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NATIONAL TRANSPORTATION SAFETY COMMITTEE

Aircraft Accident Investigation Report

PT. ASI Pudjiastuti (Susi Air)
PK – VVL
Diamond Star DA40
Shooting Field, Infantry Training Center
Cipatat, Padalarang, West Java
Republic of Indonesia

28 October 2008

NATIONAL TRANSPORTATION SAFETY COMMITTEE
MINISTRY OF TRANSPORTATION
REPUBLIC OF INDONESIA
2010

This Report was produced by the National Transportation Safety Committee (NTSC), Karya Building 7th Floor Ministry of Transportation, Jalan Medan Merdeka Barat No. 8 JKT 10110, Indonesia.

The report is based upon the investigation carried out by the NTSC in accordance with Annex 13 to the Convention on International Civil Aviation, Aviation Act (UU No.1/2009), and Government Regulation (PP No. 3/2001).

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GLOSSARY OF ABBREVIATIONS

AD	Airworthiness Directive
AFM	Airplane Flight Manual
AGL	Above Ground Level
ALAR	Approach-and-landing Accident Reduction
AMSL	Above Mean Sea Level
AOC	Air Operator Certificate
ATC	Air Traffic Control
ATPL	Air Transport Pilot License
ATS	Air Traffic Service
ATSB	Australian Transport Safety Bureau
Avsec	Aviation Security
BMG	Badan Meterologi dan Geofisika
BOM	Basic Operation Manual
°C	Degrees Celsius
CAMP	Continuous Airworthiness Maintenance Program
CASO	Civil Aviation Safety Officer
CASR	Civil Aviation Safety Regulation
CPL	Commercial Pilot License
COM	Company Operation Manual
CRM	Cockpit Recourses Management
CSN	Cycles Since New
CVR	Cockpit Voice Recorder
DFDAU	Digital Flight Data Acquisition Unit
DGCA	Directorate General of Civil Aviation
DME	Distance Measuring Equipment
EEPROM	Electrically Erasable Programmable Read Only Memory
EFIS	Electronic Flight Instrument System
EGT	Exhaust Gas Temperature
EIS	Engine Indicating System
FL	Flight Level
F/O	First officer or Copilot
FDR	Flight Data Recorder
FOQA	Flight Operation Quality Assurance
GPWS	Ground Proximity Warning System
hPa	Hectopascals
ICAO	International Civil Aviation Organization

IFR	Instrument Flight Rules
IIC	Investigator in Charge
ILS	Instrument Landing System
Kg	Kilogram(s)
Km	Kilometer(s)
Kt	Knots (NM/hour)
Mm	Millimeter(s)
MTOW	Maximum Take-off Weight
NM	Nautical mile(s)
KNKT / NTSC	Komite Nasional Keselamatan Transportasi / National Transportation Safety Committee
PIC	Pilot in Command
QFE	Height above aerodrome elevation (or runway threshold elevation) based on local station pressure
QNH	Altitude above mean sea level based on local station pressure
RESA	Runway End Safety Area
RPM	Revolution Per Minute
SCT	Scattered
S/N	Serial Number
SSCVR	Solid State Cockpit Voice Recorder
SSFDR	Solid State Flight Data Recorder
TS/RA	Thunderstorm and rain
TAF	Terminal Aerodrome Forecast
TSN	Time Since New
TT/TD	Ambient Temperature/Dew Point
TTIS	Total Time in Service
UTC	Coordinated Universal Time
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions

SYNOPSIS

On the afternoon of 28 October 2008, a Diamond Star DA40 aircraft, registered PK-VVL, was being operated by PT. ASI Pudjiastuti (Susi Air) on a private flight for company activities from Halim Perdanakusuma Airport, Jakarta to Pangandaran (Nusawiru Aerodrome), West Java. There were three persons on board; one pilot, and two passengers who were Susi Air employees.

The aircraft was refuelled with the Jet A-1 type fuel; total fuel on board was 132 liters.

After departure from Halim Airport, the pilot reported tracking via BUANA at 7,000 feet. Bandung Control instructed the pilot to track on the 315 degree radial of the Bandung VOR. The pilot was subsequently cleared to continue climbing to his requested level 9,500 feet. The pilot informed investigators that when he was approaching 8,700 feet, the engine power reduced to 75% and the ECU A inoperative indicator illuminated. That was followed by the ECU B inoperative indicator illuminating. The engine failed at 9,200 feet.

The pilot said that he tried to restart the engine with various combinations of power settings and electrical load. No power developed and the propeller continued to windmill. The pilot was unable to restart the engine.

At 0530 UTC the pilot conducted a forced landing at the Infantry Training Center shooting range, Cipatat, Padalarang, West Java.

The aircraft was substantially damaged, but the occupants were not injured and evacuated from the aircraft unaided.

1 FACTUAL DATA

1.1 HISTORY OF THE FLIGHT

On the afternoon of 28 October 2008, a Diamond Star DA40 aircraft, registered PK-VVL, was being operated by PT. ASI Pudjiastuti (Susi Air) on a private flight for company activities from Halim Perdanakusuma Airport[1], Jakarta to Pangandaran[2] (Nusawiru Aerodrome), West Java. There were three persons on board; one pilot, and two passengers who were Susi Air employees.

The aircraft was refuelled with the Jet A-1 type fuel; total fuel on board was 132 litres.

The aircraft departed from Halim's runway 24, and made a left turn to track direct to visual reporting point BUANA, and climb to 9,500 feet. The track was via Bandung to Pangandaran.

After departure, the pilot transferred from Jakarta control to Bandung control and reported tracking via BUANA at 7,000 feet. Bandung Control instructed the pilot to track on the 315 degree radial of the Bandung VOR[3] due to a departing Boeing 737. The pilot was subsequently cleared to continue climbing to his requested level 9,500 feet. Once he was established on track, the pilot requested further climb 11,500 feet, which was given by Bandung Control.

The pilot informed investigators that when he was approaching 8,700 feet, the engine power reduced to 75% and the ECU A inoperative indicator illuminated. That was followed by the ECU B inoperative indicator illuminating. The engine failed at 9,200 feet.

The pilot said that he referred to the emergency procedure 'the uses of the mechanical fuel pump', and moved the power lever in accordance with the procedures. He said that he tried to restart the engine with various combinations of power settings and electrical load. No power developed and the propeller continued to windmill. The pilot was unable to restart the engine.

At 0530 UTC[4] the pilot conducted a forced landing at the Infantry Training Center shooting range, Cipatat, Padalarang, West Java.

The aircraft was substantially damaged, but the occupants were not injured and evacuated from the aircraft unaided.

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[1] Halim Perdanakusuma Airport (WIHH) is referred to as 'Jakarta' in this report.

[2] Pangandaran Airtrip (Nusawiru Aerodrome/WICN), West Java is referred to as 'Pangandaran' in this report.

[3] VOR. Very High Frequency omni directional radio range navigation aid.

[4] The 24-hour clock used in this report to describe the time of day as specific events occurred is in Coordinated Universal Time (UTC). Local time, Western Indonesian Standard Time (WIB) is UTC+ 7 hours.

1.2 INJURIES TO PERSONS

Table 1: Injuries to persons

Injuries	Flight crew	Passengers	Total in Aircraft	Others
Fatal	-	-	-	-
Serious	-	-	-	-
Minor	-	-	-	-
None	1	2	3	-
TOTAL	1	2	3	-

The pilot was a New Zealand citizen, and the passengers were Indonesian citizens.

1.3 DAMAGE TO AIRCRAFT

The aircraft was substantially damaged. The nose and right main landing gear were fractured and the propeller blades were bent.

Figure 1: The aircraft safely landed at the Infantry Training Center shooting range, Cipatat, Padalarang

1.4 OTHER DAMAGE

There was no other damage to property and/or the environment.

1.5 PERSONNEL INFORMATION

1.5.1 Pilot in Command

Age (Date of Birth)	: 43 years (18 March 1986)
Gender	: Male
Type of licence	: No known License

At the time of the accident the pilot was reported to be a New Zealand citizen. However, the Transport Accident Investigation Commission of New Zealand informed the NTSC that the pilot was a Canadian citizen from Winnipeg, Manitoba who held Canadian and New Zealand medical certificates but did not hold pilot licenses of any kind.

The pilot did not hold an Indonesian pilot license or validation certificate.

The pilot informed the investigation team that he had the following experience.

Rating	: DA40/C172,182,185,206,207,208 PA180,181 203. GBBC,Piper cub B206.H369.R44.R22
Total flying time	: 5,800 hours
Total on this type	: 80 hours
Total last 30 days	: 4 hours 30 minutes
Total on type last 30 days	: 31 hours 48 minutes
Total on type last 3 days	: 1 hours 42 minutes
Total on the type last 24 hours	: 2 hours 48 minutes
Last proficiency check	: 17 July 2008
Medical class	: Class one
Last medical examination	: 11 September 2008
Valid to	: 3 March 2009

1.6 AIRCRAFT INFORMATION

1.6.1 General

Aircraft manufacturer	: Diamond Aircraft Company
Model	: Diamond DA 40 D
Serial number	: D4.189
Year of manufacture	: 2006
Nationality and registration mark	: Indonesia, PK-VVL
Name of the owner	: PT. ASI Pudjiastuti Airline (Susi Air)
Name of the operator	: PT. ASI Pudjiastuti Airline (Susi Air)

Certificate of Airworthiness Issued	: 14 February 2008
Valid to	: 13 February 2009
Certificate of Registration Issued	: 14 February 2008
Valid to	: 13 February 2009
Total flying hours since manufacture	: 120 hours 30 minutes
Total flying hours since last inspection	: 100 hours 20 minutes
Total cycle since new	: 217 cycles

The aircraft engines used aviation turbine-engine (Avtur JET A-1) fuel. There was no evidence of any engine malfunctions that would have required fuel testing as part of the investigation.

The investigation determined that the aircraft had no recorded defects before the accident.

1.6.2 Engine Data

Type Engine	: Common Rail Diesel
Manufacturer	: Thielert Aircraft Engine GmbH
Type	: Centurion 1.7
Model	: 02-7200-14005R5
Serial number	: 02-01-0582
Time since new	: 120 hours 30 minutes
Cycles since new	: 217 cycles
Time Between Overhauls	: 1,000 hours

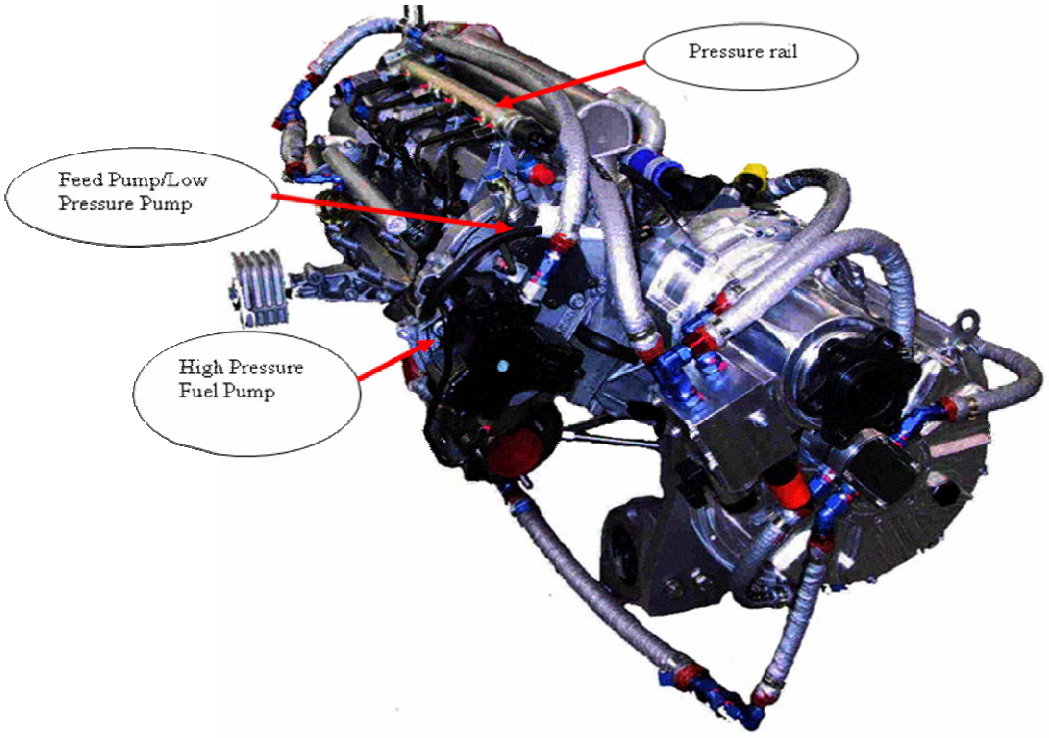

Figure 2: TAE Centurion 1.7 engine

The TAE Centurion 1.7 engine is a liquid-cooled, four‑cylinder, four-stroke, turbocharged common-rail direct injection diesel engine, designed to run on Jet A‑1 fuel. It is rated at 99 kW (135 DIN HP) at 2,300 rpm at sea level, ISA conditions. The engine drives the propeller via a 1:1.69 reduction gearbox; the maximum allowable continuous propeller speed is 2,300 rpm, corresponding to an engine speed of 3,900 rpm.

1.6.3 Propeller

Type propeller	: Constant speed
Model	: MTV-6A-187-129
Serial number	: 05064
Time since new	: 120 hours 30 minutes

The three-bladed, variable-pitch, wood-composite propeller is hydraulically regulated and the propeller governor system has its own independent oil supply. The engine and propeller are controlled electronically by a digital Electronic Control Unit (ECU).

1.6.4 Weight and Balance

The aircraft was within weight and balance limitations.

1.7 METEOROLOGICAL INFORMATION

Not relevant to this accident.

1.8 AIDS TO NAVIGATION

Ground-based navigation aids, onboard navigation aids, and aerodrome visual ground aids and their serviceability were not a factor in this accident.

1.9 COMMUNICATIONS

Communications between air traffic services and the crew were recorded by ground based automatic voice recording equipment for the duration of the flight. The quality of the aircraft's recorded transmissions was good.

1.10 AERODROME INFORMATION

The pilot force landed into the shooting range, at the Infantry Training Centre, Cipatat, West Java.

1.11 FLIGHT RECORDERS

The aircraft was not fitted with a flight data recorder or cockpit voice recorder. Neither recorder was required by current Indonesian regulations.

1.12 WRECKAGE AND IMPACT INFORMATION

During the forced landing at the military shooting range at Cipatat Padalarang, West Java, the touchdown and initial ground roll were reported to have been smooth. However, due to the rough ground surface, the nose and right main landing gear were torn from the aircraft and the propeller blades were bent and fractured as they struck the ground.

Figure 3: Damaged nose and right main landing gear,
and propeller blades

Figure 4: Right wing leading edge split in 2 locations

1.13 MEDICAL AND PATHOLOGICAL INFORMATION

No medical or pathological investigations were conducted as a result of this occurrence, nor were they required.

1.14 FIRE

There was no evidence of fire in flight or after the accident.

1.15 SURVIVAL ASPECTS

The pilot and passengers were not injured and left the aircraft unaided.

1.16 TESTS AND RESEARCH

1.17 ORGANIZATIONAL AND MANAGEMENT INFORMATION

Aircraft Owner : PT. ASI Pudjiastuti

Aircraft Operator : Susi Air
Jl. Merdeka 312
Pangandaran, 46396
West Java, Indonesia

Aircraft Operator Certificate number: 135 / 028

1.18 ADDITIONAL INFORMATION

On 25 November 2008, the engine and its system were inspected by expert from Thielert Aircraft Engines GmbH, under the supervision of an NTSC investigator. The investigation found that:

1. The fuel system filters were clean. No dirt or particles were found.

Figure 5: Fuel filter found clean condition

2. There was no fuel in the fuel line between the Low Pressure Fuel Pump (Feed Pump) and High Pressure Fuel Pump (HPFP). It was dry.

