

FINAL REPORT

on

investigation of an aviation occurrence with BOEING 737-300, registered LZ-BON, operated by Bulgaria Air occurred on 10.10.2005 during scheduled passenger flight FB-464 Amsterdam – Varna



The materials about the aviation occurrence have been classified under state file number 06/10.10.2005 in the archives of the Air Accident Investigation Unit (AAIU)

Operator: Bulgaria Air Sole-Owner JSC, with main office at Sofia, 1 Brussels boulevard, Sofia Airport, Air Operator License issued by CAA on 01.11.2002 and period of validity till 20.02.2007.

Aircraft Manufacturer: Boeing , USA

National and Registration Marks: LZ-BON, according Certificate for Registration No 1876 issued on 27.05.2004 by CAA.

Place and Date of Occurrence: in flight, at FL 350 (35000 ft), in the airspace of Federal Republic of Germany on 10.10.2005.

Notified: Aircraft Accident Investigation Unit, Civil Aviation Administration (CAA), International Civil Aviation Organization (ICAO), German Bureau for Aviation Occurrences Investigation (BFU) and United States National Transport Safety Board (NTSB).

For investigation of the aviation occurrence a Commission was appointed with the Order RD-08-442/14.10.2005 of the Minister of Transport of the Republic of Bulgaria.

Type of the Flight: Scheduled passenger flight No FB-464 from Amsterdam to Varna (AMS/VAR).

BOEING-737-300 aircraft, reg. LZ-BON took-off for scheduled flight Amsterdam – Varna at 09:38:28 UTC on 10.10.2005. After reaching an altitude of 35000ft (FL350), the oil quantity and pressure of left-hand engine started to drop with a constant rate and in three minutes it reached 20%.

Low oil pressure indication (LOW OIL PRES ENG1) on engine No1 came on and the indicator of oil pressure read zero.

All other engine parameters were normal. The crew performed the procedures for low oil pressure (ENGINE LOW OIL PRESSURE NNCQ and ENGINE FAILURE/SHUTDOWN) according Quick Reference Handbook (QRH) of Boeing 737 and after engine cooling it was shut down.

The commander's decision was to land at Frankfurt Airport as an alternate airport.

The passengers were told a landing should be done at Frankfurt Airport due to a technical problem.

The approach and landing at Frankfurt Airport were performed with one engine operative without any consequences for the aircraft, crew and passengers.

In accordance with Art.9 Para.1 & 3, of the Additional Provisions of Regulation 13 of the Ministry of Transportation about aircraft accident investigation the aviation occurrence has been classified as a Serious Incident.

1. Factual Information

1.1 History of the Flight

The flight assignment was given by the airline operator to a crew consisting of: commander, first officer, three female cabin attendants and a male cabin attendant.

1.1.1 Flight Number: FB-464.

1.1.2 Flight Preparation and Description

Preflight briefing for the flight from Amsterdam to Varna was done in Amsterdam Airport.

The slot for flight Amsterdam – Varna was set for 11:00 local time. The real take-off was performed at 12:20.

In Amsterdam Airport the crew received aeronautical and weather briefing, Flight Plan and flight documents. A briefing with cabin crew was executed.

The commander was appointed as a flying pilot for Amsterdam – Varna segment.

At Amsterdam Airport the commander and the first officer have performed preflight check of the airplane without any remarks. The boarding of thirteen passengers was executed under first officer supervising.

On the apron before aircraft towing the towing car driver observed a leak (drops) from Engine No 1 (left-hand engine) and reported to the aircraft commander. The towing was stopped.

The commander called up the authorized technical person from KLM. It was established that it was kerosene from draining system of the fuel-oil heat exchanger with an intensity of 7 drops per minute with acceptable rate up to 14 drops per minute.

The aircraft was permitted for flight by KLM technical person in accordance with the Boeing 737 Maintenance Manual, what was agreed with Technical Maintenance Department of the air operator.

The commander's decision was the aircraft to be permitted for flight.

The commander determined take-off parameters and after clearance from Amsterdam – Tower started the right-hand engine at 09:25:55 UTC and this started flight data registration in FDR. At 09:26:57 the left-hand engine was started and taxi was commenced.

