No. 4

Deutsche Lufthansa A.G., Convair 440, D-ACAT, accident at Bremen, Federal Republic of Germany, on 28 January 1966. Accident report released by the Federal Office of Civil Aeronautics, Federal Republic of Germany

1. - Investigation

1.1 History of the flight

The aircraft was operating a scheduled service of Deutsche Lufthansa on the route Frankfurt-Bremen-Hamburg under flight No. LH 005. Scheduled time of departure in Frankfurt: 1625 hours GMT, scheduled time of arrival at Bremen: 1745 hours GMT. Actually, the aircraft took off at 1641 hours GMT.

The last phase of the flight can be roughly reconstructed from the tape recordings, the evidence given by the witnesses and the position of the wreckage as follows:

17.41 GMT	Descending from flight level 60 and clearance for ILS approach to runway 27 at Bremen.
17.44 GMT	Passing of radio beacon Bremen outbound.
17.48 GMT	Passing of radio beacon Bremen inbound on final approach.
17.49.37 GMT approximately	The aircraft was seen for the first time by witnesses about 1 000 m before the threshold of runway 27 near the middle marker; later it was observed by the control tower with its landing gear extended and the landing lights turned on.
17.50.15 GMT approximately	About 1 200 m after the threshold of runway 27, close to the intersection of runways 27/09 and 32/14, the aircraft went round again at an altitude of about 30 ft above ground with a compass course of about 270°.
17.50.40 GMT approximately	With a pitch of about 30° to 60° and the left wing forward the aircraft crashed on the ground in the opposite direction to runway 27, about 385 m west of the end of runway 27 and about 380 m south of the runway centre line.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	4	42	
Non-fatal			
None			

1.3 Damage to aircraft

The aircraft was destroyed by the impact and subsequent fire.

1.4 Other damage

At the place of accident medium damage to the ground was caused.

1.5 Crew information

The crew consisted of the pilot-in-command, the co-pilot and two stewardesses.

The pilot-in-command, aged 48, held a valid airline transport pilot's licence since 28 August 1958, which was endorsed for Vickers Viscount and Convair 440. The prescribed check flights on the aircraft types CV 440 and V 814 had been performed without objections. As of the day of the accident, he had flown a total of 5 093 hours, 1 187 of which were as pilot-in-command on aircraft type CV 440. He had his last medical check on 16 August 1965 and attained the necessary marks for an airline transport pilot. On the strength of the results of the autopsy, it is believed that he sat on the left seat in the cockpit when the accident occurred and that his death was due to the injuries suffered from the impact of the aircraft on the ground. He was not under the influence of alcohol nor could CO-containing gases be traced in his lungs. His internal organs, as far as they were available for examination, showed no lesions. In the aorta wall, however, a rather diffused small round-celled and spindle-shaped polycytosis was found. The heart was not available for examination.

The co-pilot, aged 27, held a commercial pilot's licence endorsed for IFR flights on all aircraft types and for Convair 440 as co-pilot. As of the day of the accident his flying experience amounted to 793 hours, of which 533 hours had been flown as co-pilot on CV 440. He had passed his last medical check on 4 January 1966. On the strength of the results of the autopsy, it is believed that at the time of his death he sat on the right seat in the cockpit and that his death resulted from the injuries suffered from the impact of the aircraft on the ground. A residual alcohol content of 0.24 o/oo was found in his blood. An examination of the internal organs still available did not reveal any lesions. The heart, however, could not be examined.

1.6 Aircraft information

The aircraft, type Convair 440, construction No. 464, year of construction 1958, had received its first traffic licence on 18 July 1958.

On the day of the accident it had been in operation for 13 871 hours. The last partial overhaul, prescribed after every 3 800 flight hours (maximum), took place during the period 9 March to 2 April 1965, total operation time being then 12 217 flight hours. The last maintenance certificate was issued by an aircraft maintenance engineer on 29 December 1965 after a basic check at 13 727 flight hours; this certificate covered a period of 280 hours or 90 days.

All airworthiness directives were complied with. The daily flight operations check FK II was last performed during the night 27/28 January 1966 in Bruxelles. Then the aircraft was put into operation on the routes Bruxelles-Frankfurt-Köln-Bremen-Frankfurt-Bremen. The flight operations check FK I, which is to be performed prior to every flight, was carried out on the various stations and entered in the technical log-book. Technical deficiencies were found neither by the pilots during the flight nor by the mechanics on the ground.