Figure 6: High Pressure Fuel Pump

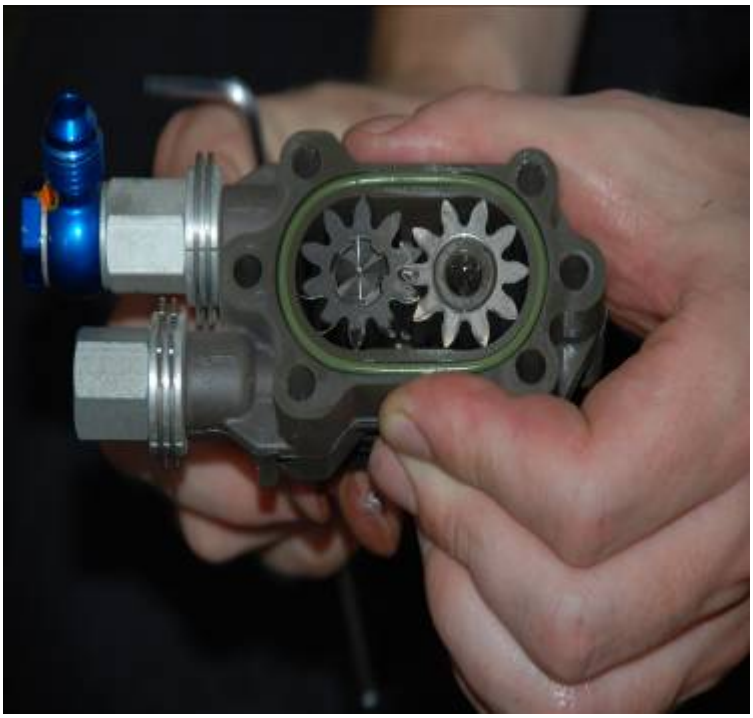

Figure 7: Feed Pump/ Low Pressure

3. Fuel was found in the injector lines.

4. There was no fuel in the return line hose.

The high pressure fuel pump (HPFP) part number 02-7310-04005R5 serial number 11521 was sent to the Thielert Engine manufacturer to be inspected and analyzed. The manufacturer informed the investigator that the HPFP was disassembled and a detailed examination carried out. The manufacturer's report is at Appendix A. See excerpt below regarding damage to the HPFP.

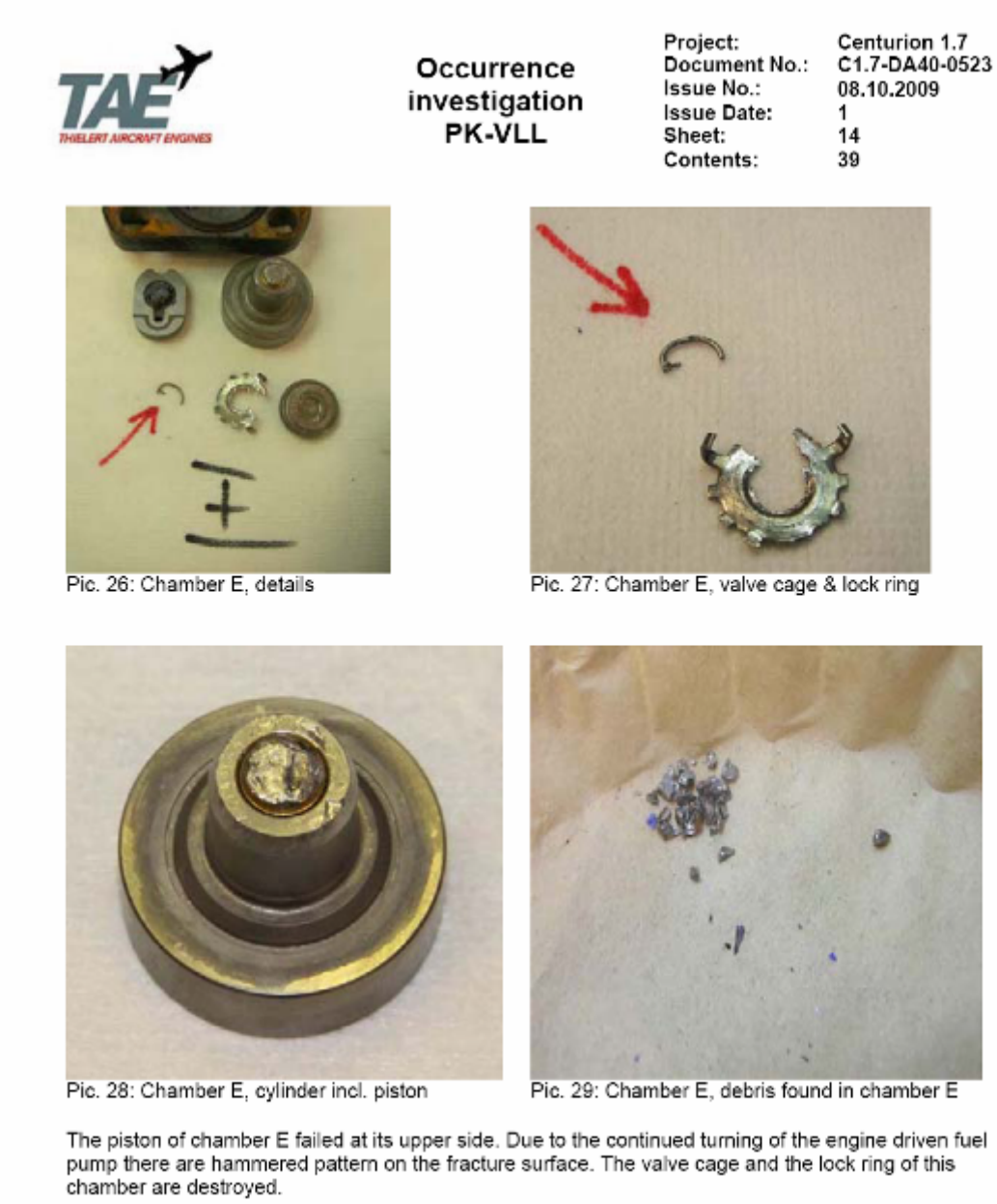

Figure 8: High Pressure Fuel Pump chamber E damaged

1.19 USEFUL OR EFFECTIVE INVESTIGATION TECHNIQUES

The investigation was conducted in accordance with NTSC approved policies and procedures, and in accordance with the standards and recommended practices of Annex 13 to the Chicago Convention.

2 ANALYSIS

The pilot informed investigators that when he was approaching 8,700 feet on climb, the engine power reduced to 75% and the ECU A inoperative indicator illuminated. That was followed by the ECU B inoperative indicator illuminating. The engine failed at 9,200 feet.

The pilot's attempts to restart the engine in accordance with the emergency procedures were not successful including subsequent attempts using various combinations of power settings and electrical load. No power developed and the propeller continued to windmill.

The investigation found that the filters were not contaminated, but that there was no fuel in the fuel line between the Low Pressure Fuel Pump (Feed Pump) and the High Pressure Fuel Pump (HPFP), and there was no fuel in the fuel return line. However, the High Pressure Fuel Pump was contaminated by debris from its failed valve cage and lock ring. The debris contamination may have contributed to a blockage in the fuel system.

There was evidence of fuel in the injector lines, but because there was no fuel in the in the fuel line between the Feed Pump and HPFP, no fuel under pressure was being supplied through the injectors to the engine cylinders.

3 CONCLUSIONS

3.1 FINDINGS

3.1.1 The Engine

The aircraft was certified, equipped and maintained in accordance with existing regulations and approved procedures.

The aircraft was certified as being airworthy when dispatched for the flight.

The pilot did not hold an Indonesian Pilot License, or an Indonesian validation of any foreign license, so was not qualified for the flight in the Indonesian registered aircraft, in accordance with existing Indonesian regulations.

Inspection for the fuel system found that all the filters were clean and no dirt or particles founded.

There was sufficient fuel in the aircraft's fuel tanks.

There was no fuel in the fuel line between the Low Pressure Pump and the High Pressure Fuel Pump, or in the return line, but there was some evidence of fuel in the injector lines.

The fuel pump failed during the flight preventing fuel being fed under pressure to the engine cylinders.

The High Pressure Fuel Pump was contaminated by debris from its failed valve cage and lock ring.

3.2 CAUSES

The investigation determined that the engine failed due to fuel starvation when the High Pressure Fuel Pump failed, preventing fuel being fed under pressure to the engine cylinders.

It is likely that the High Pressure Fuel Pump was contaminated by debris from its failed valve cage and lock ring.

4 SAFETY RECOMMENDATIONS

4.1 SAFETY ACTIONS

The National Transportation Safety Committee was not informed of any safety action taken following the accident.

4.2 RECOMMENDATIONS

As a result of the investigation into this accident, the National Transportation Safety Committee made the following recommendations;

4.2.1 Recommendation to the aircraft operator, Susi Air

The National Transportation Safety Committee recommends that Susi Air review its procedures to ensure that pilots operating its aircraft are appropriately licensed and qualified to fly Indonesian registered aircraft.

4.2.2 Recommendation to the Directorate General of Civil Aviation

The National Transportation Safety Committee recommends that the Directorate General of Civil Aviation request the European Aviation Safety Agency to ensure that the engine manufacturer, Thielert Aircraft Engine GmbH, conducts an assessment of this High Pressure Fuel Pump failure and ensure that appropriate safety action, by the manufacturer, is taken to prevent a similar occurrence with this engine type.

APPENDIX

Appendix A: Thielert Aircraft Engine Manufacturer's Report

Occurrence investigation PK-VLL

Project:	Centurion 1.7
Document No.:	C1.7-DA40-0523
Issue No.:	08.10.2009
Issue Date:	1
Sheet:	1
Contents:	39

PK-VLL

Engine Stoppage in Flight

October 28th, 2008

Status: closed

Prepared by:	Checked by:	Approved:
M. Steinberg		

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1 Introduction

A DA40 PK - VVL suffered an engine failure today (about 12:30 local time) enroute from Jakarta to Pangandaran. Emergency landing was done on an army shooting range. Apparently nose gear collapsed. 3 occupants, there are no injuries. No fire or smoke.

2 Facts

2.1 Pilot's report

The pilot was not available at the time of inspection at Pangandaran, but summarized the accident in an email dated Tue, 4 Nov 2008 04:04:18 +1300. Original wording below:

PK-VVL forced landing Ciputat 29/10/2008 @ position S06 50.14/E 107 23.35.

Pre flight background and flight sector procedures.

PK-VVL was required to fly WICN to WIHH and return on the 29/10/2008 to position Susi Air personal to WICN (Nusawiru)

Flight crew was transported to Nusawiru Airfield at aprox 10am local time and ground staff instructed that a refuel was required on arrival. Flight plan completed on arrival with normal refueling staff in attendance to refuel PK VVL to full capacity as checked with normal preflight and fuel drains completed after ground crew finished attending the aircraft. Equipment removed from around the aircraft and the area cleared for departure at aprox 1035 am local time.

Aircraft had been unused for 3 weeks and so an extended warm up with normal engine run-up given before entering the active runway.
No noted defects the aircraft started and developed full power without any power lost or engine abnormal indications.
During the taxi and backtrack extra power was used to determine any other moisture in the system or noted loss of power before take off.

Flight conducted to WIHH in 1.2 flight hours in VMC conditions with a noted rapid clearance of lower cloud layers to enable the return flight.

Aircraft landed WIHH approximately 1140am local time. Company personal where in presence on arrival and a return flight plan logged with ATC in Halim briefing office. Notams and flight details briefed by both parties.
Departure from WIHH was off runway 24 WIHH with a left turn direct to Visual reporting point Buana climbing to 9500 via BND to WICN (Nusawiru).

After departure transfer of control was given to Jakarta Approach thence to Bundung Control at Buwana. (Altitude 7000' absl aprox)

Bundung Control requested that the flight path be conducted on the 315 radial due to departing B737. Continued climb was given to requested level of 9500'. Establishing on track a request to climb 11500' was requested and given by Bundung Control.
Just minute's after this clearance at 8700' aprox the engine started to reduce in power to aprox 75% and ECU A inoperative indicator showed, thence directly after this indication the ECU B inoperative indicator showed and the aircraft loss power at 9200'absl.

Emergency procedure's that followed was the use of the mechanical fuel pump, ECU B standby . Power lever moved between idle and full power.
No power developed from this and the aircraft propeller continued to windmill. A restart was tried with the starter motor many times and no further sign's of engine power recovery given. Electrical load reduced and a planned descent profile chosen.

Mayday call given to Bundung Control 3 times to make myself clearly understood of position and intentions. Further position reports given to ATC.
Passenger brief and control given. With an Engineer occupying the rear seat advise was sort but no clear solutions to the problem where given. The engineer had noted the ECU failure before the power lost.

Continued glide approach to be clear of the steep terrain around the lake below the aircraft at the time of the

engine failure. This glide continued until aprox 10nm BND when a suitable landing area came into view below and to pilots left.

Further emergency procedures continued with the use of the essential bus to try any combination of electrics to re establish engine power.
An engine restart was attempted again with various combinations of power setting's and electrical load.

At 8nm BND and within 2000'agl of the selected landing site reassurance was given to the passenger's to the situation. Radio contact was lost with Bundung ATC and concentration given only to the glide approach. 2 orbits over the landing site left hand to complete approach profile required and a normal landing on the site achieved to round out with a controlled flare strait down the shooting range. Consideration given to the selection of area of it being of grass and with suitable length. The landing roll also continued away from ground personal and building's in the area. Any over shoot would have been to slight raising terrain.
During the last 20 Meters of the landing roll the nose leg was taken from underneath and the right main landing gear broke away on a truck tire indentation. The aircraft settled to the ground smoothly and stopped with a total landing distance of 350M aprox.

Passenger's where briefed to vacate the aircraft as non injury event. The aircraft was then secured, and ground personal came to our assistance from the Army Base.

Company contact established through the engineer while PIC secured documentation and flight records.

Aircraft was left unsecured and right wing down for the remainder of the day with many interviews and questions from the Base Commander/Mayor, Bundung ATC, Military police and the such.

Company personal arrived late in the afternoon and the aircraft was removed from the active area of the landing area.

Further actions ;
Interview and written report given to NTSC form 001.
00-Occurance identification report
07-Meteorological report
Written narrative and sequence of events

Interviews and verbal reports to Base Commander
Assistance given for dismantling of aircraft for transportation
Briefing and reconstruction of the accident given to Insurance Personal.

Many company personal enquired to the situation and safety of personal at the scene.

In all a very arduous 24hrs of scene examination and capital cost recovery.

Company Safety Report to follow.

2.2 Initial inspection

2.2.1 Inspection at the accident site

	Model	Serial Number	TTIS
Aircraft	DA40	D4.189	121h Since New
Engine	02-7200-14005R5	02-01-0582	121h Since New
Propeller	MTV-6-A-187-129	05064	121h Since New

The initial inspection which was the inspection at the accident site was done by SuziAir and documented in the Damage Report D4.189 PK-VVL.

2.2.2 Visual inspection

A visual inspection was carried through by Markus Steinberg on November 25th, 2008.

The aircraft was found partly disassembled in a provisional hangar at Pangandaran, Indonesia. The aircraft was well protected against weather influences as well as unauthorized access.

After the FADEC data had been downloaded a visual inspection of the aircraft was performed. Since the FADEC data recorded a failure mode of the fuel system, the inspection was limited to the fuel system of both, engine and aircraft. The wings of the aircraft including the fuel tanks were demounted from the fuselage and stored in a different room.

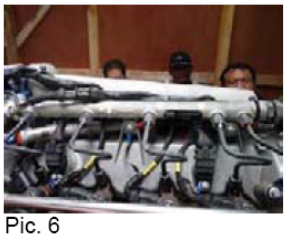

Pic. 1


Pic. 2


Pic. 3


Pic. 4


Pic. 5


Pic. 6


Pic. 7


Pic. 8


Pic. 9


Pic. 10


Pic. 11


Pic. 12

All fuel lines and fittings of the engine fuel system were dry and showed no evidence of fuel leakage. At the time of inspection the fuel filter was found demounted (Pic.8). However, the fuel filter was installed at the time of the initial inspection at accident site (Pic.10). There was no leakage reported by the mechanic who demounted and inspected the fuel filter at the accident site. The fuel filter and the aircraft gascolator showed no debris, no fungi and no rubber.
During the inspection at the accident site the fuel pressure sensor housing was found broken due to the impact forces (Pic.9). The FADEC data showed a fuel pressure reading of the sensor.
The fuel selector was found in the emergency position (Pic.11).

The propeller was turnable without any unusual resistance.

For further investigation it was decided to demount and inspect the engine low pressure pump. The fuel line between the low pressure pump and the high pressure pump as well as the output (Pic.13) of the low pressure pump was found dry and without any signs of debris. The low pressure pump showed no signs of wear and tear and appeared in a condition of a new part.


