

FINAL REPORT

on
investigation of an aviation occurrence with Ka-26 helicopter, reg. No
LZ-6080, property of Fortuna Air Ltd – Town of Veliko Tarnovo,
occurred on 15.06.2005



2005

The materials have been classified under state file number 04/15.06.2005 in the archives of the Aircraft Accident Investigation Unit (AAIU).

Operator (AO): FORTUNA AIR Sole-Owner Ltd., with a main office in Veliko Tarnovo, 2 Tsvetarska Str., based in Gorna Oryahovitsa.

Aircraft Manufacturer: Ministry of Aviation Industry - USSR

National and Registration Marks: LZ-6080, according Certificate for Registration No 1935, issued on 08.12.2004 by the Civil Aviation Authority.

Place and Date of Air Occurrence: Pishtigovo village area, district of Pazardjik, on 15.06.2005.

Notified: Aircraft Accident Investigation Unit (AAIU) and Civil Aviation Authority at the Ministry of Transport.
A commission has been appointed for investigation of the aviation occurrence by an order RD-08-304/27.06.2005 of the Minister of Transport.

Type of Flight: **Aerial** work (AW) flight for herbicide spraying, according AW Specification of air operator (AO).

On 15.06.2006 the commander of Ka-26 helicopter, reg. No LZ-6080, was carrying out eighth AW flight for the day. After refilling with herbicides he took-off from a temporary landing site in Pishtigovo village area, flew over a corn field and before the start of working passes an engine flameout of the left-hand engine occurred. The altitude was 20...25m. The commander made an unsuccessful attempt to jettison the load and executed a forced running landing on a site, chosen from the air. The nose landing gear legs, fore bottom part of the helicopter cabin and cabin glazing were destroyed. The commander was unharmed. .

In accordance with Para.3 of Additional Regulations to Regulation No 13 of the Ministry of Transport of 27.01.1999 about aircraft accident investigation the occurrence was classified as an Accident, Non-fatal.

1. Factual Information

1.1 History of Flight

1.1.1 Flight Number:

Eighth AW flight for the day – herbicide spraying.

1.1.2 Preparation and description of the flight and events:

The flight mission was assigned by the manager of Air Operator (AO) Fortuna Air in accordance with existing request for crops processing.

In the morning of 15.06.2005 at Ivailo base landing field a helicopter preflight preparation was performed by the mechanic and after that a preflight check was performed by the commander. No failures were noted during the preflight check. At 07:00 the commander took-off en-route Ivailo – Benkovski, where the helicopter was refueled with 200 l of gasoline. After refueling the helicopter was air-ferried to Karavelovo village. 7 AW flights were performed here, the helicopter was refueled again with 200 liters gasoline and was ferried at 12:30 to a landing site near Pishtigovo village, district of Pazardjik, for executing of mission for crops spraying with herbicides. Because of the high air temperature and in accordance with operational procedures, described in AO FOM, the helicopter commander decided to perform the flights after 18:00 after temperature decreasing.

At 18:30 the helicopter commander flew from the base landing site at Pishtigovo village to working site, refilled with 600 litres spraying solution and took-off for the eighth flight for AW for the day at 18:50. After take-off the commander climbed to 25m and started a manoeuvre for working pass for spraying. During the execution of manoeuvre the commander noted the left-hand engine fuel pressure decreased abruptly from 0.4...0.35 to 0.15 kg/cm². After 2...3 seconds the engine flameout occurred. The pilot made unsuccessful attempt for emergency jettison of 600 l of chemical solution. With one engine operative (right-hand one) the helicopter started to lose altitude. The commander decided for emergency landing in the direction of flight and chose a dry and smooth place. The landing was performed with landing run of about 78 meters. At the end of landing run with a speed of 20...25 km/h the helicopter met frontally a high bank of an irrigation canal, where the fore landing gear legs were deformed, the control rods and cockpit glazing were destroyed. On Figure 1 & 2, Enclosure 1, the helicopter is shown at the place of emergency landing.

The pilot wasn't injured, he disengaged electrical and fuel supply and left the cockpit.

