

TP400-D6 Turboprop

A European Collaboration Programme

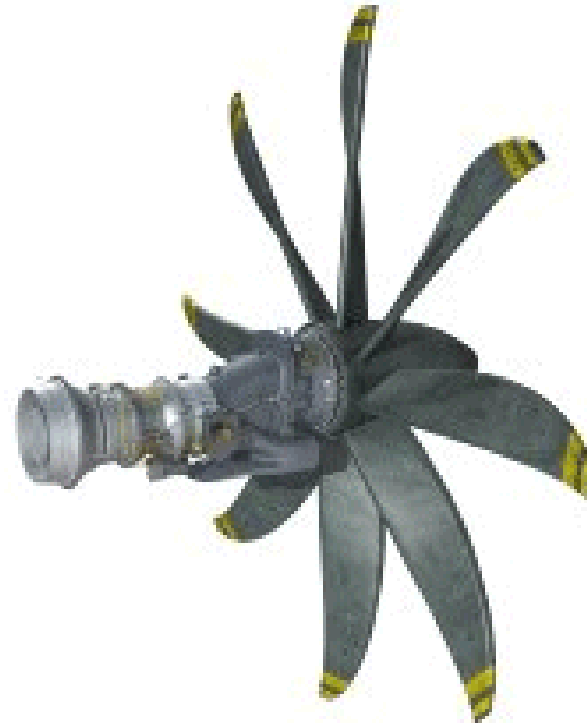


Royal Aeronautical Society Lecture, 19 September 2006
Hamburg



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Why a Turboprop ...?

- 1 Advantage in fuel efficiency for a given payload/range target
- 1 Particular operational capabilities
 - 1 Steep Descent
 - 1 Ground Manoeuvrability
- 1 Thrust responsiveness during low-level flight missions
 - 1 Airdrop missions
 - 1 Field Performance



