FLIGHT SAFETY FOUNDATION

Accident Prevention

Vol. 55 No. 9 For Everyone Concerned with the Safety of Flight September 1998

Misloaded Douglas DC-8 Pitches Up Excessively On Takeoff, then Stalls and Strikes the Ground

The cargo was not loaded aboard the airplane according to the airline's instructions. As a result, the flight crew inadvertently used a horizontal-stabilizer-trim setting that was not correct for the airplane's aft center of gravity.

FSF Editorial Staff

On Aug. 7, 1997, Fine Airlines (Fine Air) Flight 101, a Douglas DC-8-61, stalled on takeoff and struck the ground approximately 3,000 feet (915 meters) from the end of Runway 27R at Miami (Florida, U.S.) International Airport. The three flight crewmembers, a security guard aboard the airplane and one person on the ground (a motorist) were killed.

The U.S. National Transportation Safety Board (NTSB), in its final report, said, "The accident … resulted from the airplane being misloaded to produce a more aft center of gravity and a correspondingly incorrect stabilizer-trim setting that precipitated an extreme pitch-up at rotation."

NTSB said that the probable causes of the accident were:

- "The failure of Fine Air to exercise operational control over the cargo-loading process; [and,]
- "The failure of [Aeromar C por A, a freight-forwarding company] to load the airplane as specified by Fine Air."

"Contributing to the accident was the failure of the [U.S.] Federal Aviation Administration (FAA) to adequately monitor Fine Air's operational-control responsibilities for cargo loading and the failure of FAA to ensure that known cargo-related deficiencies were corrected at Fine Air," said NTSB.

The accident airplane was one of 23 DC-8s operated by Fine Air, a U.S. supplemental airline that, at the time of the accident, transported cargo in the United States, Central America and the Caribbean.

Flight 101, from Miami to Santo Domingo, Dominican Republic, originally was scheduled to be flown using another Fine Air DC-8, N30UA. The flight was rescheduled to be flown using the accident airplane, N27UA, when N30UA was delayed en route to Miami.

Flight 101 originally was scheduled to depart from Miami at 0915 local time. N27UA arrived in Miami on a flight from San Juan, Puerto Rico, at 0931. Fine Air contacted a replacement flight crew for N27UA at 1000 and told them to prepare for a 1200 departure.

The captain, 42, was hired by Fine Air in October 1993. He had 12,154 hours of flight time, including 2,522 hours as a Fine Air DC-8 captain.

NTSB said that in 1995 the captain's airman certificate and medical certificate were suspended by FAA for 30 days because he had failed to report a revocation of his motor-vehicle driver's license. "FAA records indicated that the captain was convicted for 'misdemeanor drunk driving' in California in 1986 and convicted for 'driving under the influence' in Arizona in 1994," said NTSB.

Douglas DC-8-61

The DC-8 was the first jet transport manufactured by Douglas Aircraft Co. Production began in 1959. The first five versions of the airplane — the series 10, 20, 30, 40 and 50 — had the same overall dimensions. The DC-8-61, introduced in 1965, is 36.7 feet (11.2 meters) longer than its predecessors and can carry up to 251 passengers and four crewmembers.

The freighter version of the DC-8-61 has a cargo capacity of 8,810 cubic feet (247 cubic meters). The upward-hinged cargo door on the left side of the forward fuselage is 11.7 feet (3.6 meters) wide and 7.1 feet (2.2 meters) high. The airplane can accommodate 18 cargo pallets. The pallets are moved through the cabin on rollers and guide rails, and locked into position on floor tracks.

The airplane has four Pratt & Whitney JT3D-3B turbofan engines, each rated at 18,000 pounds (8,165 kilograms) thrust. Maximum takeoff weight (MTOW) is 335,000 pounds (151,956 kilograms). Maximum landing weight is 240,000 pounds (108,864 kilograms).

Balanced field length at MTOW is 10,560 feet (3,220 meters). Rate of climb at sea level is 2,270 feet (692 meters) per minute. Maximum cruising speed is 504 knots. Normal range with maximum payload is 4,997 nautical miles (9,254 kilometers). Landing distance at maximum landing weight is 6,140 feet (1,873 meters).

Source: *Jane's All the World's Aircraft*

"An October 29, 1995, report from a psychologist to FAA concluded that 'it is clear from both written objective testing and subjective clinical interviews that [the captain] is not an alcoholic [or] a habitual problem drinker,'" said NTSB.

The first officer, 26, was hired by Fine Air in August 1994. He had 2,641 hours of flight time, including 978 hours as a Fine Air DC-8 flight engineer and 614 hours as a Fine Air DC-8 first officer. He did not have (nor was he required to have) a DC-8 type rating.

The flight engineer, 35, was hired by Fine Air in September 1996. He had 1,570 hours of flight time, including 683 hours as a Fine Air DC-8 flight engineer. NTSB said that he had failed his first oral examination and practical examination for the flight-engineer certificate. He subsequently completed requirements for the certificate in May 1996.

Fine Air and Aeromar C por A (Aeromar), a Dominican Republic company, had a written agreement that made Fine Air responsible for providing the airplane, crew, maintenance and insurance, and that made Aeromar responsible for providing fuel and for loading and unloading the airplane.

(The written agreement was labeled a wet lease. Nevertheless, NTSB said that FAA attorneys determined that the written agreement was not a lease agreement, but a transportation agreement.)