1.1.3 Location of the Occurrence

Waste rice field to the East of Pishtigovo village, with coordinates: N – 42^o15,59'; E – 024^o28,34', elevation 182 m, local time 18:52 h, daylight.

1.2 Injuries to Persons

No injuries to persons.

1.3 Damage to Aircraft

During the examination of the accident the commission established the aircraft damages were localized in its fore part and left-hand engine.

The aircraft damages in the fore part were a result of the aircraft hit into an embankment at the end of the field, chosen for landing and they contained in destroyed attachment assemblies of the nose landing gears to the fuselage. Both legs of the landing gear were found out bended backward at about 45°. As a result of the hit and following bending backward and upward of the both legs, the crossbeam of the cockpit floor was destroyed and deformed and the rods of helicopter control system were also destroyed.

During the examination of the air accident scene the commission established also a deformation of the longitudinal beam on helicopter cockpit floor, right-hand cockpit door was out of lower guiding rail; right-hand cockpit blister was destroyed and torn from its fixing base, left-hand blister was torn from its upper fixing point, but intact; there was a deformation in the cockpit fore upper part in the area immediately above and between both blisters.

At the scene of the aviation accident the commission established the left engine was blocked. The attempt to rotate it manually failed. After removal of the magnetic filter-signaler a presence of a lot of chippings and metal particles was established what was an indication for engine internal destruction.

The commission established also a rupture of a fixing rope of spraying rod for chemicals to the helicopter airframe and a bruise at 50cm from the end of one of lower propeller blades.

During the second examination of the aircraft in the air operator's hangar the commission established a deformation of the second crossbeam on the cockpit floor and a deformation of the right-hand back wall of the cockpit.

On Figure 3 & 4, Enclosure 1, the main damages of the helicopter are shown.

1.4 Other Damages

No other damages.

1.5 Personnel Information

1.5.1 Commander – male, aged 54, with valid pilot license and medical certificate.

1.6. Aircraft information

1.6.1. Airworthiness information

Helicopter Ka-26, serial number 7303504, registration number LZ-6080, was manufactured on 20.06.1973 by Ministry of Aviation Industry of USSR, it possesses Registration Certificate No 1935, issued by CAA on 08.12.2004 and it possesses Certificate of Airworthiness, issued on 10.01.2005, re-validated on 24.03.2005 and valid till 24.10.2005.

Since new till 14.06.2005 the helicopter has accumulated 7425:46 hrs and 53739 cycles. The last overhaul was certified on 12.09.1990 and after it the helicopter accumulated 894:19 hrs. In accordance with the approved by CAA on 10.01.2005 Fortuna Air Maintenance Program, Para.3.2, Helicopter Ka-26 Resource Manual, the established overhaul time was 2500 hrs or 15 years calendar time and it should expire on 12.09.2005. In order for implementation of this overhaul time the Maintenance Program of AO includes annual assessment of helicopter condition. The last such assessment written was from 25.03.2004 and an overhaul time was established with it till 26.03.2005. In the helicopter logbook the assessment made on 24.03.2005 and the prolongation of the overhaul time till 12.09.2005 wasn't written. An Act for Technical Condition Assessment was concluded by a commission without notice how and by whom this commission was appointed. In Maintenance Manual of AO in Para.7.4 Aircraft Recourses Assurance the following is written:

Aircraft/components overhaul life should be prolonged by an order of Chief Engineer on the grounds of Technical Act on Execution of Corrective Maintenance of the aircraft (in accordance with approved by CAA program), concluded by a commission presided by the Chief Engineer of Maintenance Department. A Certificate of Release to Service (SRS) for the corrective maintenance, operational and deficiencies list, measuring cards, etc. SRS, Technical Act and the Order should be enclosed to aircraft Technical Records and a copy should be kept at Technical Archives.

On the grounds of the order the prolongation of overhaul life/ life time should be written in the aircraft/engine logbook.

