



Havarikommisjonen

Accident Investigation Board Denmark

BULLETIN

Accident

12-5-2017

involving

LANCAIR IV P

SE-XRU



Certain report data are generated via the EC common aviation database

FOREWORD

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 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.

A reprint with source reference may be published without separate permit.

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BULLETIN

General

File number:	HCLJ510-2017-330
UTC date:	12-5-2017
UTC time:	06:35
Occurrence class:	Accident
Location:	2 kilometres (km) north of Grenaa (EKGR)
Injury level:	None

Aircraft

Aircraft registration:	SE-XRU
Aircraft make/model:	LANCAIR IV P
Current flight rules:	Instrument Flight Rules (IFR)
Operation type:	Non-Commercial Operations Pleasure Cross Country
Flight phase:	En route
Aircraft category:	Fixed Wing Aeroplane Small Aeroplane
Last departure point:	Denmark EKAH (AAR): Aarhus
Planned destination:	Norway ENKJ : Kjeller
Aircraft damage:	Substantial
Engine make/model:	CONTINENTAL (TELEDYNE) USA 550 FAMILY (TSIO Twin Turbo)

SYNOPSIS

Notification

All times in this report are UTC.

The Aviation Unit of the Danish Accident Investigation Board (AIB) was notified of the accident by the Area Control Centre at Copenhagen, Kastrup (EKCH) on 12-5-2017 at 06:50 hours.

The AIB notified the Danish Transport, Construction and Housing Authority (DTCHA), the Swedish Accident Investigation Authority (SHK), the US National Transportation Safety Board (NTSB), the European Aviation Safety Agency (EASA) and the Directorate-General for Mobility and Transport (DG MOVE) on 15-5-2017.

On request by the Danish AIB, the NTSB appointed a non-travelling accredited representative to the AIB safety investigation.

Summary

During climb, the oil pressure indication decreased to just above the low pressure red line. The pilot reduced the manifold pressure and diverted back towards Aarhus (EKAH). Before reaching EKAH, the pilot had to stop the engine and land in an agricultural field.

The aircraft was substantially damaged.

It has not been possible for the AIB to determine positively the root cause of the engine failure.

Findings from the engine inspections and the engine examination pointed towards engine failure due to oil starvation.

However, there was no firm conclusion, why the oil level decreased to a level, which caused the engine to fail.

The accident occurred in daylight and under visual meteorological conditions (VMC).

FACTUAL INFORMATION

History of the flight

The accident flight was a private IFR flight from EKAH to Kjeller (ENKJ).

Before the flight, the pilot – who owned the aircraft – pulled out the aircraft of the hangar and performed a walk around and inspection of the aircraft, which gave no rise to remarks.

Without remarks, the pilot performed the engine start and pre take-off checks, and the air traffic controller officer (ATCO) in Aarhus Tower (118.525 MHz) issued a take-off clearance for departure on runway 10L.

At 06:07:50 hours, the aircraft departed EKAH and turned onto a north-easterly heading inbound the reporting point LUNIP, climbing to flight level (FL) 190.

At 06:08:45 hours, the ATCO informed the pilot of observed smoke during take-off rotation presumably coming from the wings. The smoke disappeared as soon as the aircraft became airborne.

The pilot replied that he would “*have a look*”.

The pilot noted all engine indications to be normal.

At 06:12:58 hours, the pilot contacted Copenhagen Control (124.550 MHz).

At 06:20:20 hours, the aircraft was located approximately 35 nautical miles (nm) north-east of EKAH climbing through FL 120. Within a period of approximately one minute, the pilot observed the engine oil pressure indication decreasing to just above the low pressure red line.

The pilot did not experience any engine vibrations or significant rise of oil temperature

At 06:22:45 hours, when the aircraft reached FL 140, the pilot initiated a left turn back towards EKAH. The pilot reduced the manifold pressure to 15 inches and the oil pressure indication seemingly stabilized above the low pressure red line.

Simultaneously, the pilot informed Copenhagen Control of the experienced engine problems and the need of returning to EKAH.

At 06:23:13 hours, the ATCO issued a clearance back to EKAH and informed the pilot of no reported traffic within the area.

At 06:23:45 hours, the aircraft was established in a 1000 feet per minute rate of descent towards EKAH, passing FL 120 with a radar presented ground speed of 212 knots.

At approximately 06:25:00 hours, the oil pressure indication decreased to below the low pressure red line.

At 06:25:35 hours, the ATCO instructed the pilot to contact Aarhus Approach (119.275 MHz).

