Accident
Investigation Board
Norway

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# REPORT SL 2011/20

## REPORT ON SERIOUS AIRCRAFT INCIDENT 2-3 NM NORTH OF RYGGE, NORWAY ON 2 JULY 2005 WITH DIAMOND DA40-D, LN-NEX

Accident Investigation Board Norway • P.O. Box 213, N-2001 Lillestrøm, Norway • Phone: + 47 63 89 63 00 • Fax: + 47 63 89 63 01
www.aibn.no • post@aibn.no

**Photos: AIBN and Trond Isaksen/OSL**

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## REPORT ON SERIOUS AIRCRAFT INCIDENT

| | |
|---|---|
| Aircraft: | Diamond Aircraft Industries GmbH, DA40-D |
| Nationality and registration: | Norwegian, LN-NEX |
| Owner: | Oslo Flyveklubb, Norway |
| User: | Same as owner |
| Crew/commander: | Male, 26 years old |
| Passengers: | None |
| Incident site: | 2 – 3 nm north of Rygge Air Force Base (ENRY) |
| Date and time of the incident | Saturday 2 July 2005 at 1158 hours |

All hours stated in this report are local time (UTC + 2 hours) unless otherwise indicated.

## NOTIFICATION

On Saturday 2 July 2005 at 1311 hours, the inspector of accidents on duty at the Accident Investigation Board Norway (AIBN)[1] received a notification from the air traffic controller on duty at Rygge Air Force Base (ENRY). The notification concerned a plane belonging to Oslo Flyveklubb (LN-NEX) which had issued a MAYDAY call 3 – 4 NM north of the air station due to an engine failure. The pilot had made a successful landing on a taxiway, but the engine showed clear signs of complete engine failure. Two accident inspectors from the Accident Investigation Board travelled to the accident site on the same day and started their investigation. The Austrian Accident Investigation Board, Unfalluntersuchungsstelle des Bundes – Fachbereich Luftfahrt (UUB/LF), was contacted in accordance with ICAO Annex 13. They appointed an accredited representative who participated in the investigation together with consultants from the aircraft manufacturer Diamond and the engine manufacturer Thielert. Later, also the from Bundesstelle für Flugunfalluntersuchung (BFU), the German Federal Bureau of Aircraft Accident Investigation, became involved in the investigation.

## SUMMARY

The commander had practiced landing circuits at Rygge Air Force Base and was heading back to Kjeller Airport when the engine suddenly stopped with a bang. At the time the aircraft was approximately 2 – 3 NM north of the runway and the commander headed for the runway 12 threshold. As it turned out, the aircraft did not have sufficient altitude, but the commander managed to make a successful landing on a taxiway which traversed the runway. There was no personal injury or additional damage to the aircraft.

It emerged from the engine investigation that a connecting rod had split in the small end bearing. The loose end of the connecting rod then made a hole in the crankcase before pushing its way up

[1] The investigation started before 1 September 2005 when the department changed its name from the Accident Investigation Board for Civil Aviation and Railways to the Accident Investigation Board Norway (AIBN).

the cylinder wall and out through the water jacket. It was further established that on 19 April the same year the engine had been run with insufficient oil level and low engine oil pressure for a short period of time. According to the engine manufacturer, this had caused overheating of the pistons and the gudgeon pin. It is likely that such overheating could have impaired the connecting rod and the small end bearing, causing a split in the connecting rod just after departure from Rygge. It was pure coincidence that the incident occurred when it did. It was not affected by the commander's operation of the aircraft.

The DA40-D aircraft type, which received its type certificate from JAA, belongs to a new generation of aircraft with anticipated low operating costs. However, experience by the operator Oslo Flyveklubb has shown that their individuals of this aircraft type have had unacceptably low operational reliability. Repeated technical errors and frequent replacements of components have represented considerable challenges for the operator.

The Accident Investigation Board has issued a safety recommendation related to this investigation.

# 1. FACTUAL INFORMATION

## 1.1 History of the flight

1.1.1 The purpose of the flight was to refresh the pilot's experience of Diamond DA40. The commander took over the aircraft from another pilot who had flown it earlier that day. During the pre-flight inspection, the engine oil level was checked and found to be at the minimum level. It was then topped up by approx. 0.5 liters of oil. The aircraft had approx. 90 liters of fuel onboard, which was assessed to be more than sufficient for the scheduled flight. Nothing abnormal was discovered and the commander signed for the inspection in the log at 1050 hours.

1.1.2 The commander first flew from Kjeller Airport (ENKJ) to Rygge Air Force Base to practice landings. After four landings on runway 12 he wanted to return to Kjeller. He requested and obtained clearance from the tower (TWR) to head towards the SON reporting point and consequently took a left turn after departure. During the climb towards SON, he went through the checklists for cruise climb and cruise. When the aircraft had reached an altitude of approximately 1,600 ft., with an indicated speed of 100 – 110 kt and an approximate power setting of 75%, the commander heard scraping sounds coming from the engine. Immediately afterwards he heard a loud bang and the propeller stopped dead. At the time, the aircraft was 2 – 3 NM north of the runway. The commander made an immediate left turn and headed for the threshold of runway 12. He issued a distress call to the tower and reported that he intended to try and reach the runway 12 threshold. Best glide speed of approx. 70 kt was established and after a while the flaps were lowered one notch. The commander soon realized that he did not have sufficient altitude to make a normal approach to the runway. He communicated therefore to the tower that he would try to land in a field north of the airport. The commander consulted the emergency check lists with a restart in mind, but there was not enough time. He also presumed that there would be no point in trying to restart an engine which had stopped dead and which most likely had serious mechanical damage.

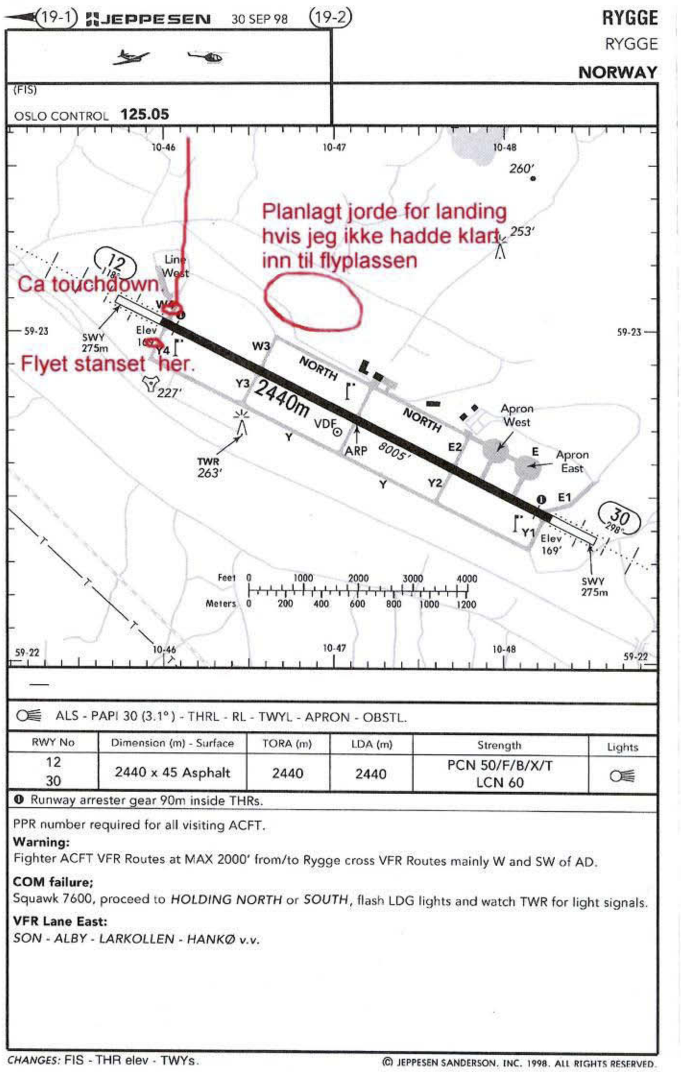


*Figure 1: The commander's description of the approach and landing.*

1.1.3 When the commander approached the airport he realized it would be possible to land on the taxiway W4 and Y4 across the runway (see Fig 1). According to the commander the decision to land on the taxiway was taken only approximately 300 m before the landing took place. He then realized that by adjusting his course somewhat he would manage to stay clear of a hangar and some trees. He reported his decision to the tower and landing took place approximately in the middle of W4. After braking for a short time, the commander released the brakes and rolled along Y4 for a bit and thus managed to move well clear of the runway. Having reported that the landing was successful and that the aircraft was clear of the runway, the commander switched off the power. Once outside the aircraft, he noticed that there was oil along the fuselage underside and on the left wing root, but that the plane seemed otherwise undamaged.

