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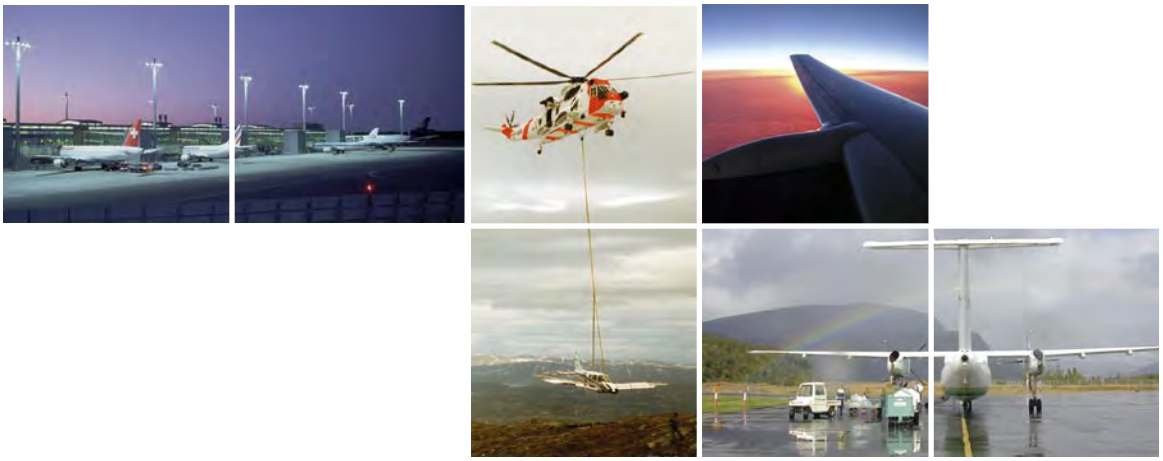

REPORT ON AIRCRAFT ACCIDENT AT ØSTRE ÆRA, HEDMARK, NORWAY ON 16. JULY 2004 INVOLVING ANTONOV AN-28 YL-KAB, OPERATED BY A/C RIGAS AEROKLUBS

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This report has been translated into English and published by the AIBN to facilitate access by international readers.
As accurate as the translation might be, the original Norwegian text takes precedence as the report of reference.

The Accident Investigation Board has compiled this report for the sole purpose of improving flight safety. The object of any investigation is to identify faults or discrepancies which may endanger flight safety, whether or not these are causal factors in the accident, and to make safety recommendations. It is not the Board's task to apportion blame or liability. Use of this report for any other purpose than for flight safety should be avoided.

Photos: AIBN and Trond Isaksen/OSL

REPORT

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This report has been translated into English and published by the AIBN to facilitate access by international readers. As accurate as the translation might be, the original Norwegian text takes precedence as the report of reference. This investigation is limited in its extent. For this reason, the AIBN has chosen to use a simplified report format. The report format indicated in the ICAO Annex 13 is only used when the scope of the investigation makes it necessary.

All times given in this report is local time (UTC + 2), if not otherwise stated.

Aircraft information:	
- Type and reg.:	Antonov AN-28, YL-KAB
- Manufacturing year:	1991
- Engine(s):	2 (two) Glushenkov TVD-10B
Operator:	A/c Rigas Aeroklubs, Latvia
Date and time:	Friday 16 July 2004 at time 1324
Location:	National Parachute Sport Centre, Østre Æra (ENAE), Åmot municipality in Hedmark (61° 15' 30"N 011° 40' 12"E)
Type of occurrence:	Aircraft accident, high-speed overrun of end of runway after emergency landing as a result of dual engine failure
Type of flight:	Private (flying with parachutists)
Weather conditions:	Wind: 360° 8-10 kt. Visibility: More than 10 km. Scattered clouds at 3,000 ft, local cumulonimbus activity in the area. Temperature / dewpoint: 16 °C / 8 °C. QNH: 1010 hPa
Light conditions:	Daylight
Flight conditions:	VMC
Flight plan:	None
No. of persons onboard:	At take-off: 2 pilots and 20 parachutists At the time of the accident: 2 pilots
Injuries to persons:	Both pilots sustained minor injuries
Damage to aircraft:	Major damage to fuselage, wings, tail surface and landing gear
Other damage:	None
Commander:	
- Sex and age:	Male, 50
- License:	ATPL (A) valid until 26 September 2006, valid type rating until 28 February 2005
- Flying experience:	Total flying time approx. 14,000 hours, of which approx. 400 hours on the aircraft type in question

First Officer:

- Sex and age:	Male, 63
- License:	ATPL (A) valid until 5 March 2008, valid type rating until 14 April 2005
- Flying experience:	Total flying time approx. 18,000 hours, of which approx. 1,000 hours on the aircraft type in question
Information sources:	Report on air accident (NF-0382 E) from the Commander, reports from the parachutists and the AIBN's own investigations.

