
Crash into terrain, West Coast Airlines, Inc., DC-9, N9101, Near Wemme, Oregon, October 1, 1966

Micro-summary: On approach, this Douglas DC-9 crashed into terrain.

Event Date: 1966-10-01 at 2010 PDT

Investigative Body: National Transportation Safety Board (NTSB), USA

Investigative Body's Web Site: <http://www.nts.gov/>

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AIRCRAFT ACCIDENT REPORT

Adopted: December 11, 1967

WEST COAST AIRLINES, INC.

DC-9, N9101

Near Wemme, Oregon

October 1, 1966

**NATIONAL TRANSPORTATION SAFETY BOARD
DEPARTMENT OF TRANSPORTATION
WASHINGTON D.C. 20591**

NATIONAL TRANSPORTATION SAFETY BOARD
DEPARTMENT OF TRANSPORTATION
WASHINGTON, D. C.

WEST COAST AIRLINES, INC.
DC-9, N9101
NEAR WEMME, OREGON
OCTOBER 1, 1966

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NATIONAL TRANSPORTATION SAFETY BOARD
DEPARTMENT OF TRANSPORTATION
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SYNOPSIS

About 2010 P.d.t., October 1, 1966, West Coast Airlines, Inc., DC-9, N9101, operating as Flight 956, crashed approximately 5.5 miles south of Wemme, Oregon. Impact occurred at the 3,830-foot level on the eastern slope of Salmon Mountain. The 13 passengers and five crewmembers were fatally injured. The aircraft was destroyed by impact and fire.

Flight 956, regularly scheduled from San Francisco to Seattle with intermediate stops at Eugene and Portland, was being vectored for an approach to Portland at the time of the accident. The crew had acknowledged descent instructions from 14,000 to 9,000 feet, and was turning to an assigned heading of 300 degrees when radar contact was lost. The controller twice requested the flight to advise him when they reached the assigned heading. At 2009:27 the crew acknowledged, "Nine five six wilco." This was the last transmission from the flight.

The Board determines the probable cause of this accident was the descent of the aircraft below its clearance limit and below that of surrounding obstructing terrain, but the Board has been unable to determine the cause of such descent.

1. INVESTIGATION

1.1 History of the Flight

On October 1, 1966, West Coast Airlines, Inc. (WCA), DC-9, N9101 was flown as Flight 941 from Seattle, Washington to San Francisco, California, with intermediate stops at Portland and Eugene, Oregon. After about one hour of ground time the aircraft and crew operated as Flight 956, which reversed the route and stops of the previous flight, departing San Francisco at 1844.^{1/} They arrived at Eugene at 1934.

Flight 956 received an Instrument Flight Rules (IFR) clearance to Portland via Victor Airway 23 at an assigned altitude of 12,000 feet. Following take-off at 1952, a radar vector of 360 degrees was issued by the Seattle Air Route Traffic Control Center (ARTCC) and the flight continued its climbout on that heading. At 2000 a traffic advisory was given by the controller and the crew responded, "Nine five six roger, we're on instruments at twelve." The flight was then assigned a new frequency and controller, who cleared them to ". . . turn right heading zero two zero and altimeter two niner seven niner, over." This transmission was not acknowledged. About a minute later, at 2002:29, instructions were issued to turn left to 360 degrees and the crew responded, "Seattle Center, West Coast nine five six request one four thousand." In subsequent transmissions the heading change was repeated and the requested altitude received. The flight was also advised to report when ready to start down, and shortly thereafter assigned a new heading of 050 degrees. In less than two minutes after the climb clearance was received, at 2004:25, they

^{1/} All times herein are Pacific daylight, based on the 24-hour clock.

requested and received descent instructions. The clearance was to 9,000 feet, which was acknowledged, "Roger, descend to nine (thousand) leaving one four (thousand)." Approximately one minute later the Center controller transmitted, "West Coast niner fifty six request altitude, squawk zero four zero zero." The crew responded, "Zero four zero zero and we're out of twelve and . . . what was the landing runway at Portland?" The controller advised that Runway 28R was in use and, following radio contacts with several other aircraft, instructed the flight to ". . . turn right heading three zero zero." After questioning the direction of the turn the crew acknowledged, "Right turn to three zero zero, roger."

