

Ministry of Economic Affairs and  
Communications

EE170/250810/GCOL, RE

Safety Investigation Bureau

# ACCIDENT INVESTIGATION FINAL REPORT

AN-26B, SP-FDP

Tallinn, Estonia

25. August 2010

Tallinn, 2011

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## ABBREVIATIONS

ATIS	Automatic Terminal Information Service
CVR	Cockpit Voice Recorder
EASA	European Aviation Safety Agency
FDR	Flight Data Recorder
AFM	Aircraft Flight Manual
MC	Medical certificate
PF	Pilot flying
QAR	Quick Access Recorder
SOP	Standard Operating Procedure
TR	Type rating
UTC	Universal Time Coordinated (local time UTC+3)
V <sub>1</sub>	Critical engine failure recognition speed
V <sub>r</sub>	Rotation speed
WOW	Weight On Wheels, "Air-Ground" switch

## SYNOPSIS

On 25<sup>th</sup> August 2010 cargo aircraft An-26B, registration SP-FDP started from Tallinn Ülemiste airport to Helsinki. After uneventful flight preparations, the aircraft started its take-off roll on runway 08. Few seconds after reaching the  $V_1$  the aircraft suddenly banked to the right and made a runway contact with the right propeller. Then the aircraft landed on the belly and skid along the runway until full stop.

No persons were injured and no fire broke up.

The occurrence was classified as an accident due to the substantial damage to the aircraft structures. The investigation into the causes of the accident was carried out by Estonian Safety Investigation Bureau according to the ICAO Annex XIII. State Commission on Aircraft Accidents Investigation, Poland, appointed Mr. Waldemar Targalski as an accredited representative to the investigation. SCAAI provided valuable input and assistance during whole process of investigation.

The draft report was made available for comments to SCAAI, Poland, and to the operator of the aircraft, Exin Co Ltd. The full text of the operators response is available [here](#).

The investigation determined the inadequate action of the flight engineer, consisting in early and uncommanded landing gear retraction, as a cause of the accident.

## 1. FACTUAL INFORMATION

### 1.1. History of the flight

On 25<sup>th</sup> August 2010 at 16:47 UTC cargo aircraft An-26B, registration SP-FDP and operated by Exin Co. Ltd, started for scheduled flight Nr. 3788 from Tallinn Ülemiste airport to Helsinki. The takeoff mass was 23 039 kg and there were 4 crewmembers onboard. First Officer was PF.

Based on pilots statements and FDR/CVR recordings the aircraft entered runway 08 from taxiway B on the West end of the runway and lined up for takeoff. On 16:47:22 the aircraft started its takeoff roll. The calculated  $V_1$  was 182 and  $V_r$  was 201 km/h. 10 seconds later PF started rotation without  $V_r$  callout at 123 km/h. The aircraft pitch angle increased to  $4.6^\circ$  2 seconds later. At 16:47:38 the navigator made  $V_1$  call-out at 160.5 km/h. 1 second later flight engineer called “Retracting” in Polish. The aircraft started to pitch down and 3 seconds later it contacted the runway and continued on its belly for 1,228 m before coming to its rest position 3 m right from the runway centerline.

The flight engineer stated that he had observed the PF rotating the aircraft and clearly heard the “Gear Up!” command from PF. Three other crewmembers did not confirm it.

According to PF statement the “Gear Up!” is commanded on the altitude 50 m. No “Positive Climb” callout was made. The PF did not recall hearing the  $V_r$  callout before rotation and stated, that he rotated the aircraft “at  $V_r$  or maybe a bit earlier”.



EETN runway with indicated aircraft position

### 1.2. Injuries to persons

No injuries.

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### 1.3. Damage to aircraft

The damage to the aircraft was caused by high speed runway contact with the belly of the fuselage and propeller blades. The damage to the fuselage was limited to the skin and structural component of the belly, which were severely abraded and worn.

The tips of the propeller blades were worn and bent backward. The damage was more conspicuous on the RH propeller.

The condition of the engines and other aircraft systems were not assessed.

### 1.4. Other damage

No other damages.