*Figure 2: Picture taken shortly after the landing. The aircraft approached over the two hangars in the background.*

## 1.2 Injuries to persons

*Table 1: Injuries to persons*

| Damage | Crew | Passengers: | Other |
|---|---|---|---|
| Fatal | | | |
| Serious | | | |
| Minor/none | 1 | | |

## 1.3 Damage to aircraft

Damage was limited to the engine (see Chapter 1.16 for more information).

## 1.4 Other damage

None

## 1.5 Personnel information

1.5.1 Commander, male 26 years old, trained as a private pilot at Oslo Flyveklubb (Oslo flying club). PPL (A) was issued on 11 April 2005. The class rating (Single Engine Piston) SEP-LAND was valid until 31 March 2007. The commander held a Class 2 medical license valid until 25 May 2009. The medical certificate had the following restrictions: ”VNL Shall have available corrective spectacles for near vision and carry a spare set of spectacles.”

1.5.2 The commander first started training on DA40, but due to many technical problems with this model, he also chose to qualify for PA-28 to have better access to club aircraft.

*Table 2: Flying experience commander*

| Flying hours | All types | Relevant type |
|---|---|---|
| Last 24 hours | 1 | 1 |
| Last 3 days | 1 | 1 |
| Last 30 days | 4 | 1 |
| Last 90 days | 12 | 2 |
| Total | 62 | 39 |

## 1.6 Aircraft information

1.6.1 General

1.6.1.1 Until around 1995, most planes operated by flying schools, aero clubs or private owners were old and well-tested with engines built according to construction principles developed around 1935. Various plane and engine manufacturers, particularly in "experimental circles," have developed new designs over a number of years. However, these have only to a limited extent been subject to ordinary type certification.

1.6.1.2 DA40 belongs to a new generation of planes developed for flying schools, aero clubs and the private market with ordinary type certification. As for several other similar planes, modern electronics and instrumentation have been used to a large extent. The model is aerodynamically optimized with the hull and wings mainly constructed by composite material. The initial flight took place in 1997 with a Lycoming IO-360 180 horse power engine.

1.6.1.3 A desire to reduce fuel consumption and increasing problems with access to AVGAS 100LL led to the development of small diesel engines for airplanes. When Diamond received type certification for the DA40 with a Thielert 125-01 diesel engine this was quite unusual. The model, which was called DA40-D, flew for the first time in 2002. It became an attractive and economical plane for aero clubs. Thielert 125-01 can run on diesel or JET A-1. This reduces fuel consumption and ensures simpler and cheaper access to fuel than conventional piston engines using AVGAS 100LL.

1.6.1.4 The DA40-D model is certified according to the construction provisions in JAR-23 Amendment 1, whereas the engine type is certified pursuant to JAR-E Change 10. The propeller originally had a German type certificate based on the certification provisions in FAA FAR Part 35 Amendment 35-5. EASA has later on issued type certificates based on the earlier type certifications for the aircraft, engine and propeller types (cf. EASA Type Certificate Data Sheet (TCDS) numbers A.022, E.055 and P.094, respectively).

1.6.1.5 Several Certification Review Items (CRI)[2] were defined during the JAA-certification of the DA40-D relating to the engine and associated systems. In this context five *Equivalent Safety Findings were also established.*[3].

[2] CRI are focus areas which are given special attention during the certification process
[3] Equivalent Safety Findings are findings which are either not covered by the certification regulations or which do not comply with the certification requirements, but where the type certifying authority nevertheless finds that safety has been sufficiently ensured.

1.6.2 Relevant data

| | |
|---|---|
| Manufacturer: | Diamond Aircraft Industries GmbH |
| Designation of type: | DA40-D |
| Serial number: | D4.028 |
| Year of manufacture: | 2003 |
| Airworthiness certificate: | Valid until 30 September 2005 |
| Total flight time: | 743 hours |
| Time since the last inspection: | 35 hours (100-hour inspection) |
| Type of engine: | Thielert Aircraft Engines (TAE) 125-01 |
| Engine serial number: | 02-01-0309-SL01-004-0133 |
| Engine total time: | 605 hours |

1.6.3 Mass and balance

According to the commander's calculations the actual mass at the time of the occurrence was 928 kg including 76 liters of fuel of the JET A-1 type. The location of the center of gravity was 2.43 m. This was within the limitations of 2.40 m – 2.60 m. Maximum permitted take-off mass is 1,150 kg.

1.6.4 In general about the engine

1.6.4.1 The TAE 125-01 engine design was developed and certified by Thielert Aircraft Engines. The engine is based on a heavily modified diesel car engine with a displacement of 1.7 liters. The engine is water cooled and turbocharged and produces 135 hp at 3,900 rpm. It has two separate oil systems for the engine and gear box respectively. It is only the engine's oil system which is relevant to and has been discussed in this report. Manufacture of this engine ceased in 2006 when it was replaced by a two-liter engine with the same output. This was marketed under the name Centurion 2.0.

1.6.4.2 Thielert Aircraft Engines experienced major financial problems in 2008. However, the company has continued a limited production under the management of a liquidator. The company has also an after sales support department which provides customer support for products delivered from 2002 and on.

1.6.5 Engine oil system

1.6.5.1 According to the *"Aircraft's operating limitations"* of 3 March 2003 the minimum oil pressure is 1.2 bar. This was still published as the applicable minimum oil pressure in June 2008. The oil pressure is indicated in the cockpit with 10 diode lights in the following manner:

2 x Red <1.2 bar

1 x Yellow 1.2 – 2.3 bar

4 x Green 2.3 – 5.2 bar

1 x Yellow 5.2 – 6.5 bar

2 x Red > 6.5 bar

The manufacturer has later informed the AIBN that minimum oil pressure limit was changed from 1.2 bar to 1.0 bar in 2010.

If the oil pressure deviates from the green range one of the yellow lights will start flashing. There will be a short sound signal and a central CAUTION light will start flashing[4]. By pressing an "acknowledge button" the CAUTION light will be switched off and the yellow light will remain on.

1.6.5.2 In order to cool the piston, engine oil is sprayed by an oil cooling nozzle into a cannel inside the piston. The oil flow varies with the oil pressure, but has no cooling effect below 2 bar oil pressure. There is, however, no piston cooling necessary at low power output, like idle.

1.6.5.3 The engine's oil level can only be read by means of a dipstick which runs via a long pipe down into the engine's oil sump. Permitted oil level is between minimum 4,5 liters and maximum 6 liters. In March 2004, the flying club added a separate column in the *"Aircraft journey log book"* for registration of oil top-ups. According to the aircraft's operating limitations of 3 March 2003, the maximum permitted oil consumption is 0.1 liter/hour.

1.6.5.4 The engine's maximum permitted oil temperature is 140 °C.

1.6.6 Aircraft history

1.6.6.1 Oslo Flyveklubb purchased the aircraft new on 18 July 2003. From the moment the aircraft arrived at the club, there were a number of technical problems with the aircraft and the engine. After 137 flight hours a new engine was installed[5]. However, the problems continued and several engine components were replaced. For example; the gear box and the clutch had to be replaced after a total of 419 flight hours, the electronic engine control had to be replaced after 491 hours and the clutch had to be replaced once more after 580 flight hours. This was mainly scheduled replacements in accordance with instructions from Thielert. Although these replacements were covered by the manufacturer's guarantee, the extensive maintenance resulted in the aircraft being out of operation for long periods. A review of the *"Journal of remarks and actions"* in the aircraft's log shows 49 entries during the period 18 July 2003 to 14 May 2005. A substantial part of these were related to fault signals due to problems with sensors and electrical plugs.

1.6.6.2 Gradually, the engine developed high oil consumption. The problem was highlighted on 19 April 2005 when a yellow warning light indicating low oil pressure came on

[4] According to a revision of the AFM in 2008, the oil pressure must drop into the red range to cause the CAUTION light to start flashing if the RPM indication is less than 1 500 RPM with the power lever at IDLE.