The Engine Team



Europrop International GmbH

n Project Management Organisation for the TP400-D6 programme

n Registered in Munich, Germany

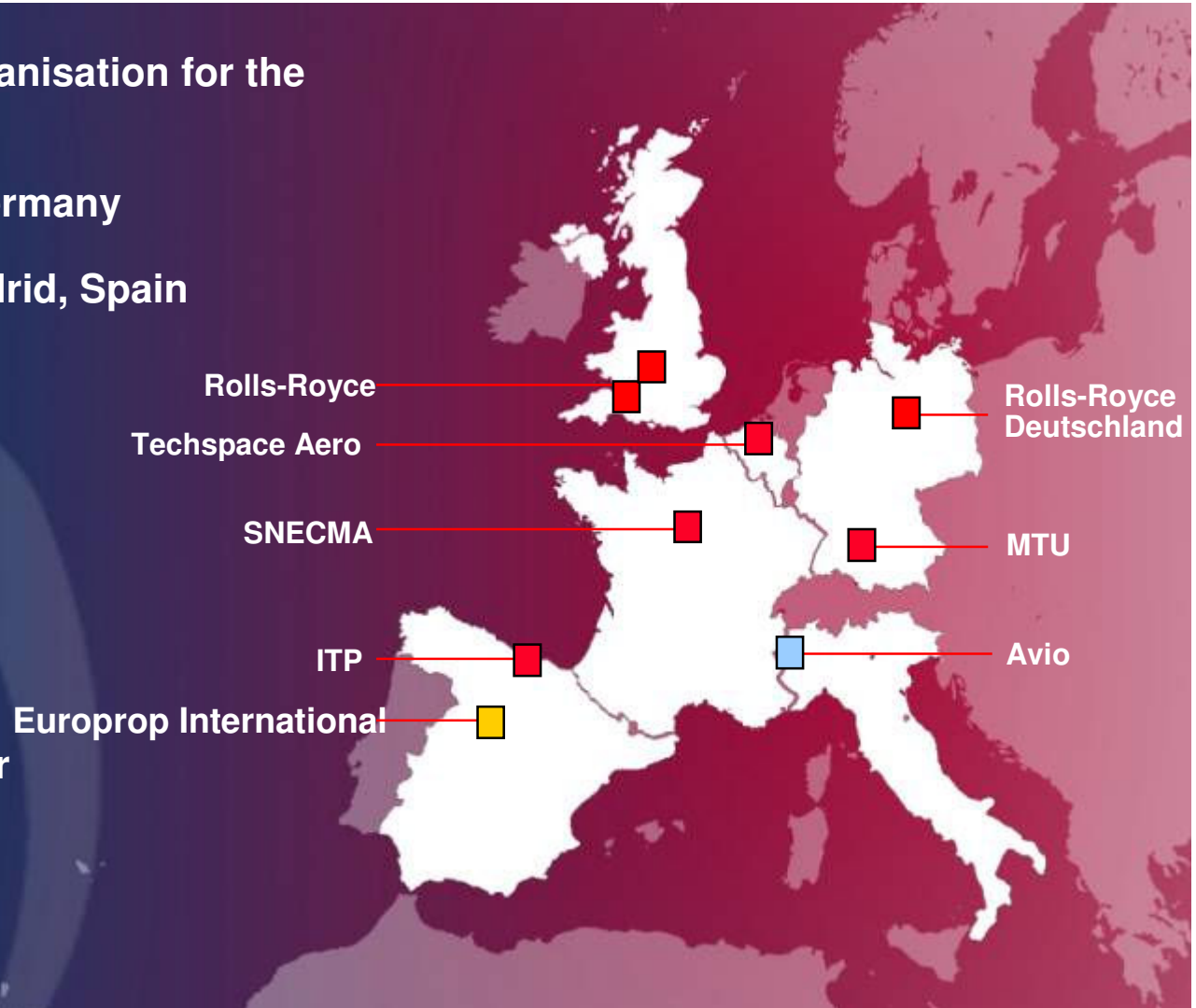
n Operational Office in Madrid, Spain

n Approx. 60 employees

n **Shareholding**

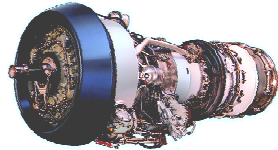
§ Snecma	28 %
§ Rolls-Royce	28 %
§ MTU	28 %
§ ITP	16 %

n 750 engines on firm order



Heritage of European Co-operation

Tyne for C-160 Transall
RR / Snecma / MTU / Techspace Aero



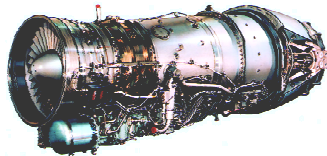
EJ200 for Eurofighter
RR / MTU / ITP / AVIO



Adour for Jaguar
RR / Turbomeca



RB199 for Tornado
RR / MTU / Avio



MTR390 for Tiger
MTU / Turbomeca / RR



Olympus for Concorde
RR / Snecma



Larzac for Alphajet
Snecma / MTU / Turbomeca / KHD



RTM322 for NH90
RR / Turbomeca



We are doing this not for the first time... but still it is “more commercial now”

TP400-D6 Partner Company Workshare



Performance
Whole Engine Model
Air/Oil System

Intermediate Casing
HP Compressor
Internal G/B
LP Shaft
Hot Strut
Sensors & Probes

Flying Test Bed
Vulnerability Assessment



Type Certificate Holder
Validation / Certification
Project Management
Integration Management
Installation Management
Interface Control
Prop G/B Management
Configuration Control



Development Tests
Test Equipment
Front Structure
Exhaust Case
LP Turbine
Dressings



