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Report RL 2002:02e

Incident involving aircraft OY-MUG at Ronneby airport, K County, Sweden, on the 8th of December 2000

Case L-008/01

SHK investigates accidents and incidents with regard to safety. The sole objective of the investigatioins is the prevention of similar occurrences in the future. It is not the purpose of this activity to apportion blame or liability.

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Translated by Dennis Lynn Anderson
From the orginal Swedish at the request of the Board of Accident Investigation

In case of discrepencies between the English and the Swedish texts, the Swedish text is to be considered the authoritative version.

Statens haverikommission (SHK) Board of Accident Investigation

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2002-02-04 L-008/01

Swedish Civil Aviation Administration

601 79 NORRKÖPING

Report RL 2002: 02e

The Board of Accident Investigation (Statens haverikommission, SHK) has investigated an incident that occurred on the 8th of December 2000 at Ronneby airport, K County, Sweden, involving an aircraft with registration OY-MUG.

In accordance with section 14 of the Ordinance on the Investigation of Accidents (1990:717) the Board herewith submits a final report on the investigation.

Olle Lundström

Monica J Wismar Henrik Elinder

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Aircraft: registration, type	**OY-MUG,** Shorts SD3-60
Class/airworthiness	Normal, valid certificate of airworthiness
Owner/Operator	MUK AIR, Copenhagen Airport South, DK-2791 Dragör, Denmark
Time of occurrence	8 December 2000, 23:38 hours during darkness. *Note*: All times in this report refer to Swedish Standard Time = UTC + 1 hour
Place	Ronneby airport, K County, Sweden, (pos 5616N 01515E, 58 meters above sea level)
Type of flight	Scheduled traffic
Weather	According to SMHI's analysis: wind southerly at 1-4 knots, visibility approximatly 1,500 meters in haze, clouds 2–4/8 stratus with cloud bases at 200 feet, 5–6/8 altocumulus with cloud bases at 7,000 feet, temperature/dewpoint +7/+7 °C, QNH 1006 hPa.
Persons onboard: crew	2/1
passengers	11
Injuries to persons	None
Damage to aircraft	None
Collateral damage	Snow removal markers on the runway edge were broken
Commander:	
Age, certificate	63 years old, Danish ATPL
total flying time	approximately 18,000 hours, of which 600 hours on the type
flying hours previous 90 days	120 hours, of which 24 hours on the type
number of landings previous 90 days	unknown, 16 on the type
Co-pilot:	
Age, certificate	29 years old, Danish CPL
total flying time	approximately 1,500 hours, of which approximately 700 hours on the type
flying hours previous 90 days	150 hours, all on the type
number of landings previous 90 days	approximately 300
Cabin crew	employed since 1998

The Board of Accident Investigation (SHK) was notified on the 3rd of January 2001 that an incident had occurred involving an aircraft with registration OY-MUG, at Ronneby airport, K County, Sweden, on the 8th of December 2000 at 23:38 hours.

The incident has been investigated by SHK represented by Olle Lundström, Chairman, Monica J. Wismar, Chief investigator flight operations, and Henrik Elinder, Chief technical investigator aviation.

The investigation was followed by Gun Ström representing the Swedish Civil Aviation Administration and by the Danish Civil Aviation Accident Board.

Summary

The aircraft was to takeoff from Ronneby airport and fly to Kalmar. During the taxi-out for takeoff the aircraft was controlled by the commander, but when they had lined-up for takeoff on runway 01 he then transferred control of the aircraft to the first officer (herein refereed to as the co-pilot).

As the aircraft's speed began to approach V1[1] the co-pilot noticed that he was unable to control the aircraft's rudder. The aircraft drifted towards the left and approached the edge of the runway. When the co-pilot was not able to steer the aircraft back towards the center of the runway, he pulled the control column aft and the aircraft lifted off the runway.

The commander chose not to take over control of the flight and allowed the co-pilot to continue flying the aircraft. The co-pilot flew the aircraft at a few meters height over the ground, parallel with the runway, until he was able to turn the aircraft back towards the runway using aileron and elevator. After being airborne a few hundred meters he landed on the runway and applied full wheel braking immediately after touchdown. The aircraft came to a standstill prior to the runway threshold and could subsequently be taxied back to the terminal.