The transportation agreement also made Fine Air responsible for supervising airplane servicing and said that Fine Air would maintain operational control of all flights.

U.S. Federal Aviation Regulations (FARs) Part 121 requires airlines to maintain operational control of their flight operations. The POI assigned to Fine Air told NTSB that this requirement applied to cargo loading, because the lease agreement made Fine Air responsible for supervising airplane servicing.

Nevertheless, Fine Air did not exercise operational control of cargo loading. "Although the terms of the [transportation] agreement … stated that Fine Air retained operational control, Fine Air managers stated that, before the accident, the company did not supervise loading operations carried out by Aeromar," said NTSB.

"In addition, Fine Air did not weigh palletized cargo delivered by Aeromar or have other procedures in place to verify cargo weights and the accuracy of the load form provided to the crew by Fine Air flight following."

Flight 101's cargo was denim fabric and accessories that were to be used for the manufacture of trousers in the Dominican Republic. A shipping document showed that the cargo weighed 89,719 pounds (40,697 kilograms).

Aeromar weighed the cargo on scales that produced a printed record of weights for billing purposes. The printed record showed that the cargo weighed 89,719 pounds. NTSB said that this confirmed the weight listed on the shipping document.

Aeromar then loaded the cargo onto pallets and weighed the loaded pallets on scales that did not produce a printed record. Aeromar manually recorded the weights. NTSB said that the pallet-loading form Aeromar provided to Fine Air showed a total palletized cargo weight of 88,923 pounds (40,336 kilograms).

“Fine Air did not use scales to verify the weight of [the loaded] pallets delivered by Aeromar,” said NTSB.

Based on the weights shown on Aeromar’s pallet-loading document, a Fine Air flight follower completed weight-and-balance calculations and a weight-distribution document for N30UA.

Aeromar had loaded the cargo onto 16 pallets. Figure 1 shows that the DC-8-61 can carry 18 cargo pallets. Each pallet measures 88 inches by 125 inches (2.2 meters by 3.1 meters).

The weight-distribution document showed that the loaded pallets were to be placed in position 1, positions 3 through 16, and position 18; no pallets were to be placed in position 2 or in position 17.

Weight-distribution Document Revised

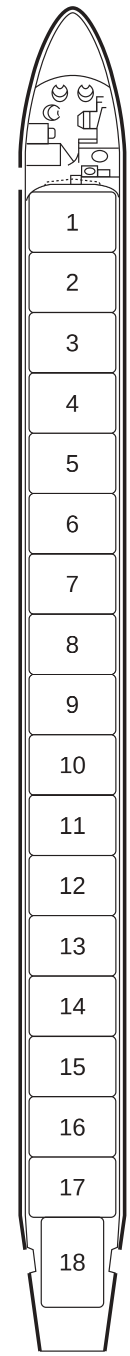
When the flight was rescheduled for N27UA, a heavier aircraft than N30UA, another Fine Air flight follower completed a new weight-distribution document showing that 1,000 pounds (454 kilograms) of cargo were to be removed from the pallet in position 10, and that the pallet in position 13 was to be relocated to position 17. The document showed that no pallets were to be placed in position 2 or in position 13.

Fine Air said that reducing the cargo weight by 1,000 pounds was necessary to comply with an airplane landing-weight limitation in Santo Domingo. Fine Air said that moving the pallet in position 13 to position 17 relocated the center of gravity (CG) aft to a location preferred by pilots because of the resulting airplane-handling characteristics.

NTSB said that such CG adjustments likely were being made because of errors on Fine Air’s DC-8-61 load sheet.

“One part of the [load sheet] that affected the CG calculation (the fuel-distribution scale) was based on data for DC-8-62 and -63 airplanes,” said NTSB. “The printed Fine Air load sheet also incorrectly listed the maximum weight allowable for pallet position 18 as 6,088 pounds [2,762 kilograms], instead of the correct weight of 3,780 pounds [1,715 kilograms].”

Douglas DC-8-61 Cargo Pallet Positions



Source: U.S. National Transportation Safety Board

Figure 1

NTSB said, “Calculations based on this form resulted in a computed CG that was farther aft than the actual CG.”

“The built-in CG errors could have accounted for reported flight-crew requests to Fine Air flight followers to provide more rearward CGs to improve the flying characteristics of their airplanes," said NTSB. "However, moving the CG aft would not correct the [attendant horizontal-stabilizer] mistrim, but would lighten control forces somewhat."

Weight-distribution documents prepared by Fine Air normally were picked up at the Fine Air flight followers' office by Aeromar security guards. NTSB said that the security guard assigned to Flight 101 was not informed that the flight had been rescheduled for a different airplane, and he did not pick up the revised weight-distribution document for N27UA.

The Fine Air flight follower who prepared the weight-distribution document for N27UA told investigators that he telephoned an Aeromar security guard (a different security guard from the one assigned to Flight 101) and informed him of the changes.

The security guard said that he conveyed the changes, by telephone, to Aeromar's operations manager, who was at home. The operations manager instructed the security guard to change the pallet-loading document to reflect the 1,000-pound cargo reduction. The operations manager said that he would issue an order to remove the 1,000 pounds of cargo when he arrived at work.

"The Aeromar operations manager told … investigators that he forgot to issue the order to remove the 1,000 pounds of cargo when he arrived at work at 1000, and that the weight was not removed," said NTSB.

