

EXPERIENCE THE POWER OF COOPERATION



**EUROJET**  
Power. Precision. Performance.



'At EUROJET we strive to apply the same exceptional standards to our partnerships as we do to producing our engine and supporting our customers. Forming relationships based on mutual respect is fundamental to long-term success for all parties.'

*Clemens Linden,  
Managing Director,  
EUROJET*



'In union there is strength.'

*Aesop*



Power, precision, performance and – above all – partnership: the values that have formed the backbone of the ground-breaking engine technology evident in the EJ200 engine. In order to fulfil the myriad requirements of diverse modern air forces throughout the world, these values are not only essential, but constitute the driving

force behind EUROJET, the company responsible for the management of the development, production, support and export of the EJ200. The cornerstones of the cooperation between four global aerospace market leaders, they have been pivotal in creating the world's most advanced military turbofan – the EJ200 from EUROJET.



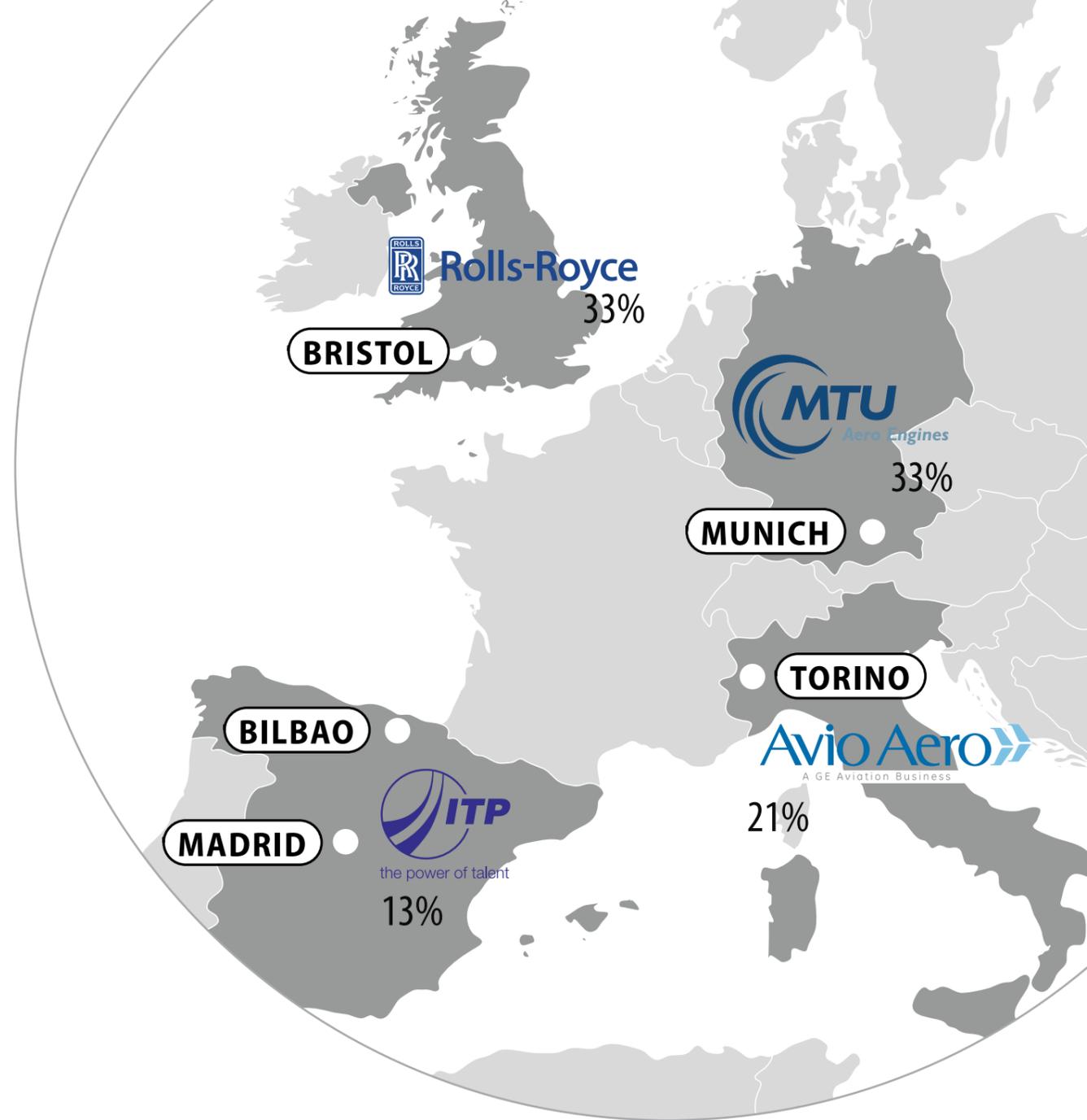
'Our customers frequently tell us they are delighted with the capability the engine brings to the aircraft and their operations. My team and I are proud to produce an engine that routinely stays on wing and just performs.'