FACTUAL INFORMATION

Two aircraft of type AN-28, operated by Rigas Aeroklubs Latvia, were dropping parachutists at the National Parachute Sport Centre, Østre Æra airstrip in Østerdalen. The company had had a great deal of experience with this type of operations, and had been carrying out parachute drops in Norway each summer for the last 9 years. They had brought their own licensed aircraft technicians with them to Østre Æra.

On Friday morning, 16 July 2004, the weather conditions were good when the flights started. The crew of YL-KAB, which comprised two experienced pilots, were rested after a normal night's sleep. They first performed six routine drop flights. After stopping to fill up with fuel, normal preparations were made for the next flight with 20 parachutists who were to jump in two groups of 10.

The seventh departure was carried out at time 1305. The Commander asked for and was given clearance by the air traffic control service to climb to flight level FL150 (15,000 ft equivalent to approx. 4,500 metres). The parachutists were then dropped from that altitude. The first drop of 10 parachutists was made on a southerly course above the airstrip, and the aircraft continued on that course for a short time before turning through 180° and getting ready for the next drop at the same location on a northerly course.

A large cumulonimbus cloud (CB), with precipitation, had approached the airfield from the north at this time. To reach the drop zone above the runway, the aircraft had to fly close to this cloud. The aircraft was not equipped with weather radar. The last parachutists to leave the aircraft were in a tandem jump that was being filmed on video. The film showed that the parachutists became covered in a layer of white ice within 2-3 seconds of leaving the aircraft. The ice on the parachutists only thawed once they had descended to lower altitudes where the air temperature was above zero.

Once the parachutists had jumped, the aircraft was positioned close to the CB cloud at a low cruising speed. They were exposed to moderate turbulence from the cloud. The Commander, who was the PF (pilot flying), started a sudden 90° turn to the left while also reducing engine power to flight idle in order to avoid the CB cloud and return to Østre Æra to land.

At this point, the First Officer who was PNF (pilot not flying) observed that ice had formed on the front windshield, and he chose to switch on the anti-icing system. He did this without informing the PF. A few seconds later both engines stopped, and both propellers automatically adopted the feathered position.

The pilots had not noticed any technical problems with the aircraft engines before they failed.

During the descent, the PNF, on the PF's orders, carried out a series of start-up attempts with reference to the checklist/procedure they had available in the cockpit. The engines would not start

and the PF made a decision and prepared to carry out an emergency landing at Østre Æra without engines.

The runway at Østre Æra is 600 m long and 10 m wide. The surrounding area is covered by dense coniferous forest and they had no alternative landing areas within reach. Because they were without engine power, there was no hydraulic power to operate the aircraft's flaps. This meant that the speed of the aircraft had to be kept relatively high, approx. 160-180 km/h. The final approach was further complicated because the PF had to avoid the last 10 parachutists who were still in the air and who were steering towards a landing area just beside the airstrip.

The PF first positioned the aircraft on downwind on a southerly course west of the airfield, in order then to make a left turn to final on runway 01. The landing took place around halfway down the runway, at a faster speed than normal - according to the Commander's explanation approximately 160-170 km/h. The PF braked using the wheel brakes, but when he realized that he would not be able to stop on the length of runway remaining, he ceased braking. He knew that the terrain directly on the extension to the runway was rough, and chose to use the aircraft's remaining speed to lift it off the ground and to alter course a little to the right. The aircraft passed over the approx. 2.5 m high embankment in the transition between the runway level and the higher marshy plateau surrounding the northern runway area, see Figure 1.

Figure 1: Embankment approx. 60 m beyond the end of the track in the extension of runway 01. The picture has been taken in the direction of travel.

