

No. 11

Japan Air Lines, Convair 880-22M, JA 8030, accident at Tokyo International Airport, Japan, on 26 August 1966. Report dated 26 August 1968, released by the Civil Aviation Bureau, Ministry of Transport, Japan

1. Investigation1.1 History of the flight

JA 8030 started a take-off run on runway 33R of Tokyo International Airport under VFR conditions at approximately 1428 hours with the pilot-in-command Manshichi Harano, examinees Yoshiomi Motouchi and Shuji Daikoku, flight engineer Terumitsu Fujimaki, and Chief Examiner of the Civil Aviation Bureau of Ministry of Transport Yukiaki Kawata, on board for the purpose of conducting a practical examination necessary for change in type rating to Convair 880-22M.

About the time the aircraft took a nose-up attitude, it began to yaw left and entered into a right side-slip. At approximately 1 500 m from the runway threshold marking, the right main landing gear started to go off the ground, and while the yaw and side-slip further increased, the under-surface of No. 1 engine began to contact the runway at approximately 1 600 m from the marking. The aircraft continued to side-slip with the nose coming down and deviated from the runway at approximately 1 700 m from the marking.

The aircraft moved on the lawn area, crossed taxiway C-4, then while proceeding in the direction of approximately 35° left in reference to the runway bearing, moved the heading to approximately 145° left in reference to the runway bearing, thence yawed right and continued the side-slip. Although the aircraft was in a slight nose-up attitude during this period, it went abruptly into a nose-down and almost at that time a fire started near No. 3 engine.

During this period the aircraft further proceeded with the left main landing gear, nose landing gear and Nos. 3, 2, 1 and 4 engines separated in this sequence, and came to a stop at a point approximately 2 100 m from runway 33R threshold marking and approximately 200 m from the runway centre line with a heading of 90° in reference to runway 33L.

The fire expanded explosively and the aircraft was damaged by fire or burnt except for the aft fuselage, empennage and a portion of the main wings.

All five persons on board died.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	5		
Non-fatal			
None			

1.3 Damage to aircraft

JA 8030 was destroyed and burnt.

1.4 Other damage

Several runway and taxiway lights and a portion of the ditch were destroyed.

1.5 Crew informationPilot-in-command - Manshichi Harano

Aged 44, joined Japan Air Lines on 1 April 1956 and was qualified as captain on Convair 880-22M on 30 August 1962.

He obtained airline transport pilot licence No. 155 on 30 November 1956 and held type ratings on Douglas DC-4, DC-6B, DC-8 and Convair 880-22M. His last medical examination was made on 6 April 1966 and the certificate was valid until 31 October 1966.

He was assigned to a company's check pilot on 25 February 1965.

He had accumulated a total of 8 446:52 flying hours (flying hours until the day before the accident date. The same applies hereinafter.), including 1 265:20 hours on Convair 880-22M. His flying hours in the last three months were 161:36 hours including 125:55 hours on Convair 880-22M. (125:55 hours includes 118:25 flying hours as a company's check pilot.)

Pilot - Shuji Daikoku

Aged 34, joined Japan Air Lines on 7 October 1963 and was qualified as co-pilot on Douglas DC-6B on 24 June 1965.

He obtained commercial pilot licence No. 1666 on 2 November 1964 and held a type rating on DC-6B. His last medical examination was made on 28 March 1966 and the certificate was valid until 31 October 1966.

He had accumulated a total of 2 618:52 hours, including 431:39 hours on DC-6B and 25:09 hours in training on Convair 880-22M. His flying hours in the last three months were 25:09 hours, all on Convair 880-22M. During this period he experienced a total of 19:19 hours' familiarization flight on Convair 880-22M.

Pilot - Yoshiomi Motouchi

Aged 29, joined Japan Air Lines on 7 October 1963 and was qualified as co-pilot on Douglas DC-6B on 24 June 1965.

He obtained commercial pilot licence No. 1667 on 2 November 1964 and held a type rating on DC-6B. His last medical examination was made on 27 September 1965 and the certificate was valid until 31 October 1966.

He had accumulated a total of 2 397:11 flying hours, including 368:51 hours on DC-6B and 23:34 hours in training on Convair 880-22M. His flying hours in the last three months were 23:34, all on Convair 880-22M. During this period, he experienced a total of 12:44 hours' familiarization flight on Convair 880-22M.

Flight Engineer - Terumitsu Fujimaki

Aged 26, joined Japan Air Lines on 1 July 1963 and was qualified as flight engineer on Douglas DC-6B and Convair 880-22M on 7 November 1964 and 22 November 1965 respectively.

