Aviation Investigation Final Report

Location:	SAN FRANCISCO, California	**Incident Number:**	LAX00IA127
Date & Time:	March 13, 2000, 20:06 Local	**Registration:**	N516DA
Aircraft:	Boeing 727-232	**Aircraft Damage:**	Minor
Defining Event:		**Injuries:**	77 None
Flight Conducted Under:	Part 121: Air carrier - Scheduled		

Analysis

The airplane landed with the right main landing gear partially extended. This was the second leg of the day in the airplane for this crew; the second officer (SO) completed walk around inspections prior to both flights and noted no discrepancies. The captain was hand flying the airplane in the initial takeoff climb, and selected landing gear up passing through 300 to 500 feet above ground level (agl). The red "doors" light illuminated on the front panel and the amber right main gear door light illuminated on the second officer's panel. All attempts to lower the right main gear were unsuccessful, so the captain elected to return to the airport and land with the right main gear extended about 15 degrees. Inspection of the right main landing gear revealed that the safety bar bent down about 20 degrees at the leading edge and 15 degrees at its midpoint. The safety bar's inboard flanges buckled just below the reinforced area. The inner gear door drive rod bent aft about 15 degrees at the upper attachment fitting, and the tube buckled and separated below the four attachment nuts. The outboard section of the clamshell gear door sustained mechanical damage. Examination of the airplane revealed that the door rods were not loose, and all were in good condition. A general inspection of the wheel well revealed no other damage. There was no abnormal wear or movement marks on the up-lock hook, and the hook was properly adjusted. The actuator adjustor plate was properly installed. Delta maintenance technicians installed new clamshell door halves and a new drive rod. They serviced the strut, isolated the right main clamshell gear door, and cycled the gear. Then they cycled the right main wheel with the door. Finally, they cycled all of the landing gear together. All wheels and doors cycled in proper sequence. Metallurgical examination discovered no cracks in the safety plate. There were no fatigue crack arrest marks or corrosion in the fracture faces on the drive rod; it fractured as a result of overstress. A black coating that felt greasy covered the interior side of the outer clamshell door. There was a rectangular scuffmark in the center of the black area, which had its long axis parallel to the longitudinal axis of the airplane. The black coating appeared pushed into a slight ridge along the outer edge of the scuffmark. A small piece of rubber was under a rivet in the middle of the scuffmark. After placing the tire and gear door together to match their positions when

the airplane came to rest, the tire did not touch the scuffmark. Fourier Transform Infrared Spectroscopy (FTIR) examination of the small piece of rubber and samples from the tire and a chock determined that they were all hydrocarbon compounds, but could not distinguish between the samples. Whether the scuffmark and rubber piece came from runway debris or another rubber object could not be determined.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this incident to be: failure of the right main landing gear to fully extend for undetermined reasons.

Findings

Occurrence #1: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation: TAKEOFF - INITIAL CLIMB

Findings
1. (C) REASON FOR OCCURRENCE UNDETERMINED

Factual Information

1.1 HISTORY OF FLIGHT

On March 13, 2000, about 2006 Pacific standard time, Delta Airlines flight 1972, a Boeing 727-232, N516DA, had the right main landing gear fail to fully extend prior to landing at San Francisco, California. Delta Airlines, Inc., was operating the airplane as a scheduled domestic passenger flight under the provisions of 14 CFR Part 121. The airline transport pilot captain, first officer (FO), second officer (SO), 4 flight attendants, and 70 passengers were not injured. The airplane sustained damage to secondary structure. The flight departed San Francisco about 1835 as a nonstop to Salt Lake City, Utah. Visual meteorological conditions prevailed, and an instrument flight rules (IFR) flight plan had been filed.

This was the second leg of the day in the airplane for this crew; their first leg was from Dallas, Texas, to San Francisco. The SO completed walk around inspections at Dallas and San Francisco and noted no discrepancies.