The aircraft ran approx. 230 m in ground effect before landing on its wheels in the flat marshy area north of the airfield. After around 60 m of roll-out, the nose wheel and the aircraft's nose struck a ditch and the aircraft turned over lengthways. It came to rest upside down with its nose section pointing towards the landing strip, see Figure 2. The floor of the cockpit was pushed up so that the nose wheel came through the floor and partially into the cockpit (Figure 3).

Witnesses have also described how it was not possible to stop on the remaining runway at the speed the aircraft was travelling at when it landed. They saw smoke coming from the tyres when the aircraft braked, and there were also clear rubber deposits on the runway after braking.

Figure 2: Aircraft wreckage after the accident.

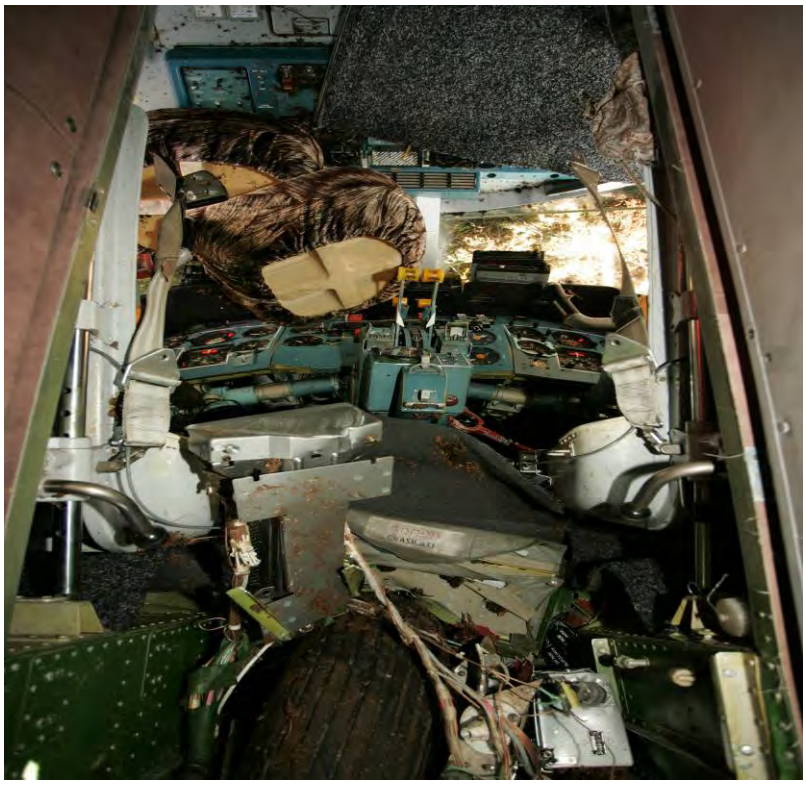

Figure 3: Cockpit with floor pushed up and the nose wheel penetrating through the floor.

The cargo doors at the rear of the cabin had been removed since they were flying parachute drops, and the two crewmembers left the aircraft unassisted through the cargo doors. They were taken to hospital for medical checks on the orders of the local police authorities. They both sustained minor injuries in the form of bruising and abrasions.

No fire arose during this accident.

The aircraft engines are equipped with a system that automatically feathers the propeller if the engine stops while airborne. Feathering is undertaken to reduce drag from the propeller of the

engine in question, thereby making it possible to continue the flight with the engine that is still running.

Two red-painted handles (Feathering Levers), one for each engine, are located on either side of the pedestal, between the pilots (see Figure 4). With the handles in the forward position, the automatic feathering system is armed for both engines. According to the aircraft manual, automatic feathering and shutdown of the engine's fuel supply will occur if the combination of compressor rpm and pressure gradient are lower than the set values, 56 % and 2.6 respectively. To avoid this, during a descent no air should be tapped from the engines to the anti-icing system if the compressor rpm is reduced below 72 %.

The propeller can also be feathered manually by the pilot moving the engine's Feathering Lever to the rear position.

Figure 4: AN-28 Flight Deck with instrument panel, central console and red Feathering Levers.

To start up the engine again after automatic feathering, the system first has to be re-armed. This is done by moving the Feathering Lever manually from the forward position to the rear position, and then back to the forward position. After that, the procedure for engine start-up in the air can be executed.

