine would allow for a reduction in the aircraft's approach speed and the resulting landing loads. Thrust vectoring (Engines with TVN are already tested on bench) could be fully integrated into the Typhoon's advanced Flight Control System (FCS), allowing the pilot to focus on flying the approach path while the FCS manages the engine nozzle position.

2. The basic design of Typhoon also works in its favour during an arrested landing. The aircraft's structure is exceptionally strong, having been designed from the outset for the high dynamic loads associated with extreme air combat manoeuvring. This helps to minimise the structural changes required to enable carrier operations – usually seen as the biggest obstacle to developing a carrier-based variant of the aircraft.

SIMILARITIES

In any discussion of a navalised Typhoon, the differences from the land-based aircraft are the natural focus. However, one should also focus on the similarities. A key design driver for a navalised Typhoon has been to maximise commonality between the two variants. Design changes are minimised, allowing for many spare parts and test equipment to be shared across a customer's air force and navy fleets. The sensors, systems and weapons available to both variants will be common, allowing for a reduction in the aircrew training requirements. And in addition, the two variants will benefit from a common upgrade path – new capabilities will be available to both the air force and navy in similar timescales.

The introduction of Thrust Vectoring potentially provides an additional boost to Typhoon's capability. The ability to change the angle of the engines' thrust will allow for a further enhancement in Typhoon's already outstanding manoeuvrability, supercruise performances, fuel consumption and the handling of asymmetric weapon configuration. When this is added to capabilities such as the Helmet Mounted Symbology System (HMSS), AESA radar and advanced air-to-air and air-to-surface missiles, the result is a truly world-beating multi-role aircraft. One that could also operate from an aircraft carrier.

NO COMPROMISE

Eurofighter has already discussed a navalised Typhoon with a number of potential customers and is keen to pursue this exciting new phase in Typhoon's development. Naval aviation will undoubtedly continue to provide nations with a flexible option for projecting power over the coming years.

In an increasingly affordability-conscious world, commonality between a nation's air force and naval aviation fleets will be of increasing importance. A navalised Typhoon can deliver this commonality, without compromising on capability.

PH/IB

INTERVIEW AT FIGHTER WING 73 "STEINHOFF" IN LAAGE

AIR-TO-GROUND TRAINING

Interview with Lieutenant-Colonel **Markus Krammel** Commander of the Fighter Wing 73

Lieutenant-Colonel Krammel, you have been the Commander of the Fighter Wing 73 "Steinhoff" in Laage, Rostock since 5th August 2010, what are your first impressions of the role and what are your goals for the coming months?
As the only Operational Conversion Unit for all Eurofighter aircrews of the Luftwaffe, Fighter Wing 73 "Steinhoff" is solely responsible for the basic conversion of our young aircrews coming from undergraduate pilot training to Eurofighter flying training at Laage Air Base. Besides that, our short-term goal is to intensify the conversion training of experienced pilots from other fighter aircraft (e.g. Tornado, F-4F Phantom) to become instructor pilots on the Typhoon. Thus, I am aiming to increase the overall Eurofighter training capacity here at Laage. The whole Eurofighter 'package' offers a great deal of possibilities for the future and I am very much looking forward to taking over the responsibilities as the Wing Commander of the 73rd Fighter Wing!