Prior to the departure from Frankfurt, the aircraft was refuelled with 5 620 lb fuel (minimum antiknock rating 108/135), 34 USG lubricant (Aero-Shell-Oil W 100), 16 USG water methanol (50% Methyl-Alcohol and 50% water). Thus the aircraft disposed of a fuel supply which was sufficient for a maximum flight duration of 5 hours and 13 minutes.

In the Federal Republic of Germany, the type certification for Convair 440 aircraft was issued on 22 March 1957 on the strength of the type certificate No. 6 A 6 and the pertaining aircraft specification No. 6 A 6 of the CAA, US Department of Commerce, of 30 January 1956. The aircraft specification No. 6 A 6 contains i.a. the following operational conditions:

maximum take-off weight		49 100 lb (CB 17)
maximum landing weight		27 650 lb
maximum permissible position of centre of gravity	forward position	rearward position
on take-off with extended landing gear and 49 100 lb all-up weight	20.1	34.0% MAC
on cruising flight and 49 100 lb all-up weight	16.2	35.0% MAC

With effect from 28 December 1965 and deviating from specification No. 6 A 6, the type certification was extended in that the maximum landing weight was increased to 49 000 lb. The actual landing weight of the damaged aircraft has been recalculated and amounted to approximately 47 438 lb. According to the trim plan the centre of gravity was 28.7% MAC for take-off and 28.2% MAC for landing.

Shortly before the departure, 12 passengers were listed as "last minute change". Assuming the last favourable occupation of the seats, the recalculation of the centre of gravity for the landing revealed a figure of possibly 34.07% MAC.

Engines

The left engine, type Pratt & Witney CB 17, construction No. 34261, year of construction 1954, had been in operation for 13 298 hours at the time of the accident, 898 hours of which since the last overhaul. The right engine, construction No. 34480, year of construction 1954, had been in operation for 14 515 hours at the time of the accident, 993 hours of which since the last overhaul.

The maximum permissible operating time for engines overhauled by Deutsche Lufthansa, was fixed on 1 January 1965 to be 1 700 hours.

The left propeller, type Hamilton Standard 43 E 60 - 469, construction No. 203954, year of construction 1958, had been in operation for 10 162 hours at the time of the accident, 4 068 hours of which since the last overhaul.

The right propeller, construction No. 217232, year of construction 1960, had been in operation for 9 392 hours at the time of the accident, 2 823 hours of which since the last overhaul. The maximum permissible operating time for propellers was fixed on 2 June 1965 to be 4 800 hours including a corrosion check every 24 months.

Systems

The communications equipment of the aircraft was in excess of the minimum requirement laid down in the directive for the operation of aircraft in commercial operations (Part 1 - Airline Services) and in the directive for the licensing of aircraft for IFR flights. The permissible operating hours of those parts of the equipment for which operating requirements exist, had not been exceeded.

1.7 Meteorological information

The flight route coincided with the line of a warm front following a warm occlusion. Prior to the departure from Frankfurt, the crew received i.a. the following weather information:

Forecast from the terminal airport Bremen valid
from 1600 hours to 0100 hours GMT -
Wind: 200°/05 kt
Visibility: 3 km
Cloud coverage: 5/8 on 500 ft - 7/8 on 3 000 ft and
temporary decrease of the visibility to 1.5 km with
rain and drizzle and lowering of clouds to 300 ft.

During the last 10 minutes prior to the accident, the aircraft was flying in altitudes with temperatures above freezing point; for the descent the freezing level can be assumed to have been 6 000 ft. The last weather report from Bremen received by the crew, was:

Weather observation in Bremen as of 1720 hours GMT -
Wind: 140°/07 kt
Visibility: 1.2 km, rain
Cloud coverage: 5/8 on 400 ft, 8/8 on 500 ft.
No essential changes to be expected.

Shortly before the accident, a decline of the visibility to 1 km and a lowering of the cloud base to 300 ft were observed. This report did not reach the aircraft because at this moment the aircraft was already above the runway.