The controller lost radar contact with the flight while it was still in the right turn, passing through an estimated heading of 140-160 degrees. At 2009:09 the crew was requested to report when established on a heading of 300 degrees. No acknowledgement was received, and the message was repeated. At 2009:27 the crew stated, "Nine five six wilco." When the radar target failed to reappear, and there were no other transmissions from the flight, the controller transmitted a series of radio calls to the flight, but there was no response. At 2015 accident notification procedures were initiated.

The aircraft crashed at 45°51'21" N latitude and 121°59'36" W longitude, in a relatively unpopulated section of the Mt. Hood National Forest, during hours of darkness. Nonetheless, 70 persons were interviewed in all quadrants surrounding the accident at distances varying from 2.5 to 33 miles. Although there were many reports of eyewitnesses who saw Flight 956, they were subsequently found to be describing other flights. Statements were obtained from

18 ground witnesses, three of whom described an unusual orange glow in the sky in the vicinity of the accident site. The others were aural witnesses who heard the aircraft in flight or described a noise which they associated with impact. There was general agreement that the aircraft sounded normal, although some felt it was low. The weather was generally described as low overcast with rain, but there was considerable variation in the wind reported.

1.2 Injuries to Persons

<u>Injuries</u>	<u>Crew</u>	<u>Passengers</u>	<u>Others</u>
Fatal	5	13	0
Nonfatal	0	0	0
None	0	0	

1.3 Damage to Aircraft

The aircraft was destroyed by impact and ground fire.

1.4 Other Damage

None.

1.5 Crew Information

Captain Donald Alldredge, age 50, held airline transport pilot certificate No. 137209, with ratings in the DC-3, F-27, and DC-9. He was hired on March 1, 1947, and had accumulated 18,998 total flying hours of which 17:31 hours were in the DC-9. His FAA first-class medical certificate was issued April 8, 1966, without limitations. His last proficiency check was completed on September 29, 1966. He had a rest period of 24:40 hours preceding this series of flights, and had been on duty approximately 6:45 hours at the time of the accident.

Captain Charles C. Warren, age 42, held airline transport pilot certificate No. 314493, with ratings for the DC-3, F-27, and DC-9. He was hired on September 1, 1947, and had accumulated 21,800 total flying hours of which 50:15 hours were in the DC-9. His FAA first-class medical certificate was issued on July 22, 1966, without limitations. His last proficiency check was completed on September 20, 1966. He had a rest period of 26:35 hours prior to this sequence of flights and had been on duty approximately 6:25 hours at the time of the accident. He was check captain on this flight.

First Officer Pete M. Labusky, age 38, held airline transport pilot certificate No. 1369711, with ratings in the DC-3. He was hired on March 13, 1957, and had accumulated 9,545 total flying hours of which 9:04 hours were in the DC-9. His FAA first-class medical certificate was issued on July 22, 1966, without limitations. His last proficiency check was completed on September 29, 1966. He had a rest period of 13:17 hours prior to this sequence of flights and had been on duty approximately 6:25 hours at the time of the accident.

Stewardess Bonnie Weinberger, age 27, was hired October 21, 1959, and received her most recent recurrent emergency training on June 21, 1966. She received 16 hours of DC-9 training on September 19-20, 1966.

Stewardess Margrethe Bjornson, age 25, was hired November 23, 1964, and received her last recurrent emergency training on June 20, 1966. She also received 16 hours of DC-9 training on September 19-20, 1966.

