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The EC 120 Program : Choices, Realization, Results

by

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The study initiated in 1993 was intended to produce a lightweight, single-engine, 5-seat helicopter in the 1500 kg series which was missing from the EUROCOPTER production range.

Though it was developed with two major partners as CATIC HAMC and SINGAPORE AEROSPACE, the program has rapidly been completed and the JAA 27 certification is expected by the end of 1996.

The studies have initially been conducted by a joint engineering team in Marignane enabling to meet the deadline for the production of the first prototype aircraft and test rig sub-assemblies.

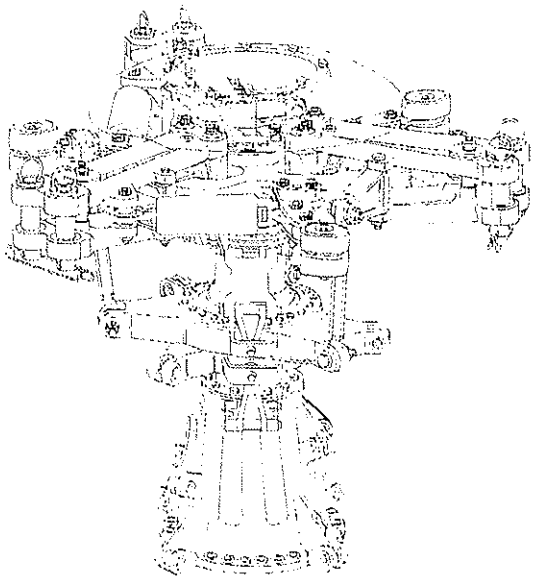
The body structure and tail boom/Fenestron fantail assembly respectively from Harbin in CHINA and SINGAPORE were received in France in March 1995.
The first flight took place, as planned, on 9 June 1995.

Though conventional, the EC 120 design features interesting innovations such as a very large cargo compartment, simplified mechanical systems thanks to the leftward-offset engine, a single-bearing supercritical tail rotor drive shaft, a quiet Fenestron, an under-cowling air intake, a roomy cabin with great visibility, and lastly, crashworthy forward and rear seats and fuel system.

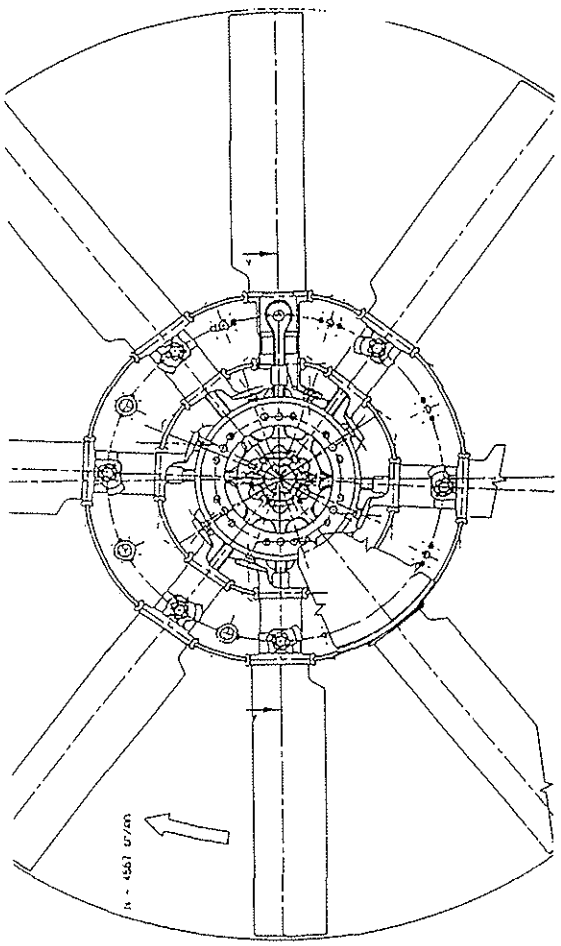
TECHNOLOGICAL CHOICES

Light alloy central fuselage made up of large panels machined from solid thus reducing the number of parts.

Original design, light alloy, skid landing gear offering an excellent weight/flexibility/crash-worthiness compromise.
Canopy posts and doors made from carbon providing sufficient stiffness without weight penalties.



