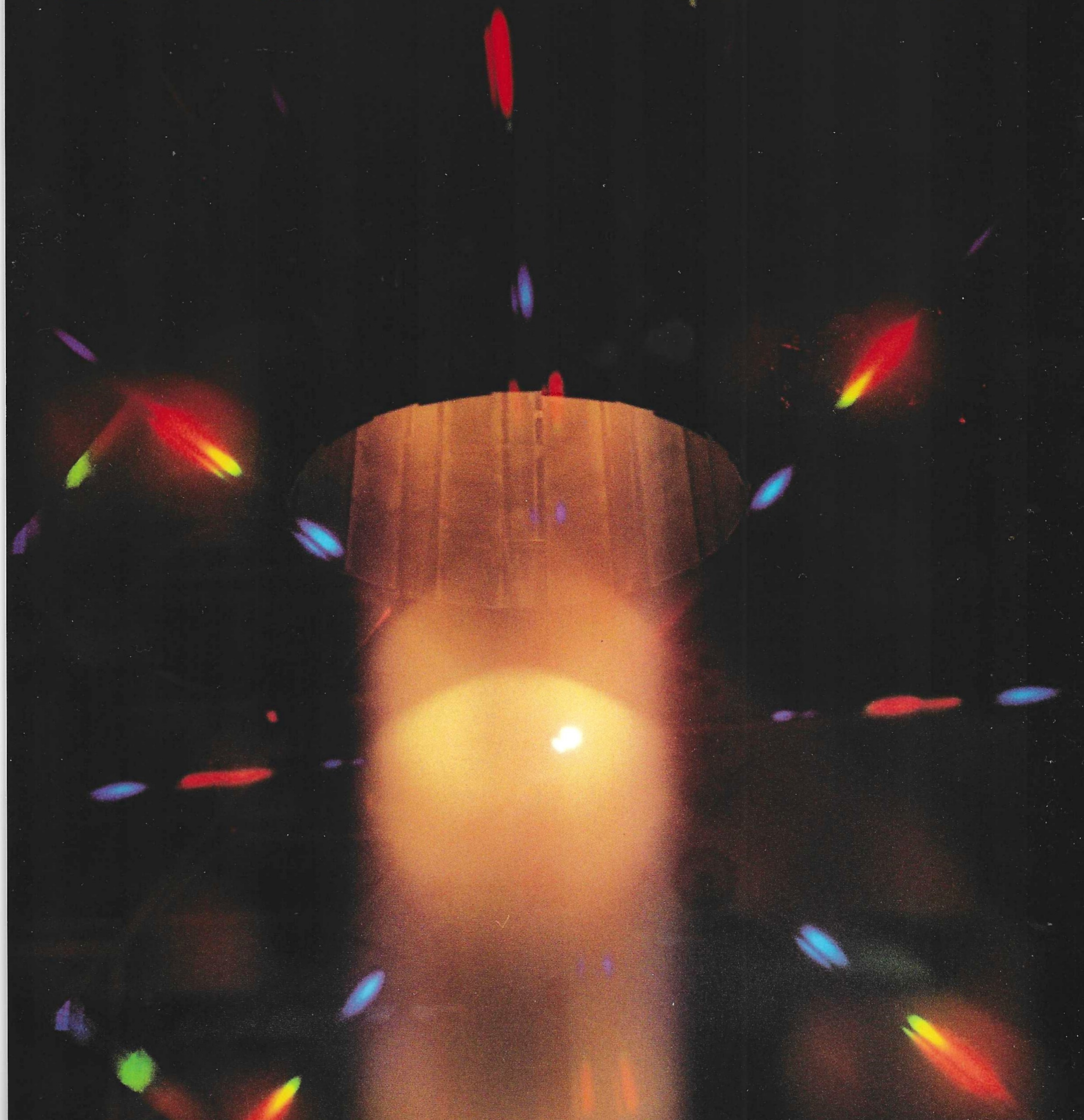
EUROJET
EJ200



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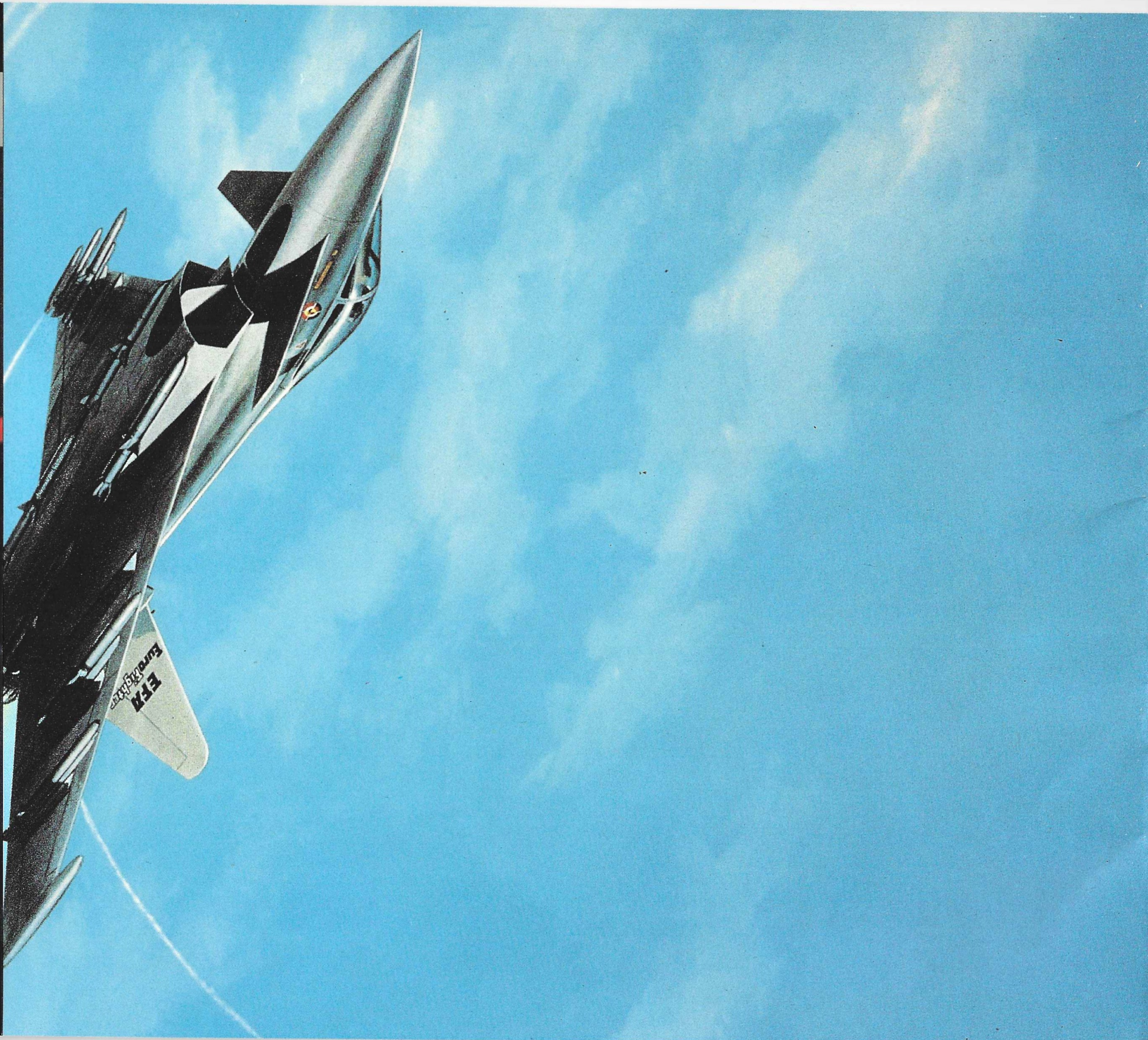


Setting the Standards

The EJ200 has been designed to fullfil the demanding engine requirements set up by the participating Nations for the next generation of military aircraft. Within design criteria equal priority has been given to performance and life cycle costs, combining the following requirements:

- Unprecedented Thrust/Weight ratio
- Multimission capability
- Low fuel consumption in reheat or dry operation
- Superior handling capability & high tolerance to inlet distortion
- Significant growth potential for future power requirements
- High bleed and power-off take capability throughout the flight envelope
- Fully modular construction and utmost simplicity for ease of maintenance & mission reliability
- Very high design life and reliability of components

No existing engine is able to meet these standards. The engine is being developed initially for the European Fighter Aircraft but dry and derivative versions will provide for a wide range of applications in single and multi-engined aircraft