At 09:53:39 the oil quantity in the left-hand engine started to decrease quickly from OQL = 53.2, at 09:54:53 to OQL = 18.8 respectively. At 09:55:57 the oil quantity in the left hand engine was registered OQL = 6.0 and in the same time the oil pressure in the left-hand engine started to decrease. At 09:56:58 oil pressure in the left-hand engine decreased to zero, the pressure in the right-hand engine was OIPR = 37.

The crew established idling mode for cooling for the left-hand engine, informed ATC about the technical problem and its decision for landing at Frankfurt Airport, descended to FL250. The commander declared emergency situation and informed the passengers.

At 10:01:35 the left-hand engine was shut down.

The landing approach was performed in accordance with the normal landing procedure without peculiarities.

At 10:22:28 the aircraft landed at a speed of 136.5kts. After landing a reverse of the operational right-hand engine was used for 10 s and it was disengaged at a speed CAS=64kts.

At 10:32:02 the aircraft left the RWY07 and after taxiing was parked.

1.1.3 Location of the Occurrence

The serious incident occurred at 09:56:53 UTC on 10.10.2005 in horizontal flight in the Federal Republic of Germany airspace at an altitude of 35000ft (FL350).

1.2 Injures to Persons

No injures to crew and passengers.

1.3 Damage to Aircraft

No damages were found on the aircraft.

1.4 Other Damages

No other damages.

1.5 Personnel Information

1.5.1 Commander – male, aged 35, with valid ATPL License and medical certificate.

1.5.2 First Officer – male, aged 33, with valid ATPL License and medical certificate.

1.5.3. Chief Cabin Attendant - female, aged 42, with valid C/AL License and medical certificate.

1.6. Aircraft information

1.6.1. Airworthiness information

Boeing B737-300, registered LZ-BON, manufacturer serial number (MSN) 29060, Certificate of Airworthiness No 1876, issued on 27.06.2004 by CAA, confirmed on 22.05.2005 and valid until 21.05.2006.

As on 09.10.2005 (the day before the aviation occurrence) the aircraft has accumulated 18976:44 hrs total time since new and 16334 cycles since new.

The last 1C-Check was performed on 09.05.2004 with 15035 hrs total flight time and 14618 cycles. The next C check should be performed at 19035 hrs, but according approved by CAA request for postponement No 15/08.09.2005 the next 1C-check was postponed with 195 hrs until accruing 19230 hrs, but no later than 15.11.2005. The postponement was due to the loaded charter program and it is in accordance with the approved by CAA Maintenance Program for Boeing 737-300 for Bulgaria Air air operator, which should permit scheduled maintenance with interval up to 5000 hrs to be increased up to 10%. The requested increasing was for 195 hrs and it represents an increasing of maintenance interval by 4.88%, what was in accordance with the maintenance program approved. The postponement was agreed with Boeing and the aircraft owner.

The last 4A check was performed on 27.09.2005 at 18917 hrs total flight time and 16308 cycles since new.

On 29.09.2005 an 8A-check was performed.

Two engines CFM 56-3C1 were installed on the aircraft.

The engine, related with the aviation occurrence was at position 1 (left-hand) and its serial number is 856208.

The engine was leased under a contract between Bulgaria Air and Snecma Morocco Engine Services (SMES) Safran Group from August 5th, 2005 and the engine itself was owned by Aero Turbine Inc., USA. The engine was leased for the period of overhaul of the original engine CFM 56-3C1, MSN 5858749, which was removed from the aircraft on 19.08.2005 with 18222 hrs total flight time and 15793 cycles since new and sent for overhaul on the same date.

According the attached reference from SMES about the history of the engine with MSN 856208, as on 10.08.2005 the engine had 26621:29 hrs and 16183 cycles since new. Since the last shop visit the engine has accumulated 1137 hrs and 681 cycles.

The engine last shop visit was certified on 13.01.2005 at 25484 hrs and 15502 cycles since new and the engine had an EASA Form 1 No 0031/2005, issued by Lufthansa Technik Airmotive Ireland Limited, as well Form 8130-3 of FAA No 0030/2005. There was also a report for ground testing attached to the documents for the shop visit.

