
Hard landing and wheel separation, Douglas DC-8-63F, July 18, 1998

Micro-summary: A hard landing resulted in the separation of a wheel from this Douglas DC-8-63F.


Event Date: 1998-07-18 at 700 PDT

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

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

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		NTSB ID: SEA98IA141		Aircraft Registration Number: N921R	
		Occurrence Date: 07/18/1998		Most Critical Injury: None	
		Occurrence Type: Incident		Investigated By: NTSB	
Location/Time					
Nearest City/Place SEATTLE		State WA	Zip Code 98168	Local Time 0700	Time Zone PDT
Airport Proximity: On Airport		Distance From Landing Facility:		Direction From Airport:	
Aircraft Information Summary					
Aircraft Manufacturer McDonnell Douglas		Model/Series DC-8-63F		Type of Aircraft Airplane	
Sightseeing Flight: No			Air Medical Transport Flight: No		
Narrative					
Brief narrative statement of facts, conditions and circumstances pertinent to the accident/incident:					
<p>HISTORY OF FLIGHT</p> <p>On July 18, 1998, approximately 0700 Pacific daylight time, Emery Worldwide Airlines flight 26, a Boeing (formerly McDonnell Douglas) DC-8-63F, N921R, experienced a separation of the number 1 main landing gear wheel from the aircraft upon landing at Seattle-Tacoma International Airport, Seattle, Washington. Following the separation, the wheel entered the Horizon Air ramp area (in front of the airport main terminal building's C concourse) and struck a Horizon Air maintenance truck parked adjacent to gate C4, damaged one other vehicle and a baggage cart, and sent debris through a window of the Horizon Air maintenance office in the main terminal building. The airplane sustained minor damage in the incident and there were no injuries to the airline transport pilot-in-command, first officer, flight engineer, or two jumpseating crewmembers aboard the aircraft, nor were there any injuries to persons on the ground. Instrument meteorological conditions (IMC) existed at the time of the incident, and an instrument flight rules (IFR) flight plan had been filed for the 14 CFR 121 non-scheduled domestic cargo flight from Dayton, Ohio.</p> <p>The flight was cleared by air traffic control (ATC) for the instrument landing system/distance measuring equipment (ILS/DME) approach to runway 34R. Crew statements and log entries indicated that the first officer, whom a representative of Emery reported had been with the company for approximately 9 months, was the pilot flying at the time of the incident. The first officer reported that during the approach, "I decided to try using the command bars during the descent and turned them off after intercepting final when they started giving me erroneous turns." The flight crew's statements indicated that the aircraft broke out of the weather at minimums, left of centerline. The first officer reported that at this point, the captain asked him if he thought he could continue and he replied affirmatively and aligned himself with the runway. The first officer stated that as he passed the threshold, the aircraft was on centerline and airspeed, and that as he began the landing flare the right wing dipped slightly. The first officer stated that the captain assisted on the controls to neutralize the wings. He reported that the landing was in the touchdown zone with the right main gear touching first, and that the spoilers did not automatically deploy upon landing (the flight engineer also indicated that they did not automatically deploy, that they were armed, and that he deployed them manually; however, the flight crew did not indicate any discrepancies with the spoiler system in the aircraft log after the flight.) The statements of the flight crew and jumpseating crewmembers indicated that they did not observe anything that would cause the wheel to depart the aircraft (one jumpseater reported that "The first and only indication we had of a problem was the tower report that a tire had departed from the aircraft.")</p> <p>Five witnesses (two Seattle tower controllers including the one on duty at the Local Control position, two Port of Seattle ramp controllers, and a Horizon Air ground service agent) provided statements to investigators. Of the five witnesses, three reported they observed the aircraft's wings rocking on approach, with one witness reporting that the airplane went right of the runway centerline just before touchdown and that the aircraft's left wing almost contacted the ground.</p>					
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One witness also reported that the airplane was "making over correct[ion]" or "trying to correct" when landing. Additionally, two witnesses reported either that the aircraft's right wing dipped just before touchdown, or that the airplane made a right bank just before touchdown. One witness reported that the airplane dropped just before touchdown, with three witnesses reporting that the airplane landed either "hard" or "rough" (the witness who described the landing as "rough" stated that the airplane did "not [make] an excessive flare.")

Two witnesses reported that the airplane landed on one side first (one of these stated it landed on the right side first.) Two witnesses reported the airplane bounced after touchdown (one of these reported it bounced about 20 feet back into the air), with one witness reporting seeing two puffs of smoke from the aircraft's tires. One witness reported that the wheel separated at touchdown, one reported she observed it separated in the touchdown area, one reported that it separated during the touchdown-bounce-settle back to the runway sequence, and one witness reported he observed the wheel separate after touchdown. Two witnesses reported that the aircraft's touchdown point was between taxiways R and Q (taxiway R intersects the runway approximately 2,000 feet past the threshold, and taxiway Q intersects the runway approximately 2,500 feet past the threshold) and one witness reported that the aircraft touched down north of taxiway P, which intersects the runway approximately 2,900 feet past the threshold.