The captain was hand flying the airplane in the initial takeoff climb, and selected landing gear up passing through 300 to 500 feet above ground level (agl). The red "doors" light illuminated on the front panel and the amber right main gear door light illuminated on the second officer's panel. The crew notified air traffic control, briefed the passengers, and climbed the airplane to 5,000 feet on vectors to a safe maneuvering area over the ocean. The crew completed their checklists; the captain gave the FO control of the airplane, and briefed the flight attendants. He did not dump fuel to allow maximum time to analyze the situation.

The captain contacted Delta maintenance in Atlanta to discuss all available options. The crew completed the emergency procedures in their flight manuals, and discussed cycling the landing gear. Delta procedures did not allow the pilot to cycle the landing gear in this situation with the intent to avoid more complications. The captain selected landing gear down, and green lights illuminated for the nose gear and left main gear, while a red light illuminated for the right main gear. The red "doors" light on the front panel and the amber right main gear door light on the second officer's panel remained illuminated. The SO, who went into the cabin to view the landing gear position through a porthole, reported seeing the clamshell door, the wheel canted down about 10 to 15 degrees, and the ground. The crew attempted manual extension procedures several times with no movement of the wheel. They made preparations for a partial gear landing. The checklist included briefing for an emergency evacuation.

The captain declared an emergency with air traffic control.

The captain called the lead flight attendant up to the cockpit, and explained the problem. The lead flight attendant briefed the other flight attendants. The flight attendants reviewed their

procedures and briefed the passengers and divided the required duties.

The flight crew depressurized the cabin. After announcing their intentions to the passengers, the flight crew shook the airplane to try and loosen the gear. The attempt was unsuccessful. The captain resumed control of the airplane, returned to the airport, and flew an instrument landing system (ILS) to a visual approach. He acquired the airport at the outer marker. He aligned the airplane slightly left of centerline in case the airplane pulled to the right. He pulled about 20 degrees of spoiler for better roll authority, and did not use the thrust reversers. He applied left aileron to hold the right wing up as long as possible, and the wing stayed off of the ground until about 110 knots. He used slight pressure on the left brake, and said that the airplane went straight ahead. The airplane stopped smoothly about 3 feet right of centerline. The tower said that there were no signs of fire, and the captain noticed crash and rescue personnel around the airplane. The captain ordered an evacuation, completed the evacuation checklist, and pulled the T handles. The flight crew then assisted with the evacuation.

1.2 DAMAGE TO AIRCRAFT

The right wing leading edge slats, right flaps, right wing tip, and right main gear doors sustained damage.

1.3 PERSONNEL INFORMATION

1.3.1 Captain

The captain held an airline transport pilot certificate with an airplane multiengine land rating. He held type ratings for the DC-9, B737, and B727. He also held a certified flight instructor's (CFI) certificate with ratings for airplane single engine land and glider. He held a first-class medical certificate issued on January 21, 2000, with no limitations or waivers. He had 19,021 hours total time; 1,695 hours in this make and model, and 183 hours logged in the last 90 days.

1.3.2 First Officer

The first officer held a commercial pilot certificate with multiengine land and instrument ratings. He held a first-class medical issued on October 18, 1999, with no limitations or waivers. He had 9,979 hours total time; 6,231 were in this make and model with 171 hours logged in the last 90 days.

1.3.3 Second Officer

The second officer held an airline transport pilot certificate with an airplane multiengine land rating. He had type ratings for the CL65 and EMB120. He held a flight engineer's certificate. He held a first-class medical certificate issued on October 18, 1999, with no limitations or waivers. He had 8,095 hours total time.

1.4 AIRCRAFT INFORMATION

1.4.1 Airframe

The airplane was a Boeing 727-232, serial number 21432. The operator reported a total airframe time of 63,246.5 hours. The airplane was maintained on a continuous airworthiness program, and the last inspection occurred on March 8, 2000, approximately 42 hours prior to the mishap. The three engines were Pratt and Whitney JT8D-15A models, rated at 15,000 pounds of thrust each. Serial numbers for engines 1, 2, and 3, respectively, were: 700797, 687501, and 695292.

