



Havarikommisjonen
Accident Investigation Board Denmark

Bulletin 2023-364



Serious incident to LN-TEP (Cessna U206G) near the city of Helsingør on 4-7-2023

ISSUED MAY 2024

INTRODUCTION

This bulletin reflects the opinion of the Danish Accident Investigation Board regarding the circumstances of the occurrence and its causes and consequences.

In accordance with the provisions of EU Regulation 996/2010, the Danish Air Navigation Act and pursuant to Annex 13 of the International Civil Aviation Convention, the safety investigation is of an exclusively technical and operational nature, and its objective is not the assignment of blame or liability.

The safety investigation was carried out without having necessarily used legal evidence procedures and with no other basic aim than preventing future accidents and serious incidents.

Consequently, any use of this bulletin for purposes other than preventing future accidents and serious incidents may lead to erroneous or misleading interpretations.

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CONTENTS

GENERAL	4
SYNOPSIS	5
FACTUAL INFORMATION	6
History of flight.....	6
Injuries to persons	6
Damage to aircraft.....	6
Other damage	6
Personal information	6
License and medical certificate.....	6
Flying experience.....	7
Aircraft information	7
General information.....	7
Meteorological information.....	7
Low Level Forecast.....	7
Terminal Aerodrome Forecast (TAF).....	7
Aviation Routine Weather Report (METAR).....	8
Aftercast.....	8
Survival aspects.....	8
AIB technical safety investigation.....	8
Additional information	11
ANALYSIS.....	12
General	12
Engine cylinder no. 2 head fracture.....	12
CONCLUSIONS.....	13
APPENDIX 1	14
APPENDIX 2	15

GENERAL

State file number: 2023-364
UTC date: 4-7-2023
UTC time: 11:50
Occurrence class: Serious incident
Location: Near the city of Helsingør
Injury level: None
Aircraft registration: LN-TEP
Aircraft make/model: Cessna U206G
Current flight rules: Visual Flight Rules (VFR)
Operation type: Private
Flight phase: En route
Aircraft category: Fixed wing
Last departure point: A fjord near the town of Kragerø (58 51 56N, 009 27 16E)
Planned destination: Copenhagen Sea Airport (EKCC)
Aircraft damage: None
Engine make/model: 1 x Continental IO-520-F

SYNOPSIS

Notification

All time references in this bulletin are Coordinated Universal Time (UTC).

The pilot notified the Aviation Unit of the Danish Accident Investigation Board (AIB) of the serious incident on 7-7-2023 at 07:30 hours (hrs).

The Danish AIB notified the Danish Civil Aviation and Railway Authority (DCARA), the Norwegian Safety Investigation Authority (NSIA), the US National Transportation Safety Board (NTSB), the European Aviation Safety Agency (EASA), and the Directorate-General for Mobility and Transport (DG MOVE) on 19-7-2023 at 13:58 hrs.

Summary

Intercrystalline corrosion in the cylinder head material of cylinder no. 2 led to a cylinder head fracture.

The cylinder head fracture caused vibrations and an uncommanded engine power reduction, and consequently a pilot decision on making a precautionary safety landing on a nearby lake.

Non-compliance with the engine manufacturer recommendation of not operating the engine beyond the Time Between Overhaul (TBO) introduced a latent flight safety risk, like an engine failure due to unrevealed corrosion.

This serious incident occurred in daylight and under Visual Meteorological Conditions (VMC).

FACTUAL INFORMATION

History of flight

The flight was a private VFR flight from a fjord near the town of Kragerø in Norway to Copenhagen Sea Airport (EKCC).

The seaplane LN-TEP, equipped with floats, flew in formation with another seaplane LN-SEA at an altitude of approximately 2000 feet (ft).

LN-SEA was the lead seaplane of the formation.

When the seaplanes were close to the city of Helsingør, the pilot of LN-TEP suddenly experienced light vibrations and an uncommanded engine power reduction.