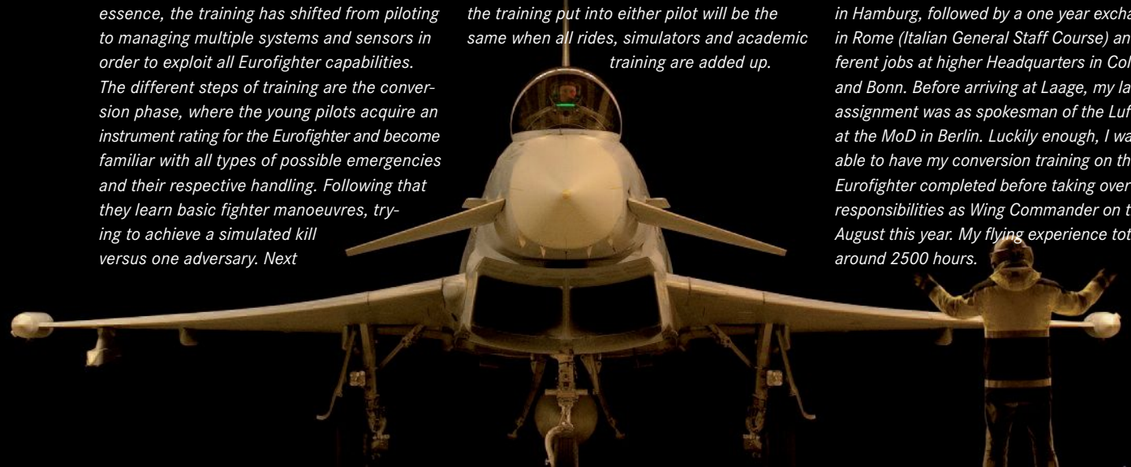
The main task of Fighter Wing 73 is the training of Eurofighter pilots. What is your experience with the training of pilots? What are the different steps of the training?
Our experience so far has shown that the basic piloting tasks are quite easy to handle due to the sophisticated fly-by-wire system which relieves the pilot's workload. However, the time spent training pilots on how to best employ the Eurofighter Typhoon in a tactical mission has increased tremendously in comparison to legacy systems like the Tornado or the F-4F Phantom. This is due to the complexity of the entire system, the availability of additional sensors and the amount of information the pilot simply was not confronted with in the past. In essence, the training has shifted from piloting to managing multiple systems and sensors in order to exploit all Eurofighter capabilities. The different steps of training are the conversion phase, where the young pilots acquire an instrument rating for the Eurofighter and become familiar with all types of possible emergencies and their respective handling. Following that they learn basic fighter manoeuvres, trying to achieve a simulated kill versus one adversary. Next comes the team phase, where the students learn how to fight with two aircraft in a team versus one or several adversaries within visual range. At the end, the training culminates with beyond visual range training and applying a combination of all phases during the air combat tactics phase. A night and low-level introduction is also incorporated into the training course.

Which milestones are planned in Laage for the coming years?
The next milestone we are looking forward to will be the implementation of the upcoming air-to-ground capabilities of the Eurofighter into the conversion training. The respective conceptual work to modify and adapt the Eurofighter training is in progress and the first operational air-to-ground strafing trials were successfully conducted in September 2010.

The first pilots of the Fighter Bomber wing 31 "Boelke" are in retraining from Tornado to Eurofighter. These pilots are the first who are using Eurofighter in the air-to-ground role. What are the differences in training between fighter pilots and fighter bomber pilots?
During the conversion phase, all pilots run through the same mission profiles. As soon as the air-to-air phase starts, the fighter bomber pilots basically fly one mission more than the air-to-air experienced pilots in every phase. The goal is to produce the same proficiency level for all pilots regardless of entry parameters. The current set-up of our training programme allows an individual adaption to achieve exactly that.
In 2011, Laage started to train all Eurofighter pilots as multi-role fighter pilots, meaning that air-to-air and air-to-ground elements are basically equally matched. This means that the guys with air-to-air experience will need more air-to-ground rides and the air-to-ground guys will need more air-to-air rides. So in the end, the training put into either pilot will be the same when all rides, simulators and academic training are added up.