No technical failure has been found on the aircraft. SHK have found that the control lock handle's placement and design is inadequate. Locking of the rudder can take place spontaneously during ground operations if the control lock handle is not properly locked.

The incident was caused by the control lock handle probably not being correctly locked during the takeoff.

Recommendations

None.

[1] V1 – (Take-off decision speed) Designation for the speed attained by an aircraft during takeoff when the takeoff can either be rejected or continued.

1 FACTUAL INFORMATION

1.1 History of the flight

On the 8th of December 2000 the aircraft flew MUK AIR's scheduled route number ZR 479 between Copenhagen/Kastrup airport in Denmark, via Ronneby airport to Kalmar airport in Sweden. After a short ground stop at Ronny airport, the aircraft was to takeoff to fly onwards to Kalmar. During the taxi-out for takeoff the aircraft was controlled by the commander, but when they had lined-up for takeoff on runway 01 he then transferred control of the aircraft to the first officer (herein refereed to as the co-pilot).

They initiated the takeoff at time 23:38. As the aircraft's speed began to approach V1[2] the co-pilot noticed that he was unable to control the aircraft's rudder. The aircraft drifted towards the left and approached the edge of the runway. When the co-pilot was not able to steer the aircraft back towards the center of the runway, he pulled the control column aft and the aircraft lifted off the runway. At the time of liftoff a scraping sound was heard by the cabin attendant seated farthest aft in the aircraft. This sound emanated from the aircraft undercarriage.

The commander chose not to take over control of the flight and allowed the co-pilot to continue flying the aircraft. The co-pilot flew the aircraft at a few meters height over the ground, parallel with the runway, until he was able to turn the aircraft back towards the runway using aileron and elevator. After being airborne a few hundred meters he landed on the runway and applied full wheel braking immediately after touchdown. The aircraft came to a standstill prior to the runway threshold and could subsequently be taxied back to the terminal. Some of the passengers felt uncomfortable about the flight. The cabin attendant was of the opinion that the flight was "bumpy" and that the touchdown onto the runway was quite hard.

After the passengers had exited the aircraft the pilots found that the over-pressure valve on the right-hand main gear wheel had been activated and the tire had been depleted of its nitrogen gas. When they inspected the runway together with an airport employee they discovered a tire track about 20 centimeters outside of the left asphalt edge of the runway and that the aircraft had broken a few snow removal markers along the side of the runway.

The incident took place at position 5616N 01515E, 58 meters above sea level.

1.2 Injuries to persons

	Crew	*Passengers*	*Other*	*Total*
Fatal	–	–	–	–
Serious injuries	–	–	–	–
Minor injuries	–	–	–	–
None	3	11	–	14
Total	3	11	–	14

1.3 Damage to aircraft

None.

[2] V1 – (Take-off decision speed) Designation for the speed attained by an aircraft during takeoff when the takeoff can either be rejected or continued.

1.4 Collateral damage

Snow removal markers along the runway edge were broken.

1.5 The crew

1.5.1 The commander

The commander was 63 years old at the time and held a Danish ATPL-certificate (Airline Transport Pilot Licence) with an age exemption valid until the 30 th of August 2002.

Flying hours previous	*24 hours*	*90 days*	*Total*
All types	3	120	approx. 18,000
This type	3	24	approx. 600

Number of landings this type previous 90 days: 16.
Flight training on the type concluded 1999-06-06.
Latest PC (proficiency check) carried-out 2000-09-25 on the SD3-30/60.
The commander also holds instructor qualification, TRI(A) for aircraft types ATR42/72 and SD3-30/60 until the 21 of March 2003.

1.5.2 The co-pilot

The co-pilot was 29 years old at the time and held a valid Danish CPL-certificate (Commercial Pilot Licence) with Instrument Rating.

Flying hours previous	*24 hours*	*90 days*	*Total*
All types	–	150	approx. 1,500
This type	–	150	approx. 700

Number of landings this type previous 90 days: approximately 300.
When flight training on the type was concluded is unknown.
Latest PC (proficiency check) carried-out 2000-03-28 on the SD3-30/60.

1.5.3 Other crew members

A cabin attendant was on duty in the cabin. She was employed by the company in 1998 and completed her latest emergency training in August of 2000.

