Eurofighter 2000

SECURING THE FUTURE


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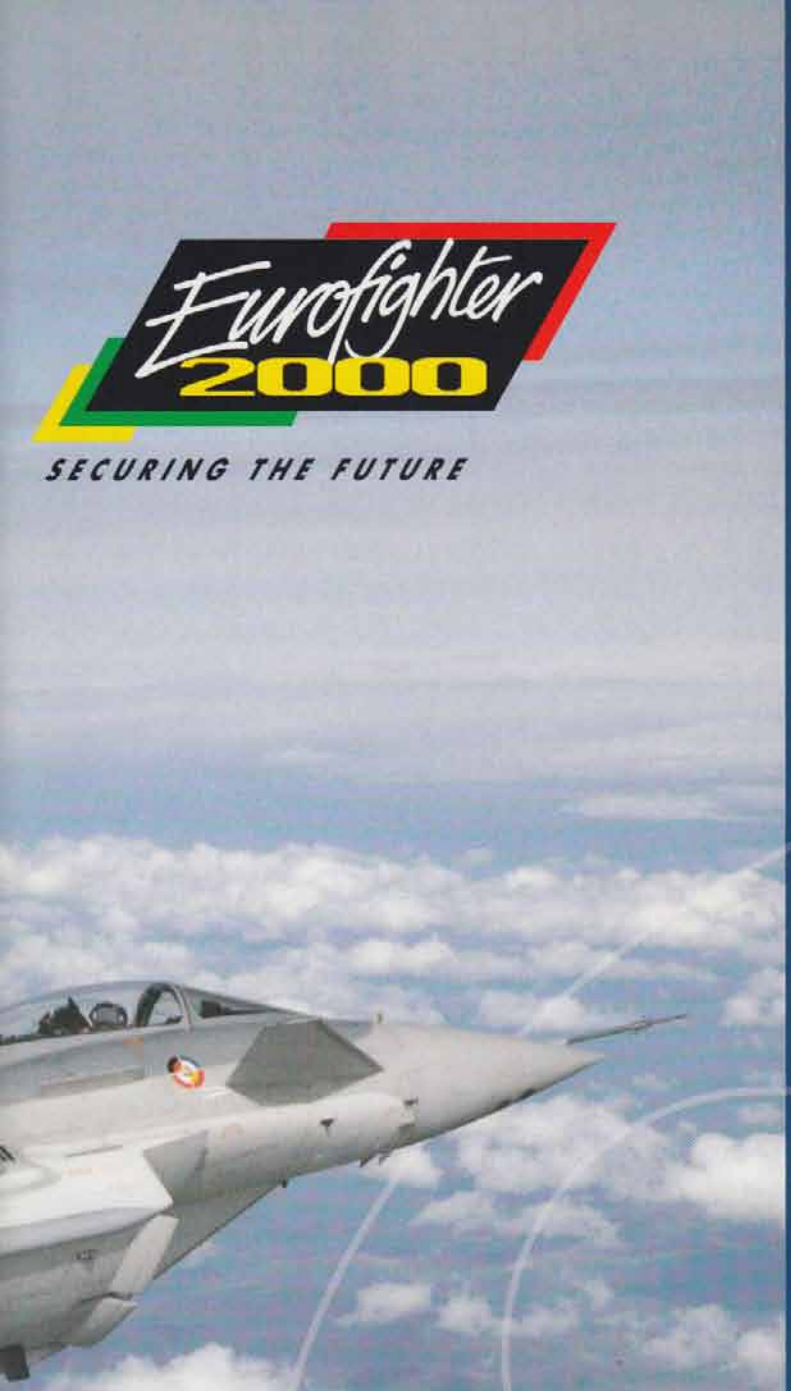

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The Challenge

Developments in East/West détente have not eliminated entirely the threat to Western security; unforeseen adventurism and instability, demonstrated by the Gulf War and events in Eastern Europe, have still to be taken into account. Even with force reductions, the countries of the former Soviet Union still retain large forces including Air Forces equipped with derivatives of the Mig-29 Fulcrum and Su-27 Flanker. Furthermore, world-wide marketing of both these types is evident and the technological threat from such aircraft must be at least matched to provide a credible air defence.

By the turn of the century the current in-service aircraft of the UK, Germany, Italy and Spain tasked with air superiority - Phantoms, F-104s, and Mirage F-1s will be life expired and replacements will be needed.