After that date the engine was installed on Boeing 737-300 aircraft, Reg. No 9M-AAB of the Malaysian Air Asia Airline. On 17.05.2005 the engine was ground tested by Air Asia on order to return it to the lessor. A report for the testing was attached to the engine folder.

On 19.05.2005 the engine was preserved for a period up to one year – till 18.05.2006 and a copy from the preservation tag was attached to the engine folder.

On 31.05.2005 a borescope control was performed on the engine at Lufthansa Technik, Brussels by request of Aero Turbine Inc. The successful accomplishment of aforesaid operations was certified with FAA Form 8130-3 with No 2005-169.506142005, issued by FAA authorized factory with a number UOXR689Y on 14.06.2005 and in the form was indicated that the engine was released to service.

On 29.06.2005 a borescope control of the engine was performed by Sheelin Aviation Maintenance, Ireland, what was certified with a form for operation permit Form 1 of EASA with No 0051, issued by Sheelin Aviation.

The engine MSN 856208 was installed on LZ-BON aircraft of Bulgaria Air air operator on 19.08.2005 in Brussels by Sabena Technic.

As to 09.10.2005 the engine has accumulated 27019 hrs and 16357 cycles since new, including 398 hrs and 174 cycles on LZ-BON aircraft of Bulgaria Air. After the last shop visit the engine has accumulated 1535 hrs and 855 cycles (including 398 hrs and 174 cycles on LZ-BON aircraft).

Engine maintenance was performed on condition in accordance with Air Operator Bulgaria Air Aircraft Maintenance Program, approved by CAA on 21.06.2005.

Air operator didn't submit to the Commission a copy of the Program, according to which the engine was serviced by the previous lessor and there was no document, approved by the CAA, for harmonization between the two programs.

According sheet No 000002 from LZ-BON aircraft technical logbook before the flight Varna – Amsterdam the technical staff of the air operator Bulgaria Air was performed Daily and Transit Check on the aircraft and the aircraft was refueled with 6780 kg JET A-1 fuel according Invoice No 60268.

Engine N01 was refilled with 2 quarts of oil and the oil quantity in engine No 1 was 100%. Engine No2 was refilled with 2 quarts of oil and the oil quantity in engine No 2 was 97%.

No remarks were written during the check.

The aircraft was accepted by the crew and this was certified by a signature.

According the aircraft technical logbook sheet No 000003 of LZ-BON a WALK-AROUND CHECK was performed by the commander and the first officer.

On the apron stand before aircraft towing after a fuel leak was established from the left engine and in "Defects" column of the technical logbook was written: "Fuel leak from fuel-oil heat exchanger of the left-hand engine - 7 drops per minute".

The KLM technical person with license No 39185 has written in the column "Actions taken" "Checked, in the acceptable limits in accordance with the aircraft Maintenance Manual".

The commander certified by his signature the admittance of the aircraft for the forthcoming flight.

In the "Oil Level" column for the left-hand engine it was written 100% and for the right-hand one – 97%.

According with the approved by CAA Maintenance Program for Boeing 737-300 for Bulgaria Air Operator on 21.06.2005 TRANSIT CHECK of the aircraft should be performed by authorized air crew. This requirement of the Maintenance Program is not included in Section

8 of Flight Operation Manual of the Air Operator and in Section 6 of Description and Maintenance Control Manual. In the Section 0 of the same Manual there isn't mentioned any contract with subcontractors for small repairs at off-base airports.

1.6.2. Airplane performance

The maximum take-off weight of the airplane in accordance with the Certificate of Airworthiness No 1876/27.05.2004 is 63276 kg. The actual take-off weight of the aircraft for the flight FB464 according to the loadsheet was 44252 kg. The balance was within the operational limits and did not influence the occurrence.

The aircraft is equipped with Airborne Collision Avoidance System (TCAS) and Enhanced Ground Proximity Warning System with improved additional function for terrain assessment along the flight direction (EGPWS).

1.6.3. Fuel

According the aircraft technical logbook sheet No 000003 of LZ-BON before the flight Amsterdam – Varna first officer has confirmed aircraft refueling with 6480kg JET A1 and the total quantity of on-board fuel was 9210 kg and it was enough for execution of Amsterdam – Varna flight.