1.6 The aircraft

1.6.1 General

THE AIRCRAFT

Manufacturer:	Short Brothers & Harland Ltd
Type:	SD3-60 300
Serial number	SH-3716
Year of manufacture:	1987
Gross weight:	Maximum allowable 12,292 kg, actual 10,505 kg
Center of gravity:	Within allowable limits
Total flight hours:	13,284 hours
Number of cycles:	15,037

Flight hours since latest periodic check:	61 hours	
Fuel uplifted prior to the event:	Jet A1	
ENGINE		
Engine manufacturer:	Pratt & Whitney	
Engine model:	PT6A-67	
Number of engines:	2	
Engine	*Nr 1*	*Nr 2*
Total operating time:	Unknown	Unknown
Operating hours since latest overhaul:	Unknown	Unknown
Cycles after overhaul:	Unknown	Unknown
PROPELLER		
Propeller manufacturer:	Hartzell	
Operating hours since overhaul:		
Propeller 1:	Unknown	
Propeller 2:	Unknown	

The aircraft had a valid Certificate of Airworthiness.

1.6.2 Gust Lock System

This aircraft type is equipped with an electro-mechanical rudder locking system (Gust Lock System) through which all flight control surfaces can be locked when the aircraft is on the ground. The system is controlled with the help of a handle, ”Control Lock Handle”, placed on a console between the pilot seats, behind the seat backs. The handle has two detent positions, ”UNLOCKED” and ”LOCKED”. In order to move the handle from one position to the other one must first depress a button on the end of the handle. The handle is not spring loaded to either position. It must be manually moved to the respective stop before it will lock in the selected position. The position of the throttles does not affect the movability of the handle.

Elevator and aileron locking takes place via a mechanical linkage system between the control lock handle and the respective flight control system. Locking of the rudder takes place with the assistance of an electrical actuator (Bulk Plunger Solenoid) in the tail section of the aircraft. The actuator is controlled by a proximity switch in the control lock handle. The actuator has two fixed positions, one of which means that the rudder is mechanically locked in the neutral position and the other that the rudder has free movement.

The system has some safety-bolts:

– When the control lock handle is in position “Locked” the moving of the throttles is mechanically limited to positions corresponding to low engine power;
– An electrical solenoid is activated and locks mechanically the control lock handle in position “UNLOCKED” when the aircraft rotates. A requirement for this locking is that the handle is exactly in the position “UNLOCKED” when the solenoid is activated.

A red warning light in the middle of the instrument panel is illuminated when the control lock handle is not in the ”UNLOCKED” position or when the rudder lock actuator is in the “LOCKED” position.

1.7 Meteorological information

According to SMHI’s analysis: wind southerly at 1–4 knots, visibility approximately 1,500 meters in haze, clouds 2–4/8 stratus with cloud bases at 200 feet, 5–6/8 altocumulus with cloud bases at 7,000 feet, temperature/dewpoint +7/+7 °C, QNH 1006 hPa.

1.8 Aids to navigation

Not applicable.

1.9 Communications

Customary radio communications took place between the crew and the air traffic control at Ronneby airport.

1.10 Aerodrome information

The airport had operational status in accordance with the Swedish AIP (Aeronautical Information Publication).

1.11 Flight recorders

The information concerning the incident first became known to SHK on the 3rd of January 2001. At this point in time the aircraft had returned to operational traffic and data from the flight data recorder and the cockpit voice recorder had not been saved.

1.12 Incident site and the aircraft

1.12.1 Incident site

Runway 01 at Ronneby airport.

1.12.2 The aircraft

With the exception of a deflated tire, no damage was caused to the aircraft.

1.13 Medical information

Nothing has been found that would indicate that the physical or mental condition of the pilots was impaired prior to or during the flight.

1.14 Fire

There was no fire.

1.15 Survival aspects

Not applicable.

1.16 Technical investigation

With assistance from the aviation company's technicians, an investigation of the aircraft's flight control systems and control lock system was accomplished. No fault or abnormality could be found. After the deflated main tire had been changed the aircraft was returned to service and was flown back to Copenhagen the day after the incident by the same flight crew. The aircraft functioned normally at this time.