[5] It was this engine, with serial number 02-01-0309-SL01-004-0133, which was in the aircraft at the time of the engine failure

approximately 30 NM before landing at Kjeller Airport (See also Chapter 1.11). According to the log, the oil level in the engine was full prior to departure from Kjeller. During a stopover at Fagernes airport Leirin (ENFG) after one hour's flight, the commander checked the oil level, which was half full (between maximum and minimum on the dipstick). The yellow light came on during the return trip to Kjeller, after a flight time of approximately 40 minutes. After landing the engine was refilled with 3 liters of engine oil. The engine’s total running time was then 565 hours. The technical supervisor of the club consulted Thielert and submitted downloaded data from the engine's electronic control system (Full Authority Digital Electronic Control – FADEC). On 6 May 2005, TAE Support replied the following:

> *”According to the data you have sent, we have no objections against further operation.”*

One of the reasons for this statement was that no oil pressure below the minimum of 1.2 bar had been registered during the flight. After advice from Thielert, it was nevertheless decided to replace the turbo, as this was suspected to be the cause of oil consumption above the permitted maximum level. However, calculations after the incident showed that the oil consumption actually increased after the turbo was replaced on 14 May 2005, from approximately 5 liters in 40 hours to approx. 11 liters in 40 hours[6].

1.6.6.3 In connection with the high oil consumption, the club reviewed the method for verifying the oil level. During the review, it emerged that the dipstick indications varied considerably according to whether the engine was warm or cold, and according to how much time passed between stopping the engine and checking the oil level. For a better understanding of the oil consumption, the club decided to fill up the engine during the first inspection of the day when the engine was cold. The oil consumption would then be checked before each flight.

1.6.6.4 After the turbo had been replaced, the aircraft underwent a 100-hours inspection on 3 June 2005 at an engine time of 570 flight hours. The engine was then topped up with 4 liters of Shell Helix Ultra 5W40 oil on the engine and 1 liters of EP 90 oil on the gear box. The engine failure occurred after the aircraft had a total flight time of 743 hours. Correspondingly, the engine had run for 605 hours.

1.6.6.5 The technical supervisor of the club, who was also a licensed aircraft technician, conducted the daily follow-up and coordination of any technical issues regarding LN-NEX (see also chapter 1.17). This also applied to the club's other aircraft of the same type (LN-NEZ) which had experienced similar operating problems. Based on orders from the technical supervisor, most major maintenance tasks were conducted by Aeromech AS at Kjeller Airport. The airplane workshop is a JAR 145 organization which is certified for, among others, the DA40-D model. The club's technical supervisor was of the opinion that maintenance and technical issues ideally should be coordinated with Aeromech. However, discussing engine problems with Aeromech, who then had to consult Diamond and finally Thielert, took up much time and resources. In practice, the technical supervisor of the club often had to contact Thielert directly. Despite the direct contact, the technical supervisor was critical of the engine manufacturer's ability to understand and solve the problems that occurred.

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[6] Calculated according to oil top-up registrations in the aircraft's log

1.6.7 Aircraft Flight Manual

1.6.7.1 The DA40-D Airplane Flight Manual, including revision 3 of 26 May 2003, contains several emergency procedures. The manual distinguishes, for instance, between the procedure for start of windmilling propellers and stationary propellers. The procedure for *"Restarting the engine with stationary propeller"* contains for example 10 items.

1.6.7.2 The checklist for *"3.5.1 Emergency landing with engine off"* states the following:

1. Select suitable landing area. If no level landing area is available, a landing on an upward slope should be sought.

2. Consider wind

3. Approach: If possible, fly along a short-cut rectangular circuit. On downwind leg of circuit the landing area should be inspected for obstacles from a suitable height. The degree of offset at each part of the circuit will allow the wind speed and direction to be assessed.

4. Airspeed……………………………….. 73 KIAS (1150 kg, 2535 lb.)
   68 KIAS (1000 kg, 2205 lb.)
   60 KIAS (850 kg, 1874 lb.)

5. Radio………………………………….. Advice ATC

6. Emergency fuel valve…………………. OFF

7. ENGINE MASTER…………………… check OFF

   *when it is certain that the landing field will be reached:*

8. Flaps…………………………………… LDG

9. Safety harnesses……………………….. tighten

   **CAUTION**
   If sufficient time is remaining, the risk of fire in the event of collision with obstacles can be reduced as follows:

   ELECTRICAL MASTER………… OFF

10. Touchdown……………………………. with the lowest possible airspeed

1.6.7.3 The aircraft flight manual chapter *"Abnormal Operating Procedures"* (dated 1 June 2008) states the following under the heading *"Low oil pressure"*:

- Reduce power
- Monitor oil temperature (OT)
- Expect loss of oil with engine failure. Prepare for an emergency landing in accordance with 3.5.1 – EMERGENCY LANDING WITH ENGINE OFF

## 1.7 Meteorological information

The commander has reported the following meteorological information:

Wind: 210° 8 kt. CAVOK. Temperature: 20 °C. Dewpoint: 9 °C. QNH: 1018 hPa

## 1.8 Aids to navigation

Not relevant

## 1.9 Communication

Normal two-way VHF-radio communication was maintained throughout the flight between the commander and the relevant air traffic control units.

## 1.10 Aerodrome information

1.10.1 At the time of the incident, Rygge was a military Air Force Base with limited civil operations.

1.10.2 The runway is 174 ft. above sea level.

1.10.3 The combined length of the W4 and Y4 taxiways was approximately 540 m. The minimum width of the taxiways was 15 m. W4 rises considerably towards the runway and Y4 slopes slightly down from the runway. See also Fig. 1 and 2 for further details.

## 1.11 Flight recorders

1.11.1 The aircraft was not equipped with a conventional Flight Data Recorder (FDR) or Cockpit Voice Recorder (CVR). This is not a requirement for this type of aircraft.

1.11.2 The aircraft had Full Authority Digital Electronic Control (FADEC) which recorded a number of parameters. From the unit a list can be downloaded of any exceeded given values. For example, any oil pressure of 1.2 bar or lower will be recorded. A complete data log for the last three hours of flying can also be downloaded. All recorded information from both the flight on 19 April 2005 (see section 1.6.6.2) and the relevant incident on 2 July was available during the investigation.

1.11.3 The data log shows that the oil pressure after departure from Fagernes on 19 April was approximately 2.5 bar, but that it dropped slowly to 2.3 bar approximately 25 minutes into the flight. . During the approach to Kjeller, approximately 36 minutes after departure, the oil pressure had dropped to 2.1 bar. This emerges from the printouts from the data logs below.