Pic.13

Afterwards the high pressure pump was demounted as well but not disassembled. The High Pressure pump was turnable by hand, but not without hesitation. Therefore it decided to send the high pressure pump to TAE's facility in Germany. Both, inlet and outlet, showed no signs of any debris. The camshaft drives of both engine fuel pumps were found in a proper condition (Pic. 14, 15 & 16).


Pic. 14


Pic. 15


Pic. 16

Both wing fuel tanks of the DA40 were inspected with a borescope. There was no debris found. All aircraft fuel lines were flushed and showed no debris. Due to the fact that the aircraft was disassembled the fuel level sensors and their indications could not be tested during the inspection.

2.3 FADEC Data Download

2.3.1 FADEC Logger Data

November 1st, 2008 the FADEC data were downloaded.

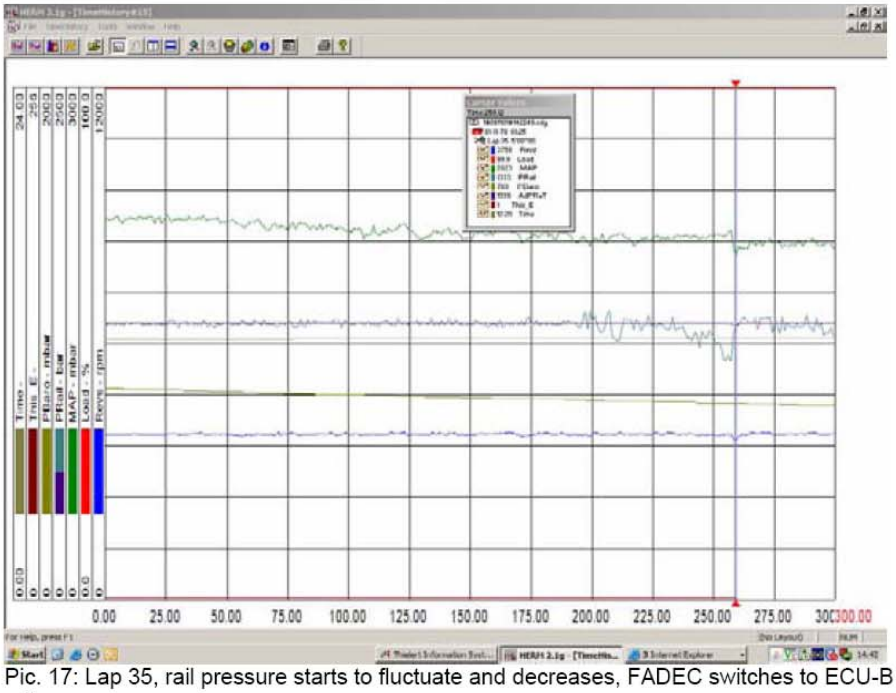
The pilot's input to the FADEC is recorded in percentage of the maximum movable angle of the power lever. In the FADEC data the power lever position value is named LOAD.

Flight before the accident flight:
According to the FADEC data the engine was started at 10:23. The aircraft took off at Nusawira at 10:31. The power lever position remained stable at 100% power lever position from 10:31 to 11:33; in total 62 minutes at 100% power lever position.
The power setting was reduced for descent. At 11:39 the aircraft landed at Halim airport and taxied. At 11:44 the engine was switched off

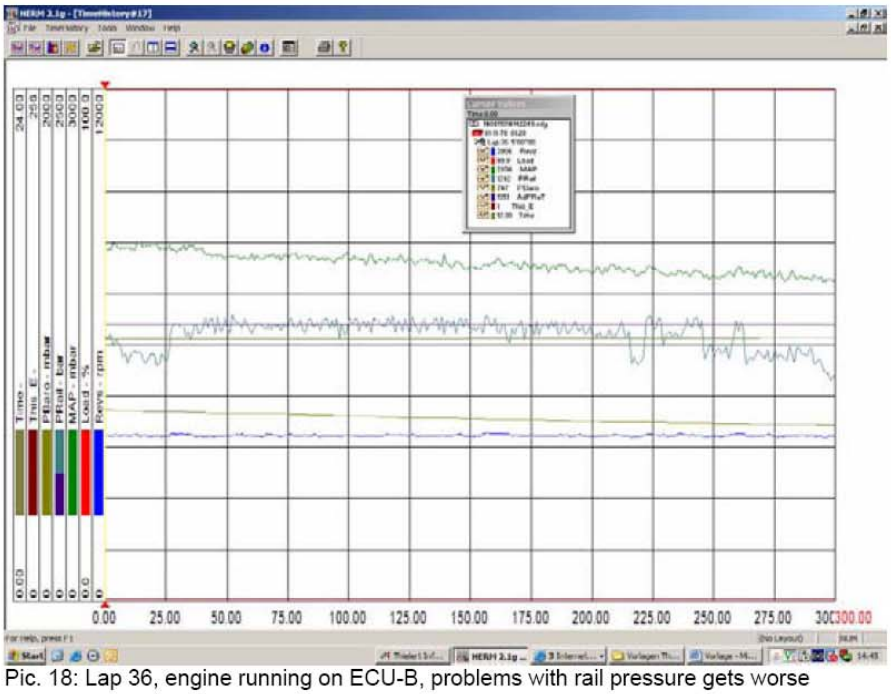
Accident flight:
The engine was started again at 12:03; the aircraft took off at Halim airport at 12:09.
The power lever position remained stable at 100% power lever position from 12:09 to 12:37; 28 minutes at 100% power lever position. At 12:37 the power setting was reduced for emergency descent. At 12:45 the engine master switch was switched off

The FADEC recorded also flight before the mentioned above. Since the FADEC just recorded the time but not the date it cannot be concluded that these flights had been on the same day.
The engine was started at 10:03; the aircraft took off at 10:08. The power lever remained stable at 100% Load setting from 10:08 to 10:10; 2 minutes at 100% power lever position. From 10:10 to 10:20 the power setting was varying between 50% and 90%. From 10:20 to 10:21 the power setting was reduced for landing. At 10:21 the aircraft landed and taxied. At 10:23 the engine was switched-off. This looks more or less like a pattern around Nusawiru. For this flight there was no entry in the flight log.

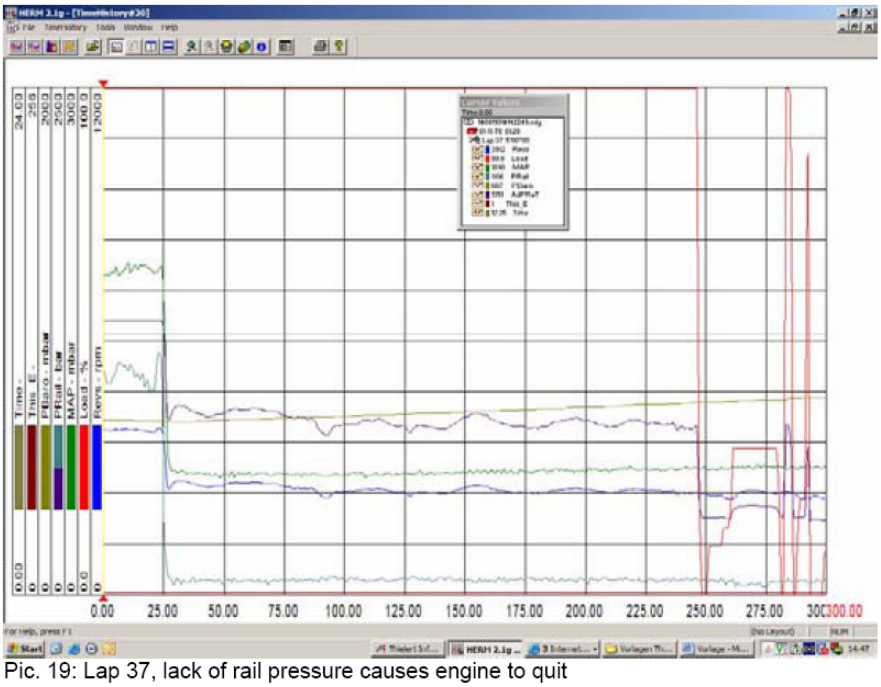
The FADEC data are recorded in data laps of 300 seconds. The accident flight was recorded in the laps 31 to 39. Pic 17 to Pic 21 show the last laps of the accident flight.



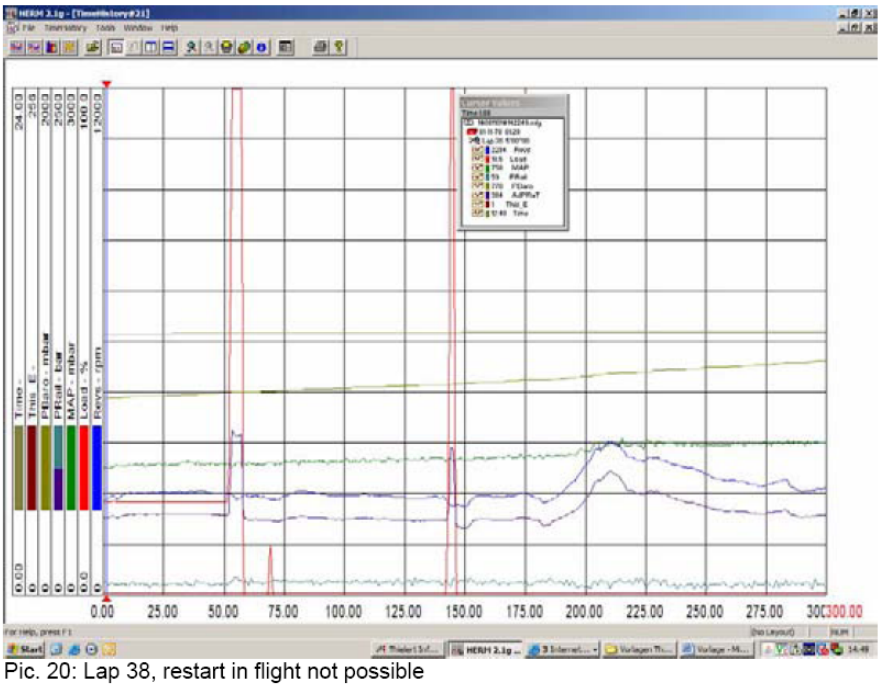
Pic. 17: Lap 35, rail pressure starts to fluctuate and decreases, FADEC switches to ECU-B due to low rail pressure



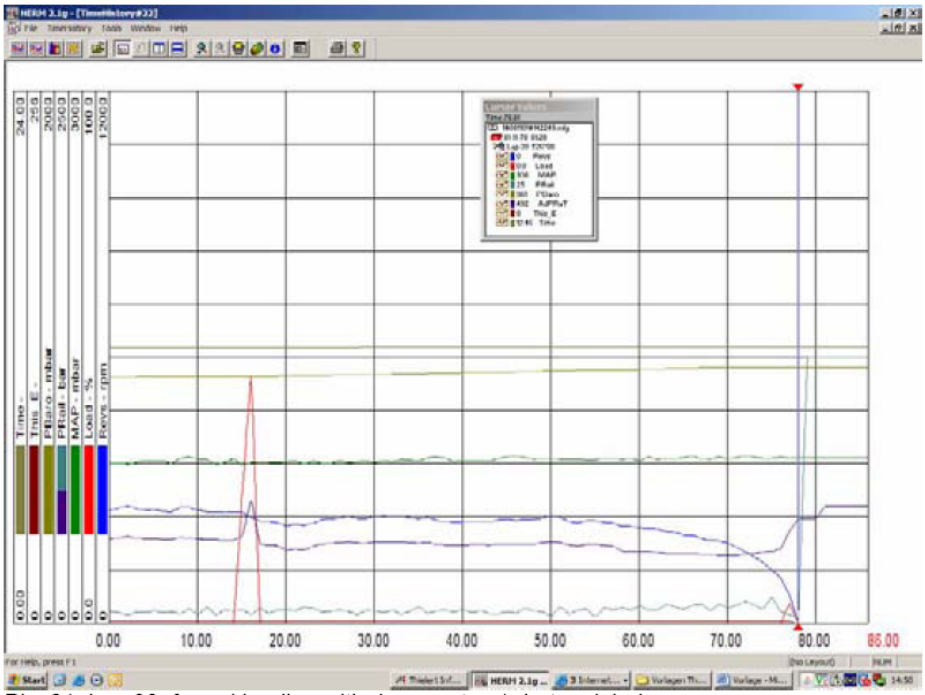
Pic. 18: Lap 36, engine running on ECU-B, problems with rail pressure gets worse



Pic. 19: Lap 37, lack of rail pressure causes engine to quit



Pic. 20: Lap 38, restart in flight not possible



Pic. 21: Lap 39, forced landing with damage to a/c but no injuries

2.3.2 FADEC Data Eventlog

The FADEC was initialized September 22nd, 2005

The Event log was read out November 1st, 2008:

FADEC-A Events in chronological order:

…
28/10/2008 12:27:59 - High negative PRail delta: up to 616 bar for 5.7 seconds
28/10/2008 12:34:17 - Low PRail: down to 42 bar for 10.0 seconds
28/10/2008 12:44:58 - Low PRail: down to 17 bar for 648.8 seconds
01/11/2008 14:25:12 - PRail Sensor failed for 10.0 seconds
…

FADEC-B Events in chronological order:

…
28/10/2008 12:30:44 - High negative PRail delta: up to 204 bar for 10.0 seconds
28/10/2008 12:30:57 - High negative PRail delta: up to 210 bar for 22.4 seconds
28/10/2008 12:34:12 - High negative PRail delta: up to 206 bar for 6.1 seconds
28/10/2008 12:34:46 - High negative PRail delta: up to 226 bar for 10.0 seconds
28/10/2008 12:34:49 - High negative PRail delta: up to 226 bar for 12.9 seconds
28/10/2008 12:35:03 - High negative PRail delta: up to 263 bar for 9.2 seconds
28/10/2008 12:35:13 - High negative PRail delta: up to 216 bar for 10.0 seconds
28/10/2008 12:36:06 - Low PRail: down to 38 bar for 10.0 seconds
28/10/2008 12:46:47 - Low PRail: down to 17 bar for 648.5 seconds
28/10/2008 12:46:47 - High negative PRail delta: up to 1034 bar for 701.4 seconds
28/10/2008 12:47:09 - PRail Sensor failed for 10.0 seconds
…

The complete eventlog can be found in Appendix 5.1

2.4 History and maintenance program

Available maintenance records were reviewed November 25th by Markus Steinberg. There was no unusual maintenance recorded.