1.17 Organizational and management information

1.17.1 General

MUK AIR is an aviation company with headquarters at Copenhagen/ Kastrup airport in Denmark**.** The company holds an operational license in accordance with JAR-OPS[3] and at the time of the incident undertook

[3] JAR-OPS - Joint Aviation Requirements - Operations

scheduled and non-scheduled traffic with seven aircraft of types Short 330, 360, ATR 240 and Embraer EMB-110.

1.17.2 Checklist

Subsequent to the incident the aviation company has complemented the MUK AIR Normal Checklist, SD 360 OY MUG. In the section ”Before take off” the following point has been introduced:

”Control Lock Handle..... ckd”

1.18 Additional information

1.18.1 SHK’s investigation

Due to several reasons the occurrence was initially not treated as a serious incident. The trouble-shooting measures that were accomplished on the aircraft by the company subsequent to the occurrence took place therefore without the participation of any representative from SHK. SHK has however complete confidence in the steps that were taken and the information that the company submitted concerning the work done.

1.18.2 The rudder lock

To a certain extent the pilots have diverging opinions about the sequence of events concerning the control lock and its indications. Both have stated that they released the control lock and checked the free movement of the rudder prior to takeoff. The commander has stated that he double-checked that the handle was locked into the correct position.

The co-pilot, who was flying the aircraft, felt that the rudder became locked during the takeoff run when the airspeed had reached approximately 70 knots and remained locked during the flight, the landing and the taxi-in to the ramp. His recollection is that the warning light for rudder locking illuminated during the takeoff run but was not illuminated during the in-taxing. He does not remember the position of the control lock handle. Nor does he remember who it was that locked the rudder in connection with parking after the incident. When the pilots together accomplished a functional check of the control lock system after the incident, it functioned normally.

According to the commander the handle was in the correct position during the entire takeoff run and the warning light for rudder locking never illuminated. During the roll-out after the incident the flight controls were locked according to the valid checklist. On the parking ramp they performed a functional check of the control lock system and determined that it functioned normally at that time.

According to the company’s operations management, there have been earlier cases where the control lock handle has not been completely moved to the correct detent position in connection with takeoff.

1.18.3 De-icing fluid

The possibility that de-icing fluid might have temporarily affected the rudder function has been considered. However de-icing fluid was not used either prior to takeoff from Copenhagen or from Ronneby.

2 ANALYSIS

No technical fault has been found on either the aircraft or the control lock system. Even if a transient failure cannot be completely outruled, such a failure is unlikely. Furthermore, the system functioned normally both prior to and after the incident.

Both the pilots recall that the control lock was disengaged and that the rudder control freedom was checked prior to the takeoff. This is attested to by the fact that the co-pilot did not experience anything abnormal concerning aircraft maneuverability during the initial portion of the takeoff run.

It is therefore plausible that the control lock handle, in connection with switch-over, was not completely and correctly moved to the full detent position (UNLOCKED). Because of the handle not being spring-loaded in either direction it could subsequently, under the influence of aircraft vibrations during taxi, spontaneously move aft in the direction of detent position (LOCKED). When the handle reached a certain position the proximity switch for the rudder locking function was activated which caused the rudder to become locked. The co-pilot also remembers that the warning light for the rudder lock illuminated at about the same time that the rudder locking occurred.

This and similar previous incidents that have occurred indicate that the control lock handle's somewhat "out of the way" placement, design and locking function can give rise to mistakes being made in connection with the moving and locking of the handle. As such a mistake can result in a spontaneous locking of the rudder during takeoff, possibly before the pilots have managed to perceive that the warning light has been illuminated, this constitutes a flight safety risk. The aviation company's measure, to introduce a special checklist item regarding the locking of the handle prior to takeoff, is therefore well-founded and to be recommended.

The over-pressure valve on the right main wheel was activated due to the over-heating that arose during the heavy braking after the touchdown.

3 CONCLUSIONS

3.1 Findings

a) The pilots were qualified to perform the flight.
b) The aircraft had a valid Certificate of Airworthiness.
c) No technical failure has been found on the aircraft.
d) The rudder became spontaneously locked during the ground run during takeoff.
e) The control lock handle's placement and design is inadequate.
f) Locking of the rudder can take place spontaneously during ground operations if the control lock handle is not properly locked.

3.2 Causes of the incident

The incident was caused by the control lock handle probably not being correctly locked during the takeoff.

4 RECOMMENDATIONS

None.