EF 2000 has been fully evaluated against alternatives such as Rafale and enhanced versions of F-15, F-16 and F-18, and has been identified as the only aircraft capable of meeting the air defence requirements of the four European nations well into the next century.

European Staff Requirement

The European Staff Requirement for Development, ESR-D, defines in detail the key parameters relating to the combat performance of the aircraft, the equipment it must carry, the ease with which it can be maintained, and its ability to operate in all weathers, with minimum support, from short runways. The outcome of the ESR-D is a single-seat, high performance, agile combat aircraft, optimised for the air superiority role in both beyond visual range and close combat scenarios but with a comprehensive air-to-surface attack capability.

EF 2000 is designed to meet the requirements of the four European partner nations and it will be capable of worldwide operation; the name 'Eurofighter 2000' simply reflects the aircraft's origin.

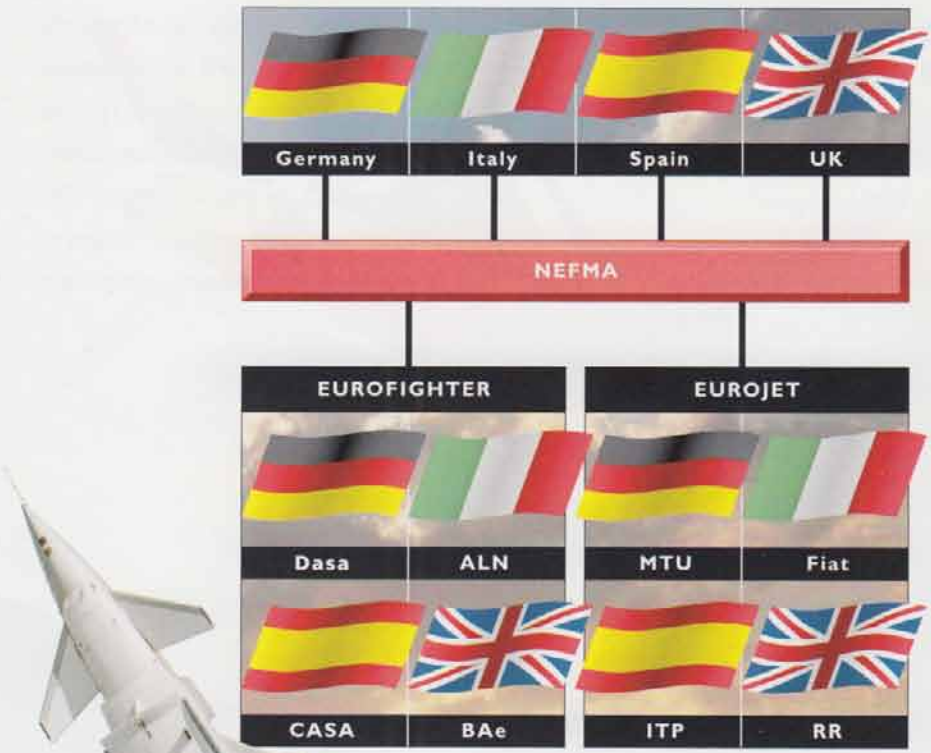
Industrial Organisation

The EF 2000 management structure is modelled on that for the three nation Tornado programme, with Spain joining the United Kingdom, Germany and Italy for the four nation EF 2000 programme.

NEFMA, the NATO Eurofighter 2000 Management Agency, represents the interests of the four Governments.

EUROFIGHTER is the industrially owned management company which co-ordinates the activities of its four partners - Alenia, British Aerospace, CASA and Daimler-Benz Aerospace. This consortium is responsible for the complete weapon system except the engine. Final assembly lines for the aircraft exist in all four countries.

EUROJET, comprising Rolls-Royce, Motoren und Turbinen Union, Fiat and ITP, is the industrial company responsible for the development and manufacture of the engine for EF 2000, the EJ 200.



The Development Contract

The two main Development Contracts governing the complete development of this important new aircraft weapon system and its propulsion system were signed on November 23rd 1988, by NEFMA and Eurofighter and Eurojet respectively.

The Development Programme

BAe
CASA/BAe
DASA
Alenia
CASA/Alenia

The Workshare

Overall workshare of the development programme is apportioned according to the planned numbers of aircraft required by each nation at the time of the contract signature, and is broken down as follows

United Kingdom 33%
Germany 33%
Italy 21%
Spain ..... 13%.

