



Aviation Investigation Final Report

Location:	Detroit, Michigan	Accident Number:	CHI01FA104
Date & Time:	March 17, 2001, 07:05 Local	Registration:	N357NW
Aircraft:	Airbus Industrie A320-200	Aircraft Damage:	Substantial
Defining Event:		Injuries:	3 Minor, 150 None
Flight Conducted Under:	Part 121: Air carrier - Scheduled		

Analysis

The Airbus A320 contacted the runway and the terrain during takeoff on runway 3C (8,500 feet by 200 feet, wet) at the Detroit Metropolitan Wayne County Airport. An emergency evacuation was made during which time the emergency evacuation slide on the 2 left (2L) door failed to deploy. The captain reported that during the initial takeoff run, he held half forward pressure until reaching 80 knots. He reported that up to this point, everything was normal. He stated he released forward stick pressure by about 100 knots and the nose of the airplane began lifting off the ground with neutral stick, which was not normal. He reported he applied about half forward stick and the nose came back down. He reported that at 120 knots the nose again began to rise with one half to one quarter stick input. He then pushed the stick forward to the forward stop and the nose came up at a rapid rate. The captain reported that his attention was focused outside the airplane and he did not hear the first officer call V1. He reported that he felt the airplane was going to stall so he pulled the power off and aborted the takeoff. The captain stated that he was trained not to perform high-speed aborted takeoffs, but he felt the airplane would have been uncontrollable if the takeoff continued. The captain stated the thrust reversers were deployed and he initially thought there was enough runway remaining to stop. He assumed the autobrakes activated, but he pressed on the brakes anyway. He reported the airplane was not decelerating and it departed the end of the runway at a high speed. The captain reported that deceleration was rapid once the airplane departed the paved surface and the engines flamed out during the ground roll. Post accident inspection of the airplane revealed the horizontal stabilizer trim was set to negative 1.7 (units of trim), when it should have been set at positive 1.7. The first officer stated he set the trim while on the taxiway. The captain did not notice the improper trim setting during the cross check which was part of the taxi checklist. Further investigation revealed the operator procedures were to set the trim using units instead of percentage of mean aerodynamic chord as recommended by the manufacturer. In addition, it was discovered that the manner in which the units of trim were displayed on the trim control wheel, on the electronic centralized aircraft monitoring system (ECAM), and in the aircraft communications addressing and reporting system (ACARS) were

not consistent. As a result the Safety Board issued Safety Recommendations A-02-06 and A-02-07. Post accident examination of the 2L slide/raft that did not deploy revealed an improper chamfer on the telescopic girt bar which attaches the slide/raft to the airplane structure. This allowed the slide/raft to detach from the airplane when the 2L door was opened. As a result the Safety Board issued Safety Recommendations A-01-27 and A-01-28. Being a fly-by wire airplane, the Airbus A320 has two sources of control lag in the pitch control. One is the latency between the pilot's input and the elevator movement through the elevator aileron control (ELAC) computer and the other is the rate limit of the elevator. Examination of the digital flight data recorded data for this accident revealed the pilot changed the pitch input faster than the elevator system would respond and saturation occurred in the rate at which the elevator surface could respond to the inputs. This resulted in pilot induced oscillations (PIO) during the takeoff roll.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot induced oscillations and the delay in aborting the takeoff. Factors associated with the accident were the first officer used an improper trim setting and the captain did not identify and correct the setting during the taxi checklist, and the wet runway conditions.

Findings

Occurrence #1: LOSS OF CONTROL - IN FLIGHT
Phase of Operation: TAKEOFF

Findings

1. (F) STABILATOR TRIM - IMPROPER - COPILOT/SECOND PILOT
2. (F) STABILATOR TRIM - NOT CORRECTED - PILOT IN COMMAND

- 3. (C) PORPOISE/PILOT-INDUCED OSCILLATION - INADVERTENT - PILOT IN COMMAND
- 4. (C) ABORTED TAKEOFF - DELAYED - PILOT IN COMMAND

Occurrence #2: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: TAKEOFF

Occurrence #3: OVERRUN
Phase of Operation: TAKEOFF - ABORTED

Findings

- 5. (F) AIRPORT FACILITIES, RUNWAY/LANDING AREA CONDITION - WET
- 6. TERRAIN CONDITION - SOFT

Occurrence #4: MISCELLANEOUS/OTHER
Phase of Operation: STANDING - ENGINE(S) NOT OPERATING

Findings

- 7. MISC EQPT/FURNISHINGS, SLIDES - DISENGAGED
- 8. MISC EQPT/FURNISHINGS, SLIDES - NOT DEPLOYED

Factual Information

HISTORY OF FLIGHT

On March 17, 2001, at 0705 eastern standard time, an Airbus Industrie A320-200, N357NW, operated by Northwest Airlines (NWA) as Flight 985, contacted the runway and the terrain during takeoff on runway 3C at the Detroit Metropolitan Wayne County Airport, Detroit, Michigan. The airplane received substantial damage. Three passengers reported minor injuries. The captain, co-pilot, 4 flight attendants, and 144 passengers were not injured. The 14 CFR Part 121 flight was operating in instrument meteorological conditions and an IFR flight plan was filed. The flight was originating at the time of the accident and the intended destination was Miami, Florida.