The minimum weather conditions for the aircraft type CV 440 are: for Bremen airport as terminal airport on an ILS approach to runway 27:

Visibility: 600 m (runway visual range)
Cloud base: 200 ft

Upon clearance for landing at 1748 hours GMT, Bremen control tower informed the pilot of a surface wind of 140°/09 kt; the wind at an altitude of 300 ft was given by the meteorological office as 230°/14 kt.

Taking account of the surface wind, the tail wind component must have been 6 kt and the cross-wind component from the left 6 kt. The maximum permissible wind components for the aircraft type CV 440 are 5 kt tail wind and 25 kt cross-wind.

The tail wind component, however, may be up to 8 kt if the landing run available is sufficient and if the runway conditions do not require any limitation.

Neither the crew of the aircraft in question nor the pilots who landed prior to or after the accident reported any difficulties in connection with icing or turbulence when approaching and landing at Bremen.

1.8 Aids to navigation

Bremen Airport is equipped with an instrument landing system. It was operating at the time of the approach. A special calibration made on 29 January 1966 proved that the course accuracy of localizer and glide path were within the permissible tolerances. This fact was confirmed by five pilots who had landed at Bremen shortly before or after the accident; only one pilot reported a slight deviation of the localizer.

1.9 Communications

The aircraft had radio contact with the ground stations of Frankfurt aerodrome control, Frankfurt control tower, Frankfurt radar control, Frankfurt Nord radar control, Hannover area control, Bremen approach control and Bremen control tower. According to the tape recordings the flight was performed in compliance with the directions of air traffic control. The crew of the aircraft in question did not report any difficulties with a safe conduct of the flight.

The radiocommunication of the last phase of the flight was recorded as follows:

17.48.00 GMT:	Flight No. LH 005 reports to Bremen control tower the crossing of Bremen radio beacon on final approach.
Immediately afterwards:	Bremen control tower clears Flight No. 005 to land, reports a surface wind of 140°/09 kt and asks for acknowledgement in case the intensity of the runway lighting should be reduced.
17.48.20 GMT:	The last radiocommunication from Flight No. LH 005 to the control tower is as follows: Roger - cleared to land - shall call you (with regard to reduction of light intensity).
17.50.23 GMT:	After the aerodrome controller had noticed the Flight No. LH 005 had started to go round again, clearance was given for the missed approach procedure, an approach on runway 09 was offered, and visibility and cloud height observed by the meteorological office at 1720 GMT were reported.
17.50.35 GMT:	End of this last radiocommunication from the control tower to Flight No. LH 005.

1.10 Aerodrome and ground facilities

Runway 27 of Bremen Airport runs 272°M. The obstruction clearance limit for the ILS approach on runway 27 is 17° ft above ground. At the time of the accident, the

landing run available for landings on runway 27 was 1 909 m plus a stopway with a length of 125 m; the take-off run available on the same runway was 1 740 m plus a clearway with a length of 169 m. The landing run required for the aircraft type CV 440 with a take-off weight of 47 500 lb, a wing flap setting of 22° and a 6-knot cross-wind component is 1 515 m. The take-off run required for the aircraft with the same take-off weight, a wing flap setting of 15° and the same cross-wind component is 1 603 m.

The airport was equipped with a Calvert system for the runway lighting and the approach lighting of runway 27. The approach and runway lights were functioning properly when the aircraft approached.

1.11 Flight recorders

The aircraft was not equipped with a flight recorder. Taking into account the location of the impact, a recalculation of probable flight profiles during the final phase of the flight revealed that the aircraft apparently stalled. From the findings at the wreckage which indicate the landing gear to have been retracted, the wing flaps to have been set to 15°, and the propeller speed governors of both engines to have been set to METO power, it is concluded that the aircraft already sheared off in the 4th climb segment.

Flight recorder readouts of stall tests conducted with CV 440 type aircraft by the manufacturer in 1955 revealed the following:

> The aircraft, when stalled with the wings in unbanked attitude, tends to roll to the left. With wing flaps extended and engine power increased this roll tendency is increased, according to the manufacturer.
>
> Test report Z1 - 440 - 001 reads: "Rolling characteristics during the power-on stall were marginal for the intermediate and full-flap positions. Heavy usage of ailerons was necessary, shortly after buffet onset, to prevent roll beyond desired maximum".

Material on stall tests during turns is not available, neither in the form of flight recorder readouts nor in the form of sound statements by the manufacturer.