The availability of Eurofighter Typhoon is the highest in the German fighter fleet. What are the experiences with the Eurofighter Typhoon in the daily training at Laage?
The Eurofighter is an extremely complex new generation fighter plane. It features an enormous amount of sophisticated computers that significantly enhance the capabilities of the weapons system just by updating the employed software. Only through the use of our very capable fly-by-wire system is it possible to reach the aerodynamic and physical limits of the flying envelope in a safe and carefree manner. At the same time, those computers provide a very useful self-diagnostic system that ultimately leads to a high availability of the aircraft to the user. Those built-in tests, combined with the means to monitor and analyse internal states of the aircraft, make the Euro-fighter an easy to handle aircraft for maintenance. Our highly trained and qualified technicians are well prepared to handle the aircraft and together with the described technical means, we are able to achieve the aforementioned high availability rates. The philosophy behind the Eurofighter is an on-condition maintenance, which means inspections and maintenance between flying sorties are kept to a minimum. This generally leads to a reduced maintenance and repair factor when compared to previous weapons systems.

The readers of Eurofighter World Magazine would like to know more about you and your training. What aircraft have you flown and what is your flying experience?
After finishing training at Sheppard Air Force Base in Texas, my flying career started at Fighter Bomber Wing 32 in Lechfeld near Augsburg on the Tornado ECR (Electronic Combat and Reconnaissance). During that time, I qualified as a Fighter Weapons Instructor and gained combat experience during the operations over former Yugoslavia, mainly during operation "Allied Force". Following that, I was Squadron Commander of the 341 "Grünherz" staffel at Fighter Bomber Wing 34 in Memmingen. After that wonderful experience I wasn't able to evade the desk-jobs any more: two years General Staff Course at the Führungsakademie in Hamburg, followed by a one year exchange in Rome (Italian General Staff Course) and different jobs at higher Headquarters in Cologne and Bonn. Before arriving at Laage, my last assignment was as spokesman of the Luftwaffe at the MoD in Berlin. Luckily enough, I was able to have my conversion training on the Eurofighter completed before taking over the responsibilities as Wing Commander on the 5th August this year. My flying experience totals around 2500 hours.



CUTS, CUTS, CUTS, BUT WHAT DOES CUTTING A PROGRAMME LIKE THE EUROFIGHTER MEAN?

THE ECONOMIC IMPACT IN GERMANY

WHAT IS THE REAL IMPACT GENERATED BY THE PROGRAMME?

It is readily acknowledged that the aerospace industry in Germany is a key technology driver for the country's economy. In support of this is the fact that the German aerospace industry managed to hold its own and enjoyed growth in 2009 and 2010 despite the economic crisis. Yet Eurofighter Typhoon, the largest collaborative programme in Europe and fundamental to the economy, could be facing cuts and has long been plagued with criticisms over costs.

When we talk about cost, Eurofighter Typhoon, the Luftwaffe's premier multi-role combat aircraft, has faced many criticisms over recent years, but it is likely that the German tax payers would be reassured to know that their money has been well invested in the aircraft, not only because of the formidable capability the Typhoon brings, but also because the Eurofighter Typhoon offers the best value for money against any other solution, delivering a huge industrial return to the German economy.

Pride in the success of Germany's aerospace Industry begins with facts and figures. Waiting for the 2010 results, here are the 2009 ones: turnover in the aerospace industry rose by 4% to 23.6 billion euros last year, whilst employment increased slightly by 0.8% to 93,700, totalling around 250,000 highly skilled workers directly and indirectly involved in the industry. In 1996 the turnover was 8.6 billion euros and the workforce totalled 61,000 people. In the 12 years that the Eurofighter programme has been running, the sector has almost tripled in size and recorded increasingly high levels of efficiency.

When looking at the aerospace defence sector only it increased revenue by 4.6% of its total turnover in 2009 reaching 6 billion euros. This segment employed around 21,300 people last year, a rise of 1.3% since 2008. The ramp-up of the Eurofighter, the NH90 and Tiger helicopter programmes, continue to shape the situation in aerospace defence – the largest of the three defence segments in Germany.

If we look specifically at the Eurofighter programme in Germany, we see that around 3000 employees work directly on the programme within EADS in Germany, plus 22,000 through indirect jobs in the country. Cassidian, an EADS business that builds the Eurofighter, had a 2009 turnover of 5.4 billion euros.