The captain stated that when he reported on the morning of the accident, he completed his paperwork then went to the airplane where he performed the captain's "flow", checked maintenance records, briefed the flight attendants, and loaded the flight plan into the multifunction control display unit (MCDU). He stated they received the load data five to six minutes before they pushed back and it was entered into the flight management guidance computer (FMGC). The V-speeds were also set while at the gate. He stated that it was snowing so he had the first officer arrange to have the airplane deiced. The captain stated the first officer set the stabilizer trim prior to reaching the deice pad.

The captain reported they taxied to the deice pad and he left the engines and auxiliary power unit (APU) running while the airplane was being deiced. Type 1 deice fluid was used, which resulted in a 15 minute hold over time, giving him 10 minutes to become airborne by time the deicing was completed. The captain reported they moved the airplane out of the deice pad before they turned the systems back on. They then completed the engines-running deicing procedure checklist and requested a taxi clearance.

The captain reported the deice pad used was only 5 or 6 airplane lengths away from the end of runway 03C. He said he performed the taxi checklist as the airplane was taxied to the end of the runway, accomplishing all the checklist items. He reported that as part of the checklist, he noted the trim setting on the electronic centralized aircraft monitoring (ECAM) display and the maximum gross load (MGL). He reported that he checked this information against the setting on the trim wheel, making sure it was in the green band. New automatic terminal information service (ATIS) information was received and he noted that the weather was deteriorating. He stated they accomplished the before takeoff checklist, and he briefed the first officer regarding what they would do in case of an engine failure on takeoff. The airplane was then cleared into position to hold, followed 30 seconds later by the takeoff clearance.

The captain reported that takeoff/go-around (TOGA) thrust was set, and he held half forward

pressure on the control yoke until reaching 80 knots. He reported that up to this point, everything was normal. He stated he released forward stick pressure by about 100 knots, and the nose of the airplane began lifting off the ground with neutral stick, which was not normal. He reported he applied about half forward stick and the nose came back down. He reported that at 120 knots the nose again began to rise with one half to one quarter stick input. He then pushed the stick forward to the forward stop and the nose came up at a rapid rate. The captain reported that his attention was focused outside the airplane and he did not hear the first officer call V1. He reported that he felt the airplane was going to stall so he pulled the power off and aborted the takeoff. The captain stated that he was trained not to perform high-speed aborted takeoffs, but he felt the airplane would have been uncontrollable if the takeoff continued.

The captain stated the thrust reversers were deployed and he initially thought there was enough runway remaining to stop. He assumed the autobrakes activated, but he pressed on the brakes anyway. He reported the airplane was not decelerating and it departed the end of the runway at a high speed. The captain reported that deceleration was rapid once the airplane departed the paved surface and the engines flamed out during the ground roll.

The captain reported that he believed the tail struck the runway during the aborted takeoff, followed by the main gear and then the nose gear. He stated the impact was hard enough that he thought the airplane was structurally damaged and there was a threat of fire so he initiated an emergency evacuation of the airplane. The flightcrew performed the emergency evacuation checklist, notified the tower, and went to the back of the airplane. He reported he waited until the airplane was empty, then he exited the airplane through the 1R door and the first officer exited using the 1L door.

The first officer stated he checked in for the flight and proceeded to the gate where he met the captain and flight attendants. He received his paperwork and waited for the arriving flight to be off loaded. He then proceeded to the airplane where he checked the flight attendant log and reviewed the minimum equipment list with the captain. He then left the airplane to perform the external preflight. The first officer stated that after returning to the cockpit, he arranged to have the airplane deiced, then he continued the preflight. He reported he received the aircraft communication addressing and reporting system (ACARS) load data prior to pushback at which time he entered the request for runway 3C, and requested a pack-off variable speed takeoff. He stated he discussed this with the captain and the captain concurred. The first officer stated he entered the V speed, the zero fuel weight, and the block-out fuel weight information into the computer. He then began his "flow", accomplished the before-start checklist, and called for a pushback clearance. After pushback he called for the taxi clearance.

The first officer stated that while established on the taxiway, he set the stabilizer trim to negative 1.7 and performed the flight control check. He then received their taxi clearance to the runway 3C deice pad. The first officer stated the airplane felt normal while taxiing. The deicing checklist was then accomplished and the deicing was performed. During the deicing

he reviewed the hold over chart and used "light snow" for determining the holdover time. They then accomplished the before taxi checklist and received their taxi clearance to runway 3C. The first officer stated the taxi checklist was completed, new ATIS information was received, and the before takeoff checklist was completed before the flight was cleared into position and hold. The flight was then cleared for takeoff.

