EASA
European Union Aviation Safety Agency

CARI 29-01 update

13th Rotorcraft Symposium

Cologne, 10th December 2019

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An Agency of the European Union

Summary

→ Origin and Scope of CARI 29-01

→ Collected data

→ EASA approach on the lesson learnt

Origin and Scope of CARI 29-01

LN-OJF Accident 29th April 2016

Technical evidences on the accident are coming from:

→ AIBN Accident Investigation Report

→ AH activity in frame of Continued Airworthiness with EASA

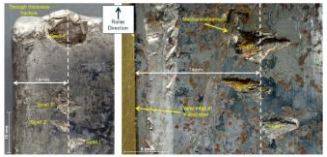
Photo: AIBN Report SL 2018/04, credit CHC Helikopter Service

Origin and Scope of CARI 29-01

Fatigue fracture of 2nd stage planet gear outer race

Existing Chip Detectors performance not enough for the limited spalling of LN-OJF

Maintenance criteria following chip detection Particle criteria (e.g. total area accumulated) not adequate for the limited spalling of LN-OJF



Limited spalling release prior to failure (est. 28 mm^2)


aibn

REPORT SL 2018/04

REPORT ON THE AIR ACCIDENT NEAR TU
ØYGARDEN MUNICIPALITY, HORDALAND
COUNTY, NORWAY 29 APRIL 2016 WITH AI
HELICOPTERS EC 225 LP, LN-OJF, OPERA
CHC HELIKOPTER SERVICE AS

EASA AD No.: 2017-0134

EASA Airworthiness Directive

AD No.: 2017-0134

Issued: 27 July 2017

Design Approval Holder's Name: AIRBUS HELICOPTERS

Type/Model designation(s): AS 332 L2 and EC 225 LP helicopters

Effective Date: 01 August 2017

TCDS Number(s): EASA.R.002

Foreign AD: Not applicable

Supersedure: This AD supersedes EASA AD 2017-0111 dated 23 June 2017.

ATA 05 – Time Limits / Maintenance Checks – Main Gearbox Particle Detector / Oil Filter / Oil Cooler – Inspection

ATA 63 – Main Rotor Drive – Epicyclic Module – Replacement / Modification / Reduced Service Life Limit

Manufacturer(s): Airbus Helicopters (formerly Eurocopter, Eurocopter France, Aerospatiale)

Applicability: AS 332 L2 and EC 225 LP helicopters, all manufacturer serial numbers.

Reason: Following a fatal accident that occurred in Norway to an EC 225 LP helicopter, involving in-flight detachment of the main rotor hub from the Main Gearbox (MGB), EASA issued Emergency AD 2016-0089-E and Emergency AD 2016-0103-E to require some immediate inspections as an initial precautionary measure.

After EASA AD 2016-0103-E was issued, a second preliminary report from the investigation board indicated metallurgical findings of fatigue and surface degradation in the outer race of a second stage planet gear of the MGB epicyclic module. At that time, it could not be determined whether that was a contributing factor to the accident, or a subsequent failure of another origin.

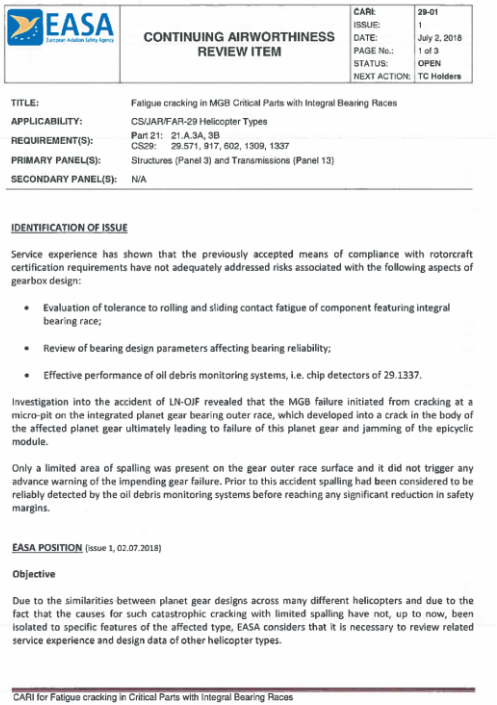
Development of micro pitting on the max stress contact line with the roller

Contact pressure, surface hardening, inadequate inner vs. outer race contact pressure ratio and level of stress through the rim may increase the likelihood of subsurface cracking

Scrapping gears due to wear, corrosion, pits and spalling without in-depth analysis may prevent the identification of a significant subsurface damage

Photo: AIBN Report SL 2018/04, credit AIBN/QinetiQ

Origin and Scope of CARI 29-01



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CONTINUING AIRWORTHINESS REVIEW ITEM