Without considering that Eurofighter offers a variety of industrial benefits, some 70% of the German costs of Typhoon are flowed back to the German Government as tax revenues compared with a tax return of less than 10% for example, for the purchase of a US aircraft.

The technology spin off is another bonus. The Typhoon is 70% carbon fibre made and the carbon fibre manufacturers on Typhoon are centres of excellence in each partner nation. This technology has been applied to the civil aviation sector, to heavy machines, and cars. For example, EADS is using its carbon fibre technology from the Typhoon for its role working on its Airbus aircraft and many other programmes.

At Cassidian Germany, 96% of its Eurofighter employees are skilled. On Typhoon R&D work, Cassidian employs 60% engineers; 25% blue collar; 5% commercial and legal; with the rest as support. Similarly on Typhoon production, the Cassidian workers comprise of 25% engineers and 60% blue collar. Overall, about 50% of the Typhoon workforce in Germany has university and higher level education qualifications (with 5% apprentices/trainees). The labour skills on Typhoon development and production work are highly transferable. For example, in the Bavarian region, development and production workers on Typhoon have skills easily transferable to the local automotive and electronics industries.

1ST CLASS IN ENGINE PERFORMANCE AND OPERATIONAL AFFORDABILITY

EUROJET EJ200

The EJ200 engine, which combines the highest thrust-to-weight ratio with the most simple engine architecture, provides the Eurofighter Typhoon with maximum levels of multi-role capability at an affordable cost of ownership. This is possible thanks to the engines unprecedented design which has been fully integrated into the weapon system platform.

However, in today's world of economic awareness, the question is how will the EJ200 continue to provide an affordable operational capability for the future?

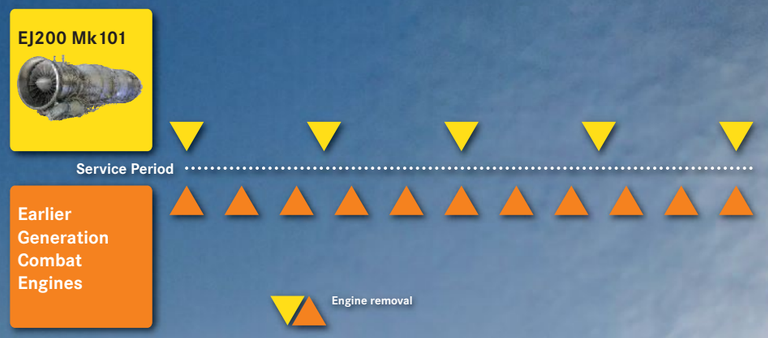
A common obstacle faced by all latest generation military aero engine suppliers is that the typical life cycle for such a product is exceptionally long. During such a period, it is normal to experience economic changes as well as changes in requirements of the engine which could affect operational costs as well as the availability of funds.

According to recent studies, two of the more significant drivers behind operational costs for a military aero engine are; maintenance (especially the kind which requires engine removal from the aircraft) and also fuel costs.

MAINTAINABILITY

The EJ200 has been deliberately developed with maintainability in mind. The rationale adopted by the design of the EJ200 is to ensure a safe, affordable operational capability by keeping the engine 'on wing' for as long as possible. Experience from earlier generation engine programmes has shown that when an engine is removed from the aircraft, significant costs are incurred. Such costs are based on the need to supply a serviceable spare engine for continued operation and also due to the inevitable scope creep that occurs during repair & overhaul of the removed engine.

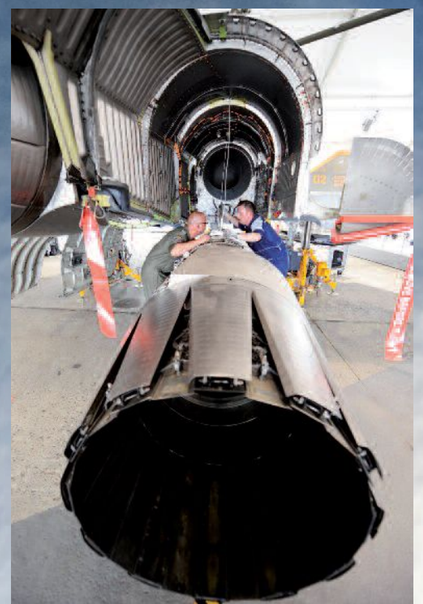
To maximise the 'on wing' duration of the EJ200 engine, there has been a conscious decision to increase component life, increase levels of reliability and to provide a 'no surprises' approach to engine management through intelligent Engine Health Monitoring (EHM).