At 06:25:52 hours, as the aircraft descended through FL 094, the pilot contacted Aarhus Approach, stating that he had an engine failure due to a very low oil pressure.

The ATCO at Aarhus Approach cleared the aircraft for a left hand visual approach to runway 10R.

At 06:25:55 hours, the ATCO alerted the airport fire and rescue services.

At 06:29:17 hours, the pilot informed the ATCO of the aircraft being incapable of reaching EKAH and requested radar vectors for landing at Grenaa (EKGR).

The ATCO issued a radar vector towards EKGR and informed the pilot of EKGR located in the 11 o'clock position at a distance of 6 nm.

At 06:29:59 hours, the aircraft passed the north-eastern coastline of Djursland at a radar presented altitude of 3100 feet and a radar presented groundspeed of 213 knots.

The oil pressure indication decreased further and the pilot decided to shut down the engine by pulling out the mixture control lever. The engine did not respond, and the pilot set the fuel selector to "Shut off".

The engine stopped, as the aircraft descended through an altitude of approximately 2000 feet. The radar presented ground speed was 130 knots.

The pilot prepared for an emergency landing and selected the landing gear to the down position.

At 06:30:34 hours, the pilot informed the ATCO of the stopped engine and requested directions for EKGR.

The ATCO informed the pilot of EKGR located in his 12 o'clock position at a distance of 3,6 nm.

At 06:31:28 hours, the ATCO informed the pilot of EKGR located straight ahead at a distance of 2 nm.

The pilot acknowledged the distance.

The aircraft was incapable of reaching EKGR, and the pilot decided to land in an agricultural field.

The pilot made a turn to avoid a farm building and selected the flaps to the full down position.

Free of the building, the pilot stopped the turn and flared the aircraft at a height of approximately half a meter above the field.

During the flare, the aircraft stalled and the right main gear and the right wing made contact with the field.

The aircraft turned approximately 90 degrees to the right.

The aircraft slid forward and the left main gear and the nose gear made contact with the field and collapsed.

The left wing and the nose made contact with the field and the aircraft stopped, resting on the left wing, the nose and the right main gear.

Injuries to persons

<i>Injuries</i>	<i>Crew</i>	<i>Passengers</i>	<i>Others</i>
Fatal			
Serious			
None	1	1	

Damage to aircraft

During the sequence of events:

- All three propeller blades bended approximately 90 degrees backward.
- The left main gear and the nose gear assembly were severely damaged and both wheels separated from their respective gear assembly.
- The right main gear assembly got minor damages.
- The flight control linkage to the flaps and the right aileron broke.
- An approximately 50 centimeter (cm) long crack occurred at the fuselage to the right wing mounting.
- The right wing broke in a downward direction, halfway between the fuselage and the tip. The tip separated from the right wing.
- The lower part of the engine cowling was severely damaged.

Other damage

Fuel from the left wing tank leaked onto the agricultural field.

Personnel information

License and medical certificate

The pilot - male, 73 years - was the holder of a valid Norwegian private pilot license (PPL (A)) issued on 11-1-1968.

The class rating single engine piston land (SEP land)/IR was valid until 30-8-2017.

The medical certificate (class 2) was valid until 2-5-2018. The certificate contained the limitation VML (Correction for defective distant, intermediate and near vision).

Flying experience

	Last 24 hours	Last 90 days	Total
All types	0	3	4264
This type	0	3	333
Landings this type	0	5	

Aircraft information

General information

The aircraft was built as an Amateur-built aircraft, also known as a Homebuilt or Kit-aircraft. The supplier of the Lancair VI P Kit was Lancair International Inc., USA.

The aircraft operated on a National Permit to Fly issued by the Swedish Transport Agency.

According to the National Permit to Fly:

- The manufacturer was defined as an "Amateur Built".
- The aircraft type (designation) was "Lancair-IV-P".
- The aircraft class was "Experimental".
- The aircraft category was "Private".
- The National Permit to Fly was valid until 28-2-2018.
- The year of manufacture was 1999.
- The serial number was LIV-284-1063.

Aircraft total time was 692 hours.

Propeller information

Hartzell, 3 blade variable pitch, overhauled at 688.1 hours.

Propeller total time was 692 hours.

Engine information

Teledyne Continental TSIO-550-B 6-cylinder, turbocharged, air-cooled, horizontally opposed and direct-drive- aircraft engine with hydraulic lifters, 2 pushrod-actuated valves per cylinder, wet oil sump and a fuel control with manual mixture.

