



Aviation Investigation Final Report

Location:	MAUI, Hawaii	Accident Number:	LAX00LA192
Date & Time:	May 9, 2000, 09:50 Local	Registration:	N192AT
Aircraft:	Lockheed L1011-385-1	Aircraft Damage:	Substantial
Defining Event:		Injuries:	370 None
Flight Conducted Under:	Part 121: Air carrier - Scheduled		

Analysis

The scheduled airline Lockheed L-1011, sustained a tail strike during landing damaging the pressure bulkhead and several bell frames and stringers in the aft fuselage. According to the flight crew, the captain was landing on runway 2 using a flaps 42 (full down) setting. The ATIS was reporting winds from 060 degrees at 18 knots with gusts to 26 knots. Both pilots stated that as the airplane descended through 30 to 40 feet agl, a sudden high sink rate developed. The captain added power and pitched the nose up to arrest the rate of descent. All three crewmembers said that the landing was harder than normal, but none would classify as a "hard landing." According to the airport METAR, the winds at 0954 were from 060 degrees at 22 knots with higher gusts to 27 knots. Review of the high resolution ASOS wind data from a sensor near the touchdown zone for the runway disclosed no significant speed variations in either the head or crosswind components during the last 10 seconds of the approach. An FAA inspector entered the cockpit after the aircraft had been parked at the gate and observed the captain's airspeed indicator final approach speed bug setting at 142 knots. According to the airline's L-1011 Operations Manual, the inner bug is set to the final approach speed, which is V_{ref} adjusted for 1/2 of the steady state wind plus all of the gust additive. The final bug setting cannot be less than $V_{ref} + 5$, nor more than $V_{ref} + 20$. For the aircraft's landing weight, the zero wind V_{ref} was calculated at 138 knots, with a wind adjusted final approach speed of 150 knots. Read out of the Flight Data Recorder disclosed that in the 48 seconds prior to touchdown, the calibrated airspeed varied from 154 to 145 knots. In the 10 seconds prior to touchdown, the airspeed varied from 143 to 130 knots at wheel contact. In the 10-second period before touchdown, the airspeed decreased from 143 to 135 knots, then increased to 143 knots 3 seconds later, and then steadily decayed to the 130-knot value recorded at ground contact. At touchdown, the aircraft was 8 knots below the no-wind reference speed, and, 13 knots below the airline's minimum specified speed. The maximum pitch attitude value of 8.79 degrees aircraft nose up was 4 degrees less than the maximum allowable pitch attitude to prevent a tail strike. Teardown of the left and right main landing gear assemblies revealed no discrepancies, and no write-ups were found in the maintenance records for the previous 180

days.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The captain's failure to maintain the proper wind-adjusted Vref airspeed, by a margin which varied from 7 to 20 knots too slow, during the final 10 seconds of the approach prior to touchdown.

Findings

Occurrence #1: HARD LANDING

Phase of Operation: LANDING - FLARE/TOUCHDOWN

Findings

1. (C) AIRSPEED(VREF) - NOT MAINTAINED - PILOT IN COMMAND

Factual Information

On May 9, 2000, at 0950 hours Hawaiian standard time, ATA Flight 671, a Lockheed L1011-385-1, N192AT, sustained a tail strike during landing at the Kahului airport, Maui, Hawaii. The airplane was owned and operated by American Trans Air, Inc., as a regularly scheduled domestic passenger flight under 14 CFR Part 121 of the Federal Aviation Regulations. The airplane sustained substantial damage to the pressure bulkhead and several bell frames and stringers in the aft fuselage. None of the airline transport pilot licensed 3 flight crew, 10 flight attendants, or the 357 passengers were injured. An IFR flight plan was filed for the nonstop flight that originated in San Francisco, California, on the day of the accident at 0805 Pacific daylight time.