He obtained flight engineer licence No. 215 on 4 November 1964 and held type ratings on DC-6B and Convair 880-22M. His last medical examination was made on 30 March 1966 and the certificate was valid until 6 November 1966.

He had accumulated a total of 841:04 flying hours including 408:23 hours on Convair 880-22M. His flying hours in the last three months were 146:17 hours, all on Convair 880-22M.

1.6 Aircraft information

JA 8030, a Convair 880-22M, manufacturer's serial No. 45, was manufactured on 24 July 1961.

The aircraft had accumulated a total of 5 290:33 flying hours until the day before the accident date, including 297:23 hours since the last No. 1 overhaul.

The type of the engines was General Electric CJ-805-3B and their history was as follows:

<u>Engine</u>	<u>Serial No.</u>	<u>Total Operating Hours</u>	<u>Operating Hours after Overhaul</u>
No. 1	403-175	6 049:21	649:38
No. 2	403-204	4 908:17	943:36
No. 3	403-116	5 514:46	991:49
No. 4	403-141	7 102:03	1 534:11

The aircraft had airworthiness certificate No. 923 issued on 30 June 1966 which was continuously valid.

The aircraft had been used in scheduled operation on domestic trunk routes of Japan Domestic Airlines until 30 June 1966, and was held on lease by Japan Air Lines from 1 July 1966 mainly for crew training purposes.

The No. 1 overhaul was conducted from 28 May to 15 June 1966. A check of the maintenance records revealed no discrepancies related specifically to this accident.

The gross weight at the time of take-off was 149 570 lb and the centre of gravity was computed as 28.1%, both being within the allowable limits.

The fuel on board was ASTM Standard Jet B.

1.7 Meteorological information

Meteorological conditions of Tokyo International Airport at the time of the accident were VFR as follows:

Time:	1428 hours
Sky Condition:	2 000 ft scattered
Visibility:	10 miles
Temperature:	85°F
Wind:	60°/11 kt

1.8 Aids to navigation

Not relevant to this accident.

1.9 Communications

JA 8030 was in contact with the airport ATC unit, but did not report any irregularities.

1.10 Aerodrome and ground facilities

Runway 33R is a runway of asphalt-concrete pavement, 3 150 m long, 60 m wide on a true bearing of 325°27'. The runway was dry.

1.11 Flight recorders

The aircraft was not equipped with flight recorders.

1.12 Wreckage

After the aircraft deviated from the runway, all the engines, the nose landing gear and left main landing gear separated from the airframe. Most of the airframe was damaged by fire or burnt except for a portion of the right wing, the aft fuselage and the empennage.

The right wing was burnt except for the wing box beam outboard of near station 224.8 (about 5.6 m from the longitudinal axis), the aileron and outboard portion of the trailing edge.

The fuselage aft of the rear pressure bulkhead remained almost intact. The rest of the fuselage including the cockpit, cabin, and installations below the floor was almost all burnt except for a slight portion of the forward fuselage.

Wreckage of the pedestal panel in the cockpit was recovered, but lever shafts and their linkages were damaged by fire to such a degree as not to permit estimation of the relative position of each lever.

The horizontal stabilizer was in a position of 3° nose-up, judging from the position of the screw jack actuator.

The slats and leading edge flaps were in the fully extended position while the trailing edge flaps were at 22°, all being in the take-off positions. The jack screw of the rudder trim tab overrode the extreme nose-right position. No unusual appearances were recognized for the elevator and rudder systems aft of the rear pressure bulkhead.

With regard to the nose gear, left and right drag braces, trunnion, actuator rod end and torque link were fractured, the steering control cables broken, and the rack gear of the steering cylinder was found 7° to 10° steered left.

With regard to the left main gear, the shock strut piston was fractured with the crack reaching as far as the torque link lug. The piston was fractured in such a state as it was subjected to impact loads from the right forward direction. Almost all of the piping, wiring and hoses were fractured by tension. Bursts caused by impact were recognized on the tires, but there was no evidence of spot wear. The outside rim flange of the left rear wheel was fractured throughout its circumference and blown out in such a state that it is estimated to be caused by considerable side forces applied from the out-board direction.

Most of the right main gear was burnt together with the airframe except for parts made of steel.

All the four engines were separated from the airframe. From their distribution, it was estimated that they separated in the following sequence: Nos. 3, 2, 1 and 4.

No. 1 engine was separated from its pylon. The transfer gear box and engine accessories were separated from the engine and the rear gear box was destroyed. Compressor blades of first to seventh stages were bent opposite to the rotating direction with their tips bent to the rotating direction.