*James McLeod,  
Chief Engineer – Defence  
Production Programmes,  
Rolls-Royce*

## COMPANY PROFILE

The origin of the EUROJET partnership lies in the decision made in the mid-1980s by the governments of the UK, Germany, Spain and Italy, to issue a development contract for the engine system of what would eventually become known as the Eurofighter Typhoon fighter aircraft. EUROJET Turbo GmbH was founded in 1986 as the single interface for all EJ200 engine project activities. Having successfully completed the development phase, EUROJET has gone on to coordinate the production, support, customer service and export of the EJ200 from its headquarters in Hallbergmoos, Germany (located near Munich Airport).

EUROJET is a joint venture with four shareholders: Rolls-Royce (UK), MTU Aero Engines (Germany), ITP (Spain) and Avio Aero (Italy) who are the industrial contractual partners for their respective core nation. The EJ200 engine is assembled in four different assembly lines, located at the shareholder company in each of these partner nations. The shareholder percentages (which reflect the number of engines ordered) and locations of the production centres are indicated on the map opposite.



The EJ200 programme, together with the Eurofighter Typhoon programme, represents around 100,000 direct and indirect jobs across Europe and involves over 400 companies. This constitutes one of Europe's largest industrial programmes representing a direct commitment by partner nations and companies for investment in sustainable technology and furthering the industrial potential of the European aero-engine industry.

To date, the EJ200 project in the Eurofighter Typhoon programme has four export customers: Austria, the Kingdom of Saudi Arabia, the Sultanate of Oman and the State of Kuwait. Since it went into service in 2003, over 1,000 production engines have been delivered and over 600,000 engine flying hours in service have been achieved.

Year	Milestone
1986	Development Contract Signature
1988	Development Contract Signature
1995	First Eurofighter Typhoon Flight with EJ200 Engines
1998	Production Contract Signature
2001	Delivery of the First EJ200 Production Engine
2003	Export Contract for Austria
2007	Export Contract for the Kingdom of Saudi Arabia
2012	Export Contract for the Sultanate of Oman
2013	1,000th EJ200 Production Engine Delivery
2015	600,000 Engine Flying Hours
2016	Export Contract for the State of Kuwait

# EUROJET – THE POWER OF COOPERATION



- Combustion System
- High Pressure Turbine
- Engine Health Monitoring System



- Low Pressure Compressor
- High Pressure Compressor
- Digital Engine Control and Monitoring Unit