ATC radar data on the aircraft, furnished by Seattle approach control, was sent to the NTSB's Vehicle Performance Division in Washington, D.C., which produced a study of the radar data (attached). The radar study depicted the aircraft's recorded radar positions over time in relation to the airport runways and the runway 34R localizer and glide slope. According to the radar study, the plots showed the aircraft initially lining up slightly left of the runway 34R localizer centerline, returning to the localizer centerline, then (at 0657:53) deviating generally away from, and remaining left of, the localizer centerline for 1 minute and 38 seconds, until 0659:31. The aircraft reached a maximum deviation of approximately 3/8 of full-scale displacement (about 3/4 dot deviation) at 0659:07, before beginning to track back toward the localizer centerline. The aircraft altitude at 0659:07 was recorded as 1,200 feet. The aircraft was back within approximately 1/4 scale (1/2 dot) deviation at 0659:26 (altitude 1,000 feet), and was back on the localizer centerline at 0659:31 (altitude 900 feet). It remained approximately on centerline from 0659:31 to 0659:44, then deviated slightly less than 1/4 scale (1/2 dot) right of centerline from 0659:49 to 0659:54, and subsequently crossed back through the localizer centerline from right to left and diverged away from centerline to the left. The aircraft reached a maximum deviation of between 3/4-scale (1 1/2 dots) and full-scale (2 dots) to the left of centerline at 0700:12 and 500 feet before turning and tracking back toward the landing runway.

The radar study showed the aircraft as being nearly on glide path at an altitude of approximately 2,000 feet and 5.5 nautical miles from the threshold of runway 34R. From 1,500 feet down to 800 feet, the aircraft was shown as going below glide path; it reached approximately 1/2 scale (1 dot) low at 1,200 feet and remained generally 1/2 scale or more below glide path from 1,200 feet down to 800 feet, where it was shown as being close to a full-scale low deviation. The aircraft was shown as leveling at 800 feet until recapturing the glide path from below. Below 800 feet, the aircraft was shown as fluctuating about the glide path but remaining mainly below it. The aircraft's altitude immediately prior to crossing the runway 34R threshold (0700:17) was reported as 400 feet, and immediately after crossing the threshold (0700:21) was given as 300 feet. Subsequent plots of the aircraft in the vicinity of the runway showed the aircraft's altitude as 200 feet, increasing to 300 feet. (NOTE: The actual touchdown zone elevation is 368 feet. In the radar data, aircraft altitudes were recorded to the nearest 100 feet.)

FAA Flight Standards Handbook Bulletin for Air Transportation (HBAT) 98-22, "Stabilized Approaches", dated May 26, 1998, directs FAA principal operations inspectors (POIs) with certificate management responsibilities for 14 CFR 121 air carrier operating certificate holders to review their operators' training and operations manuals to ensure that the concept of stabilized approach configurations is addressed. HBAT 98-22 further directs POIs to "ensure that their

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operator's operations and training manuals contain criteria for the stabilized approach as referenced in FAA Order 8400.10, Air Transportation Operations Inspector's Handbook...." HBAT 98-22 directs that the operator's operations and training manuals shall contain, among other items, "Minimum requirements for the stabilized approach and the immediate actions needed to be taken if the stabilized approach conditions are not met (i.e., missed approach or go/around [sic])...." Emery's DC-8 Aircraft Operating Manual, revision number 29 (effective June 22, 1998) defines a stabilized approach, with respect to localizer and glide slope, as being within 1/2 dot (1/4 scale needle deflection) on the localizer and 1/2 dot (1/4 scale needle deflection) on the glide slope. The manual indicates that it is mandatory to be stabilized by 1,000 feet height above the airport when in IMC, and states: "Any deviation from the stabilized approach profile will be cause for consideration to abandon the approach."

The incident aircraft was equipped with a cockpit voice recorder (CVR) and flight data recorder (FDR). The CVR and FDR were removed from the aircraft following the incident and sent to the NTSB Vehicle Recorders Division in Washington, D.C., for readout. Pertinent data from the CVR and FDR readouts is presented in the FLIGHT RECORDERS section below.