1.7. Meteorological information

The weather at take-off from Amsterdam (AMS): RWY 24, visibility 1700 m, haze, cloudiness 1 – 2/8 at 200ft, 3 – 4/8 at 300ft, wind from 140°, speed 5 m/s, temperature 12°C, dew point 12°C, QNH=1021hPa.

Terminal weather at Frankfurt Airport: wind from 070°, speed 6 m/s, visibility 5000m, haze, temperature 12°C, cloudiness 3-4/8 at 500ft, 8/8 at 900ft, QNH=1024 hPa.

1.8. Aids to navigation

Standard aids for B 737-300 aircraft.

1.9. Communications

Standard communication equipment for B 737-300 aircraft.

1.10. Airport

The aviation occurrence emerged at FL350 in the airspace of Federal Republic of Germany.

The aircraft took-off from Amsterdam Airport and landed at Frankfurt Airport on RWY07L.

The reference point of the airport is with coordinates 50⁰ 02,0' N, 008⁰ 34,2' E.

Airport elevation is 329 m.

The airport is equipped with all necessary systems for landing.

1.11. Flight data recorders

The data from FDR was taken at Frankfurt Airport after the landing in presence of a Commission member. Decoded data are given in Enclosure 1.

After decoding of the records from FDR it was established, that:

- at the take-off start the oil quantity and pressure parameters for the left-hand and right-hand engines were respectively:

OQL = 90.8 OQR=90.8
OIPL=21,0 OIPR=21.0 and

FL350 was reached at 09:51:03 UTC , where the oil reading were as follows:

OQL = 87.8 OQR=94.5

At 09:53:49 the quantity in the left-hand engine started to decrease and it was already OQL=18.8 and at 09:55:57 it was already OQR=6.0.

With the decrease of the oil quantity the oil pressure also decreased and at 09:56:58 the oil pressure in the left-hand engine was OIPL=0 (the oil pressure in the right-hand engine at that moment was OIPR=37).

Low oil pressure indication came on.

At 09:58:35 the left-hand engine mode was reduced to idle and under commander's decision the following was performed:

1. Check List 7.13- "Engine Low Oil Pressure";
2. Check List 7.4 – "Engine Failure/Shutdown"

At 10:01:35 the left-hand engine was shut down and autopilot was disengaged.

3. Check List 7.20 – "One Engine Inoperative Landing".

The crew started descending for landing at Frankfurt Airport.

The landing approach and the landing itself were uneventful and without and consequences for the passengers and aircraft.

At 10:23:02 the aircraft left RWY 07 FRA by the taxiway and was parked on the apron stand.

1.12. Wreckage and impact information

No impact and no destructions on the aircraft and engine No 1 were found.

The aviation occurrence emerged in flight and as a consequence the No 1 (left-hand) engine was shut down and aircraft landed with right-hand engine operational. The landing was performed without any complications and there weren't any consequences for the passengers, crew and aircraft.

1.13. Medical and pathological information

Not applicable for the aviation occurrence emerged.

1.14. Fire

No fire appeared in the failed engine.

1.15. Survival aspects

Not applicable for the aviation occurrence emerged.

1.16. Tests and research

For the purpose of the technical investigation the following tests and research have been conducted:

- Visual inspection of the engine condition and fixing of the engine systems components in the left engine nacelle;

- Non-destructive control and analyses of the condition of flange gasket for fixing of the line from fuel-oil heat exchanger to scavenge system oil filter to the oil filter in a SNECMA laboratory;
- Aircraft documents for organization and executing of the flight;
- Documents related with aircraft airworthiness;
- Documents related with engine airworthiness;
- Read-out, decoding and analyses of the flight data records;
- An interview with the crew was carried out and written explanations were taken in relation with the aviation occurrence;
- Consultations with a representatives of engine manufacturer – CFM International, German Bureau for Aviation Occurrences Investigation (BFU) and Dutch Bureau for Aviation Occurrences Investigation (DSIB).
- logical and probabilistic analyses of the possible reasons for the air occurrence.