COMPONENT LIFE

The Hot Gas Path Parts (HGPP) for the EJ200 have been qualified to an extremely high life. These lives have also been purposely synchronised with the lives of other engine components meaning that the number of engine removals through an engines design life is reduced to the minimum.

As a further benefit, the EJ200 Mk101 follows an 'on condition' maintenance philosophy. In practice, this means components are not simply replaced once a set number of engine hours are reached. Instead, they are monitored and replaced when their physical condition is deemed to be unacceptable or when the EHM system calculates a life and/or limit exceedance. The latest experience from in-service confirms the qualified lives and in many cases indicates an increased life which will further reduce maintenance activities for the future.

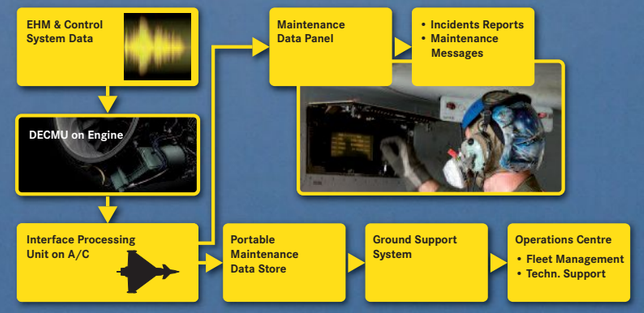


ENGINE HEALTH MONITORING

The EJ200 has a world leading, state-of-the-art EHM system. A true 'strength' of the EHM is that it has been intentionally designed as an 'end-to-end' system, fully integrated within the Typhoon airframe. This results in an un-impeded flow of validated data from engine through to the operations centre. As an additional benefit, it is also possible to view EHM data whilst the aircraft is stood on the apron. This is achieved through the use of the Eurofighter Typhoon mounted Maintenance Data Panel (MDP). Being able to access EHM data during aircraft operations is a cost and time efficient way of confirming engine health before the aircraft is re-dispatched for further operations.

At the heart of the EHM system resides the MTU developed Digital Electronic Control & Monitoring Unit (DECMU). This powerful engine mounted accessory fulfils a combined role of engine control and monitoring. The monitoring aspect of the DECMU has been specifically designed to continuously monitor multiple data streams from the EHM sensors and has capacity to accept and process additional data should the need arise in the future.