All three flight crewmembers submitted written statements. The captain was the flying pilot and they were landing on runway 2 using a flaps 42 (full down) setting. The crew reported that the Automated Terminal Information Service (ATIS) broadcast was reporting winds from 060 degrees at 18 knots with gusts to 26 knots. Both pilots stated that the Instrument Landing System (ILS) was tuned and used as flight path guidance. As the airplane descended through 30 to 40 feet agl, a sudden high sink rate developed. The captain added power and pitched the nose up to arrest the rate of descent. All three crewmembers said that the landing was harder than normal, but none would classify as a "hard landing." During the post flight walk around inspection, the flight engineer discovered an area of damage along the fuselage centerline from FS 1770 to FS 1815.

According to the Kahului airport METAR, the winds at 0954 were from 060 degrees at 22 knots with higher gusts to 27 knots.

Written statements were provided by the 10 cabin crewmembers. Several reported that the engine speed increased just before the airplane "slammed down" onto the runway. Two ceiling panels on the cabin left side around rows 30 and 31 fell down. Eight of the 10 flight attendants reported neck and back pain and were medically evaluated at an Urgent Care Medical facility near the airport. All were subsequently released.

AIRCRAFT INFORMATION

The maintenance records were reviewed with regard to the main landing gear assemblies. The left and right assemblies, serial numbers 178ELA and 1107EBA respectively, were last overhauled on July 15, 1990, and installed on the accident airframe on July 26 of that year. Both units had accumulated a total of 6,944 cycles since the overhaul. The component overhaul period for the main landing gear assemblies is 10 years or 10,000 cycles. The units were last inspected and serviced on April 19, 1999. Review of the records found no write-ups for the 180 days preceding the accident.

The left and right main landing gear assemblies were removed from the airplane and sent to Hawker Pacific Aerospace, a Federal Aviation Administration (FAA) approved repair station, for teardown. The examination disclosed that the internal condition of both assemblies were consistent with normal wear conditions. All dimensions were acceptable in accordance with overhaul manual repair limits.

FAA inspectors from the Honolulu Flight Standards District Office responded to the airport and examined the aircraft while parked at the gate. One inspector entered the cockpit and observed the captain's airspeed indicator bug settings. The three outer bugs were set at 178, 158, and 138, while the inner bug was set to 142.

According to the ATA L-1011 Operations Manual, the inner bug is set to the final approach speed, which is V_{ref} (flaps 42) adjusted for $1/2$ the steady state wind plus all of the gust additive. The final bug setting cannot be less than $V_{ref} + 5$, nor more than $V_{ref} + 20$. The outer bugs are set based on flaps 42 V_{ref} and are in order; $V_{ref} + 60$, $V_{ref} + 40$, and $V_{ref} + 20$. The manual stipulates that these speeds are calculated by the flight engineer and entered on a landing card, which is then presented to the captain.

The load manifest for the flight listed the predeparture estimated landing weight as 348,700 pounds. The aircraft total weight indicator on the flight engineer's fuel panel was showing 352,000 pounds when examined by the FAA inspectors.

According to the charts in the ATA L-1011 Operations Manual for 352,000 pounds, the computed zero wind speeds for bug setting purposes would be: V_{ref} (flaps 42) = 138 knots, $V_{ref} + 20 = 158$ knots, $V_{ref} + 40 = 178$ knots, and $V_{ref} + 60 = 198$ knots. Based on the wind reports from the control tower, 060 degrees at 22 knots with gusts to 27 knots, the steady and gust headwind components at the time of the landing were 16 and 4 knots, respectively. The final V_{ref} wind additive would therefore be $8 + 4$ for a total of 12 knots, or an inner bug final approach setting of 150.

The ATA L-1011 Operations Manual discusses airspeed management on final approach and states: "After landing flaps are extended, complete the landing checklist and slow the aircraft to approach speed indicated by the Speed Command System [inner bug setting], or, if the SCS is inoperative, to V_{ref} (plus one half the wind and all the gust factor, not to exceed $V_{ref} + 20$ knots)."

The flaps 42 landing field length limit chart shows that for 352,000 pounds, a landing field length of 5,200 feet is required.