1.4.2 Landing Gear System

1.4.2.1 Overview

The main gear doors close over the wheel well opening when the landing gear are retracted or extended by the normal hydraulic system. Hydraulic power normally operates the wheel well doors. Mechanical linkage from the landing gear operates the wing doors, which close over the shock strut aperture only when the gear is retracted. A safety bar mechanism completely opens the wheel well doors upon manual extension or with a malfunction of the power operating system. There is a release mechanism, which allows opening of the doors for servicing. Only hydraulic action closes the wheel well doors.

1.4.2.2 Main Gear Doors

The doors consist of two parts, an inner door hinged to the keel beam and an outer door hinged to the outer edge of the inner door. The door actuator and actuation beam connect to a large bracket on the inner door. The outboard end of the actuator pivots in the actuator beam. The actuator beam connects to the structure via a swinging link and an adjustable rod. Hinges raise the outer door when its inner door closes. Each end of the outer door has a radius rod installed between the outboard edges of the door, which raises the outer end into position as the door closes. The gear sequence control rod attaches to a bracket mounted on the aft end of the inner door near the hinge line.

1.4.2.3 Wing Doors

The wing doors are hinged to the lap inner rail. An actuator rod is attached to a support fitting mounted on the door center rib. The opposite end of the actuator rod attaches to the shock strut. A hook mechanism supports the wing doors in the closed position, and prevents them from drooping during high-speed flight. Correct sequence of operation is ensured since the main gear doors open and close only when the main gear conveying the wing doors are locked in the up or down positions.

1.4.3 Safety Bar Mechanism

The door safety bar mechanism is in each main gear wheel well. It will completely open the wheel well doors if they are not fully open when the main landing gear extend. The mechanism includes a safety bar, a pushrod, a door drive rod, and a bellcrank. The safety bar and the bellcrank pivot on fittings attached to the wheel structure. Both the pushrod and the door drive rod can be adjusted. Each safety bar hinges to the keel bean and projects horizontally when the wheel well doors close. The pushrod connects the safety bar to the bellcrank arm. The door drive rod connects the door to the door drive arm. The door and safety bar operate simultaneously.

During normal operation of the wheel well doors, the inboard doors raise and lower the safety bar. The safety bar rises to a horizontal position when the doors close, and lowers clear of the main gear retraction path when the doors are fully opened. Door movement is transmitted to the safety bars through the door drive rod, bellcrank, and pushrod. If the doors do not open or fail to open fully when the landing gear is extended, the descending main gear tire contacts the safety bar, which will be forced down by the weight of the gear. The movement transmits through the pushrod to the bellcrank, which rotates and opens the doors by pushing down on the door drive rod.

1.5 METEOROLOGICAL INFORMATION

A routine aviation weather report (METAR) for San Francisco was issued at 1956. It stated: skies scattered at 800 feet; visibility 10 miles; winds from 260 degrees at 18 knots; temperature 53 degrees Fahrenheit; dew point 52 degrees Fahrenheit; altimeter 30.18 inches of mercury.

1.6 COMMUNICATIONS

The airplane was in contact with Bay Terminal Radar Approach Control (TRACON) throughout the departure and approach.

1.7 AIRPORT INFORMATION

The airport/ facility directory, southwest U. S., indicated that runway 28 R was 11,870 feet long and 200 feet wide. The runway surface was grooved asphalt.

1.8 Flight Recorders

A National Transportation Safety Board specialist performed a readout and evaluation of the Digital Flight Data Recorder (DFDR). The specialist's factual report is attached. It noted that touchdown occurred after 5,589 seconds elapsed time. The airplane touched down in a slight left wing down attitude at 138 knots on a magnetic heading of 284 degrees. It then rolled to a maximum of 11.027 degrees right wing down. The airplane's heading deviated to 274 degrees before coming to rest on a heading of 280 degrees. The maximum vertical acceleration during

the landing and rollout was 1.313 G's.