FiatAvio

mtu
Deutsche Aerospace

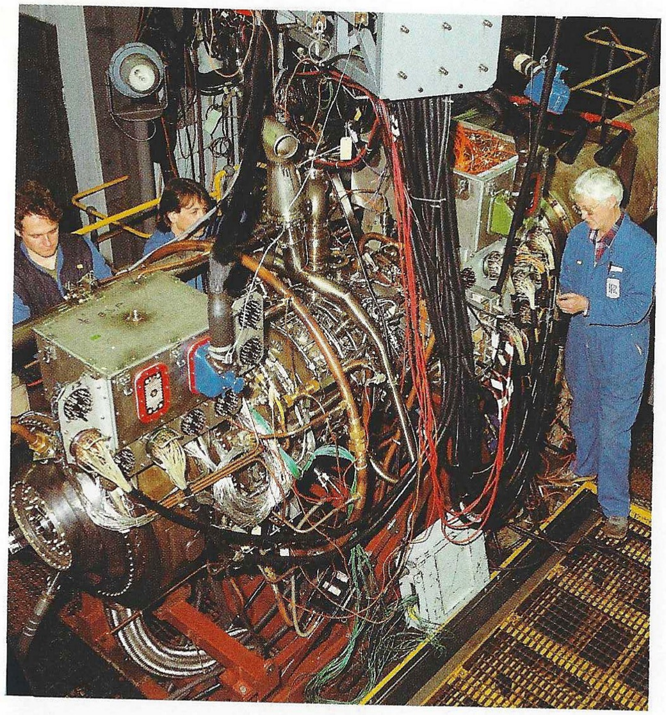
ROLLS ROYCE

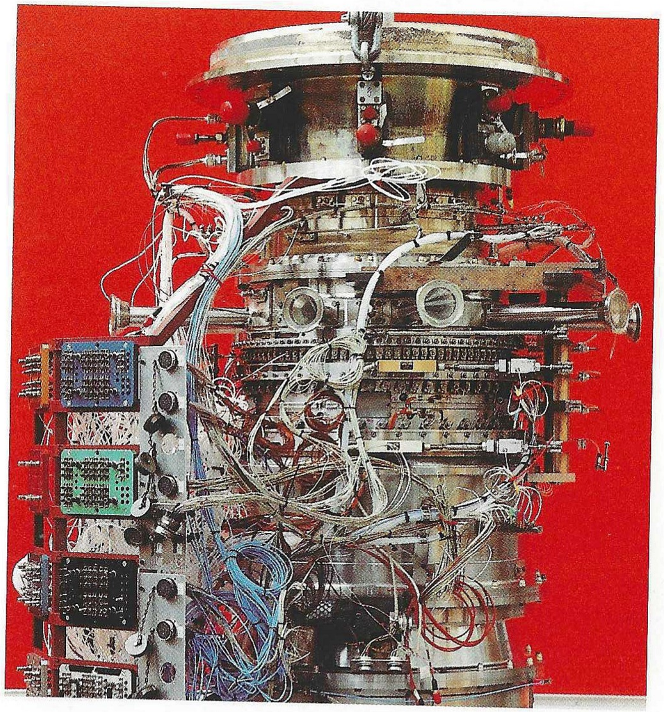
ITP

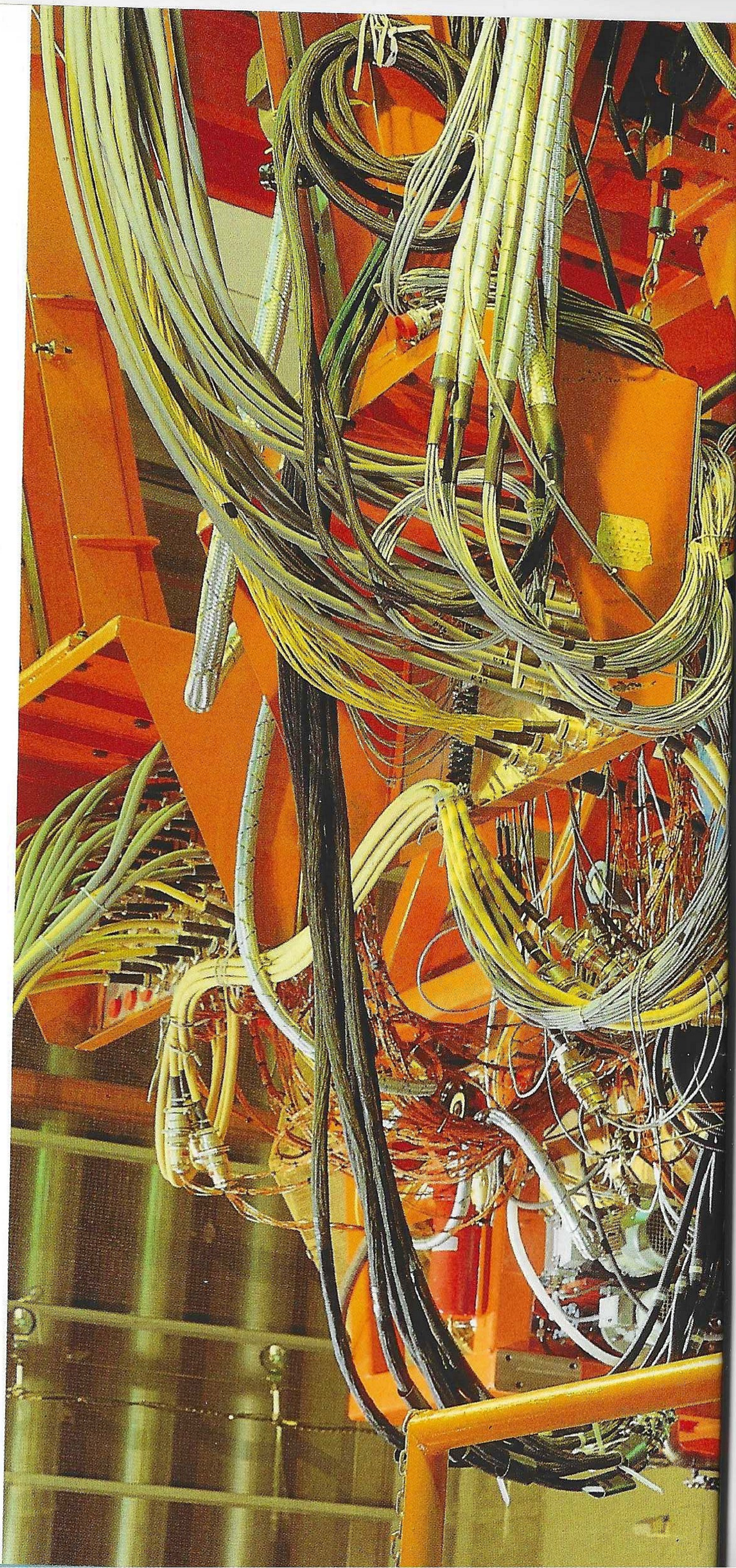
A Low Risk Programme

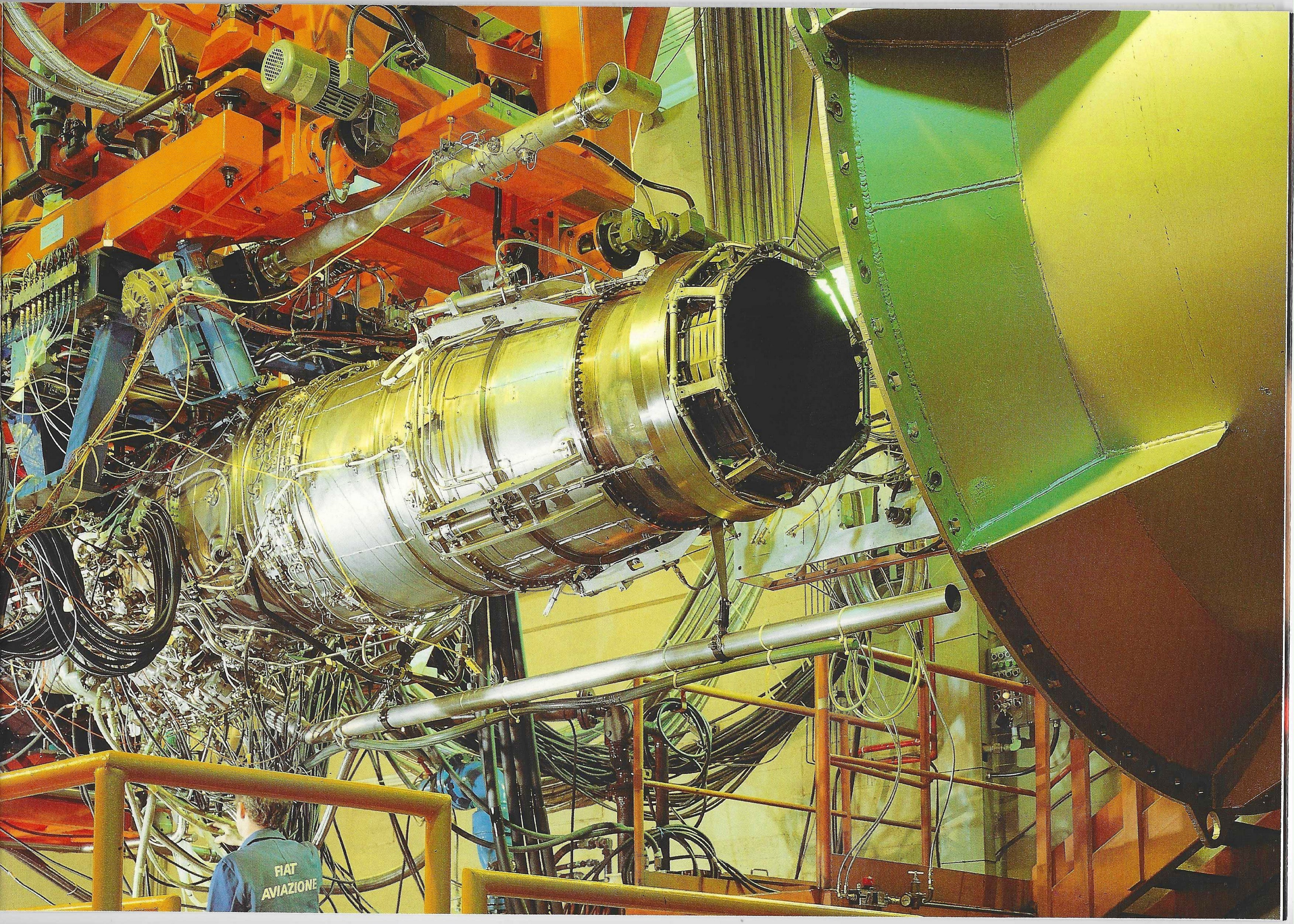
The EJ200 Programme is low risk in terms of development cost and timescale:

- The Technology-Aquisition Phase has successfully demonstrated that the technologies used fully achieve their objectives
- The Design-Verification Phase has already demonstrated that the engine design meets or exceeds the contractual requirements
- The Development Phase will further develope the performance and reliability in line with the specification to enable Preliminary Flight Clearance
- The Flight-Test Phase will finalize engine evaluation leading to Type Certification








FIAT
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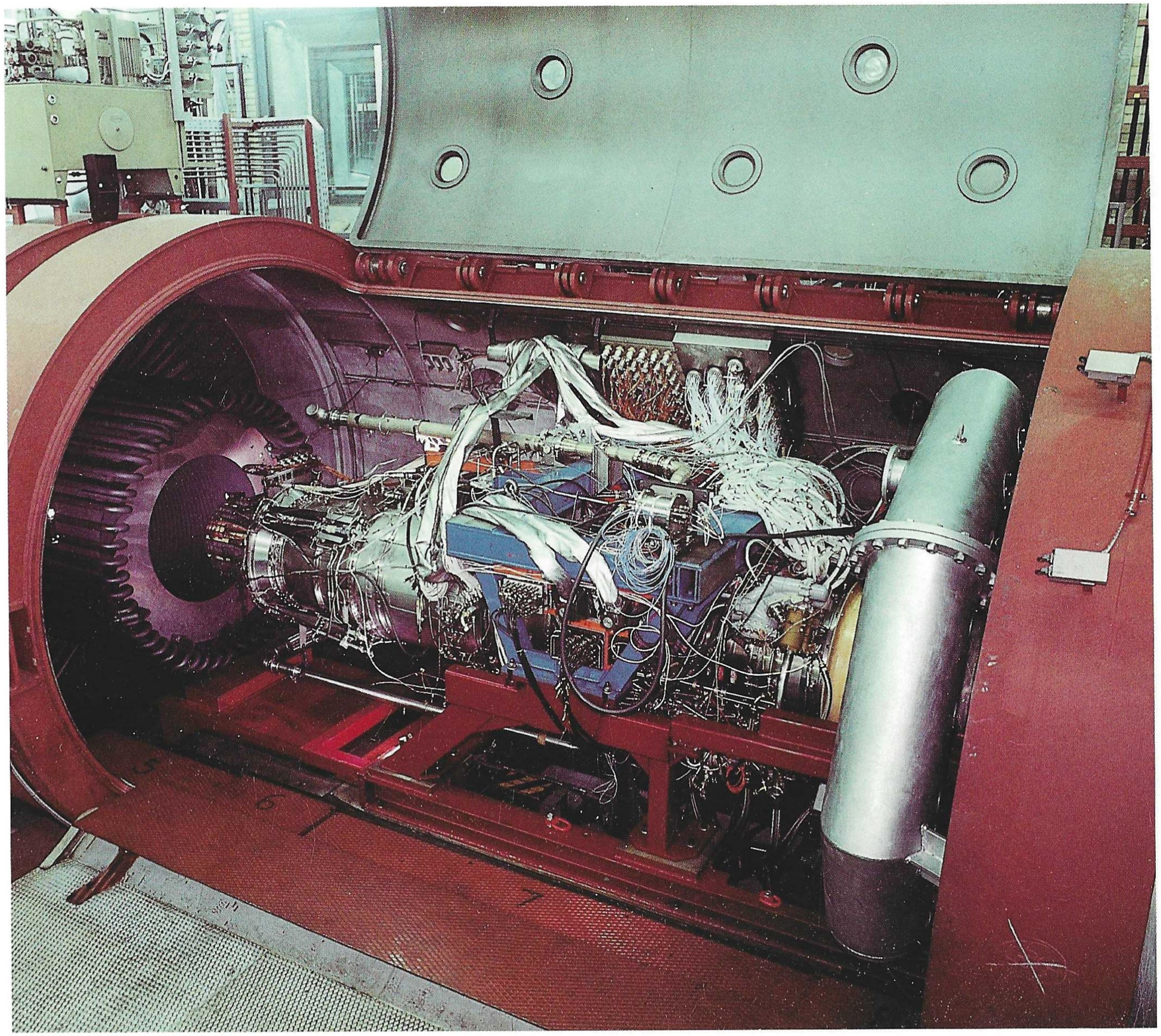
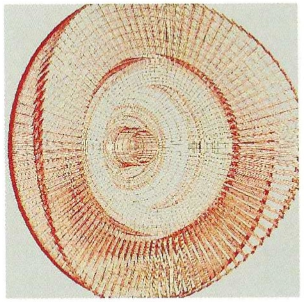
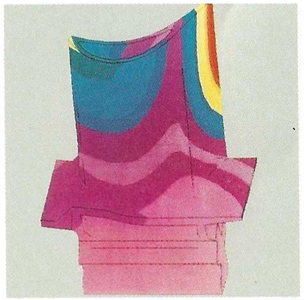
Demonstrated Technology



EJ200 Technology is drawn from more than 100 rigs, core engines and full demonstrator engine test programmes.

These test programmes are supported by numerous engineering research activities, including the latest developments in air-oil- and fuel systems, advanced structural design techniques, advanced material and leading aero-thermal and dynamics analysis. These are coupled with similar advances in manufacturing technology.





Widechord airfoils for FOD tolerance & high efficiency

Single-crystal turbine blades for long life and high turbine entry temperature

Blisks (integral rotor blades & disks) for low weight

Advanced air-, oil- & fuel system for reduced weight & increased performance

Built-in-Technology

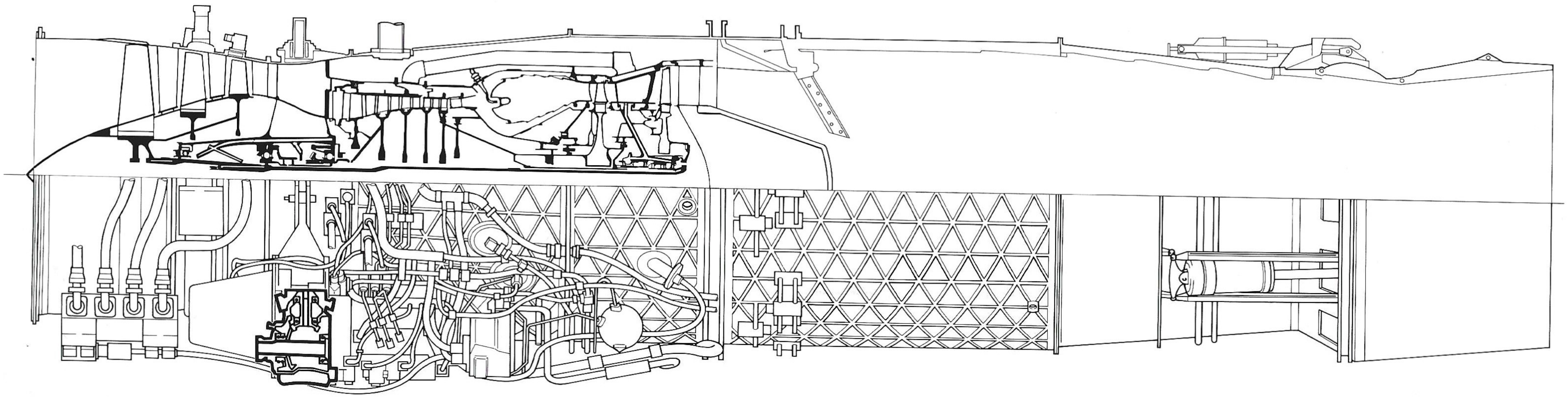
3D transonic compressor & Turbine design. For high efficiency & reduced component weight