Flight testing of seven development aircraft is shared between the four countries. The first aircraft (DA1) flew in Germany on 27th March 1994; DA2 (UK) and DA3 (Italy) are also flying. Two of the seven aircraft (DA4 and DA6) will be the two seater version, and DA5 will be the first aircraft to be fitted with the new ECR 90 radar.
All development aircraft will be flying in 1996.

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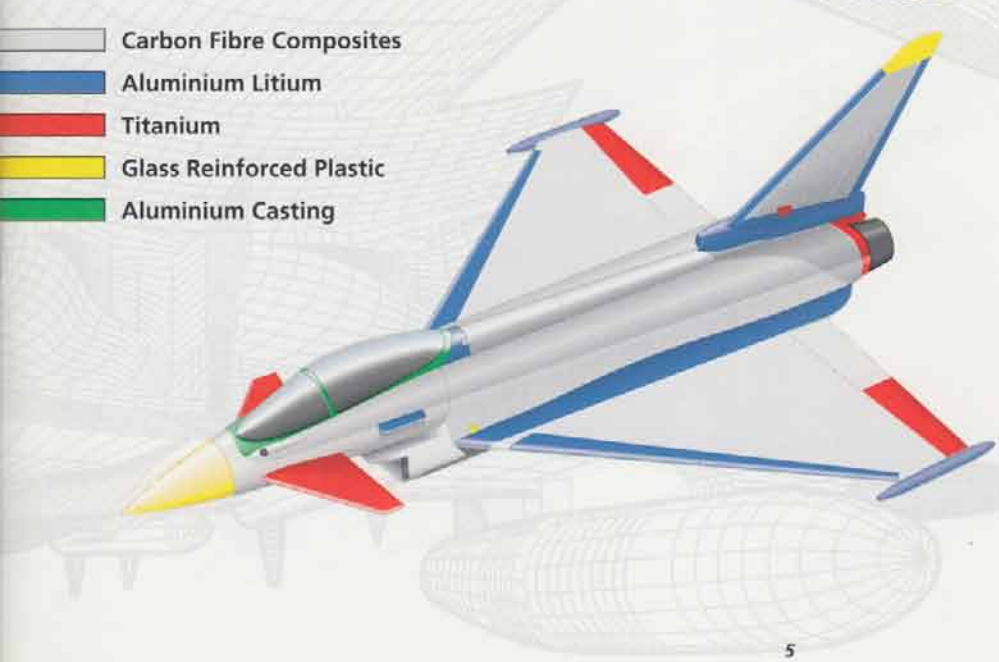
The Design Philosophy

To meet the ESR-D, EF 2000 must be extremely agile and capable of air combat manoeuvres not possible in previous fighters. Special emphasis has therefore been placed on low wing loading, high thrust-to-weight ratio and 'carefree handling'. The aircraft's high performance is matched by excellent all-round vision and by sophisticated attack, identification and defence systems which include the long range radar and infra-red search and track system, advanced medium and short range air-to-air missiles and a comprehensive electronic warfare suite to increase further the weapon system effectiveness and survivability.

High reliability, high component life and ease of maintenance are not just important design features of EF 2000, they are contractual obligations aimed at greatly reducing the life cycle cost of the aircraft and minimising support requirements.

The extensive use of carbon fibre composites and other advanced materials confers strength and durability with low weight, and ensures a smooth conformal finish to minimise drag.



Material	Surface Area
CFC	70%
GRP	12%
Metal	15%
Other	3%

Aircraft Systems

Primary Control Surfaces
Secondary Control Surfaces
Secondary FCS Functions

Flight Control System

Eurofighter 2000 is intentionally aerodynamically unstable to provide extremly high levels of agility, reduced drag and enhanced lift. The unstable design cannot be flown by conventional means and the pilot controls the aircraft via a computerised digital fly-by-wire system which offers:

- Artificial stabilisation
- Excellent control characteristics throughout the flight envelope
- Gust alleviation
- Fully carefree handling

Pitch and roll control is achieved via the all-moving foreplanes and the inboard/outboard full span flaperons, whilst the rudder provides yaw control in the conventional sense. The automatic leading edge slats provide optimum wing camber at all angles of attack.

The airbrake, intake cowls and nosewheel steering comprise the secondary control system. The entire flying control system is integrated with all of EF 2000's other systems by means of avionics and utilities control system databuses, including fibre optics.