Loading Personnel Trained on the Job

NTSB said that the security guard assigned to Flight 101 instructed the cargo handlers to load the airplane according to the weight-distribution document for N30UA.

Five cargo handlers, the security guard and a supervisor employed by Aeromar loaded the airplane. A Fine Air loading supervisor assisted them.

"Four of the Aeromar cargo handlers had previous experience in air-cargo operations in Miami," said NTSB. "However, one cargo handler and the Aeromar loading supervisor had no experience in air-cargo operations before employment with Aeromar. The Aeromar loading supervisor was hired about three and a half months before the accident and had been promoted to supervisor about two weeks before the accident."

"Training for loading personnel at Aeromar and Fine Air was described as on-the-job training," said NTSB.

Fine Air told investigators that it did not monitor Aeromar's loading of Fine Air airplanes, and that the Fine Air loading supervisor was not responsible for supervising the loading of Flight 101.

"The Aeromar loading supervisor asked the Fine Air loading supervisor to drive the forklift, and he agreed to assist the Aeromar loading crew," said NTSB.

NTSB said that the first cargo pallet was loaded at 1030 and the last cargo pallet was loaded at 1206. The cargo handlers then could not engage the locks on several pallets, because cargo extended over the ends of the pallets and prevented the pallets from being positioned close together.

"In an attempt to correct this, all pallets from position 5 aft were pushed back one position each, which resulted in pallet position 17 being filled and position 5 being emptied," said NTSB. Also, the pallet in position 4 was turned 90 degrees and moved back, so that it occupied all of pallet position 5 and part of pallet position 4.

Thus, the airplane was not loaded in compliance with either the weight-distribution document for N30UA or the weight-distribution document for N27UA.

"When it became evident to the loading crew that the cargo would not secure properly, decisions were made about pallet positioning and load security that suggest a desire to complete the job quickly," said NTSB. "Little or no attempt was made to determine whether these changes would adversely affect the airplane in flight."

The cargo loaders told investigators that locks were engaged on the pallets in position 1 and position 3. The pallet that was turned and pushed back to occupy position 5 and most of position 4 was tied down, and locks were engaged in front of the pallet.

NTSB said the cargo loaders gave contradictory statements about the number of locks engaged on the pallets in position 6 through position 18.

"The Aeromar loading supervisor stated that he crawled back aft to pallet position 18 and put up several locks," said NTSB. "He stated that he was depending on other loaders to make sure locks were up between [other] pallet positions. According to the supervisor, it was hot and difficult to breathe in the cabin."

NTSB said that the Fine Air aircraft operating manual required the flight engineer during his airplane preflight inspection to verify that at least three locks were engaged on each cargo pallet.

Nevertheless, Fine Air's director of operations told investigators that "it would be unusual" for the flight engineer or another crewmember to crawl back over pallets to the rear of the airplane to ensure that the pallet locks were engaged.

"Fine Air's chief operating officer testified that such a check 'is a highly improbable situation' and that an element of trust existed between the loading supervisor and the flight crew that the locks had been properly locked," said NTSB.

"Other company personnel indicated that, in Miami, airplanes were typically loaded before flight crews arrived and some loads did not provide sufficient clearance for the flight engineer to verify the status of the locks in positions aft of the cargo door," said NTSB.

Load Sheet Showed Incorrect Trim Setting

The flight crew's load sheet showed that the cargo weighed 87,823 pounds (39,837 kilograms). This reflected the 1,000-pound reduction intended to meet the landing restriction and a 100-pound (45-kilogram) error in recording the weight of one pallet from the Aeromar pallet-loading form, which showed a cargo weight of 88,923 pounds.

The load sheet also showed that the CG was located at 30.0 percent mean aerodynamic chord (MAC) and that the appropriate horizontal-stabilizer-trim setting was 2.4 units nose-up.

NTSB said that these data were not correct.

NTSB was not able to reconstruct precisely the airplane's loading. "The succession of errors made by Fine Air and Aeromar in loading this flight and the deficiencies in the Aeromar and Fine Air loading procedures … made it impossible to precisely determine the weight and CG from the data that were available following the accident," said NTSB.

"For example, the cargo destined for the accident airplane was listed as weighing 89,719 pounds when it arrived at Aeromar's warehouse. … Pallets and netting added an additional 275 pounds [125 kilograms] per pallet (or about 4,400 pounds [1,996 kilograms] to the total cargo weight).

"Based on postaccident Aeromar statements that the entire cargo delivered to Aeromar was loaded onto pallets for shipment on the accident airplane, the actual cargo weight could have been at least 94,119 pounds [42,692 kilograms]."

Based on a cargo-and-pallet weight of 94,119 pounds, and on evidence of how the loaded pallets might have been distributed in the airplane, NTSB and Douglas Products Division calculated a CG of 32.8 percent MAC.

NTSB said that the appropriate horizontal-stabilizer-trim setting for a CG of 32.8 percent MAC was 0.9 units nose-up.

(NTSB also said that the cargo might have weighed more than 94,119 pounds, and that the airplane's CG might have been at the aft limit or beyond the aft limit. The aft CG limit is 33.1 percent MAC.)

The airplane did not have a sum total aft and nose (STAN) system, which provides a cockpit readout of gross weight and CG. "If the flight crew had had an independent method for verifying the accident airplane's actual weight and balance and gross weight in the cockpit, it might have alerted them to the loading anomalies, and might have prevented the accident," said NTSB.