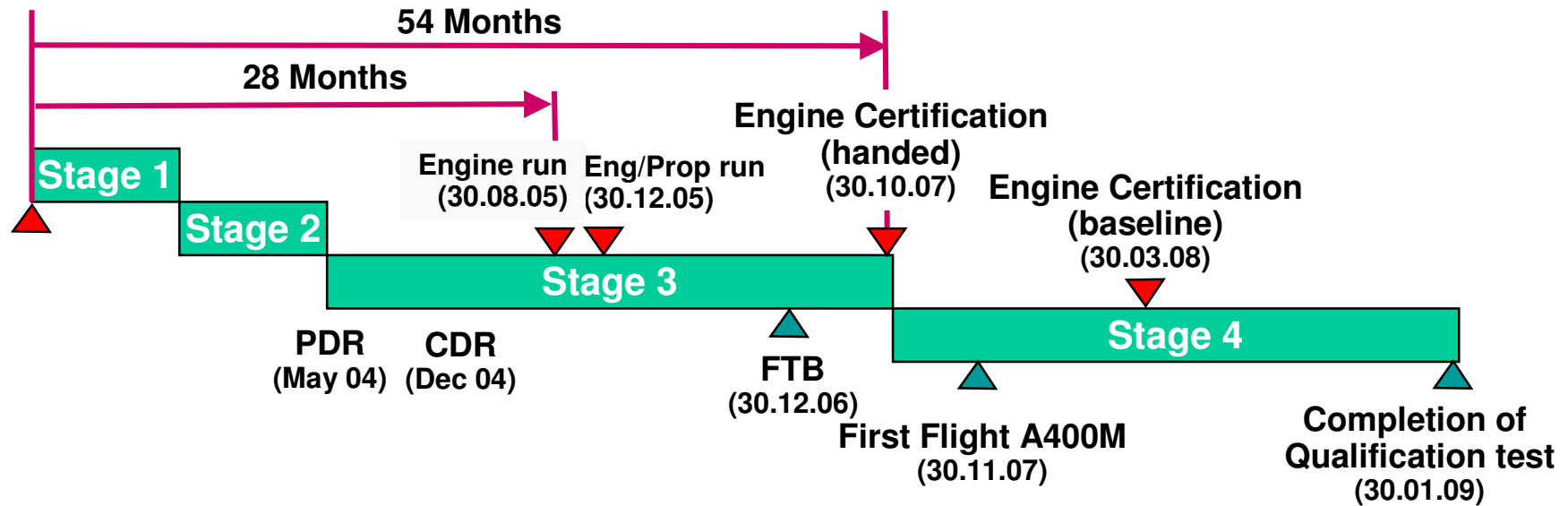
Installation
Control System
Development Tests
HP Turbine
Combustor
Acc G/B



Production Assembly
Control System
Development Tests
IP Compressor
IP Shaft
IP Turbine



TP400-D6 – Engine master programme



- n Fixed Price contract against frozen specification
- n First engine run achieved 28 October 2005
- n First Engine & Propeller run achieved 28 February 2006
- n Flying Test Bed engine scheduled for early 2007
- n First flight of TP400-D6 powered A400M scheduled for end November 2007

A military development programme with civil schedule timescales

TP400-D6 Overview



TP400-D6 – Technical features

- 1 10,500+ shp
- 1 3-shaft engine architecture
- 1 Overall pressure ratio 25:1
- 1 5 Stage IP compressor
- 1 6 Stage HP compressor
- 1 Single stage unshrouded HP turbine
- 1 Single stage shrouded IP turbine
- 1 3 Stage free Power (LP) turbine
- 1 Chin air intake
- 1 Offset power gearbox (9.9 ratio)



The most powerful modern turboprop in the western world!