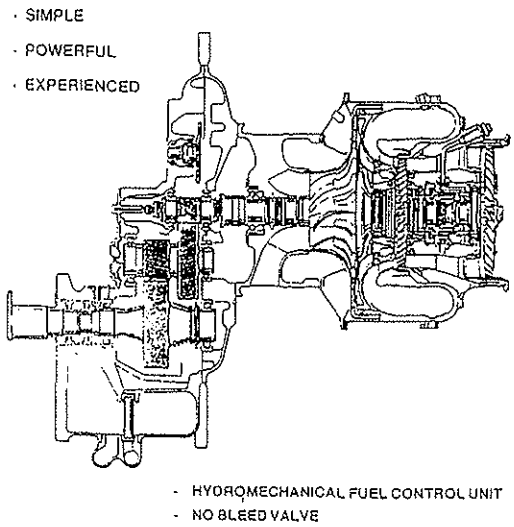
Dauphin type tail boom made of light alloy skin and Nomex honeycomb core providing a better weight/stiffness/damping compromise.
Fenestron shroud and fin made from carbon, a solution that was proven on Dauphin and EC 135.
Carbon horizontal stabilizer, lighter and better frequency-located than the metal stabilizer.



The mechanical systems feature the minimum number of parts and high-performance, well-ageing materials : dural casings ; latest-design, surface-hardened teeth, stainless steel rotor mast, new grade, little notch-effect sensitive titanium rotor hub, MMC (dural with silica inclusions).

Evolutive ONERA airfoil, rounded tip cap, carbon fiber main rotor blades (better performance, less noise, ...).
Metal, non-evenly distributed fantail rotor blades (less erosion and noise).

Main rotor flight controls using rods routed outside the cabin and cargo compartment, not-roominess hampering. Single hydraulic circuit. Ball-type, unassisted yaw control. TURBOMECA Arrius 1F engine issued from the experience gained on Arrius 1 (355 N) and Arrius 2 (EC 135) and using their mechanical items but with a specific fuel consumption-optimized gas generator for the EC 120. The hydromechanical fuel control (gained from the experience on Arriel) is lightweight, simple and low-cost.

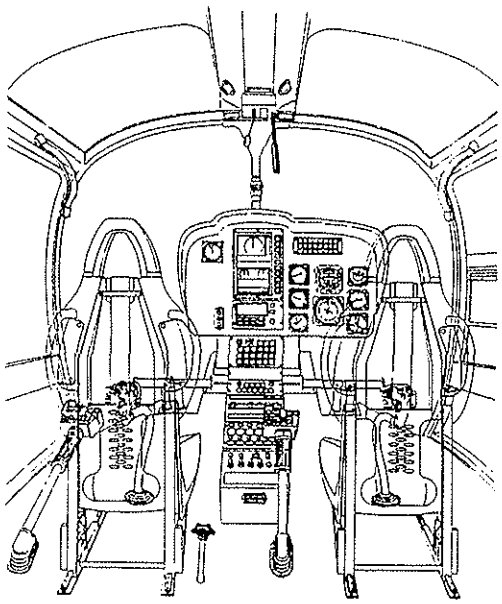


AVIONICS

The new concept is the display system for engine control parameters, generator speed, torque, engine temperature, as well as engine oil pressure and temperature, and voltage monitoring.

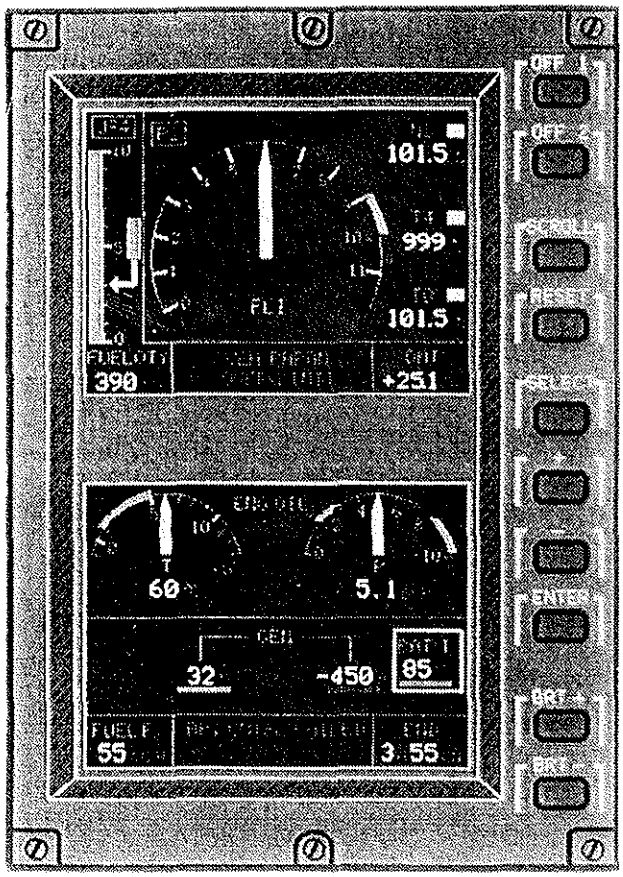
The display system is comprised of two LCD screens controlled by two separate processors. Should one lane fail, all data are available on the other screen.