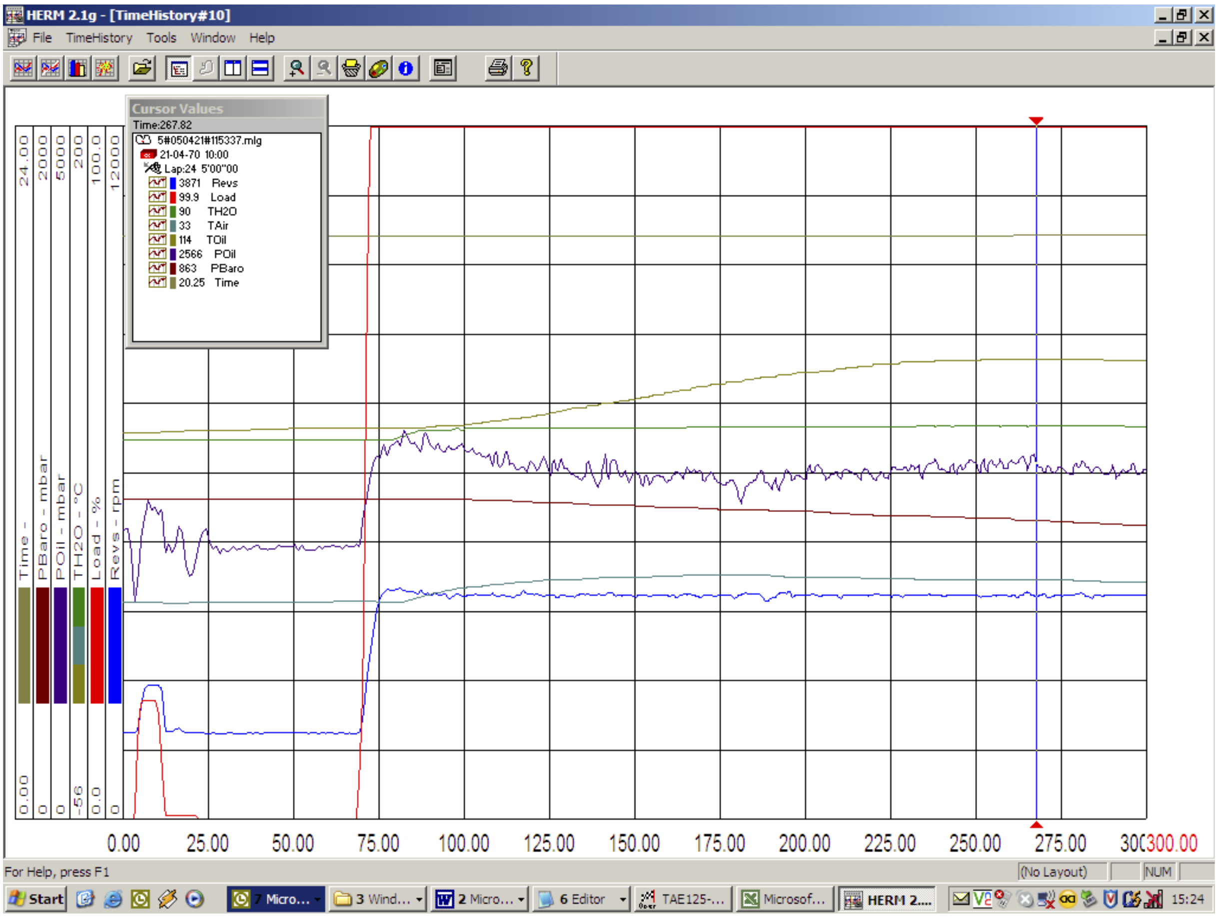

Figure 3: The FADEC data log printout shows that the oil pressure (dark blue graph) was approximately 2.5 bar during the departure from Fagernes on 19 April 2005.

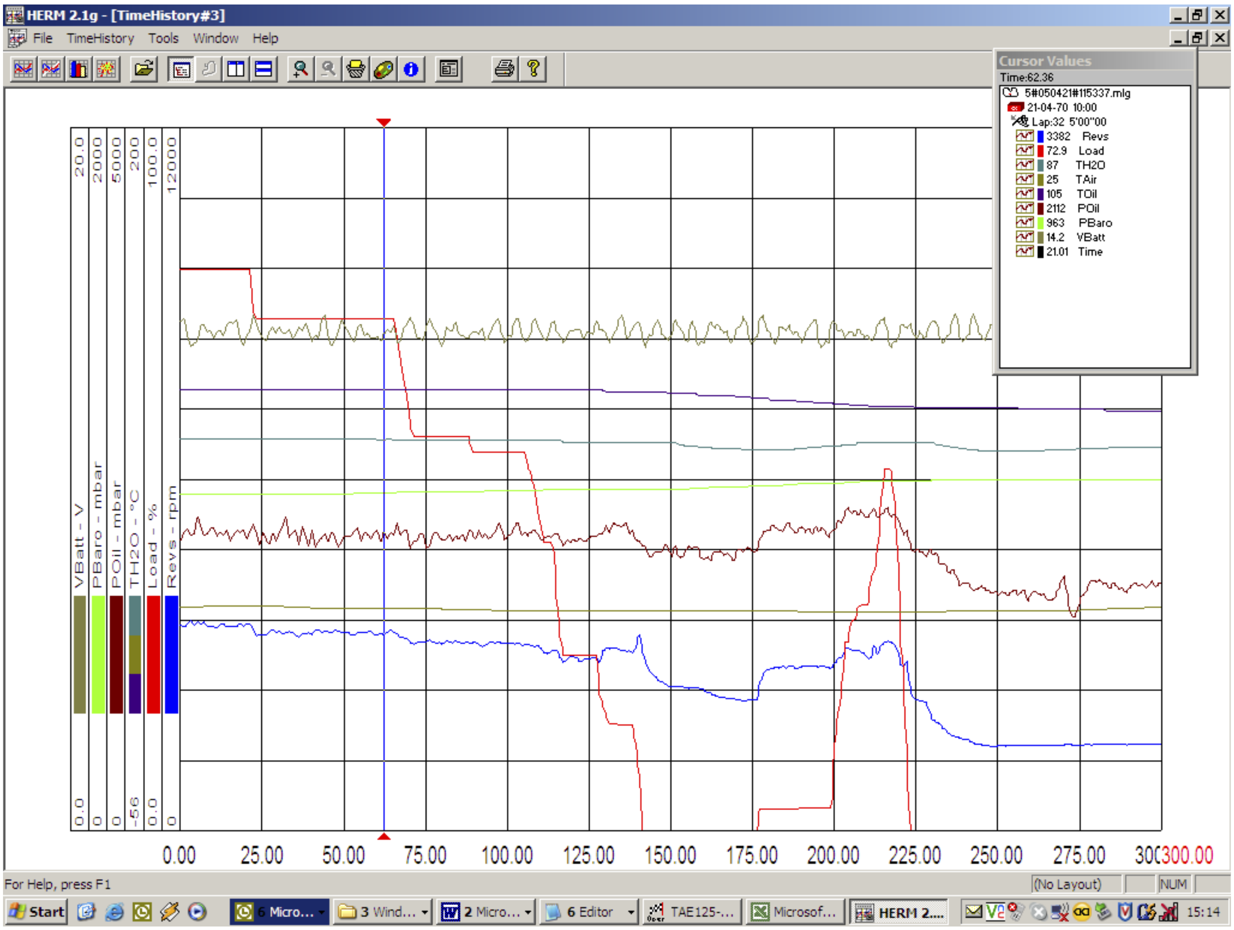

*Figure 4: Printout from the FADEC data log showing that the oil pressure (brown graph) was approx. 2.1 bar during the approach to Kjeller on 19 April 2005.*