### 1.5. Personnel information

#### *Crew experience*

Name, position	Total hours		On type		IFR	
	Total	Last 90 days	Total	Last 90 days	Total	Last 90 days
Captain	5569:55	73:45	4432:55	73:45	4044:50	73:45
First Officer	738:30	49:30	485:10	49:30	485:10	49:30
Navigator	4306:35	89:35	4306:35	89:35	4120:20	89:35
Engineer	4704:35	19:00	4204:35	19:00	4204:35	19:00

#### *Licenses, ratings and medical certificate validity*

Captain	ATPL(A)-PL, TR An-26, MC valid Class 1
First Officer	CPL(A)-PL, TR An-26, MC valid Class 1
Navigator	Flight Navigator License, TR An-26, MC valid Class 2
Flight Engineer	FEL-PL, TR An-26, MC valid Class 2

The crew was composed five days earlier, on 20.08.2010. Flight engineer was new member in the crew and before joining it he had three month gap in his flight activities followed by eight flights on An-26B.

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The crew is based in Helsinki, where the operator has a guesthouse. The flight engineer said in his statement, that despite a restless night in Helsinki he had an opportunity to sleep approx. 3 hours in Tallinn before the flight and felt fresh. He also added that for no specific reason he felt thoughtful during the accident flight and could not concentrate.

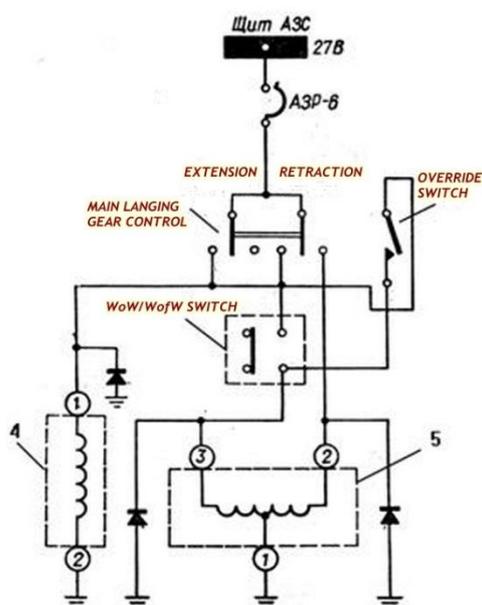
The rest and duty time rules were observed.

According to the crewmembers' statements they all have passed the Crew Resource Management training in May-June 2010.

## 1.6. Aircraft information

### 1.6.1. General

Manufacturer:	AVIANT Kyiv Aviation Plant
Model:	An-26B
MTOW	24 000 kg
Serial number:	119-03
Year of manufacture	1982
Flight hours:	21510/5648+163
Last maintenance	B-check 11.08.2010
Airworthiness review Certificate	valid



The An-26B is a transport airplane designed to carry cargoes (either stacked on standard pallets or without pallets) and wheeled vehicles along short and medium range routes. The airplane is equipped with two main propulsion turboprop engines with the propellers and one auxiliary turbojet engine. The main engines are accommodated in nacelles on the wing center section.

### 1.6.2. Landing Gear Retraction

The main landing gear is located under the engine gondola. The landing gear extension and retraction is actuated by electro-hydraulic system controlled through control in the cockpit. Main hydraulic cylinders are actuated through electric solenoid valves. The circuit is fitted with WOW switches on the main landing gear support to block the undercarriage retraction while on ground. The circuit also consists of an override switch to override the WOW blocking in case of malfunction. The override switch is located on the right lower side of the central

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instrument panel. The switch is protected with a cap and is spring loaded in OFF position. To actuate the switch it must be held in ON-position by hand.