The engine serial number was 802123.

Engine total time was 692 hours.

Aircraft maintenance, repair, installation and flight summary

Maintenance

According to aircraft maintenance personnel and with reference to the aircraft class, the aircraft was maintained according to Danish National Regulation for Civil Aviation for Annex II aircraft (Bestemmelser for Civil Luftfart BL 1-3).

The aircraft maintenance program complied with the instructions of the aircraft manufacturer.

The pilot – as the aircraft owner – was responsible for adhering to any date or flight-time limitation concerning maintenance and airworthiness.

Engine repair

A Part 145 approved aircraft maintenance organisation repaired the engine at 688.1 hours engine total time.

Engine installation and flight summary

A Part 145 approved aircraft maintenance organization performed the engine installation and the 100 hours / annual inspection.

- Jan. 2017: Engine repaired at workshop at engine total time 688.1 hours - [see appendix 1](#)

11-1-2017: Engine installed in aircraft by maintenance organisation - [see appendix 2](#)

12-1-2017: First engine *ground test* (performed by the pilot).
 19-1-2017: 100 hours / annual inspection performed - [see appendix 2](#)
 19-1-2017: Certificate of Release to Service (CRS) issued.
 3-3-2017: Second engine *ground test* (performed by the pilot).
 8-3-2017: First engine *flight check* (FL 080) (flown by the pilot).
 21-3-2017: Second engine *flight check* (FL 080) (flown by the pilot).
 16-4-2017: Round trip flight EKAH to Odense (EKOD) (FL 080) (flown by the pilot).
 1-5-2017: Demonstration flight with potential aircraft buyer (FL 200) (flown by the pilot).
 12-5-2017: The accident flight EKAH – ENKJ.

The engine *ground tests* and *flight checks* were performed in accordance with Continental Motors Aircraft Engine Service Bulletin No. SB15-6A, as recorded on work order 17002AA, task no. 4 and no. 5 - [see appendix 3](#)

After each *ground test* and *flight check*, the pilot and the maintenance organisation personnel discussed the observed engine parameters.

During the second *flight check*, aircraft maintenance personnel noted manifold pressure, fuel flow, cylinder head temperature (CHT) and turbine inlet temperature (TIT). All parameters were within limits. Neither the pilot nor the aircraft maintenance personnel made any recordings in the engine logbook.

The *ground tests* and the *flight checks* gave no rise to remarks.

After the two *flight checks*, the aircraft maintenance organisation was no longer involved in the engine break-in procedure.

During the three subsequent flights on the 16-4-2017 and the 1-5-2017, the pilot did not observe any abnormal engine indications.

Oil consumption

Following the engine repair, the engine was supplied with 12 quarts (qts) of AeroShell 80 (SAE-J-1966 SAE 40) (break-in oil).

According to the flight journey log, the oil consumption following the engine repair was:

Date (2017)	Departure	Destination	Flight time	Oil refill, qts.	Oil stick indication before flight (after refill), qts.
8-3	EKAH	EKAH	0:45		12
21-3	EKAH	EKAH	0:45	1	11

16-4	EKAH	EKOD	0:30	1	12
16-4	EKOD	EKAH	0:30		
1-5	EKAH	EKAH	0:50		11
12-5	EKAH	-		3	11

After the *flight checks* (8-3 and 21-3), the pilot and aircraft maintenance personnel discussed the oil consumption. The aircraft maintenance personnel considered the oil consumption to be normal.

According to the pilot, he discussed the increased oil consumption (3 qts) that occurred during the demonstration flight on 1-5-2017 with the aircraft maintenance personnel. The pilot had the impression that the aircraft maintenance personnel considered the oil consumption as being normal during an engine break-in period.

According to the aircraft maintenance personnel, there was only *loose talk* and no direct discussion of the oil consumption after neither the two flights on the 16-4-2017 nor the flight on the 1-5-2017,

As far as the aircraft maintenance personnel recalled, there was no specific mention of 3 qts used during the demonstration flight on the 1-5-2017.

Meteorological information

Terminal Aerodrome Forecast (TAF)

ekah 120511z 1206/1306 10015kt 9999 bkn030 tempo 1209/1215 11015g28kt tempo 1215/1306
ra sct030cb=

Aviation Routine Weather Report (METAR)

ekah 120520z auto 10013kt 070v130 9999ndv few011/// bkn038/// 08/05 q1008=
ekah 120550z auto 10013kt 9999ndv sct010/// bkn037/// 08/05 q1008=
ekah 120620z auto 09016kt 9999ndv sct010/// 09/05 q1008=
ekah 120650z auto 09015kt 9999ndv few011/// 09/05 q1009=

Wreckage and impact information

Approximately 2 km north of EKGR, the aircraft crashed in an agricultural field.