The cockpit-voice-recorder (CVR) transcript shows that the flight crew set the stabilizer trim to 2.4 units while taxiing to the runway at 1234:15. Thus, the stabilizer trim inadvertently was misset by at least 1.5 units (2.4 units listed on the load sheet minus 0.9 units calculated by NTSB and Douglas).

"Such a mistrim would cause a greater-than-expected nose-up pitching moment," said NTSB. "This would be exacerbated by the lighter control-column forces that result from an aft CG location."

Pitch-control Problem Occurred on Rotation

Visual meteorological conditions existed, with 10 statute miles (16 kilometers) visibility and scattered clouds at 3,000 feet. Surface winds were variable at six knots. The temperature was 90 degrees Fahrenheit (32 degrees Celsius), and the dew point was 75 degrees Fahrenheit (24 degrees Celsius).

The CVR shows that the first officer radioed the airport ground controller at 1232:59 for taxi clearance. The controller cleared the crew to taxi to Runway 27R.

"During the approximately one-minute taxi, the flight crew … performed a flight-control check," said NTSB. The crew conducted an elevator check at 80 knots during the takeoff roll.

"Statements recorded on the CVR indicated that the flight crew recognized a problem with airplane handling about the pitch axis immediately as the airplane rotated," said NTSB.

At 1235:49.9, the captain said, "Rotate."

At 1235:51.5, the captain said, "Easy, easy, easy, easy."

The flight data recorder (FDR) showed that the first officer, the pilot flying, continued moving the control column aft.

"The first officer's continued aft column input for two seconds after the captain began his 'easy, easy, easy, easy' remark exacerbated the pitch-up that was developing from the mistrimmed stabilizer," said NTSB.

"However, the first officer's two-second response time in responding to the captain was understandable in light of the

Cockpit Voice Recorder Transcript, Fine Airlines Flight 101, Aug. 7, 1997

(FSF editorial note: The following portion of the transcript, which begins as the crew calls for taxi clearance, is as it appears in the U.S. National Transportation Safety Board accident report, except for minor column rearrangement and addition of notes defining some terms that may be unfamiliar to the reader.)

1234:28	**RDO-2**	Fine Air one oh one is ready for takeoff two seven right.
1234:30	**CAM-1**	I got this guy.
1234:31	**TWR**	Fine Air one oh one's traffic's five mile final seven four seven two seven right fly heading two seven zero cleared for takeoff.
1234:35.9	**RDO-2**	cleared for take off two seven right Fine Air one oh one heavy.
1234:36.6	**CAM-1**	below the line please.
1234:39.7	**CAM-3**	anti skid.
1234:40.0	**CAM-1**	on light's checked.
1234:42.2	**CAM-3**	stand-by rudder pump's on continuous ignition.
1234:42.8	**CAM-2**	all engines.
1234:43.9	**CAM-3**	transponder DME.
1234:44.4	**CAM-2**	on on.
1234:45.2	**CAM-3**	okay landing lights.
1234:46.1	**CAM-1**	they're on.
1234:47.0	**CAM-3**	okay checklist complete.
1234:50.0	**CAM-1**	this guy's pretty pretty close to I think we'll need to take it rollin' he looks like he is closer than four miles to me I don't want him to go around, we're not that heavy anyway *.
1235:01.4	**CAM-1**	I'll just stand them up here, take it on the roll, okay you're spooled.
1235:02.1	**CAM**	((sound of increasing engine sounds)).
1235:07.6	**CAM-3**	okay four spooled and ah stable.
1235:10.6	**CAM-2**	max power.
1235:13.2	**CAM-1**	just like auto throttles.
1235:15.2	**CAM-2**	yeah.
1235:17.3	**CAM-2**	airspeed on the right.
1235:19.5	**CAM-1**	okay comin' up on sixty knots power's set.
1235:26.2	**CAM-1**	eighty, you got the steer on the rudders.

physiological, neurological and cognitive contributors to reaction time. Further, it is not clear that the flight crew would have recognized the need for abrupt, aggressive and sustained action at the initiation of the pitch-up."

At 1235:00, the first officer said, "What's goin' on?" He moved the control column forward, then aft again.

"In moving the control column forward and aft, the first officer might have been attempting to judge what nose-down control column inputs were required to correct the airplane's developing pitch-up attitude," said NTSB. "Application of immediate and forceful nose-down control inputs at rotation is counterintuitive and contrary to the training and experience of line flight crews."

The FDR showed that at 1235:57, the first officer moved the control column full forward. The CVR showed that he began to trim the horizontal stabilizer nose-down just before the first stall warning occurred at 1236:02. NTSB said that the airplane was at approximately 300 feet and had a 30-degree nose-up pitch attitude and a 20-degree wing angle of attack (AOA). (Stall AOA is about 15 degrees.)

"Although aggressive nose-down trim inputs were made thereafter and until the trim reached its full nose-down position, about a five-second delay occurred between the flight crew's first attempt to control the pitch-up with nose-down column inputs and the first inputs of nose-down trim," said NTSB.

"If the first officer had chosen to trim the airplane in the first, critical moments during and after rotation, he would have obtained a greater nose-down pitching moment and might have been able to correct most, or all, of the mistrim condition, preventing the airplane from stalling."

NTSB said that it considered whether the captain, a more experienced pilot than the first officer, might have applied nose-down trim earlier if he had been the pilot flying.

