

ATTACHMENT 1

**Reprint from Japanese accident report concerning speech analysis
(6 pages)**

AIRCRAFT ACCIDENT INVESTIGATION REPORT

Japan Air Lines Co., Ltd.
Boeing 747 SR-100. JA8119
Gunma Prefecture, Japan
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Aircraft Accident Investigation Commission
Ministry of Transport

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(Tentative Translation from
Original in Japanese)

that strength of cross wind and effect of gust component must be taken into account, but conclusion was that the landing on the Haneda runway was possible even if a portion of the vertical fin and the rudder were lost, provided control functions of the aileron system and the elevator system remained normal.

Failure Configuration ④

In all cases except for one example in which landing on Haneda Runway 33R was tried, landing on the runway was given up, and a water landing was selected. Water landings were possible with an airspeed slightly over 200 knots, if functions of the aileron and spoiler system had remained normal. However, the variation in pitch angle at touchdown is of considerable amount.

Failure Configuration ④'

In failure configuration ④' where only the elevator system remains effective, the captains gave up landing on the runway, and instead tried a water landing. The simulation test indicated that water landings were possible with an airspeed under 200 knots, a rate of descent under 300 feet per minute, and a pitch angle over 3°.

3.1.9 Voice Analysis of CVR Record

(1) Stress estimated from CVR Record

Many studies have been reported on the correlation between stress and the voice fundamental frequency of pilots and other crew members. An analysis was conducted to estimate stress of the crew of the accident aircraft from their voice record based on a method developed by Aeromedical Laboratory of Air Self-Defense Force (*Note).

The voice fundamental frequency is the frequency per second of vibration of the vocal cords, and it is said there is a difference of about one octave between man and woman. In this analysis, 150 Hz for man and 240 Hz for woman, which are said to be voice fundamental frequencies in normal conversations of the Japanese, were taken as standard frequencies.

Table-8 is a grade table by which to evaluate a stress, in case it was caused, into grades (1) to (9) with reference to increase of the voice fundamental frequency over the standard frequencies.

Although a great number of the crew's voices are recorded in CVR and ATC communication record, the analysis was carried out on 67 cases of voice communication in the following six flight segments set up in the light of change in flight situation of the accident aircraft, and others:

- A. departure
- B. immediately before the abnormal situation occurred
- C. immediately after the abnormal situation occurred
- D. about 15 minutes after the abnormal situation occurred
(altitude about 22,000 feet)
- E. about 25 minutes after the abnormal situation occurred
(altitude about 9,000 feet)
- F. immediately before crash

Results of the analysis are shown on Table-9.

(*) Note Kuroda, I., O. Fujiwara, N. Okamura, and N. Utsuki. Method for determining pilot stress through analysis of voice communication. Aviation Space and Environmental Medicine. 1976

(a) Stress until the Sound like "bang" occurred after Take-off (see Table-9)

Stress of the captain, as estimated from voice in ATC communication record during a climb from take-off at Haneda till 1818:38 hours, varies within grade (1) to (3) of the 9 grade system. Such degrees of stress are considered normal in a take-off to climb step, and there would be less possibility that at this time the captain was cognizant of occurrence of some abnormality.

The CVR record of the accident aircraft starts with a intercom. call from a cabin attendant to the cockpit at 1824:12 "Someone want to do. May I permit it?". The stress estimated from this female voice is grade 3 as shown in Table-9, and judging from her collected way of talk, there would be less possibility that at this time the cabin attendant was cognizant of some abnormality.

Stresses of (5) to (7) of the 9 grade system were estimated from voices of the flight engineer and the copilot answering to the ordinary request of the cabin attendant. These figures indicate high stress considered somewhat abnormal under the normal flight condition. Therefore, it is conceivable that the flight crew had perceived at this time some trend of such an abnormality as to raise their stress.

(b) Stress after the Sound like "bang" occurred

The stress, as estimated from voices of the captain, copilot and flight engineer immediately after the sound like "bang" occurred, varied within grade (6) to (8), and thereafter gradually increased its extent repeating some variation up to grade (9) immediately before the crash. Such change in stress would be considered natural in view of the fact that the accident aircraft fell into, so to speak, the most unfavorable emergency condition.

(2) Hypoxic Hypoxia as reviewed from CVR Record

According to CVR record, the altitude alert of the passenger cabin rung for about one second from 1824:37 immediately after the sound like "bang" was heard, and after an interruption of 26 seconds resumed to ring until 1847:28 at which time the altitude became less than 10,000 feet. It is, however, estimated that the flight crew did not wear the oxygen mask, judging from the fact that voices of the crew were recorded on CVR through the microphone for picking up sounds within the cockpit (hereinafter referred to as "area mike"), which should have been impossible if they had perceived the depressurization within the airframe by the alert sound and had put on the mask.

An investigation was made on any possible symptom of hypoxic hypoxia to the flight crew who are estimated from CVR record to have flown for about 18 minutes without wearing oxygen mask under no pressurization at altitudes more than 20,000 feet. The results were as follows:

As seen in Table-9, there are many entries of the remark "unclear" in column "maximum of voice fundamental frequency" of Section D of the table. The entry means that in this portion high harmonics of the voice fundamental frequency are unclear, which is said to be symptomatic of hypoxic hypoxia. The unclear harmonics may have been caused by hypoxic hypoxia they suffered from. The following are a list-up of portions regarded as hypoxia-related in CVR voice record. (see Attachment-6).

(a) The volume of conversation between the captain and the copilot from the latter half of 18 hours 29 minutes through 36 minutes was remarkably little, and the conversation among the flight crew was also extremely little from 18 hours 40 minutes to the first half of 43 minutes. (It is noted that after about 1845 when the flight altitude became less than 20,000 feet the conversation within the cockpit started to increase, and their answer was made to calls from the ground)

(b) Although it was suggested by the flight engineer twice about 1833:50 to wear the oxygen mask, the captain disregarded it, just replying "yes" in either case.