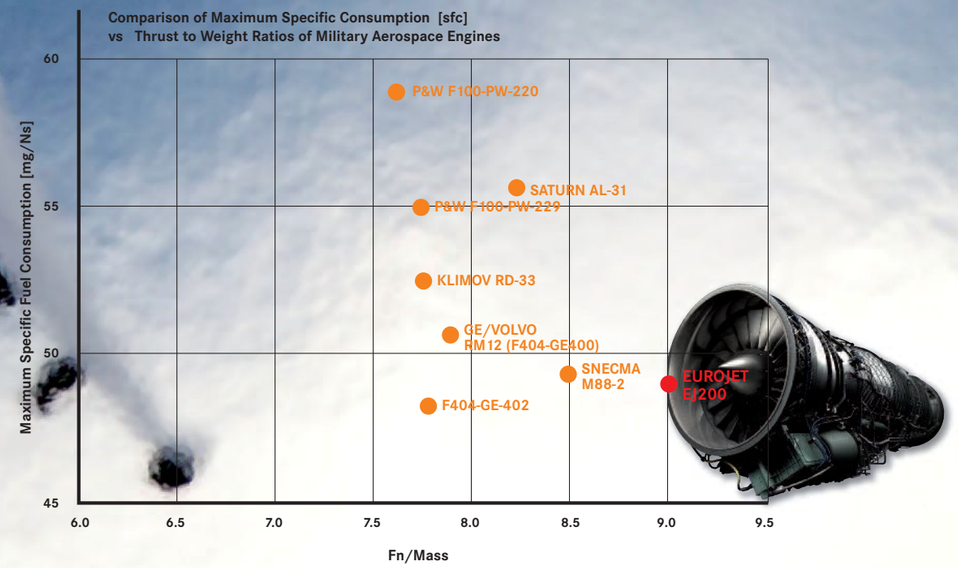
Through intelligent interpretation of the engine data, the EHM system is capable of monitoring the engines operational performance both on the ground and in-flight. This provides the operator with a real-time account of component life usage and also a prognosis of future engine functional & mechanical performance. Having easy access to this level of data for each engine at the end of each sortie is 'key', particularly whilst taking executive decisions such as whether to deploy an engine or to send to the repair and overhaul depot for maintenance. Engine management of this caliber ensures weapon system availability without the need to provision for large quantities of spare engine modules or engines.



FUEL CONSUMPTION

The fuel consumption of the EJ200 is extremely low for an engine of its pedigree. This is largely due to careful selection of the key gas turbine design parameters which results in the EJ200 delivering unrivalled installed engine performance with minimal fuel consumption. In addition, through clever use of hot section advanced cooling and sealing technologies, engine cooling requirements are kept to a minimum. This increases cycle efficiency and reduces fuel consumption. A final contributor to the EJ200's outstanding level of fuel consumption is that primarily the fuel system is managed and controlled by the onboard DECMU. The DECMU continuously evaluates whole engine performance alongside key fuel system parameters. This ensures continued optimal fuel system management at all times.

The design of the EJ200 engine is sympathetic towards ensuring unrivalled installed performance at an affordable cost of ownership. The engine, as operated by today's air forces, has confirmed component lives to be similar to those qualified but in many cases it's believed that lives will be greater in service. This will provide further reductions in engine maintenance to those previously anticipated. The advanced EHM system accommodated by the engine currently provides a 'world leading' capability which has the capacity to provide further benefits in the future. Having simple access to real-time engine data offers flexibility to engine management for today and the future. The design and control of the EJ200 ensures an efficient engine which requires minimal fuel consumption whilst delivering maximum performance. Digital fuel system management and control will guarantee continued economical use of the engine.



SHOOTING DUCKS WHILE ROWING THE BOAT

THE EVOLUTION OF THE SINGLE SEAT SWING-ROLE FIGHTER

The P1E upgrade programme is planned to be completed by the end of 2012 and will transform the Eurofighter Typhoon into the first true single-seat multi/swing-role fighter. The previous generation of fighters, such as the F-16 and the F/A-18 Hornet were the first single-seat multi-role fighters. They were revolutionary because they utilised the first small, relatively easy-to-use, multimode radars and the first airborne computers powerful enough to accurately calculate the trajectory of the dumb bombs and unguided rockets exclusively used in the 1970/80's. They were also the first operational fighters with digital flight control systems providing a good performance in a small airframe.

However, the precision weapons of that age were only employed by very advanced and expensive two-seat fighters such as the F-111, because of the high complexity of the systems and weapons required for this kind of operation. The user interface to the systems were exceptionally specialised and vulnerable while the weapon employment was very complicated, all demanding one dedicated person's full attention throughout the entire engagement from target acquisition to impact whilst an additional pilot flew the aircraft.

The two seat aircraft had measurable advantages within some specialised missions, and the F-111 was replaced by the F-15E, which still required two crew members because of the high complexity of the weapon system inherited from the F-111 generation and because of the 1970's technology of the F-15 Eagle design. Simultaneously, the Europeans started using the two-seat Tornado in a similar role.