The pilot noticed that all engine instruments were within the green range.

The pilot switched fuel tank, turned on the electrical fuel pump, and enriched the mixture.

Because the vibrations and the uncommanded engine power reduction continued, the pilot decided to make a precautionary safety landing as soon as possible.

A scanning of the landscape for a suitable landing site led to a pilot decision on making the precautionary safety landing on Lake Esrum.

Upon coordination with the pilot of LN-SEA and radio communication on flight plan changes with the involved air traffic service unit, both seaplanes landed on Lake Esrum without any further occurrences.

See [appendix 1](#).

Injuries to persons

Injuries	Crew	Passengers	Others
Fatal			
Serious			
None	1	3	

Damage to aircraft

Engine cylinder no. 2 suffered damage.

Other damage

None.

Personal information

License and medical certificate

The pilot - male, 63 years - was the holder of a valid Norwegian Commercial Pilot Licence (CPL (A)).

The rating Single Engine Piston (land) was valid until 30-11-2024.

The rating Single Engine Piston (sea) was valid until 31-8-2024.

The medical certificate (class 2) was valid until 29-4-2024.

Flying experience

	Last 24 hours	Last 90 days	Total
All types	3:10	35:00	4813:00
This type	3:10	15:00	2100:00
Landings this type	2	42	6000

Aircraft information

General information

Manufacturer:	Cessna Aircraft Company
Type:	U206G
Serial number:	U206-05186
Airworthiness Review Certificate:	Valid until 11-4-2024
Engine manufacturer:	Continental Aircraft Engine
Engine type:	IO-520-F
Engine serial number:	570006
Engine Time Since Overhaul (TSO):	1,006:30 hours (hrs)/17 years
Engine Time Since New (TSN):	5,766:00 hrs
Engine recommended TBO:	1,700 hrs/ 12 years
Propeller manufacturer:	Hartzell Propeller
Propeller type:	PHC-J3YF-1RF/F8468A-6R
Maximum take-off mass (MTOM):	3,500 lbs
Fuel on board (landing):	130 litres (l)
Latest maintenance:	27-3-2023

Meteorological information

Low Level Forecast

General:	Cold unstable air and strong winds. An occlusion slowly moved toward east/southeast.
Visibility:	More than 8 kilometres (km), locally in showers 3-5 km.
Ceiling:	More than 4,000 feet (ft), locally 1,500-2,000 ft.
Clouds:	Isolated cumulonimbus (cb).
Icing:	Not expected.
Surface wind:	West/southwest 5-32 knots (kt) gusting up to 42 kt.
Turbulence:	Moderate.

Terminal Aerodrome Forecast (TAF)

København Kastrup (EKCH) was located approximately 27 nautical miles (nm) south of the city of Helsingør and Lake Esrum.

TAF EKCH 040930Z 0409/0506 25018KT 9999 SCT030 TEMPO 0409/0412
 23020G32KT 3000 SHRA BKN030CB PROB40 TEMPO
 0409/0412 TSRA TEMPO 0412/0418 24020G32KT 4000 SHRA

SCT030CB TEMPO 0418/0421 24015G25KT BECMG 0423/0501 23008KT=

TAF EKCH 041114Z 0412/0512 25018KT 9999 SCT030 TEMPO 0412/0418 24020G32KT 3000 SHRA BKN030CB PROB40 TEMPO 0412/0416 TSRA TEMPO 0418/0421 24015G25KT BECMG 0423/0501 23008KT BECMG 0507/0509 13015KT -RA TEMPO 0509/0512 12018G28KT RA BKN014=

Aviation Routine Weather Report (METAR)

METAR EKCH 041120Z 22015KT 9999 BKN030CB BKN065 14/10 Q1007 TEMPO 24020G30KT 3000 SHRA=

METAR EKCH 041150Z 22015KT 9999 BKN030CB BKN065 18/11 Q1007 TEMPO 24020G28KT 3000 TSSHRA=

Aftercast

Aftercast valid for Lake Esrum and the city of Helsingør on 4-7-2023 at 11:30.