1.6 Aircraft Information

N9101, a DC-9-10, serial No. 45794, was manufactured by the Douglas Aircraft Company, Inc., (DACO) and purchased by West Coast Airlines, Inc., on September 16, 1966. At the time of the accident it had flown a total of 164:10 hours, and had been maintained in accordance with FAA requirements. The aircraft was equipped with two Pratt and Whitney JT8D-1 engines installed as follows:

<u>Position</u>	<u>Serial Number</u>	<u>Total Time</u>
1	P 653730D	166:45
2	P 653723D	166:45

The takeoff gross weight at Eugene was 65,025 pounds, which was below the maximum allowable of 79,500 pounds. The center of gravity (c.g.) was computed to be 25 percent, which was within the allowable range of 15.3-39.2 percent for this weight. The aircraft was serviced with JP-1 type fuel.

1.7 Meteorological Information

The aviation area forecast, issued by the Weather Bureau (WB) office at Seattle, valid from 1800-0600, was in part as follows:

Western Washington and extreme northwest Oregon remaining 500-1,500 feet scattered variable to overcast, 2,500-4,000 feet overcast variable to broken, 8,000-10,000 feet overcast, visibility 4-7 miles, light rain, fog, smoke, layers to 30,000 feet, and locally occasionally ceiling zero sky obscured, visibility 1/2 mile, moderate drizzle, fog.

Mountain passes through the Cascades of Washington and north Oregon remaining obscured. Light icing in clouds above the freezing level.

Moderate, occasionally severe turbulence just east of the Cascades of Washington and Oregon, and elsewhere moderate turbulence within 4,000 feet of terrain where there are strong surface winds.

The 1700 WB radiosonde ascent at Salem indicated the freezing level near 11,600 feet m.s.l. The winds aloft observation was in part as follows:

<u>Height (m.s.l.)</u>	<u>Direction (True)</u>	<u>Velocity</u>
1,000 feet	280 degrees	13 knots
2,000	270	13
3,000	270	13
4,000	290	11
5,000	300	13
6,000	310	18
7,000	290	18
8,000	290	21
9,000	300	27
10,000	300	33
12,000	290	36
14,000	280	50

The 2020 surface weather observation at Portland was 3,500 scattered, estimated 5,000 feet broken, 13,000 feet broken, visibility 15 miles, wind 200 degrees, 4 knots, altimeter setting 29.78.

There were no radar weather observations pertinent to the time and place of the accident. The crew obtained a self-help weather briefing at San Francisco.

The accident occurred in darkness.

1.8 Aids to Navigation

There were no reported discrepancies with any navigational aids in the area.

1.9 Communications

There were no reported problems with communications, although the last transmission from the flight was of poor quality. The volume was

beginning to fade with simultaneous breakup of speech evident. However, this same phenomenon occurred during the corresponding portion of a special simulation of the flight. All transmissions from Flight 956 were made by the same crewmember, but it was not determined whether it was the captain or first officer.

1.10 Aerodrome and Ground Facilities

The Portland International Airport is located just north of Portland, Oregon, on the south shore of the Columbia River, at an elevation of 23 feet. Runway 28R is hard surfaced, 8,000 feet long and 150 feet wide, with sequenced flashing approach lights and an instrument landing system. The Jeppesen Approach Chart for Runway 28R indicates the minimum altitude within 10 miles of the outer marker (located 5.0 miles from the threshold) is 3,700 feet and contains the following note, "Caution; terrain rises to 11,245 feet within 35.0 NM (nautical miles) of (the outer marker)." The Portland VORTAC is located 9.2 miles north of the airport on a bearing of 339 degrees.

1.11 Flight Recorders

The aircraft was equipped with a flight data recorder and a cockpit voice recorder. Although both were recovered from the wreckage, only the flight data recorder provided a usable record.

The flight data recorder was a United Data Control Model F-542, serial No. 1761. The flight recorder was destroyed by impact and fire, but the tape magazine assembly was recovered from the debris and a readout made. All parameters were functioning properly throughout the time period from

Eugene to the impact except the acceleration stylus which was approximately one second out of alignment with the other styli.