Nonetheless, the F-15E still maintained the major penalties for the additional crewmember: higher annual maintenance cost due to the extra complexity added by the extra seat and reduced fuel capacity and performance due to higher weight. Finally, the additional cost for training, payment and proficiency of the second crew member made the two-seat fighter operators have a careful look at the much cheaper single-seat operations.

In 1989, the US Marine Corps conducted an intensive study of the single seat F/A-18 Hornet and compared it to two seat operations through simulation and actual flying. It clearly showed that the single-seat cockpit was more effective in weapon delivery and that a second person in the cockpit did not reduce the number of ground impacts – a major concern even today. But the technology was still not sufficiently developed to allow the single-seat Hornet to use its sensors more effectively than the two-seater in adverse weather and night conditions.
A USAF report in 1994 had identified all the required elements for the ultimate one-seat fighter: sensor fusion, data link, helmet mounted displays, head steered sensors and voice controls - at that time all items already included in the visionary Eurofighter design.

It became clear that the new targeting pods, sensors and data links entering the arena produced more data than the old generation of fighters could cope with, so the F-18 was developed into a new version, the Super Hornet. Simultaneously, the F-15E was developed into a more advanced version for South Korea and Singapore, and also the F-16 was produced in a version with a dedicated second crew member to take care of the systems. Even the French produced a two-seat multi-role fighter, the Mirage 2000D, and plan to produce the majority of their Rafales in a two-seat version.

All these types still needed a pilot to "row the boat" and a weapon system operator "to shoot the ducks", because their 1970's-heritage prevented full integration of all their systems. A technological leap was needed to reduce the cost and to increase the effectiveness of the fighter.

Actually, something had happened in the dark. With the Harrier and the Jaguar, the first true stand-alone single seat fighter bombers with precision weapon capability and on board targeting capability was the F-117. Unfortunately, its revolutionary single-seat stand-alone targeting and weapon delivery capability was overshadowed by the world's singular focus on the F-117's stealth features. This turned out to be the type's Achilles heel, forcing an early retirement after the stealth myth was broken when an F-117 was shot down during the Kosovo war in 1999.

Fortunately, the vision of the single-seat, swing-role fighter has now been realised. The full automatic integration of all systems: sensors, attack & identification, data link, electronic warfare, navigation, cockpit, engine and all the housekeeping systems including the airframe structure itself – and finally the advanced flight control system comprising of advanced autopilot and carefree handling characteristics, are the major trademarks of the new generation fighter such as the Eurofighter Typhoon.

The Typhoon's large field of view radar as well as the Infra Red Search and Track System and Identification System (IFF), advanced Electronic Warfare System and multi-role targeting pod provide large amounts of data to the fighter's sensor fusion process, which automatically reduces and prioritises the information presented to the pilot.

Link16 and ROVER data links have revolutionised the transfer of target information between coalition fighters, command and control units and Forward Air Controllers on the ground. The Helmet Mounted Display and associated sighting systems allow the pilot to constantly keep their eyes out of the cockpit and acquiring targets while managing the system configuration with Direct Voice Input (DVI). Simultaneously, the Electronic Warfare system monitors and, where appropriate, jams the emitting threats.

The Ground Proximity Warning System (GPWS) is the Typhoon's safety observer, keeping a constant eye on the ground and the flight control system ensures that the pilot does not depart nor damage the fighter in hectic situations. The autopilot flies the most optimised path into the weapon release zone, while the pilot manages the tactical situation.

The Eurofighter Typhoon is the first next-generation fighter to combine all these items into one cockpit. Thanks to the fighter's advanced integrated systems and the carefully developed Human Machine Interface (HMI) of the Eurofighter, the Typhoon pilot can safely fly the aircraft, navigate, manage threats, acquire targets, employ multiple precision, long range air-to-air as well as air-to-ground weapons, re-plan the mission in flight, and still maintain full situational awareness whilst both fighting his way into the target area and fighting his way back out.

In the Typhoon the pilot shoots the ducks whilst rowing the boat.

