

No. 26

Air France, Boeing 707-328, F-BHSA accident at Hamburg - Fuhlsbüttel Airport, Germany, 27 July 1961. Report, dated 6 June 1963, released by the Federal Office of Aviation, Germany.

Circumstances

Flight 272 which was flying the Polar route Paris-Hamburg-Anchorage-Tokyo landed in Hamburg at 1224 hours GMT. While taking-off for Anchorage with a total of 41 persons aboard the aircraft, including 26 passengers, the pilot had difficulty holding the aircraft on a straight heading along the runway and decided to abandon the take-off. Despite his efforts, the aircraft veered to the left, ran off the runway and finally came to rest 2 840 m from the starting point in a depression 140 m from the runway. It was severely damaged. Four crew and six passengers were seriously injured.

Investigation and EvidenceThe Aircraft

It had operated a total of 3 978 hours and had made 1 080 landings.

The aircraft's actual take-off weight was 133.42 t, (i. e. within limits), and its aft trim was 22.4% MAC. The aircraft should have been trimmed four units heavy in the tail. (The manufacturer recommends 3.5 units.) The longitudinal trim was found to be 4.5 or 5 units. It is assumed that the trim was adjusted in accordance with tested values.

The Crew

The pilot-in-command was the holder of a valid airline transport pilot's licence which was endorsed for Boeing 707 aircraft. He had flown a total of 14 000 hours of which 401 hours had been in command on Boeing 707's.

The co-pilot also held a valid airline transport pilot's licence and had flown approximately 8 000 hours including about 960 hours on Boeing aircraft. He had also flown approximately 5 000 hours as radio operator.

The other crew members aboard were a flight engineer, a navigator, cabin attendants and a relief crew. All had valid licences.

The Runway

The aircraft was taking-off from runway 23 (2330). The runway is 2 923 m in length, is 45 m wide and is at an elevation of 45 ft amsl.

Weather

At the time of the accident (1420 hours GMT) the following meteorological conditions existed at Hamburg:

wind 280/18 kt, gusts up to 28 kt, cloud cover 1/8 at 4 000 ft, 5/8 at 20 000 ft, visibility 25 km; QNH 1005.8 mb, ground temperature 19°C.

Reconstruction of the take-off

The reconstruction is based on statements of the crew, witnesses inside and outside of the aircraft, and the findings of the inquiry.

Permission was granted for take-off at 1418:40 hours. The throttle lever was thrust forward and while the captain's right hand still rested on it, the engineer set the four engines at the calculated EPR

(engine pressure ratio) of 2.45 in accordance with the instructions. The captain operated the rudder pedals with his feet, the nosewheel controls with his left hand and the throttle lever with his right. To compensate for the starboard headwind he steered a little left. The co-pilot held the control column forward and applied a little bank on the starboard side because of the crosswind. As the aircraft gathered speed and the effect of the rudder became more marked the captain slowly released pressure on the left rudder pedal. When the co-pilot had called out a speed of 80 kt the captain released the nosewheel steering controls and took over the control column. The captain, having heard the co-pilot call out 100 kt, concluded that the aircraft had reached this speed within the predetermined time. He stated that between 100 and 120 kt the aircraft suddenly veered to the left, and that he brought it back by using the rudder, which was difficult to move. Neither pilot could remember calling out 120 kt or having heard it called out. The pilot made a check and ascertained that acceleration had been carried out within the predetermined period of 37 seconds.

Between 120 and 130 kt the aircraft again veered left and the direction was again corrected. The resistance had increased. The yaw to the left persisted, and the captain realized that, despite great effort, the rudder pedal could no longer be actuated right, and he felt that it was jammed. The flight engineer noted, at this time, that the rudder's hydraulic pressure had fallen quickly from 3 000 to 1 000 psi.

At approximately the same time the captain began interrupted take-off procedures. He pulled back all four throttle levers, reversed thrust on engines 3 and 4 to stop the aircraft on the runway, and applied the brakes to the starboard undercarriage.

According to the skid marks the nosewheel was pointing at about a 35° angle to the right of the longitudinal axis of the aircraft, and the aircraft must have

slid slightly left. The captain maintained that he had not used the nosewheel steering to bring the aircraft back on heading.

All the expert witnesses outside the aircraft said that they saw the nosewheels lift off the ground. The captain, however, stated that he had kept the aircraft's nose on the ground all the time. From this, it was assumed that in his efforts to make the rudder work the captain unconsciously pulled back the control column. Shortly after, both nosewheels broke off.

Although the steps taken by him to correct heading had some effect, the yaw to the left persisted. Thereupon he reversed thrust on all four engines and applied both wheel brakes. The reverse thrust was, however, violently interrupted when the navigator, who was not fastened in his seat, was flung against the pilots' control stand when the nosewheel undercarriage broke off.

Having rolled 2 360 m, the aircraft ran off the runway in a gentle curve to the left. In turn, the nose gear assembly, the port undercarriage and finally the starboard undercarriage broke off. Finally the aircraft came to rest in a depression 1.5 m deep and 30 m wide with its fuselage broken into three parts. (See Figures 10, 11 and 12).

