

Hungarian Army
Institute of Aeronautics

ICR KFT
26.ABP Szirtes Street, Budapest
H-1016

Csaba Csiky-Lukács
Managing Director

Re: Report on Using Friction Decreasing Micro-Oil Type ZX-1 on Helicopters

Dear Mr. Director,

Ten to fifteen minutes after an initial warm-up period the operating temperature of a synthetic lubricant used to lubricate and to cool the main reducer of a helicopter (Serial No. K 220575) belonging to and being in service at the Hungarian Army is exceeding 90°C. The Operating Instructions of the main reducer allow for a 90°C maximum operating temperature. During the flights, at the end of landing the oil temperature has reached 97-98°C. These data are logged in the log books of the helicopter and the reducer. Due to the failure the helicopter has been steadily out of order.

We have tried to solve the problem by several means such as:

- Cleaning of the internal lubricating system of the reducer by replacing the oil several times;
- Internal and external cleaning of oil coolers using different cleaning agents (e.g. ESSO Clean, Vertikulin, etc.)
- Checking, replacement, and calibration of instruments and transmitters;
- Checking of the cooling fan.

In spite of the actions taken the oil temperature remained high. Theoretical considerations have led to the following conclusion: although the reducer has a very high transmission efficiency, about 300 kW power still dissipates as heat and a slight increase of internal friction will kick the system out of thermal balance.

In order to solve the problem we recommended to the Institute of Aeronautics of the Hungarian Army to issue a license for experimental use of ZX-1 Micro-Oil in the helicopter. Before filling it into the reducer the additive was mixed to the oil Type B-3V. Incompatibility problems have not been observed during the mixing.

Ground tests were carried out on June 24, 1994 by adding 5 vol. % ZX-1 Micro-Oil to the B-3V oil of the main reducer. The original oil filling was not replaced.

Data of the First Start-Up:

Reducer Serial Number:	L 801058
Reducer Manufacturing Date:	March 31, 1980
General Overhaul of the Reducer:	November 24, 1989
Flight Time since the Start of Operation:	1374 Hours and 41 Minutes
Flight Time since the General Overhaul:	470 Hours and 30 Minutes
Ambient Temperature:	30°C
Wind Speed:	4 - 5 m/sec
Maximum Oil Temperature on the Ground:	70°C
Maximum Oil Temperature on Hovering (Hovering Time 20 Minutes):	87°C

Repeated starts and ground tests have produced similar results (within the specified limits). Based on the opinion of the crew the noise level of the main reducer decreased (the high pitch sounds were less pronounced) and the rotor run-down time slightly increased. These observations are not based on accurate measurements, since the conditions before filling-in the additive have not been recorded.

Data of the First Flight:

Date:	June 30, 1994
Ambient Temperature:	29°C
Wind Speed:	3-5 m/sec
Maximum Base Temperature on the Ground:	70°C
Maximum Base Temperature in Air:	88°C

Test Crew has declared the helicopter fit for service without restrictions.

Test flights have continued with the first filling until July 5, 1994, when the oil was replaced because deposits, scalling, and impurities were dissolved by the ZX-1. The replacement was a previously planned action. Since filling-in the ZX-1 oil the flight time of the helicopter reached 3 hours by July 5, 1994. On September 9, 1994 the amount of ZX-1 was increased to 7 volume % because during a formation flight the temperature raised to 90°C.

By January 25, 1995, in accordance with the plans the helicopter has been flying a total of 48 hours and 54 minutes without any malfunctions or defects.

Results of tribology test of the oil are as follows:

	Fe	Al	Cr	Cu	Ni	Pb	Sn	Ti	Cd	Zn
575	12	0	1	0	1	0	8	1	5	15

The above figures are in Part Per Million (ppm) and have not been changing during the tests (four measurements).

Conclusions:

- The ZX-1 is easily mixed with synthetic oil Type B-3V;
- Has very good cleaning properties;
- Reduced heat development inside of the reducer;
- In case of oil lubricating system failure of the reducer (emergency) the safety is increased because of the dry lubricating effect;
- Friction induced metal content of the lubricating oil is kept steadily low.

Since all tests have been carried out on a single helicopter, in order to confirm and generalise the results it is necessary to carry out further tests. Such tests can be carried out on three helicopters by the end of the first semester of 1995.

Budapest, January 25, 1995

Dániel Kovács, Lt-Col.
Head of Test Flights Department


György Makai, Maj.
Head of SHM Department

Következtetések:

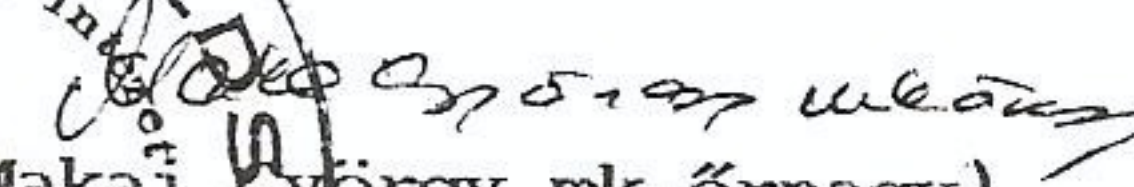
- a ZX-1 jól keverhető a B-3V típusú szintetikus olajjal;
- igen jó tisztító hatással rendelkezik;
- csökkentette a reduktor belsejében felszabaduló hőt;
- szárazkenési tulajdonságai miatt növeli a biztonságot a fő-reduktor olajrendszerének meghibásodása miatti különleges esetben;
- tartósan alacsony szinten tartja a kopásfémek mennyiségét az olajban.

Mivel a kísérletek csak egy helikopteren kerültek végrehajtásra, az eredmények általánosítása érdekében szükség van további kísérletek lebonyolítására. Ezen kísérletek 3 helikopteren történő végrehajtására 1995. 1. félév végén kerülhet sor.

Budapest, 1995. január 25.


(Kovács Dániel alezredes)
berepülő osztályvezető




Székely György mk.őrnagy)
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