eurocopter
an EADS Company

Service à la Clientèle
Direction Technique Support

13725 Marignane Cedex - France
Tél .+ 33 (0) 4 .42.85.85.85 - Fax. + 33 (0) 4.42.85.99.66
Télex HELIC 420506
Télégramme : EUROCOPTER Marignane

DIFFUSION/ISSUE
AUSGABE/PUBLICATION

B	R

Lettre-Service
No. 1649-29-03

Marignane 04.12.2003

SUBJECT:

EC 120	B

HYDRAULIC POWER SYSTEM: Servo Transparency

Dear Customer,

This message is being issued as a reminder about the Servo Transparency phenomenon that can be encountered during excessive maneuvering of any single hydraulic system equipped helicopter, if operated beyond its approved flight envelope. This phenomenon is known variously as Servo Transparency or Servo Reversibility, but is referred to here as Servo Transparency. This aircraft phenomenon occurs smoothly and is not dangerous, if properly anticipated by a pilot during an abrupt or excessive high load maneuver such as a high positive g-turn or pull-up. The factors that affect Servo Transparency are airspeed, collective pitch input, gross weight, "G"-loads and density altitude.

What Happens ?

Hydraulic control boost is accomplished by irreversible hydraulic systems, which isolate the pilot from the aerodynamic forces of the main rotor by the use of servos. The loads are transmitted from the blades through the pitch rods to the swash plate assembly. The hydraulic power system counter-acts these forces through the servos. Since this results in zero control forces, artificial pilot control forces are then created by frictions, springs or force-trims. The maximum force the servo actuators can produce is constant and is a function of hydraulic pressure and of the servo characteristics. The system is designed to exceed the requirements of the approved helicopter flight envelope. However, the maximum available hydraulic power must be limited by design to protect the airframe against overstress, if the approved flight envelope is exceeded. With excessive maneuvering and under a combination of the above listed factors, the aerodynamic forces can increase beyond the opposing servos forces and Servo Transparency occurs. The aerodynamic forces in excess of the hydraulic forces are then transmitted back through the control links to the pilot's cyclic and collective controls.

On clockwise turning rotors as on the AS-350 and EC 120, the right servo is the highest loaded when maneuvering (retreating blade), so servo-transparency results in gradually increasing left cyclic control loads required to avoid uncommanded right cyclic motion accompanied by down collective movement due to the general overload on the swash plate assembly. The cyclic and collective control inputs required to counter these control motions may give a pilot who is not aware of this phenomenon an impression that the controls are jammed. If the severity of the maneuver is not reduced, the aircraft will roll right and may pitch-up. The amplitude of the induced control feedback loads is proportional to the severity of the maneuver, but the phenomenon normally lasts less than 2 seconds since the resultant aircraft reaction helps to reduce the factors that contribute to the severity of the maneuver and of the Servo Transparency.

The Pilot's Reaction.

The pilot's reaction to the first indication of control forces feedback should be to IMMEDIATELY reduce the severity of the maneuver. Once developed, Servo Transparency will reduce the helicopter' speed due to some pitch-up, and reduce control loads by induced down collective movement, so the servo transparency phenomenon is self-correcting. The pilot reaction is to follow the control movement and allow the collective pitch to decrease (of course, monitor main rotor rpm speed at very low pitch) to reduce the overall load on the rotor system, and smoothly counteract the right cyclic tendency to prevent an abrupt left cyclic movement as hydraulic assistance is restored.

Pilots should understand that Servo Transparency is a natural phenomenon for a perfectly flyable helicopter. Basic airmanship should prevent encountering this phenomenon by avoiding combinations of high speed, high gross weight, high density altitude and aggressive maneuvers which exceed the aircraft's approved flight envelope. It is a basic rule tells you that it is particularly inappropriate to perform maneuvers which reach and exceed several aircraft limitations simultaneously.

Yours sincerely,

M. SOULHIARD

Technical Support Operations
Customer Service