TP400-D6 knowledge transfer examples

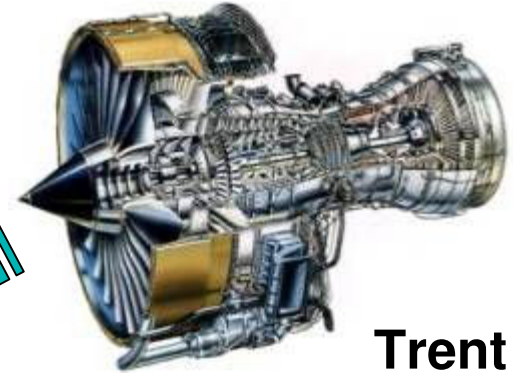


RTM322

- IPS design tools

T56 and AE2100

- In-service experience
- Gearbox experience
- Mount arrangement



Trent

- 3 shaft architecture
- Transmissions work

Civil / Military R&T

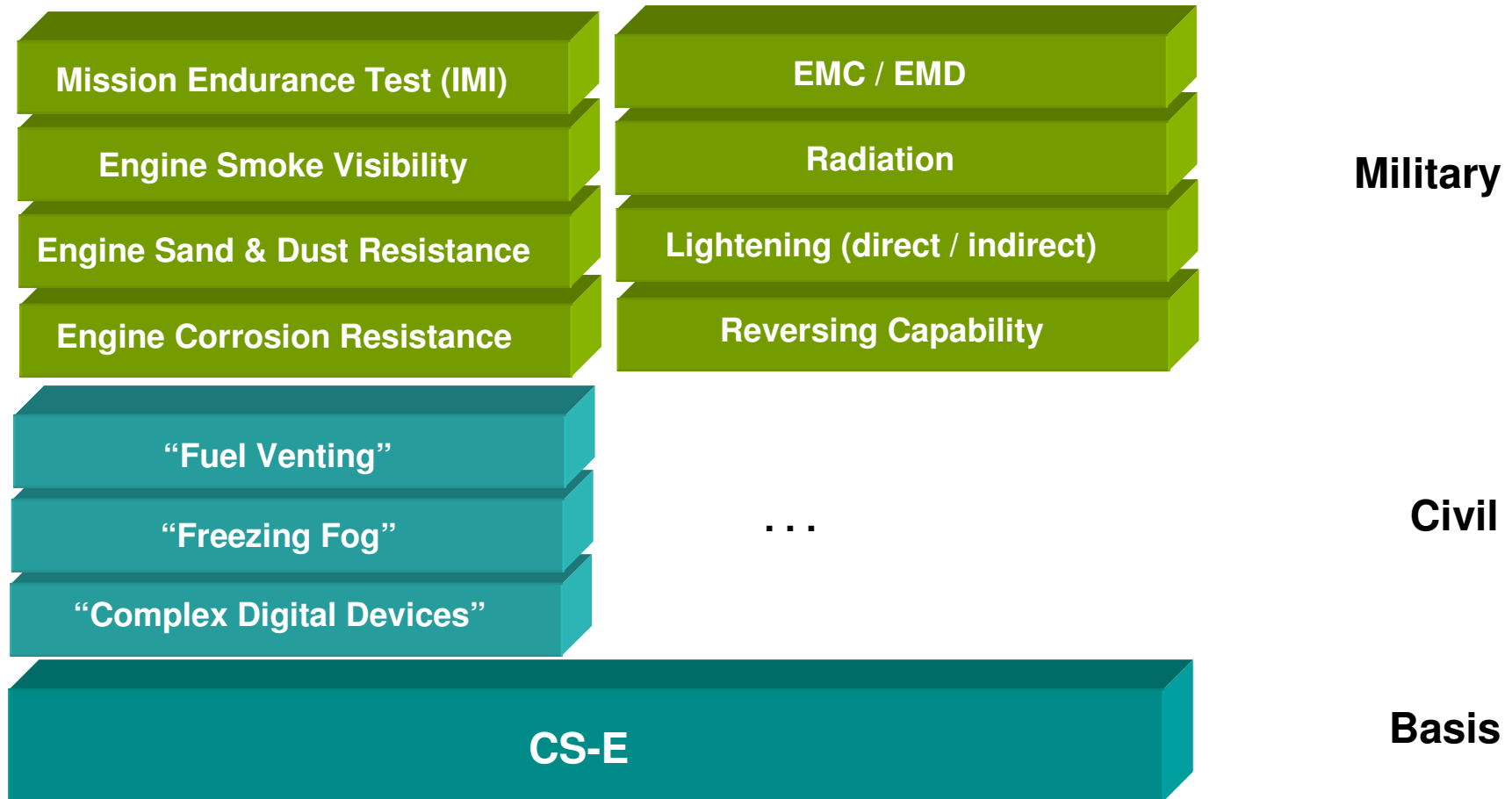
- Aero methods from Civil R&T programmes
- Corporate Compressor Systems

TP400-D6 Validation Programme



TP400-D6 Certification basis

- 1 Certification against Civil Basis amended by Military Requirements
- 1 Qualification against Airbus Military Specifications