No. 2 engine was separated from the wing still attached to its pylon. The right under portion of about a quarter of the front frame was missing, and an amount of soil was filled in at the forward portion of the compressor. Compressor blades of first to fourth stages were bent opposite to the rotating direction. The transfer gear box and engine accessories were separated from the engine.

No. 3 engine was discovered in the burnt aft fuselage. The transfer gear box and rear gear box were destroyed by fire and the accessories were separated from the engine. Damage to the compressor blades was slight as a whole. Turbine blades of all the first, second and third stages were fractured at their root and dispersed. The third stage turbine wheel with its mounting bolt fractured was discovered at approximately 200 m from the location where the aircraft came to a stop.

The whole of No. 4 engine was destroyed by fire. The front frame was burnt and the turbine frame was completely destroyed. The transfer gear box was burnt and the accessories were separated from the engine. The compressor casing was largely dented near its 4 o'clock position. Blades of each stage compressor were bent opposite to the rotating direction, this being significant for first and second stage compressors. An amount of soil was filled in near the 3 o'clock position of the third stage turbine. Third stage turbine blades were bent opposite to the rotating direction.

Variable stator vane actuator rods of each recovered engine were set in the lengths corresponding to the following revolutions:

<u>Engine</u>	<u>Left Actuator</u>	<u>Right Actuator</u>
No. 1	81%	82%
No. 2	94%	93%
No. 3	100%	100%
No. 4	86%	87.5%

1.13 Fire

After JA 8030 deviated from runway 33R, a fire occurred near No. 3 engine. The fire expanded explosively and the aircraft proceeded on the lawn area, came to a stop east of runway 33L and was enveloped by black smoke.

The airport fire-fighting unit which received the information at the same time as the accident occurred dispatched one minute later three chemical fire engines, two water tank vehicles, one destruction vehicle and a commanding car. They arrived at the site of the accident two minutes thereafter and engaged in extinguishing the fire.

The airport fire-fighting unit also requested assistance of a fire-fighting organization outside the airport in consideration of the situation. The fire was extinguished at approximately 1540 hours with the aid of many fire engines. The aircraft was damaged by fire or burnt except for the aft fuselage, empennage and a portion of the main wings.

Foam, water and CB (chlorobromomethane) fire extinguisher were used.

1.14 Survival aspects

All five persons on board died.

1.15 Tests and research

The track, and attitude and manoeuvring conditions (yaw, roll, side-slip, etc.) of the aircraft were estimated from factors such as speed, bank and pitch computed from traces marked on the runway by the landing gear, scratches on the runway by No. 1 engine as well as 8-mm cine films and 35-mm films taken by several persons on the roof of the airport terminal building. The moment necessary for such a movement was computed by conducting a theoretical analysis; and the moment theoretically obtained was compared with the moment which could possibly be caused by either control or malfunction of the mechanism. Through this process the following estimation could be reached:

At the time the tire trace of the right main landing gear started to be marked, the lateral control was operated right to the fullest extent or adjacent thereto in one of the situations below.

- (a) The rudder was in the neutral position in case No. 1 engine had no thrust.
- (b) The rudder was operated somewhat right in case Nos. 1 and 2 engines both had no thrust.

- (c) The rudder was operated left to the fullest extent or adjacent thereto in cause imbalance in thrust did not exist between the port and the starboard engines.

During the period from the time the right main gear started to go off the ground to the time the tire trace of the gear disappeared after several bounces, the lateral control was operated right to the fullest extent or adjacent thereto in either of the situations below.

- (a) The rudder was operated left to the fullest extent in case No. 1 engine had no thrust.
- (b) The rudder was operated about 2/3 to the left in case Nos. 1 and 2 engines both had no thrust.

At the time the tire trace of the right main gear disappeared, the aircraft was in such a condition that the rolling moment to the left resulting from the right side-slip could not be counteracted by the aileron and flight spoilers.

The major reason why such a considerable rolling moment was produced is that the side-slip angle increased abruptly due to yawing acceleration immediately after the tire trace of the right main gear started to be marked.

In order to cause such a considerable side-slip it would be necessary for No. 1 or possibly both Nos. 1 and 2 engines to lose their thrust and at the same time considerable rudder be applied to the left.

2.- Analysis and Conclusions

2.1 Analysis

The investigation of qualifications and working conditions of the flight crew as well as the autopsy of their remains revealed no evidence related to the cause of the accident.