Two M-14V26 engines were installed on the helicopter as follows:

1. Left-hand engine, serial number KE643004, produced on 01.11.1976, has accumulated 2310:52hrs since new with total service life of 2750hrs, without limitation of calendar operational life. After the overhaul the engine was accumulated 133:14 hrs and 2 years, 6 months and 18 days. The last engine overhaul was certified on 27.11.2002. In accordance with the receiving certificate for reception of the engine after the last overhaul a 500 hrs time between overhaul (TBO) for 5 years was determined. During this overhaul life the engine should not exceed the following engine operating time:

- at take-off regime: 50:25 hours;
- at first nominal regime: 75 hours;
- at second nominal regime: 250 hours.

After the last overhaul only the total engine operating time was registered and the engine operating time at take-off regime, first and second nominal regime wasn't registered. (There was an error in keeping of the records, which resulted to an increasing of the engine operating time by 600 hrs, what led to 2910:52 hrs recorded and it exceeded the total engine service life.)

2. Right-hand engine, serial number KE623001, produced on 31.05.1976, has accumulated 2156:28 hrs since new with total service life of 2750 hrs, without limitation of calendar operational life. After the overhaul the engine has accumulated 103:47 hrs and 1 year, 6 months and 19 days. The last engine overhaul was certified on 26.11.2003.

In accordance with the receiving certificate for reception of the engine after the last overhaul a 500 hrs TBO was determined for the 5 years. During this overhaul life the engine should not exceed the following engine operating time:

- at take-off regime: 50:15 hours;
- at first nominal regime: 75 hours;
- at second nominal regime: 250 hours.

After the last overhaul only the total engine operating time was registered and the engine operating time at take-off regime, first and second nominal regime wasn't registered.

A gearbox serial No 2703288, produced on 26.07.1977, was installed on the helicopter. Since new the gearbox has accumulated 2616:15 hrs with total service life of 4000 hrs and without limitation of calendar operational life. After the last overhaul the gearbox has accumulated 128:42 hrs and 1000 hrs TBO was determined. (There was an error in keeping of the records, which resulted to an increasing of operating time by 300 hrs.)

The maintenance of AO aircraft was performed by Air Concord Ltd in accordance with Fortuna Air Maintenance Program, according the power arising from Maintenance Organization License No MOA-85/0202. The last maintenance done was a 300 hrs check, attested on 06.11.2004 and there was a Certificate of Release for Service No 1/6080 (the number was missing in helicopter on-board copy).

According this certificate the next scheduled maintenance should be performed prior to accumulating of 100 flight hours from the date of certificate issuance, but no later than 24:00 hrs on 10.11.2005 (15 years term after the last overhaul expires on 12.09.2005). In the helicopter logbook 58:24 flight hours were registered for the period from 06.11.2004 till 14.06.2005. On 15.06.2005 till the occurrence emerging in accordance with the registered data in helicopter logbook were accumulated 02:40 hrs, hence the total flying time was 61:04 hrs. On the aviation accident scene the commission took from the helicopter a Flight Logbook 6080, started on 10.05.2005 and completed till 15.05.2005 and Monthly logbook for pre-flight and post-flight maintenance, started on 17.05.2005 and completed till 15.06.2005. In these two documents the flight hours should be registered along with the other data. In Table 1 a comparison between flight hours registered in Flight Logbook and Monthly Logbook for Pre-flight and After-flight Maintenance and Aircraft Logbook was made.

Table 1

TABLE OF COMPARISON

between the records in Flight Logbook and Monthly Logbook and Ka-26 Aircraft Logbook, reg. No LZ-6080, for the period from 10.05.2005 to 15.06.2005.