CARI:	29-01
ISSUE:	1
DATE:	July 2, 2018
PAGE No.:	1 of 3
STATUS:	OPEN
NEXT ACTION:	TC Holders

TITLE:	Fatigue cracking in MGB Critical Parts with Integral Bearing Races
APPLICABILITY:	CS/JAR/FAR-29 Helicopter Types
REQUIREMENT(S):	Part 21: 21.A.3A, 3B CS29: 29.571, 917, 602, 1309, 1337
PRIMARY PANEL(S):	Structures (Panel 3) and Transmissions (Panel 13)
SECONDARY PANEL(S):	N/A

IDENTIFICATION OF ISSUE

Service experience has shown that the previously accepted means of compliance with rotorcraft certification requirements have not adequately addressed risks associated with the following aspects of gearbox design:

- Evaluation of tolerance to rolling and sliding contact fatigue of component featuring integral bearing race;
- Review of bearing design parameters affecting bearing reliability;
- Effective performance of oil debris monitoring systems, i.e. chip detectors of 29.1337.

Investigation into the accident of LN-OIF revealed that the MGB failure initiated from cracking at a micro-pit on the integrated planet gear bearing outer race, which developed into a crack in the body of the affected planet gear ultimately leading to failure of this planet gear and jamming of the epicyclic module.

Only a limited area of spalling was present on the gear outer race surface and it did not trigger any advance warning of the impending gear failure. Prior to this accident spalling had been considered to be reliably detected by the oil debris monitoring systems before reaching any significant reduction in safety margins.

EASA POSITION (Issue 1, 02.07.2018)

Objective

Due to the similarities between planet gear designs across many different helicopters and due to the fact that the causes for such catastrophic cracking with limited spalling have not, up to now, been isolated to specific features of the affected type, EASA considers that it is necessary to review related service experience and design data of other helicopter types.

CARI for Fatigue cracking in Critical Parts with Integral Bearing Races

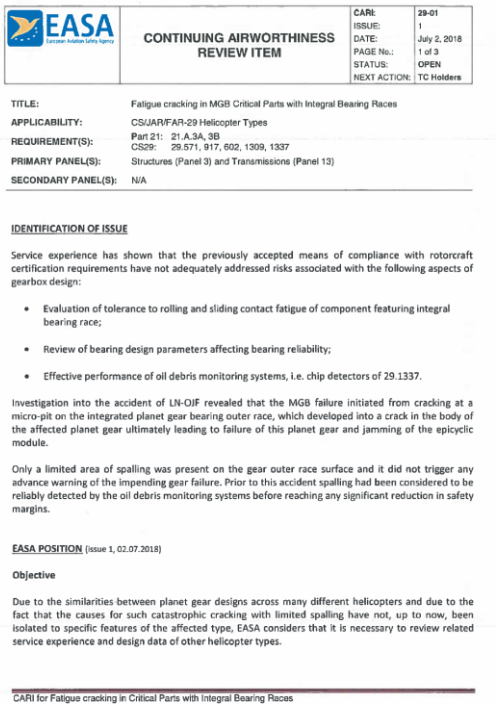
→ Fatigue cracking in MGB Critical Parts with Integral Bearing Races

→ CS/JAR/FAR 29 helicopters

→ Accepted MoC have not adequately addressed risks associated to:

- Rolling/sliding fatigue on bearing races
- Bearing design parameters affecting reliability
- Performance of debris monitoring systems
- Continuous integrity verification of critical components

Origin and Scope of CARI 29-01



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CARI for Fatigue cracking in Critical Parts with Integral Bearing Races

Requested reporting:

→ Bearings

- Cases of through cracks
- Details on discards due to outer ring damages
- Design parameters of critical integral race bearings

→ Oil debris monitoring

- Failures detected by chip (performance index)
- Spalled area
- Methods for establishing the detection performance at design and any re-assessment due to in-service events
- ICA criteria for particles evaluation
- Overhaul criteria for rejection of integral race bearings (dents, pits, markings, …)

Collected Data

- → EASA has collected data from all the involved European Manufacturers
- → Following the Bilateral agreement provisions with TCCA and FAA, data have been collected from almost all the applicable Canadian and US Manufacturers
- → Provided data are under analysis. No specific risk is emerging from the reported in-service experience

EASA approach on the lesson learnt

- → Design assessment of gearbox components should consider the effects of cracking of bearing integrated races
- → Review of design parameters and analyses to evaluate the likelihood of spalling and cracking on bearing races
- → Characterization of the bearing spalling and spalling detection, supported by the demonstration of an adequate chip detection effectivness
- → Justification of the ICA and O/H criteria for particle identification and inspection/removal criteria

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