According to the ATA L-1011 Operations Manual, the maximum allowable aircraft nose up flare attitude is 12.5 degrees; this limit is predicated on tail clearance from the pavement during touchdown. The manual further notes that a normal flare consists of about 1.5 degrees additional nose up from the aircraft body attitude during the approach. The ATA L-1011 fleet

manager used performance charts and other data in the manual to calculate the nose up attitude of the aircraft for the landing weight of 352,000 pounds, flaps set to 42, and flying a 3-degree glide slope. The calculations predicted that the airplane would have flown the approach about a 7-degree nose up attitude.

METEOROLOGICAL INFORMATION

A Safety Board staff meteorologist prepared a Meteorological Factual Report of the conditions existing during the aircraft's approach and landing. The complete report is appended to this report.

Review of the visible satellite image for 1000 hours showed clear skies at the Kahului airport, with no convective buildups present in the airport's vicinity. No weather radar echoes were present.

The airport is equipped with an ASOS wind-monitoring tower, which is located near the touchdown zone of runway 2. In pertinent part, the ASOS system records high-resolution wind data in the form of both 2-minute and maximum 5-second average velocities, with respect to the runway orientation and the computed crosswind component. The data shows that the maximum 5-second average wind peaked at 0948, at 27 knots, decreased to 22 knots at 0949, and finally increased to 24 knots at 0950. The computed maximum 5-second average crosswind component for those same time frames was 15 knots, 13 knots, and 12 knots, respectively.

AIRPORT INFORMATION

The Kahului airport has two hard surfaced runways. Runway 2 was used by the accident airplane and is 7,000 feet long by 150 feet wide. It is equipped with a V4L VASI aligned to a 3.0-degree glide slope with a designed threshold crossing height of 65 feet.

FLIGHT RECORDERS

The aircraft was equipped with a digital flight data (DFDR) and a cockpit voice recorder (CVR). Both recorders were removed from the aircraft and sent to the Safety Board's Vehicle Recorder Division laboratory in Washington, D.C., for readout and evaluation.

The CVR records for 30 minutes before the recording medium is overwritten by new material. Review of the CVR recording found conversations during the taxi-in and shutdown periods, with no conversations remaining covering the approach or landing. A formal readout was not performed.

The Lockheed Aircraft Service Company DFDR model 209F, serial number 111, was read out in the laboratory, and detailed data plots and tabular listings of the recovered parameters is included with the Flight Data Recorder Factual Report, which is appended to this report. In

pertinent part, the data disclosed the following (the time in seconds noted is the FDR Subframe Reference Number, which is the time in seconds from the beginning of the data transcription):

1. The local maximums for the captain and first officer's control column position were recorded at 548 seconds and were -6.54 and -7.13 degrees aft column, respectively.
2. The maximum normal vertical acceleration recorded was +2.047 G's at 549 seconds. After a local minimum value of +0.706 G's at 550 seconds, a second local maximum of +1.374 G's was recorded at 551 seconds.
3. Local lateral and longitudinal acceleration maximums of 0.158 and 0.434 G's, respectively, were recorded at 549 seconds.
4. From 490 through 538 seconds, the calibrated airspeed varied from 154 to 145 knots. From 539 through 548 seconds, the airspeed varied from 143 to 130 knots. The calibrated airspeed at 549 seconds was recorded as 130 knots. In the period from 538 to 539 seconds, the airspeed decreased from 143 to 135 knots, then increased to 143 knots by 541 seconds, and then steadily decayed to the 130-knot value recorded at 548 seconds.
5. The local maximum pitch value of 8.79 degrees aircraft nose up was recorded at 549 seconds.

The data set values from the Nos. 3 and 4 right leading edge slats and the L5 and L6 spoilers were considered erroneous.