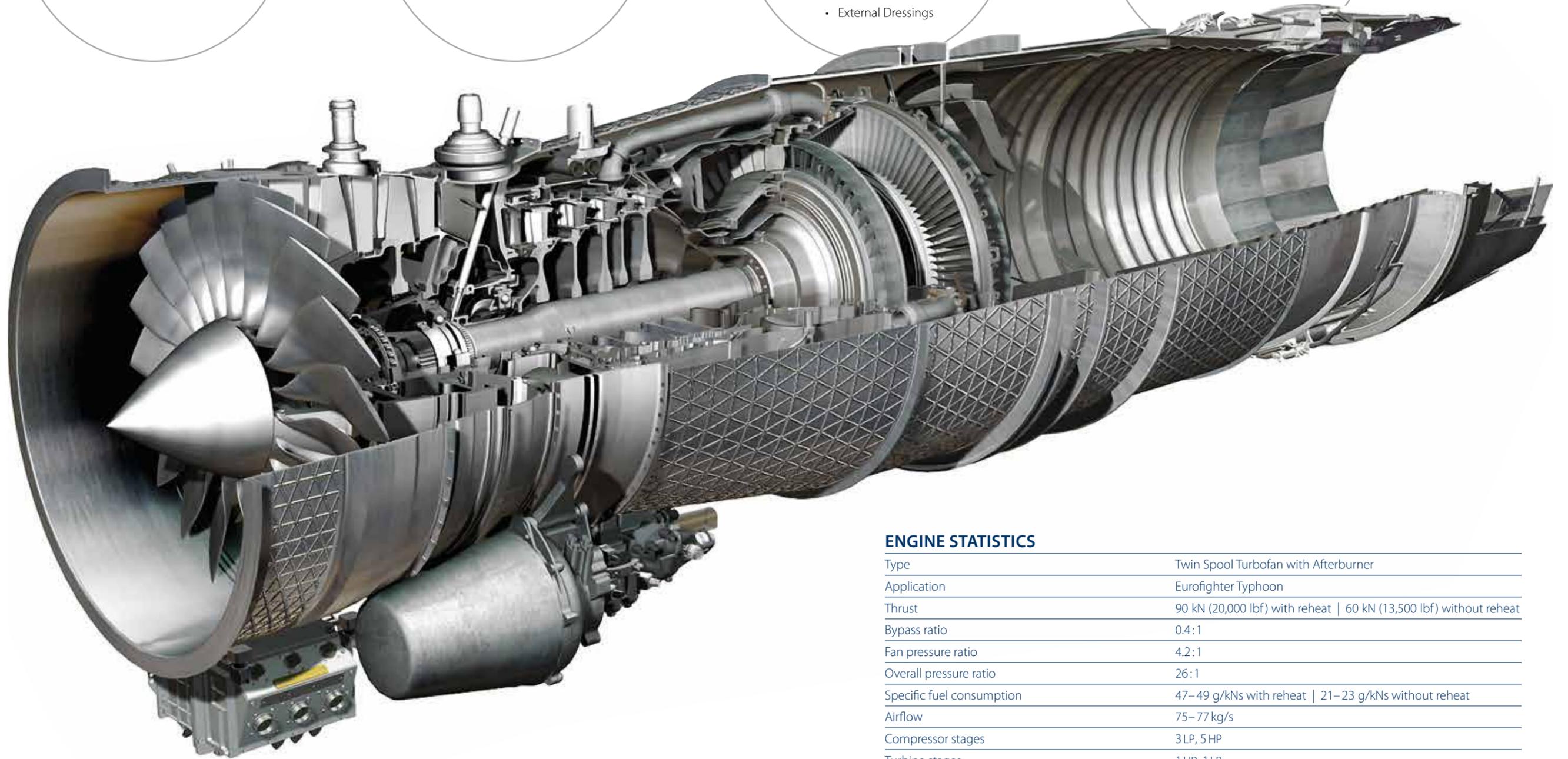


the power of talent

- Exhaust Nozzle
- Jet Pipe
- Exhaust Diffuser
- By-pass Duct
- External Dressings



- Low Pressure Turbine
- Reheat System
- Gearbox
- Air/Oil System



## ENGINE STATISTICS

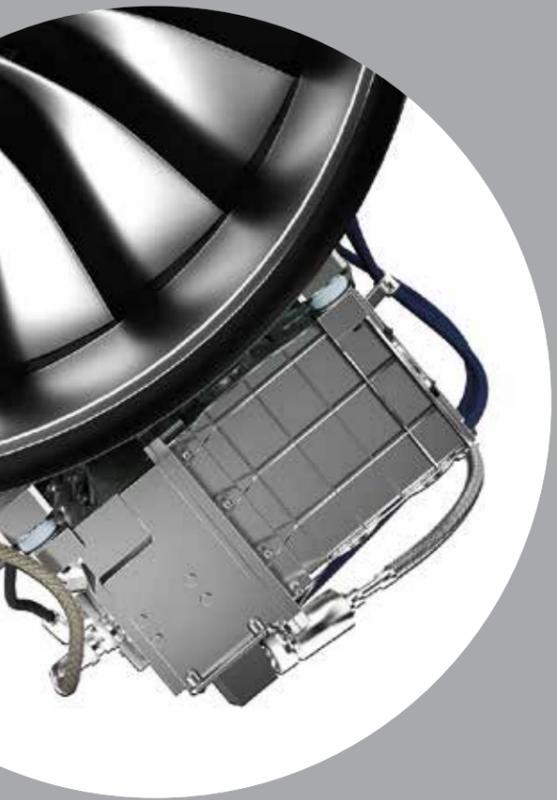
Type	Twin Spool Turbofan with Afterburner
Application	Eurofighter Typhoon
Thrust	90 kN (20,000 lbf) with reheat   60 kN (13,500 lbf) without reheat
Bypass ratio	0.4:1
Fan pressure ratio	4.2:1
Overall pressure ratio	26:1
Specific fuel consumption	47–49 g/kNs with reheat   21–23 g/kNs without reheat
Airflow	75–77 kg/s
Compressor stages	3 LP, 5 HP
Turbine stages	1 HP, 1 LP
Combustion system	Annular Airspray
Weight	ca. 1,000 kg
Length	ca. 4 m