2. Analysis

The cause for the forced landing at Frankfurt Airport was oil leakage from oil system of the left-hand engine, followed by oil pressure drop down to zero. In executing of the procedures foreseen for such cases the crew shut down the engine and undertook an emergency landing at Frankfurt Airport

After the visual inspection at Frankfurt Airport by Lufthansa Technik personnel the following ascertainments were done:

1. Leak of oil from the gasket of the flange for fixing of the scavenge oil line from the return oil filter to the filter;
 2. Loosen four bolts for fixing of the scavenge oil line flange to the scavenge oil filter;
- The findings from the inspection were given in Enclosure 2.

The gasket was changed and the bolts tightened in accordance with the requirements of Aircraft Maintenance Manual (AMM). The Manual requires the tightening of bolts to be done with a torque of 6.5 – 7.0 Nm. Engine checks and test for oil leak were performed. After no deficiencies were established the engine was released to service on the ground of authorizing letter of Bulgaria Air No 33/11.10.2005.

For revealing of the causes for oil leaking the Commission has considered four hypotheses:

1. Loosed bolts for fixing the flange for fixing the scavenge oil line from the scavenge filter to the filter with the required torque during the last shop visit, certified on 13.01.2005 at Lufthansa Technik Airmotive Ireland Limited;
2. Use of a gasket without the required quality for sealing of the flange for fixing of the scavenge oil line from scavenge oil filter to the filter;
3. Self-loosening of the bolts for fixation of the pipeline for fixing of the scavenge oil line from scavenge oil filter to the filter as a result of vibration;
4. Errors made during the technology process, related with maintain of engine airworthiness during the operation after the last shop visit.

- In connection with the first hypothesis the Commission analyzed the documents about the History of CFM56-3C1 engine, serial number 856208 from the last shop visit in Lufthansa Technik Airmotive Ireland Limited and examined the data from the report about the tests

performed on the engine. No deficiencies were established, related with the document keeping and the test results didn't reveal any deviations from the technical requirements. Taking into account the abovementioned and the fact that the engine after the overhaul has accumulated 1535 hrs and 855 cycles (including 398 hrs and 174 cycles on LZ-BON aircraft), the Commission considered this hypothesis as a highly unlikely;

- As for the second hypothesis, the Commission with cooperation with Field Service Program Manager of CFM International for the region sent the gasket for examination in the laboratory of Snecma. The examination result is given in Enclosure 3. On one of the two surfaces there was a fixed eccentric imprint in an angle sector, caused by a contact with the oil line. The most probable cause for this imprint was a wrong fitting of the line during installation, leading to a bad contact between the two surfaces during flange bolt tightening. In case of wrong installation the low values of the torque for bolt tightening (maximum 7 Nm) don't allow to correct the bad fitting of the line. As times goes by, because of loads and vibrations, the bad fitting of the pipeline might bring to loosening of the joint and oil leakage.

Uninstalling and reinstalling of the line between the scavenge oil filter and fuel-oil heat exchanger in operational conditions might be executed in case of change of fuel-oil heat exchanger, scavenge oil filter casing, indicator for scavenge oil filter clogging, the main engine control (MEC) and lines to the fuel filter. The Commission didn't find records for such a change in the operational documentation. The installation of the joint was made most probably during the last shop visit.

- For the third hypothesis an analyses was made of the records of the values of the two engines vibrations of LZ-BON aircraft for 44 flights performed during the period from 09.09.2005 till 10.10.2005. In 38 flights (86.4%) the maximal values of the left-hand engine fan vibrations were higher than 1 unit, in 16 (36.6%) they were more than 1.5 units and in 24 (4.5%) they were more than 2 units, and the highest value was 2.32 units. In the same time the right-hand engine vibration values 12 (27.3%) of the values of fan vibrations were over one unit, and the highest value was 1.38 units. During all examined flights the left-hand fan vibrations were higher than the right-hand engine ones and the average overshoot was about two times. The vibration recording was made every 64 s and the maximum values were achieved at fan rotating speed 59 – 73% and the highest values were in the range 61 – 64%. From the foregoing it may be concluded, that for the both engines during flights considered the vibration level was less than the operational limits. But there was a raised vibration background of the left-hand engine. The bolts used for pipeline fixing between the scavenge oil filter and fuel-oil heat exchanger are of self-locking type and after tightening with the torque required by AMM they wouldn't be loosened in case of such vibrations. Moreover, the problem in question is for loosening of four bolts at one time and the probability for this is negligibly small. But the raised vibration background in case of bad fitting of the line may bring to loosening of contact and to cause oil leaking. It was established that in fulfillment of its quality program the air operator didn't observe the tendency in engine vibrations.