The cockpit voice recorder, United Controls Corporation Model V-557, serial No. 1490, was found in the wreckage with no apparent damage to the exterior of the recorder unit. The chassis was severely fire damaged and the electronic components were either fused and melted by heat or broken by impact. The interior water-filled thermal barrier contained a slight residue of moisture, but as successive layers of insulating material were removed the heat discoloration increased. Upon removal of the magazine cover the erase, record, and test/monitor heads fell away, and the tape was found to be fused together with some charring of the upper portions.

1.12 Wreckage

The aircraft crashed on the eastern slope of a 4,090-foot ridge in the Salmon Mountain complex of Mt. Hood National Forest at an elevation of 3,830 feet. The aircraft attitude was 30 degrees right bank, in a 3-4 degree climbing flightpath on a heading of 265 degrees at impact. After shearing numerous large fir trees, it struck the 30-35 degree upslope and slid uphill approximately 150 feet. The main wreckage came to rest at an elevation of 3,890 feet, and a severe ground fire occurred.

All of the extremities of the aircraft were accounted for, and no evidence of inflight structural failure, fire or explosion was found. The aircraft impacted in a clean configuration and all flight control trim positions were at normal settings.

Examination of the engines and components revealed that both were rotating in excess of the range where the bleed valves close. There was no evidence of internal failure and both thrust reversers were in the stowed position.

Portions of the various aircraft hydraulic, instrumentation, electronic, flight control, and electrical systems were found scattered through the wreckage path. All components outside the ground fire area exhibited no evidence of exposure to heat. The remaining components were recovered from the fire area severely burned, partially consumed, and otherwise distorted by heat.

Both AC and DC electrical power was being developed at impact and primary attitude reference instruments were compatible with the impact. The radio altimeters were on and receiving power at impact, but no minimum decision altitude had been selected. Both instruments were indicating approximately 180 feet at impact.

1.13 Fire

A severe ground fire occurred at the main wreckage site.

1.14 Survival Aspects

This was a nonsurvivable accident.

1.15 Tests and Research

The altimeters were examined to establish the altitude displayed at impact. Due to a design feature the outer drums of each reacted to decelerative forces and read approximately zero. The altimeters were then examined to establish component relationships from impact damage. Although the

terminal positions of the captain's and first officer's inner drums were 6,000 and 7,000 feet respectively, the physical imprint of the bevel drive gear on the surface of each drum corresponds with approximately 4,000 feet.

The Mach/airspeed indicator as recovered indicated 129 knots, and .64 on the Mach dial was opposite the airspeed limitation marking. This corresponds to 10,000-^f500 feet when related to altitude. No positive repositioning of any internal parts could be established to account for the readings.

DACO performed three flight profiles to help determine whether Flight 956 was being controlled by the autopilot or manually during the final portion of the flight. In addition to a profile flown manually, and one with the autopilot, a third profile was flown with the autopilot using manual application of rudder at various points, usually at the start of a turn. The flight recorder readouts from these profiles were then compared with the recorder trace from Flight 956. Both the quantitative and qualitative evidence indicates that the flight was being flown on autopilot.

DACO also conducted a series of descents through actual rain conditions to investigate the effects of rain on the static system. Eleven actual and simulated IIS descents were made in a simulated DC-9 Series 10 landing configuration. ^{2/} Three instances of "sticky" altimeters, consisting of 40 to 60-foot jumps, were noted. At least one of these instances coincided with water rivulets flowing over the static port, which were observed on closed circuit television. After removal of the camera installation an additional

^{2/} A DC-9 Series 30 aircraft was modified to incorporate a simulated DC-9 Series 10 static system. It was flown with gear down, 50 degrees flaps, closed slats at Series 10 V_{Ref} ^f 5 knots.

five descents were made through light to heavy rain. Several instances of "sticky" altimeters were noted on three of the descents, including one where the altimeter lagged by 100 feet for a short period of time before catching up in 30 to 40-foot jumps.