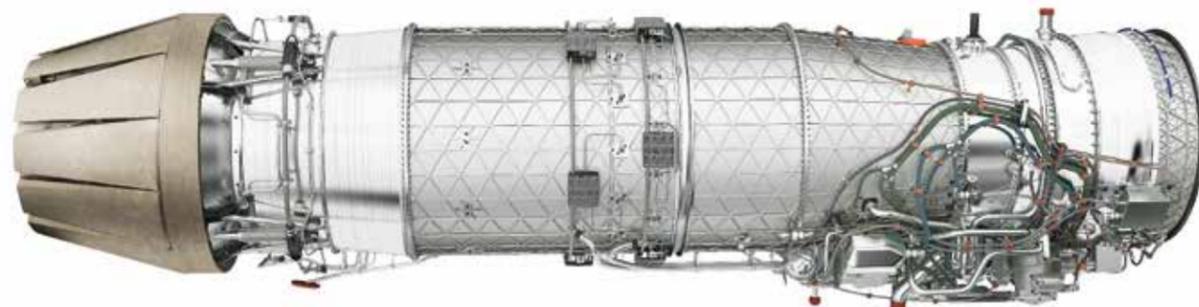
## THE EJ200 IN DETAIL



'One of the major benefits of this project is working for a market leader and with equally experienced partners to produce the most innovative product of its kind – it is surely every engineer's dream scenario.'

*Christian Köhler,  
Chief Engineer EJ200,  
MTU Aero Engines*





### TECHNOLOGICAL FEATURES

- High surge margin and automatic surge detection and recovery
- Latest technology turbine aerodynamics – cycle efficiency
- Executive Lifing within DECMU and ground systems
- Variable parameter nozzle (more thrust and better sfc)
- Advanced cooling technology in turbines – cycle efficiency
- Thrust Vectoring for Weapon System capability
- Exceptional life of R/H components

### OPERATIONAL BENEFITS

- Latest generation technology
- High performance
- High operational availability
- Power for multi-role capability
- High thrust-to-weight ratio
- High reliability levels
- Low cost of ownership

### RELIABILITY

- Low engine removal rate at < 1/1,000 engine flying hours (EFH)
- Mean Time Between Defects Core Engine (MTBD) > 1,000 EFH

### MAINTAINABILITY

- Modular construction – quick engine recovery
- Advanced on-condition maintenance
- Easy access to LRI's
- Engine replacement time < 45 minutes
- Extensive boroscope access

### SUPPORTABILITY

- Use of common hand tools
- Low level of training required
- Low direct maintenance man-hours per engine flying hour
- Non-handed engines

### ENGINE HEALTH MONITORING

- Fully integrated with Digital Control System
- Continuous engine health monitoring and event reporting