Brush seals for reduced weight, high efficiency & ease of maintenance

Digital engine control for optimum accuracy & performance over the entire flight envelope

Powder metallurgy disks for light weight & high strength

Convergent/divergent long flap nozzle for increased performance levels



Engine Description

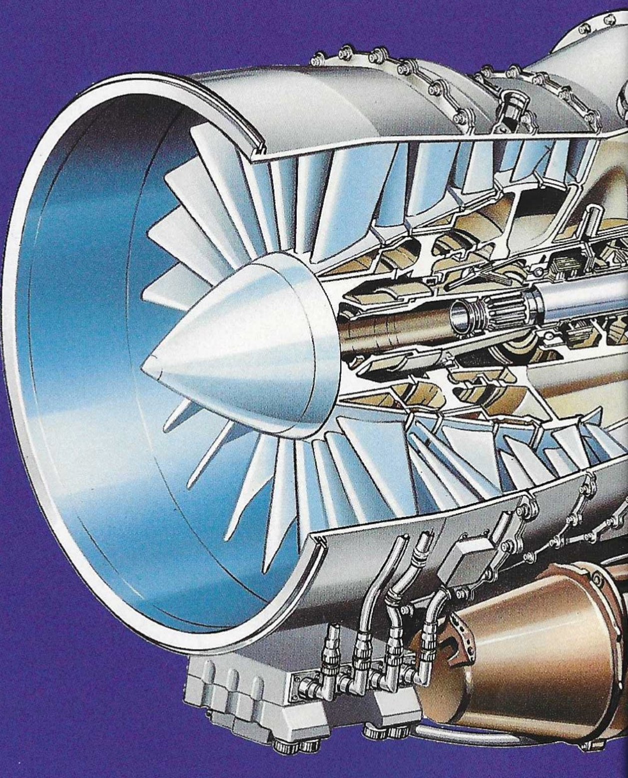
The EJ200 features mechanical design simplicity, for example the engine has a minimum number of robust compressor and turbine stages. It is a two-spool engine with variable geometry confined to the HP compressor in one location only. Single stage turbine drive the 3 stage fan and the 5 stage HP compressor. The combustor is annular with vaporising burners. The Engine is fully modular and allows for on-condition maintenance with built-in-engine health monitoring and test equipment. An Advanced Full Authority Digital Engine Control (FADEC) system with fault diagnostics and health monitoring is used. From inception, low maintenance, operating and support costs have been prime design objectives.

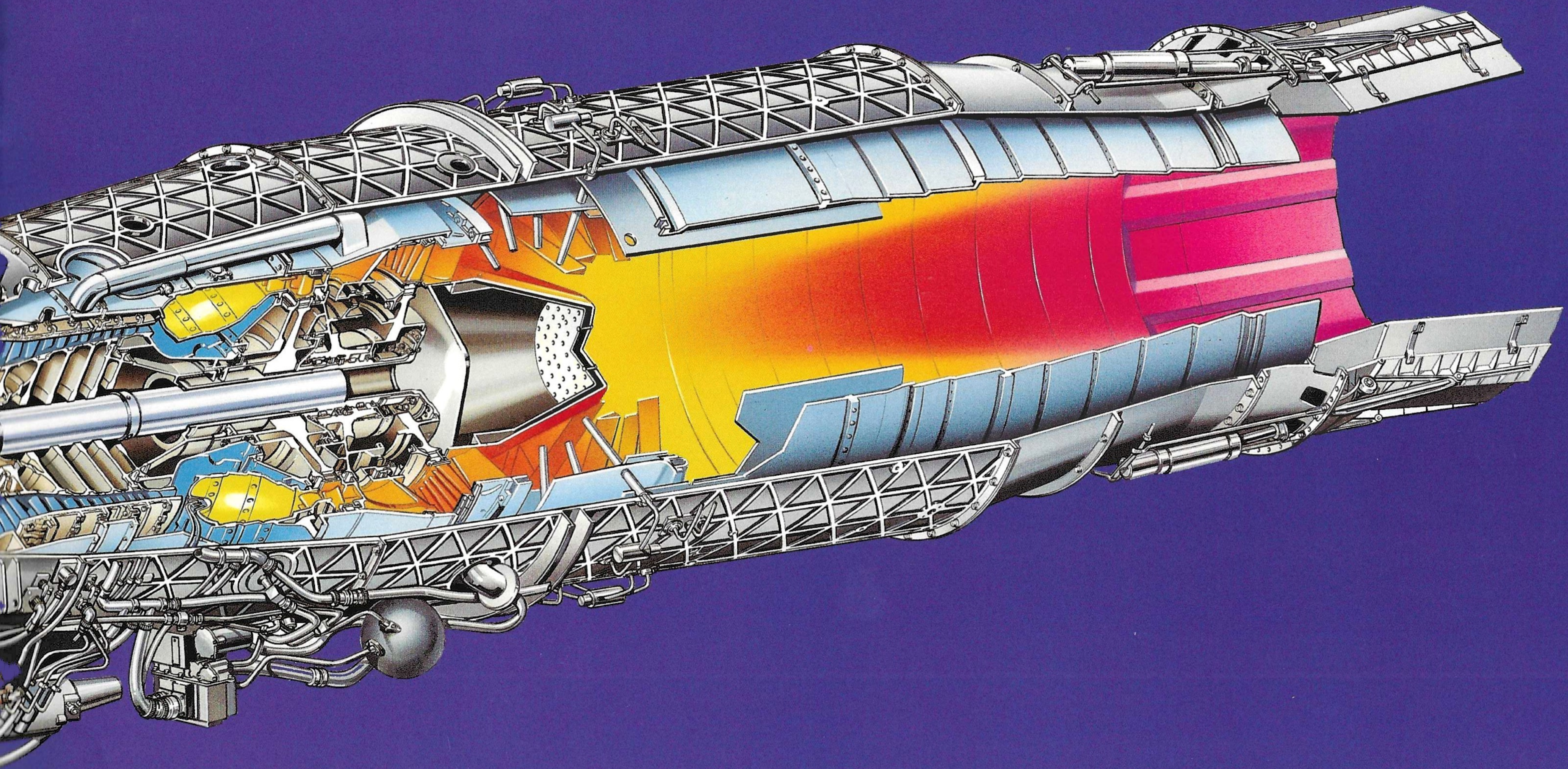
Design Feature

- Overhung fan with no Variable Inlet Guide Vanes
- Smokeless annular combustion chamber with vaporizers
- Low density single crystal turbine blades
- Turbine interstage strut
- Variable area convergent/divergent nozzle
- Negative and zero "G" oil system
- Advanced FADEC
- Fully modular design

Benefits

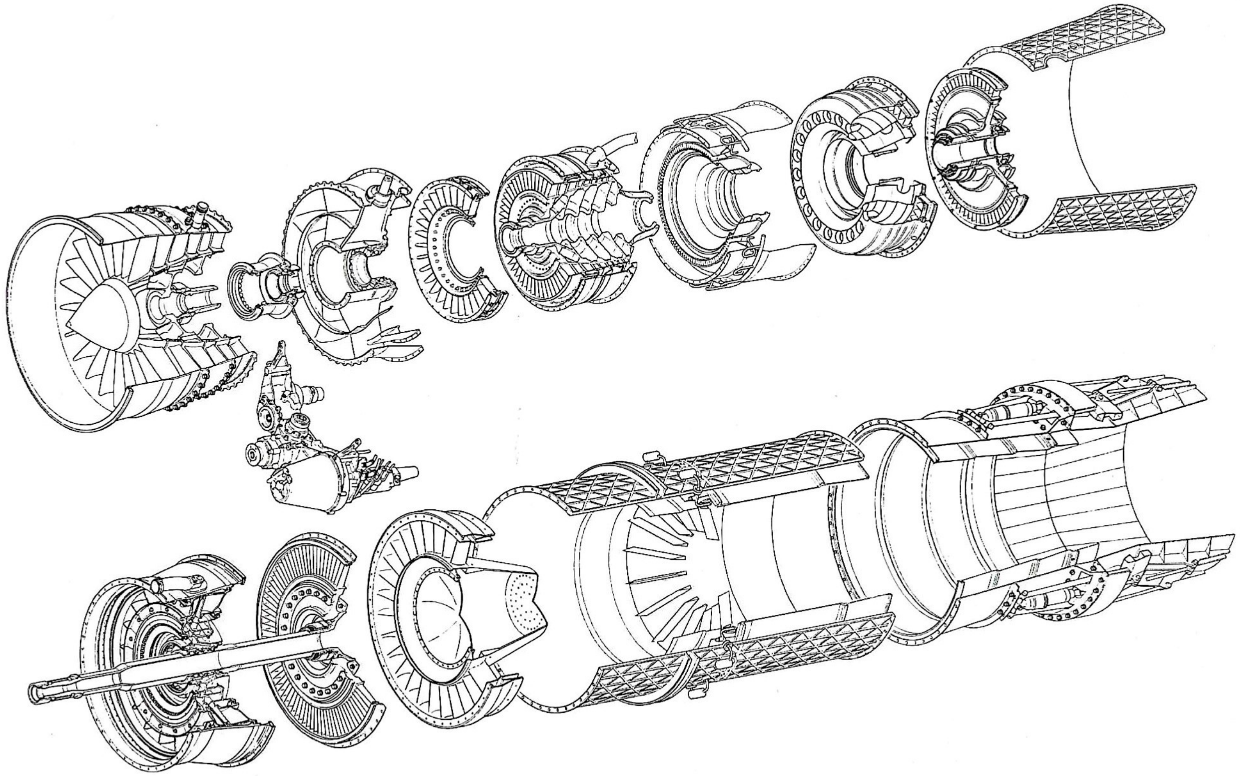
- Compactness, FOD tolerance, Simplicity, Lower weight
- Fuel burning efficiency, Compactness, Low maintenance, Less detectible
- Light wight, Higher temperature capability at longer life
- High strength, Compactness
- Increased performance
- Improved combat capability
- High operational effectiveness, Low pilot work load, Excellent R & M
- Reduced spares & maintenance costs, Support flexibility