The pilot-in-command Harano had received a captain route qualification check including an item for emergency operations two times every year. According to the record of the check made ten times during a period of December 1961 to August 1966, he obtained "excellent" or "above average" marks for every item including one engine out take-off, with the overall evaluation also of the same mark. It is recognized from the record that his manoeuvring ability was excellent.

Both of the other two pilots had completed transition training from co-pilot of DC-6B to that of Convair 880-22M and a report of the instructor in charge indicates that their records were "average", although a tendency was noted in the training that both of them were slightly slow in acquiring proficiency.

The flight engineer received an "above average" mark at a company periodic check conducted on 28 March 1966.

Most of the hydraulic system including piping and hoses were burnt and could not be investigated. However, the investigation of each engine-driven hydraulic pump revealed no malfunction of Nos. 1, 2 and 4 pumps excepting No. 3 pump damaged by fire. (Hydraulic pressure sources of the rudder and spoilers are Nos. 1 and 2 pumps.)

Most of both the fuselage portion from the cockpit to rear pressure bulkhead and the left and right wings were damaged by fire or burnt, and therefore it was impossible to ascertain whether their components functioned normally or not. It was, however, recognized from positions of the screw jacks that the horizontal stabilizer, slats, leading edge flaps and trailing edge flaps were in take-off positions.

Although major parts of the lateral control system were burnt, it is estimated to have been in operation judging from the photograph.

With regard to the rudder system, the jack screw of the rudder trim tab overrode the extreme nose-right position and stuck there. A tear-down investigation revealed a deep scratch in the housing made by the cable pulled to the nose-right position. From this, it was estimated that the rudder trim tab having been at the extreme nose-right position resulted from the cable having been abruptly pulled at the time of the destruction. The control system such as the pedal force amplifier and cables was damaged by fire or burnt and therefore could not be investigated. No discrepancies, however, could be found on functional parts of the rudder such as the rudder control valve and rudder actuator which were not damaged by fire.

In a functional test conducted on the rudder control valve, the relation between cylinder port pressure of the control valve and load on the control cable was measured under a hydraulic system pressure of 3 000 psi. The test indicated that the cylinder port pressure was 2 500 to 2 700 psi even where load on the control cable was high. Judging from the result that the highest hydraulic pressure applied to the rudder actuator is 2 500 to 2 700 psi, it may have been possible for the rudder to move opposite to the direction to which the rudder was intended to be operated due to the blow-back effect if a pressure in excess of the above values was applied from the part of the rudder. Furthermore, the fact that the rudder and rudder flight tab were both displaced to the left around the time the aircraft reached taxiway C-4 could be attributable to the mechanism of the rudder control system by which such situation results when an external force is applied to the rudder from the right while the right pedal is being operated.

Investigation was also made on wreckage of the elevator system, but no discrepancies were found.

With regard to the landing gear, investigation was made on wreckage of the struts, steering units, wheels, brakes and tires, but no discrepancies were found.

With regard to the engines, it was estimated that Nos. 2, 3 and 4 engines were developing higher thrusts than No. 1 engine, judging from the evidence of lengths of variable stator vane actuator rods, soil sucked in, dispersion of turbine blades and bent of compressor blades. A tear-down investigation revealed no discrepancies of Nos. 1, 3 and 4 engines leading to a drop in thrust.

In the compressor section of No. 2 engine was discovered an amount of small pieces of the stub duct seal (made of silicone rubber) together with soil. In the combustion and turbine sections were also discovered white powder produced as a result of burning of the stub duct seal. The majority of small pieces of the seal were burnt in sections (Nos. 4, 5 and 6 combustion liners) located below the engine and a large amount of the white powder resulting from burning of the seal was found adhered to the rear external surface of Nos. 4, 5 and 6 combustion liners. From the facts that the small pieces were discovered together with soil in the compressor section and that they were burnt in the sections which were located below the engine, it was estimated that most of the seal and

soil were sucked in simultaneously when the air intake flow became low. It might also be conceivable that a portion of the seal was sucked in before the aircraft deviated from the runway. No determination was made on the degree to which the engine thrust was influenced in case a portion of the seal was sucked in.

A quality test conducted on samples taken from a tank (San Ai Oil Co. Tank No. 33) which supplied fuel to the accident aircraft as well as the fuel filter of No. 1 engine indicated that the fuel met the specifications.

In view of testimony that the pilot-in-command was in the right-hand seat and pilot Daikoku was in the left-hand seat when the aircraft left the parking area, testimony that communication with the ATC unit was maintained by the pilot-in-command, locations where the crew's remains were found, and the purpose of the flight, it was estimated that pilot Daikoku was in the left seat and was in control of the aircraft.