(The Aircraft Logbook was completed since 10.05.2005, and Monthly Logbook since 17.05.2005 and both were taken from the air accident scene)

Flight Logbook/Monthly Logbook	Aircraft Logbook
10.05. – 2:45 hrs, 19 cycles	No record
11.05. – 1:45 hrs, 4 cycles	No record

17.05. – 0:30 hrs, 1 cycle	No record
18.05. – 4:40 hrs, 33 cycles	18.05. – 2:00 hrs, 33 cycles
19.05. – 5:00 hrs, 40 cycles	19.05. – 2:20 hrs, 40 cycles
20.05. – 0:30 hrs, 1 cycle	No record
21.05. – 1:30 hrs, 1 cycle	21.05. – 1:00 hr, 1 cycles
22.05. – 5:00 hrs, 50 cycles	22.05. – 2:00 hrs, 50 cycles
23.05. – 4:30 hrs, 49 cycles	23.05. – 1:40 hrs, 49 cycles
26.05. – 0:35 hrs, 1 cycle	No record
29.05. – 0:10 hrs, 1 cycle	No record
30.05. – 1:45 hrs, 15 cycles	30.05. – 0:40 hrs, 15 cycles
31.05. – 2:25 hrs, 26 cycles	No record
01.06. – 1:30 hrs, 7 cycles	No record
02.06. – 2:10 hrs, 16 cycles	02.06. – 1:10 hrs, 16 cycles
03.06. - 2:00 hrs , 9 cycles	No record
04.06. – 2:30 hrs, 22 cycles	04.06. – 1:20 hrs, 22 cycles
07.06. – 1:30 hrs, 1 cycle	No record
08.06. – 0:55 hrs, 7 cycles	No record
09.06. – 4:20 hrs, 36 cycles	09.06. – 2:00 hrs, 36 cycles
10.06. – 2:20 hrs, 1 cycles	No record
12.06. – 3:00 hrs, 19 cycles	12.06. – 1:10 hrs, 20 cycles
13.06. – 2:10 hrs, 17 cycles	13.06. – 0:40 hrs, 17 cycles
14.06. – 0:40 hrs, 4 cycles	14.06. – 0:20 hrs, 4 cycles
Total – 54:10 hrs, 380 cycles	Total – 16:20 hrs, 303 cycles

It is obvious from the table that instead of 54:10 hours flown for the period in Aircraft Logbook is registered 16:22 hrs, i.e. 3.32 times less. The difference between records is 37:50 hrs.

During the period from 22.03.2005 till 09.05.2005 the Air Operator didn't keep records in helicopter Flight Logbook and Monthly Logbook (or didn't like to submit them to the commission). During the same period in the Aircraft Logbook were registered 10 flying days with 18:53 hrs flown, and in the individual flight logbook of the pilot-participant in occurrence were registered 37 flying days with 74:45 hrs flown by the same helicopter. The difference between records is 55:52 hrs.

During the period from 24.02.2005 till 21.03.2005 in helicopter flight logbook 25:38 hrs flown were registered and in the Aircraft Logbook 21:35 hrs were registered. The difference between records is 4:03 hrs.

On the grounds of abovementioned it is reasonable to accept that the hours flown from the last scheduled maintenance were 97:45 hrs more than registered in the Aircraft Logbook or till the moment of the occurrence the helicopter has flown 156:09 hrs and it has exceeded 100 hrs, which were regulated by Certificate of Release for Service No 1/6080.

Before the flights on 15.06.2005 a preflight preparation was performed on the helicopter and it was registered in the Monthly Logbook. There were no registered faults, revealed during the examinations. No such faults were established also during the after-flight servicing on 14.06.2005.

1.6.2. Helicopter performance

Maximum take-off weight of Ka-26 helicopter in agricultural variant is 3250 kg. Empty weight is 2248 kg. At the moment of the aviation occurrence there was about 180 liters of fuel with relative weight 737.5 kg/m^3 , 600 kg spraying solution and a single pilot crew on board, what gave about 3061 kg flight weight and the center of gravity was in operational range.

Maximal speed 130 km/h.

Long range cruising speed 80...85 km/h.

There are two engines M-14B26 installed.

M-14B26 is nine-cylinder radial engine with air cooling and engine displacement of 10.16 liters, take-off power of 325 horse power. Peak rpm of the crankshaft is 2800 rpm.

Cylinder-head temperature should be in the range of 120...140°C according the Engine Operation Manual.

Carburetor inlet fuel pressure is 0.2...0.5 kg/cm². Main oil line pressure should be 5...7 kg/cm².