1.9 SURVIVAL ASPECTS

The captain briefed the lead flight attendant on their condition; he told her that they would land with the right main gear partially extended. They discussed the situation. He told her that they would have about 20 to 30 minutes to prepare. He told her that three dings of a bell would signal brace, and he would also announce brace over the public address (PA) system. He would give the evacuation order. He made an announcement to the passengers, and instructed them to follow the flight attendants' commands.

The lead flight attendant gathered the other members of her crew; she reviewed emergency procedures, emergency lighting, and emergency equipment. She verified the brace and evacuation signals, and stressed that they would not evacuate until instructed by the captain or they observed fire. She then assigned duties to all of them. They secured the galleys and luggage, briefed emergency row passengers, read the emergency announcement, and went through the cabin and reassured the passengers.

The lead flight attendant knew that she had two flight attendants from other airlines on board. She briefed them on the situation. She placed one of them in an emergency row exit, and attendants moved men to another exit. She specifically briefed passengers with special needs; one couple had a baby. Another couple could not hear or walk well, so she instructed them to follow nearby passengers, and arranged for the nearby passengers to help the couple. The flight attendants briefed everyone seated in the emergency exit rows. They walked through the cabin and reassured the passengers. Some flight attendants instructed passengers with glasses to store them in the seat pocket, and told those with high heals to put them in the overhead storage.

The captain sounded three dings, and announced brace over the PA system. The flight attendants repeated the brace command, and instructed the passengers to stay low with their heads down.

Air traffic control tower personnel informed the flight crew that there were sparks, but no fire. After the airplane came to a stop, crash and rescue personnel sprayed foam onto the right wing. The front right side of the airplane was low to the ground and fire and rescue personnel were standing by at that location. The captain ordered evacuation through the R1 (right front) door only. The flight attendants at the front of the cabin opened the R1 door and blew the slide. After the first few passengers exited, firemen arrived at the bottom of the slide to assist them.

All passengers remained calm, and evacuated the cabin with no injuries. Most passengers followed the crew's instructions and left carry-on luggage behind. A few passengers got their bags, but the flight attendants instructed them to leave the bags in seats near the emergency exits. Most women carried their purses. Four or five passengers carried their computer bags,

and dropped them down the slides before they exited. At least one woman left her computer in a seat as instructed.

After completing shutdown, the flight crew exited through the forward galley door. The FO and SO assisted at the forward galley, while the captain went to the cabin's over wing area and watched for signs of smoke or fire. After all passengers evacuated, the captain followed the lead flight attendant out. Passengers and crew met away from the airplane as briefed.

The captain complimented his training and thought that the crew resource training was an important factor in the successful outcome of this incident. The FO thought that it was helpful that they had a three-person crew, which allowed one person to fly and two to handle the problem. The SO went into the cabin twice to observe the landing gear position.

1.10 TESTS AND RESEARCH

1.10.1 On Scene Examination

To facilitate removing the airplane from the runway, maintenance personnel deflated the right main gear strut, and removed an upper wing fillet. They placed pins in the gear, and towed the airplane to a hangar.

Investigators from the Safety Board, the Federal Aviation Administration, and Delta examined the airplane. Inspection of the right main landing gear revealed that the safety bar bent down about 20 degrees at the leading edge and 15 degrees at its midpoint. The safety bar's inboard flanges buckled just below the reinforced area. The inner gear door drive rod bent aft about 15 degrees at the upper attachment fitting, and the tube buckled and separated below the four attachment nuts. The outboard section of the clamshell gear door sustained mechanical damage.

Delta maintenance technicians removed both clamshell door pieces. They checked the door rods for looseness, and all were in good condition. A general inspection of the wheel well revealed no other damage. They did not detect any abnormal wear or movement marks on the up-lock hook, and the hook was properly adjusted. They verified that the actuator adjustor plate was properly installed.

The technicians verified that the drive rod attachment fittings were the correct part number. They verified that there were no abnormal switch positions in the cockpit.

Delta maintenance technicians installed new clamshell door halves and a new drive rod. They serviced the strut with an initial charge of 1,200 psi (pounds per square inch) of nitrogen, and then to the "X" dimension per the placard in the wheel well.