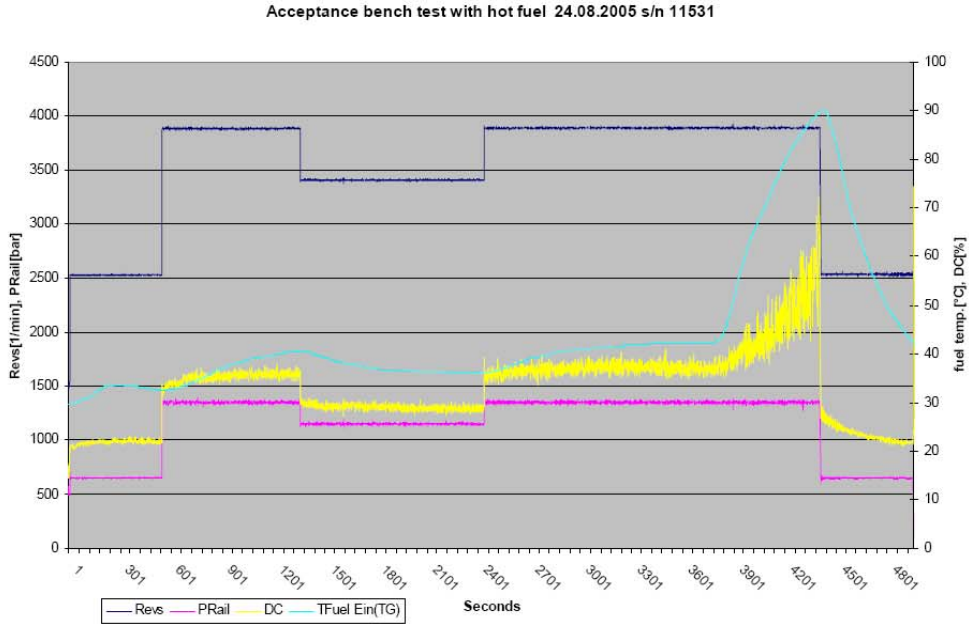
2.5 *Inspection of the High Pressure Pump*

2.5.1 Details of the High Pressure Pump

Part number:	02-7310-04005R5		
Built:	24.08.2005		
Serial Number.:	11531		
Camshaft:	E0307		
Polygon:	B0370		
	C	D	E
Piston:	D1095	D1098	D1100
Cylinder:	A1488	A0298	EA689
Tappets.:	D0133	D0817	D1085

Pic. 22: Serial numbers of major high pressure pump parts

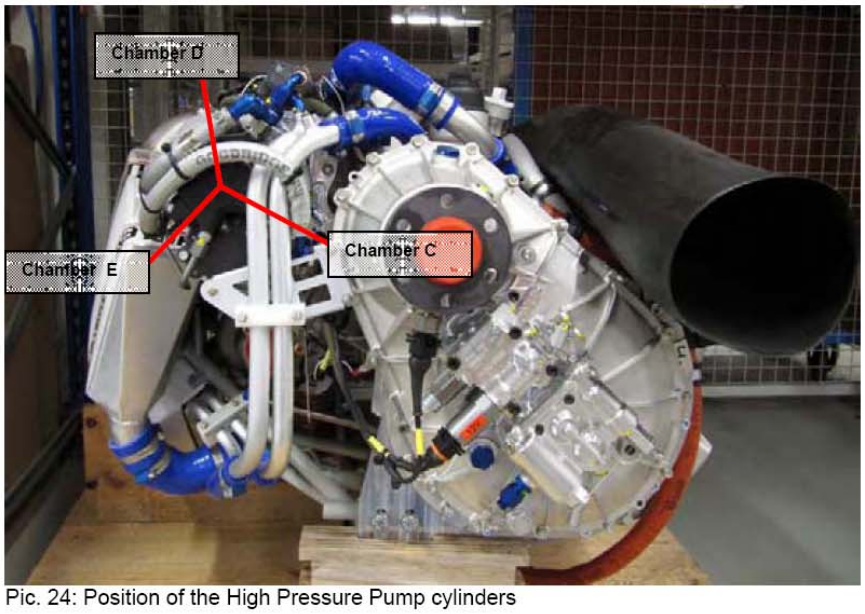
2.5.2 Acceptance Test run at the time of production



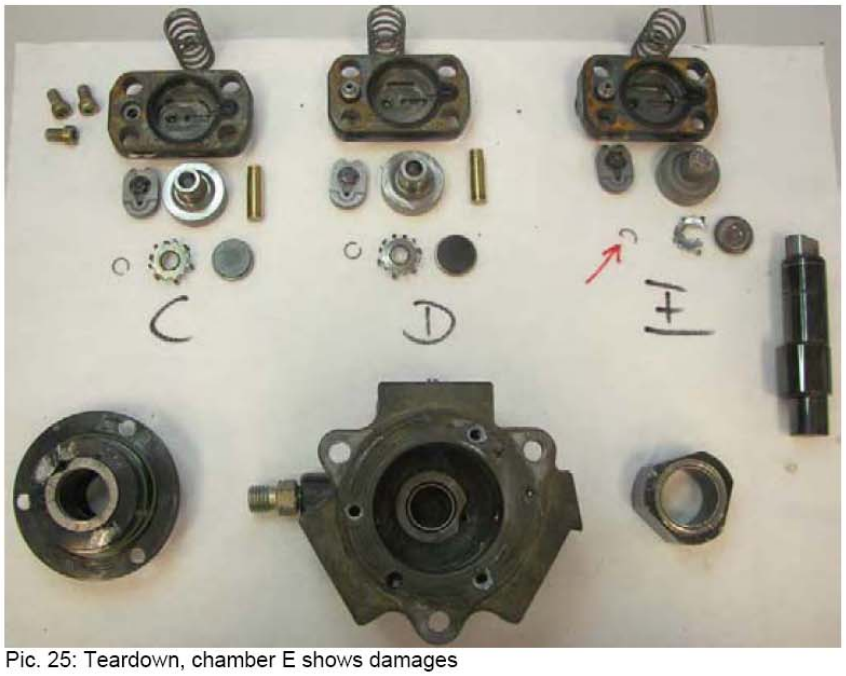
Pic. 23: Acceptance Bench test of the affected High Pressure Pump at the time of production

At the time of production the High Pressure Pump with the serial number 11531 was well above the limits of 1350 bar at a fuel temperature of 70°C, which is one of the acceptance criterion of new High Pressure Pump.

2.5.3 Tear down inspection of the High Pressure Pump s/n 11531



Pic. 24: Position of the High Pressure Pump cylinders



Pic. 25: Teardown, chamber E shows damages

Pic. 26: Chamber E, details

Pic. 27: Chamber E, valve cage & lock ring

Pic. 28: Chamber E, cylinder incl. piston

Pic. 29: Chamber E, debris found in chamber E

The piston of chamber E failed at its upper side. Due to the continued turning of the engine driven fuel pump there are hammered pattern on the fracture surface. The valve cage and the lock ring of this chamber are destroyed.

Pic. 30: Radial and axial bearing

The bearing bush does not show any wear or tear. There are significant scratches and hammer marks visible on the axial bearing surface.

Pic. 31: Housing

Pic. 32: Damage marks at chamber E

Pic. 33: Bearing bush in the housing

The housing shows several damage marks especially in the area of chamber E.

Pic. 33: inlet chamber C

Pic. 34: inlet chamber D

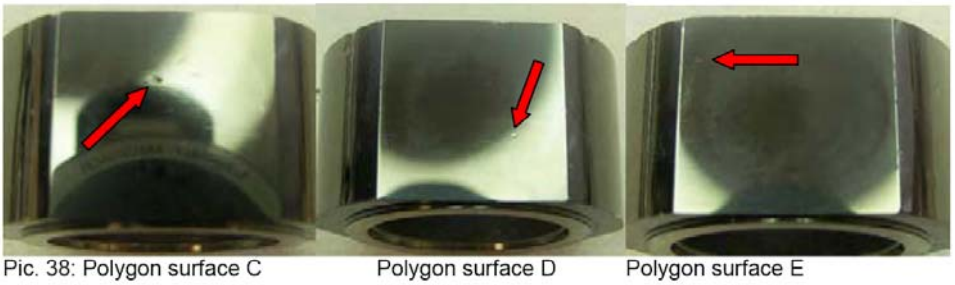
Pic. 35: inlet chamber E

The inlets show slight corrosion but only limited to the outer surface which have contact to the environment. All internal surfaces show no signs of corrosion or damages.

Pic. 36: Camshaft

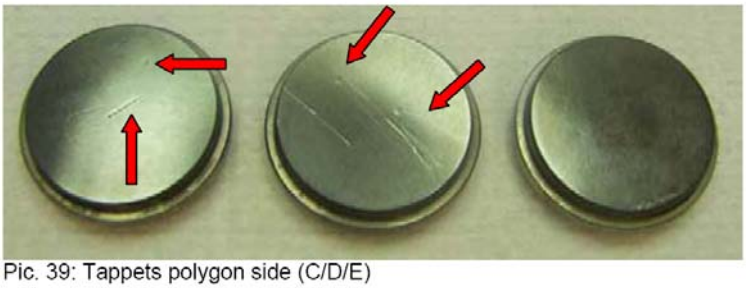
The camshaft does not show any signs of damage or corrosion

Pic. 37: Polygon



Pic. 38: Polygon surface C Polygon surface D Polygon surface E

The bearing bush of the polygon shows one deeper scratch in the coating of the bearing. On the outer surfaces of the polygon there are hammer marks visible. These marks were potentially caused by the debris found in the pump, see pic 29.
Although the surfaces show hammer marks there are still in a proper condition.



Pic. 39: Tappets polygon side (C/D/E)

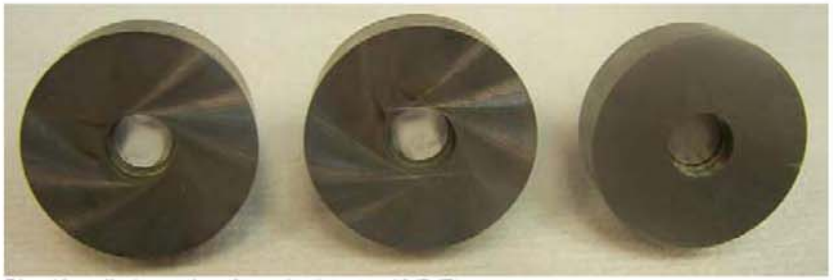
Pic. 40: Tappets piston side (C/D/E)

All tappets show on the polygon side some deep scratches and hammer marks in their coating. The piston sides of all tappets are in good conditions. Only the tappet of chamber E shows a single hammer mark.

Pic. 41: pistons (C/D/E)

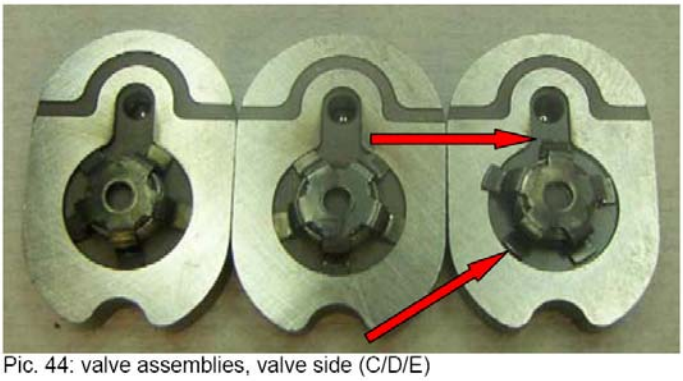
On the surface of piston C there is a small hammer mark visible. Piston C and piston D show blue and brown heat colors. Both pistons show nearly no damages at all. Piston E could not be removed from its cylinder chamber by normal manual forces.

Pic. 42: cylinders, view from the side (C/D/E)

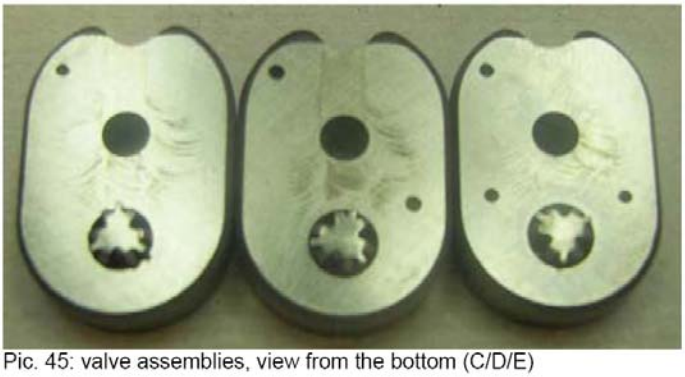


Pic. 43: cylinders, view from the bottom (C/D/E)

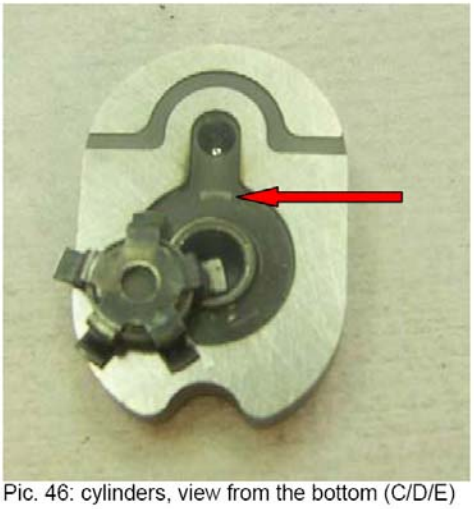
The cylinder bores of cylinder C and D just show minor wear and tear. All sealing surfaces are in a proper condition. The cylinder bore E is blocked by the piston. The sealing surfaces are in proper condition as well.



Pic. 44: valve assemblies, valve side (C/D/E)

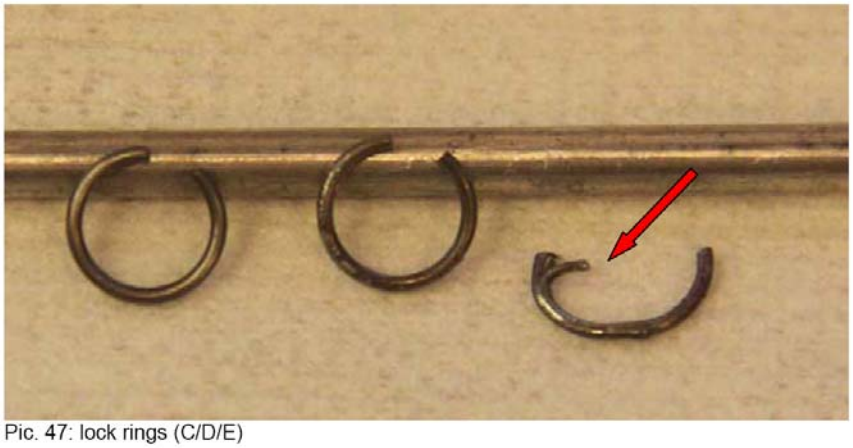


Pic. 45: valve assemblies, view from the bottom (C/D/E)



Pic. 46: cylinders, view from the bottom (C/D/E)

There are no damages or signs of wear and tear at the valve assemblies C and D. There are scuffing marks at the valve assembly of chamber E. It seems that the valve cage has moved.



Pic. 47: lock rings (C/D/E)

The lock rings of the pistons C and D have minor deformation marks originating from piston movement, which is normal. The lock ring of piston E is significantly deformed.

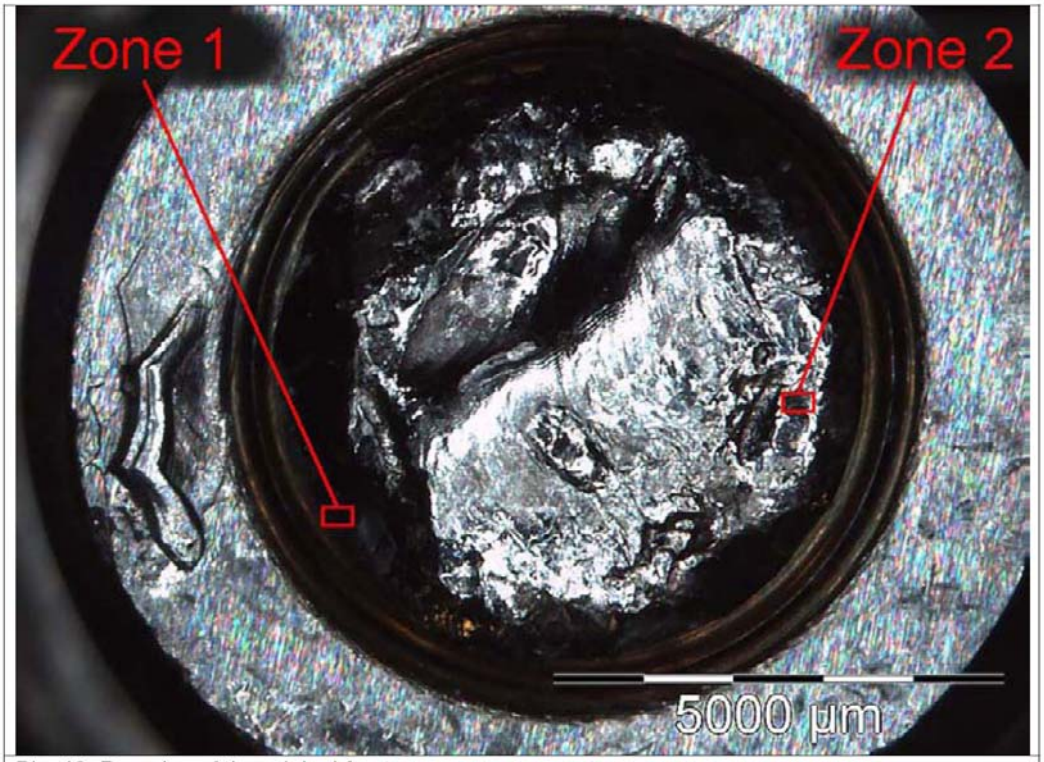
2.5.4 Detailed inspection of the High Pressure Pump Piston E

The piston of chamber E is broken at the mounting for the tappet disc. The fracture surface is badly damaged, which might have been caused after the piston failed and when the pump was in operation. Only fragments of the counterpart, which caused damage on several parts of the pump, are left. The piston was found stuck in the cylinder.