The crops had a length of approximately 40 to 50 cm.

There was no traces of engine oil on the ground below the aircraft.



AIB technical investigation

AIB inspection

The wreckage was transported from the crash site to a local nearby farm, where the AIB inspected the engine.

The inspection revealed:

- Less than 3 qts of remaining oil in the engine.
- There were signs of oil leakage around cylinders no. 2, no. 4 and no. 6.
- There were sign of oil on the left exhaust.
- The breather line contained oil.
- Sparkplugs from cylinders no. 2, no. 4 and no. 6 were contaminated with oil.
- When removing the lower sparkplug from cylinder no. 4, oil was dripping from the sparkplug hole.
- Only very limited traces of oil were found outside the engine, i.e. in the engine compartment and on the underside/fuselage of the aircraft.

Aircraft maintenance facility inspection

Based on the initial findings and observations, the AIB decided to remove the engine and bring it to an aircraft maintenance facility in EKAH for further investigation.

The inspection revealed (in extract):

- Engine severe internal distress.
- Crankcase penetrated by connecting rod big end above cylinder no. 4.
- Bearing shells indicated running without oil on all cylinders.
- Cylinder no. 1 showed no damage.
- Cylinder no. 2, no. 3 and no. 5 showed heat damage at connecting rod big end. Cylinders no. 3 and no. 5 were damaged by parts from cylinders no. 4 and no. 6.
- Cylinder no. 4 bore contained oil residue. The piston and connection rod big end of cylinder no. 4 were damaged, partly by debris, and the connection rod big end and the bearing cap were found separated. The lower connection rod bearing cap bolt was found in four pieces, with the nut still installed on the bolt. The upper connection rod bearing cap bolt was found in three pieces. The nut was not installed on the bolt and was found separately from bolt. The threads on the bolt and the nut were intact.
- Large amount of engine debris found in the oil sump.

Workshop inspection

Following the inspection at the aircraft maintenance facility, the engine was transported to an approved aircraft engine workshop for further examination.

The examination included the:

- Engine block and cylinders.
- Engine oil gallery.
- Ignition system.
- Exhaust system.
- Turbochargers.

The report contained the following findings and comments (in extract):

Engine block and cylinders:

- *disassembled partial. (some parts cracked to heavy to be disassembled)*
- *cylinders disassembled (4 ea), 2 are not disassembled, pos. no. 3 and 6, only boroscoped.*
- *one cylinder, no. 2., shows signs of metal-particles on the top of the piston.
(this piston shows also sign of pre-ignition at the edge or overheat)*
- *one con rod bolt (cyl. no. 4) seems to have been loose, to state if it was loose before the incident or it became loose due to heat can not be concluded.*
- *connecting rod journals and bearings melted due to lack of oil/lubrication. (high temp.)*
- *crankshaft main journals lubricated, no remarks.*
- *camshaft lubricated, no remarks.*
- *oil-pump lubricated, no remarks.*

Our comments in general:

- *engine seems to have been in an acceptable/fine condition before the incident.*
- *parts seem to be renewed at last repair as described in the paperwork.*

WRAP UP:

To give a definite conclusion is at this stage not possible as we have different indications which all are 'rejected'/can be argued by either statements or findings:

- A. *Oil-level to low before take off?*
Pilot state oil-level was checked and found OK before take off.
- B. *Pre-ignition on the magnetos?*
Magnetos tested/inspected, no signs of mal-function.

C. Loose con rod bolt on cyl. no. 4?

Will not create high temp. 'only' engine damage.

D. Turbochargers burned the oil. (White smoke at the take off)?

Turbochargers are both very fine and show no indication of oil-contamination.

*Exhausts are all showing having had normal temp. (dry and light in their colour)
(except for inlet from breatherline from crankcase which was wet of oil).*

The workshop engine report – [see appendix 4](#)

Metallurgy examination

The AIB sent the cylinder no. 4 upper and lower connecting rod bolts and spiral lock nuts to a metallurgy laboratory for examination.

The examination concluded:

The fracture mode is overload imposed in the course of escalating engine problems.

The fracture in the bolts is due to consequential damages.