"Although [NTSB] was unable to determine precisely how far aft the CG was located and, thus, the extent to which the airplane was mistrimmed, [NTSB] concludes that the mistrim of the airplane (based on the incorrectly loaded cargo) presented the flight crew with a situation that, without prior training or experience, required exceptional skills and reactions that cannot be expected of a typical line pilot," said NTSB.

Airplane Entered Deep Stall

The first officer's control inputs resulted in a brief recovery from the stall when AOA decreased to 10 degrees. AOA then increased, and the airplane stalled again and descended to the ground at 1236:25.

"The ground scars and the airplane damage indicated that at impact, the pitch angle was about 23 degrees, while the flight path angle was about 26 degrees down," said NTSB. "This resulted in an AOA of at least 49 degrees at the time of impact, consistent with the airplane being in a deep stall."

NTSB said that the accident was not survivable. The airplane, valued at US$10 million, was destroyed by the impact and postimpact fire.

"Airplane wreckage and the postcrash fire destroyed 12 vehicles parked in front of a warehouse and retail stores," said NTSB. "The building front was damaged by fire, but did not sustain impact damage from the airplane wreckage. Damage and clean-up costs were estimated at $900,000."

Flight-crew toxicology tests produced negative results for a wide range of drugs, including marijuana, cocaine, opiates, phencyclidine and amphetamines.

NTSB said that there was no evidence of structural failure or flight-control failure, but there was evidence of a possible power loss:

- A Fine Air DC-8 captain who witnessed the takeoff said that he saw flames coming from the no. 4 (right outboard) engine;
- An air traffic controller who witnessed the takeoff said that he heard popping noises;
- The CVR transcript showed that about 13 seconds before the airplane was rotated for takeoff, the flight engineer said that the no. 4 engine temperature was rising; and,
- The accident airplane's logbook contained six reports in the 90 days preceding the accident that flight crews had to reduce power on the no. 4 engine to maintain engine temperature below the maximum limit.

Nevertheless, NTSB determined that all four engines were developing power at impact. "Popping noises and flames coming from one or more engines reportedly heard and seen by witnesses after takeoff, and engine performance data … were consistent with engine compressor surges induced by [interrupted airflow through the engine at the] extremely high AOAs," said NTSB.

NTSB also considered whether the cargo had shifted during the takeoff. The board said that there was evidence that only a few of the cargo-pallet locks were engaged.

"For example, 57 of the 60 locks recovered from the wreckage (from a total of 85 installed) were found in the unlocked position, and postaccident testing found no evidence of cracking, shearing or elongation associated with impact damage and failure," said NTSB.

1235:36.7	**CAM-3**	okay number four's is (heatin' up a little).
1235:39.6	**CAM**	((sound of thump)).
1235:43.1	**CAM-1**	vee one.
1235:47.3	**CAM**	((sound of thump)).
1235:49.9	**CAM-1**	rotate.
1235:51.5	**CAM-1**	easy easy easy easy.
1235:55.6	**CAM-1**	vee two.
1235:56.9	**CAM-1**	positive rate.
1235:58.7	**CAM-2**	gear up.
1235:00.0	**CAM-2**	what's goin' on.
1236:01.3	**CAM-1**	whoa #.
1236:01.7	**CAM-1**	##.
1236:01.8	**CAM**	((sound of trim-in-motion tone)).
1236:02.2	**CAM**	((sound of stick shaker starts)).
1236:02.8	**CAM**	((sound of trim-in-motion tone)).
1236:04.5	**CAM**	((sound of trim-in-motion tone)).
1236:05.6	**CAM**	((sound of trim-in-motion tone)).
1236:07.4	**CAM-1**	oh no # no.
1236:07.5	**CAM**	((sound of trim-in-motion tone)).
1236:08.8	**CAM**	((sound of trim-in-motion tone)).
1236:09.3	**CAM-1**	oh no # No.
1236:12.0	**CAM**	((stick shaker stops)).
1236:13.3	**CAM-1**	# # #.
1236:15.1	**CAM-1**	hold on hold on keep it light easy #.
1236:17.8	**CAM**	((stall warning starts and continues until end of recording)).
1236:17.6	**GPWS**	too low gear.
1236:19.2	**CAM-1**	oh #.
1236:19.4	**GPWS**	too low — terrain terrain.
1236:20.73	**CAM**	((sound similar to engine surge)).
1236:20.8	**CAM-1**	oh ##.
1236:20.81	**CAM**	((sound similar to engine surge)).
1236:20.88	**CAM**	((sound similar to engine surge)).
1236:21.9	**GPWS**	woop woop pull up.
1236:21.96	**CAM**	((sound similar to engine surge)).
1236:22.73	**CAM**	((sound similar to engine surge)).
1236:22.85	**CAM**	((sound similar to engine surge)).
1236:22.9	**CAM-2**	something — what's happening.
1236:24.5	**CAM-2**	oh no.
1236:25.4		end of recording.

RDO	=	Radio transmission from accident aircraft
CAM	=	Cockpit area microphone sound or source
-1	=	Voice identified as captain
-2	=	Voice identified as first officer
-3	=	Voice identified as second officer
TWR	=	Miami local controller (tower)
*	=	Unintelligible word
#	=	Expletive deleted
( )	=	Questionable text
(( ))	=	Editorial insertion
—	=	Pause
DME	=	Distance measuring equipment

Notes: All times are local. Only radio transmissions involving the accident aircraft were transcribed.