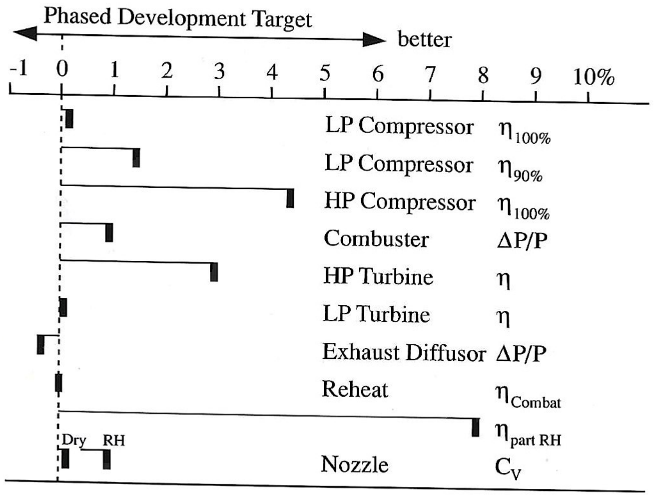
Leading Particulars EJ200 Engine

Performance Data (Uninstalled, ISA, SLS)		
Thrust		
max dry	kN (lbs)	60 (13.500)
with reheat (combat)	kN (lbs)	90 (20.000)
Typical air mass flow	kg/s (lb/s)	75-77 (165-170)
Bypass ratio		0.4
Overall pressure ratio		26:1
Average specific fuel consumption		
max dry	g/kNs (lb/lb/hr)	21-23 (0.74-0.81)
with reheat	g/kNs (lb/lb/hr)	47-49 (1.66-1.73)



The EJ200 fitted with a convergent/divergent nozzle, has achieved very successfully, simulated altitude testing – performance calibrations have been taken at all corner points of the operational flight envelope, as well as numerous other steady-state and transient results. Sea-level and altitude testing has validated a wide range of performance predictions during very early running, well in advance of the development timescale normally anti-cipated by aviation industry worldwide – outstanding achievment.

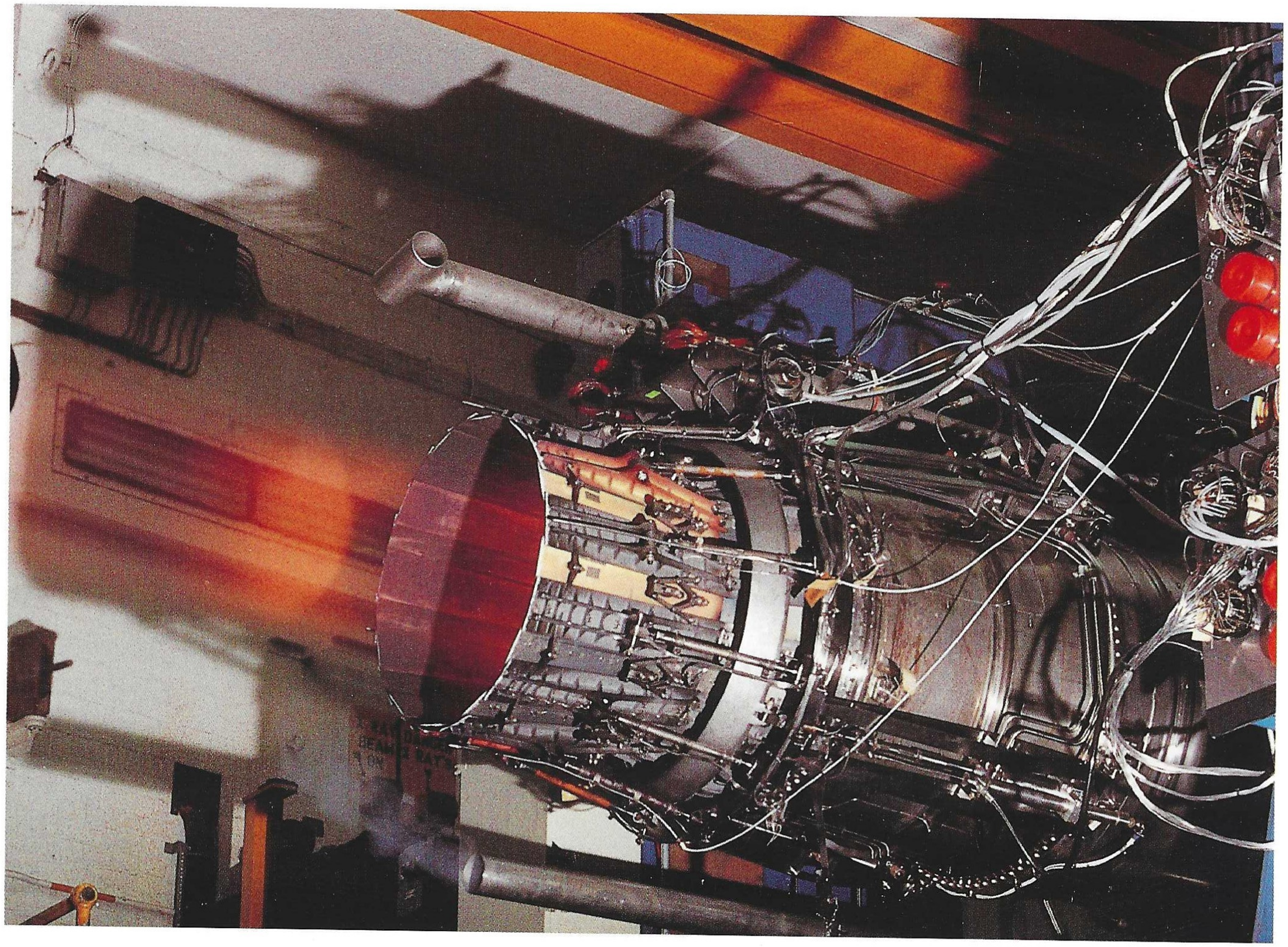
In addition, over 90 hrs/200 major cycles of Accelerated Simulated Mission Endurance Testing "ASMET" (including over 2500 idle to max. cycles), were successfully completed at full temperature ratings, within the first 12 month of testing; testing which is equivalent to several hundred hours of mission flying for many components. Performance deterioration apparent after the ASMET was within expectation and full strip examination showed components to be in excellent mechanical condition.



Test Results

More than 500 hours running have been included in the engine test programme prior to Full Scale Development (FSD) testing. FSD testing which will run on continously from 1990 through to first flight, full certification and initial production.

The EJ200 engine has produced results, exceeding contractual performance levels, well ahead of timescale and in budget targets.