OTHER DAMAGE

The impact of the separated main gear wheel from Emery 26 (the weight of the wheel and tire assembly is approximately 307 pounds, according to the aircraft maintenance manual) damaged a parked Horizon Air maintenance truck, a baggage tug and a baggage cart, and also sent small debris through the window of the Horizon Air maintenance office located at ramp level in the Seattle-Tacoma International Airport main terminal building. The maintenance truck the wheel struck was parked in front of the Horizon Air maintenance office, and blocked the wheel from entering the Horizon Air maintenance office. Damage to the Horizon van was reported by the Port of Seattle Police as being in excess of \$6,000.00. The wheel also knocked over a ladder in the ramp area, which struck a van registered to the ESTEY Corporation resulting in cosmetic damage to the ESTEY van. There was no damage to the tug and minor damage to the baggage cart.

AIRCRAFT INFORMATION

The incident aircraft, a McDonnell Douglas DC-8-63F (fuselage number 548, serial number 46145), was initially delivered by McDonnell Douglas on May 26, 1971. The aircraft had 64,037.7 total airframe hours and 20,866 landings at the time of the incident, according to a copy of the aircraft maintenance log. Emery reported that the airplane had last received a continuous airworthiness inspection on July 11, 1998, one week and 60 flight hours before the incident. According to copies of the aircraft maintenance records furnished to the FAA by Emery, the aircraft's number 1 main landing gear wheel and tire were changed on June 29, 1998, at 63,933.0 airframe hours and 20,820 landings. The Emery mechanic who stated he performed the wheel and tire change prepared a statement indicating that the change was performed per McDonnell Douglas DC-8 Maintenance Manual 32-40-1, and that no defects were noted to the wheel and tire assembly at that time. Emery reported that a computer record search conducted by the airline for "any & all ILS & DME work done on [the] aircraft" from March 1, 1998, to January 2000, disclosed no corresponding aircraft maintenance record entries.

The aircraft's weight and balance/load manifest, prepared by the first officer, indicated a planned landing weight of 245,388 pounds. The aircraft's maximum landing weight is 275,000 pounds, according to the aircraft load planning documentation.

According to an excerpt from the DC-8 Operation Manual furnished by Boeing's Douglas Products Division, the airplane landing limit load factor is determined by two conditions: "first, landing at the maximum certified landing weight...for a 600 foot-per-minute [10 feet per second] rate of descent; and second, landing at the maximum certified takeoff gross weight...for a 360 foot-per-minute [6 feet per second] rate of descent."

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METEOROLOGICAL INFORMATION

According to the National Oceanic and Atmospheric Administration (NOAA) Internet METAR observation archive, the ceiling at Seattle-Tacoma on the day of the incident was 200 feet overcast from 0439 until 0823. The ceiling improved to 200 feet broken (with 500 feet overcast) at 0856, to 300 feet broken (with 600 feet overcast) at 0936, and to 800 feet broken at 0944. Weather conditions reported in the Seattle-Tacoma 0557 hourly observation were: ceiling 200 feet overcast; visibility 1 1/4 statute miles in fog; runway 16R runway visual range (RVR) variable from 3,000 to 6,000 feet; temperature and dewpoint 13 degrees C; wind from 220 degrees at 5 knots; and altimeter 30.06 inches Hg. Conditions were reported in the next observation (at 0656) as: ceiling 200 feet overcast; visibility 1 statute mile in fog; runway 34R runway visual range (RVR) greater than 6,000 feet; temperature 14 degrees C; dewpoint 13 degrees C; winds variable at 4 knots; and altimeter 30.07 inches Hg.

In his statement, the first officer stated: "We knew leaving Dayton that the weather in Seattle was at minimums and updated the weather many times enroute." FAA air traffic control transcripts indicated that upon check-in on frequency with Seattle Approach at 0648:11, the crew of Emery 26 indicated they had Seattle-Tacoma automatic terminal information service (ATIS) information "Juliet". Seattle Approach replied that information "Kilo" was then current, and that the runway 34R RVR was more than 6,000 feet. The crew of Emery 26 replied that they would get information "Kilo". Seattle Tower again informed the crew that the runway 34R RVR was "more than six thousand" at 0657:27, upon clearing Emery 26 to land.

Emery's General Operations Manual dated January 6, 1997, states that the captain will not allow the first officer to fly an approach below weather minimums of 500 foot ceiling and 1 mile visibility "except in unusual circumstances."


AIDS TO NAVIGATION

At the time of the incident, the published ILS DME runway 34R (I-SEA) final approach course was 338 degrees magnetic. The published final approach course was based on a 1965 magnetic variation value of 22 degrees East (at the time of the incident, the actual magnetic variation at the airport was 19.05 degrees East.) According to FAA airways facilities officials, the I-SEA localizer centerline is aligned with the runway 34R centerline. The I-SEA glide slope angle is 2.75 degrees. The published minimum runway visual range (RVR) for a full system ILS approach to this runway is 1,800 feet. Decision height (DH) for the approach is 568 feet above sea level (MSL) (200 feet above the touchdown zone elevation of 368 feet MSL), and threshold crossing height is 64 feet.