The technicians isolated the right main clamshell gear door and cycled the gear. Then they cycled the right main wheel with the door. Finally, they cycled all of the landing gear together.

All wheels and doors cycled in proper sequence.

1.10.2 Materials Laboratory Examination

1.10.2.1 Drive Rod and Safety Plate

The door drive rod, which connected the inner door to the wheel well attachment point, fractured and separated several inches below the attachment point. The Safety Board investigator-in-charge (IIC) sent several components to the Safety Board Materials Laboratory, Washington, D.C., for examination.

The laboratory examined the bent safety plate and the fractured drive rod. A specialist prepared a factual report, which is attached in its entirety. The specialist observed no cracks in the safety plate.

The specialist examined the drive rod fracture surfaces with a bench binocular microscope. He observed ductile dimple features. He observed no fatigue crack arrest marks or corrosion in the fracture faces.

1.10.2.2 Rubber Samples

A black coating that felt greasy covered the interior side of the outer clamshell door. There was a rectangular scuffmark in the center of the black area, which had its long axis parallel to the longitudinal axis of the airplane. The black coating appeared pushed into a slight ridge along the outer edge of the scuffmark. Investigators found a small piece of rubber under a rivet in the middle of the scuffmark. After placing the tire and gear door together to match their positions when the airplane came to rest, the tire did not touch the scuffmark. The IIC sent this small piece of rubber and samples from the tire and a chock to the Materials Laboratory.

The laboratory sent the rubber compounds to Artech Testing for examination, and their report is an attachment. Artech used Fourier Transform Infrared Spectroscopy (FTIR) to examine the samples. They determined that all were hydrocarbon compounds, but could not distinguish between the samples.

1.10.3 Sequence Valves

The IIC observed testing of the gear operated door sequence valve and the door operated gear sequence valve at Dowty Aerospace, Los Angeles, California, on April 26, 2000. Dowty recommended a visual inspection for leaks every 2,500 hours, and an overhaul of these units every 5,000 hours. Delta's maintenance manual listed these units as "on condition" items. The airplane accumulated 63,246 hours prior to the incident.

A visual inspection of the door operated gear sequence valve, part number 1U1084, serial

number 2982, revealed that it had the original Dowty seals installed, and had not been overhauled since delivered new on January 5, 1977. Dowty personnel completed their Functional Test Procedures, and results of all test segments were within limits established by the Components Maintenance Manual (CMM).

The gear operated door sequence valve, part number 1U1085, serial number 2293A, had been shipped new on June 27, 1979. It had not been returned to Dowty for repair or overhaul. However, the original Dowty seals had been removed indicating that some work or repair had been accomplished. Dowty personnel completed the Functional Test Procedure for part 1U1085. All procedures fell within limits established by the CMM except item 12, the slide force test. The actuator jammed on the down to up test. Technicians removed all pressure from the unit, and the actuator remained jammed. They disassembled the unit with difficulty, and inspected the lap assembly (a matched set consisting of piston and sleeve, items 20 and 21, on pages 16 and 17 of the overhaul manual) with a microscope and a borescope. They observed no burrs or scratch marks. Light corrosion was evident on the sleeve, but they detected none inside. Cap 1085-17 exhibited linear gouges on the inner diameter land area. Technicians replaced the lap assembly (1085-33, a pre-service bulletin 32-04 assembly) in the actuator housing with a 1085-34 lap assembly Dowty had in for overhaul. They tested this combination, and the results were within limits of the CMM. They then installed the lap assembly that had jammed in Dowty's test actuator housing. It tested at 6 pounds on the intermediate to down cycle, and 5 pounds on the intermediate to up cycle; 25 pounds was the maximum limit. Technicians removed pressure and attempted disassembly; the lap assembly again jammed and they could only remove it with great difficulty. The Dowty repair station manager reported that they had discovered about a dozen units that came in for overhaul since 1985 that jammed like this. He was not aware of any that jammed in service. He noted that this test simulated a condition that the unit would not encounter in service when installed on the airplane.