Pic. 48: Fracture surface of the piston, which is still seated inside the cylinder.

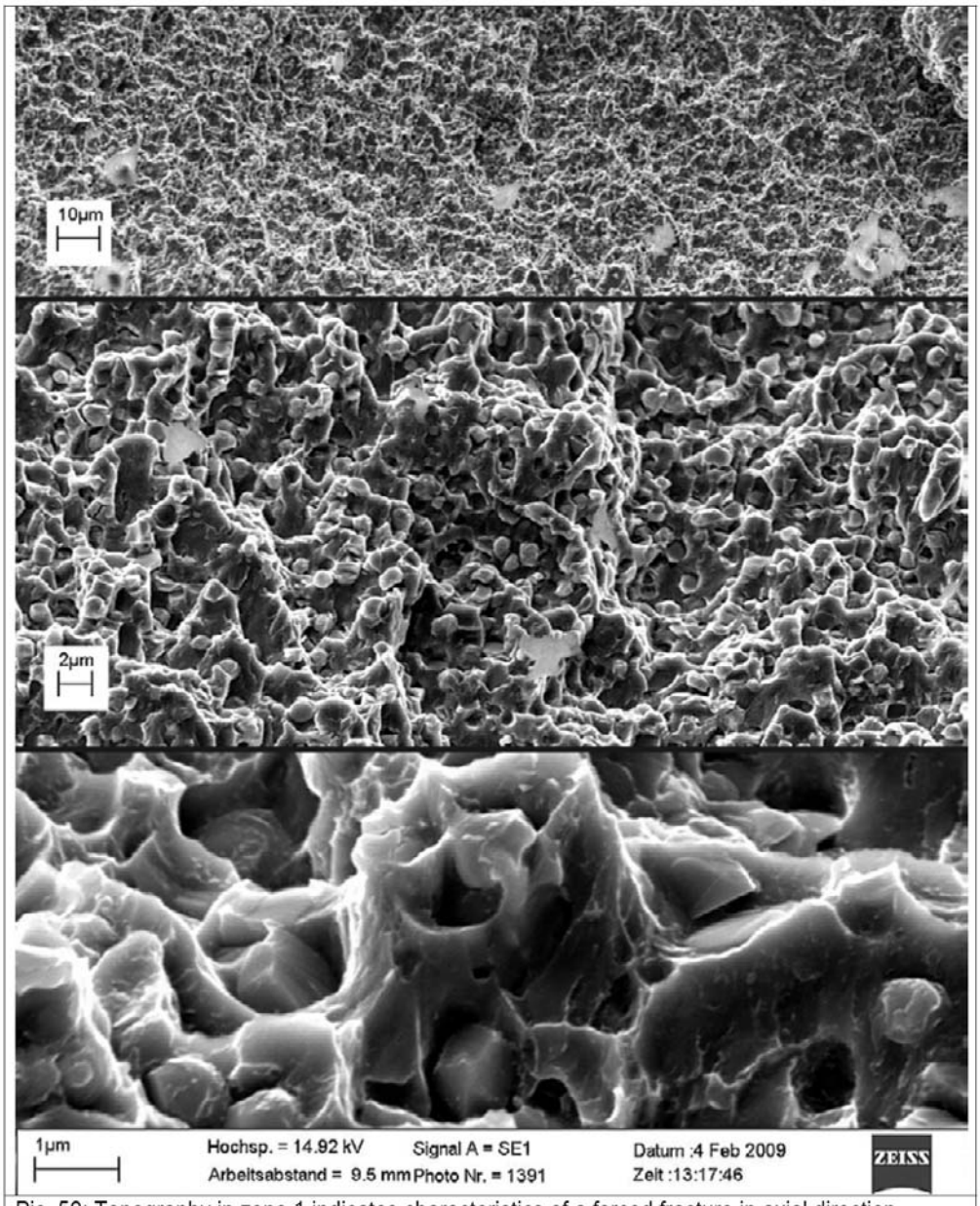
2.5.4.1 Fractography of the piston E

The piston was inspected on possible fracture topographies by means of the scanning electron microscope to determine the type of fracture.

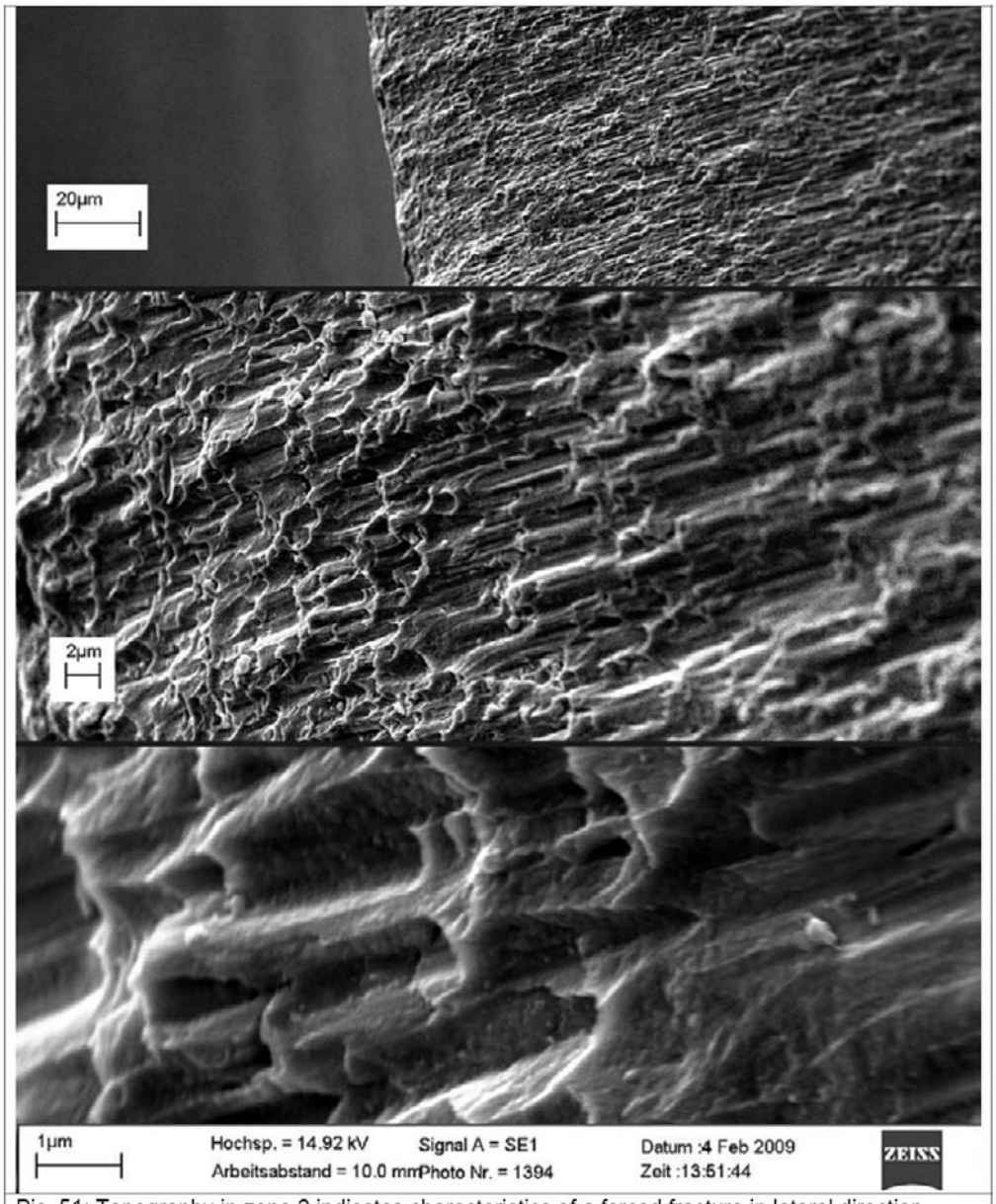


Pic. 49: Remains of the original fracture

Remains of the original fracture were found in two places. Those areas were marked with Zone 1 and Zone 2 in the figure above and are described / documented in the pictures to follow.



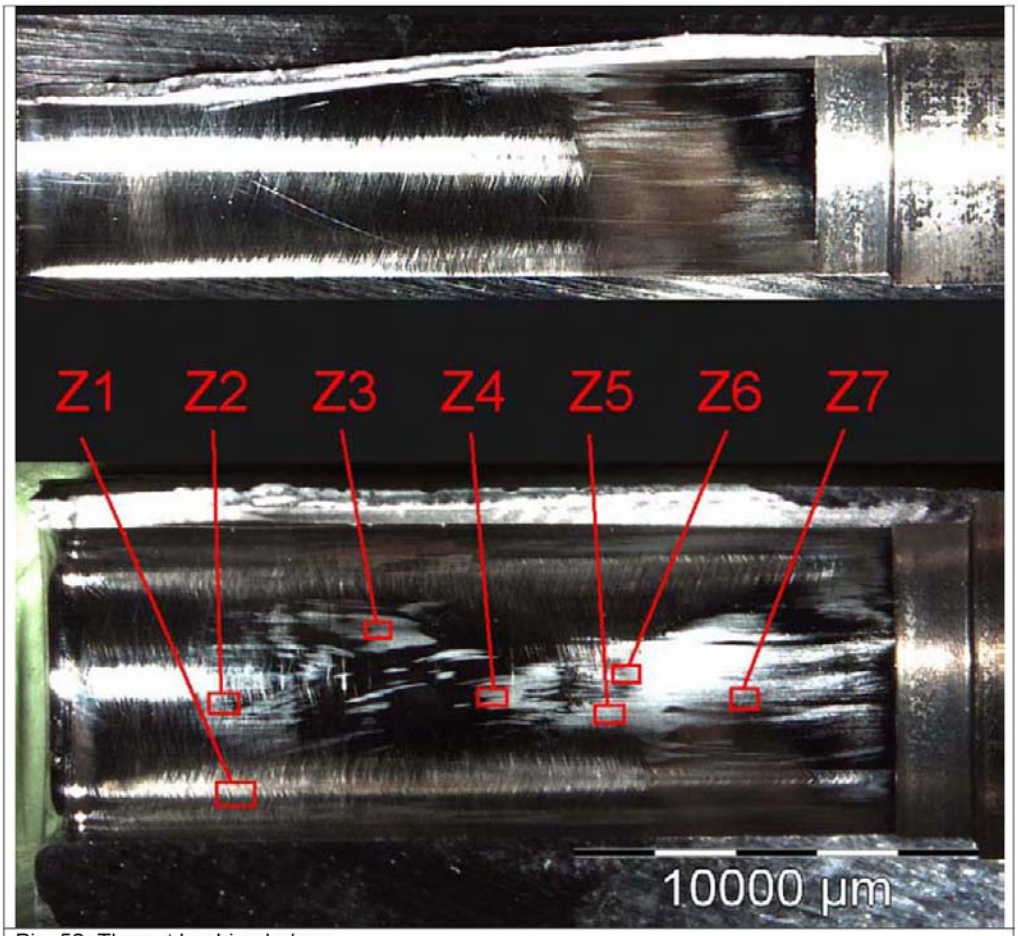
Pic. 50: Topography in zone 1 indicates characteristics of a forced fracture in axial direction.



Pic. 51: Topography in zone 2 indicates characteristics of a forced fracture in lateral direction.

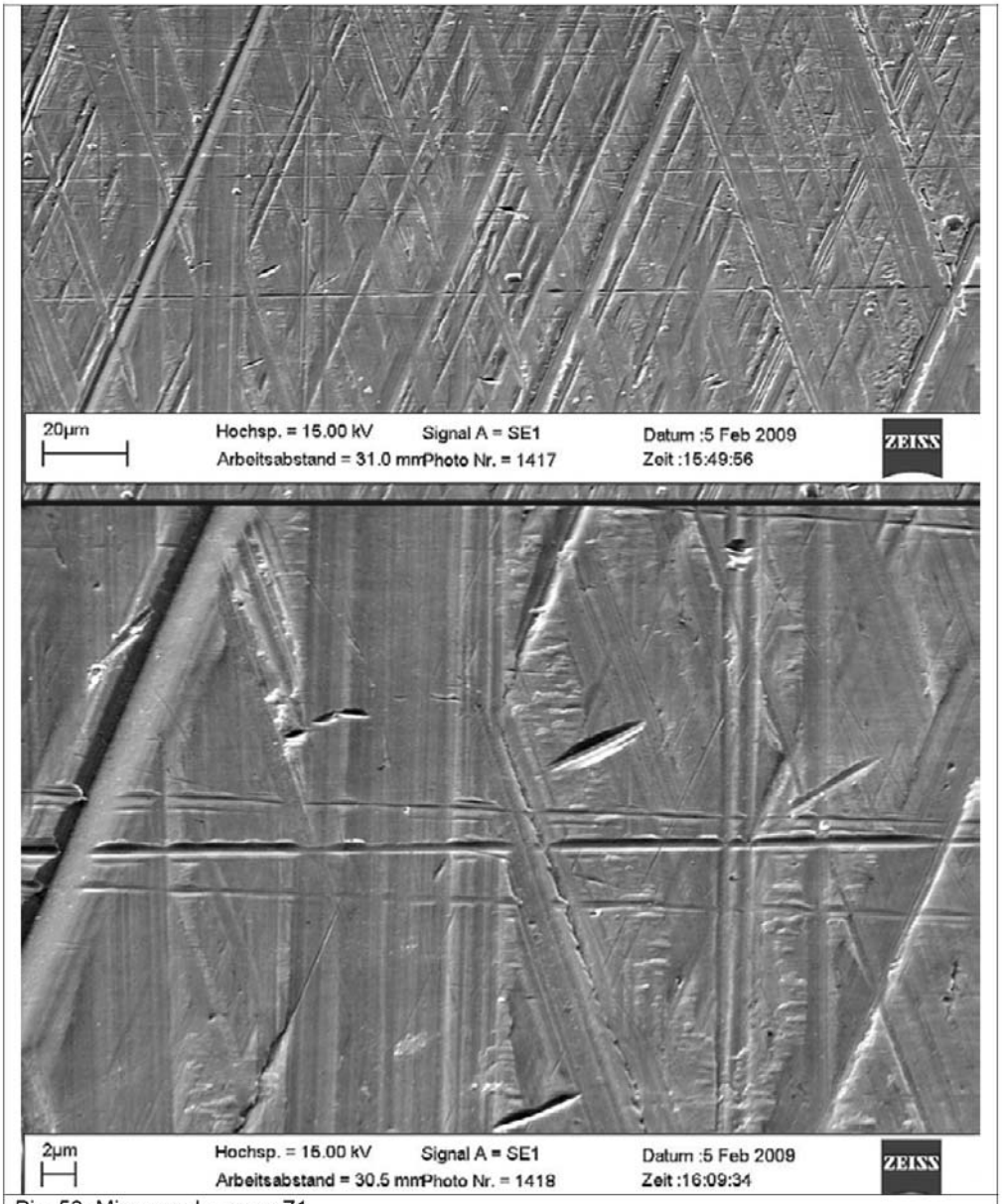
2.5.4.2 Inspection of the bushing contact surfaces

It was not possible to move the piston in the cylinder. To avoid surface damages of the piston surface the cylinder was be cut. The contact surfaces of the cylinder were inspected subsequently.