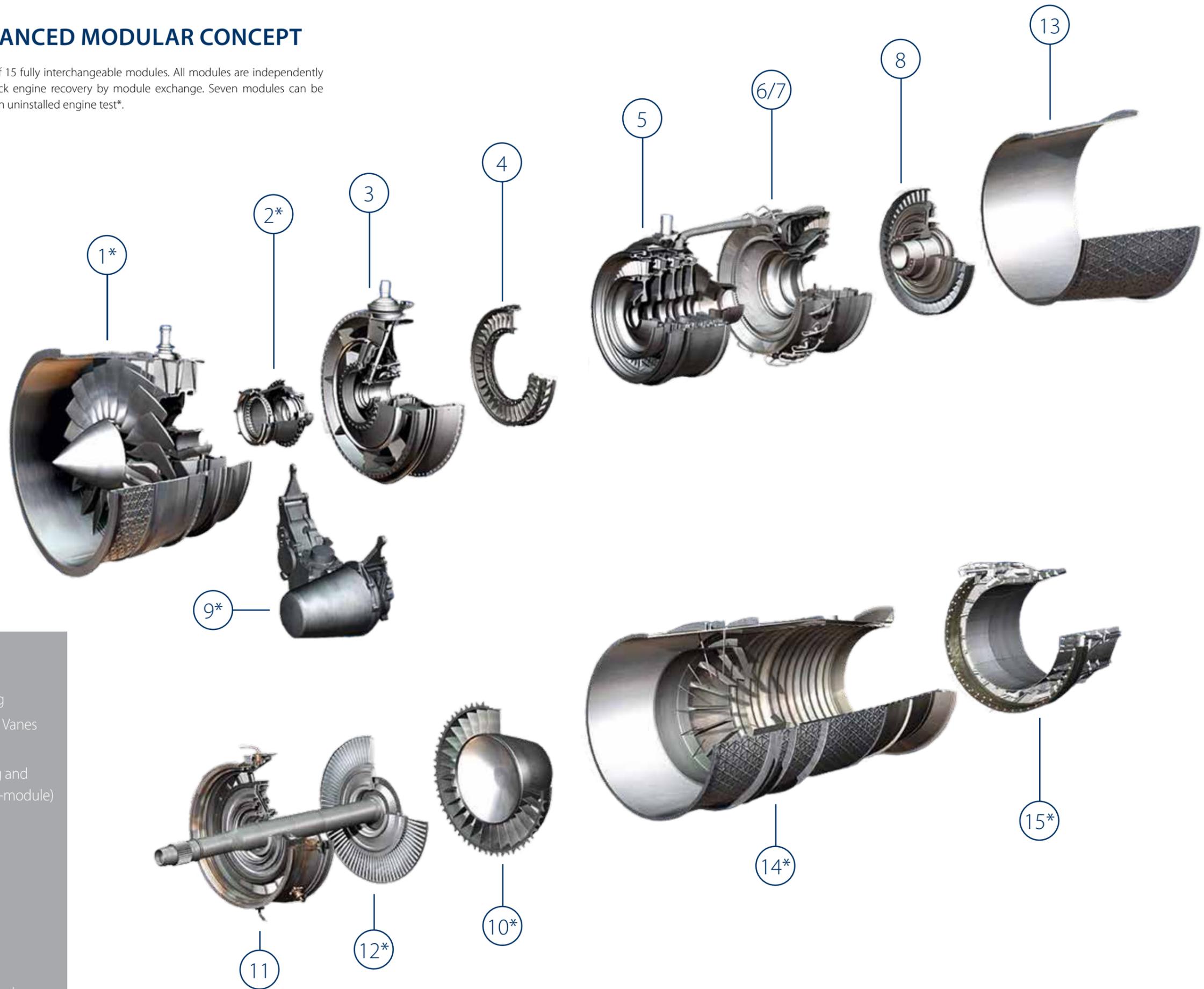
'At ITP, we endeavour to deliver components of the utmost quality. It is reassuring to know that the other partners within EUROJET also follow the same philosophy – this is of paramount importance for our supply chain.'