- Under the fourth hypothesis all works for airworthiness maintenance were analyzed for the period from 19.08.2005 till the aviation occurrence. A discussion was held and written explanations were taken from the technical staff, who took part in aircraft release to service after engine installation by Sabena Technic in Brussels and in execution of 4A and 8A checks during the period in question, the technical records for the works done during this period was

checked and analyzed, an assessment was fulfilled about the possibility for unregulated actions and violations of the technological process, which might bring to the event under discussion. The following conclusions were done:

Technical personnel consisting of two engineers - one airframe and engine engineer and one avionics engineer, was sent for aircraft release to service after engine installation. They both presented during installation and subsequent tests. The tests passed successfully and after engine documentation examination an acceptance protocol was signed. During the acceptance and inspections no leaks of oil, fuel or other working fluids were established.

Air operator has no program and check list for aircraft acceptance.

The records in Aircraft Technical Logbook were checked for the period since 19.08.2005 till 10.10.2005. No records were found out for faults and fault removal on the engine and its systems till 09.10.2005 including. Aircraft preflight preparation for Flight 463 Varna – Amsterdam, including Daily and Transit Check, was recorded in Technical Logbook No 000002, issued on 09.10.2005 and no marks for any faults and corrective actions were established, i.e. the engine nacelle hatches were not opened. In the Technical Logbook No 000003, issued on 10.10.2005 and reflecting Flight 464 Amsterdam – Varna in the “Faults” column there is a record: “Leak of fuel from fuel-oil heat exchanger of the left-hand engine – 7 drops per minute”. In the “Actions taken” column there is a record by the technical person from KLM with licence No39185: “Checked, in the acceptable limits in accordance with the Aircraft Maintenance Manual”.

At Amsterdam Airport the commander and the first officer have executed walk-around check and after passenger boarding and arming the doors they asked clearance for aircraft towing. Push-back driver informed about a spot under engine No1 before towing. The commander stopped the towing, disarmed doors and requested a step for additional inspection of the engine. After inspection, during which the hatches of the engine No1 were opened, the technical person from KLM made the record cited above and the commander took decision for flight execution. During the checks performed by the maintenance person the crew was in the cockpit. A possible chance existed, that the technical person inadvertently might affect on the line connecting the fuel-oil heat exchanger with the low pressure filter during oil-heat cooler inspection, what might bring to shift in the wrong installed flange.

In the left-hand engine area some tasks also had been performed during 4A and 8A checks on September 27th and 29th respectively. No changes and removals of components were done. Only task cards were executed. The Commission discussed this with the technical staff which had performed the tasks on the engines. Written explanations also were taken. Direct influence for the occurrence had the tasks performed under Boeing Card No C7100-00-A-1. The content of this card is as follows: “Inspection of the left engine components, including connection cables, lines, connectors, rope and fixing clamps for their condition and secured fixing”. The card should be performed during 4A check, i.e. after 1000 flight hours, what means, that it is the first 4A check, performed on the engine by this air operator. During the card execution there were no peculiarities recorded, no peculiarities were established also during the discussion with the staff, who executed the card. It should be noted, that air operator doesn't have “Instruction, which describes the succession and the way of execution of specific maintenance tasks” as it is laid down in Art. 64, item 5 of Regulation 145 of 11.08.2004 of the Ministry of Transport and Communications. Because of the large scope of the tasks to be performed in relation with the above mentioned, the lack of such instruction

leads inevitably to possibility for omissions in the performance. It is also necessary to note the low level of controllability of the flange connections of the line between the fuel-oil heat exchanger and the scavenge oil filter. It is impossible to establish during the visual inspection bolt loosening, except in case of leak. Because of this the possibility of revealing of a leakage at a preliminary stage is embarrassed. It is advisable to use self-locking bolts with marks or to make a red paint marks.