1.11.4 Correspondingly, the FADEC data log was printed out in connection with the engine failure on 2 July 2005.

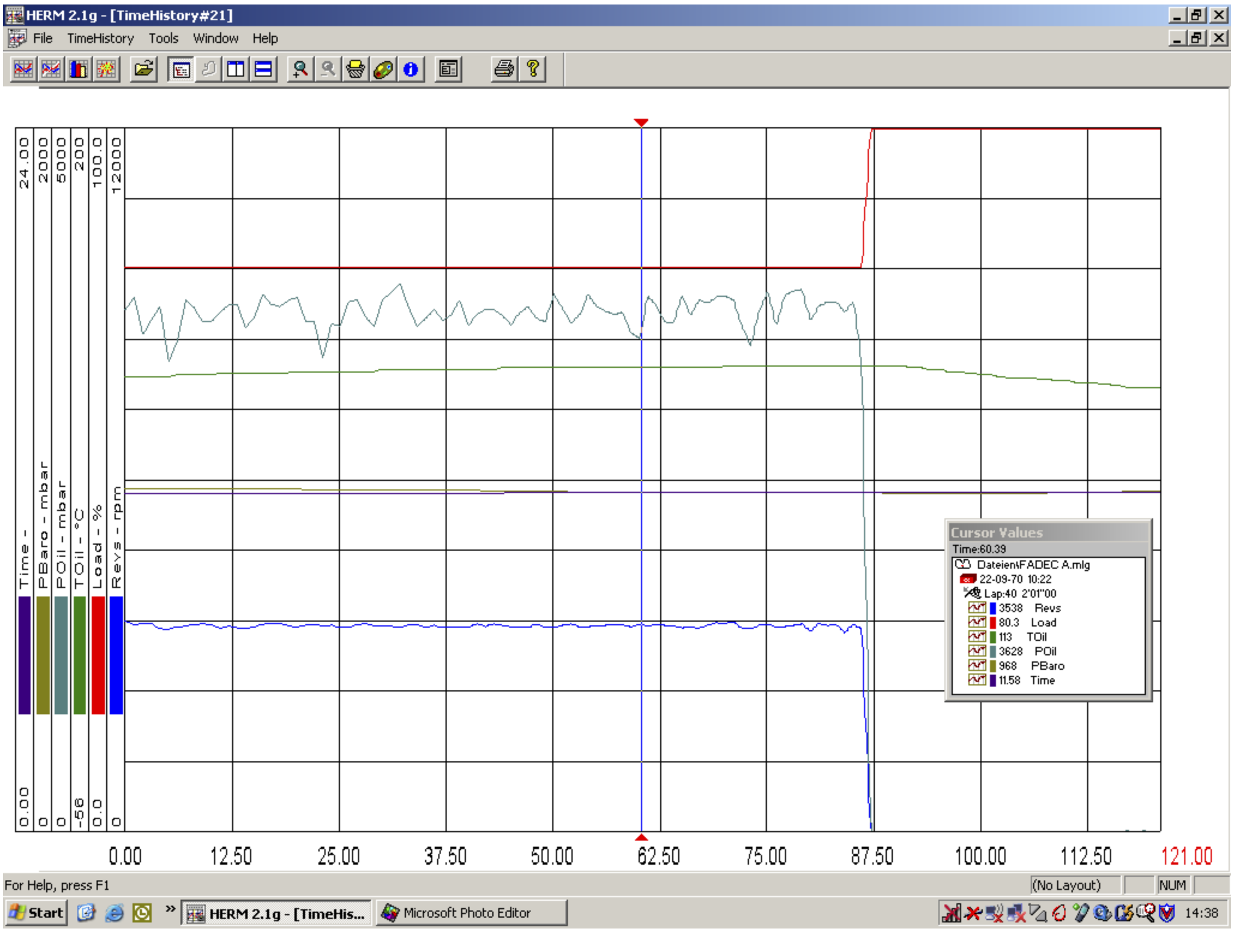


*Figure 5: Printout from the FADEC data log showing that the oil pressure (turquoise graph) was 3.6 bar before the engine suddenly stopped.*

## 1.12 General inspection of the airplane

1.12.1 The investigation conducted at the site of the emergency landing confirmed that there was a hole on the lower right-hand side of the engine where the crankshaft was visible, and a hole on the left side where parts of a connecting rod were sticking out. Furthermore, there was engine oil and cooling fluid leakage in the engine compartment. It was decided that the aircraft should be transported to the Accident Investigation Board's premises in Lillestrøm so that the engine could be removed and sent to the engine manufacturer Thielert in Germany for closer inspection (see chapter 1.16).

1.12.2 During the removal, approximately 3 liters of engine oil level were drained from the engine.

## 1.13 Medical and pathological information

No body fluid samples were taken.

## 1.14 Fire

There was no fire as a result of the incident.

## 1.15 Survival aspects

1.15.1 The commander wore the standard seat belts.

1.15.2 From the moment the engine stopped and before the aircraft landed it flew over a number of fields which would have been suitable for an emergency landing.

1.15.3 The air traffic controller in the tower raised the alarm. The Air Force Base Fire and Rescue Service turned out and were ready at the runway as LN-NEX landed.

## 1.16 Tests and research

1.16.1 The engine was examined at the engine manufacturer's premises on 11 October 2005. An inspector of accidents from AIBN was present and in charge of the investigation work. The photos below were taken when the engine was removed and show the damage to the engine.

*Figure 6: The left-hand side of the engine with the connecting rod sticking out.*

*Figure 7: The engine oil filter contaminated by metal particles.*

*Figure 8: Picture viewing down into the cylinders. The piston in cylinder no. 3 (no. 2 from the left) was slightly damaged as a result of the impact with the cylinder head.*

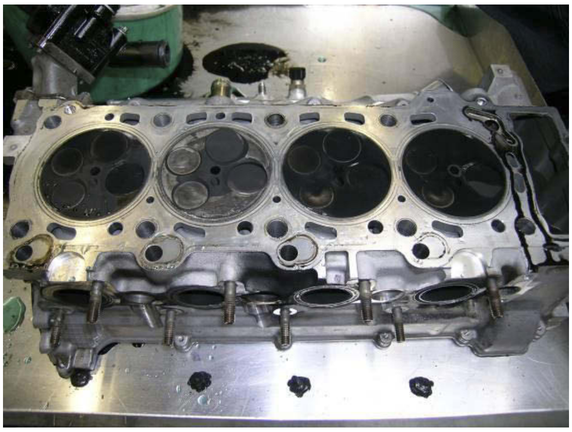

*Figure 9: Corresponding damage to the cylinder head in cylinder 3.*

*Figure 10: Damage to the crankshaft's journal bearing no. 1.*

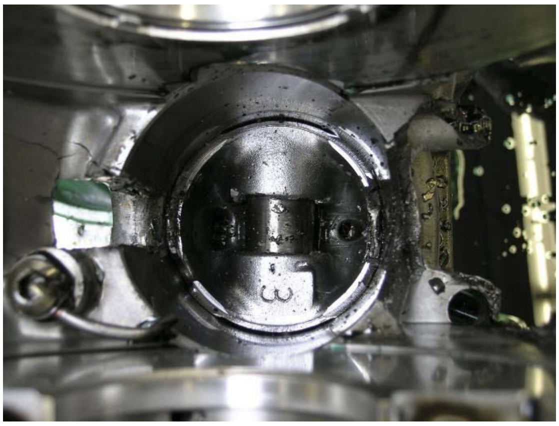

*Figure 11: Cylinders and piston no. 3 after the crankshaft and the connecting rod had been removed.*

*Figure 12: The connecting rod and the piston from cylinder no. 3.*

*Figure 13: Small and large metal debris were discovered in the oil pan and oil filter unit.*

*Figure 14: Burnt carbon deposits on the inlet valve.*

*Figure 15: The colors on the gudgeon pins indicate overheating.*

*Figure 16: Color difference. Piston which has run for 1000 hours (reference piston) to the left and piston no. 1 from LN-NEX to the right.*

*Figure 17: Color difference. Piston which has run for 1000 hours (reference piston) to the left and piston no. 1 from LN-NEX to the right.*

1.16.2 In addition to the obvious visible outside damage on the engine the following was observed:

- The expected quantity gear box oil was drained from the reduction gear box (the oil was light and not mixed with engine oil).
- The combined oil pump on the gear box was mechanically intact.
- The motor oil filter was heavily contaminated by metal particles, including metal of the type present in the upper bearings of the connecting rod (the gudgeon pin).
- No mechanical damage on the clutch between the motor and the gear box.
- Injection nozzles of normal appearance.
- A valve rocker arm for the front exhaust valve on cylinder no. 3 was broken and was lying loose on top of the cylinder head.
- The bearings and the cams on the camshafts were in good condition.
- The cylinder head was in good condition, but there were clear evidence from impact between the piston and the cylinder head with associated valves in cylinder no. 3. There was some carbon on the cylinder head of the other cylinders, but this had nearly disappeared due to the impact with the piston in cylinder no. 3.
- There was a lot of burnt carbon on the inlet valves.
- The oil sump contained large amounts of ground-up bearing materials, parts of the upper end of connection rod no. 3 and several crankcase bits.
- The engine's primary oil pump was intact and showed little sign of wear and tear. However, there were small grooves on the cog wheels indicating that the oil had been contaminated by metal particles.
- The suction strainer to the oil pump was not clogged as a result of contamination.

- The piston cooling oil nozzles for piston 1, 2 and 4 appeared to be intact and aligned. The damages on the nozzle for piston 3 were obviously secondary damage linked to the engine failure. No system flow check was, however, performed.

- The crankshaft bearings were in good condition and showed little sign of wear and tear. However, the journal bearing liners of bearing no. 1 and 2 (opposite end of the gear box) had small areas where there were depressions in the bearing material (see figure 10).

- Rod no. 3 was without the upper half of the small end bearing. The connection rod was slightly bent and the fracture surfaces and the surface of the small end bearing were completely deformed.

- There was major damage to the underside of piston no. 3 and the gugeon pin was in place. Some flattened bearing material from the small end bearing was left around the gudgeon pin.

- There were scratches on the surface of gudgeon pin no. 3, as well as signs of severe wear and tear.

- With the exception of clear overload damage in cylinder no. 3, all cylinders were in good condition and without significant wear and tear.

- No bearing or gasket defects were discovered in the turbo. Nor were there any signs of oil leaks in connection with the turbo.