*Iñaki Diaz,  
Casings and NCP' Center of  
Excellence Director,  
ITP*

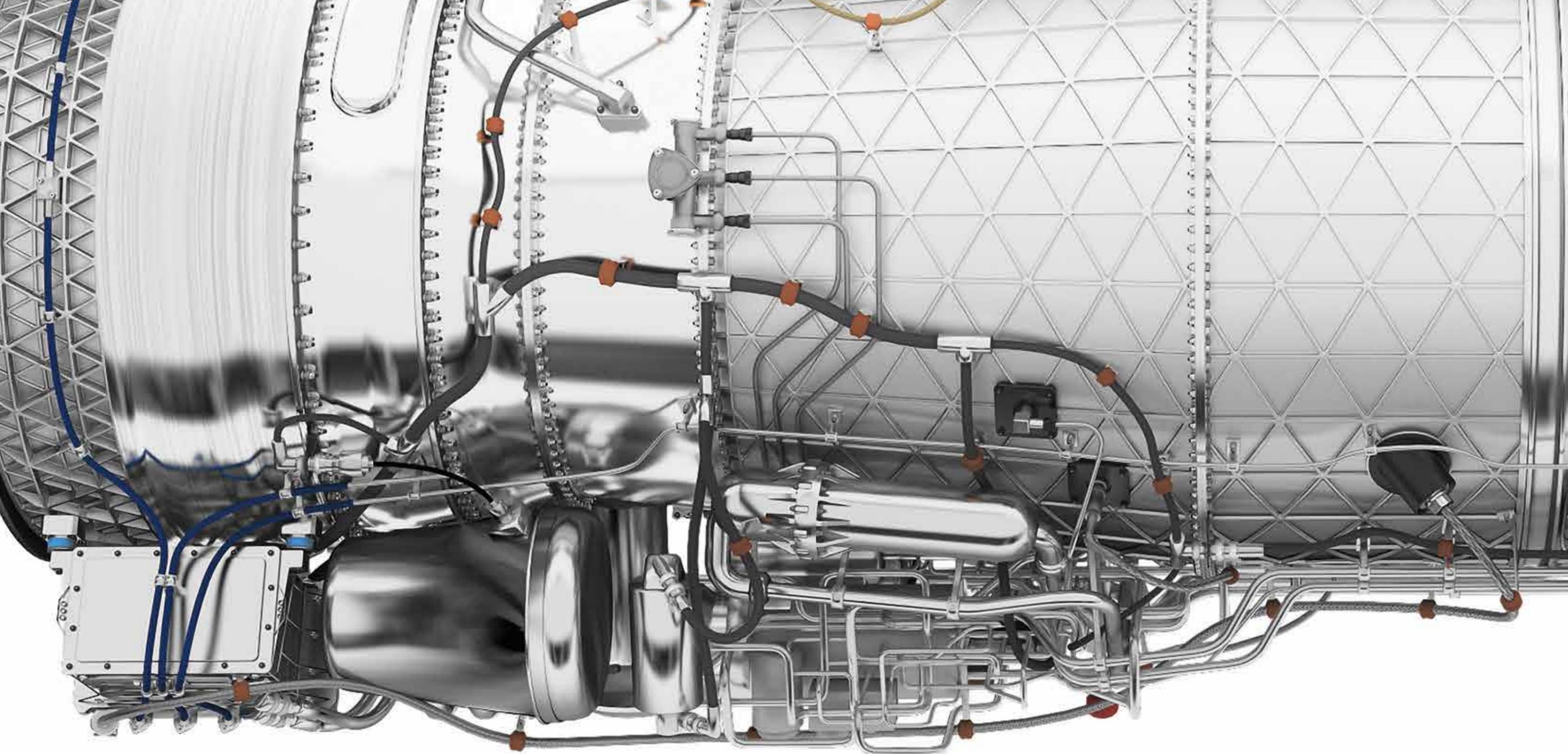


## THE EJ200 ADVANCED MODULAR CONCEPT

The EJ200 Engine is composed of 15 fully interchangeable modules. All modules are independently maintainable, which enables quick engine recovery by module exchange. Seven modules can be exchanged without conducting an uninstalled engine test\*.



1. LP Compressor
2. Bearing Support
3. Intermediate Casing
4. Variable Inlet Guide Vanes
5. HP Compressor
- 6/7. Combustion Casing and Combustor (Combi-module)
8. HP Turbine
9. Gearbox
10. Exhaust Duct
11. LP Stator
12. LP Rotor
13. Bypass Duct
14. Afterburner
15. Variable Exhaust Nozzle



## CUTTING-EDGE INNOVATION AND TECHNOLOGY

The EJ200 is designed to fulfil the most demanding requirements of today's fighter aircraft, delivering a high thrust-to-weight ratio combined with simple engine architecture. The design of the engine allows for maximum availability and minimum operating costs throughout the life of the weapon system.

The EJ200 is a two-spool turbo-based fan with modular design. The wide-chord fan with integrally bladed discs (blisks) is light and aerodynamically efficient and possesses a high level of resistance to foreign object damage. The advanced aerodynamics employed in the fan allows optimum operation without the need for inlet guide vanes.

Both the low pressure compressor (3 stages) and high pressure compressor (5 stages) are driven by single-stage advanced air-cooled turbines, featuring the latest single crystal blade

technology and operating at temperatures which are 300° Kelvin above those of previous generation engines. Engine brush seals are widely used rather than labyrinth seals in the air system. The annular combustor, incorporating air spray fuel injectors, has been designed for extremely low smoke and emission levels.

The reheat system features radial hot stream burners, independent cold stream burning and the engine features a hydraulically operated convergent/divergent nozzle.

All accessories, including the DECMU (FADEC), are self-contained and engine mounted. The gearbox provides drive for accessories. The engine is designed for a life of 6,000 flying hours which corresponds to approximately 30 years of operation.