Taking into account the so far stated in Part 2 Analysis, the Commission accepted as a cause for leakage from the flange connection of the scavenge oil filter line from the scavenge oil filter might be pointed out the incorrect installation, possibly during the last shop visit or during the engine operation in Air Asia or Bulgaria Air and possible influence of increased vibration background, which assisted in its loosening, with impossibility for effective control for maintenance by the air operators.

In situation emerged in flight the crew acted in accordance with the requirements of the Flight Operation Manual, what leded to a landing at Frankfurt Airport with no consequences for passengers, crew and aircraft.

3. Conclusions

The technical investigation conducted gives the grounds for the conclusion, that the aviation occurrence is a result from the following

Main cause

Oil leak from the oil system of the left-hand engine from the flange gasket for fixing of the scavenge oil filter line, possibly caused by incorrect connection installation and subsequent engine operation in conditions of increased vibration background, promoted its loosening.

During investigation the following deficiencies were also established:

1. Air operator doesn't have a copy of the program, under which the leased engine CFM 56-3C1, serial number 856208 has been maintained by the preceding lessor and there is no documents, approved by CAA for harmonization of this program with its own program.
2. Flight Operation Manual of the air operator is not developed in accordance with the content of the Attachment 5 to Art.30, Para.1 of Regulation No 24 of 15.02.2000 for issuing of an Air Operator Certificate.
3. Flight Operation Manual of the air operator is not developed in accordance with the requirements of Art.26, Para.1 of Regulation No 24 of 15.02.2000 for issuing of an Air Operator Certificate.
4. Section 11 of Flight Operation Manual of the air operator is not pursuant with the requirements of the Regulation No 13 of 27.01.1999 for aircraft accidents investigation of the Ministry of Transport.
5. In Section 8 of the Flight Operation Manual of the air operator and Section 6 of Description and Maintenance Control Manual of the air operator the requirement of the Maintenance Program for Boeing 737-300 for Bulgaria Air air operator for Aircraft Transit Check to be performed by authorized flight personnel is not included.

6. In Description and Maintenance Control Manual of the air operator there isn't any contract with subcontractors for small repairs at off-base airports.

7. In following of its quality program the air operator doesn't observe the tendency in changes of engine vibrations.

8. Air operator has no program and check list for aircraft release to service, according which to accept the aircraft after engine replacement at a base of another operator.

9. Air operator doesn't have an Instruction, developed in accordance with Art. 64, item 5 of Regulation 145 of 11.08.2004 of the Ministry of Transport and Communications, describing the succession and the way of execution of the tasks under Boeing Card No C7100-00-A-1.

Having in view the above described, the Commission proposes the following

Safety recommendations:

1. Air operator Bulgaria Air to revise its Flight Operation Manual in conformity with the requirements of Attachment 5 to Art.30, Para.1, Art.26, Para.1 of Regulation No 24 of 15.02.2000 for issuing of an Air Operator Certificate and Regulation No 13 of 27.01.1999 for air accidents investigations of the Ministry of Transport. The requirement of the Maintenance Program for Boeing 737-300 for Bulgaria Air air operator that the Aircraft Transit Check to be performed by authorized flight personnel to be included in the FOM.

Time: 60 days after the day of handing in of the report. Person responsible: Executive Director of Bulgaria Air.

2. Air operator Bulgaria Air to introduce changes in Description and Maintenance Control Manual, in which to take into consideration the possibility for aircraft Transit Check execution by authorized flight personnel and to include organizations, which should be used as subcontractors at out-off base airports.

Time: 60 days after the day of handing in of the report. Person responsible: Maintenance Director of Bulgaria Air.

3. Air operator Bulgaria Air to develop in accordance with the requirements of Art. 64, item 5 of Regulation 145 of 11.08.2004 of the Ministry of Transport and Communications technical instructions, describing the succession and the way of execution of the tasks under task cards for A-checks according a approved by CAA list, for which the lapses in execution may have dangerous consequences for the flight safety.

Time: 90 days after the day of handing in of the report. Person responsible: Chief Engineer of Bulgaria Air.

4. In order to implement visual inspection of the flange fixation bolts position for oil line between the fuel-oil heat exchanger and scavenge oil filter of CFM 56-3C1 engines the bolts to be marked by red paint.

Time: 30 days after the day of handing in of the report. Person responsible: Maintenance Director of Bulgaria Air.