The rotor speed in case of failure of one engine decreases from 84...86% to 75...74% and immediate actions should be undertaken by the pilot for keeping the rotor speed over the minimal acceptable according AOM value of 82% .

1.6.3. Fuel

Before the flight to Pishtigovo village the helicopter was refueled with 200 liters of fuel. There is a record about refueling in Monthly Logbook of the helicopter. At the moment of accident there was 180 liters of fuel in the tanks.

According the air operator air gasoline 91 was imported from Romania, for which a certificate was submitted and it was enclosed to investigation materials.

Fuel samples were taken from the mud-box of the helicopter fuel system filter on the scene of the aviation occurrence, from the barrel for refueling and the fuel sample, taken during pre-flight preparation. All three fuel samples were of red color. According ASTM D 910-03 standard, aviation gasoline type 91 should be of brown color. In April 2004 during an investigation of air occurrence with Ka-26 helicopter reg. No LZ-6013, Aircraft Accident Investigation Unit has taken a sample of aviation gasoline, for which the same specification with the same number 170, of the same date 11.03.2004 and from the same

importer, but the fuel was of faintly green color. The protocols from laboratory tests of these samples are stored in AAIU archives.

A specification for aviation gasoline was requested from the Air Accident Investigation Bureau of Republic of Romania. No color was mentioned in the specification, but in a letter it was noted production of this gasoline was ceased one year ago.

The samples taken were given for analysis to Chemical Laboratory at Sofia Airport for assessment of compliance with specification and to Test Laboratory for fuels, lubricants and additives of Liquid Fuels Quality Control Main Directorate for octane number determination.

The protocols were enclosed to the deed.

The samples didn't comply with aviation gasoline 91 on following parameters:

- octane number;
- increased temperature during distillation by 90%;
- increased temperature during distillation by 97%.

The obtained value during octane number test was 98.7(\pm 0.6), what means the used fuel was of another type, but not aviation gasoline 91, and moreover, with aggravated vaporization properties and not approved for use by the engine manufacturer.

A sample was taken from the oil of the left-hand engine and given for examination into Independent Analysis Laboratory 2000 Ltd in Sofia. In accordance with the certificate presented the oil was Aviation Oil MC-20 First Grade. The examination results are given in the Report No1674/07.07.2005, enclosed to the investigation materials. There are substantially decreased values of ignition point of the oil. According the examination results it is 190°C, in the oil specification the actual value of 269°C is given and the minimal allowable value is 265°C. Ignition point of no less 220°C is allowable for used oil according the manufacturer technology documentation. The allowable carbonization (cocking) is no more 0.3%, but the result of test was 0.35%. Change of oil was registered on 05.11.2004 during execution of 300 hrs maintenance check.

1.7. Meteorological information

Daylight, visual flight conditions, CAVOK, wind 1 – 2 m/s

1.8. Aids to navigation

Standard aids for Ka-26 helicopter.

1.9. Communications

Standard communication equipment for Ka-26 helicopter

1.10. Airport

Ivailo base landing site, district of Pazardjik.

1.11. Flight data recorders

Not available for the aircraft type.

1.12. Wreckage and impact information

The helicopter landed with one engine operative on chosen by air site - waste rice field. The landing was performed with a landing run. The distance from the point of first touch of the landing gear to the point of helicopter halt was 78 m. At the end of landing run with a speed of about 20...25 km/h the helicopter met frontally high embankment of irrigation canal, where the fore landing gear legs were deformed, the control rods and cockpit glazing were destroyed. Description of damages emerged is given in Para.1.3. There were no parts torn from the helicopter construction.

1.13. Medical and pathological information

No consequences for the pilot after forced landing.

1.14. Fire

After the inspection made the commission established there were no signs of fire.

1.15. Survival aspects

After the examination and analysis done by the commission the following main survival aspects may be pointed out:

- timely registration of the complicated flight conditions by the pilot, caused by left-engine flameout;
- timely commander's decision for emergency landing;
- happy choice of landing site for emergency landing;
- use of safety belts in flight by the pilot;
- maximum possible helicopter forward speed deceleration during the landing and landing run.