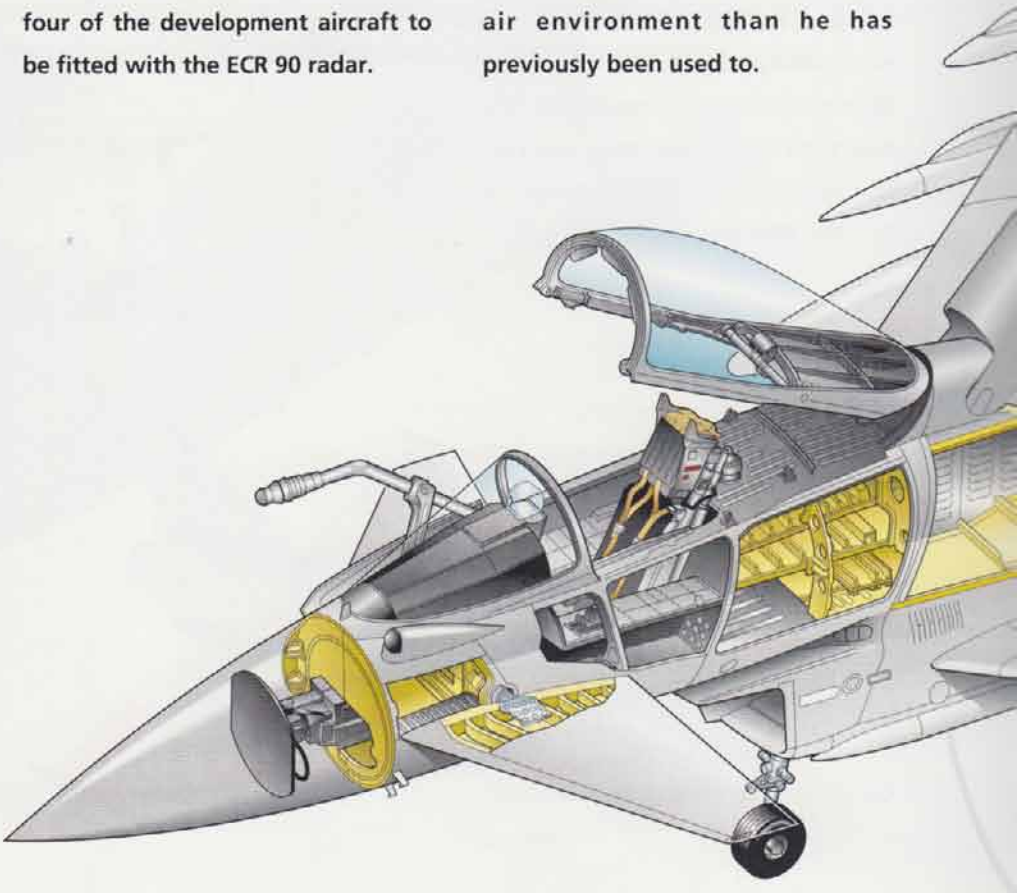
Radar

The ECR 90 radar is being developed by Euroradar, a consortium led by GEC Marconi of UK, with INISEL of Spain, FIAR of Italy, and Telefunken Systemtechnik of Germany. It is an advanced pulse-doppler system with high technology features throughout, particularly within the transmitter, antenna, and signal processor. Much of the technology has been derived from the highly successful Blue Vixen radar.

The fourth development aircraft, DA4, will be the first to have the full avionic suite; DA5 will be the first of four of the development aircraft to be fitted with the ECR 90 radar.