1.12 Wreckage

Findings at the site of the accident

The largest recognizable part of the aircraft was the aft fuselage including horizontal and vertical stabilizers. The left horizontal tail surface was still connected to the aft fuselage and was found to be positioned at an angle of approximately 70° to 80° in relation to the ground. From the positions of the tail unit and of the wings, it was concluded that the azimuth angle of the aircraft's longitudinal axis at the time of impact was approximately 080°.

The remainders of the wings were found immediately in front of the tail unit. It would appear that the left wing had contacted the ground shortly prior to the right wing.

Damage by fire was less substantial to the right wing than to the left; damage due to the impact, however, was more substantial to the former than to the latter.

The three landing gear units were found in proper positions in relation to the main wreckage.

The engines were found in front of the wreckage of the left wing, buried in the soil up to the aft pistons almost perpendicular to the surface of the ground. The propeller blades were broken at the hub on impact.

The cockpit wreckage was buried in the soft soil and was partly covered by the cables of the electrical and radio systems, which were installed behind the cockpit. Most of the wreckage of the fuselage and cabin was found in a direction of approximately 080° from the main wreckage, within a sector of approximately 45° and a distance up to 50 m. Most parts did not show any evidence of fire.

Investigation of the aircraft structure

On account of the high degree of primary and secondary damage by impact and fire, respectively, an investigation on structural failure was impossible.

Investigation of the powerplants

On impact the propeller blades of both engines were set to 29° to 31° (low pitch), the propeller governor of the right engine was set to 2 680 rpm, that of the left engine to 2 540 rpm (approximately METO power), and the pumps for feathering or pitch reversal were not operating.

The solenoid valves for pitch reversal of both engines were operating properly. Both engines were in such condition as to permit an analysis of their operating condition prior to the impact. No part of the engines showed signs of evidence that would lead to the conclusion that a malfunction might have occurred in the operation of one of the engines prior to the accident.

A sample of the fuel taken aboard at Frankfurt was secured from the supplier for examination. The result revealed that the analysed data met the demand for aviation fuel 108/135 as authorized for the operation of CV 440 aircraft. The analysis of the lubricants did not give evidence of any malfunction of the engines. In the operation of CV 440 aircraft, all take-offs and go-arounds are conducted using water-methanol injection. According to regulations the respective container is filled up with 16 USG prior to each departure. The examination of the supply indicator revealed an indication of a content of 6.4 USG. A subsequent test, however, revealed that such indication corresponds to a substantially greater actual amount of fluid if the pitch angle of the aircraft is high (e.g. to 13 USG at a pitch angle of 60°).

The damage incurred by the crank shaft gearing leads to the conclusion that power was applied to the engines at the time of impact.

The indication of the rpm indicator of the left engine (the indicator of the right engine was not available for investigation), of the manifold pressure indicators of both engines, and the setting of the propeller blades on impact result in an engine power of both engines close to idle power.

Investigation of the aircraft systems

Flight controls

All flight controls, trim tabs, and wing flaps were available for examination. By inspection of the relevant parts and by material examinations or stress test, it was found that most probably no damage or malfunction existed prior to the impact. The setting of both wing flap drive units and of the cockpit indicator as well as an inspection of the extension cables revealed that the wing flaps were extended symmetrically up to approximately 15° (take-off setting). The emergency wing flap handle had not been operated.

Fuel system

The inspection of the fuel system revealed that most probably no damage or malfunction occurred prior to the impact.

Landing gear, Fire protection, and Wind-shield Wipers

The landing gear was retracted and locked, the fire protection system was not actuated, and the wind-shield wipers were not in operation.

Navigation and Radio Navigation systems

Both artificial horizons and both turn-and-bank indicators were operating until the time of destruction. According to the artificial horizons, it would appear that the aircraft's pitch angle was between 30° and 60°.

The turn-and-bank indicators still indicated the left turn on the vertical axle which occurred at the time when the front fuselage was destroyed. Both gyros of the compass system indicated the heading cursor to have been set to approximately 090°. These gyros were also operating until the time of destruction.

Both compass systems indicated 106° at the left indicator, 104° at the right indicator, and 088° at the left VOR-RMI.