#### The Engines

In engine No. 2 the thrust reversal valves were found in the closed position while in the other three engines they were open. The crew had not noticed any signs of abnormality in the engines and the speeds of 100 and 120 kt were attained within the specific times. Since the SFIM flight recorder registered normal acceleration up to the abandonment of take-off, it is reasonable to assume that the engines were functioning satisfactorily, and the wheel brakes could not have been on, at least not noticeably.

#### Rudder

There was no further trace of jamming of the rudder which the pilot had reported.

On the day of the accident there was a gusty crosswind which must have obliged the pilot to shift the rudder quickly and far over, (while moving at a low speed), after he had changed over from the nosewheel controls to the rudder. If the rudder is moved abruptly hard over when it is at boost-on this can produce a marked decrease in pressure in the auxiliary hydraulic system, as noticed by the flight engineer during take-off. Great resistance is then felt in the rudder pedal and may give the impression that it is stiff or even jammed. It must be assumed that the pilot knew of this feature from experience.

In the November 1961 issue of the "Boeing Airliner" under the heading "Rudder Operation and Control" there is a further explanation.

If the pressure control valve comes to rest in the central position, thus impeding the supply of hydraulic pressure to the rudder power control unit, the moment the pedal is pressed it ceases to be power-operated and has to be operated directly. The rudder resistance unexpectedly increases and can easily give the impression that the rudder is stiff or jammed. The pressure required on the rudder pedals to achieve a 50° extension of the rudder fin at 200 kt, for example, rises from about 40 to 90 lb. Also, the pilot receives no warning that a switch-over will ensue, since the pressure through the pressure control valve may remain at full right up to the moment when, as a result of pedal action, a steadier flow of hydraulic fluid through the rudder power control unit makes the pressure in the system fall off sharply. The warning light cannot give any knowledge of this, although it will flash whenever the rudder is switched to direct operation. This was not observed by any crew member.

The manufacturer has issued Service Bulletin No. 1482 recommending incorporation of a bypass line which will ensure sufficient pressure to the rudder power control unit even when the valve switch functions unsatisfactorily.

#### The Handling of the Aircraft

It gave no indication as to the possible cause of the accident.

The emergency brake had not been used. Its use would probably have resulted in the aircraft leaving the runway even earlier on account of its leftward veer.

The normal wheelbrake and reverse thrust were in order, and the pilot was justified in assuming that he would be able to stop the aircraft on the remaining portion of the runway. The accident would probably have been less critical if the navigator had not fallen on to the control levers and stopped the reverse thrust. The navigator said he had released his safety belt to get a better view when he noticed that the take-off was going wrong.

The flight recorder showed that a change of heading occurred during take-off. The maximum speed registered was 155 - 157 kt, but an erroneous indication may have resulted from impact. The speed, however, was estimated to be approximately 150 kt.

#### Probable Cause

The cause of the accident could not be determined. The pilot could not keep the aircraft on the runway after abandoning take-off.

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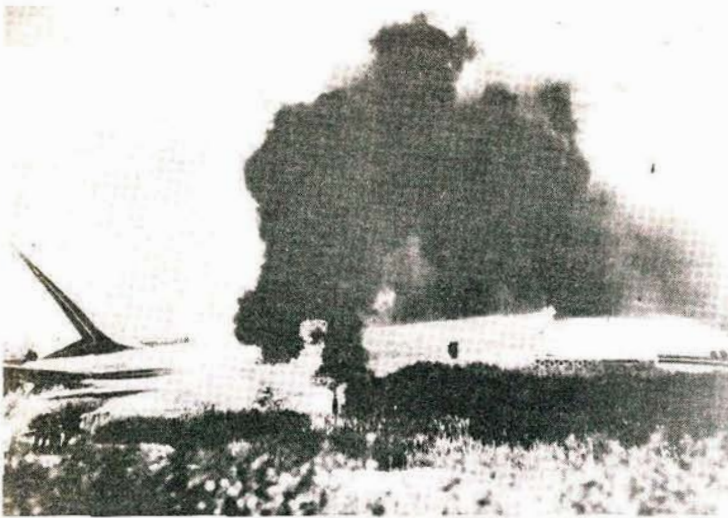


FIGURE 10

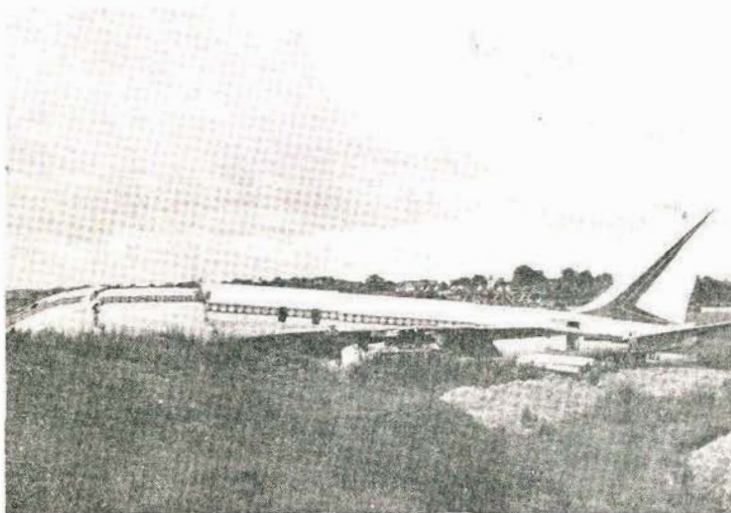


FIGURE 11



FIGURE 12