Avionics Systems Integration

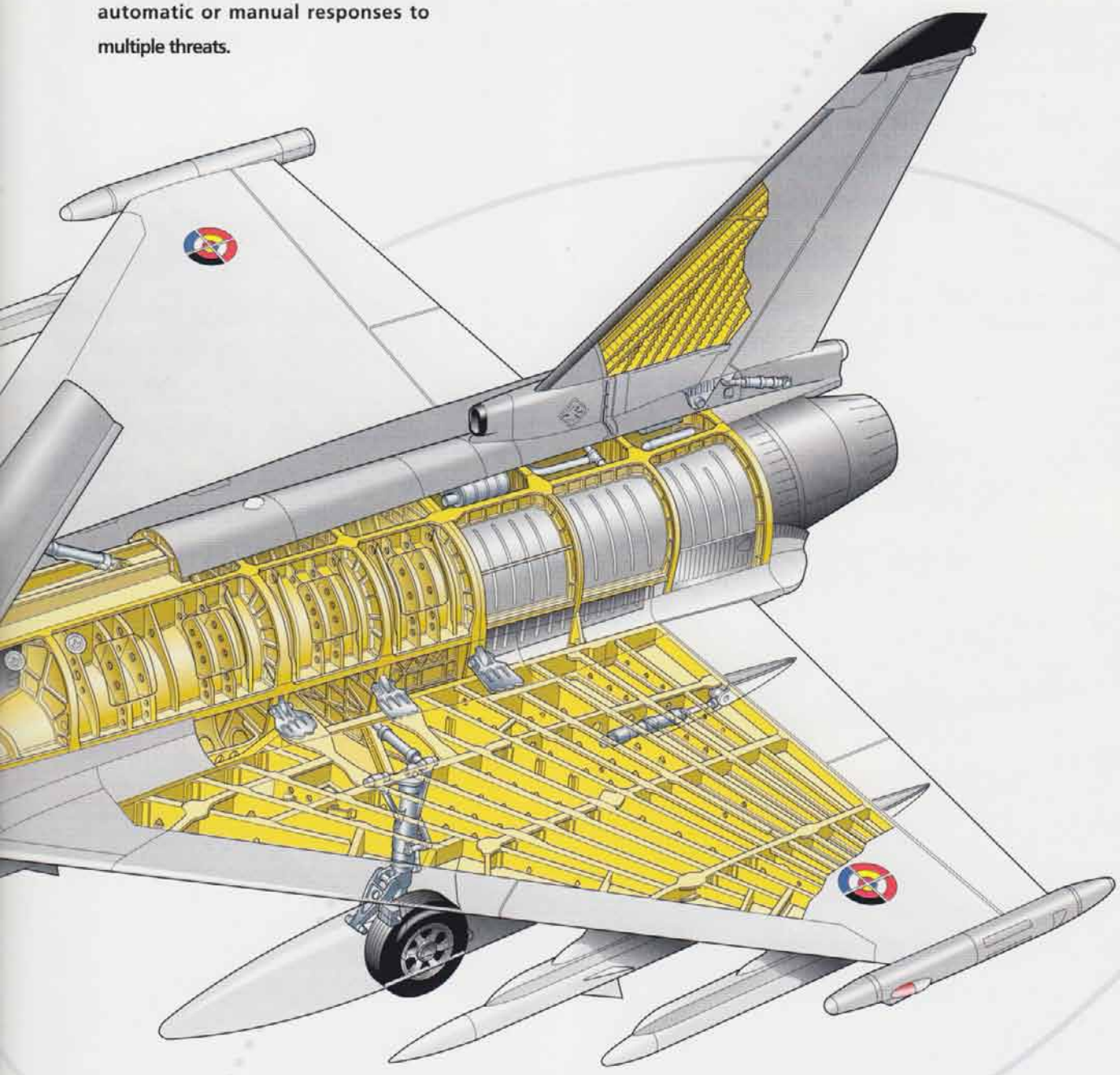
High mission effectiveness and survivability of EF 2000 will be realised through an integrated avionics system comprising seven functional sub-systems - all working together to give the pilot an autonomous ability to assess the tactical air situation and fight the battle. The individual systems are difficult to describe in isolation simply because of the degree with which they are integrated - and it is due to this sharing of information between the sub-systems that the pilot will be presented with a much more comprehensive picture of his air environment than he has previously been used to.



Defence Aids

All EF 2000's defence aids will be accommodated within the basic aircraft structure (there are no pod add-ons), and integrated with the overall avionic systems. The Defensive Aids Sub-System (DASS) aims to provide an all-round and prioritised threat assessment, with automatic or manual responses to multiple threats.

The DASS features will include a full ECM/ESM suite, front and rear threat warnings, decoy systems and chaff/flare dispensation. To complement the DASS system, the aircraft design also incorporates measures to minimise EF 2000's radar signature.



Aircraft Data

Design

Max speed ..... Mach 2.0
Operational runway length ..... 700m (2,297 ft)
'g' limits ..... +9/-3 'g'

Power Plants ..... Two Eurojet EJ 200 reheated turbofans of 90 kN (20,000 lbs) max thrust each

Dimensions

External:

Wing span ..... 10.95 m (35 ft 11 in)
Wing aspect ratio ..... 2 : 205
Length overall ..... 15.96 m (52 ft 4 in)
Height..... 5.28 m (17 ft 7 in)

Area:

Wings, gross ..... 50.0 sq m (538 sq ft)

Masses

Basic mass empty ..... 9,999 kg (22,000 lb)
Max-take off ..... 21,000 kg (46,305 lb)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The Cockpit

Excellent all-round vision, head-up operation in all missions, and low pilot workload are the major drivers in the design of EF 2000's high technology single seat cockpit.

