

**Accidents Investigation Bureau at the Luftfahrt-Bundesamt
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FLIGHT ACCIDENT SUMMARY REPORT

Reference: C X 032-0/95

Accident to:	Aircraft Socata TBM 700
on: 07.12.1995	at Braunschweig
Injuries to persons: injured.	2 persons seriously and 4 persons slightly
Damage to aircraft:	substantially damaged
Other damage:	field damage

History of the flight:

On December 12, 1995, a private flight under instrument flight rules (IFR) planned from Linz to the regional airport of Braunschweig was conducted with the a.m. aircraft. Aboard were the pilot-in-command, one trainee to be familiarized with the a/c as well as four passengers.

The flight served the purpose of familiarization of a pilot with the TBM 700. At the same time, a business date was to be observed.

Immediately after commencing the final descent for an NDB/DME approach to runway 08 at Braunschweig, the aircraft, under control of the autopilot, got into severe oscillations about the vertical and the longitudinal axes. The pilot-in-command disengaged the autopilot and tried to manually regain aircraft control, this, however, was not successful. Approximately 3 nm before the threshold of runway 08, the aeroplane touched a high voltage powerline and crashed in a flat angle into an arbour'd meadow, skidded through a brook of approximately 5 m width and came to a standstill with the aft portion of the fuselage still in the water.

According to the Convention on International Civil Aviation (ICAO Annex 13), the sole objective of the investigation of an accident or incident shall be the prevention of future accidents and incidents. It is not the purpose of this activity to apportion blame or liability.

Two occupants suffered serious and the other four others minor injuries. The aircraft was substantially damaged. Furthermore field damage was caused and leaking operating fluids led to water pollution.

Investigation:

The investigation of the wreckage was conducted on the premises of the FUS, the autoflight system components were checked by the manufacturer in the United States in the presence of a staff member of the FUS.

The following findings were made:

1. Powerplant

Distinct traces on the powerplant show that the powerplant had produced power at the moment of impact. The casing of the hot section had been twisted by torsion as a result of a counter torque of the propeller. All three propeller blades were evenly bent backwards and showed impact marks on the leading edges. The pitch links were broken so that the blades were freely movable in the pitch control bearings. The fuel feed lines to the fuel control unit were filled with fuel. When the fittings were opened clean fuel, which was partly under pressure and could be identified as grade Jet A1 turbine fuel, leaked out. As a result of the accident, the fuel control unit and the engine driven fuel pump were damaged in such a way that benchtests were no longer possible.

2. Control system

All components of the control system as well as the landing flaps had been connected correctly and showed no signs which would indicate a possible cause of the accident. Whereas the elevator and aileron trim were in neutral position the rudder trim tab was deflected to the right. According to the manufacturer, the trim positions found corresponded to high speed cruise flight and not to the approach configuration at low speed.

3. Autoflight System

A metrological check of the individual autoflight system components and a functional check of the combined system with an electrical harness prepared for the TBM 700 were conducted at the manufacturer's. Findings indicating a malfunction which could probably be considered to be an accident cause have not been made.

During conversations experience gained during the certification procedure was reported. During the flight tests for the adaption of the autoflight system to the TBM 700, short time oscillations about the vertical axis were experienced especially during landing gear extension, which, however, faded out each time. These findings, however, have not resulted in restrictions relating to type approval.

4. Landing gear

At the moment of the impact on the ground, the hydraulically operated retractable landing gear was locked in the down-position. The landing gear position found corresponds to the statements of the pilot in command who explained that he had extended the landing gear immediately prior to the initiation of the final descent.

According to the information given by the aeroplane manufacturer the gear extension system has a particularity such that both main gears do not extend synchronously but consecutively leading to a marked yawing movement of the aeroplane.