Both OMNI-MAG indicators for the instrument landing system showed an identical indication, i.e. the localizer needle indicated one dot to the right, the glide path needle full up deflection.

The Zero Reader was set to VOR-LOC. Normal setting would have been either APPROACH or FLIGHT - INSTRUMENT. The Zero Reader heading selector was set to 272°, corresponding to the direction of runway 27 at Bremen Airport. The examination of the Zero Reader computer revealed that the gyro had been operating until the time of destruction and that it had been blocked at a pitch angle of 47°.

Engine indication

At the manifold pressure indicator an indication of 18 inches mercury was ascertained for the left engine, and 25 inches mercury for the right engine. The rpm indicator only showed an indication in respect of the left engine, i.e. approximately 1 200 rpm.

The left engine oil quantity indicator showed a quantity indication of 16.5 USG, the right one an indication of approximately 21 USG. The water-methanol quantity indicator indicated a quantity of 6.4 USG. The wing flap setting indicator revealed the flaps to have been set at approximately 15°. The outside air thermometer indicated approximately plus 5°C.

Electrical power

From the results of the examination of the electrically powered airborne equipment and navigation systems, it is concluded that most probably no power loss had occurred prior to impact, neither in the D.C. nor in the A.C. system.

1.13 Fire

Due to the destruction of the airframe on impact approximately 2 500 litres of fuel were released and ignited immediately. Consequently the main wreckage and an area of approximately 400 sq.m were exposed to fire for a considerable time. The fire was extinguished approximately 40 minutes after the accident.

1.14 Survival aspects

On impact many of the aircraft occupants had been thrown from the site of the impact together with their seats and with parts of the fuselage. Most of them were found in a direction of 90° from the main wreckage, within a sector of approximately 80° and up to 36 m from the main wreckage. All occupants had sustained fatal injuries on impact.

1.16 Others

Within the scope of the criminal investigation all aircraft occupants were examined in respect of

- former life
- family conditions
- state of health, especially mental diseases
- life insurances

The results of these investigations did not give rise to the suspicion of a criminal delict in respect of any of the occupants.

2. - Analysis and Conclusions

2.1 Analysis

All flight crew members were holding the required licenses and ratings which were valid on the date of the accident. The required proficiency check flights had been conducted as prescribed and had not given rise to complaint. Both pilots had sufficient piloting experience. The regulations in respect of maximum permissible flight time and flight duty time as well as minimum rest time had not been infringed. The dissection of the corpse of the co-pilot revealed a residual amount of alcohol contained in the blood; this amount, however, was too insignificant as to have influenced the piloting ability of the co-pilot.

The aircraft was certificated airworthy in accordance with relevant regulations. The maximum number of operational hours of airframe and engines, as well as of equipment and accessories with limited periods of operation had not been exceeded. The required maintenance inspections had been conducted at the prescribed time intervals. The causes of irregularities having occurred during the operation of the aircraft had been removed prior to subsequent flights. The fuel and oil quantities available on take-off were considerably in excess of the required minimum quantities; the available quantity of water-methanol was sufficient.

Note: The location of the centre of gravity could not be accurately determined. According to the mathematical recalculation, the centre of gravity was most probably within the permissible limits.

The aircraft was equipped with all navigation and radiotelephony communications systems, covering the relevant frequency bands, which were required for the route to be flown. There is no indication of the requirements for the orderly conduct of the flight not having been met prior to take-off.

Up to the time when the aircraft was passing the Bremen non-directional beacon on final approach, the flight had been conducted without irregularity.

The further conduct of the flight indicates that the pilot intended to land; during approach, however, he continued to fly over the runway until such point where the remaining runway length was less than the required landing distance.

The meteorological visibility and cloud height were not below the aerodrome meteorological minima required for landing. The fact that the permissible tail-wind component was exceeded is not considered a contributing factor since the excess was negligible.

Neither turbulence nor icing prevailed. It does not appear that engine performance and control function were affected by meteorological conditions.

Approach and runway lighting were in normal operation. Radiotelephony communication was properly conducted both on the ground and in the aircraft.

Due to the prevailing meteorological conditions, the instrument landing system (ILS) was required to execute the approach-to-land. No malfunction was detected, neither in the ground system nor in the airborne equipment.