Cockpit Features

HOTAS (Hands-On-Throttle-And-Stick) ergonometry allows the pilot to carry out complex tasks with relative ease in high intensity situations. The stick and throttle tops house around two dozen finger-tip functions, all of which are related to:

- Sensor and weapons control
- Defence aids management
- In-flight handling

DIRECT VOICE INPUT (DVI) is a means whereby the pilot may perform certain moding and data entry functions by voice command as an alternative to using manual methods. Some areas of DVI application are:

- Manual Data Entry
- HUD/MHDD Moding
- Radio/Navigation Aids selection
- Target selection

A HELMET MOUNTED SYMBOLOGY SYSTEM (HMS), together with the HEAD-UP DISPLAY (HUD), will include, as a minimum, flight reference data, weapon aiming and cueing modes, and FLIR (Forward Looking Infra-Red) imagery. The helmet system will also incorporate night vision aids, and protection against flash and optical threats.

Three MULTI-FUNCTION HEAD DOWN DISPLAYS (MHDDs) will present a wide range of information in sunlight viewable full colour and will typically include:

- The overall tactical situation
- System status and check lists
- Map displays, including air traffic procedures

Any of the MHDDs can show any required information, which is called up through soft-keys arranged around each display.

The adoption of a high level of system integration and automation has enabled EF 2000 to be optimised for single-seat operation. Advanced digital technology not only enhances the operability and survivability of the aircraft, but also simplifies the maintenance of the aircraft system.

Eurofighter's Active Cockpit

Weapon Carriage

Thirteen weapon carriage points are available on EF 2000 - four on each wing and five on the fuselage.

A typical air-to-air configuration will be four MRAAMs carried in semi-recessed fuselage stations, and two ASRAAMs on outboard pylons. AIM-9L missiles will be interchangeable with ASRAAMs. If required, a mix of at least 10 short and medium-range missiles can be carried.

EF 2000 will also be able to carry most of the present inventory of air-to-surface weapons on seven stations, including avionic stores such as laser designators. A single internally mounted 27 mm cannon will be fitted. Two wing stations and the central fuselage point are also designed to carry external fuel tanks.