General: Strong westerly flow of cold and unstable air over Denmark with cb showers.
An occlusion over Skagerrak moved toward east/southeast.

Visibility: More than 10 km, but in showers 3,000 meters (m). No shower activities over the city of Helsingør and Lake Esrum.

Clouds: Scattered/broken cumulus/towering cumulus at 2,500-4,000 ft.

Surface wind: 210°-250° 10-20 kt with gusts up to 20-35 kt.

Survival aspects

The pilot and the passenger in the front seats used lap and shoulder harnesses.

The passengers in the aft seats used lap harnesses.

AIB technical safety investigation

a. Onsite investigation

An engine inspection revealed the following findings:

Cylinder no. 2 (left hand inner) cylinder head had several cooling ribs with cracks, and exhaust gas deposits were visible on the adjacent cylinder no. 4 cooling ribs.

After removal of the air induction pipe and the exhaust pipe from cylinder no. 2, the fractured cylinder head dropped down.

Removal of cylinder no. 2 revealed no damages to the cylinder wall, piston, and piston rings.

An inspection of the engine oil filter gave no rise to remarks.

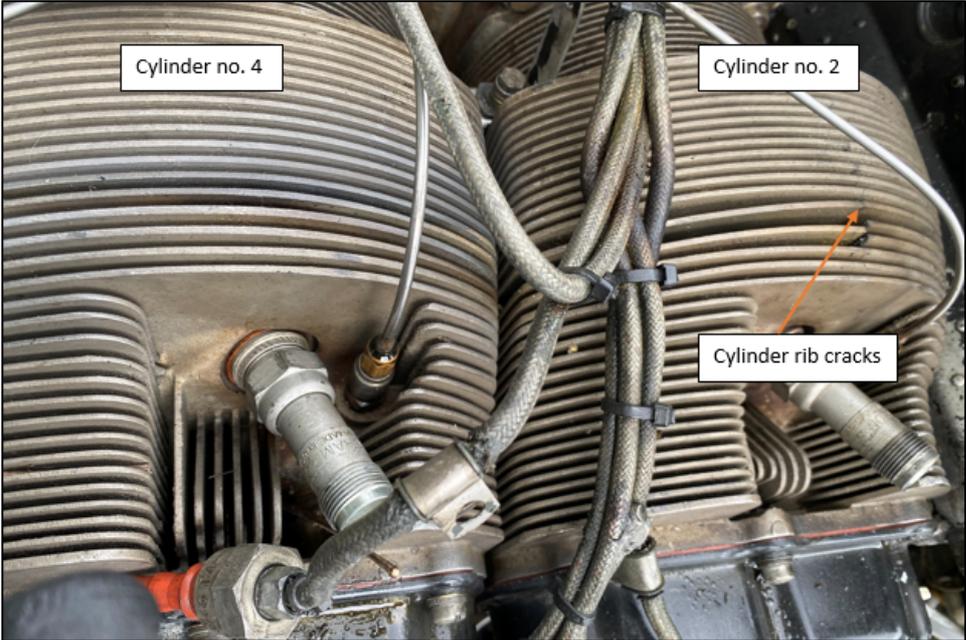


Figure 1. Cylinder no. 2 cooling rib cracks. Dark exhaust deposits on cylinder no. 4 cooling ribs.