TP400-D6 Validation programme

1 3 Sea Level Test Beds

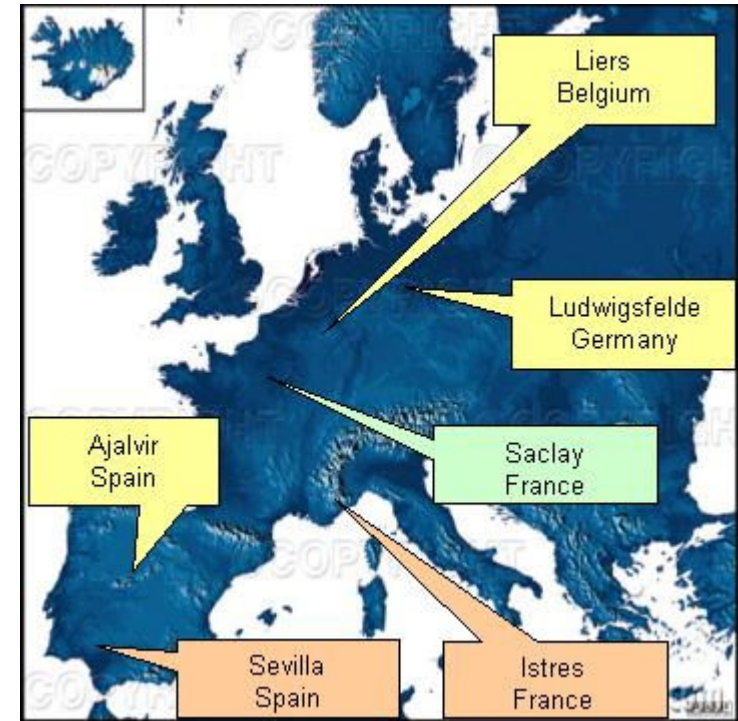
- 1 Rain/Hail and Sand/Dust ingestion
- 1 LP telemetry
- 1 150hr type and cyclic endurance test
- 1 Thermal paint
- 1 Overspeed, Overtemperature, etc...

1 1 Altitude Test Bed

- 1 Performance and handling
- 1 Windmill / relight
- 1 Air/Oil/Fuel System verification
- 1 HP / IP telemetry

1 2 Outdoor Test Beds

- 1 150hr type tests and cyclic endurance
- 1 Bird ingestion
- 1 Dyno-prop control and propeller integration
- 1 Crosswind and noise



TP400-D6 First engine run – 28th October 2005



First Engine & Propeller Test – 28th February 2005



Snecma Outdoor Testbed (Istres, near Marseille)

Engine tested with propeller unfeathered & feathered (up to 15 degrees)