(c) They did not respond to call made by Japan Air Tokyo 4 times during 1833 to 1843. In this connection, about one minute was necessary for the crew to decide to which of Tokyo and Osaka they were to answer.

(d) For about one minute after about 1835 the tone of voice of the captain had been extremely raised.

Table-8 Stress (Grade) Conversion Table

Stress (Grade)	Voice Fundamental Frequency (Hz)	
	Male	Female
(1)	— 150	— 240
(2)	151 — 164	241 — 262
(3)	165 — 182	263 — 290
(4)	183 — 201	291 — 322
(5)	202 — 228	323 — 365
(6)	229 — 261	366 — 418
(7)	262 — 308	419 — 492
(8)	309 — 374	493 — 598
(9)	375 —	599 —

Grade (1)–(3) represent degrees of stress caused generally under normal conditions.

" (4)–(6) represent degrees of stress caused generally under conditions somewhat abnormal but not yet reaching an emergency.

" (7)–(9) represent degrees of stress caused generally under an emergency. From past examples, it has been accepted that cool-headed disposition or judgement would become difficult to do under stress(9).

Table-9 Stress Analysis Table (Reference Material - Addendum 6)

Time Zone	No.	Time	Utterer	Content of Utterance	Maximum Voice Fundamental Frequency and Stress Grade
A	1	17:53:17	CAP	Ah TOKYO clearance JAPAN AIR 123	136Hz(1)
	2	:59:38	CAP	Clearance delivery JAPAN AIR 123--	154 (2)
	3	18:03:43	CAP	Roger JAPAN AIR 123, 15 left	165 (3)
	4	:07:43	CAP	Alfa 4 A runway to charlie 7---	150 (1)
	5	:09:45	CAP	Into position and hold 15-----	150 (1)
	6	:12:24	CAP	Roger JAPAN AIR 123	138 (1)
B	7	:16:35	CAP	Roger own navigation direct ah---	162 (2)
	8	:16:55	CAP	TOKYO CONTOROL JAPAN AIR 123 passing ---	168 (3)
	9	:18:38	CAP	Present position direct SEAPERCH--	170 (3)
	10	:24:12	STW	Someone want to do. May I permit it.	267 (3)
	11	:" :15	COP	Be careful.	250 (6)
	12	:" :16	F/E	Ok, be careful please.	290 (7)
	13	:" :17	COP	Quick..	220 (5)
	14	:" :18	STW	Yes, thank you.] simultaneously	300 (4)
	15	:" :18	F/E	Be careful please.] recorded	210 (5)

C	16	:24:35		"Bang"	250 (6)
	17	:":39	CAP	Something exploded?	290 (7)
	18	:":42	CAP	Squawk 77	260 (6)
	19	:":43	COP	Gear door	240 (6)
	20	:":43	CAP	Check gear. gear.	300 (7)
	21	:":44	F/E	What	270 (7)
	22	:":44	CAP	Check gear. gear.	270 (7)
	23	:":46	CAP	Engine?	260 (6)
	24	:":47	COP	Squawk 77	320 (8)
	25	:":48	F/E	All engine. . .	275 (6)
	26	:":51	COP	Look at this.	
D	27	:38:29	CAP	Use both hand. both hand.	unclear
	28	:":30	COP	Yes.	"
	29	:":32	F/E	How about gear down? Gear down.	340 (8)
	30	:":34	COP	Shall we gear down?	unclear
	31	:":45	CAP	Doesn't work. Gear doesn't go down.	"
	32	:":54	CAP	Lower the nose.	"
	33	:":55	COP	Yes.	"
	34	:39:13	F/E	Shall I lower it slowly by alternate?	"
	35	:":18	CAP	Yes. wait a moment.	350 (8)
	36	:40:00	CAP	Ah. lower the nose.	240 (6)
	37	:":01	COP	Yes.	300 (7)
	38	:":22	F/E	I have lowered the gear.	240 (6)
	39	:":23	COP	Yes.	280 (7)
	40	:":41	CAP	Lower the nose.	210 (5)
	41	:":42	COP	Yes.	332 (8)
	42	:41:00	CAP	Lower the nose.	320 (8)
	43	:":01	CAP	Never mind that.	unclear
	44	:43:23	CAP	Lower the nose.	"
	45	:44:22	CAP	Is the wheel pushed all the way?	"
	46	:":23	COP	All the way. it's all the way.	
E	47	18:47:53	CAP	We'll hit a mountain!	330 (8)
	48	:":	COP	Yes.	250 (6)
	49	:47:59	CAP	Max. power.	300 (7)
	50	:48:00	COP	Max. power.	280 (7)
	51	:":02	F/E	Keep trying.	354 (8)
	52	:":10	CAP	Left turn. this time.	362 (8)
	53	:":19	CAP	Ah. right right. lower the nose.	368 (8)
	54	:":23	CAP	Lower the nose.	400 (9)
	55	:":25	COP	Wheel is pushed all the way.	325 (8)
	56	:":51	COP	Shall I increase power?	280 (7)
F	57	:55:44	CAP	Hey. halt the flap.	326 (8)
	58	:":47	CAP	Flap. stop crowding together.	400 (9)
	59	:":56	CAP	Power.	370 (8)
	60	:":58	CAP	Flap.	410 (9)
	61	:":59	F/E	It is up.	318 (8)
	62	:56:04	CAP	Raise the nose.	360 (8)
	63	:":07	CAP	Raise the nose.	400 (9)
	64	:":10	CAP	Power.	380 (9)