There is no indication that the undercarriage was not properly extended for landing. The fact that the aircraft overshot the touchdown zone can partly be explained in that it was flying considerably above the ILS glide path during the final stages of the approach-to-land when descending below the clouds, and probably even for some time before. The most probable reason for the aircraft approaching too high appears to be the possible malfunction of one of the flight instruments available for use during approach-to-land. There is no indication of such malfunction of the ILS airborne instruments.

Experience has shown, however, that Zero Reader instruments, as installed in the aircraft in question, are frequently affected by malfunctions. If a Zero Reader operates improperly during approach-to-land, such malfunction cannot be detected immediately by the pilot. A wrong indication of the Zero Reader can only be recognized if the aircraft, during the further conduct of the approach, has deviated from the glide path to such extent that the deviation becomes apparent through cross reference with the ILS cross

pointer indicator. The majority of pilots are accustomed to using the Zero Reader for ILS approaches. It is therefore most probable that for the flight in question the Zero Reader was initially coupled to the ILS glide path and was used by the pilot for the approach. In this case it is assumed that the pilot followed the indication of the Zero Reader until the latter was recognized as malfunctioning and, since it could not be used for the further conduct of the approach-to-land, was switched to the setting as found after the accident. The further progress of the flight was dependent on the time at which the malfunction of the Zero Reader was recognized by the pilot and on the manoeuvres executed to correct the flight path of the aircraft. The actual progress of the flight shows that corrections were not applied to the extent required. Incidentally, the application of such corrections was hampered by the change in wind direction during the approach, resulting in a change from head wind component to tail wind component.

Another factor contributing to the overshoot is believed to be the probable underestimation by the pilot of the height above ground during transition from instrument flight to visual flight. The likelihood of such wrong assessment having been made is concluded from the fact that the pilot did not abandon his intention to land until he had already overflown half of the runway length.

The late abortion of the attempt to land would appear to have been a major contributing factor to the fatal progress of the missed approach.

From the mathematical recalculation of probable flight profiles between the go-around over the middle of the runway and the impact in the immediate vicinity of the aerodrome, it is concluded that the aircraft wreckage should not have been found in such attitude as it was at the site of the accident unless it had stalled in flight. The probability of a structural failure of the airframe can be excluded on account of the situation of the wreckage parts and due to the fact that the forces acting upon the structure during a go-around do not constitute a peak stress.

The result of the examination of the aircraft systems did not reveal any defects or malfunctions. From the result of the toxicological examination of the corpses of both pilot-in-command and co-pilot, it is concluded that prior to the aircraft impact neither fire nor smoke had developed.

Radio-navigation aids were not required for the initial phase of the missed approach. An uninterfered reception of the Bremen non-directional beacon and a correct indication of the radio compass would only have been required if the aircraft would have conducted the remaining portion of the missed approach and initiated a second approach.

The initial task was, therefore, to investigate whether an engine failure was the likely cause of the stall. The examination of the engines as well as of fuel and oil did not reveal any deficiencies.

From the result of the investigation, it is concluded that on impact the propeller blades of both engines were set at low pitch, the propeller speed governors of both engines were set to an rpm approximately equivalent to METO power, and that in respect of the pumps for feathering and pitch reversal none of the propellers was in the process of pitch being changed, neither on purpose nor involuntarily. The possibility of a malfunction of the water-methanol injection system can be excluded with a high degree of probability.

With METO power set power remains the same, whether with or without the use of water-methanol. From the testimony of witnesses regarding flight profile and engine noise, it is further concluded that the power required to go-around was available. The time period of approximately five seconds prior to impact during which ear witnesses witnesses recorded the engine noise to have ceased coincides, according to recalculation of the probable flight path, with that phase of the flight during which the aircraft is considered to have already stalled. These observations by witnesses have led to the conclusion that the flight crew had reduced engine power after the aircraft had sheared off in the stall. Coincident with this assumption are the findings at the engine indicators and the propeller pitch which indicate that on impact the engines were running approximately on idle power. No reason exists, therefore, to assume an engine failure to have been the cause for the stall.

Although there is no specific indication of a sudden physical disorder of one of the pilots, the possibility of a coronary malfunction having been the cause of the accident must be taken into account, since the heart of neither of the pilots, though the most important piece of evidence, was available for examination. The probability of a causal connection between accident and a possible interference with the duties of the flight crew by the conduct of a passenger was also considered. An assumption along these lines might initially have been made since at the site of the accident the corpse of a passenger was found lying on top of the corpse of the co-pilot.