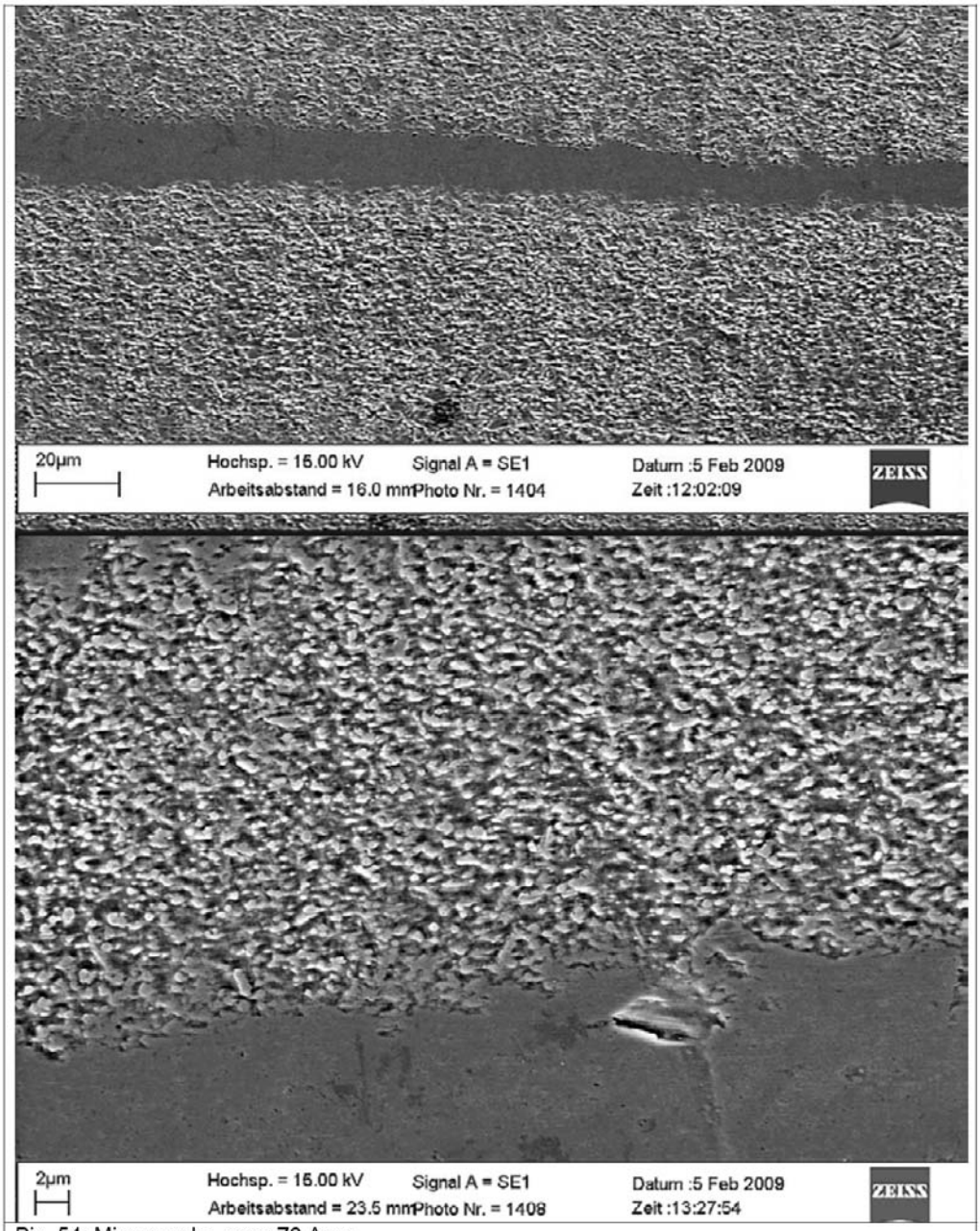
Pic. 52: The cut bushing halves

The bushing surfaces show signs of wear and annealing colors. The annealing colors are present in the front section (marked Z7). In order to be able to assign the following SEM micrographs, zones 1 to 7 were highlighted as reference points.



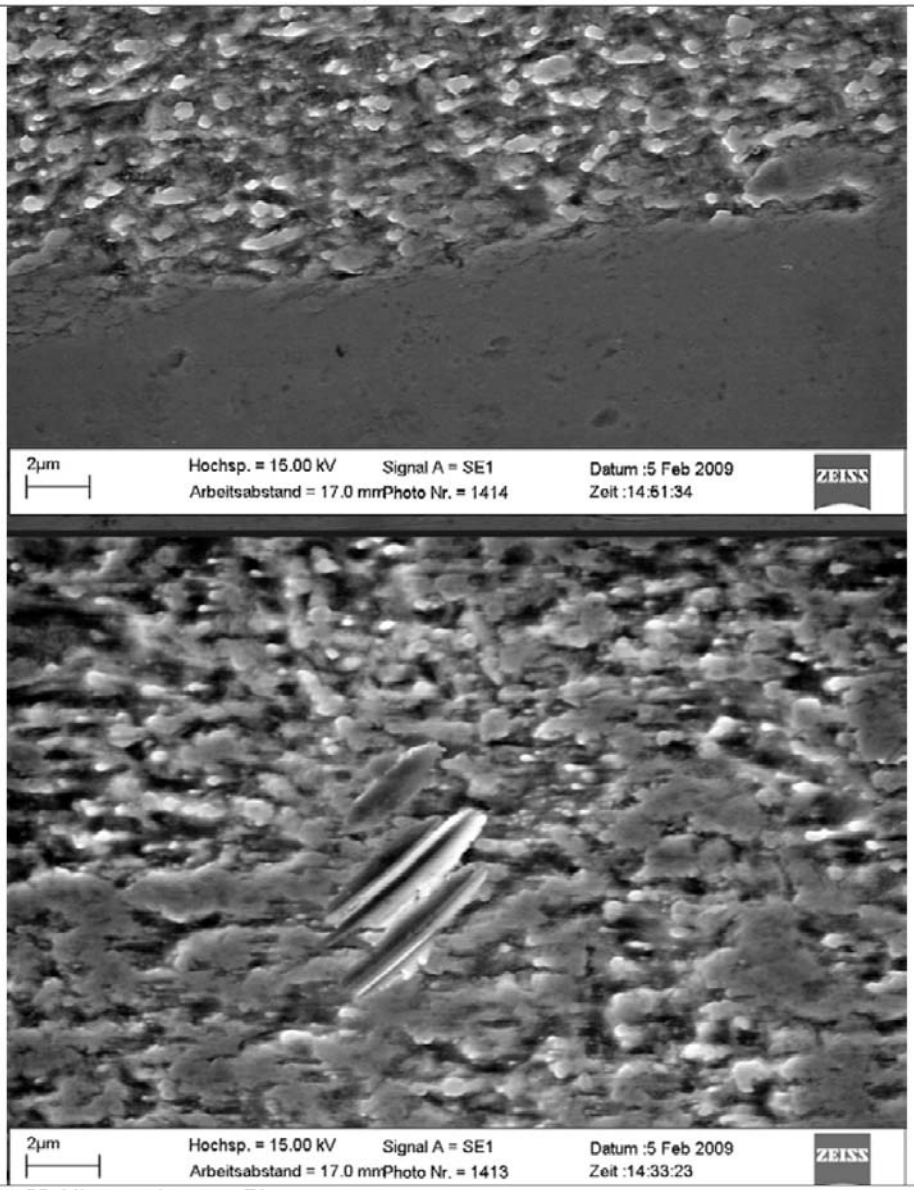
Pic. 53: Micrographs, area Z1

The micrographs above show area Z1, which shows normal wear and tear. The traces of honing (diagonal) and traces originated from grinding (vertical) are still visible.
There are sporadic signs of abrasion through single particles present.



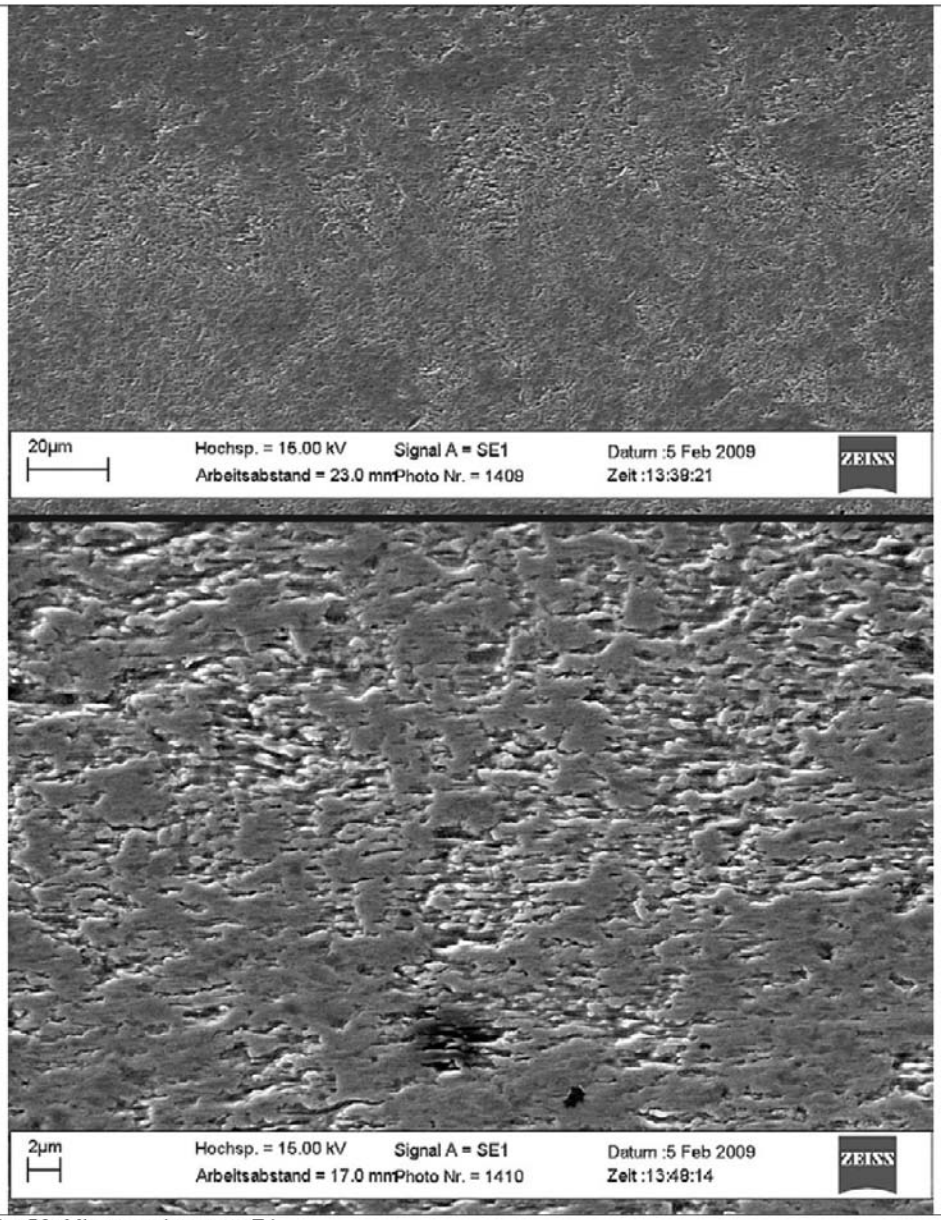
Pic. 54: Micrographs, area Z2 Area

The area Z2 shows traces of adhesive wear, which is a kind of fretting



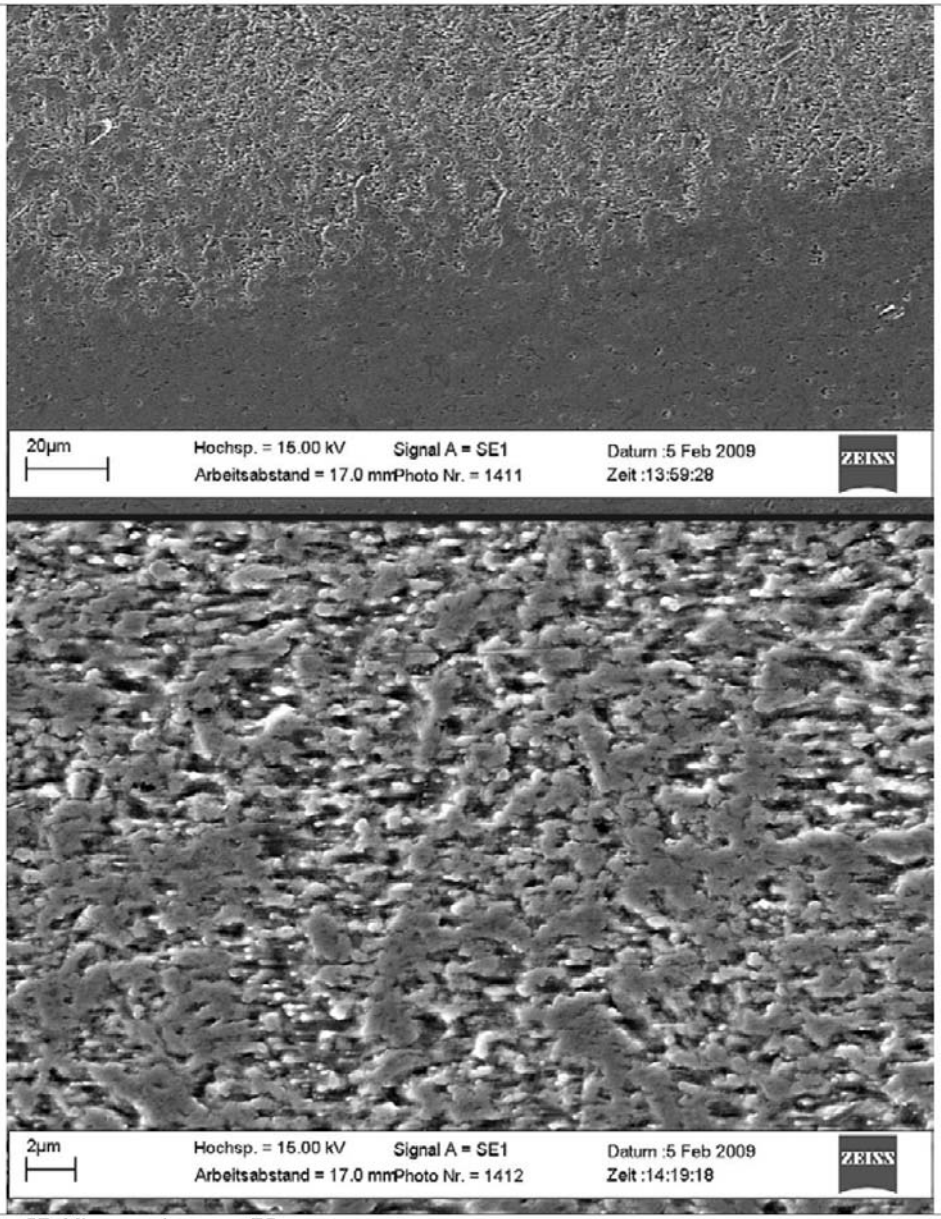
Pic. 55: Micrographs, area Z3

The area Z3 shows traces of adhesive wear. The lower micrograph shows abrasions caused by particles.



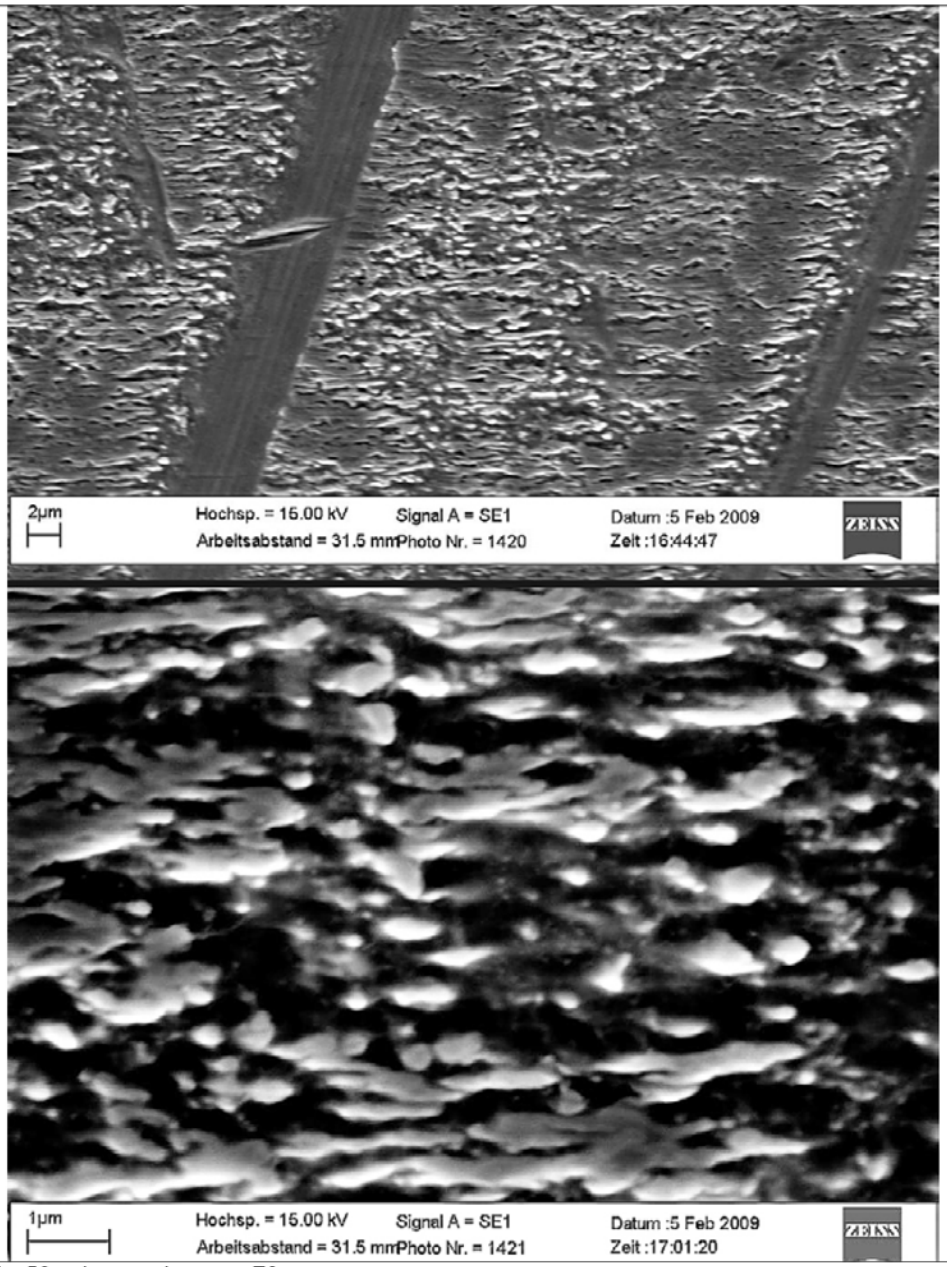
Pic. 56: Micrographs, area Z4

Area Z4 shows adhesive wear as well. It can be observed that micro particles were separated from the softer structural material, whereas the harder parts remained in place.