It is necessary to note that emergency jettison system of chemicals failure led to significant complication of the flight conditions and to emerging of the need of emergency landing. During the inspection after the occurrence it was established sticking of the flap seal of emergency jettison system of chemicals to the housing, Fig.5 in Enclosure 1. In the helicopter Monthly Logbook there was a record that a check of emergency jettison system of chemicals was made on 22.05.2005, i.e. 24 days before the occurrence emerging. During the helicopter preparation for operation in spring and summer conditions on 28.02.2005 a check of emergency jettison system of chemicals was registered. There was no registered flight on this date (the closest date to this with registered flight was 06.03.2005).

1.16. Tests and research

For the purposes of technical investigation the following was accomplished:

- inspection on the site of the serious incident and helicopter and engines condition; a recovery of the flight during the forced landing, view and photographing of the helicopter airframe elements, condition and positions of the valves and selector switches in the cockpit, of the gauge readings and component condition in the left-hand engine was made;

- laboratory examination for assessment of fuel compliance with the specification requirements;
- laboratory examination for determination of gasoline octane number;
- laboratory examination of used oil of the left-hand engine;
- control disassembly and flow detection of the blocked helicopter left-hand engine;
- examination of the records in operational documentation of the helicopter;
- examination of the operational documentation of the air operator.

The materials and the results of the tests and research made are enclosed to the deed.

2. Analysis

During the examination of the occurrence scene the commission established that the left-hand engine was blocked. After removal of the filter of the signaler for chippings in oil it was established a large quantity of chippings, apparently aluminum ones and from the space around it a large number of metal chippings and steel particles were brought out. The condition of the filter of the signaler for chippings is shown on Fig. 6 in Enclosure 1. During the flight and forced landing the pilot didn't observe the light of the indicator for chippings in the oil. The check of the operable condition of the indicator for chippings circuit on the scene was impossible because of torn conductors and disengaged electrical supply.

At its meeting held on 06.07.2005 the commission for investigation of the occurrence decided: A control disassembly of M-14B26, serial No KE643004 of Ka-26 helicopter, reg. No LZ-6080 to be performed at MRP (Military Repair Plant) TEREM - LETETS for investigation of the causes for its blocking.

Engine disassembly was performed on July 26 and 27, 2005 by commission, appointed by an order of the TEREM-LETETS Ltd director in presence of the occurrence investigation commission members. A verification report about the disassembly was prepared and enclosed to the materials of investigation.

The engine is of nine-cylinder, radial construction. In order to disassembly the engine it was mounted on a special frame. At first the engine reducer was removed. The reducer wasn't blocked and it could be rotate without any resistance. An attempt was made to turn the engine crankshaft, but it turned to be unsuccessful and after that engine cylinder removal was started. Because of their blockage it was necessary to drive them out by a hammer. On Fig.8, Enclosure 1 the engine on the frame for disassembling is shown.

The first cylinder removed was No 9. After its removal was established a piston-rod torn and the part between the upper and bottom bush missing, the piston was blocked in the bushing and the lugs of the piston bolt were destroyed. After driving the piston from the cylinder a lack of one of the plugs of the piston bolt and wearing as a result of friction along the side of missing plug of the piston bolt was established. At the left-hand side in flight direction there were destructions of the cylinder bushing, caused by the broken part

of the piston-rod. As a result of piston ramming to the cylinder head the piston edge between the crown and the side surface obtained some ovality and there were bruises from the valves. This part of the piston-rod, which was remained with the crankshaft, wouldn't be move by hand. After the crankcase split and crankshaft removal after light knocking it was moved up, after removing of its fixing axle to the main piston rod no bruises were established and the oil passage were in good condition. Possibly the difficulties in movement were caused by metal particles presence from the internal destructions in the crankcase. In Enclosure 1 on Fig.9 the removed cylinder No 9 is shown with the blocked piston in it, and on Fig.10 the flange for fixing of cylinder No 9 is shown, the piston-rod torn is visible.