1.11 ADDITIONAL INFORMATION

One of the ramp personnel reported that he observed nothing unusual about the airplane. He observed no scratches, dents, or flat tires, and he didn't observe anything dripping, hanging, or falling from the airplane.

The captain noted that the runway at San Francisco had a raised bump at the intersection of runway 1R and either 28L or 28R, and he noticed a solid thump as the airplane crossed it.

The IIC interviewed station managers and ground personnel from the previous two stops and none of them reported any missing equipment.

The IIC released the airplane to the owner's agent. Parties to the investigation were the Federal Aviation Administration, Delta Airlines, the Air Line Pilot's Association, Dowty, and Boeing.

Pilot Information

Certificate:	Airline transport; Flight instructor	**Age:**	49,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):	Airplane single-engine	**Toxicology Performed:**	No
Medical Certification:	Class 1 Without waivers/limitations	**Last FAA Medical Exam:**	January 1, 2000
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	July 1, 1999
Flight Time:	19021 hours (Total, all aircraft), 1695 hours (Total, this make and model)		

Co-pilot Information

Certificate:	Commercial	**Age:**	44,Male
Airplane Rating(s):	Multi-engine land	**Seat Occupied:**	Right
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 Without waivers/limitations	**Last FAA Medical Exam:**	October 1, 1999
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	February 1, 2000
Flight Time:	9979 hours (Total, all aircraft), 6231 hours (Total, this make and model)		

Flight engineer Information

Certificate:	Airline transport	**Age:**	33,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Rear
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Unknown	**Last FAA Medical Exam:**	
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	8095 hours (Total, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Boeing	**Registration:**	N516DA
Model/Series:	727-232 727-232	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Transport	**Serial Number:**	21432
Landing Gear Type:	Retractable - Tricycle	**Seats:**	156
Date/Type of Last Inspection:	March 1, 2000 Continuous airworthiness	**Certified Max Gross Wt.:**	184200 lbs
Time Since Last Inspection:	42.1 Hrs	**Engines:**	3 Turbo fan
Airframe Total Time:	63246.5 Hrs	**Engine Manufacturer:**	Pratt & Whitney
ELT:		**Engine Model/Series:**	JT8D-15A
Registered Owner:	WILMINGTON TRUST CO. TRUSTEE	**Rated Power:**	15000 Lbs thrust
Operator:	DELTA AIRLINES, INC.	**Operating Certificate(s) Held:**	Flag carrier (121)
Operator Does Business As:		**Operator Designator Code:**	DALA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Night/dark
Observation Facility, Elevation:	SFO	**Distance from Accident Site:**	
Observation Time:	19:56 Local	**Direction from Accident Site:**	
Lowest Cloud Condition:	Scattered / 800 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	18 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	260°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.18 inches Hg	**Temperature/Dew Point:**	12°C / 11°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	SAN FRANCISCO, CA (SFO)	**Type of Flight Plan Filed:**	IFR
Destination:	SALT LAKE CITY, UT (SLC)	**Type of Clearance:**	IFR
Departure Time:	18:35 Local	**Type of Airspace:**	

Airport Information

Airport:	SAN FRANCISCO INTL SFO	**Runway Surface Type:**	Asphalt
Airport Elevation:	13 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	28R	**IFR Approach:**	ILS;Visual
Runway Length/Width:	11870 ft / 200 ft	**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	7 None	**Aircraft Damage:**	Minor
Passenger Injuries:	70 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	77 None	**Latitude, Longitude:**	37.620277,-122.379997

Administrative Information

Investigator In Charge (IIC):	Plagens, Howard
Additional Participating Persons:	ROBERT SMEDLEY; Federal Aviation Administration; Oakland, CA John Potthast; Delta Airlines; Atlanta, GA Richard Mayfield; Boeing; Renton, WA Thomas Randel; Dowty; Los Angeles, CA Michael Cox; Air Line Pilots Association
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