The metallurgy examination report – [see appendix 5](#)

Survival aspects

Both the pilot and the passenger used hip and shoulder harnesses.

Neither the pilot nor the passenger seat and neither the pilot nor the passenger harnesses showed signs of damage or overload.

The aircraft cabin was intact.

ANALYSIS

General pilot status

In the opinion of the AIB, the license, the qualifications and the medical status held by the pilot had no influence on the sequence of events.

Aircraft maintenance, engine repair and engine installation

The AIB finds that the aircraft maintenance, the engine repair and the engine installation were performed according to the instructions of the aircraft and the engine manufacturer and according to the Danish national regulation for Annex II aircraft.

Both the engine *ground tests* and *flight checks* were performed in unison by the pilot and the aircraft maintenance organisation, and seemingly in accordance with the instructions of the engine manufacturer (SB15-6A).

According to the pilot and aircraft maintenance personnel, no abnormal engine parameters were observed during neither the *ground tests* nor the *flight checks*.

Taking into consideration the available information, the AIB considers the aircraft to be airworthy at the time of the accident, which is in line with the general comments of the workshop inspection report.

Subsequent flights

The three flights performed on the 16-4-2017 and the 1-5-2017 – i.e. after the second *flight check* – were performed by the pilot and did not give rise to remarks.

Since the aircraft was not equipped with any type of engine parameter recorder, the available information is based on the pilot's observations only. For that reason, it is possible – albeit not very likely – that engine parameters were exceeded without the pilot's knowledge.

Oil consumption

The 3 qts of oil used during the demonstration flight (1-5-2017) seems to the AIB to be a consumption that significantly differed from the oil consumption recorded on the other flights following the engine repair. Whether this increased oil consumption was caused by the required engine power needed to climb to FL 200, or was due to other reasons is unclear.

To the AIB, the pilot's perception of the post-demonstration flight discussion/talks with aircraft maintenance personnel led the pilot to believe that the aircraft maintenance organisation validated the increased oil consumption to be normal. To the pilot, this meant that no further action was required, and the pilot considered the aircraft airworthy.

Because aircraft maintenance personnel considered their involvement to have ended after the two *flight checks*, and since they had no recollection of 3 qts being mentioned, they did not take any further action.

However, the increased oil consumption recorded on the demonstration flight might - in the opinion of the AIB -, have been a precursor of impending engine problems.

Oil pressure decrease

Over a period of approximately one minute while climbing through FL120, the pilot observed an oil pressure drop.

To the AIB this pilot observation indicated that no internal engine mechanical failure occurred right away, but instead the oil capacity reached a critically low level causing an oil pressure drop.

The absence of engine vibrations prior to and during the pressure drop period supports this statement.

Engine inspections

The AIB initial inspection and the maintenance facility inspection revealed severe internal engine distress and a remaining oil quantity of less than 3 qts.

The amount of oil located outside the engine compartment and on the fuselage was limited. Taking these findings and the sequence of events into consideration, the AIB finds the probability for an engine in-flight oil-leak of 7-8 qts to be unlikely.

However, there were several signs of oil-leakage found especially around the left side of the engine, both internally and externally. Throughout the engine, bearings shells revealed signs of running without lubrication (oil), and heat damage was evident at the connecting rod big end of several cylinders.

Some cylinders were damaged by parts from other cylinders, and the engine top crankcase was penetrated by the cylinder no. 4 connecting rod big end. The connecting rod big end and the bearing cap was separated and both connecting bolts were broken into several pieces. One bolt was found with the nut installed, the other bolt was found without the nut installed.

Engine debris contaminated the engine oil sump.

Overall, it was not possible for the AIB to determine whether the engine distress was due to oil issues or due to mechanical issues.

The aircraft workshop inspection included a general engine examination and tested four hypotheses causing the engine failure.

The conclusion was that the engine had most likely been in fine working condition prior to the accident flight, and all of the four hypotheses could be rejected due to stated pre-flight conditions, inspection results or lack of further/other engine damage.

Finally, a metallurgy examination of the two connecting rod big end bolts of cylinder no. 4 revealed no signs of bolts being loose prior to failure. All damages and fractures to bolts and nuts were consequential events.

CONCLUSIONS

It has not been possible for the AIB to determine positively the root cause of the engine failure.

Findings from the engine inspections and the engine examination pointed towards engine failure due to oil starvation.

However, there was no firm conclusion, why the oil level decreased to a level, which caused the engine to fail.

