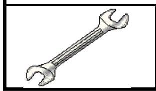
No. 3890-S-00

SAFETY INFORMATION NOTICE

SUBJECT: GENERAL

Oscillations and/or vibrations during Helicopter External Sling Load Operations (HESLO)

For the attention of




AIRCRAFT CONCERNED	Version(s)	
	Civil	Military
EC120	B	
AS350	B, BA, BB, B1, B2, B3, D	L1
AS550		A2, C2, C3, U2
AS355	E, F, F1, F2, N, NP	
AS555		AF, AN, SN, UF, UN, AP
EC130	B4, T2	
SA365 / AS365	C1, C2, C3, N, N1, N2, N3	F, Fs, Fi, K, K2
AS565		MA, MB, SA, SB, UB, MBe
SA366		GA
EC155	B, B1	
SA330	J	Ba, L, Sm
SA341	G	B, C, D, E, F, H
SA342	J	L, L1, M, M1, Ma
ALOUETTE II	313B, 3130, 318B, 318C, 3180	
ALOUETTE III	316B, 316C, 3160, 319B	
LAMA	315B	
EC225	LP	
EC725		AP
AS332	C, C1, L, L1, L2	B, B1, F1, M, M1
AS532		A2, U2, AC, AL, SC, UE, UL
EC175	B	
H160	B	
EC339		KUH/Surion
BO105	C (C23, CB, CB-4, CB-5), D (DB, DBS, DB-4, DBS-4, DBS-5), S (CS, CBS, CBS-4, CBS-5), LS A-3	CBS-5 KLH, E-4
MBB-BK117	A-1, A-3, A-4, B-1, B-2, C-1, C-2, C-2e, D-2, D-2m, D-3, D-3m	D-2m, D-3m
EC135	T1, T2, T2+, T3, P1, P2, P2+, P3, EC635 T1, EC635 T2+, EC635 T3, EC635 P2+, EC635 P3, T3H, P3H, EC635 T3H, EC635 P3H	

INTRODUCTION

Airbus Helicopters has been informed about several incidents during Helicopter External Sling Load Operations (HESLO) where pilots reported significant vertical bouncing, vibrations, and/or oscillations.

The purpose of this Safety Information Notice (SIN) is to share some lessons learned from the analysis of these incidents.

This SIN does not address pendulum oscillations or spinning of the load, which is another phenomenon that commonly occurs during HESLO.

BACKGROUND

A load slung underneath a helicopter behaves somewhat like a mass hanging on a spring - it is known by scientists as a mass-spring system. The sensitivity of the helicopter-load-sling combination to vertical oscillations and the frequency of the oscillation will depend on parameters such as the elasticity of the long line, the damping of the line and connectors, the mass of the load, and the aerodynamic characteristics of the load. Especially when the load is quite heavy compared to the helicopter, a vertical oscillation of the load will also cause the helicopter to oscillate and vice versa.

Any disturbance to the helicopter or load (due to e.g. turbulence, control input, rotor airflow on the load, ground contact) can trigger a vertical oscillation of the helicopter and load. Normally, these motions are well damped. However, some factors may cause these oscillations to become very severe and even divergent.

In most cases, releasing the external load was the only way to get rid of the bouncing. This SIN will provide some insight into possible causes of vertical oscillations and provide some recommendations to avoid and reduce them.

PILOT INDUCED OSCILLATION (PIO) / PILOT ASSISTED OSCILLATION (PAO) PHENOMENON

One possible cause of severe or divergent oscillations are pilot induced or assisted oscillations. They occur when the pilot is tightly grasping the controls (especially the collective lever) when the aircraft is oscillating vertically. In this case, the helicopter's vertical motion can be introduced back into the control system. This control input then creates an even larger disturbance, which further excites the mass-spring system. This kind of excitation can become divergent. It is what is commonly known as a Pilot Induced Oscillation (PIO) or Pilot Assisted Oscillation (PAO).

PIO is a phenomenon in which the pilot has an active participation in the control loop. It occurs at very low frequency (up to 2Hz) corresponding to an adverse control due to lead–time between pilot actions and the helicopter reactions. The pilot tries to control a rapidly oscillating parameter and is unable to keep up with the fast oscillation.

PAO is a phenomenon in which the pilot has a passive involvement in the control loop through involuntary input. It occurs at low frequency (2Hz to 8Hz) corresponding to a pilot shaken by the helicopter oscillations while holding the sticks and thus reinjecting these oscillations on the flight controls. The pilot's muscular system (involuntary) acts like its own spring mass that amplifies the up and down motion of the seat.

The good thing is: The pilot does not need to know whether it is a PIO or PAO that is causing the vertical oscillation. Releasing the collective or loosening the grip on the controls is often enough to stop a PIO or PAO. Of course, this is not always possible due to operational conditions (environment, obstacles…).

One way of preventing PIO/PAO is to make sure that the collective lever has sufficient friction if the helicopter is equipped with an adjusting device. Friction has a dampening effect and may prevent PIO/PAO. On helicopters with a force trim release (FTR), avoid flying with the FTR permanently pressed (especially in the collective axis).

AERODYNAMIC EXCITATION

Load and/or longline can generate significant aerodynamic excitations depending on the aerodynamic shape, size, mass, and mass distribution. External loads may bounce up-and-down, oscillate, rotate, and swing. It is very difficult to predict how a load will react. At low speed, excitations can be caused by the helicopter's downwash. In forward flight, the excitations are usually caused by the airflow and will typically degrade with increasing airspeed.

If excitations occur in forward flight, slowing down the helicopter often reduces or stops aerodynamic excitation.

USE OF THE AUTOPILOT

The autopilot is designed to provide additional stability and damping. However, the autopilot cannot be designed to cope with all possible load and sling combinations. Especially when the external load is quite heavy compared to the helicopter mass, autopilot upper modes may not be able to cope with a load "yanking" the helicopter and may contribute to oscillations. This is particularly critical in forward flight, but may also be an issue in hover and low speed. On some helicopters models, the use of AFCS upper modes may be prohibited (refer to FLM).[LV1]

If oscillations occur, disconnect all upper modes and fly the helicopter using attitude mode. (On some models, disconnecting the A.TRIM may be recommended as a further means to reduce oscillations.)

AIRBUS HELICOPTERS DESIGN

When designing a helicopter for use with external sling loads, it is impossible to consider and test all imaginable combinations of loads and slings.

The most recent certification regulation requires Airbus Helicopters to test with loads up to the maximum load.

Airbus Helicopters is working continuously to improve its products, which includes trying to reduce the sensitivity to PIO/PAO and improving the low frequency damping when slung loads are attached.

AIRBUS HELICOPTERS RECOMMENDATIONS

To minimize the risk of vibrations/oscillations during HESLO:

- Avoid clasping the flight controls tightly (especially the collective lever),
- Adjust the friction of the controls to an appropriate level if equipped.

In case of vibrations/oscillations appearance during HESLO:

- Disconnect any AFCS upper modes if equipped,
- Relax your grip on the controls (especially collective), release the force trim release (FTR) pushbutton if equipped, and avoid jerky control inputs,
- <u>If operationally possible</u>, release the collective lever until the oscillations disappear,
- Reduce airspeed in cruise flight,
- As an ultimate measure release/jettison the external load.