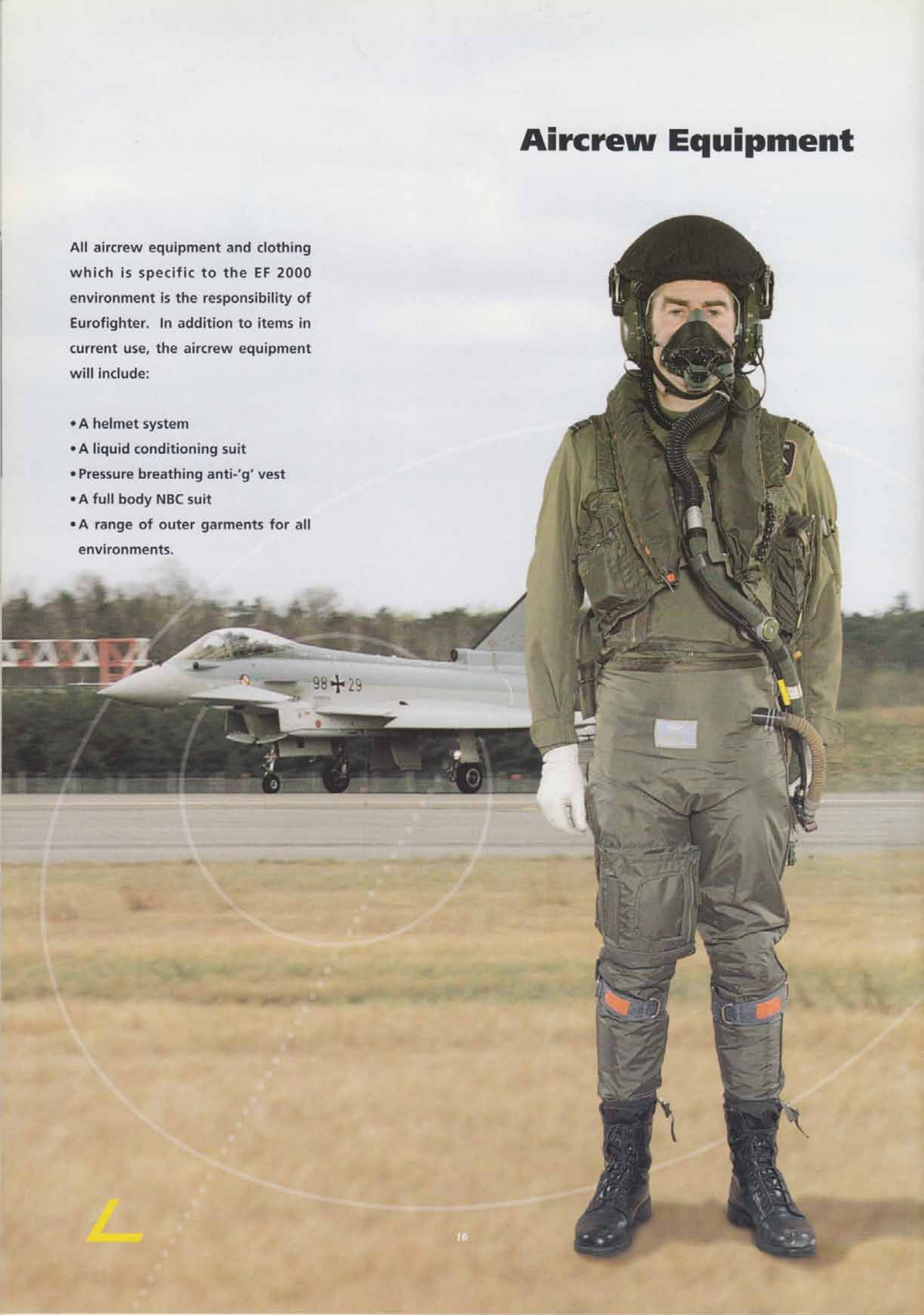
Optimum Air-to-Air configuration

Typical Air-to-Surface configuration

Aircrew Equipment

All aircrew equipment and clothing which is specific to the EF 2000 environment is the responsibility of Eurofighter. In addition to items in current use, the aircrew equipment will include:

- A helmet system
- A liquid conditioning suit
- Pressure breathing anti-'g' vest
- A full body NBC suit
- A range of outer garments for all environments.