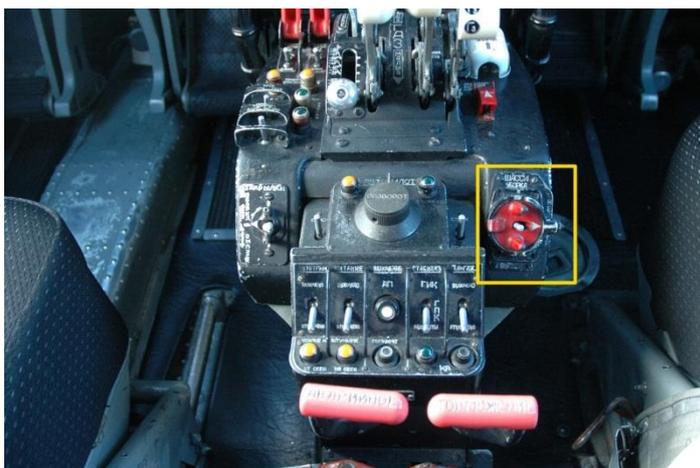


*1.6.3. Maintenance and troubleshooting*

WOW switch is adjusted by threaded rod. The system is to be maintained after every 500 flight hours.

*1.6.4. Landing Gear Control*

Landing gear control switch is located in the cockpit central console aft right corner. It is operated by flight engineer by turning it from neutral position counterclockwise to retract the landing gear.



The landing gear control is located out of the field of view of the pilots and therefore are operations not observable by the captain and first officer, specifically during take-off and landing, when both pilots are engaged with forward view and instrument scan.

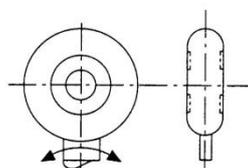
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EASA has issued Restricted Type Certificate EASA.IM.A.351 to *State-Owned Company ANTONOV Aviation Scientific Technical Complex* for An-26 and An-26B. In Type Certificate Data Sheet under *3.1.4 Equivalent Safety Findings* there are two safety findings related to the landing gear controls:

25.777(f): the arrangement of landing gear controls;

25.781: the shape of the landing gear and engine controls;

Certification Specifications and Acceptable Means of Compliance for Large Aeroplanes CS-25 defines:



LANDING GEAR CONTROL KNOB

*CS 25.777(f) The landing gear control must be located forward of the throttles and must be operable by each pilot when seated with seat belt and shoulder harness (if provided) fastened.*

*CS 25.781 Cockpit control knobs must conform to the general shapes (but not necessarily the exact sizes or specific proportions) in the following figure: (left)*

## 1.7. Meteorological information

ATIS information 16:21: wind 130° 4 knots, QNH 993. Visibility 9999, no precipitations, runway dry, braking action good.

## 1.8. Aids to navigation

Not relevant

## 1.9. Communications

Standard radiotelephony exchange took place on Tallinn Tower frequency 120.6 MHz. Emergency was declared on TWR frequency at 16:48:05.

## 1.10. Aerodrome information

Tallinn Airport runway 08 was used for takeoff. The usable length of the asphalt-concrete runway was 2800 m.

## 1.11. Flight recorders

Aircraft was fitted with FDR and CVR. Readout was performed at the ATM S.S. recorders lab in Warsaw. Additional voice recordings were received from Estonian Air Navigation Services; surveillance video recordings capturing the occurrence were received from Tallinn airport.