Source: U.S. National Transportation Safety Board

"However, when Aeromar loaders pushed all of the cargo pallets from position 5 rearward one position and turned pallet 4 sideways into position 5, this created a line of contiguous pallets from position 5 to position 18, the aftmost cargo pallet position in the airplane," said NTSB.

"This suggests that the misloaded, aft-heavy condition existed at the time of rotation and was not caused by cargo shifting as the airplane's deck angle increased. However, based on load statements that cargo extended over the sides of some pallets (which prevented the locks from being engaged), some shifting of cargo … might have occurred as the airplane's deck angle increased."

Postaccident Investigation Revealed Loading Problems

NTSB said that preaccident inspections of Fine Air by the U.S. Department of Defense (DoD) and by FAA had identified problems in cargo-loading procedures and weight-and-balance documentation.

A DoD inspection in September 1994 revealed load-manifest discrepancies and resulted in DoD's rejection of Fine Air's application to transport cargo for the U.S. Air Mobility Command (AMC).

A ramp check in April 1995 of four Fine Air DC-8s by an FAA regional aviation safety inspection program (RASIP) team revealed unsecured cargo and an illegible cargo-lock placard.

A DoD inspection in January 1996 revealed load manifest discrepancies. "The [DoD] report stated, 'Checked six packages of required flight documentation — noted a discrepancy on three load sheets for [a] DC-8-61 in one package,'" said NTSB. Nevertheless, DoD concluded that Fine Air met AMC quality and safety requirements.

An FAA national aviation safety inspection program (NASIP) team discovered in April 1997 that Fine Air had no standards or schedules for calibrating the scales used to weigh cargo. The NASIP team also discovered that Fine Air's loading-schedule instructions did not include instructions for calculating weight and balance.

NTSB said that FAA inspectors assigned to Fine Air did not ensure that the deficiencies revealed by these investigations were corrected.

"The manager of FAA's Miami FSDO [flight standards district office] stated that he believed that FAA surveillance of Fine Air's operations was 'adequate' before the accident, but acknowledged that inspectors were 'concentrating their emphasis on other areas,' not on cargo loading," said NTSB.

NTSB said that one month before the accident, a Fine Air DC-8-54 was involved in a pitch-up incident during takeoff at Miami International Airport. The captain told investigators that the airplane began an uncommanded rotation at V_1 (defined at the time as takeoff decision speed).

"At V_R [rotation speed], the airplane rotated and became airborne without control inputs," said NTSB. "The captain stated that he used forward pressure and trim to maintain V_2 [takeoff safety speed] plus 10 knots."

The captain said that he retrimmed the horizontal stabilizer from 3.4 units nose-up to 1.5 units nose-down.

"The captain stated that he had no difficulty controlling the airplane after the trim adjustments were made [and that he] elected to continue to his destination [El Salvador]," said NTSB.

The captain did not make a written report of the incident, but he discussed the incident with Fine Air's director of operations. "The captain stated that the director of operations later discussed the event with the POI [FAA principal operations inspector] assigned to Fine Air and that the POI 'was satisfied with the explanation,'" said NTSB.

NTSB said that an FAA RASIP inspection of Fine Air after the accident revealed systemic weight-and-balance control problems. The inspection team observed the loading and unloading of several airplanes.

"The inspection team report stated that 'problems found in the area of weight and balance [included] ground handling, weighing of cargo, security of cargo on pallets, accuracy of individual pallet weights, and condition of pallets and nets used to restrain cargo,'" said NTSB.

The inspection team said that on Aug. 10, 1997, a Fine Air pilot reported that cargo pallets were loaded in his airplane "with no weights attached."

"[The pilot] also discovered an error in the calculation of CG on the weight-and-balance forms," said NTSB. "The flight was canceled."

"The RASIP team also investigated a Fine Air pilot report of a nose-heavy takeoff on Aug. 18, 1997," said NTSB. The inspection team found two different load sheets for the flight. One of the load sheets showed different pallet weights than the pallet weights shown on the weight-distribution document for the flight.

"The RASIP report concluded that because two load sheets existed for this flight, Fine Air did not have 'evidence that the aircraft [was] loaded according to an approved schedule that [ensured] that the aircraft [CG was] within approved limits,'" said NTSB.

The inspection team conducted a ramp check of N30UA. The team discovered several cracks and holes in the cargo-compartment floor, and that numerous areas of the floor were very soft. FAA advised Fine Air that the floor should be repaired. NTSB said that only one floor repair was made before the airplane was flown again. When the airplane returned to Miami, an inspection revealed the same floor discrepancies discovered during the ramp check.

NTSB said that the accident airplane's logbooks showed recurring maintenance problems regarding the engines, thrust reversers and cargo doors.

"Although none of these problems were factors in the accident, the safety board is concerned because the CAS [continuing analysis and surveillance] program was designed to alert operators to repeat deficiencies and to facilitate prompt corrective maintenance action in problem areas," said NTSB.

"Fine Air's CAS program was not as rigorous as its program description indicated, and failed to result in the correction of systemic maintenance deficiencies," said NTSB.

NTSB said that the accident airplane's logbooks also showed that flight crews logged all significant maintenance entries on return flights to Miami, where Fine Air's maintenance facilities were located.

"No significant entries were made at any outstation location," said NTSB. "The FAA PMI [principal maintenance inspector] assigned to Fine Air told … investigators that he had 'raised concerns' with Fine Air management about flight crews 'having all their problems on final in Miami,' adding that proving when the discrepancies actually occurred was impossible unless the inspector was accompanying the flight crew on an en route inspection."