Outside the starting phases, all NG, torque, and T4 temperature limitations are combined into a single FLI (First Limit Indicator) data which makes piloting simpler.



This VEMD system uses its computation power to supply other functions such as :

performance calculation,
health and usage monitoring,
engine cycle counting,
limitation exceeding memorization,
fuel quantity display,
outside air temperature display,
optional equipment data, ...



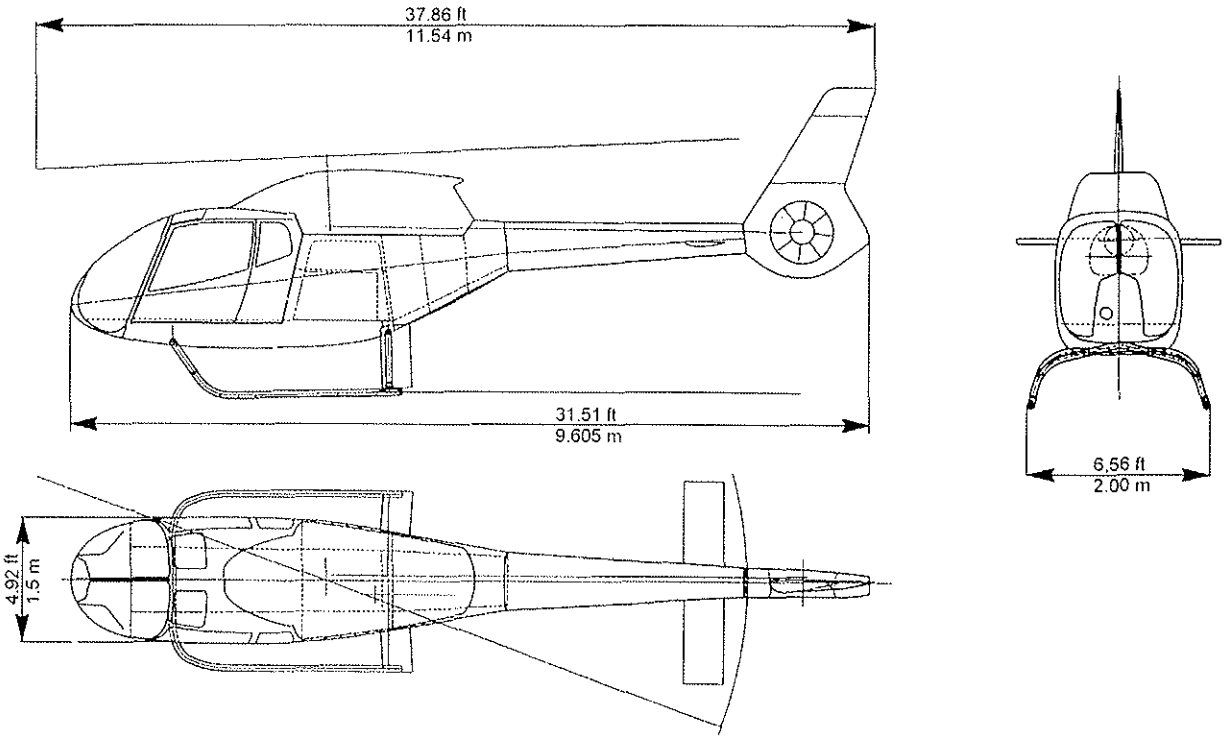
The EC 120 will be able to integrate the conventional VHF, VOR, ADF, GPS systems thanks to its large size instrument panel and console. The installation of a two-axis stability augmentation system is planned and the use of NVG's as well.