APPENDIX 1

Return to [aircraft maintenance, repair, installation and flight summary](#)

		Engine Type: Conti. TSIO-550-B Sn: 802123 TT: 67N 688-1 W/O: 16065 (Experimental)									
-	Overhaul	X	Repair	X	Insp.	X	Mod.	-	Test Run	-	Preservation
Modifications embodied or checked. MSB-96-10B Magnetic particle / Ultrasonic insp. perf. Magnetic particle insp. perf. on all reused steelparts.											
New parts besides requirements acc. to manufacturer.											
All Cyl. Kit assy, incl. Piston pins p/n 658603A1 (EQ7563) Camshaft p/n 649322R Gear Camshaft p/n 654085 Gov. Gear p/n AEC629748 Hyd bodies (6) p/n SA628488 Hyd bodies (6) p/n SA658077 Counterweight OHC (2) 639195 Counterweight OHC (2) 639196 Pin counterweight (4) p/n SA643626-105 Pin counterweight (2) p/n SA643626-104						Pin Counterweight (2) p/n SA 643626-103 Plate counterweight pin (16) p/n SA643629 Lock ring counterweight (16) p/n SA629104 Con. Rod bushing all p/n 530658 Trans Collar p/n 629680M.010 Bearing Con. Rod all p/n SA642398M.010 Bearing Main set p/n SA646592-A1M.010 Bushing rocker arm all p/n 652953 Gasket kit p/n EQ7158					
Work performed. Complete dismantling & insp. perf. – All tolerances verified and brought within the manufacturer's specifications. Crankshaft OH and regrind to undersize perf. iaw. Aircraft specialties Form tracking ASI-071410 / wo 236282 Crankshaft counterweight's overhauled w/ new bushings, pins, plates & retainer rings. All Trust-, Main- & Con. Rod bearings renewed w/ M.010. – Trans Collar renewed w M.010. All cyl. Assy kit renewed. – All piston pins renewed. – All Con. Rod bushings renewed. – All rocker arm bushings and shafts renewed. Camshaft and all hyd bodies renewed. Complete assembly of engine w/ new seals and gaskets. - Turbo's & other accessories was not installed on engine All work perf. iaw. Continental Maintenance & OH Manual Pub. M-16, Change 2, Jul. 2015. TEST-RUN OF THIS ENGINE HAVE NOT BEEN PERFORMED AFTER ASSEMBLY. OBS ! – Complete operational check & break-in. <u>must</u> be perf. by installer. – iaw. Conti. SB SB15-6A.											
I hereby/Certifies that the work specified except as otherwise specified was carried out in accordance with Part-145 and in respect to that work the aircraft/aircraft component is considered ready for release to service.						EASA Part 145  Date: 08 DEC. 2016.					

The AIB has removed the names of the maintenance organisation and the involved personnel.

APPENDIX 2

Return to [aircraft maintenance, repair, installation and flight summary](#)

 LUFTFARTSVERKET The Swedish Civil Aviation Administration	Journal Nr <u>1</u> Log Book No	EXPERIMENT
MOTORJOURNAL Engine Log Book		
Tillverkare <i>Manufacturer</i>	<u>CONTINENTAL</u>	
Typbeteckning <i>Model designation</i>	Tillverkningsnr <i>Serial No</i>	<u>TS10-550B</u> <u>802123</u>
Typcertifikat Nr <i>Type certificate No</i>	Tillverkningsår <i>Year of construction</i>	<u>1996</u>
Upprättandet av denna journal godkänt <i>The establishment of this journal is approved</i> EAA 222 <u>Barkarby 1999-10-22</u> Ort, datum och namnteckning <i>Place, date and signature</i> Luftfartsverkets stämpel <i>The Authority's stamp</i>		

UNDERHÅLL - MODIFYING Maintenance - Alteration			
Gångtid Time	Luftvärdighetsdirektiv. Större inspektioner. Reparationer. Komponentbyten. Långtidskonserveringar. Översyner. Modifieringar. Lfv besiktn. Airworthiness Directives. Major inspections. Repairs. Change of components. Preservations for long term storage. Overhauls. Alterations. The Authoritys inspections.	Åtgärden utförd av The action effected by	
Ind- or	Total Total	Namnteckning Signature	Tillstånd MM-Nr RSC/Licence No
1	688.1	ENGINE INSTALLED AFTER REPAIR BY [REDACTED] 100 HRS/ANNUAL INSPECTION PERFORMED I.A.W. LANCHEIR INSPECTION REPORT CHECK USI REV. C JUL 1997 12 HR 80 OIL. 17002 HA	
	688.1	FAA AD 2016-21-04 N/A	

The AIB has removed the names of the maintenance organisation and the involved personnel.