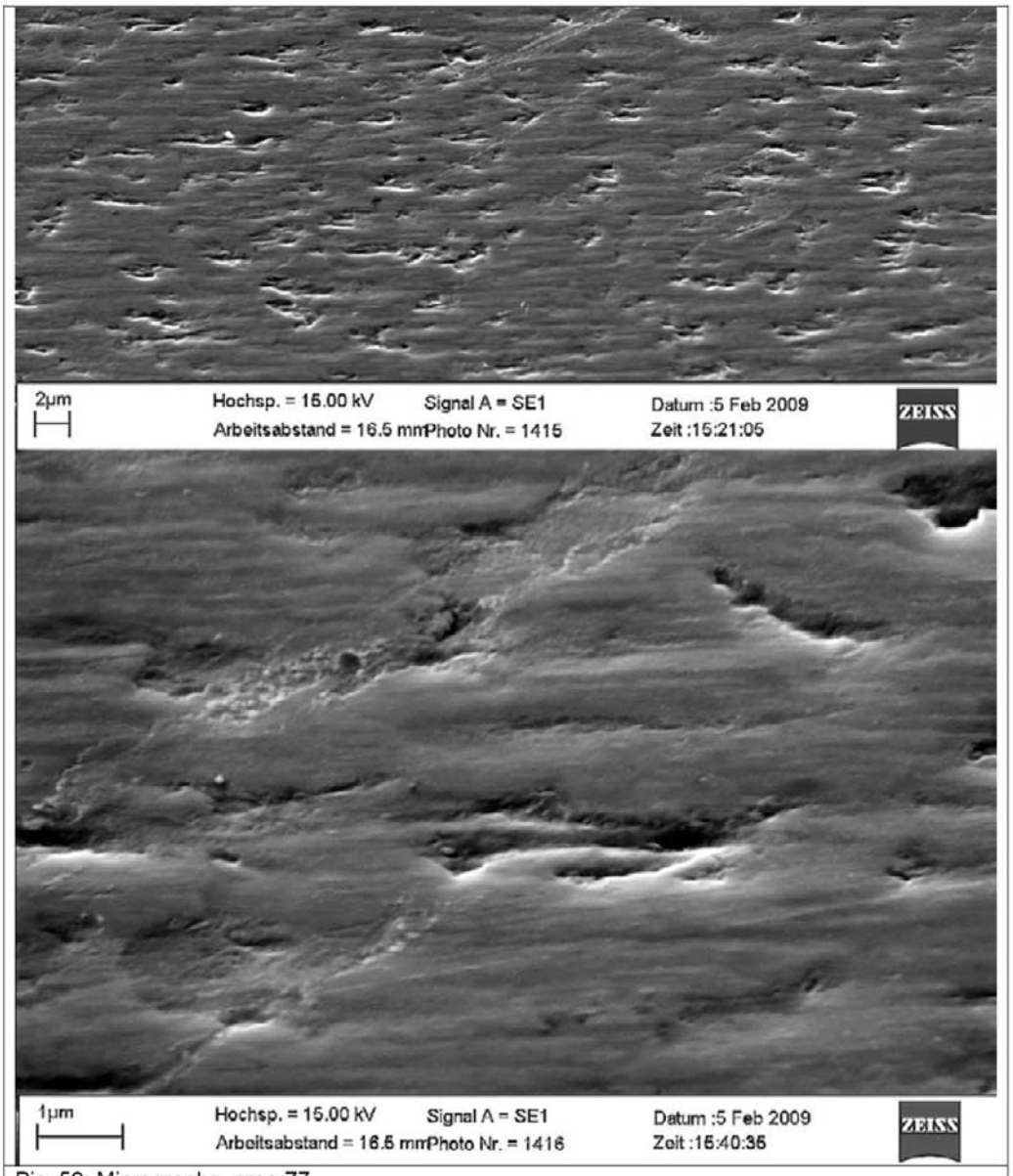
Pic. 57: Micrographs, area Z5

The micrographs show adhesive wear in area Z5 as well. The upper micrographs show various degrees of wear.



Pic. 58: micrographs, area Z6

Area Z6 shows adhesive wear. The upper micrographs show additionally traces of honing.



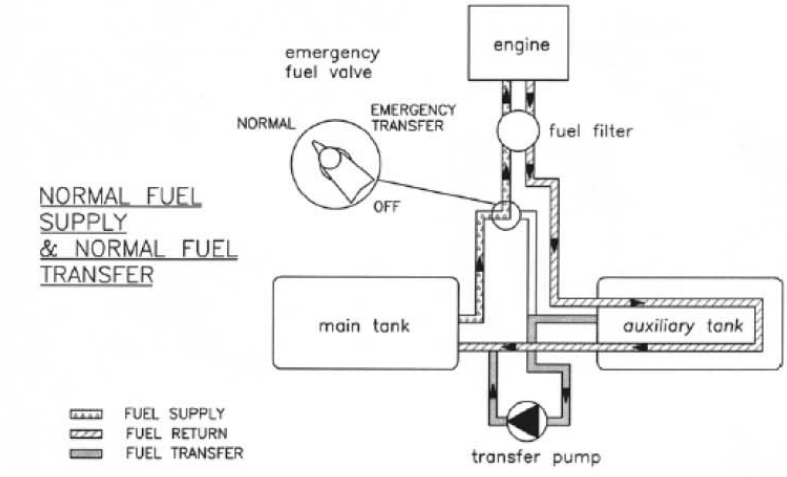
Pic. 59: Micrographs, area Z7

The area Z7 shows adhesive wear in a different state. The direction of fretting is clearly visible.

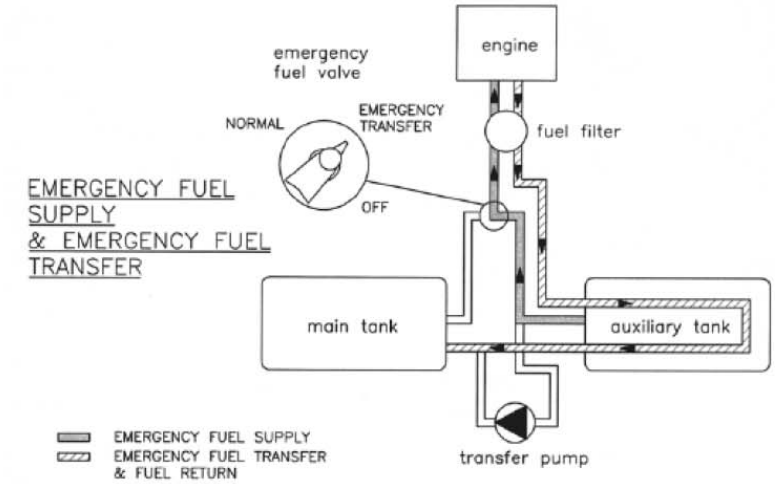
3 Analysis

3.1 Analysis of the pilot's report

The pilot reported that the FADEC A caution light was activated initially, following by FADEC B caution light shortly afterwards. Both comply with the FADEC eventlog entries in which the FADEC A caution light activation was recorded at 12:27:59 und the FADEC B caution light activation was recorded at 12:30:44. According to his report the pilot switched-on the fuel pump. In this installation there are two wing fuel tanks which are usually not connected, but can be connect in case of emergency. The engine is supplied from the main tank (in flight direction left side). Therefore, from time to time the pilot has to transfer fuel from the auxiliary tank to the main tank by switching on an electrical fuel transfer pump.
As shown in the schematics below the fuel pump does only transfer fuel from the right to the left tank, but not directly to the engine.



Pic. 60 Fuel System description for normal fuel supply, DA40 AFM



Pic. 61 Fuel System description for emergency fuel supply, DA40 AFM

According to the pilot's report he used emergency procedures during which he switched a mechanical fuel pump which feeds the engine fuel system directly. Since there is no mechanical fuel pump installed in DA40D aircraft which is accessible for the pilot during flight it is assumed that the pilot meant that he switched the fuel selector to the emergency position.

All emergency procedures which were followed by the pilot were related to a failure mode of which the root cause is related to the engine fuel supply. There is no other indication other than fuel tank indicator to identify fuel supply problems.

3.2 Analysis of the FADEC data

All data show that the in-flight shutdown is related to a problem of the fuel supply to the high pressure fuel system. Therefore the inspection was focused to the fuel system.

3.3 Analysis of the inspections

The failure is limited to one cylinder of the high pressure pump. The failure of the chamber E and the debris found explain the damage to all remaining parts of the high pressure pump. The degree of destruction shows that the time during which the pump run with a failed chamber seems to be low.
All inspections including the inspection of the high pressure pump showed that there was no debris found in the fuel system, outside the high pressure pump. Since there is a very high return fuel flow of 1.2 to 1.4 liters per minute any debris created by seizing high pressure pump would have been visible in all return line, in the main fuel tank as well as in the fuel filter.
The adhesive wear identified in the SEM analyses, especially in areas Z2 to Z6, might be the result of micro welding joints.

5 Attachments

5.1 Eventlog FADEC-A

FADECDATA#ca6c4f088decfa5420af90a5#

Event Log read 01/11/2008 14:23:06 from FADEC #2214

FADEC-A Events in chronological order:

22/09/2005 19:13:36 - Info only: Warnings cleared
22/09/2005 19:13:58 - Info only: Warnings cleared
30/01/2006 14:01:04 - Load Sensor failed for 10.0 seconds
30/01/2006 14:01:04 - Info only: Left low fuel for 10.0 seconds
31/01/2006 14:40:11 - Load Sensor failed for 10.0 seconds
31/01/2006 14:40:11 - Info only: Left low fuel for 10.0 seconds
31/01/2006 14:43:43 - Load Sensor failed for 10.0 seconds
31/01/2006 14:43:43 - Info only: Left low fuel for 10.0 seconds
31/01/2006 14:48:18 - Info only: Warnings cleared
31/01/2006 14:59:09 - Load Sensor failed for 10.0 seconds
31/01/2006 14:59:09 - Info only: Left low fuel for 10.0 seconds
01/02/2006 20:50:33 - Info only: Left low fuel for 10.0 seconds
02/02/2006 14:35:51 - Info only: Left low fuel for 10.0 seconds
03/02/2006 16:12:37 - Info only: Warnings cleared
14/07/2006 13:50:20 - Info only: Low coolant for 10.0 seconds
14/07/2006 13:52:51 - Info only: Low coolant for 10.0 seconds
29/05/2007 22:23:26 - Info only: Low coolant for 10.0 seconds
29/05/2007 22:23:59 - Info only: Low coolant for 10.0 seconds
31/05/2007 15:58:36 - Info only: Left low fuel for 10.0 seconds
31/05/2007 15:58:50 - Info only: Left low fuel for 23.7 seconds
31/05/2007 18:03:21 - Info only: Low coolant for 10.0 seconds
25/06/2007 14:20:24 - Info only: Low coolant for 10.0 seconds
24/10/2007 14:01:12 - Info only: Left low fuel for 10.0 seconds
24/10/2007 14:01:29 - Info only: Left low fuel for 10.0 seconds
24/10/2007 14:02:50 - Info only: Left low fuel for 86.1 seconds
28/12/2007 13:13:32 - Info only: Low coolant for 10.0 seconds
28/12/2007 13:13:43 - Info only: Injector shorted: #2
28/12/2007 13:13:43 - Info only: InjectorPower1 shorted
29/12/2007 10:43:58 - Info only: Low coolant for 10.0 seconds
29/12/2007 12:55:44 - Info only: Low coolant for 10.0 seconds
17/01/2008 14:59:43 - Info only: Low coolant for 10.0 seconds
17/01/2008 15:00:16 - Info only: Low coolant for 10.0 seconds
12/02/2008 14:27:36 - Info only: Low coolant for 10.0 seconds
12/02/2008 17:19:28 - Info only: Low coolant for 10.0 seconds
14/02/2008 16:30:04 - Info only: Low coolant for 10.0 seconds
14/02/2008 17:24:00 - Info only: Low coolant for 10.0 seconds
25/02/2008 10:26:16 - Info only: Low coolant for 10.0 seconds
01/03/2008 11:31:42 - Info only: Low coolant for 10.0 seconds
01/03/2008 12:06:27 - Info only: Low coolant for 10.0 seconds
01/03/2008 12:15:00 - Info only: Low coolant for 10.0 seconds
01/03/2008 12:36:58 - Info only: Low coolant for 10.0 seconds
03/03/2008 09:21:07 - Info only: Low coolant for 10.0 seconds
03/03/2008 13:40:29 - Info only: Low coolant for 10.0 seconds
04/03/2008 11:40:56 - Info only: Low coolant for 10.0 seconds
05/05/2008 14:25:08 - Info only: Low coolant for 10.0 seconds
06/05/2008 14:00:47 - Info only: Low coolant for 10.0 seconds
06/05/2008 15:14:36 - Info only: Low coolant for 10.0 seconds
08/05/2008 13:11:51 - Info only: Low coolant for 10.0 seconds
08/05/2008 14:33:07 - Info only: Low coolant for 10.0 seconds
08/05/2008 15:55:22 - Info only: Low coolant for 10.0 seconds
08/05/2008 15:56:24 - Info only: Low coolant for 71.6 seconds
08/05/2008 17:07:03 - Info only: Low coolant for 10.0 seconds
09/05/2008 15:05:53 - Info only: Low coolant for 10.0 seconds
09/05/2008 16:21:00 - Info only: Low coolant for 10.0 seconds
09/05/2008 17:21:53 - Info only: Low coolant for 10.0 seconds

10/05/2008 10:07:29 - Info only: Low coolant for 10.0 seconds
10/05/2008 11:10:28 - Info only: Low coolant for 10.0 seconds
10/05/2008 13:28:47 - Info only: Low coolant for 10.0 seconds
10/05/2008 13:29:08 - Info only: Low coolant for 30.8 seconds
12/05/2008 09:33:18 - Info only: Low coolant for 10.0 seconds
12/05/2008 10:43:50 - Info only: Low coolant for 4237.3 seconds
12/05/2008 13:38:13 - Info only: Low coolant for 10.0 seconds
12/05/2008 13:57:06 - Info only: Low coolant for 10.0 seconds
13/05/2008 13:12:51 - Info only: Low coolant for 10.0 seconds
13/05/2008 13:13:03 - Info only: Low coolant for 21.4 seconds
13/05/2008 15:32:06 - Info only: Low coolant for 10.0 seconds
15/05/2008 14:39:32 - Info only: Left low fuel for 10.0 seconds
06/08/2008 08:28:06 - Info only: Injector shorted: #2
06/08/2008 08:28:06 - Info only: InjectorPower1 shorted
28/10/2008 12:27:59 - High negative PRail delta: up to 616 bar for 5.7 seconds
28/10/2008 12:34:17 - Low PRail: down to 42 bar for 10.0 seconds
28/10/2008 12:44:58 - Low PRail: down to 17 bar for 648.8 seconds
01/11/2008 14:25:12 - PRail Sensor failed for 10.0 seconds