Pilot Information

Certificate:	Airline transport	Age:	58, Male
Airplane Rating(s):	Single-engine land; Multi-engine land	Seat Occupied:	Left
Other Aircraft Rating(s):	None	Restraint Used:	
Instrument Rating(s):	Airplane	Second Pilot Present:	Yes
Instructor Rating(s):	None	Toxicology Performed:	No
Medical Certification:	Class 1 Valid Medical--w/ waivers/lim	Last FAA Medical Exam:	March 22, 2000
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	
Flight Time:	24769 hours (Total, all aircraft), 8178 hours (Total, this make and model), 16339 hours (Pilot In Command, all aircraft), 165 hours (Last 90 days, all aircraft), 57 hours (Last 30 days, all aircraft), 5 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Lockheed	Registration:	N192AT
Model/Series:	L1011-385-1 L1011-385-	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	
Airworthiness Certificate:	Transport	Serial Number:	139C-1057
Landing Gear Type:	Retractable - Tricycle	Seats:	379
Date/Type of Last Inspection:	May 7, 2000 Continuous airworthiness	Certified Max Gross Wt.:	452000 lbs
Time Since Last Inspection:	5 Hrs	Engines:	3 Turbo fan
Airframe Total Time:	63701 Hrs	Engine Manufacturer:	Rolls-Royce
ELT:	Installed, not activated	Engine Model/Series:	RB-211-22
Registered Owner:	AMERICAN TRANS AIR, INC.	Rated Power:	40140 Lbs thrust
Operator:		Operating Certificate(s) Held:	Flag carrier (121)
Operator Does Business As:		Operator Designator Code:	AMTA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	Condition of Light:	Day
Observation Facility, Elevation:	OGG ,54 ft msl	Distance from Accident Site:	
Observation Time:	09:54 Local	Direction from Accident Site:	
Lowest Cloud Condition:	Scattered / 3000 ft AGL	Visibility	10 miles
Lowest Ceiling:	None	Visibility (RVR):	
Wind Speed/Gusts:	22 knots / 27 knots	Turbulence Type Forecast/Actual:	/
Wind Direction:	60°	Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	30 inches Hg	Temperature/Dew Point:	80°C / 65°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	SAN FRANCISCO (SFO)	Type of Flight Plan Filed:	IFR
Destination:	(OGG)	Type of Clearance:	IFR
Departure Time:	08:05 Local	Type of Airspace:	Class D

Airport Information

Airport:	KAHULUI OGG	Runway Surface Type:	Asphalt
Airport Elevation:	54 ft msl	Runway Surface Condition:	Dry
Runway Used:	2	IFR Approach:	Visual
Runway Length/Width:	7000 ft / 150 ft	VFR Approach/Landing:	Full stop;Traffic pattern

Wreckage and Impact Information

Crew Injuries:	13 None	Aircraft Damage:	Substantial
Passenger Injuries:	357 None	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	370 None	Latitude, Longitude:	20.870656,-156.449523(est)

Administrative Information

Investigator In Charge (IIC): Rich, Jeff

Additional Participating Persons: EDEN SPURLIN; HONOLULU , HI
EDWARD DUCHNOWSKI; INDIANAPOLIS , IN
COREY STEPHENS; HERNDON , VA

Original Publish Date: January 2, 2002

Last Revision Date:

Investigation Class: [Class](#)

Note: The NTSB traveled to the scene of this accident.

Investigation Docket: <https://data.nts.gov/Docket?ProjectID=49160>

The National Transportation Safety Board (NTSB) is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant events in other modes of transportation—railroad, transit, highway, marine, pipeline, and commercial space. We determine the probable causes of the accidents and events we investigate, and issue safety recommendations aimed at preventing future occurrences. In addition, we conduct transportation safety research studies and offer information and other assistance to family members and survivors for each accident or event we investigate. We also serve as the appellate authority for enforcement actions involving aviation and mariner certificates issued by the Federal Aviation Administration (FAA) and US Coast Guard, and we adjudicate appeals of civil penalty actions taken by the FAA.

The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, “accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties ... and are not conducted for the purpose of determining the rights or liabilities of any person” (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB’s statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)). A factual report that may be admissible under 49 *United States Code* section 1154(b) is available [here](#).