The FAA furnished records of flight inspections conducted on the runway 34R localizer on August 8, 1997, March 16, 1998, and February 9, 1999. The flight inspection reports documented that during the February 9, 1999, flight inspection, the localizer course width was found to be out of tolerance when intentionally adjusted to a "wide alarm" condition (the system did not automatically shut off until reaching a course width of 3.83 degrees, with a maximum allowable course width of 3.79 degrees at system shutoff.) However, examination of flight and ground inspection results from the February 1997 to March 2000 time period disclosed that the normal, "as-found" localizer course width and alignment were within acceptable tolerances, and were stable to within approximately 2% for width and 3 microamperes for alignment, during that entire time frame.

AERODROME AND GROUND FACILITIES

Seattle-Tacoma International runway 34R is 11,900 feet long and 150 feet wide, and is oriented on a heading of 000.34 degrees true (341.29 degrees magnetic at the time of the incident, based on actual magnetic variation value for July 1998 of 19.05 degrees East.) The runway surface is grooved asphalt, with a weight-bearing capacity of 357,000 pounds for dual tandem landing

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gear-equipped aircraft such as the DC-8. At the time of the incident, the runway was equipped with high intensity runway lights, centerline lighting, touchdown zone lighting, 2,400-foot ALSF-1 approach lighting system with sequence flashing lights, and 4-bar precision approach path indicator (PAPI). The usable landing distance beyond the glide slope is 10,766 feet. The runway slopes up at 0.8%.

FLIGHT RECORDERS

Cockpit Voice Recorder (CVR)

The incident aircraft was equipped with a Collins model 642C-1 CVR. The CVR, which showed no evidence of exterior or interior damage, was removed from the incident aircraft and sent to the NTSB CVR Laboratory in Washington, D.C., where a CVR group comprised of representatives from the NTSB, FAA, Emery Worldwide Airlines, and the Air Line Pilots Association (ALPA) convened on August 4, 1998, and prepared a transcript of 10 minutes and 43 seconds of the 32 minute and 25 second CVR recording. The CVR group reported that the recording consisted of four channels of mixed quality audio information: one channel contained the cockpit area microphone (CAM) audio information, which was of very poor quality, and the other three channels contained the captain, first officer, and flight engineer audio panel information, and were mostly of fair to good quality. The pilots of the incident aircraft were invited to review the CVR transcript and to suggest revisions or corrections prior to its publication, but had not accepted this invitation as of the transcript's publication date of September 10, 1998.

Clock times of events indicated in the CVR transcript were referenced to a preliminary estimate of the time of touchdown made by the NTSB investigator-in-charge from ATC radar data. Transmission times recorded in FAA ATC communications transcripts subsequently disclosed that the actual clock times of the radio transmissions were 4 seconds earlier than those indicated in the CVR transcript.

As such, event times given below are based on event times as determined from the FAA ATC transcripts (i.e. clock times indicated in the CVR transcript minus 4 seconds.) A synopsis of the CVR transcript follows.

The transcript began approximately 0653:15, 1 minute and 1 second (01:01) after the start of the recording. At 0653:26, the first officer stated, "OK, I've got uh, DH is five sixty eight, and uh, twenty five hundred is set." At 0653:42, the CAM recorded a sound similar to the Morse code identifier "I-S-E-A". At 0654:13, the flight was assigned, and the crew acknowledged, a right turn to a heading of 270 degrees. ATC subsequently instructed the crew to reduce airspeed to 170 knots, at 0655:16, and the crew acknowledged.

At 0655:38, the flight engineer inquired, "gear?", and an unidentified individual replied, "down three green." At 7 miles from BUCKK intersection (BUCKK is on the I-SEA localizer at 6.0 DME from the Seattle VOR, is slightly past the glide slope intercept point on the ILS approach, and constitutes the final approach fix for a localizer-only approach to runway 34R), the flight was turned right to a heading of 310 degrees, instructed to maintain 2,200 feet until on the localizer, and cleared for the ILS DME runway 34R approach by ATC at 0655:44. At 0656:00, ATC instructed the flight to maintain 170 knots until 5 DME. The captain replied, "one seventy to the uh, I think you said the six DME, OK?", and ATC replied, "Emery twenty six heavy, that's fine. six DME will work."