FADEC-A statistics:

ECU Uptime: 0.04h
Total ECU Uptime: 147.00h
Total Engine Runtime: 145.92h

Engine Runtime in Load steps:A: 18.87 / B: 12.09 / C: 4.03 / D: 5.26 / E: 13.19 / F: 42.76 / G: 29.16 / H: 20.56
Engine Runtime in TH2O steps:A: 8.70 / B: 4.52 / C: 100.04 / D: 28.32 / E: 4.34 / F: 0.01 / G: 0.00 / H: 0.00
Engine Runtime in TOil steps:A: 13.21 / B: 6.90 / C: 15.35 / D: 22.36 / E: 58.04 / F: 24.02 / G: 6.04 / H: 0.00
Engine Runtime in TGear steps:A: 126.27 / B: 17.66 / C: 1.97 / D: 0.03 / E: 0.00 / F: 0.00 / G: 0.00 / H: 0.00
Engine Runtime in PBaro steps:A: 0.01 / B: 14.67 / C: 32.85 / D: 11.47 / E: 10.49 / F: 12.60 / G: 23.84 / H: 39.99
Engine Runtime in POil steps:A: 0.17 / B: 0.04 / C: 9.09 / D: 56.98 / E: 79.54 / F: 0.10 / G: 0.00 / H: 0.00
Engine Runtime in RPM steps:A: 25.39 / B: 7.36 / C: 8.63 / D: 27.81 / E: 41.01 / F: 35.39 / G: 0.32 / H: 0.00
Engine Runtime in VBatt steps:A: 0.02 / B: 0.08 / C: 0.03 / D: 0.04 / E: 25.11 / F: 120.64 / G: 0.01 / H: 0.00

FADEC A active warnings:

000: 000 001: 000 002: 000 003: 000 004: 000 005: 000 006: 000 007: 000 008: 000 009: 000
010: 000 011: 000 012: 000 013: 000 014: 000 015: 000 016: 000 017: 000 018: 000 019: 000
020: 000 021: 000 022: 000 023: 000 024: 000 025: 002 026: 000 027: 000 028: 000 029: 000
030: 000 031: 000 032: 000 033: 000 034: 000 035: 000 036: 000 037: 000 038: 000 039: 000
040: 000 041: 000 042: 000 043: 000 044: 000 045: 000 046: 000 047: 000 048: 000 049: 003
050: 000 051: 000 052: 000 053: 000 054: 000 055: 000 056: 000 057: 000 058: 000 059: 000
060: 000 061: 000 062: 000 063: 000 064: 000 065: 000 066: 000 067: 000 068: 000 069: 000
070: 000 071: 000 072: 000 073: 000 074: 000 075: 000 076: 000 077: 000 078: 000 079: 000
080: 000 081: 000 082: 000 083: 000 084: 000 085: 000 086: 000 087: 002 088: 000 089: 000
090: 000 091: 000 092: 000 093: 000 094: 000 095: 000 096: 000 097: 000 098: 000 099: 000
100: 000 101: 000 102: 000 103: 000 104: 000 105: 000 106: 000 107: 000 108: 000 109: 000
110: 000 111: 000 112: 000 113: 000 114: 000 115: 000 116: 000 117: 000 118: 000 119: 000
120: 000 121: 000 122: 000 123: 000 124: 000 125: 000 126: 000 127: 000 128: 000 129: 000
130: 000 131: 000 132: 000 133: 000 134: 000 135: 000 136: 000 137: 000 138: 000 139: 000
140: 000 141: 000 142: 000 143: 000 144: 000 145: 000 146: 000 147: 000 148: 000 149: 000
150: 000 151: 000 152: 000 153: 000 154: 000 155: 000 156: 000 157: 000 158: 000 159: 000
160: 000 161: 000 162: 000 163: 000 164: 000 165: 000 166: 000 167: 000 168: 000 169: 000
170: 000 171: 000 172: 000 173: 000 174: 000 175: 000 176: 000 177: 000 178: 000 179: 000
180: 000 181: 000 182: 000 183: 000 184: 000 185: 000 186: 000 187: 000 188: 000 189: 000
190: 000 191: 000 192: 000 193: 000 194: 000 195: 000 196: 000 197: 000 198: 000 199: 000
200: 000 201: 000 202: 000 203: 000 204: 000 205: 000 206: 000 207: 000 208: 000 209: 000
210: 000 211: 000 212: 000 213: 000 214: 000 215: 000 216: 000 217: 000 218: 000 219: 000
220: 000 221: 000 222: 000 223: 000 224: 000 225: 000 226: 000 227: 000 228: 000 229: 000
230: 000 231: 000 232: 000 233: 000 234: 000 235: 000 236: 000 237: 000 238: 000 239: 000
240: 000 241: 000 242: 000 243: 000 244: 000 245: 000 246: 000 247: 000 248: 000 249: 000
250: 000 251: 000 252: 000 253: 000 254: 000 255: 000

5.2 Eventlog FADEC-B

FADEC-B Events in chronological order:

22/09/2005 19:13:40 - Info only: Warnings cleared
22/09/2005 19:14:01 - Info only: Warnings cleared
30/01/2006 14:01:12 - Load Sensor failed for 10.0 seconds
30/01/2006 14:01:12 - Info only: Left low fuel for 10.0 seconds
31/01/2006 14:40:20 - Load Sensor failed for 10.0 seconds
31/01/2006 14:40:20 - Info only: Left low fuel for 10.0 seconds
31/01/2006 14:43:52 - Load Sensor failed for 10.0 seconds
31/01/2006 14:43:52 - Info only: Left low fuel for 10.0 seconds
31/01/2006 14:48:27 - Info only: Warnings cleared
31/01/2006 14:59:18 - Load Sensor failed for 10.0 seconds
31/01/2006 14:59:18 - Info only: Left low fuel for 10.0 seconds
01/02/2006 20:50:42 - Info only: Left low fuel for 10.0 seconds
02/02/2006 14:36:00 - Info only: Left low fuel for 10.0 seconds
03/02/2006 16:12:46 - Info only: Warnings cleared
14/07/2006 13:50:49 - Info only: Low coolant for 10.0 seconds
14/07/2006 13:53:20 - Info only: Low coolant for 10.0 seconds
29/05/2007 22:24:38 - Info only: Low coolant for 10.0 seconds
29/05/2007 22:25:12 - Info only: Low coolant for 10.0 seconds
31/05/2007 15:59:49 - Info only: Left low fuel for 10.0 seconds
31/05/2007 16:00:03 - Info only: Left low fuel for 23.7 seconds
31/05/2007 18:04:34 - Info only: Low coolant for 10.0 seconds
25/06/2007 14:21:38 - Info only: Low coolant for 10.0 seconds
24/10/2007 14:02:53 - Info only: Left low fuel for 10.0 seconds
24/10/2007 14:04:14 - Info only: Left low fuel for 90.4 seconds
28/12/2007 13:15:04 - Info only: Low coolant for 10.0 seconds
29/12/2007 10:45:30 - Info only: Low coolant for 10.0 seconds
29/12/2007 12:57:16 - Info only: Low coolant for 10.0 seconds
17/01/2008 15:01:16 - Info only: Low coolant for 10.0 seconds
17/01/2008 15:01:49 - Info only: Low coolant for 10.0 seconds
12/02/2008 14:29:10 - Info only: Low coolant for 10.0 seconds
12/02/2008 17:21:02 - Info only: Low coolant for 10.0 seconds
14/02/2008 16:31:39 - Info only: Low coolant for 10.0 seconds
14/02/2008 17:25:35 - Info only: Low coolant for 10.0 seconds
25/02/2008 10:27:51 - Info only: Low coolant for 10.0 seconds
01/03/2008 11:33:18 - Info only: Low coolant for 10.0 seconds
01/03/2008 12:08:03 - Info only: Low coolant for 10.0 seconds
01/03/2008 12:16:36 - Info only: Low coolant for 10.0 seconds
01/03/2008 12:38:34 - Info only: Low coolant for 10.0 seconds
03/03/2008 09:22:43 - Info only: Low coolant for 10.0 seconds
03/03/2008 13:42:05 - Info only: Low coolant for 10.0 seconds
04/03/2008 11:42:32 - Info only: Low coolant for 10.0 seconds
05/05/2008 14:26:47 - Info only: Low coolant for 10.0 seconds
06/05/2008 14:02:26 - Info only: Low coolant for 10.0 seconds
06/05/2008 15:16:15 - Info only: Low coolant for 10.0 seconds
08/05/2008 13:13:31 - Info only: Low coolant for 10.0 seconds
08/05/2008 14:34:46 - Info only: Low coolant for 10.0 seconds
08/05/2008 15:57:02 - Info only: Low coolant for 10.0 seconds
08/05/2008 15:58:04 - Info only: Low coolant for 71.6 seconds
08/05/2008 17:08:42 - Info only: Low coolant for 10.0 seconds
09/05/2008 15:07:33 - Info only: Low coolant for 10.0 seconds
09/05/2008 16:22:40 - Info only: Low coolant for 10.0 seconds
09/05/2008 17:23:33 - Info only: Low coolant for 10.0 seconds
10/05/2008 10:09:09 - Info only: Low coolant for 10.0 seconds
10/05/2008 11:12:08 - Info only: Low coolant for 10.0 seconds
10/05/2008 13:30:27 - Info only: Low coolant for 10.0 seconds
10/05/2008 13:30:48 - Info only: Low coolant for 30.8 seconds
12/05/2008 09:34:57 - Info only: Low coolant for 10.0 seconds
12/05/2008 10:45:30 - Info only: Low coolant for 4236.7 seconds
12/05/2008 13:39:53 - Info only: Low coolant for 10.0 seconds
12/05/2008 13:58:46 - Info only: Low coolant for 10.0 seconds
13/05/2008 13:14:31 - Info only: Low coolant for 10.0 seconds

13/05/2008 13:14:43 - Info only: Low coolant for 21.4 seconds
13/05/2008 15:33:46 - Info only: Low coolant for 10.0 seconds
15/05/2008 14:41:12 - Info only: Left low fuel for 10.0 seconds
28/10/2008 12:30:44 - High negative PRail delta: up to 204 bar for 10.0 seconds
28/10/2008 12:30:57 - High negative PRail delta: up to 210 bar for 22.4 seconds
28/10/2008 12:34:12 - High negative PRail delta: up to 206 bar for 6.1 seconds
28/10/2008 12:34:46 - High negative PRail delta: up to 226 bar for 10.0 seconds
28/10/2008 12:34:49 - High negative PRail delta: up to 226 bar for 12.9 seconds
28/10/2008 12:35:03 - High negative PRail delta: up to 263 bar for 9.2 seconds
28/10/2008 12:35:13 - High negative PRail delta: up to 216 bar for 10.0 seconds
28/10/2008 12:36:06 - Low PRail: down to 38 bar for 10.0 seconds
28/10/2008 12:46:47 - Low PRail: down to 17 bar for 648.5 seconds
28/10/2008 12:46:47 - High negative PRail delta: up to 1034 bar for 701.4 seconds
28/10/2008 12:47:09 - PRail Sensor failed for 10.0 seconds
01/11/2008 14:27:02 - PRail Sensor failed for 10.0 seconds

FADEC-B statistics:

ECU Uptime: 0.04h
Total ECU Uptime: 148.01h
Total Engine Runtime: 146.09h

Engine Runtime in Load steps:A: 15.38 / B: 15.32 / C: 3.82 / D: 4.96 / E: 10.59 / F: 42.87 / G: 30.31 / H: 22.83
Engine Runtime in TH2O steps:A: 8.86 / B: 4.71 / C: 102.98 / D: 26.55 / E: 2.99 / F: 0.00 / G: 0.00 / H: 0.00
Engine Runtime in TOil steps:A: 13.43 / B: 7.13 / C: 15.58 / D: 23.71 / E: 58.21 / F: 23.27 / G: 4.75 / H: 0.00
Engine Runtime in TGear steps:A: 127.24 / B: 16.97 / C: 1.85 / D: 0.02 / E: 0.00 / F: 0.00 / G: 0.00 / H: 0.00
Engine Runtime in PBaro steps:A: 0.01 / B: 17.90 / C: 33.31 / D: 10.57 / E: 9.88 / F: 13.34 / G: 31.06 / H: 30.02
Engine Runtime in POil steps:A: 0.17 / B: 0.04 / C: 8.87 / D: 49.73 / E: 87.11 / F: 0.17 / G: 0.00 / H: 0.00
Engine Runtime in RPM steps:A: 25.50 / B: 7.45 / C: 8.62 / D: 27.90 / E: 41.00 / F: 35.29 / G: 0.33 / H: 0.00
Engine Runtime in VBatt steps:A: 0.01 / B: 0.08 / C: 0.05 / D: 0.05 / E: 15.63 / F: 130.24 / G: 0.03 / H: 0.00

FADEC B active warnings:

000: 000	001: 000	002: 000	003: 000	004: 000	005: 000	006: 000	007: 000	008: 000	009: 000
010: 000	011: 000	012: 000	013: 000	014: 000	015: 000	016: 000	017: 000	018: 000	019: 000
020: 000	021: 000	022: 000	023: 000	024: 000	025: 002	026: 000	027: 000	028: 000	029: 000
030: 000	031: 000	032: 000	033: 000	034: 000	035: 000	036: 000	037: 000	038: 000	039: 000
040: 000	041: 000	042: 000	043: 000	044: 000	045: 000	046: 000	047: 000	048: 000	049: 003
050: 000	051: 000	052: 000	053: 000	054: 000	055: 000	056: 000	057: 000	058: 000	059: 000
060: 000	061: 000	062: 000	063: 000	064: 000	065: 000	066: 000	067: 000	068: 000	069: 000
070: 000	071: 000	072: 000	073: 000	074: 000	075: 000	076: 000	077: 000	078: 000	079: 000
080: 000	081: 000	082: 000	083: 000	084: 000	085: 000	086: 000	087: 002	088: 000	089: 000
090: 000	091: 000	092: 000	093: 000	094: 000	095: 000	096: 000	097: 000	098: 000	099: 000
100: 000	101: 000	102: 000	103: 000	104: 000	105: 000	106: 000	107: 000	108: 000	109: 000
110: 000	111: 000	112: 000	113: 000	114: 000	115: 000	116: 000	117: 000	118: 000	119: 000
120: 000	121: 000	122: 000	123: 000	124: 000	125: 000	126: 000	127: 000	128: 000	129: 000
130: 000	131: 000	132: 000	133: 000	134: 000	135: 000	136: 000	137: 000	138: 000	139: 000
140: 000	141: 000	142: 000	143: 000	144: 000	145: 000	146: 000	147: 000	148: 000	149: 000
150: 000	151: 000	152: 000	153: 000	154: 000	155: 000	156: 000	157: 000	158: 000	159: 000
160: 000	161: 000	162: 000	163: 000	164: 000	165: 000	166: 000	167: 000	168: 000	169: 000
170: 000	171: 000	172: 000	173: 000	174: 000	175: 000	176: 000	177: 000	178: 000	179: 000
180: 000	181: 000	182: 000	183: 000	184: 000	185: 000	186: 000	187: 000	188: 000	189: 000
190: 000	191: 000	192: 000	193: 000	194: 000	195: 000	196: 000	197: 000	198: 000	199: 000
200: 000	201: 000	202: 000	203: 000	204: 000	205: 000	206: 000	207: 000	208: 000	209: 000
210: 000	211: 000	212: 000	213: 000	214: 000	215: 000	216: 000	217: 000	218: 000	219: 000
220: 000	221: 000	222: 000	223: 000	224: 000	225: 000	226: 000	227: 000	228: 000	229: 000
230: 000	231: 000	232: 000	233: 000	234: 000	235: 000	236: 000	237: 000	238: 000	239: 000
240: 000	241: 000	242: 000	243: 000	244: 000	245: 000	246: 000	247: 000	248: 000	249: 000
250: 000	251: 000	252: 000	253: 000	254: 000	255: 000				

---End of Log ---