The second removed cylinder was No 3. Its piston rings were in relatively good condition, one of them was broken, possibly during the extraction; half of oil-scraper ring was missing; bushing of piston cylinder was deformed and notched in its lower part; the valves were in relatively good condition. On Fig.11, Enclosure 1, the piston of third cylinder is shown with a coke on the crown.

The third removed cylinder was No 1. The piston rod was torn at two places at a distance of about one centimeter from the bushes and the part between the two breaks was missing, the bushing was heavily bruised in the part, which enters into the crankcase. The piston was driven into the cylinder head and it should be knocked. There were imprints of the valves on the piston crown. On Fig.12, Enclosure 1 cylinder No 1 is shown with the piston blocked in it.

Cylinder No 2 was removed after cylinder No 1. The piston rod was integral, but with bruises, the rings were in good condition, the cylinder bushing was torn in the part, which enters into the crankcase.

An inspection was made on the crankshaft bearing from the side of the reducer; it was a journal-axial bearing. No visible damages were established on the bearing. The slits of the bearing shaft and of the driving gear to the reducer were heavy fouled and there was significant quantity of oil sludge (oil mud) accumulated. On Fig. 13, Enclosure 1 the accumulated fouling of the slits is visible.

After that the other cylinders were removed in the following order: eighth, fourth, seventh, sixth and fifth. On the main piston rod, which is in fourth cylinder, and on the other secondary piston rods there were deep bruises and deformations, but there was no blocking in their fixing points. There was no bending of the 5th and 6th cylinder piston rods. The cylinder bushings were heavy bruised in their lower part. A coke and colorization was established on the piston crown of 8th cylinder and a coke on the piston crown of cylinders No 4, 5 & 6. The piston rings were in relatively good condition. On Fig.14, Enclosure 1 the piston of eighth cylinder is shown.

After the crankcase split and removal of the upper cover, the crankshaft was turned what was evidence that the bearings weren't blocked. On Fig 15 & 16, Enclosure 1 the destructions in the crankcase are visible after removal of the upper cover.

The accessory gear train on the rear cover and the supercharger were moving without retarding. After oil pump disassembling no faults were established. The check of filter-signaller for chippings 14-602-55 showed that it operated normally.

On the grounds of the above mentioned establishments, analyses of the technical condition of M-14B26 engine, serial No KE643004 and the data from the report about the disassembly of the engine at TEREM-LETETS the following assumption may be done about the cause of engine destruction:

During the engine work a destruction of the plug of the piston bolt 14-605-100 occurred of 9th cylinder or possibly the plug wasn't installed after the last repair after what the piston bolt was displaced axially and started to rub into the cylinder wall. As a result of prolonged exposure on cyclic loadings constantly growing cracks emerged, possibly at first in the fore in flight direction opening for piston bolt fixing. These processes were supported by using of non-standard fuel with higher octane number and higher vaporization temperature and also by wrong recording of engine working time and thus decreasing of the hours flown and violation of maintenance program. The cracks resulted in destruction of piston rod fixing lugs and tear of the piston rod in its upper part. The part left after the 9th cylinder piston rod breaking deformed the skirts of the other cylinders in the direction of crankshaft rotating and caused further destruction in 1st cylinder and bruises in the entire crankcase till crankshaft blocking and engine flameout.

If the plug of the piston bolt was destroyed in operational conditions, it should be started the chippings-in-oil signaller, which event already happened. As it was noted above, the pilot didn't observe signaller switch-on, even during the engine blockage, after what a large quantity of chippings was established on the filter-sensor. A possibility for defective chippings-in-oil signaller circuit exists. The inspection of the filter-signaller showed it worked normally, but the remaining part of the circuit couldn't be tested because of the damages emerged at a hit in the obstacle.

The pilot's activities after left-hand engine flameout were timely and proper for the sudden complication of the flight conditions and rapidly developing emergency situation.

The decision for landing in flight direction was proper, because any attempt for maneuvering at minimum allowable helicopter speed would bring to much more severe consequences.

The positions of collective pitch-throttle control lever and control stick, established by commission, were in accordance with the described in FOM emergency landing procedure with one engine operative.