## WHAT THE EJ200 ALREADY INCORPORATES THAT NO OTHER 20,000 LB ENGINE HAS YET:

- Full Blisk technology in the LP Compressor and in 3 stages of the HP Compressor resulting in optimised weight and increased safety
- Advanced Compressor Blade design for optimised efficiency and unparalleled bird-strike resistance
- Advanced combustion design with high durability and optimised fuel burn
- Single crystal turbines with 3D Aero giving significant life increase and optimal performance
- Executive Lifing, allowing maximum use of the 6,000 EFH design life (over 20,000 TACs)
- A combined unit for Control and Monitoring resulting in optimised health monitoring and maintenance
- 3-Stage Reheat System for optimised fuel burn and thrust

## EJ200 LIFE CYCLE COSTS

### WHAT MAKES THE EJ200 AFFORDABLE TO OPERATE?

There are a number of factors that play into the decision to purchase an engine, of which the original purchase price is just one. To be cost efficient an engine needs to be considered over its entire Life Cycle, its operating costs, maintenance, the number of hours the engine is flying and its life span. In this, the EJ200 has a significant lead on other engines as it is designed to minimise costs in a number of areas and allows for a maximum time on wing.

### WHERE THE EJ200 CAN OFFER SIGNIFICANT LIFE CYCLE COST SAVINGS:

- Maximum Time on wing is provided through the exceptional high reliability of the engine which has proven to be better than specification requirement
- The consequent application of an on-condition maintenance concept reduces O Level maintenance burden to a minimum
- The decision for engine removal is based on boroscope inspection and advice of the fully automated "on board health and monitoring system" only. Engine Exchange can be completed within 45 minutes
- The repair effort off wing is efficient and can be done in very short turnaround times due to the modular construction which enables rapid repair by module exchange
- The facility costs on Main Operating Base are minimised with the very efficient I level Maintenance Concept
- Given seven modules can be exchanged without consequential bench test requirement, a cost-effective maintenance concept can be implemented which removes the requirement for an engine test bed on Main Operating Base
- The design, low turnaround times and the proposed advanced maintenance concept results in low quantity pool requirements for spares, spare engine and spare modules
- Maintenance Concept optimises personnel requirements in terms of Air Force/Industry head count and training requirements
- Administration costs can be reduced significantly as the proposed maintenance concept supports any form of cooperation between Air Forces and Local Industry



### THE EVIDENCE

- Extremely low, unplanned engine removal rate: < 1/1,000 engine flying hours (EFH)
- Average engine on-wing time: over 1,000 EFH
- Fleet leader has currently over 2,000 EFH on wing excluding scheduled maintenance
- Mean Time Between Removals (MTBR) significantly higher than specification requirement
- In Flight Shutdown Rate (IFSD) significantly lower than specification requirements

## EJ200 – TAILORED GROWTH FOR CUSTOMER NEEDS

In essence, the growth requirements for an engine are mostly related to achieving increased thrust. There are a number of different factors that can influence the way thrust growth is achieved depending on the level of growth and the relevant portion of the flight envelope to be addressed.

In defining an optimised growth engine, it is beneficial to tailor these measures to the individual needs of the application. EUROJET is prepared to define growth requirements in close liaison with the airframe manufacturer to achieve an optimised thrust growth for the application concerned.

Over the past few years, EUROJET and partner companies have worked on technologies for growth opportunities addressing various EJ200 components. Rig- and component testing has been performed to achieve a maturity level which allows technology insertion at low risk. A prominent example is the 3D-thrust vectoring nozzle, where a full-scale engine test has been successfully performed.

Until now, the EJ200 programme has not required any growth steps due to the engine's unprecedented performance. Therefore, the full growth potential, designed into the engine from the beginning, is still available.



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## THE POWER TO MEET FUTURE CHALLENGES

The outstanding capabilities of the EJ200, and its unprecedented performance as demonstrated by the Eurofighter Typhoon aircraft, have raised the interest of many other nations. The EJ200 also offers growth potential and can be adapted to the requirements of a new aircraft. With this in mind, EUROJET is actively pursuing a number of export campaigns, both for indigenous engine programmes and

as part of a package with Eurofighter Typhoon, in various countries around the world. Having already established a strong international presence, EUROJET is seeking to grow and enhance its customer base beyond the core programme, while at the same time providing the very best maintenance and support for its existing customers. The EJ200 and EUROJET: Partnering your long-term defence strategy.



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*Clemens Linden,  
Managing Director,  
EUROJET*

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