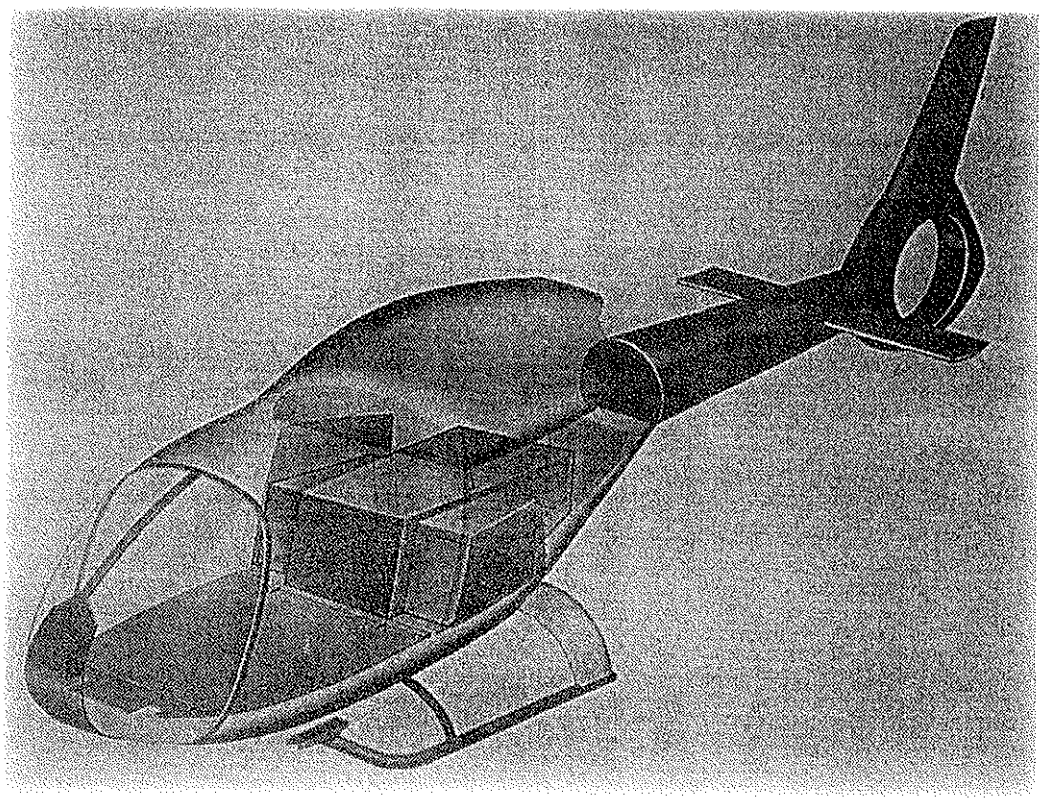
CHARACTERISTICS

With an empty weight of 850 kg, the EC 120 offers a cabin space of 4 m3 and a cargo compartment of 1 m3. Since both areas are communicating, the carrying capacity is significant for such a lightweight aircraft.

Taking off can be achieved with a 50 kg equipment, five people (400 kg) aboard, full fuel 300 kg (without auxiliary tank) at the 1600 kg all-up weight. In these conditions, the range is in excess of 700 km. The maximum level speed is 130 kt.

For a single-engine aircraft, the ability to autorotation is fundamental. The rotor characteristics such as the diameter, solidity, inertia have been determined accordingly and yielded an interesting result : 65 kt-stabilized rate-of-descent below 1400 ft/mn and H/V diagram low point obtained at 10 ft for a weight of 1600 kg.





The flyover noise measurements as per ICAO standard, Chapter 11 show a 5 dB margin which makes the EC 120 stand as one of the best aircraft ever produced or under development.

The SPHERIFLEX hub (Super Puma concept) provides an excellent stability/controllability compromise, and the aircraft can be flown for several minutes with the cyclic stick secured without noting any pitch oscillations or dutch roll while keeping a high controllability allowing load factors below 0.5 g's, roll rates over 50°/s, pull-outs in excess of 2 g's without pitch-up.

A meticulous design of the tail section further improves these characteristics (yaw damping) to a still-never-reached level on already produced aircraft.

By integrating, from the very design stage, the various constraints such as the production cost, the maintenance cost and readiness, the criticisms by future professional operators, the EC 120 development group has made its task complicated and the necessary compromises more difficult. In the current state of the program, that is with the development phase completed, and mid-way of the certification process, we can say that the bet is won. Owing to its simplicity, efficiency, maintainability and the pleasure it will give the pilots, the EC 120 will mark a new date in the development of these wonderful machines we call helicopters.