The impression that this passenger may have been in the cockpit during the final phase of the flight is refuted by the fact that, attached to his body by the remainders of a torn seat belt, a broken part of a seat suspension was found which did not belong to a cockpit seat but to a cabin seat. On the other hand the presence of both pilots in the cockpit, in seated position in their seats, is evidenced by the analysis of their bone fractures and by parts of the wreckage attached to their corpses.

The rate of climb after go-around could not be ascertained. Further it could not be established whether, in view of the late initiation of go-around, a rate of climb would have been able to be maintained which would have permitted the aircraft to clear the local obstructions, since airspeed and flap setting at the time of initiation of go-around are unknown. If, on account of the intention to land, speed had been low and wing flap extension considerable, then the position of the aircraft to execute a go-around would have been unfavourable. In addition, only a short portion of the runway lighting system on the opposite end of the runway, which would in the prevailing darkness have enabled the pilot to control visually the attitude of the aircraft, in respect of horizontal displacement, was available. Furthermore, the missed approach path was located close to aeronautical obstructions. These unfavourable conditions probably influenced the action of the pilot. This assumption is intensified by the statement made by several witnesses that during go-around they heard the engines roar up. From this statement it is concluded that engine power was increased rapidly. All these circumstances lead to the assumption that the aircraft was brought to an abnormal attitude by the pilot strongly pulling up, which subsequently resulted in a rapid loss of speed. The pilot could recognize his mistake at the latest when transiting from visual flight to instrument flight upon entering the base of clouds. Since the aircraft was stalled shortly thereafter, it must be assumed that during this phase of flight the pilot did not apply any corrections to the aircraft attitude, or only insufficient corrections.

The calculations of the flight profile do not permit valid conclusions to be drawn in respect of the actions or omissions of the pilot upon initiation of the stall. They reveal, however, that irrespective of which of the probable aircraft attitudes actually prevailed the relevant minimum safe airspeed was infringed.

The attitude performance of the aircraft upon approaching this minimum safe airspeed under the conditions prevailing at the accident is not known. When drawing conclusions, the limited amount of information available from less recent in-flight tests conducted by the manufacturer has to be considered. It is a fact, however, that a characteristic peculiar to this aircraft type is the occurrence of a strong roll tendency at speeds considerably above the minimum safe airspeed.

Paying regard to the significantly higher engine power applied to the aircraft involved in the accident as compared to the power applied during the test flights, a relevant increase in roll tendency must be assumed, according to the statement of the manufacturer. From the flight profile calculations, it must further be assumed that the rate of loss of speed was higher than during the test flights. During the latter already $3\frac{1}{2}$ and $1\frac{1}{2}$ seconds after the beginning of the stall warning (buffeting), the roll tendency had to be counteracted upon by full aileron and considerable rudder deflections. The foregoing facts combined lead to the conclusion that an extremely short time period was left to decide upon the execution of such strong activation of controls. It must appear doubtful, therefore, whether under these difficult conditions during instrument flight the stall could be controlled by a pilot with average ability and experience.

After the aircraft had sheared off, it was definitely impossible to re-establish a normal aircraft attitude due to the low altitude of the aircraft. This would explain why during this phase of flight the pilot reduced engine power.

2.2 Conclusions

(a) Findings

While approaching to land, the aircraft overshot and stalled during the execution of the missed approach.

(b) Cause or Probable cause(s)

The overshoot on approach to land was probably caused by the fact that - possibly on account of a malfunction of one of the flight director instruments - the pilot was not in a position to remain on the glide path and that he made a wrong assessment of the height above ground after transition to visual flight. The stall was probably induced by wrong activation of controls. Such activation was possibly caused by sudden occurrence of a physical disorder of one of the pilots.

After the aircraft had stalled, the pilot could not control the further progress of the flight on account of the rather poor stall performance of the aircraft type, the extraordinary difficulties to control a stall during instrument flight conditions, and the insufficient height available for transition from stall to a normal attitude after the aircraft had sheared off.

Other factors may have contributed to the accident.

ICAO Ref: AR/006/66

Scheduled domestic
Landing
Stall
Pilot-misuse, flight controls