1.16.3 On the basis of the investigation, Thielert prepared report no. OIR-02-01-02-07-2005 *"Occurrence Investigation LN-NEX"*. We quote from the report:

> *"Bearing failures, in general are caused by lack of lubrication. Therefore it is assumed that the initial damage was caused at least 40 hours before this occurrence happened with at least one flight with too low oil pressure. Furthermore a long-term high oil consumption, above defined max. oil consumption published as limitation in the engine Operating and Maintenance Manual, OM-02-01, was recognized before.*
>
> *The high oil consumption after the replacement of the turbocharger seems to be the result of a hyper sensitisation of the pilots. This was caused by the fact that the oil level increases in the first 3 to 5 minutes after engine shut down. By checking the oil level immediately after shut down, the indicated oil level is lower than the actual oil level. This can lead to overfill the engine with oil. The overfilled oil will be rejected via the breather line.*
>
> *TAE conducted several oil inspection tests depending on the oil specification and on time. It was found out that independent of the oil specification the oil dip stick shows after five minutes 80%, after 17 minutes 90% and approximately after 30 minutes 100%."*

## 1.17 Organizational and management information

1.17.1 The relevant flight is classified as a private flight, which entails that the commander was personally responsible for complying with the relevant laws, regulations and administrative provisions. Moreover, the flight took place under the direction of Oslo Flyveklubb which is affiliated with the airplane section of the Norwegian Air Sports Federation (NLF). This means that to rent one of the club's aircraft the commander had to comply with the club's internal provisions, such as the club's own check-out program for this type of aircraft.

1.17.2 Maintenance of aircraft defined for private use must take place in accordance with the Norwegian aviation regulations BSL B 2-3. LN-NEX is in this connection classified as a small aircraft in maintenance category II. The following requirements apply to powered aircraft in maintenance category II:

*”a) aircraft used for private purposes shall be maintained in accordance with the manufacturer's maintenance program.*

*b) 100-hour inspections, minor repair works and minor modifications can be carried out by an airplane workshop, authorized workshop, licensed aircraft technician or person with special permission from the Civil Aviation Authority.*

*c) yearly inspections, more extensive inspections than a 100-hour inspection, major repair works and major modifications must be performed by an airplane workshop or authorized workshop.*

*(3) Powered aircraft in maintenance category II and III classified as private and operated by an aero club, must be maintained according to an authorized maintenance program.”*

1.17.3 LN-NEX was operated by Oslo Flyveklubb. The club has its own maintenance program which has been approved by the Civil Aviation Authority. In short, the maintenance program entailed that the club's technical supervisor was responsible for following up the maintenance of the aircraft, whereas Aeromech was responsible for the execution of the maintenance tasks referred to in section c) above. As to the extent of the Accident Investigation Board's investigations, the relevant regulations and maintenance program have been complied with.

## 1.18 Additional information

1.18.1 Based on the experience with the two DA40-D planes in Norway and this incident with LN-NEX, the Civil Aviation Authority wrote a letter to the European Aviation Safety Agency (EASA) on 28 November 2005 expressing concern about the operational reliability of the engine and whether it was suitable as an aero club aircraft.

1.18.2 In August 2009, the Austrian Accident Investigation Board (Unfalluntersuchungsstelle des Bundes – Fachbereich Luftfahrt) (UUB/LF) issued a report seriously questioning the type certification of Diamond 40 and 42 with Thielert engines. In the report, the UUB/LF makes several safety recommendations to the EASA. The AIBN has noted two recommendations in particular (AIBN translation from German into English):

> *”SE/UUB/LF/9/2009: Within the framework of the type certification of the aircraft, engine and propeller according to CS-23, CS-E and CS-P, we request a general assessment to be conducted as regards the potential impact of the AMCs, CRIs, and Special Conditions for the aircraft in general.*

*SE/UUB/LF/11/2009: Change CS-E for piston engines in order to demonstrate, prior to the first customer delivery of a new engine type, that the complete and conform engine installation has functioned well over a period of time which includes a significant part of the running time between overhauls, without the occurrence of engine failures or other significant mechanical defects."*

### 1.19 Useful or effective investigation techniques

During this investigation, no methods have been used which require special mention.

# 2. ANALYSIS

### 2.1 Introduction

2.1.1 It seems clear that the reasons for this serious aircraft incident have no connection to the way the commander operated the aircraft during the actual flight. It was pure coincidence that the incident occurred when it did. For that reason the analysis will mainly discuss the aircraft's design, operational reliability, maintenance and operations by the club.

2.1.2 Having said that, the AIBN would like to commend the commander for his rational and resolute actions during the incident. He was capable of both flying the aircraft and considering alternative landing grounds whilst communicating with the air traffic control. He chose a field which most likely would have functioned well as an emergency landing ground. When he realized later on that he might be able to reach a taxiway, he still left the option of landing in the field open until he was sure that he would reach the taxiway. There are many examples of pilots rejecting acceptable emergency landing grounds with good approach opportunities because they discover a seemingly better place to land. When the new emergency landing ground then turned out to be unsuitable, it was too late to return to the first alternative. In this case, the commander kept two emergency landing options open until he was sure that he would be able to reach the best alternative.

2.1.3 We would also like to draw attention to the commander's correct prioritization as he chose not to spend any of his limited time on trying to restart the engine. When a propeller suddenly stops with a bang, it is very likely that there is mechanical damage in the engine which again indicates that there is not much chance of restarting the engine. The commander's performance during the incident proves that critical situations can be solved in a good manner by focusing on ”Aviate – Navigate – Communicate”, leaving other actions to be performed according to the pilot's capacity.

### 2.2 The operational reliability of the engine

2.2.1 <u>General</u>

The DA40-D model appeared to be an attractive and economical plane for aero clubs. It was soon discovered, however, that the operational reliability was not as good as Oslo Flyveklubb had expected. Defects occurred and components had to be replaced. To make up for the recurrent problems, the manufacturers introduced a series of improved components which were gradually installed. Furthermore, some maintenance intervals were reduced. This did not seem to improve the general picture significantly and the club continued to have operational problems with LN-NEX right up until the time of the incident. This presented new challenges for Oslo Flyveklubb, which had broad previous operating experience of simple, reliable planes of a more conventional type. AIBN is of the opinion that this serious incident highlights two important issues which are described below.

2.2.2 Type certification

2.2.2.1 AIBN is of the opinion that the incident gives reason to question the type certification conducted by JAA. Also the Austrian Accident Investigation Board has expressed its doubt about the certification process (see section 1.18.2). The Accident Investigation Board has not looked into in detail how Diamond and Thielert documented that the certification requirements were complied with during the type certification. We can, however, establish that the aircraft type as it was operated in the club, did not maintain an acceptable level of operational reliability. AIBN is of the opinion that the frequent technical problems and warning signals constituted a safety hazard. Firstly, defects occurred which in certain circumstances could have been serious, and, secondly, one must assume that the repeated warning signals weakened the respect for warning signals in general. Some "teething problems" must be expected with new aircraft types. However, in this case, it may seem that the type of aircraft and engine installation had not been sufficiently tested, and were somewhat incomplete, when they were released on the market, which gives grounds for concern.

2.2.2.2 In this connection, the Accident Investigation Board finds that the recommendations made by the Austrian Accident Investigation Board (UUB/LF) were highly relevant. As the issue is also relevant for aircraft registered in Norway, the Accident Investigation Board believes it is important that the Civil Aviation Authority follow up the issues from a Norwegian perspective, possibly in cooperation with the Austrian supervisory authorities. Further, it might be beneficial for EASA to assess experiences from operation of this aircraft and engine combination regarding possible improvements of the type certification processes.

2.2.3 Introduction of complex aircraft in aero clubs.

2.2.3.1 It is to be expected that aircraft with many complex systems are more demanding for the operator with regard to follow-up and maintenance than has been the case with more conventional light aircraft. Aero clubs in Norway are run by its members on a voluntary basis. Furthermore, their operations are based on experience gained throughout the years with aircrafts such as the Piper PA-28 and Cessna 172. When Oslo Flyveklubb acquired the two DA40-D planes the club had to adapt to a new reality involving modern instruments, a water-cooled diesel engine and several electronic control systems. In addition, the club had to deal with repeated technical problems and comprehensive maintenance. Furthermore, it seems that neither the aircraft maintenance facilities in Norway, nor the aircraft manufacturer or engine manufacturer was prepared for the club's extensive need of assistance. The result was that the aero club's new planes were grounded for long periods of time. Pilots in the aero club became accustomed to false error messages and at times the club's technical supervisor was in doubt as to whether the aircraft could be used. This doubt was intensified by the fact that the aircraft and engine manufacturer did not seem to show the necessary understanding of the problems that the aero club was experiencing.