Aircraft YL-KAB was equipped with the aircraft manufacturer's flight manual. This manual contains descriptions of the aircraft's technical systems and detailed procedures for normal and emergency operation of these systems. While airborne, the manual was kept in a cabinet in the aircraft's passenger cabin. No user-friendly checklist system had been drawn up. Certain pages from the manual, containing normal and emergency procedures had been copied and placed in plastic pockets in a folder that was kept in the cockpit while flying.

In the folder in the cockpit there was a procedure for starting engines in the air. The procedure contained an item about verifying that the Feathering Lever is in the forward position, but did not mention that, after automatic feathering of the propeller, it is first necessary to re-arm the system. According to the explanation given by the crew of YL-KAB, both Feathering Levers were in the

forward position the whole time while the start-up attempts were made. Finding the correct method for starting an engine that has stopped with the propeller automatically feathered, required three different chapters in the flight manual to be consulted.

The manufacturer has emphasized that according to the flight manual, section 6.2 *"Shutdown of two Engines"*, an emergency landing is prescribed in cases like this. Further, start up is permitted only to an operative engine which was shut down for training or testing purpose or by pilot's mistake. It is prohibited to start up the engines in case of icing. Based on this, the manufacturer concludes that the crew's attempts to start up the engines in flight were erroneous and led to loss of time and impeded the preparation for the emergency landing.

No flight simulator is available for this type of aircraft to provide effective crew training in normal and emergency procedures. During training, neither of the pilots had practised engine start-up after an automatic shutdown and feathering of the propeller had taken place.

The aircraft was equipped with a Flight Data Recorder (FDR) and a Cockpit Voice Recorder (CVR). These recorders were sent to the Interstate Aviation Committee (IAC) in Moscow to be downloaded. No data was available from the FDR because of a technical fault. The CVR data was of good quality, and the information was well in concordance with the information given to the AIBN by the crew.

There were no findings to indicate that there was any technical fault on the aircraft prior to landing. The weight and balance of the aircraft was within valid limits. The CAA of Latvia verified that maintenance and technical inspections on the aircraft had been carried out in compliance with the stipulations of the Latvian civil aviation authorities.

In a supplement to the flight manual for the AN-28, dated 10 July 1993, the CAA of Latvia specifies the special procedures that apply when an AN-28 is used for dropping parachutists. Among the things made clear by this is that the highest permitted drop altitude is 4,200 metres, (equivalent to approx. 13,800 ft), and that the aircraft must be flown without any rapid attitude changes and at a maximum banking angle of 30°. The speed should be reduced to 160-170 km/h and flaps set to 15° prior to parachute-jumping.

The drop of the last group of 10 parachutists was carried out at time 1319. The aircraft had been flying at an altitude of approx. 15,000 ft for more than 5 minutes. At altitudes like this, in aircraft with non-pressurised cabins, an extra oxygen supply is necessary in order to prevent gradual hypoxia (a deficiency of oxygen in the body which reduces brain and organ function). At altitudes above 13,000 ft, for example, international regulations (ICAO Annex 6) state that sufficient oxygen must be available to supply everyone onboard. Based on physiological considerations, reduced mental and physical performance and a risk of fainting, the air medicine advice in Norway is for crew members in non-pressurised aircraft always to use extra oxygen when flying at altitudes above 10,000 ft (ref. AIBN rep. 28/2003).

The Norwegian Air Sports Federation, parachute section, has informed the AIBN that parachutists now use additional oxygen in cases where they are exposed to altitudes above 13,000 ft for more than 10 minutes. The guidelines have emerged in consultation with the principal centre of expertise in aviation medicine in Norway, the Norwegian Institute of Aviation Medicine. Parachutists use the same oxygen supply system as the Norwegian Armed Forces.

The Norwegian Civil Aviation Authority (CAA-N) has stated that it issued a permit to Rigas Aeroklubs for carrying out *"lifting and dropping of parachutists (aerial work)"* for parachute clubs

in several locations in Norway. The approval was in accordance with general conditions at that time, and was valid for a limited period during the summer season in question. In 2006, the *Regulation concerning civil parachute jumping (BSL D 4-2)* came into force. Among the requirements specified in this is a requirement for aircraft used for parachute jumping to have appropriate procedures in place for this, which have been approved by the CAA-N. Supplementary information about this national regulation is set out on the CAA-N's Internet pages: CAA-N - GA Operations.