The malfunction of the emergency chemical jettison system was caused by sticking of flap seal assembly. It imposes the matter about the periodicity of the system check and supervision of these checks to be reconsidered.

The factual destructions and deformations of helicopter construction resulted from the relatively small dimensions of the landing site chosen and the existence of insurmountable obstacle and the end of landing run and they were not a consequence of non-professional activities of the pilot.

3. Conclusions

The technical investigation conducted, the results of examination and analysis give the grounds for the commission to make the conclusion, that the air occurrence was a result from the following

Main Cause:

Violation of operational requirements, related with helicopter maintenance led to left-hand engine flameout in flight because of crankshaft blocking and subsequent malfunction of the emergency chemical jettison system.

Immediate Reason:

Material fatigue destruction of the piston bolt lugs of ninth cylinder as a result of:

1. Load redistribution because of wrong installation of the piston bolt in repair workshop or possible wearing of its plug.
2. Engine operation using non-prescribed by the manufacturer type of fuel and non-compliant with aviation gasoline standard.
3. Decreasing of the hours flown and related with this violation of the maintenance system.

During the investigation the following deficiencies were also revealed:

1. The total flying time was written only into the technical log book, with no division of this time into take-off, first nominal and second nominal regime.
2. The helicopter airworthiness certificate was certified till 24.10.2005 and the TBO period was till 12.09.2005.
3. The assessment of the technical condition of the helicopter, made on 24.03.2005 was not registered in the helicopter technical logbook, on the base of which the lifetime was prolonged till 12.09.2005.
4. The document for assessment of the technical condition of the helicopter from 24.03.2005 was wrongly drawn up.
5. There was an error in left-hand engine logbook keeping, manufacturer No KE643004, in result of which the total number of flying hours registered 2910:52 is more than the total operating life of the engine.
6. There was also an error in gearbox logbook keeping and it led to overstating the flying hours with 300 hrs.
7. There is erroneous keeping of the flying hours in helicopter and engine technical logbooks and they are understated systematically.
8. The maintenance system is violated because of understating of the flying hours and as a result the regular 100 hrs check hasn't been performed.
9. The helicopter has been refueled with gasoline with octane number 98 instead of the prescribed octane number of 91.

10. The regular change of oil hasn't been made because of non-regulated extension of the TBO period, what resulted in it excessive contamination and deterioration of its operational properties.

11. Air operator didn't keep Flight Logbook and Monthly Logbook for the helicopter during the period from 22.03.2005 till 09.05.2005.

Safety recommendations:

During the investigation the following immediate safety measures were recommended to the CAA by a letter reg. No 10-01-96/21.06.2005 for all air operators, who operate Ka-26 helicopters:

1. Extraordinary single check of engine oil filters for presence of chippings and oil condition. The check should be recorded in helicopter's Monthly Logbook.

2. Extraordinary check of the functioning of the emergency jettison of load. The check should be recorded in helicopter's Monthly Logbook.

Having in mind the results of the investigation performed the commission recommended also the following:

1. To conduct a single check of the condition and functioning of the warning system for presence of chippings in engine oil of all helicopters Ka-26 having airworthiness and the check should be certified by a record in helicopter technical logbook.

Time – one month after submitting the report.

2. During the active season of Aerial Works the air operator, who operate Ka-26 helicopter, should perform monthly check of the serviceability and functioning of emergency jettison system for chemical load and to register it in the helicopter logbook.

Time – permanently.

3. In the monthly book for refueling of Ka-26 helicopters to register not only the quantity, but also the type of fuel and the registration should be certified by a signature of aircraft technician and commander.

Time – permanently.

4. During airworthiness certification of Ka-26 helicopters the CAA inspectors to compare the records for flying hours in the helicopter logbook with the records in the flight logbook for the elapsed time.

Time – permanently.

5. CAA should oblige air operators of Ka-26 helicopters to register in engine logbooks the time of regimes, limited by the manufacture or overhaul plant: take-off, first and second nominal regimes.

Time – permanently.