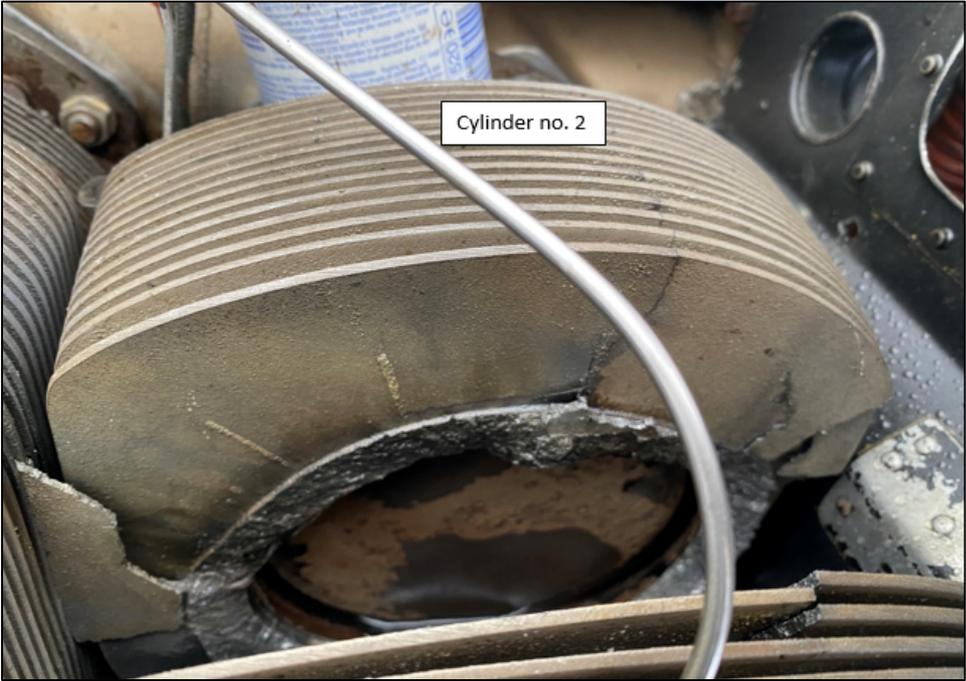


Figure 2. Fractured cylinder head of cylinder no. 2.



Figure 3. Side view of the engine with the fractured cylinder head of cylinder no. 2.

b. Follow up investigation

The AIB sent the fractured cylinder no. 2 to an external laboratory for a detailed examination of the fractured cylinder head surfaces.

Visual and metallographic examinations revealed that the aluminium alloy cylinder head fractured due to intercrystalline corrosion.

Intercrystalline corrosion were black lines and clusters along the grain boundaries in the microstructure of the fractured surface of cylinder no. 2 head.

[See appendix 2.](#)

Intercrystalline corrosion initiated small geometrical notches reducing the resilience and strength of the cylinder.

A visual examination of the fracture indicated a fracture progression affected by both corrosion and fatigue.

Inside the cylinder no. 2 head, degradation of the surface protection was visible.

c. Additional technical information

None of the engine cylinders had been replaced or individually overhauled since latest engine overhaul.

At the latest overhaul in 2006, all cylinders were installed as new.

After installation of a new cylinder no. 2, an on-ground operational test of the engine gave no rise to remarks.

d. Engine TBO

The engine manufacturer recommended a TBO of either 1,700 hrs or 12 years.

Operation of LN-TEP was solely private and not commercial.

For this type and size of aircraft, operated privately, EASA and the Civil Aviation Authority Norway (CAA-N) did not require a mandatory overhaul of the engine at the TBO interval.

Additional information

Intercrystalline corrosion is corrosion attack along the grain boundaries of the material when the surface protection coating is damaged allowing moisture and corrosive agents to enter.

ANALYSIS

General

The pilot was properly licenced.

The aircraft Airworthiness Review Certificate was valid.

On board fuel was sufficient to complete the planned flight.

A pilot decision on making a precautionary safety landing on a nearby lake was rational and optimum.

Engine cylinder no. 2 head fracture

None of the cylinders had been replaced or individually overhauled since the latest engine overhaul in 2006.

The engine manufacturer recommended TBO for this engine was 1,700 hrs/12 years. The actual engine TSO was 1,006 hrs and 17 years.