At 0656:21, the first officer stated, "I'm not getting' [sic] anything on my side." The captain replied, "I'm sorry disregard, I've got the VOR on my side....sorry about that. Let me set you up here [unintelligible]." At 0656:43, the captain stated, "and we're ten miles out. Got four miles till we intercept the glide slope." At 0656:50, the flight was handed off to Seattle tower. The captain stated, "[unintelligible] localizer alive", at 0657:01. The captain then radioed the Seattle tower at 0657:22, stating the flight was eight miles out for runway 34R. Seattle tower replied that the runway 34R RVR was "more than six thousand", that the flight was following a Boeing 737 (B-737) on one mile final, and cleared the flight to land on runway 34R.

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At 0657:44, the captain said, "still got you a couple hundred feet low here and uh, [unintelligible]." Ten seconds later, he said, "the glide slope should be just about", and the first officer replied, "can't see it from over here." An unidentified individual then said, "alive one dot [unintelligible]." The first officer then stated, at 0658:00, "glide slope's alive on the right. [unintelligible] one dot. [unintelligible] one dot low." At 0658:06, the first officer said, "thirty five", and the captain responded, "flaps thirty five." At 0658:12, the captain said, "OK, there goes, BUCKK. altitude...", and an unidentified individual then said, "BUCKK."

At 0658:16, the captain stated: ".twenty one hundred. flaps full, landing gear no flags [unintelligible]." Eight seconds later, the flight engineer stated, "landing check's completed." An unidentified individual then stated, "flaps are full", to which other crewmembers responded, "[unintelligible] showing...", and "[unintelligible] thirty five." An unidentified crewmember then said, "set fifty", approximately 0658:33. Approximately 0658:38, the captain asked, "are they slowly comin' down or what are they doing there?" Another crewmember also asked, "are they down?" The captain then said, "yeah forty... you've got forty yeah." An unidentified crewmember then said, "[unintelligible] fifty." There were then several unintelligible comments between the crew, around 0658:48. At 0658:51, the captain said, "yeah, let's add five knots to the speed", and the first officer replied, "OK." At 0658:55, the captain said, "you wanna set uh, make it one fifty [unintelligible] flaps."

At 0659:03, the captain said, "I got you backed up, you got a glide, a dot low on the glide slope." An unidentified crewmember called, "[unintelligible] thousand above", at 0659:08. An unidentified crewmember replied, "[unintelligible] above." At 0659:33, the captain stated, "dot low"; three seconds later, he called, "five hundred above." At 0659:41, the captain stated, "correcting on glide", then, at 0659:44, he stated, "coming right [unintelligible] center." At 0659:55, the captain called, "OK, on glide. course is comin' to center." Three seconds later, he called, "approaching minimums. everybody look outside, you stay inside."

Five seconds later, at 0700:03, the flight engineer called, "lights right down here at one o'clock." The first officer responded, "OK, to your right. runway to your right." An unidentified crewmember then said, "one o'clock, one o'clock." The captain then said, "[unintelligible], push it down, push it down, push it down", at 0700:08. At 0700:11, the captain asked, "you got it or you want me to get it?" The first officer replied, "I can get it", and the captain said, "OK." At 0700:17, the CAM recorded, "one hundred." The CAM then recorded the captain calling "fifty" and "forty" at 0700:20, "thirty" and "twenty" at 0700:21, "ten" at 0700:22, and a sound the CVR transcript identified as "sound of impact" at 0700:23.

In the four seconds following the "sound of impact", two unidentified crewmembers made unintelligible statements, and one unidentified crewmember said, "hey man." At 0700:28, the CAM recorded a sound similar to engines decreasing in RPM. Two seconds later, at 0700:30, another aircraft advised Seattle tower that Emery 26 had just lost a wheel.

At 0700:34, an unidentified crewmember said, "[unintelligible] spoilers." The CAM then recorded unidentified crewmembers saying, "four in reverse", and "[unintelligible] comin' out." The captain radioed Seattle tower at 0700:45, saying, "yeah, what'd we lose?" The transcript ended at 0701:18, 9:04 after start of recording.

Flight Data Recorder (FDR)

The incident aircraft was equipped with a Sundstrand model UFDR GQUS 11-parameter digital flight data recorder (DFDR). The DFDR was removed from the incident aircraft and sent to the NTSB Vehicle Recorders Division in Washington, D.C., for readout. Readout of the aircraft's DFDR revealed a peak vertical acceleration of 1.788 G during FDR subframe reference number 565 (NOTE: FDR subframe reference numbers are calibrated in seconds.) The vertical acceleration increased abruptly to this

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value from a baseline value of approximately 1.1 G immediately prior to, and in the initial readings for, FDR subframe reference number 565, and was followed by two additional peaks during the next 5 seconds (to 1.504 G during FDR subframe reference number 568, and to 1.458 G during FDR subframe reference number 570) and five additional peaks of lesser magnitude in 7 more seconds before stabilizing again around 1 G. Approximately 1 to 2 seconds after the 1.788 G peak, all four engine pressure ratios (EPRs) increased from a baseline value of about 1.00 for 2 seconds, to peak values of 1.31 on the #1 engine, 1.21 on the #2 engine, 1.10 on the #3 engine, and 1.22 on the #4 engine; they then returned to baseline values around 1.00.