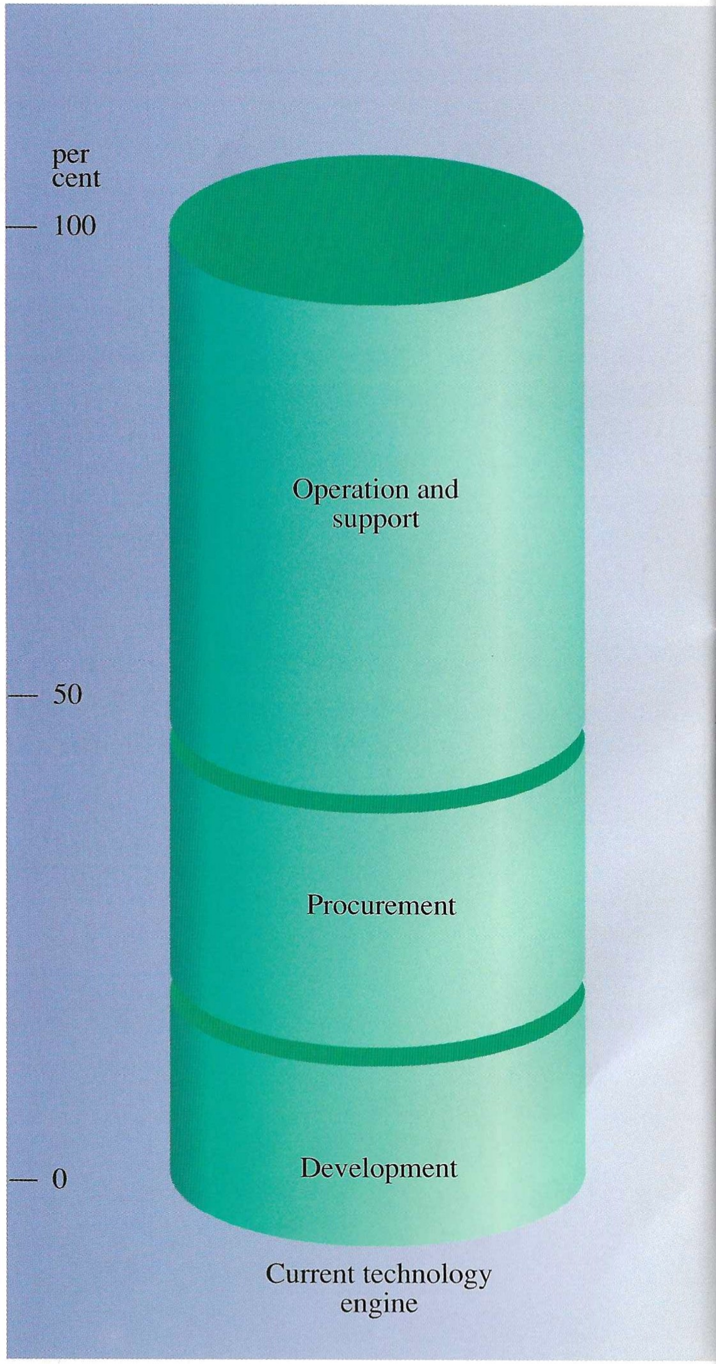
Engine Life Cycle Costs

The primary EJ200 engine design aim is to minimize Life Cycle Costs (LCC) whilst meeting specified performance and operational criteria.

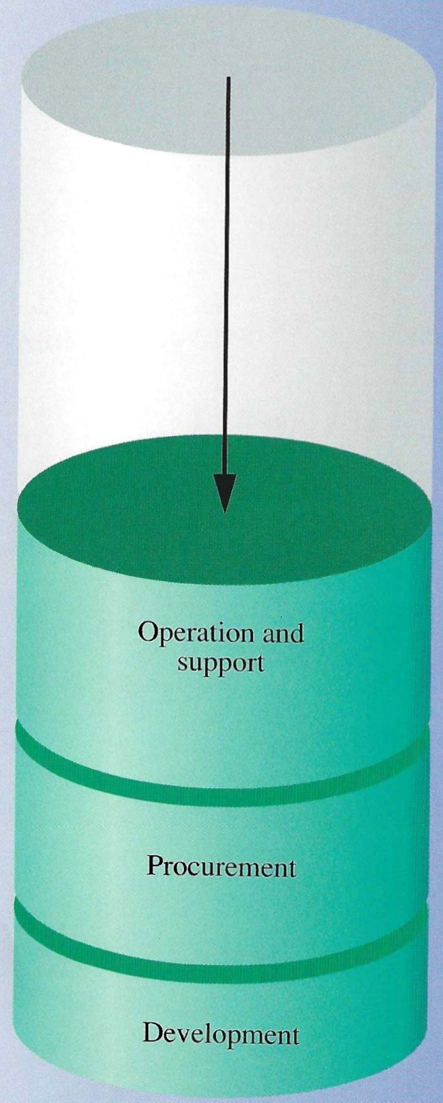
A close monitor of the LCC of the engine and its accessories is maintained and each commercial aspect as well as design feature is subject to a careful investigation.

Amongst these major initiatives a special consideration is given to the Operation and Support costs in which the ILS discipline plays an important role. This is based upon the following basic concepts:

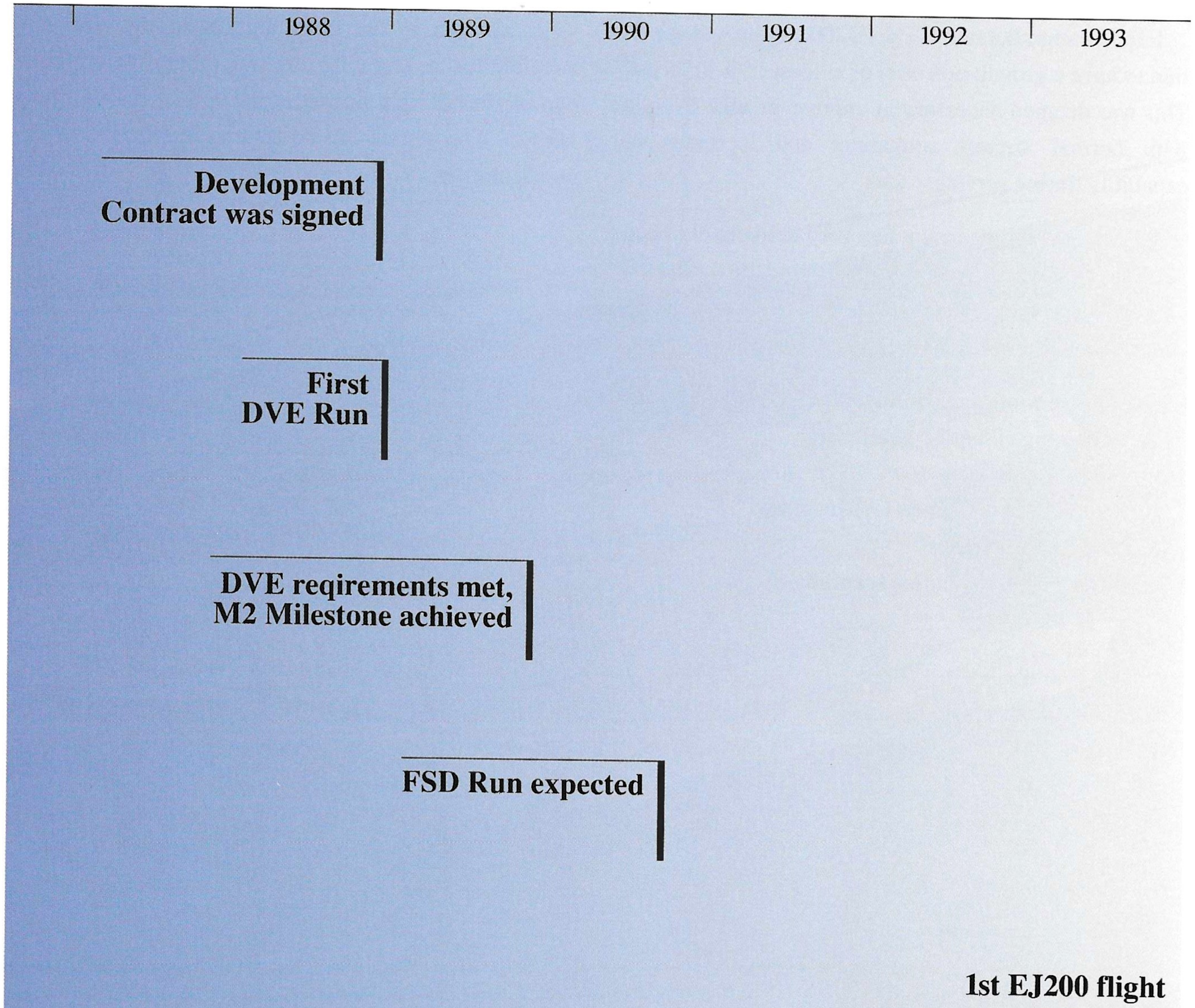
- to ensure support considerations influence engine requirements and design
  - supportability engineers are an integral part of the design team
  - support costs are a fundamental part of the design analysis process
- to define Support requirements through Logistic Support Analysis. Support aspects include
  - reliability, maintainability, testability, repairability
  - spares supply, Aerospace Ground Equipment, Technical publications, facility requirements, training and Industrial Support



EJ200 Programme Outline



EJ200 engine



Other Opportunities

EJ200 Future Potential. The EJ200 engine was specified to have a growth potential of at least 15% in thrust. This was deemed necessary in order to be able to cope with normal aircraft equipment and increases in capability during service.

The actual engine design has very deliberately been aimed at significantly larger growth than 15% so that the engine will remain a front line leader for at least 25 years in service with EFA and other applications.