The flight history of JA 8030 was estimated as follows, judging from the cine films and photographs, tire traces and testimony:

The aircraft waited for a take-off clearance from the ATC unit while holding near the runway threshold marking of runway 33R and started the take-off run at approximately 1428 hours.

It was estimated that the aircraft was not in a specific abnormal condition during take-off run prior to reaching a nose-up attitude.

From around the time of the nose-up, the aircraft began to make a right side-slip with somewhat yaw to the left. The tire traces on the runway started to be marked from a point of approximately 1 400 m from the threshold marking for the right main gear and approximately 1 430 m for the left main gear. The trace of the right main gear terminated at approximately 1 530 m, thereafter only the trace of the left main gear remained and ended at approximately 1 600 m. Meanwhile, the trace made by No. 1 engine began at approximately 1 600 m.

At the time the trace of the right main gear started to be marked, the aircraft was at the right of the runway centre line (the left main gear was almost on the runway centre line), yawed to approximately 5° left (a side-slip angle of approximately 8°), and was rolling gradually left with an initial bank angle of approximately 2° right. Furthermore, yawing to the left started to increase when the tire trace of the right main gear began to be marked on the runway.

During a period of approximately 0.5 second in which the right main gear began to go off the ground and thence bounced several times, the aircraft approached the runway centre line, and yawed left to approximately 7.5° to 10° (a side-slip angle of approximately 10° to 12.5°) with a bank angle of 0° to 1.5° left, and thence rolled left abruptly.

After No. 1 engine came into contact with the ground, the aircraft deviated from the runway with both main gears off or almost off the ground, further continued side-slip with some yaw to the left, crossed taxiway C-4, increased the yaw gradually to approximately 145° left in reference to the runway bearing while proceeding in a direction of approximately 35° left in reference to the runway bearing, thence yawed right and continued side-slip. During this period the aircraft was in a nose-up attitude, but thereafter went abruptly into a nose-down in such an attitude as to make impact with the ground, and the left main gear, nose gear, engines, etc. were separated from the airframe. Immediately prior thereto a fire occurred near No. 3 engine.

On check flights for type rating the outboard engine is usually idled at the time of initial take-off. In the light of the flight history already described, it would be inconceivable that No. 4 engine was idled. Also, the pilot-in-command Harano made another flight on the morning of the accident with another pilot for a periodic check of a captain route qualification. Testimony of various kinds on this flight as well as the analysis of a film of the take-off taken for an aviation movie revealed that No. 1 engine was idled by him on the same runway and in the same adverse right cross-wind conditions. From the above evidence, it was considered that No. 1 engine was idled during the fatal take-off.

As mentioned in paragraph 1.15 above, the fact that a considerable left rudder was used might be attributed to excess, delay, or error in control due to difficulties in maintaining the heading during take-off with a cross-wind of 11 kt when one outboard engine was idled. Malfunctions of the rudder actuating mechanism may also be conceivable, but no evidence was found on both the above possibilities.

From a computation based on the 8-mm cine film, it was estimated that the aircraft was unable to be airborne although it had reached a speed high enough.

Evidence of the tire trace where it began to be marked on the runway indicated either that the aircraft was nearly airborne or that the distance off the ground was very slight, if any. This may be attributable to increase in drag and loss in lift due to the fact that flight spoilers were in operation combined with action to lower the right wing for correcting the side-slip of the aircraft at that time.

2.2 Conclusions

(a) Findings

No evidence related to the cause of the accident could be found from qualifications, working conditions and others of the flight crew.

No evidence related to the cause of the accident could be found from investigation of the aircraft wreckage.

It was recognized that JA 8030 was flown by pilot Daikoku in the left-hand seat.

It was estimated that the aircraft was taking off with left rudder and right wing down to counteract a cross-wind from the right.

It was estimated that No. 1 engine was idled around the time V_R was reached.

Although it was estimated that the left rudder was in operation around the time No. 1 engine was idled, it was not clear why and when the rudder came to operation.

It was estimated that the aircraft was in a right side-slip conditions at the time the tire trace of the right main landing gear started to be marked.

It was estimated that, at the time the tire trace of the right main landing gear had disappeared, it became impossible for the crew to counteract by control the rolling moment to the left due to the right side-slip. It is also estimated that the rolling moment produced to a considerable extent resulted from an abrupt increase in side-slip angle due to yawing acceleration after the time the tire trace of the right main landing gear started to be marked.

(b) Cause or
Probable cause(s)

The reason for the uncontrollable left yaw was not determined.

Training
Take-off
Loss of control
Undetermined