The aircraft's pitch angle maintained a baseline of approximately +2 to +3 degrees from FDR subframes 541 to 551, at which point it began to decrease. The pitch angle reached approximately 0 degrees at FDR subframe 553 and maintained a baseline of approximately 0 degrees until approximately FDR subframe 558, at which point it began to increase again. The aircraft attained its maximum pitch attitude of +5.69 degrees during FDR subframe 565, just prior to the 1.788 G vertical acceleration peak which occurred in that subframe. The pitch angle then decreased to about +2 to +3 degrees at FDR subframe 567, increased back to about +4 degrees during FDR subframe 568, then decreased back to about zero by FDR subframe 572, where it remained thereafter.


Approximately 20 seconds before the 1.788 G vertical acceleration peak, from FDR subframe reference numbers 544 to 546, the aircraft's magnetic heading was 329.63 degrees magnetic, or approximately 11.7 degrees left of the runway heading of 341.29 degrees. The aircraft then turned right, reaching a heading of 350.25 degrees at FDR subframe reference number 559 (6 seconds before the 1.788 G vertical acceleration peak), then turned back to the left. The aircraft's heading was 339.44 degrees at FDR subframe reference number 565, and continued left to a heading of 334.52 degrees at FDR subframe reference number 567 (2 seconds after the 1.788 G peak.) The airplane then remained on a magnetic heading of approximately 334 degrees for 4 seconds before beginning a right turn back to the runway heading at FDR subframe reference number 572.

The aircraft's roll angle, initially +11.91 degrees at FDR subframe reference number 551, increased to 13.61 degrees at FDR subframes 552 and 553, then began to decrease, going below 10 degrees in subframe 554. The aircraft attained 0 degrees of roll at FDR subframe 559, and continued rolling to -3.58 degrees at FDR subframe 562 before valid roll angle data was lost. The FDR did not record valid roll angle data for subframe intervals 522-523, 537 through 550, or 563 through 576. During the time the aircraft's roll angle was recorded as greater than 10 degrees (subframes 551 through 554), the aircraft's pressure altitude was recorded by the FDR as 450 feet in subframe 551, decreasing to 427 feet by subframe 554. The FDR recorded the aircraft's pressure altitude as 223 feet during subframe 565, when the 1.788 G vertical acceleration spike was recorded. (NOTE: Emery's DC-8 Aircraft Operating Manual states that on ILS final approach, bank angle should not exceed 10 degrees below 200 feet above ground level [AGL].)

An interval of 22 seconds was noted between the time of the 1.788 G vertical acceleration peak (at FDR subframe 565) and the first VHF keying recorded after this peak (at FDR subframe 587.) This time interval matched the interval between the "sound of impact" recorded on the CVR (0700:23) and the captain's radio transmission, "yeah, what'd we lose?" (0700:45), recorded on the CVR.

WRECKAGE

Post-incident examination of the aircraft and separated wheel revealed that the wheel was missing both main wheel bearings as well as the upper portion of its two-piece hubcap, with the upper hubcap retaining rivets sheared out and the lower portion of the hubcap remaining fastened to the wheel. No evidence of distress to the wheel bearing races was observed. The axle nut and one main wheel spacer were missing from the axle, with one spacer remaining on the axle. One of the two axle nut retaining bolts remained in place and exhibited shear overstress fracture signatures, while the other retaining bolt was missing. Post-incident measurements of the number 1 main landing gear axle performed by an Emery mechanic revealed that the vertical diameter of the axle was 0.023

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inches less than the horizontal diameter of the axle. According to a copy of the aircraft maintenance log, company mechanics conducted a hard landing inspection on the aircraft at the request of the FAA following the incident. The log indicated "no defects found" during the hard landing inspection other than the missing wheel and tire assembly, damaged threads on the number 1 axle, and damage to the number 1 main wheel brake assembly.

A castellated nut generally matching the dimensional specifications of a DC-8 main landing gear axle nut was found on the airport between runway 34R and the Seattle VOR/DME facility, approximately abeam taxiway R, by an airport operations supervisor on the day after the incident. Visual examination of this nut revealed gouging of the threads at approximately a 90-degree angle across the threads at locations corresponding to the missing axle nut retaining bolt and the keyway on top of the axle, and evidence of stripped threads under magnification. The nut screwed onto an intact DC-8 main landing gear axle, but exhibited significant free play while screwed onto the axle.