The engine configuration allows the necessary growth in the following essential parameters:

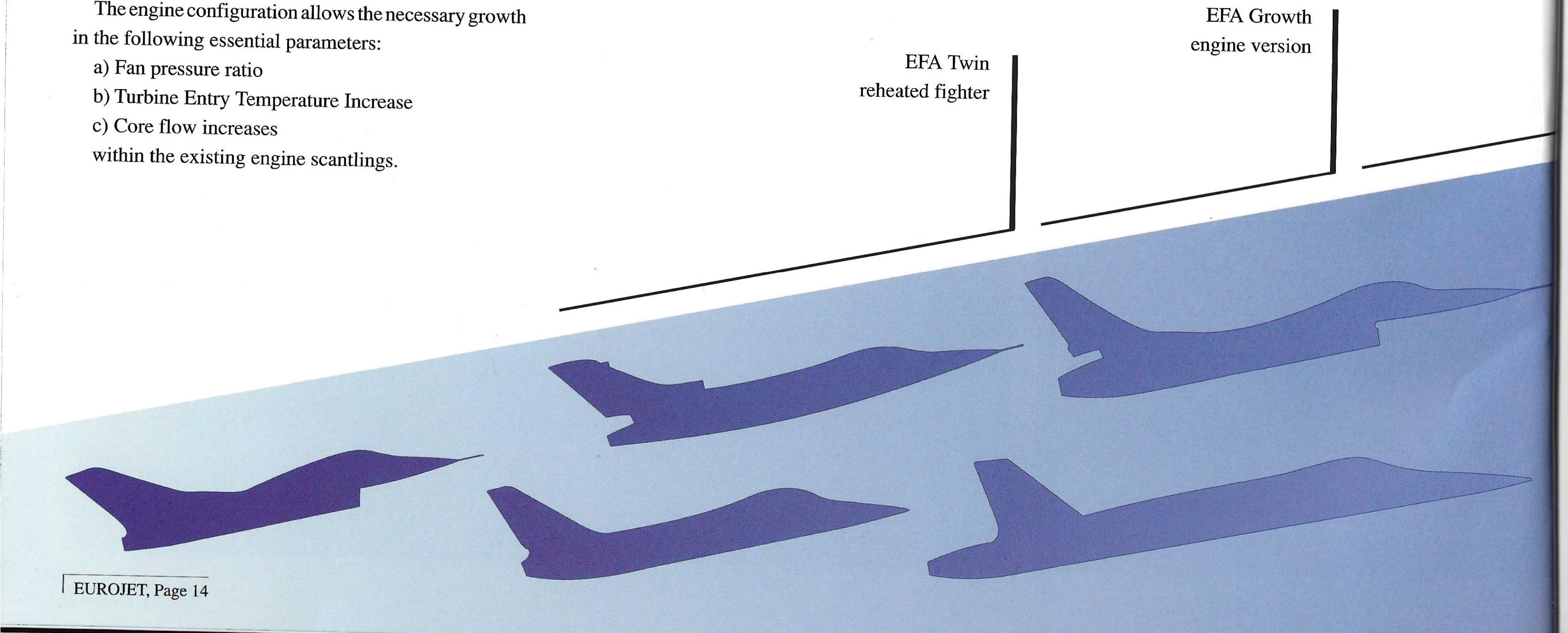
a) Fan pressure ratio

b) Turbine Entry Temperature Increase

c) Core flow increases

within the existing engine scantlings.

In addition to the EFA application the engine is suitable for re-engining existing aircraft and future generations of light fighter, strike and advanced trainer aircraft. The engine can be offered in reheated or dry configuration.

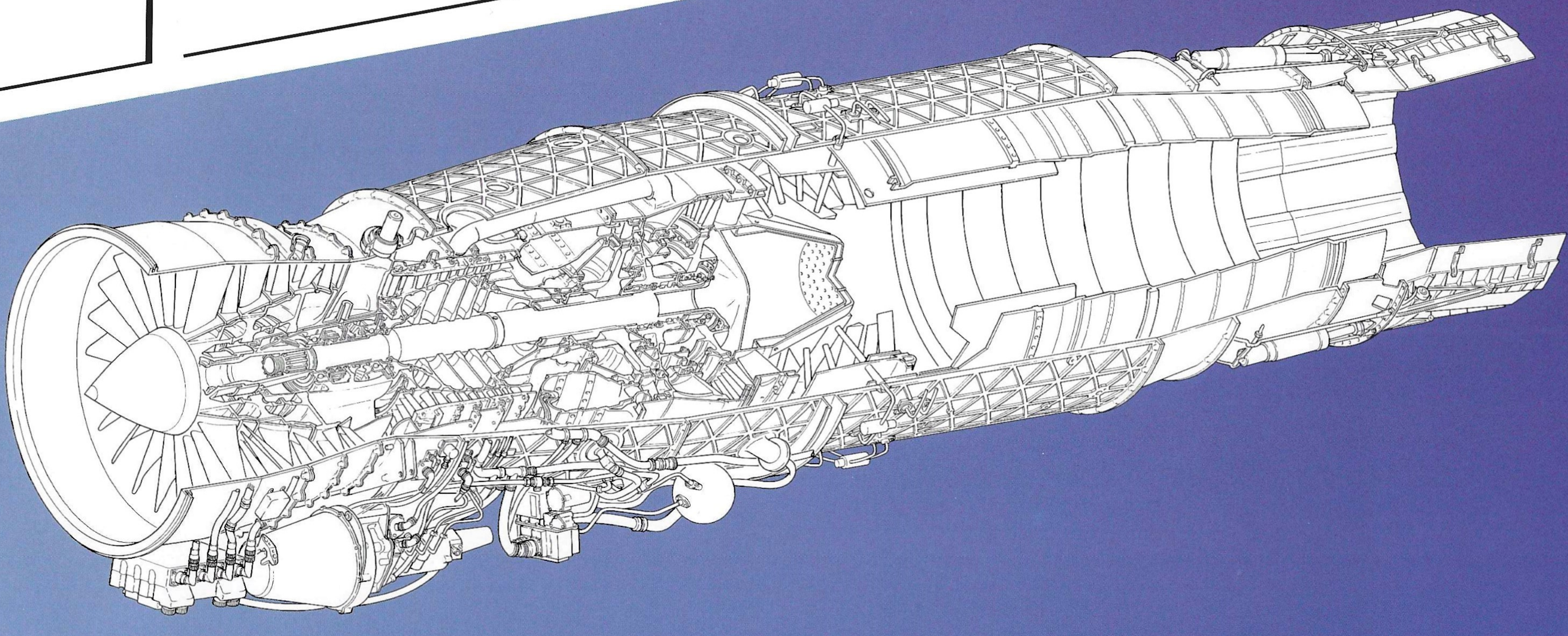


Derivative engines with advanced cores

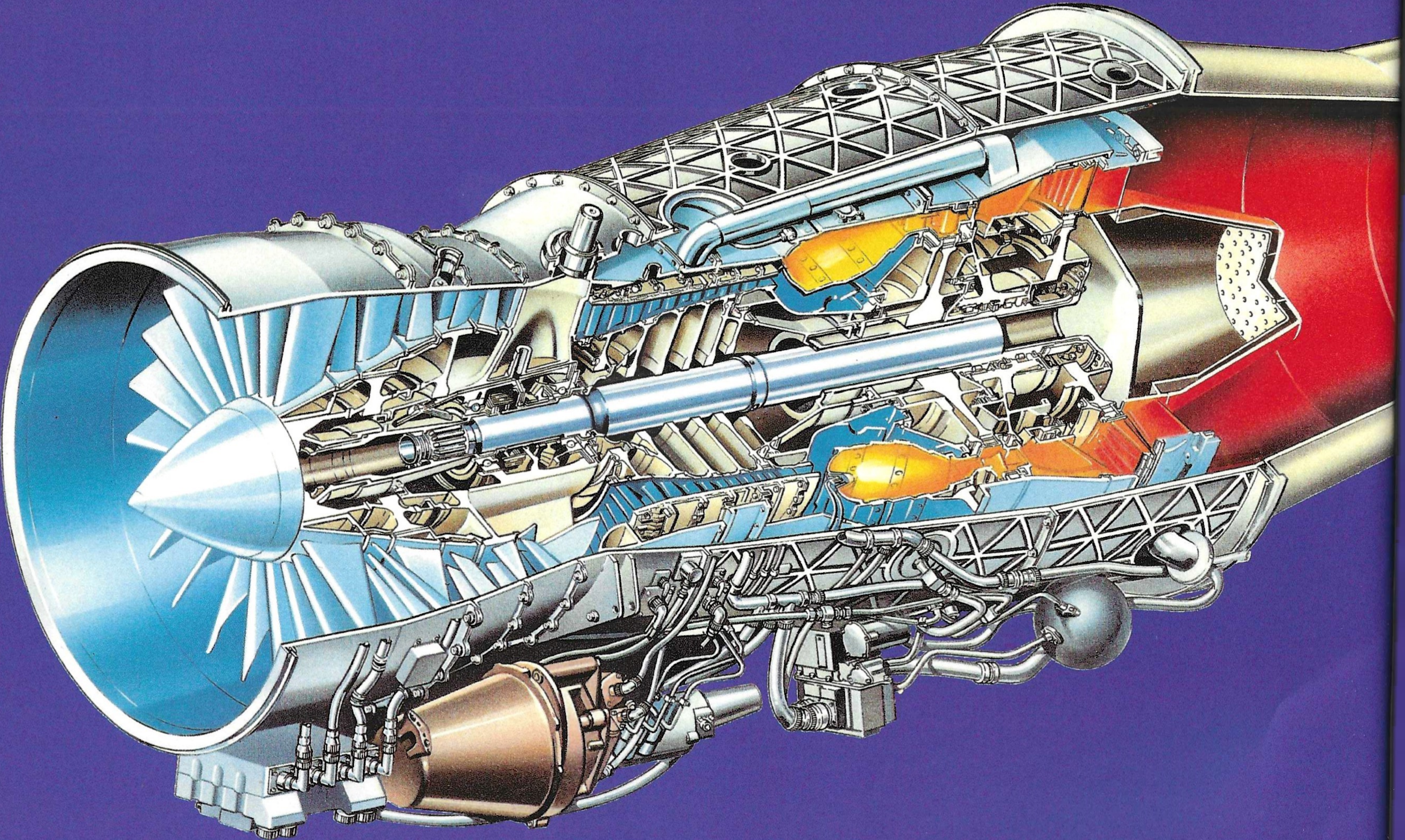
Reheated version for simple single engine fighter