LJ

In addition to this article, to read the paper "Single Seat Fighter – The Way Ahead for the 21st Century" written by Craig Penrice, Typhoon Test Pilot (Ret'd), please visit our website: www.eurofighter.com/eurofighter-world/publications

EXERCISE AIR KHANJAR IN THE UAE

EUROFIGHTER OVER THE GULF

Interoperability with E-3D AWACS was one of the goals of Exercise AIR KHANJAR

The Royal Air Force's Typhoon jets have been busy in recent months on joint exercises across the East in partnership with some of the world's leading air forces. Most recently, after the deployment of six aircraft to India for the Indra Dhanush exercise in October - as per the earlier article in this issue - the RAF Typhoons arrived in Al Dhafra for further training.

The Air Khanjar exercise took place at the end of November 2010 with the RAF and United Arab Emirates Air Force (UAEAF) working together in joint training. Interoperability with the UAE Air Force and operating in the challenging desert conditions were the main targets of the Air Khanjar exercise which was based on a 'building block' approach to gradually increase the complexity of training. It was soon apparent that the skill levels of both individual squadrons were closely aligned and therefore the exercise accelerated into more complex areas at an impressive rate.

Wing Commander Jez Attridge, Officer Commanding XI Sqn, and Officer Commanding 906 Expeditionary Air Wing for the duration of exercise Air Khanjar said: "We've found the UAE Air Force to be very flexible in its operations and able to adapt well to working with us. They have some excellent aircraft that have integrated remarkably well with Typhoon".

He went on by saying, "The UK has long standing close cooperation with UAE as well as complementary weapons systems, which given the current political and military realities of most military operations worldwide being coalitions, it is always good to rehearse operations with other proficient partner nations". He described the fantastic facilities at the Al Dhafra Air Base and explained how the warm conditions were conducive to maximising training time.

One of the bonuses that came with the exercise was the air-to-ground and air-to-air ranges available within UAE. The environment provided a perfect opportunity for a world class fighter aircraft like the Typhoon to practice Dissimilar Air Combat Training against other modern and challenging adversaries such as the F-16 and Mirage 2000-9 from the UAEAF.

An essential part of the Air Khanjar exercise was the command and control contribution of Royal Air Force 8 Sqn's AWACS E-3D aircraft. The AWACS aircraft is more than a 'flying radar', it provides information superiority for commanders in the air and on the land or sea. To demonstrate this important aspect of the exercise, the involvement of HMS Cumberland, operating in the Persian Gulf, added significant value. The combined forces of RAF Typhoons and aircraft from the UAEAF rehearsed both protecting and attacking the ship, all controlled from a distance by the AWACS.

Another target of the exercise was to test the Expeditionary Air Wing model that combined both forces of Typhoons and AWACS, utilising dedicated aircraft types and personnel ready to deploy as a single unit. Whilst both the Typhoon and AWACS crew are used to regularly working together back in the UK, the rest of the Expeditionary Air Wing, the force headquarters and supporting areas such as the engineers and administrators, rarely get the opportunity to do so until they are deployed together.

A remarkable aspect of exercise Air Khanjar, which underlines the rapid response and adaptability of airpower, was that it wasn't launched from the UK, but directly from exercise Indradanush in India. If that wasn't enough of a challenge, then supporting a Royal Fly-past for a State Visit by Her Majesty the Queen to Abu Dhabi was a public demonstration of the seamless cooperation and levels of precision that were quickly reached between the RAF and UAEAF crews.

Exercise Air Khanjar was extremely successful as it proved yet again, the deployability and sustainability of Typhoon in hot and dusty environments. The exercise was concluded with an opportunity for Colonel Mubarak, the Base Commander of Al Dhafra Air Base, to experience the potent power and manoeuvrability of a Typhoon mission. And if a picture can paint a thousand words on airpower, a backseat flight in Typhoon will fill a library.

A Typhoon from 29 Sqn taxies at Al Dhafra Air Base

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