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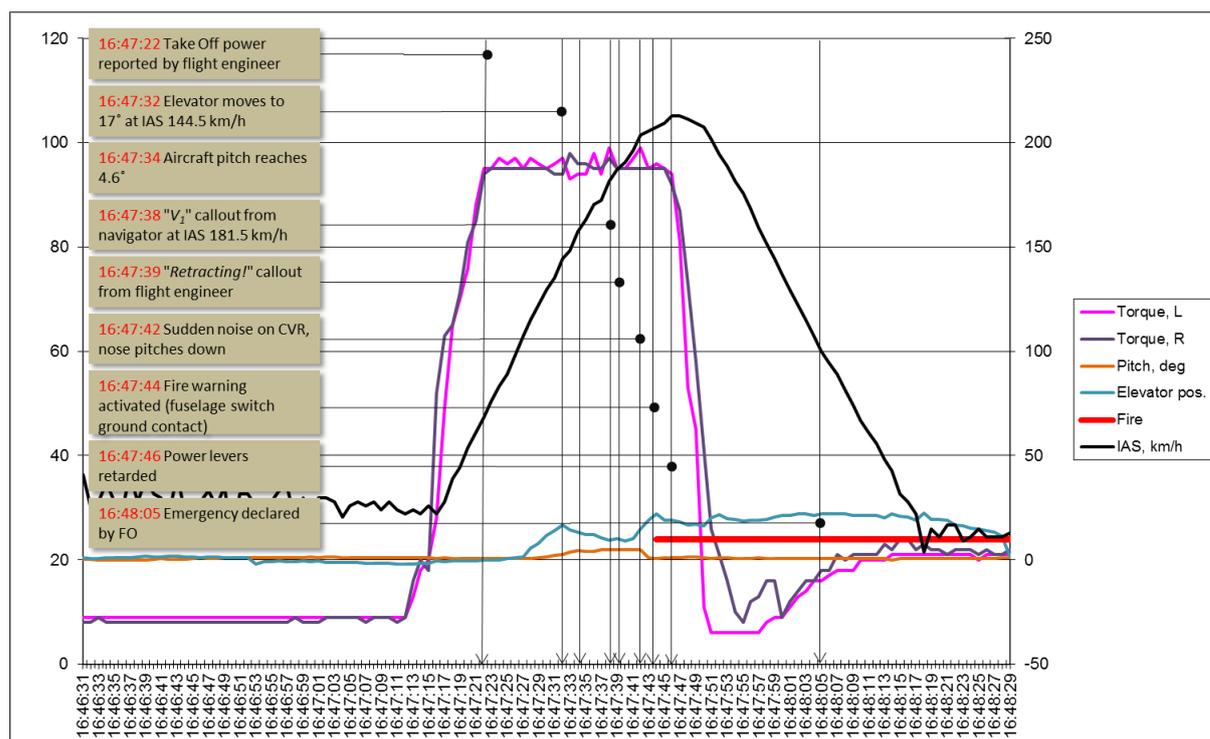
The recorders were installed by ATM S.A. Parameters on the downloaded data did not match the parameter list provided by the ATM S.A. The FDR did not record the landing gear position, its locking or the bay door position. Only parameter linked to the landing gear system was recording the gear retraction switch “Gear Down” position and during the whole sequence this discrete parameter remained unchanged. The “Air-Ground” status of the aircraft was also not recorded on the FDR.

The IAS values recorded on the FDR provided sufficient reliable data for evaluating the changes in speed and acceleration.

Fire warning was activated by automatic fire suppression system activated by switches located on the fuselage belly.

It is significant, that elevator position changes start from neutral at IAS 107.4 km/h and reaches 17° at IAS 144.5 km/h. During the next seconds the elevator position changes to 12° and later to 9.2°. The calculated  $V_r$  was 201 km/h.

The relevant values from FDR are plotted on the graph.



## 1.12. Wreckage and impact information

The first contact with the runway pavement was made with antenna and fuselage belly. Few seconds later blades of the RH propeller contacted the pavement, leaving characteristic

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marks on the runway. LH propeller marks appear later along the skidding track on the short distance. Distance between the marks was 0.58 m and decreasing.

Aircraft's belly was substantially and uniformly worn and abraded, the tips of propeller blades were worn and bended backward. The LH propeller blades were worn ca 40 mm, RH blades 85 mm.

The main landing gear was retracted and bay-doors closed, nose gear was retracted and the left bay door partly broken off and bent to the left.

### 1.13. Medical and pathological information

All crewmembers tested negative for alcohol.

### 1.14. Fire

There was no post-impact fire. However, during the skidding along the runway the intensive fire and smoke are clearly visible on the surveillance recordings.

### 1.15. Survival aspects

Not relevant

### 1.16. Tests and research

The WOW switch ДП-702 from the left side was detached and tested.

### 1.17. Organizational and management information

Not relevant

## 2. ANALYSIS

### 2.1. General

According to the AFM the landing gear retraction must be commanded after reaching altitude not less than 5 m and IAS 230 km/h, when the rotating wheels are stopped by braking and nose-wheel steering control light goes off. Based on CVR recordings and crewmembers statements the flight engineer retracted landing gear without command from PF.