A Timken roller bearing marked with the number 48286 was found by airport personnel during a foreign object pickup walk at the airport on July 31, 1998. The bearing was found between runway 34R and parallel taxiway B, between intersecting taxiways J and L. An Emery mechanic identified this bearing as a DC-8 main wheel inner bearing. Examination of the bearing revealed that it rolled freely, and no sign of heat discoloration or overheat damage to the bearing was evident.

The main wheel outer bearing, second spacer, and upper hubcap portion of the number 1 main wheel assembly were not located.

TESTS AND RESEARCH

With the concurrence of the NTSB investigator-in-charge (IIC), Emery had two dimensional and material examinations of the number 1 main landing wheel axle and axle nut conducted, the first by AAR Landing Gear Services of Miami, Florida, on August 20, 1998, and the second by Boeing's Service Engineering department in Long Beach, California, on February 11, 1999. The AAR Landing Gear Services examination noted an oversize condition of approximately 0.028 inches on the axle nut, and reported that the major diameter and pitch diameter of the axle were both within allowable limits. AAR Landing Gear Services also reported that the hardness of the axle checked within limits.

Boeing's examination of the axle, axle nut, and axle nut retaining bolt (retainer pin) noted "a very slight amount of wear" to the axle, with the axle major diameter approximately 0.005 inch below the minimum diameter specified by the drawing; and that "the axle nut exhibited evidence of wear along the threaded region." Boeing's examination report stated that on the axle nut, "wear had increased the internal minor (thread crest to thread crest) diameter to 4.403/4.420 [inches], beyond the engineering drawing requirements of 4.3698/4.3773 [inches]." The Boeing report noted that "some of the wear along the thread crests exhibited a transverse orientation...however no evidence of shearing of the threads was observed." Boeing's report stated that hardness measurements along the nut produced an average hardness value within the expected range for the material specified by the engineering drawing for the nut, and that "no material or processing discrepancies were observed" to either the axle or axle nut. The Boeing report stated that the retainer pin "failed by shear overload."

ADDITIONAL INFORMATION

FAA Order 8400.10, Air Transportation Operations Inspector's Handbook, states the following with regard to the stabilized approach concept:

...Operational experience has shown that the stabilized approach concept is essential for safe operations with turbojet aircraft...A stabilized approach for turbojet aircraft means that the aircraft must be in an approved landing configuration (including a circling configuration, if appropriate), must maintain the proper approach speed with the

National Transportation Safety Board

FACTUAL REPORT

AVIATION



NTSB ID: SEA98IA141

Occurrence Date: 07/18/1998


Occurrence Type: Incident


Narrative (Continued)

engines spooled up, and must be established on the proper flightpath before descending below the minimum "stabilized approach height" specified for the type of operation being conducted. These conditions must be maintained throughout the rest of the approach for it to be considered a stabilized approach. Operators of turbojet aircraft must establish and use procedures which result in stabilized approaches.

A stabilized approach must be established before descending below...1000 feet above the airport or touchdown zone elevation during any straight-in instrument approach in instrument flight conditions[.]

Note on attached Recorded Radar Study: The term "ACP", used as a unit of angular measurement, denotes "azimuth change pulses." There are 4,096 ACPs in a circle, or approximately 11.3778 ACPs per degree.

		NTSB ID: SEA98IA141			
		Occurrence Date: 07/18/1998			
		Occurrence Type: Incident			
Landing Facility/Approach Information					
Airport Name	Airport ID:	Airport Elevation	Runway Used	Runway Length	Runway Width
SEATTLE-TACOMA INTL	SEA	429 Ft. MSL	34R	11900	150
Runway Surface Type: Asphalt					
Runway Surface Condition:					
Type Instrument Approach: ILS-complete					
VFR Approach/Landing:					
Aircraft Information					
Aircraft Manufacturer		Model/Series		Serial Number	
McDonnell Douglas		DC-8-63F		46145	
Airworthiness Certificate(s): Transport					
Landing Gear Type: Retractable - Tricycle					
Homebuilt Aircraft? No	Number of Seats: 5	Certified Max Gross Wt.	355000 LBS	Number of Engines: 4	
Engine Type:	Engine Manufacturer:	Model/Series:	Rated Power:		
Turbo Jet	P&W	JT3D-7	19000 LBS		
- Aircraft Inspection Information					
Type of Last Inspection	Date of Last Inspection	Time Since Last Inspection	Airframe Total Time		
Continuous Airworthiness	07/1998	60 Hours	63996 Hours		
- Emergency Locator Transmitter (ELT) Information					
ELT Installed? Yes	ELT Operated? No	ELT Aided in Locating Accident Site?			
Owner/Operator Information					
Registered Aircraft Owner		Street Address			
FLEET NATIONAL BANK		777 MAIN ST.			
		City	State	Zip Code	
		HARTFORD	CT	06115	
Operator of Aircraft		Street Address			
EMERY WORLDWIDE AIRLINES		303 CORPORATE CENTER DR.			
		City	State	Zip Code	
		VANDALIA	OH	45377	
Operator Does Business As:			Operator Designator Code: RRXA		
- Type of U.S. Certificate(s) Held:					
Air Carrier Operating Certificate(s): Flag Carrier/Domestic; Supplemental					
Operating Certificate:			Operator Certificate:		
Regulation Flight Conducted Under: Part 121: Air Carrier					
Type of Flight Operation Conducted: Non-scheduled; Domestic; Cargo					