Statements of the pilot-in-command

The pilot-in-command declared that prior to the final descent he had set the landing flaps to the approach position, extended the landing gear and immediately afterwards initiated the descent by selecting the MDA on the altitude selector, selecting a corresponding sink rate and setting the vertical speed mode. Immediately afterwards, the aeroplane started to heavily oscillate about the vertical axis and shortly afterwards also the longitudinal axis. He disconnected the autopilot at once by pushing the AP-disc-button on the control wheel and tried to regain control of the aeroplane manually, this, however, was not successful. He stated that during the uncontrolled descent, the air speed had continuously dropped from approximately 130 kts in the beginning to approximately 90 kts. Shortly before the impact on the ground he had set the power lever to maximum power. However, according to his statements, the powerplant did not develop any power.

He precluded that the trainee, who was sitting on the left side, had possibly given control inputs after the onset of the uncontrolled flight condition. But in contrast with this the latter declared approximately that they had tried „jointly“ to regain control of the aeroplane.

Design of the autoflight system

The autoflight system King KFC 275 is a two-axis autopilot with a flight director. In addition, a yaw damper is installed.

The flight attitude is controlled exclusively by means of the elevator and the ailerons. The rudder is not controlled by the autopilot. The yaw damper has the function to damp only oscillations about the vertical axis by corresponding short-time deflections of the rudder, using an acceleration measurement as a control value. This system design is very common for single and twin-engined utility category aeroplanes. As compared with other aeroplane types of comparable size, the TBM 700 as a single-engine aeroplane has an exceptionally high power rating. Of course, the high torque at the propeller causes a correspondingly heavy reaction of the aeroplane about the vertical and the longitudinal axes. Thus in case of an incorrect adjustment of the rudder trim, this aeroplane more than other types would get into a considerably heavier yawing condition to be compensated only by an opposite aileron deflection by the autopilot.

For other aircraft types with similar performance characteristics, e.g. the Pilatus PC XII, the autoflight system is designed as a three-axis autopilot. By continuous rudder control as well as the rudder trim control, yawing conditions are excluded as far as possible.

Meteorological conditions

According to the information given by the controllers at Braunschweig Airport the weather conditions at the moment of the accident were as follows:

Wind: 110°, 7 kts, clouds: overcast at 900 ft GND, temperature: - 4°C, dew point -5°C, QNH: 1021 hPa, ambient light: night. In addition, the pilot-in-command stated that he had not noticed any icing of the airframe.

Analysis

As the statements of the pilot-in-command and the other occupants have definitely shown, the uncontrolled flight condition have been caused by oscillations about the vertical axis immediately afterwards superimposed by oscillations about the longitudinal axis.

Recovery from such a flight condition, known as a so-called Dutch roll, is very difficult under instrument flight conditions and results in a heavy loss of height. The speed drop noticed by the pilot-in-command is to be explained by the fact that at the beginning of the descent, the aeroplane was flown at a power well reduced for the approach and that the pilot selected take-off power only shortly before the impact on the ground. For a powerplant of this design, the delay between the advancing of the power lever and the actual development of power is normally up to 5 seconds. It is to be supposed that already within this delay the impact on the ground occurred.

The cause of the uncontrolled flight condition could not be established with absolute certainty. But it is to be regarded as probable that due to an incorrect rudder trim setting the aeroplane got into a yawing condition so that the autopilot had to give an opposite bank angle input in order to maintain the preselected heading. The additional yawing moment caused by the asymmetric extension of the landing gear combined with the initiation of the descent almost at the same time then resulted in unstable oscillations.

It cannot be excluded that by means of the autoflight system the aeroplane would have recovered from this flight condition quickly. The pilot-in-command, however, reacted in a way which is normal for aeroplanes of this category and switched off the autopilot. The recovery from the Dutch roll under instrument flight conditions presumably made excessive demands on him, particularly since it cannot be excluded that the trainee seated on the left had also given control inputs at this moment.

Causes:

The accident was caused by the fact that during the initiation of the final descent for an NDB/DME approach the aeroplane got into an uncontrolled flight condition due to vibrations about the vertical and the longitudinal axes. The exact cause could not be established with absolute certainty.