NTSB said, "[There was] no evidence that corrective action was taken by the airline after the PMI raised his concerns to Fine Air management, and no evidence of further FAA follow-up on the matter."

NTSB said that it "is concerned that this return-leg logging practice … may be as widespread in the industry as it is difficult to verify [and] has become an unspoken and largely tolerated way of avoiding costly outstation repairs and flight delays."

Flight Data Recorder Provided Limited Data

NTSB said that its investigation of the accident was hampered by lack of information from the airplane's FDR.

The FDR was designed to record 11 data parameters, but recorded only five parameters: altitude, control-column position, magnetic heading, longitudinal acceleration and time.

The FDR did not record six parameters: engine-pressure ratio, airspeed, pitch attitude, roll attitude, vertical acceleration and microphone keying.

"The failure of the accident airplane's FDR to record six of the 11 required parameters of data hampered the … investigation into the pitch-up and stall events that resulted in the airplane's departure from controlled flight," said NTSB.

NTSB also said that the magnetic heading data recorded by the FDR were 180 degrees in error.

NTSB said that investigations of a number of other recent accidents have revealed FDR data-recording problems.[1] The accidents prompted NTSB in May 1997 (three months before the Fine Air accident) to recommend that FAA require examinations within 180 days of all 11-parameter FDRs to ensure that all data were being recorded properly.

In its June 1998 report on the Fine Air accident, NTSB said that FAA in December 1997 issued a flight standards bulletin containing FDR maintenance guidelines, and that FAA proposed requiring compliance with the maintenance guidelines when FDR tests are conducted during "C" checks. (C checks are among Part 121 continuing-maintenance-program requirements.)

The accident airplane's FDR had been tested during a C check in April 1997. (C checks of Fine Air airplanes were required every 3,300 hours or 36 months.) Fine Air's analysis of data downloaded from the FDR determined that all 11 data parameters were being recorded properly.

NTSB said that there was no requirement to document the FDR test, and that Fine Air did not document the test.

"Although Fine Air's maintenance manual required that the accident airplane's FDR data be downloaded into a computer to determine that the parameters were being recorded properly, the maintenance job card that tracked the work performed did not require this readout data to be printed or retained," said NTSB.

"Only a mechanic's signature was required to certify that the readout had been accomplished. Consequently, there was no way for another person to verify that the readout was correct."

Based on its investigation of other accidents involving FDR data-recording problems, NTSB in May 1997 reiterated a recommendation initially made in 1990 that FAA issue an advisory circular (AC) containing guidance on FDR installation procedures, maintenance procedures and documentation.

FAA said that the AC would be published by January 1998. "The AC promised by FAA to be issued by January 1998 has not yet been completed, even though the safety board provided a draft version of the AC upon request by FAA staff," said NTSB.

The accident airplane's FDR was overhauled, bench-checked and returned to service in May 1997. The bench check did not require verification that the FDR was recording all 11 data parameters.

NTSB said, "The problems with the Fine Air FDR in this accident once again underscore the need for prompt action in determining the functionality and airworthiness of retrofitted 11-parameter FDRs."

NTSB said that FDR data are essential not only for accident and incident investigation, but also for flight operations quality assurance (FOQA) programs.

"Analysis of downloaded FOQA data enables operators to enhance crew and aircraft performance, to develop tailored training and safety programs, and to increase operating efficiency," said NTSB. "FOQA programs can also be used to refine ATC procedures and airport configurations, and to improve aircraft designs."

Nevertheless, NTSB said that because an FDR's primary function is to provide data for accident and incident investigation, the FDR may not be considered essential to an airplane's airworthiness.

"As a result, air carrier maintenance technicians may not view the FDR system as critical to the operation of the airplane, and FAA avionics inspectors may have little or no exposure to the complex data-collection and recording features of FDR systems," said NTSB.

"FAA PAIs [principal avionics inspectors] may lack the experience and training to provide adequate oversight of FDR installations and continued FDR airworthiness requirements." NTSB said that PAIs should be trained to properly oversee FDR installation and maintenance.

Improved Training of Pilots, Cargo Loaders Recommended

As a result of the accident investigation, NTSB recommended that FAA:

- "Require all [Part 121] air carriers to provide flight crews with instruction on mistrim cues that might be available during taxi and initial rotation, and require air carriers using full-flight simulators in their training programs to provide flight crews with special-purpose operational training that includes an unanticipated pitch-mistrim condition encountered on takeoff (A-98-44);

- "Conduct an audit of all [Part 121] supplemental cargo operators to ensure that proper weight-and-balance documents are being used, that the forms are based on manufacturer's data or other approved data applicable to the airplane being operated, and that FAA principal inspectors confirm that the data are entered correctly on the forms (A-98-45);

- "Require carriers operating under [Part 121] to develop and use loading checklists to positively verify that all loading steps have been accomplished for each loaded position on the airplane, and that the condition, weight and sequencing of each pallet is correct (A-98-46);

- "Require training for cargo-handling personnel and develop advisory material for carriers operating under [Part 121] and [for POIs] that addresses curriculum content that includes, but is not limited to, weight and balance, cargo handling, cargo restraint and hazards of misloading, and require all operators to provide initial and recurrent training for cargo-handling personnel consistent with this guidance (A-98-47);