Nine simulated ILS approaches were made in the DC-9 Series 30 landing configuration. ^{3/} Both the normal and alternate static systems were monitored and only one instance of an altimeter jump, approximately 30 to 35 feet, was noted during an approach in heavy rain. There were no instances of "sticky" operation on any of the simulated Series 10 static systems during these descents.

Five descents, varying between 2,300-3,000 feet per minute (fpm), were made in a clean configuration through rain. There were no instances of "sticky" or lagging altimeter operation in any of the systems.

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

The aircraft had been maintained in accordance with FAA regulations, and the gross weight and c.g. were within allowable limits. The crew was properly certificated.

There was no evidence of inflight fire, explosion or structural failure. Examination of the components of the hydraulic and electrical systems indicates that both systems were operating normally. Although an exact power setting cannot be established for the engines, the closed position of the bleed valves indicates that they were operating considerably above the idle range.

^{3/} Series 30 V_{Ref} + 5 knots, landing gear and slats extended, and 50 degrees flaps.

A correlation of communications with the flight and the flight recorder trace reveals that all clearances and instructions were received, understood, and complied with, except the altitude restriction of 9,000 feet. This altitude assignment was clearly transmitted and the flight acknowledged, "Roger descend to nine (thousand) leaving one four (thousand)." One minute later (2005:35) the flight was instructed, "West Coast niner fifty six request altitude, squawk zero four zero zero." The crew acknowledged, "Zero four zero zero and we're out of twelve. . . ." This series of transmissions was the second of two which contained reference to the number "4." In an earlier conversation on the company radio, at approximately 2004, the flight had been advised that they would be parked at Gate 4. Inasmuch as there were no other communications with any other flight on the frequency during this time span (2004 to 2010) which mentioned 4,000 feet, it is believed that no confusion as to the altitude assignment existed.

The flight began the final descent from 14,000 feet on a heading of 050 degrees, and was monitored closely to ensure that the aircraft would not enter the 13,500-foot minimum altitude airspace around Mt. Hood. At 2007:26, Flight 956 was instructed to turn right to 300 degrees. The crew immediately queried the controller about the desired direction, since a right turn would carry them closer to the mountains and required a longer turn. The controller, who was endeavoring to provide separation from other traffic approaching Portland, verified the right turn and the crew commenced the turn. Flight recorder information shows that between 2004:38 and 2006:58 the aircraft initial rate of descent

of 1,800 fpm gradually increased to a maximum rate of 3,700 fpm. During this time the airspeed decreased from approximately 326 to 280 knots. Over the next 30 seconds the rate of descent decreased to 2,800 fpm and remained constant for 1:10 minutes. At 2007:38 an abrupt airspeed decrease from 290 to 266 knots was recorded, just prior to the turn toward 300 degrees. Since this vector turned the flight toward the Portland terminal area, it is believed that the speed reduction was indicative of the crew's awareness of their geographic location and their proximity to the area of speed restriction within 30 miles of a terminal area. At 2008:38 the flight began a transition from the descent to level flight. The transition was completed in ten seconds and the flight continued in a level turn until 2009:26, when an abrupt climb began. This was two seconds before impact.

A DACO energy study of the flight recorder trace revealed that an EPR setting averaging less than 0.9 was being utilized throughout the descent, and that speed brakes, either full extension for a short period or partial for longer periods, were required to remain within the airspeed envelope. The angle of bank varied from 28 degrees to a maximum of 34 degrees, then decreased to a minimum of 22 degrees, and began increasing again to 27 degrees at impact. This angle corresponds well with the 30-degree bank angle measured at the initial impact with trees at the crash site. In general the estimated characteristics appeared to be representative of normal operation.

A plot of the aircraft flightpath over the ground, based upon witness statements, performance analysis, and wind conditions shows that the turning descent was made over the low ground of the Salmon River Valley and the

South Fork of the Salmon River. There would have been no visual cues to alert the crew because of the remoteness of the area, and the cloud cover and rain at the time. Additionally, the radar altimeters were not preset to give a "low altitude" warning.