The earth slope at the extension to the north of the runway has not been smoothed out after the accident involving YL-KAB. The airfield at Østre Æra is not included in the Norwegian airfields that have had technical/operating approval issued. The CAA-N has declared that it can nevertheless issue orders about improvements if unacceptable obstacles exist at the airfield.

COMMENTS FROM THE ACCIDENT INVESTIGATION BOARD

The experienced Commander assessed the distance to the cumulonimbus cloud as sufficient to allow the drop to be carried out, and expected that they would then rapidly make their way out of the exposed area. It appeared, however, that problems arose when the aircraft was exposed to turbulence and icing from the cloud. The AIBN believes the limits of the engines' operational range were exceeded since the anti-icing system was switched on while the power output from the engines was low, in combination with low airspeed, turbulence and sudden manoeuvring. At that, both engines stopped, and the propellers were automatically feathered. The AIBN believes the engines would not restart because the Feathering Levers were not moved from the forward to the rear position and forward again, as is required after automatic feathering.

The manufacturer has pointed out that, according to the procedures, the crew should have refrained from restart attempts and prioritized preparing for the emergency landing. AIBN acknowledges this view, taken into consideration that the crew had not received necessary training and that no suitable checklists existed. On the other hand, it is the AIBN’s opinion that this strategy may appear too passive in a real emergency. If the flight is over rugged mountain terrain or over water, an emergency landing may have fatal outcome. Provided there is sufficient time, and that crew cooperation is organised in such a way that it does not jeopardise the conduct of safe flight, a successful restart may prevent an accident.

The AIBN cannot rule out the possibility that the crew's ability to make a correct assessment of the situation was reduced due to oxygen deficiency. Low oxygen-saturation in the brain would first lead to generally reduced mental capacity. In particular, this applies to the capacity to do several things simultaneously and the ability to remember. These are factors that are crucial when a pilot in a stressful situation has to choose the best solution to a problem, and the negative effects will appear more rapidly the older a person is. The fact that the First Officer switched on the anti-icing system without asking the Commander first, indicates that crew collaboration was not functioning at its best.

The AIBN believes that the crew, after having entered this difficult situation, carried out a satisfactory emergency landing under very demanding conditions. The fact of the parachutists being within the approach sector made the scenario more complex, and a landing ahead of the threshold had to be avoided. With the flaps non-functional, it is understandable that the speed was high and the touchdown point not optimal. The fact that the Commander got the aircraft into the air again and landed on the higher marshy plateau, was probably crucial to the outcome. Continued braking would have resulted in the aircraft running into the earth embankment at relatively high residual

speed, and it is doubtful whether the crew would have survived. A safety recommendation is being put forward in connection with this.

Even if allowances are made for parachuting being a special type of operation that often takes place under the direction of a club, the AIBN believes that this investigation has uncovered several issues that cannot be considered to be satisfactory when compared to the safety standard on which they ought to be based. A user-friendly checklist system in the cockpit which is used during normal operations, in emergency situations and during flight training would increase the probability of the aircraft being operated in accordance with the manufacturer's recommendations. It is of great importance that pilots are sufficiently trained and experienced to carry out appropriate emergency procedures.

It is assumed, however, that the new regulation concerning civil parachute jumping will contribute to increased levels of safety, and the AIBN sees no need to recommend any further measures.

SAFETY RECOMMENDATIONS

The following safety recommendation[1] has been put forward by the AIBN

Safety Recommendation SL no. 2009/19T

The terrain in the extension to runway 01 at Østre Æra, with an approx. 2.5 m high earth embankment around 60 m from the threshold, could inflict severe damage to aircraft and injury to onboard personnel in the event of a potential high-speed overrun. The AIBN recommends that the CAA-N should assess whether it needs to order the owner of Østre Æra airstrip to smooth out the terrain in the extension to runway 01.

Accident Investigation Board Norway

Lillestrøm, 18. June 2009

[1] The Ministry of Transport and Communications forwards safety recommendations to the Norwegian Civil Aviation Authority and/or other involved ministries for evaluation and monitoring, see Norwegian Regulations regarding public investigations of accidents and incidents in civil aviation, § 17.