Powerplant

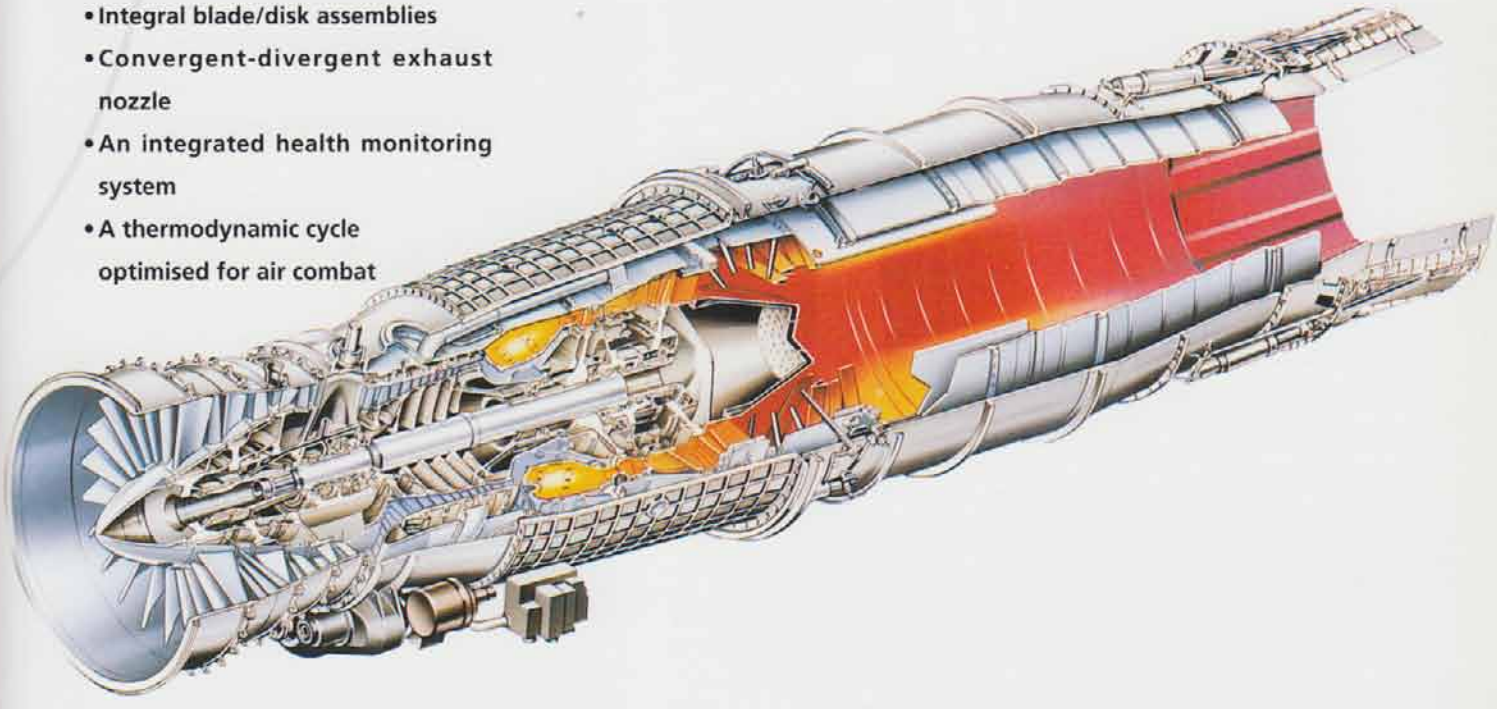
The Engine

The EJ 200 engine is tailored specifically to match EF 2000's mission requirements. In particular it offers a combination of very high thrust - around 90 kN in full reheat and 60 kN in full dry power - and low fuel consumption. As with the airframe, great emphasis is put on reliability and maintainability, low cost of ownership, and growth potential.

Fully modular, the EJ 200 incorporates digital control and state-of-the-art components and systems including:

- Wide chord aerofoils
- Single crystal turbine blades
- Powder metallurgy disks
- Lightweight compressor/turbine assemblies
- Integral blade/disk assemblies
- Convergent-divergent exhaust nozzle
- An integrated health monitoring system
- A thermodynamic cycle optimised for air combat

To allow rapid development of the aircraft envelope, the first two EF 2000 development aircraft are powered by RB-199 engines, as fitted to the Tornado. Eurojet EJ 200 engines are fitted to the third and subsequent EF 2000 development aircraft.



Development Activities

DA1 expanding the flight envelope - Germany

DA3 with EJ 200 Engines – Italy

DA7 – Italy

All 7 Development Aircraft are scheduled to have flown during 1996.

- Flight trials of the ECR 90 radar are underway
- Crew escape trials have been carried out at speeds up to 600Kts
- The EJ 200 engine continues to meet performance and schedule requirements
- Specified airframe performance has been validated by wind tunnel tests
- Aircraft mass remains within authorised ceiling
- Cockpit layout and functional design – initial operation clearance agreed
- Airframe static and fatigue tests are well underway with good results– limit loads achieved in selected cases

Crew Escape Trials – Two Seat Variant

EJ 200 Engine Runs

The ECR 90 Advanced Multi-Mode Pulse Doppler Radar

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EAP Support for EF 2000

The EAP (Experimental Aircraft Programme) technology demonstrator first flew in 1986 and brought together important new technologies and successfully integrated them into a single airframe.

For the first time, a foreplane arrangement was used in an unstable configuration, made possible by a quadruplex full authority digital flight control system.

Industry was able to develop new production techniques for advanced materials such as carbon fibre and superplastically formed titanium, with the added benefit of assessing their performance in a single airframe.

Similar advances were made in the cockpit, and in particular the avionic system. Engineers exploited new technologies to the full - the result - reduced pilot workload and increased sophistication.

A successful structural load survey was the first contribution to the EF 2000 project made by EAP. This load survey helped produce an EF 2000 structure with exactly the required strength stiffness qualities. Generally, the result is a lighter structure than would otherwise have been the case.

EF 2000 work was also carried out with EAP on the ground. Trials were carried out to study the effect of lightning striking the aircraft's critical avionic system. A total of 36 specific EF 2000 development tasks were undertaken by EAP, underlining the aircraft's significant contribution to the EF 2000 programme.

Eurofighter 2000

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