APPENDIX 3

Return to [aircraft maintenance, repair, installation and flight summary](#)

MAINTENANCE RECORD		A/C Reg.	Type / Model:	S/N:	W/O:	Page 1 of 2
		SE-XRU	LANDAVER N-P	LIV-284-1063	17002 HPA	
		A/C TT: 688.1	Engine TT: 688.1	Prop II: T50	Customer	Date: 2/1-2017
1 TASK 100 HRS / ANNUAL INSPECTION Action: 100 HRS / ANNUAL INSPECTION PERFORMED J.H.W. LANDAVER INSPECTION REPORT. REV.0 JUN 1997. ENGINE INSTALLATION COMPLETED Q THIS W/O 22:00 REM. P/N: S/N: DATE: 1/1-2017 MECH. INSP.						
2 TASK DO A CHECK ON EQUIPMENT Action: LIFE JACKET 4 BR. 2/3-2020 9/1-2019 2x 3/1-2020 FIRST AND KIT. OK 2013164 FIRE EXTINGUISHER: OK. WEIGHT 2.380 KG PLC REM. P/N: S/N: DATE: 1/1-2017 MECH. INSP.						
3 TASK DO A LANDAVER SB CHECK Action: LANDAVER SB CHECK PERFORMED. LATEST ISSUE SB74-011 I.H.W. LANDAVER HOWEPAE PLC REM. P/N: S/N: DATE: 1/1-2017 MECH. INSP.						
4 TASK DO A ENGINE CHECK AND OBEY-110 I.H.W. TCM SB15-6A "GROUND RUN" Action: FIRST GROUND RUN PERFORMED: 1/1-2017 SECOND GROUND RUN PERFORMED: 3/8-2017 PLC REM. P/N: S/N: DATE: 6/1-2017 MECH. INSP.						
5 TASK DO A ENGINE CHECK AND OBEY-110 I.H.W. TCM SB15-6A "FLIGHT TEST" Action: FIRST AND SECOND OBEY-110 TEST FLIGHT PERFORMED BY OWNER () J.H.W. TCM SB15-6A. PLC REM. P/N: S/N: DATE: 1/1-2017 MECH. INSP.						

APPENDIX 4

Return to [workshop inspection](#)



Havarikommissionen

Att.: [REDACTED]

Copenhagen, august 24, 2017.

Re.: Continental, TSIO-550-B, s/n 802123

Above mentioned engine has been partial disassembled and inspected here with the following comments:

Engine block and cylinders:

- disassembled partial. (some parts cracked to heavy to be disassembled)
- cylinders disassembled (4 ea), 2 are not disassembled, pos. no. 3 and 6, only boroscoped.
- one cylinder, no. 2., shows signs of metal-particles on the top of the piston.
(this piston shows also sign of pre-ignition at the edge or overheat)
- one con rod bolt (cyl. no. 4) seems to have been loose, to state if it was loose before the incident or it became loose due to heat can not be concluded.
- connecting rod journals and bearings melted due to lack of oil/lubrication. (high temp.)
- crankshaft main journals lubricated, no remarks.
- camshaft lubricated, no remarks.
- oil-pump lubricated, no remarks.

Engine oil gallery:

- no restrictions found.

Ignition system:

Magnetos, p/n 10-500556-101

- s/n G129902D, tested, no remarks, checked for gasket for press. installation, disassembled.
No remarks.
- s/n J160005D, not tested due to damage, only checked for gasket for press. installation.
No remarks.
- none of them showed sign of mal-function on distributor block.

Harness:

- checked for functionality, no remarks.

Exhaust system:

- engine seems to have been running satisfactory, normal signs of carbon.
- no signs of burned oil.

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Turbocharger:

- visually inspected, no remarks.
- disassembled and inspected, no remarks.
- no signs of oil etc., completely dry as per after normal function.
- no signs of burned oil.

Our comments in general:

- engine seems to have been in an acceptable/fine condition before the incident.
- parts seem to be renewed at last repair as described in the paperwork.