The crew did not receive a formal weather briefing at San Francisco; however, they were observed utilizing the self-help weather briefing table at the WCA dispatch office. The crew did not deplane at Eugene. Although the actual weather encountered was slightly worse than forecast, the difference was not of sufficient magnitude to have contributed to the accident. The flight was undoubtedly operating in clouds at 12,000 feet, and after climbing to 14,000 feet was either on or near the top of the cloud cover. Light airframe icing may have been encountered in the clouds above 11,000 feet; however, the aircraft was not above this altitude for an extended period of time, and no significant icing was reported by other pilots. Additionally, the heating blanket installed at the static ports would have precluded any icing of the static system.

The possibility that water may have collected in the static lines was also considered, but an inspection of the system as installed on WCA DC-9s revealed that drains were installed at the lowest point, which eliminated this possibility. The DACO flight tests and survey of DC-9 operators eliminated the possibility of a sticking altimeter due to waterflow over the static ports while the aircraft is in the clean configuration. Finally, had the static ports become blocked at or above 9,000 feet, a corresponding increase in indicated airspeed would have activated the overspeed warning system for approximately two minutes.

Based on the studies performed, the continuation of the normal descent and turn, and the routine manner in which the radio communications were conducted, any involvement of the aircraft or its systems which could have engendered the descent 5,000 feet below the assigned altitude must be ruled out of the causal area.

All attempts to determine crew positions and who was controlling Flight 956 have proven inconclusive. The crew did not deplane at Eugene, but since this was a route qualification flight for the captain it is presumed that he occupied the left seat. The check captain was in the right seat and the first officer sat in the jumpseat at departure from San Francisco and there is no reason to presume that they changed seats at Eugene. All crewmembers were qualified for their duties and their positions in the cockpit is not considered germane to the cause. It is significant to note that a comparison of the profile of Flight 956 with similar test profiles indicates that the aircraft was being flown on the autopilot mode rather than manually from the cruising altitude of 12,000 feet to the point of impact.

There were no transmissions to this aircraft, or any other, which could have confused the crew and caused them to mistake 4,000 feet for the assigned altitude. Furthermore, at the time the instruction to turn right at 300° was given, the aircraft was already 1,500 feet below the assigned altitude so that it does not appear that the instruction to turn in any way caused the crew to miscalculate altitude.

It is evident that the aircraft was descended to approximately 3,800 feet in a controlled manner. The readback of the clearance to 9,000 feet

as clear and concise. Only the additional request for the landing runway indicates that the crew was thinking about an approach in connection with the vectors given. The continued flight at normal speeds until the right turn, and the deliberate application of speed brakes to reduce airspeed at that time, are indicative that the crew was well aware of their geographic location. Inasmuch as the procedure turn altitude for Runway 28R is 3,700 feet, there is a possibility that the crew mistakenly descended for the approach, but no justification for such action is evident.

The destruction of the cockpit voice recorder tape in the ground fire following impact precludes any further knowledge of the actions taken by the crew.

Based upon the foregoing the Board concludes that the reason for the aircraft being permitted by the crew to descend below the assigned altitude is unknown.

2.2 Conclusions

(a) Findings

1. The aircraft was airworthy and the pilots properly certificated.
2. There was no mechanical failure of the aircraft, its systems, powerplants, or components.
3. The flight was cleared to, and acknowledged, an assigned altitude of 9,000 feet.
4. The aircraft was being flown on autopilot.

5. The flight descended in a normal manner to approximately 4,000 feet and leveled off.
6. An abrupt climb was initiated two seconds before impact.

(b) Probable Cause

The Board determines the probable cause of this accident was the descent of the aircraft below its clearance limit and below that of surrounding obstructing terrain, but the Board has been unable to determine the cause of such descent.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

/s/ JOSEPH J. O'CONNELL, Jr.
Chairman

/s/ OSCAR M. LAUREL
Member

/s/ JOHN H. REED
Member

/s/ LOUIS M THAYER
Member

/s/ FRANCIS H. McADAMS
Member