### 2.2. Gear retraction blockage, gear lever position in the cockpit

The WOW switch installed on the landing gear must prevent the retraction of the landing gear while aircraft is on ground and gear is supporting the weight of the aircraft. During the end phase of the take-off roll and early rotation the wing lift can be sufficient to minimize the aircraft weight on wheels and allow the landing gear struts to extend to the position, where WOW switch is connected and current is passed to the electro-hydraulic retraction system. The investigation could not directly determine the correctness of the WOW regulation, but indirect data from recorders and surveillance cameras indicate, that WOW switch allowed the gear retraction to be activated before the aircraft was airborne.

Blockage can be overridden when holding the override switch by hand. This cannot be done unnoticed by other crew members since the switch is located on the front panel. The override switch remained in OFF position during the event.

### 2.3. Rotation speed

According to the FDR data PF started rotation at IAS 144.5 km/h, significantly below the  $V_r$ , which was 182 km/h. The elevator was initially positioned in high angle of  $17^\circ$  and released to  $9.2^\circ$  during next 7 seconds. The aircraft pitched up by  $4.6^\circ$  increasing lift and possibly creating sufficient lift to close the WOW switch, allowing the actuation of the gear retraction mechanism.

The other effect of the early rotation of the aircraft is the indirect signal sent to other crewmembers and specifically to the flight engineer. Rotating at the correct  $V_r$  will result in aircraft being able to take off and retraction of the gear will not result in runway contact. The engineer reported that he observed the PF raising the nose of the aircraft which can influence his decision making process.

### 2.4. CRM

The Crew in its composition had 19 hours common experience. The short time does not provide for formation of the adequate resource management and cooperation. The FO, who was PF, had less than 500 hours experience on type and was trained on different aircraft types. The FE has joined the crew recently, before that he had a three month gap in his flying experience. Even considering the fact, that crewmembers had CRM training in May-June 2010, it proves insufficient for 4-member crew.

### 3. CONCLUSIONS

#### 3.1. Findings

3.1.1. The crewmembers had all necessary licenses and ratings allowing them to perform the flight.

3.1.2. The aircraft was airworthy, all systems functioned correctly

3.1.3. The landing gear was retracted by flight engineer during the take-off roll without command and while aircraft was still on ground

3.1.4. The PF started aircraft rotation at 144.5 km/h.

3.1.4. The WOW switch allowed the gear retraction to be activated before the aircraft was airborne.

3.1.5. The flight data recording system installed on the aircraft did not record information about landing gear position, travel and locking.

#### 3.2. Cause of the incident

3.2.1. The investigation determined the inadequate action of the flight engineer, consisting in early and uncommanded landing gear retraction, as a cause of the accident.

3.2.2. Contributing factors to the accident were:

1. Inadequate crew resource management and insufficient experience in cooperation and coordination between crewmembers.
2. Start of aircraft rotation at low speed and with fast elevator movement to 17°, which resulted in:
  - Lifting the aircraft sufficiently to close the WOW switch and allow the retraction of the landing gear at the speed not sufficient for the climb.
  - Providing misleading information to FE about the aerodynamic status of the aircraft.
3. Inadequate adjustment of the WOW switch, which allowed the gear retraction to be activated before the aircraft was airborne.

The position of the landing gear selector on the central console is not considered as a contributing factor to the accident. However, investigation finds necessary to point it out as a safety concern, specifically in situations, where crewmembers are trained and/or used to operate the aircrafts with gear selector location according to the EASA Certification Standards CS-25. Positioning of the gear lever to the location which is compliant to EASA document CS-25, would create additional safety barrier to avoid similar occurrences, specifically in aircrafts where landing gear is operated by FE.

#### 4. SAFETY RECOMMENDATIONS

##### 4.1. To the operator Exin Co Ltd:

4.1.1. To set up and implement the procedure to assure, that gear operations on takeoff are made in accordance with AFM. Due to the lack of visual control over the gear switch handle by captain and first officer during takeoff it is recommended to set up and implement procedure with clear verbal exchange between pilot flying and flight engineer confirming the gear operations.

4.1.2. To install QAR on the aircraft and set up and implement effective procedures to provide sufficient supervision over crew adherence to the AFM and SOP.

4.1.3. To set up and implement the procedures to increase the maintenance quality and increase the risk awareness associated with improper WOW switch regulation.

A handwritten signature in blue ink, appearing to be 'Jens Haug', written in a cursive style.

Jens Haug

22.01.2012