WRAP UP:

To give a definite conclusion is at this stage not possible as we have different indications which all are 'rejected'/can be argued by either statements or findings:

- A: Oil-level to low before take off?
Pilot state oil-level was checked and found OK before take off.
- B: Pre-ignition on the magnetos?
Magnetos tested/inspected, no signs of mal-function.
- C: Loose con rod bolt on cyl. no. 4.
Will not create high temp. 'only' engine damage.
- D: Turbochargers burned the oil. (White smoke at the take off)
Turbochargers are both very fine and show no indication of oil-contamination.
Exhausts are all showing having had normal temp. (dry and light in their colour)

Engine has been inspected here by:

-Tech. Inspector, Mr. [REDACTED]

-Inspector, Mr. [REDACTED]

Brgds.

SCANAVIATION A/S

[REDACTED]

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The AIB has removed the names of the involved personnel.

SCAN AVIATION



Turbo and transition exhaust port.



Exhaust pipe



Camshaft bearing bridge



Piston cyl.#2

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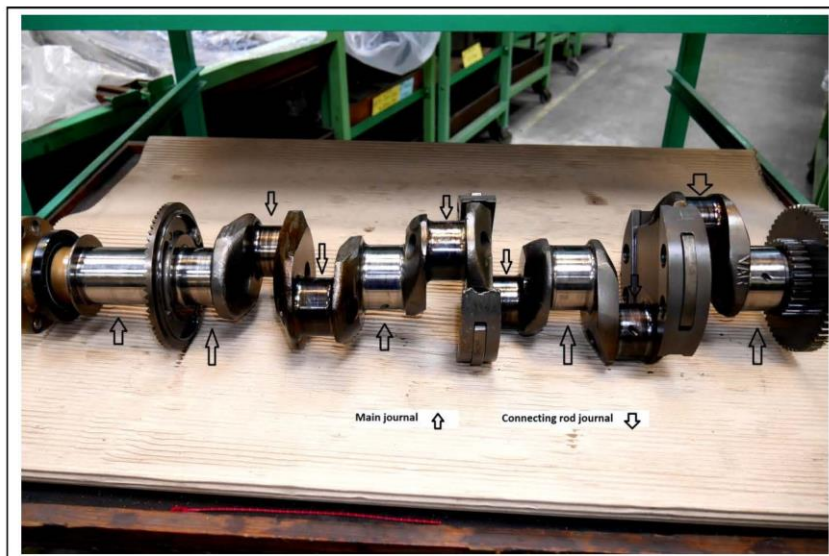
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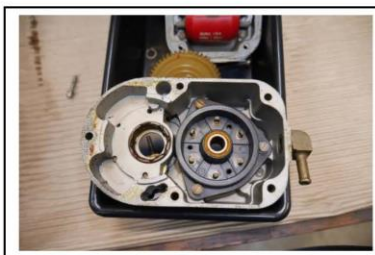
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Main and connecting rod journal



Connecting rod bearing



Magneto

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APPENDIX 5

Return to [metallurgy examination](#)

REPORT

Examination of upper and lower connecting rod bolts and spiral lock nut from Lancair IV-P aircraft. MSN LIV-284-1063

CORROSION AND METALLURGY

Reviewed by:

Reported by:

For

[REDACTED]

[REDACTED]

2017-11-06

Digitally signed by

[REDACTED]
Secretary

[REDACTED]

2017-11-06

Digitally signed by

[REDACTED]
Specialist

The report is only valid with two digital signatures from FORCE Technology. The original version of the report is archived in FORCE Technology's database and is sent in electronic duplicate to the customer. The stored version of the report at FORCE Technology prevails as documentation for its contents and validity.



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The AIB has removed the names of the involved personnel.

Examination and results

The bolts were broken in several places, and bolt heads and nuts were heavily battered from contact with surrounding bodies and surfaces, c.f. Figures 1-6 in Appendix 1.

Examination of the fractures revealed failure modes by overload due to axial, shear and bending loads. There are no signs of bolts being loose prior to failure. Likewise, there are no signs of pre-existing material defects being responsible or contributory to the fracturing. The overall appearance indicates bolt failures caused by collateral damage rather than being involved in the cause and origin of the engine problems that prompted the emergency landing.

Conclusion

The fracture mode is overload imposed in the course of escalating engine problems.
The fracture in the bolts is due to consequential damages.



Figure 1 Parts from the upper connecting rod bolt and matching spiral lock nut after cleaning.



Figure 2 Close-up of part from Figure 1.



Figure 3 Close-up of part from Figure 1.



Figure 4 Parts from the lower connecting rod bolt and matching spiral lock nut after cleaning.



Figure 5 Close-up of part from Figure 4.



Figure 6 Close-up of part from Figure 4.