Achieved full power

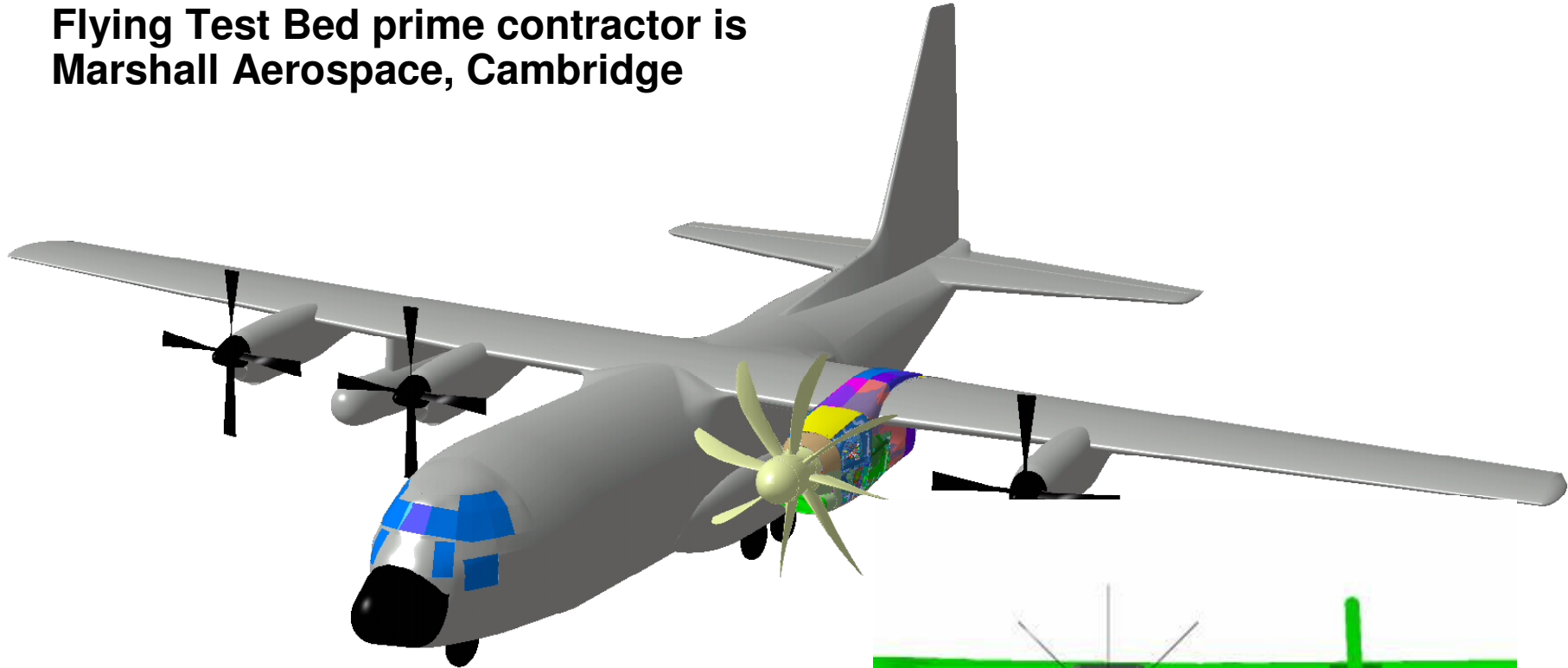
TP400-D6 Flying Test Bed

- ┆ The FTB is a C-130 Hercules
 - ┆ Owned and operated by Marshall Aerospace of Cambridge.
 - ┆ The aircraft is XV108 “Snoopy”, the former meteorological research flight aircraft.
- ┆ The programme is being led by AMSL
- ┆ EPI have to provide an instrumented engine, technical support and a financial contribution.

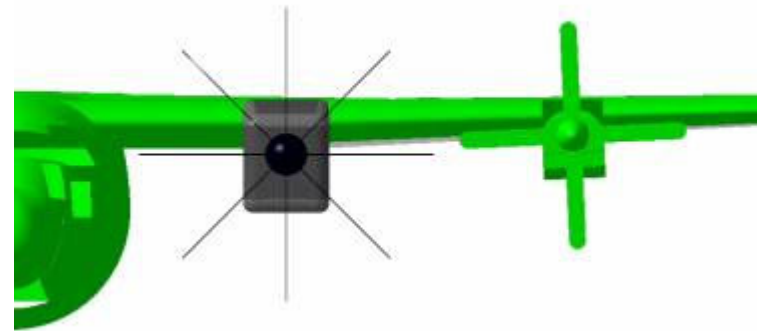


A400M Flying Test Bed – Technical Concept

Flying Test Bed prime contractor is
Marshall Aerospace, Cambridge



- 1 C130 Hercules Airframe
- 1 TP400-D6 installed at no.1 inboard
- 1 100 Flight Test hours over 15 months
- 1 700 Parameters to be recorded



Summary



TP400-D6 – Summary

- 1 **TP400 is a major step forward for European Defence collaborations**
 - 1 **Partnership builds on long experience**
 - 1 **Commercial practices applied to a military programme**

- 1 **The TP400 design is a low-risk technical solution tailored to the A400M**
 - 1 **Optimised 'Rolls-Royce' three-shaft architecture**
 - 1 **Designed for 11,000shp and capable of driving 8 bladed 17ft propeller**
 - 1 **Component design based on demonstrated technology**
 - 1 **Robust core with low cycle temperatures**
 - 1 **Sufficient growth potential**

Europrop International combines the best of Europe's engine manufacturers' resources and expertise

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For more news & information
<http://www.europrop.aero>