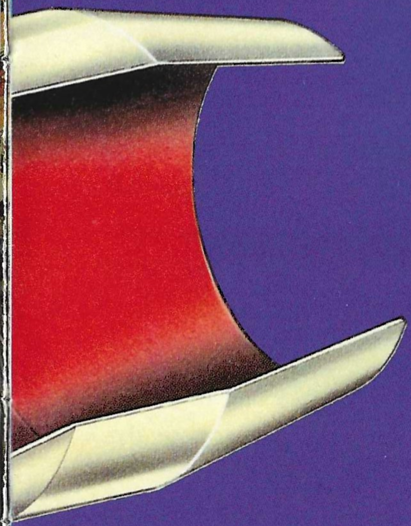
Dry version for strike/trainer

Re-engine existing fighter



EJ200 Dry Version Engine





Leading Particulars

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with reheat (combat)	kN (lbs)	–
Typical air mass flow	kg/s (lb/s)	75-77 (165-170)
Bypass ratio		0.4
Overall pressure ratio		26:1
Average specific fuel consumption		
max dry	g/kNs (lb/lb/hr)	21-23 (0.74-0.81)
with reheat	g/kNs (lb/lb/hr)	

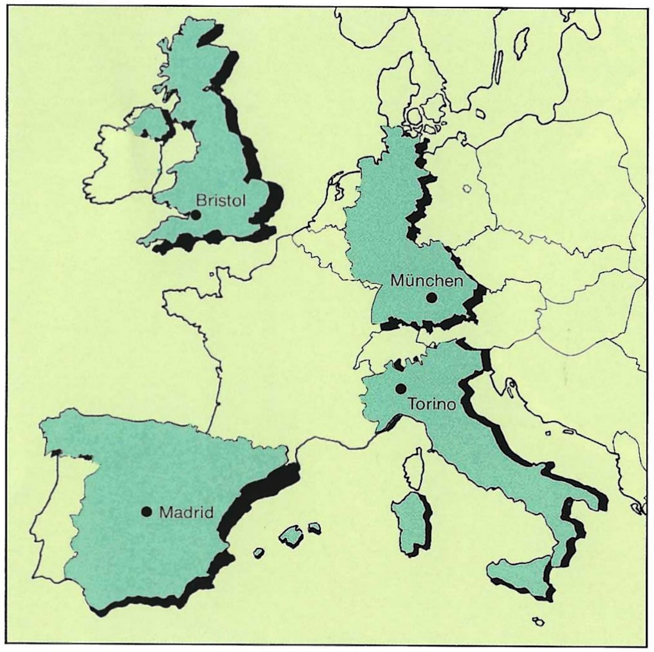
Retaining maximum commonality with the reheated version, the dry EJ200 engine will provide the ideal powerplant for the next generation of light combat and trainer aircraft.

The EJ200 features are

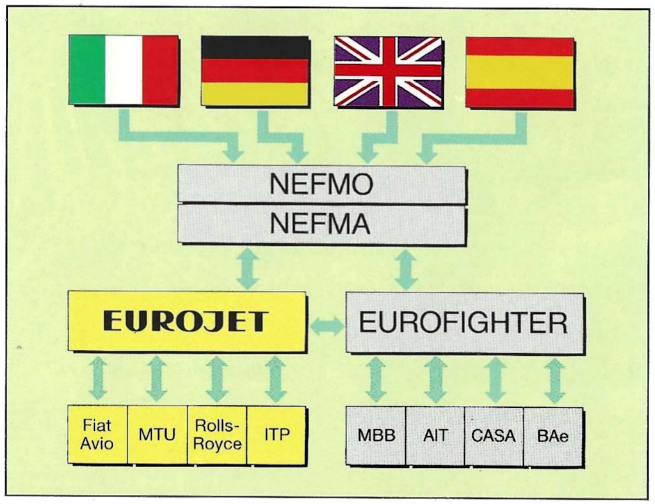
- simple and robust construction benefiting from the latest design and manufacturing technologie
- relatively small size and light weight giving excellent thrust/weight ratio
- very high reliability and maintenablity with low life cycle costs
- carefree engine handling
- minimum change from reheated engine

Collaboration

FiatAvio in Italy, Industria de Turbopropulsores in Spain, MTU Motoren- und Turbinen-Union München in Germany and Rolls-Royce in the United Kingdom have formed EUROJET Turbo GmbH to jointly design, develop, manufacture and support the EJ200. Customer co-ordination and management of the programme is conducted by NEFMA, the international management agency established in Munich by the four participating nations.



The EJ200 represents the next step in maintaining and developing European technology in the aerospace industry.



Within the EUROJET consortium each partner company is fully responsible for its allocated workshare. To make best use of technologies available in each country, the principle of participation with other partners has been introduced on the majority of the modules. This ensures maximum use is made of the techniques available within the partner companies.

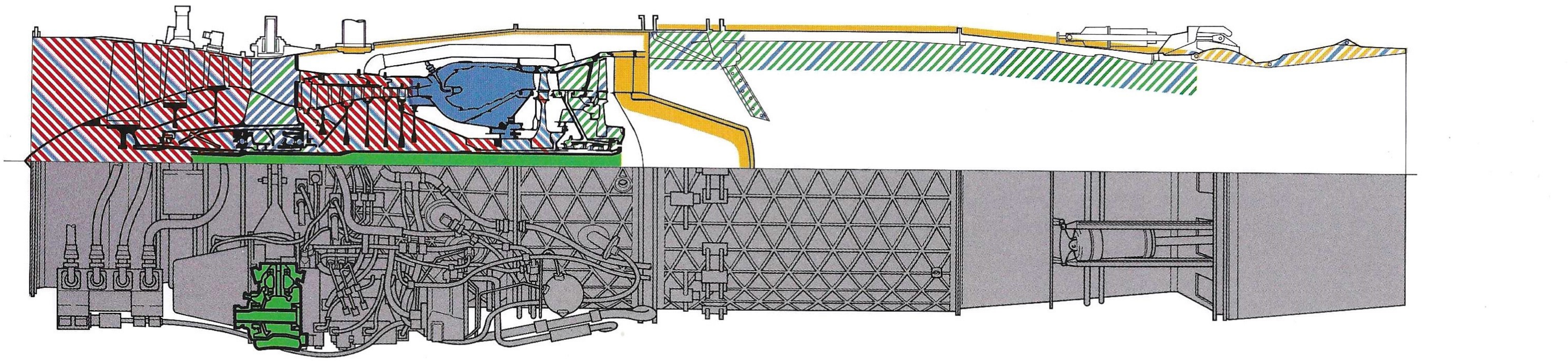
Workshare is proportional to the four Nation's expected aircraft requirements.

FiatAvio has responsability for the LP turbine, LP shaft, the interstage support, the reheat system, the gearbox and oil system, and are participating in the intermediate casing.

Industria de Turbopropulsores (ITP) has responsibility for convergent/divergent nozzle, the jet pipe, the exhaust diffuser and the bypass duct.

MTU has the responsibility for the low and high pressure compressors and is participating in the high pressure turbine. MTU also have overall system design responsibility for the FADEC.

Rolls-Royce has responsibility for the combustion system, the high pressure turbine and the intermediate casing and is paticipating in the low pressure and high pressure compressors, the low pressure turbine and interstage support, the reheat system and the convergent/divergent nozzle.



FiatAvio 21 %

MTU München 33 %

Rolls-Royce 33 %

ITP 13 %

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Subject to modifications in the interest
of technical progress.