- "Review the cargo-loading procedures of carriers operating under [Part 121] to ensure that flight-crew requirements for loading oversight are consistent with the loading procedures in use (A-98-48);

- "Evaluate the benefit of STAN (sum total aft and nose) and similar systems and require, if warranted, the installation of a system that displays airplane weight and balance, and gross weight in the cockpit of transport-category cargo airplanes (A-98-49);

- "Require all principal inspectors assigned to [Part 121] cargo air carriers to observe, as part of their annual work-program requirements, the complete loading operation including cargo weighing, weight-and-balance compliance, flight following and dispatch of an airplane (A-98-50);

- "Review its [NASIP] and [RASIP] inspection procedures to determine why inspections preceding these accidents failed to identify systemic safety problems at ValuJet and Fine Air, and, based on the findings of this review, modify those inspection procedures to ensure that such systemic indicators are identified and corrected before they result in an accident (A-98-51); [2]

- "Evaluate the surveillance programs to ensure that budget and personnel resources are sufficient and used effectively to maintain adequate oversight of the operation and maintenance of both passenger and cargo carriers, irrespective of size (A-98-52);

- "Require an immediate readout of all 11-parameter retrofitted [FDRs] to ensure that all mandatory parameters are being recorded properly; that the FDR system documentation is in compliance with the range, accuracy, resolution and recording interval specified in [Part 121], Appendix B; and require that the readout be retained with each airplane's records (A-98-53);

- "Require maintenance checks for all [FDRs] of aircraft operated under [Parts 121], 129, 125 and 135 every 12 months or after any maintenance affecting the performance of the FDR system, until the effectiveness of the proposed advisory circular and new FAA inspector guidance on continuing FDR airworthiness (maintenance and inspections) is proven; further, these checks should require air carriers to attach to the maintenance job-card records a computer printout, or equivalent document, showing recorded data, verifying that the parameters were functioning properly during the FDR maintenance check, and require that this document be part of the permanent reporting-and-record-keeping maintenance system (A-98-54);

- "Provide FAA [PAIs] with training that addresses the unique and complex characteristics of [FDR] systems (A-98-55);

- "Create a national certification team of [FDR] system specialists to approve all supplemental type-certificate changes to FDR systems (A-98-56);

- "Direct the [PMI] assigned to Fine Air to re-examine the airline's continuing analysis and surveillance program and take action, if necessary, to ensure that repetitive maintenance discrepancies are being identified and corrected (A-98-57); [and,]

- "Amend [FARs 121.563] to specifically require that all discrepancies be logged when they occur, and be resolved before departure through repair or deferral, in consultation with (the certificate holder's or contracted) maintenance personnel (A-98-58)."♦

Editorial note: This article was based on the U.S. National Transportation Safety Board Aircraft Accident Report *Uncontrolled Impact with Terrain, Fine Airlines Flight 101, Douglas DC-8-61, N27UA, Miami, Florida, August 7, 1997.* The 146-page report includes diagrams and appendixes.

Notes

1. NTSB said that FDR malfunctions were revealed during investigations of the following accidents: ValuJet DC-9, Nashville, Tennessee, U.S., Jan. 7, 1996; ValuJet DC-9, Nashville, Tennessee, U.S., Feb. 1, 1996; Air Transport International Douglas DC-8, Kansas City, Missouri, U.S., Feb. 16, 1995; ValuJet DC-9, Savannah, Georgia, U.S., Feb. 28, 1996; Million Air DC-8, Guatemala City, Guatemala, April 28, 1995; ValuJet DC-9, Miami, Florida, U.S., May 11, 1996; Million Air DC-8, Oct. 2, 1996; Million Air Boeing 707, Manta, Ecuador, Oct. 22, 1996; Express One B-727, Orebro, Sweden, Nov. 12, 1996.

2. A ValuJet DC-9-32 struck the ground on May 11, 1996, after a fire erupted in the forward (class-D) cargo compartment on departure from Miami International Airport. All 110 occupants were killed. NTSB said that the fire "was initiated by actuation of one or more oxygen generators being improperly carried as cargo." NTSB said that the probable causes of the accident were: "the failure of SabreTech [ValuJet's maintenance contractor] to properly prepare, package and identify unexpended chemical oxygen generators before presenting them to ValuJet for carriage; the failure of ValuJet to properly oversee its contract maintenance program to ensure compliance with maintenance, maintenance-training and hazardous-materials requirements and practices; and the failure of the [FAA] to require smoke-detection and fire-suppression systems in class-D cargo compartments." NTSB said that FAA RASIP and NASIP inspections had documented deficiencies in ValuJet's operations before the accident occurred.

ACCIDENT PREVENTION
Copyright © 1998 FLIGHT SAFETY FOUNDATION INC. ISSN 1057-5561

Staff: Roger Rozelle, director of publications; Mark Lacagnina, senior editor; Wayne Rosenkrans, senior editor; Rick Darby, editorial consultant; John D. Green, copyeditor, Karen K. Ehrlich, production coordinator; Ann Mullikin, assistant production coordinator; and David A. Grzelecki, librarian, Jerry Lederer Aviation Safety Library

Subscriptions: US$80 (U.S.-Canada-Mexico), US$85 Air Mail (all other countries), twelve issues yearly. • Include old and new addresses when requesting address change. • Flight Safety Foundation, Suite 300, 601 Madison Street, Alexandria, VA 22314 U.S. • Telephone: (703) 739-6700 • Fax: (703) 739-6708