At the time of the serious incident, the engine exceeded the TBO calendar interval by 5 years.

The intercrystalline corrosion initiated small geometrical notches reducing the fatigue and static strength of the cylinder head that ultimately resulted in a cylinder head fracture.

In general, degradation of an engine due to corrosion is normally associated with calendar time in combination with the operating environment.

The AIB finds it very likely that seaplane operations in a salty humid coastal environment, over time accelerate engine degradation due to corrosion.

For that reason, accepted engine operations beyond a recommended engine TBO introduce latent flight safety risks, like an engine failure due to unrevealed corrosion.

CONCLUSIONS

Intercrystalline corrosion in the cylinder head material of cylinder no. 2 led to a cylinder head fracture.

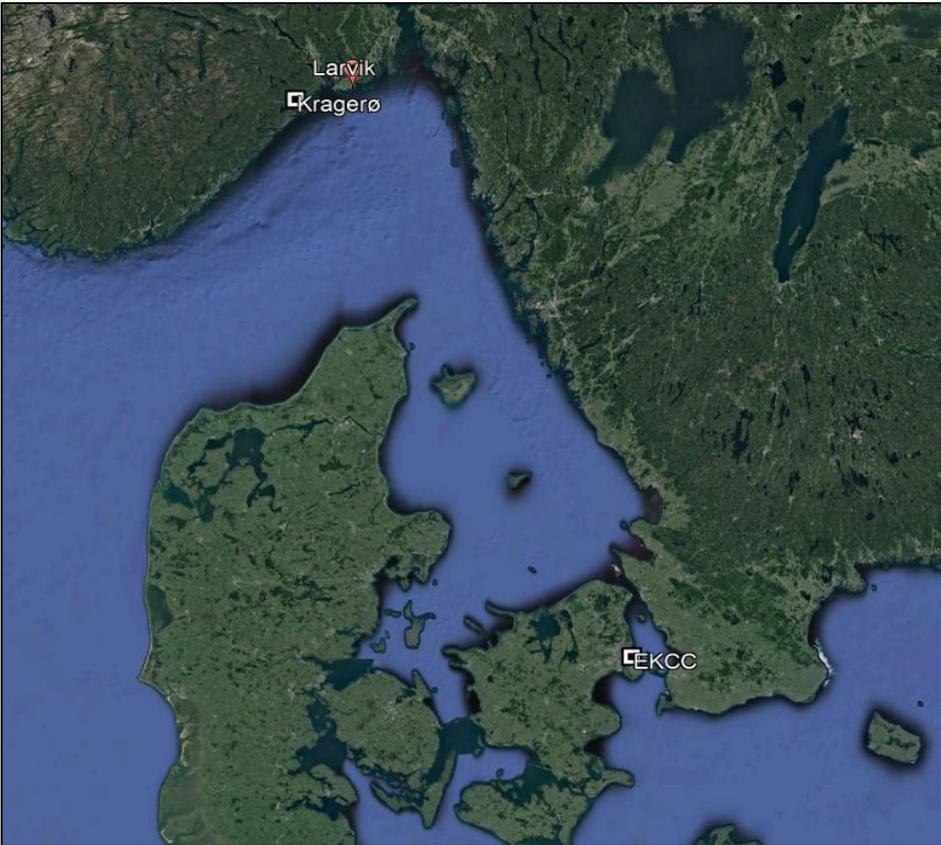
The cylinder head fracture caused vibrations and an uncommanded engine power reduction, and consequently a pilot decision on making a precautionary safety landing on a nearby lake.

Non-compliance with the engine manufacturer recommendation of not operating the engine beyond the TBO introduced a latent flight safety risk, like an engine failure due to unrevealed corrosion.

APPENDIX 1

[Return to history of flight](#)

Appendix 1



APPENDIX 2

[Return to AIB technical safety investigation](#)

Appendix 2