 <p>National Transportation Safety Board FACTUAL REPORT AVIATION</p>	NTSB ID: SEA98IA141	
	Occurrence Date: 07/18/1998	
	Occurrence Type: Incident	

First Pilot Information

Name On File	City On File	State On File	Date of Birth	Age 39
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Sex: M	Seat Occupied: Left	Principal Profession: Civilian Pilot	Certificate Number:
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Certificate(s): Airline Transport; Commercial

Airplane Rating(s): Multi-engine Land; Single-engine Land; Single-engine Sea

Rotorcraft/Glider/LTA: None

Instrument Rating(s): Airplane

Instructor Rating(s): None

Type Rating/Endorsement for Accident/Incident Aircraft? Yes	Current Biennial Flight Review?
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Medical Cert.: Class 1	Medical Cert. Status: Valid Medical--no waivers/lim.	Date of Last Medical Exam: 02/1998
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- Flight Time Matrix	All A/C	This Make and Model	Airplane Single Engine	Airplane Multi-Engine	Night	Instrument		Rotorcraft	Glider	Lighter Than Air
						Actual	Simulated			
Total Time	6772									
Pilot In Command(PIC)										
Instructor										
Last 90 Days		111								
Last 30 Days		48								
Last 24 Hours		7								

Seatbelt Used? Yes	Shoulder Harness Used? Yes	Toxicology Performed?	Second Pilot? Yes
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Flight Plan/Itinerary

Type of Flight Plan Filed: IFR

Departure Point DAYTON	State OH	Airport Identifier DAY	Departure Time 0551	Time Zone EDT
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Destination Same as Accident/Incident Location	State	Airport Identifier SEA	
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Type of Clearance: IFR

Type of Airspace: Class B

Weather Information

Source of Briefing: Company; Commercial Weather Service

Method of Briefing:

 <p>National Transportation Safety Board FACTUAL REPORT AVIATION</p>	NTSB ID: SEA981A141
	Occurrence Date: 07/18/1998
	Occurrence Type: Incident

Weather Information					
WOF ID	Observation Time	Time Zone	WOF Elevation	WOF Distance From Accident Site	Direction From Accident Site
SEA	0656	PDT	429 Ft. MSL	0 NM	0 Deg. Mag.
Sky/Lowest Cloud Condition: Unknown			0 Ft. AGL	Condition of Light: Day	
Lowest Ceiling: Overcast		200 Ft. AGL	Visibility: 1 SM	Altimeter: 30.00	"Hg
Temperature: 57 °C	Dew Point: 55 °C	Wind Direction: Variable		Density Altitude: Ft.	
Wind Speed: 4	Gusts:	Weather Conditions at Accident Site: Instrument Conditions			
Visibility (RVR): 6000 Ft.	Visibility (RVV) 0 SM	Intensity of Precipitation: Unknown			
Restrictions to Visibility: Fog					
Type of Precipitation: None					

Accident Information		
Aircraft Damage: Minor	Aircraft Fire: None	Aircraft Explosion: None

Classification: U.S. Registered/U.S. Soil					
- Injury Summary Matrix	Fatal	Serious	Minor	None	TOTAL
First Pilot				1	1
Second Pilot				1	1
Student Pilot					
Flight Instructor					
Check Pilot					
Flight Engineer				1	1
Cabin Attendants					
Other Crew				2	2
Passengers					
- TOTAL ABOARD -				5	5
Other Ground	0	0	0		0
- GRAND TOTAL -	0	0	0	5	5

National Transportation Safety Board

FACTUAL REPORT

AVIATION



NTSB ID: SEA98IA141

Occurrence Date: 07/18/1998

Occurrence Type: Incident

Administrative Information

Investigator-In-Charge (IIC)

GREGG NESEMEIER

Additional Persons Participating in This Accident/Incident Investigation:

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RENTON, WA 98055

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