2.2.3.2 AIBN is of the opinion that the aero club’s technical supervisor handled the many technical issues in a proper manner. This was partly due to the fact that he was a licensed aircraft technician. However, AIBN finds that a technical supervisor of an aero club should not be expected to handle the kind of problems that occurred in this case. Generally, one may question whether the communication chain between pilot – technical supervisor – maintenance facility – aircraft manufacturer – engine manufacturer is suitable for problem-solving when new aircraft models are introduced. In this case, the technical supervisor of the club, who was also qualified to fly this type of aircraft, assumed responsibility for solving the problems directly with the manufacturers. AIBN believes, however, that the problems that were identified when the DA40-D was introduced show that Norwegian aero clubs do not generally have the experience and resources that are required during phase-in of a new and complicated aircraft model. Consequently, AIBN believes that these challenges should be discussed before other Norwegian aero clubs acquire new advanced and untried aircraft models.

## 2.3 Reasons for the engine failure

2.3.1 The AIBN agrees with the engine manufacturer's view that the engine failure is likely to have occurred as a result of insufficient lubrication, or, more specifically, due to the lack of piston cooling caused by low oil pressure. Generally speaking, traditional air-cooled aircraft engines have a large cylinder volume, rotate at low rotational speeds and have a relatively low power output compared to their cylinder volume. A TAE 125-01 engine provides 135 hp at 3,900 RPM with a displacement of only 1.7 liters. This would normally entail a higher mechanical load on parts such as pistons and connecting rods.

2.3.2 The color differences on the pistons indicate that they have been considerably hotter than the reference piston (see Figure 17). The color differences on the gudgeon pins also indicate a high temperature. The small end bearing is normally one of the most heavily strained bearings in a piston engine. The small end bearing in the connecting rod may have failed because the steel alloy in the connecting rod was impaired as a result of high temperatures. Due to mechanical damage in the fracture surface it has not been possible to retrieve information based on the fracture surface itself. It is also possible that the high temperature caused deterioration in the small end bearing and thus abnormal strain on the connecting rod.

2.3.3 When the small end bearing split, the piston disconnected and became stationary. Later, it was struck by the rod on its way up the cylinder. This has most likely resulted in the piston striking the valves with such force that one of the valve rocker arms broke. How many times the loose connecting rod has travelled up and down inside the cylinder cannot be established. At one time, however, it came below the edge of the cylinder skirt. On its way up again it pushed through the cylinder wall, through the water jacket and all the way to the outside of the engine. This resulted in the engine going from practically normal rotational speed to full stop in the course of less than half a rotation. The hole in the crankcase on the engine's right-hand side was most likely caused by the loose rod at one time also having broken through the wall of the crankcase.

2.3.4 No other damage or defects have been discovered which may explain the broken connecting rod, including broken piston cooling oil nozzles[7]. As regards the probable poor cooling of the pistons, it is natural to look at the incident which took place on 19 April 2005 (see section 1.6.6.2). This is the only known occasion when the engine has flown with low oil pressure. Low oil pressure will inevitably lead to lower flow through

[7] Ref. EASA AD No.: 2008-0016 R1 and Thielert Service Bulletin TM TAE 125-0017 R2

the fixed nozzles and thus poorer cooling of the pistons' underside. A low oil level can further worsen the situation. It is therefore possible that the engine flew for 40 flight hours before the heat damage caused ultimate engine failure.

2.3.5 During the approach to Kjeller on 19 April 2005, the oil temperature was 105 °C, which is well below the maximum permitted oil temperature of 140 °C. This may imply that the oil temperature alone does not give an accurate indication of the temperature in critical engine components.

## 2.4 High oil consumption and flying with low oil pressure

2.4.1 Thielert states in their report that the oil consumption before the incident on 19 April 2005 was ”*above defined max. oil consumption published as limitation…..”* AIBN has not established whether the high oil consumption was a result of incorrect oil level readings, or whether the engine used more oil than permitted (in the relevant case approx. 0.13 instead of 0.1 liter/hour) or a combination of these factors. The problems experienced in connection with oil level verification illustrate the extra caution that is required during operation of this type of engine. The oil level must be checked according to a strict procedure and the oil consumption must be monitored continuously to ensure that it is safe to operate the aircraft. What appeared as an increased oil consumption following the turbo change 14 May 2005 was most likely caused by an increased focus on checking oil level and fear of flying with too little oil. Thus, it is difficult to conclude whether it was actual increased oil consumption or the engine getting rid of excessive oil. The AIBN has not got into detail to investigate the cause to what appeared as high oil consumption.

2.4.2 Furthermore, AIBN has not established whether the oil level in the engine was too low upon departure from Kjeller in the morning of 19 April, or correspondingly, whether the oil level in the engine was too low when the aircraft took off from Fagernes later on in the day. In our opinion, the most important aspect here is that the club's technical supervisor transferred all relevant information to Thielert so that the engine manufacturer could provide the best possible advice on whether it would be safe to continue flying the aircraft. As far as we can determine, the technical supervisor was only advised to replace the turbo on the basis of the incident on 19 April.

2.4.3 That there in retrospect are indications that the engine could be damaged by flying with the yellow low oil pressure warning light on, seems quite remarkable given that the minimum permitted oil pressure is listed as 1.2 bar, and has later even been altered to 1.0 bar. During the incident on 19 April 2005, the oil pressure was between 2.5 and 2.1 bar. It is, of course, not desirable to be in a situation where the yellow warning lights come on during the flight. If the consequences are as serious as they appear to be in this case, a clear warning should be issued against flying with the yellow light on. AIBN is of the opinion that the technical supervisor displayed sound judgment when he contacted Thielert and asked for advice. The fact that the engine manufacturer did not request an inspection of the engine could indicate that the manufacturer was not aware of the serious consequences low oil pressure could have for the engine. Moreover, the fact that even in the 2008 aircraft flight manual there are no warnings that a yellow light should warrant an inspection, may indicate that the engine manufacturer has not taken the problem seriously enough. AIBN is of the opinion that the aircraft flight manual should contain warnings of the potential consequences of flying with yellow warning lights for low oil pressure, and issue recommendations to that effect.

# 3. CONCLUSIONS

## Investigation results

a) The commander had valid license and privileges for the aircraft type.

b) The aircraft was registered in accordance with the regulations and had a valid environmental and airworthiness certificate.

c) The aircraft's mass and the location of its center of gravity were within the permitted limits.

d) The weather was not a factor in the incident.

e) The DA40-D aircraft type belongs to a new generation of aircraft. The technologies for this type of aircraft is much more advanced and have more demanding maintenance requirements than the types of aircraft that have been used traditionally in Norwegian aero clubs. In view of that it is debatable whether the aero clubs have sufficient resources to handle the issues that may arise during phasing-in of new and technically demanding aircraft such as the DA40-D.

f) The aero club experienced a number of technical problems with the aircraft and the engine. This resulted in the club's technical supervisor at times doubting whether it was advisable to continue to fly it.

g) It seems clear that the reason for the engine failure can be linked to the engine's construction, operational reliability and/or maintenance.

h) It was pure coincidence that the incident occurred when it did. It was not affected by the commander's operation of the aircraft.

i) The engine failure was caused by a connecting rod splitting in the small end bearing. The connecting rod, which consequently was only connected to the crankshaft, penetrated the crankcase and the engine stopped immediately.

j) For a brief period on 19 April 2005, the engine flew with an insufficient oil level and an oil pressure of 2.1 bar. Even though the pressure was well above the minimum stated by the engine manufacturer it is probable that this, in combination with the low level, caused overheating in the engine which in turn led to the engine failure.

k) After the flight on 19 April 2005, the technical supervisor of Oslo Flyveklubb followed the advice given by the engine manufacturer. The subsequent engine failure indicates that the measures that were taken were insufficient.

l) As far as we can see from our investigation, the aircraft was maintained according to the approved maintenance program and instructions given by the manufacturer.

m) During the incident, the commander acted in a rational and resolute manner. This was the main reason why he was uninjured and the aircraft undamaged after the engine failure.

n) It is debatable whether the type certification conducted by JAA was sufficient to uncover what appears to be an unacceptably low operating reliability for the DA40-D aircraft type.

# 4. SAFETY RECOMMENDATIONS

The Accident Investigation Board Norway (AIBN) makes the following safety recommendation[8]

**Safety recommendation No. 2010/16T**

Findings made in connection with this investigation indicate that flying with an engine oil pressure in the region of 2.1 bar can cause serious damage to TAE 125-01 engines even if the red warning light is not illuminated. The DA40-D aircraft flight manual contains no warnings that flying with such oil pressure (yellow warning light) may damage the engine. The Accident Investigation Board therefore recommends that Thielert Aircraft Engines GmbH reassess the limit values in the operating instructions with regard to minimum oil pressure.

The Accident Investigation Board of Norway

Lillestrøm, 8 August 2011

[8] The Ministry of Transport and Communications ensures that safety recommendations are presented to the aviation authorities and/or other relevant ministries for assessment and follow-up, cf. Section 17 of the Regulations relating to public investigation of air traffic accidents and incidents in civil aviation.

# APPENDICES

**Appendix A:** **Abbreviations**

**Appendix B:** **Comments to the final report from Bundesstelle für Flugunfalluntersuchung (BFU) the German Federal Bureau of Aircraft Accident Investigation**

# APPENDIX A

| | |
|---|---|
| AMC | Acceptable Means of Compliance |
| CAVOK | Ceiling and visibility OK (, i.e. more than 10 km and no clouds below 1,500 ft. or below the highest Min Sector Altitude, and no precipitation, thunder, fog, drifting snow or cumulonimbus) |
| CRI | Certification Review Items |
| CS-E | Certification Specifications Engine |
| CS-P | Certification Specifications Propeller |
| EASA | European Aviation Safety Agency (the joint European aviation authority) |
| FAA | Federal Aviation Administrator – the US aviation authority |
| FADEC | Full Authority Digital Engine Control |
| ICAO | International Civil Aviation Organization |
| JAA | Joint Aviation Authorities – organisation for cooperation between European aviation authorities |
| KIAS | Nautical Miles Indicated Airspeed (indicated speed in kt) |
| NM | Nautical Mile(s) (1,852 m) |
| QNH: | altimeter setting relating to the pressure at sea level |
| AIBN | the Accident Investigation Board Norway |
| UUB/LF | Unfalluntersuchungsstelle des Bundes, Fachbereich Luftfahrt (the Austrian Accident Investigation Board) |

Bundesstelle für
Flugunfalluntersuchung

BFU, Hermann-Blenk-Str. 16, 38108 Braunschweig

Telefon:
0 531 3548 529
Thomas Karge
E-Mail:
thomas.karge
@bfu-web.de

Accident Investigation Board Norway
P.O. Box 213
N-2001 Lillestrøm
Norwegen

Ihre Zeichen:

Aktenzeichen:

Datum: 20.07.2011

**Report on Serious Aircraft Incident 2-3 NM North of Rygge, Norway on 2 July 2005; Diamond DA40-D, LN-NEX.**

Dear Mr. Nørstegård,

Thank you for giving me the opportunity to comment the draft final report once again. Please find attached the reply from the engine manufacturer TAE. In detail we have the following comments which we would like to be appended to the report:

1. Reliability of the engine TAE 125-01:

Paragraph 1.6.6.1
The investigation report states "that there were a number of technical problems with the aircraft and the engine." As reference the replacement of the engine after 137 flight hours and the replacement of several engine components were listed.
BFU received information from TAE about replacements on that engine. According to this information, six of the seven replacements are required by scheduled maintenance. This includes the replacement of the gear box and the clutch as mentioned in the report.
Correctly, the AIBN report states:
"This was mainly scheduled replacements in accordance with instructions from Thielert."

Paragraph 1.18.2
The investigation report refers to another safety recommendation issued by the Austrian AIB (UUB/LF). BFU is concerned about this reference because there is no correlation between the root causes of both accidents.
Moreover, BFU was concerned about the Austrian AIB (UUB/LF) safety recommendation. Due to this, on 29 October 2009 BFU sent a letter to the Austrian AIB (UUB/LF) in which we expressed our position on that Safety Recommendation. The essential content was that at that time this Safety Recommendation was neither justified by the accidents mentioned nor by technical analyses.

In the Safety Recommendation the Austrian AIB (UUB/LF) lists four additional air accidents which were used for analysis purposes. According to information provided to BFU, in three of the four accidents the engines did not contribute to the accident. Especially the accident on 15 April 2008 in Jechtingen, which is under investigation by the BFU, was not caused by engine failure.

Paragraph 2.2 and 3.g) and 3.n)
However, later in section 2.2 of the AIBN report the reliability of the engine in general is analysed.
BFU is of the opinion that this analysis about the reliability of the engine/engine installation only based on the two facts that several ("mainly scheduled") replacements have been performed and that a Safety Recommendation was released by another AIB is not appropriate for the conclusion as drawn in Paragraph 3.g) and 3.n). A high number of scheduled maintenance is not an indication for a decreased level of reliability.
BFU is of the opinion that such general conclusion about the reliability of the engine and the engine installation should be done only on robust statistical data e.g. MTBUR, MTBF, IFSD rate etc. This information was not given in the report.

<u>2. Reasons for the engine failure:</u>

As stated in paragraph 1.16.3 the failure of the affected bearing may have been caused by lack of lubrication. With regard to the lubrication of the engine, Chapter 1 and TAE report OIR-02-01-02-07-2005 contain varied information:

- Before the replacement of the turbocharger the oil consumption was 5 litres within 40 hrs. This equals an oil consumption of <u>0,125 L/h</u>, which is marginally higher than the limit (0,1 L/h).
- On 19 April 2005, the engine was operated on a flights with low oil pressure warning "on" for about 30NM flight duration. After the flight three litres of engine oil were refilled.
- After that flight the turbocharger was replaced at 565 flight hours (engine).
- After the replacement of the turbocharger the oil consumption was 11 litres within 40 hrs. This equals an oil consumption of <u>0,275 L/h.</u> This is 0,15 L/h higher than before the repair. This value was explained by "hyper sensitisation of the pilots".
- In connection with the oil consumption the club improves the procedure for checking the oil level (see 1.6.6.3).
- TAE has demonstrated that approximately 80% of the oil level was measurable after shut down of the engine (greater than 90% after 20 min) (see OIR-02-01-02-07-2005, Appendix 5). BFU would like to point out that there is a difference in oil levels between cold and warm engines. But this is very similar to a lot of other engine models.
- There is no information available whether an unusual amount of rejected oil was noticed by the club members.

BFU concludes:
It is unlikely that the change of turbocharger was the cause of the high oil consumption because the consumption increased even after the change. Any improper refilling procedure (“hyper sensitisation of the pilots”) can be excluded because the procedure has been improved by the club and the influence of a wrong indication at the dip stick is low (see TAE report). In addition, there is no information that unusual amount of rejected oil was noticed.
If the turbocharger was not the cause for the oil consumption, there has to be another cause for the oil consumption of that engine which has not been determined.

However, over a period of approximately 80 flight hours the aircraft was operated with higher oil consumption than the approved limit. It is very likely that the aircraft was permanently operated at low oil pressure values, even if they were not below the limits and therefore were not indicated.
On 19 April 2005 the aircraft was operated below the oil pressure limit and with a low oil level.

BFU is of the opinion that the root cause of the bearing failure is either

- a failure of the oil system which could not be addressed based on the currently available information or
- the operation of the aircraft below the oil pressure limit in combination with a low oil level.

There has been no clarification achieved, why on the flight on 19.04.2005, after a relative short duration (flight of 30NM) such amount of oil has to be refilled.

Note: It is BFU opinion that the displacement and the engine power did not have any influence on the cause of events. The report does not clarify why the mechanical load on piston and connecting rod is supposed to be higher.

3. Communication between the operator and the manufacturer:

Paragraph 1.6.6.2
As stated in the report the technical supervisor of the club consulted TAE and submitted downloaded data from the engine's FADEC. On 6 May 2005, TAE Support replied the following:
*”According to the data you have sent, we have no objections against further operation.”*
There is no information available whether only the FADEC data or additional information was provided to TAE (e.g. the need to refill 3 litres of oil after the flight). There is also no information available whether TAE confirmed to operate the aircraft with higher oil consumption.

BFU is of the opinion that the report should contain the complete communication between the operator and the TAE hotline. If the operator provides only the FADEC data without any additional description of the problem, the answer of the TAE hotline was correct because “one of the reasons for this statement was that no oil pressure below the minimum of 1.2 bar had been registered during the flight”.

If the information provided to TAE was complete and also described the need to refill the aircraft and the permanent higher oil consumption, TAE had to provide complete and comprehensive data to release the aircraft. The release to service can only be made on approved data.

The information provided by the manufacturer's hotline was not an approved data. BFU is of the opinion that information affected the activity of the maintenance staff. The hotline of the manufacturer must provide reliable information or, if necessary, request additional information from the operator.
In turn the maintenance staff can release the aircraft only on the basis of approved data.

Please do not hesitate to contact me if you have further questions or require explanation of the comments.

Best regards

Thomas Karge