The first officer stated the takeoff started off normally and he made the "80 knots thrust normal" call. He stated that at 100 knots, he felt the nose coming up and he noticed the captain was correcting for it. At about 120 knots, he felt the airplane was coming up, at which time he looked at the captain and then at the airspeed indicator. He noticed the pitch rate was unusual and the captain called "abort". He stated the airplane landed hard and proceeded off the end of the runway.

The first officer stated the captain called air traffic control (ATC). They then accomplished the emergency evacuation checklist. The captain then instructed the flight attendants to evacuate the airplane. The first officer stated he and the captain then left the cockpit and exited the airplane. He stated the emergency vehicles were already at the airplane when he exited.

PERSONNEL INFORMATION

The captain held an airline transport pilot certificate with an airplane multi-engine land rating and a commercial pilot certificate with an airplane single engine land rating. He also held an experimental aircraft builder certificate. The captain held airline transport pilot type ratings in A320, CE-500, and N-265 airplanes. The captain held a first-class medical certificate that was issued on December 7, 2000. This certificate contained the restriction, "Must have available glasses for near vision."

The captain reported that he had a lot of experience with general aviation having made his first solo on his 16th birthday. He flew DC-9s as a first officer for Republic Airlines. Northwest Airlines hired him in 1985. He began flying the Airbus A320 in 1990 as a first officer and was upgraded to captain on the A320 about 2 years prior to this accident. The captain reported he had a total of about 16,000 hours of flight time of which 7,000 hours were in A320s. Of that 7,000 hours, about 1,000 hours were as captain.

The first officer held an airline transport pilot certificate with an airplane multi-engine land rating and a commercial pilot certificate with an airplane single engine land rating. He held type ratings in DHC-8 and SA-227 airplanes. He held a flight instructor certificate with airplane single engine land and airplane instrument ratings, and both advanced and instrument ground instructor ratings. In addition, the first officer held a flight engineer certificate with a turbojet rating. The first officer held a first-class medical certificate that was issued on June 2, 2000. He also had a waiver on his medical certificate with the restriction "not valid for night flying or by color signal control."

The first officer began flying in general aviation. He was employed by Mesaba Airlines where

he flew SA-227's for 2 years as a first officer and 1 year as a captain. He then flew DHC-8's before being hired by Northwest Airlines in 1998. He reported that he had been a first officer on A320s since the end of April 2000. The first officer reported having a total of about 13,000 hours of flight time of which approximately 450 hours were in A320s.

The captain and first officer had not flown together in the past. The accident occurred on the first leg of a three-day trip for this flight crew.

AIRCRAFT INFORMATION

N357NW, an Airbus A320-212, serial number 830, accumulated a total airframe time of 9345.54 hours at the time of the accident. The airplane was powered by two CFM56-5-A3 engines. The engines had a total time of 4,123 hours at the time of the accident.

The dispatch released the takeoff gross weight for the flight was 151,961 pounds with a maximum takeoff gross weight of 156,500 pounds. The mean aerodynamic chord (MAC) was calculated to be 37.6 percent. The forward MAC limit for the airplane 17.0 percent and the aft MAC limit is 43.0 percent. The airplane was within its weight and balance limitations.

The dispatch released cargo weight was 4,808 pounds. The cargo (baggage) was weighed after the accident and the actual cargo weight was determined to be 6,250 pounds.

N357NW was maintained in accordance with a Federal Aviation Administration (FAA) approved continuous airworthiness program. The last inspection of the airplane was on March 7, 2001. The airplane accumulated a total of 85 hours since that inspection.

The Safety Board studied the aircraft performance in this accident. The Report on Aircraft Performance Group Investigation is in the public docket of this report. The performance study revealed:

The Airbus A320 is a "fly-by-wire" airplane. The pilot commands are sent to computers that then send a command to the flight controls as dictated by control laws to reach a desired target. Pitch control is normally accomplished through the elevator aileron control (ELAC) computer. Different control laws are used for different phases of flight. For takeoff, the A320 is designed to initially use ground control law (a direct law that commands a given elevator deflection for a given side stick input) and then it transitions to flight law. A review of the data indicates the NWA985 remained in ground control law throughout the event.

Given that the A320 is a "fly-by-wire" airplane, there is latency between the pilot's input and the actual movement of the elevator through the ELAC computer and the rate limit of the elevator. There is also latency between the actual movement of the flight controls and the time in which the movement is time stamped on the FDR. These latencies were taken into account during the review of the accident data.

METEOROLOGICAL INFORMATION

Automatic Terminal Information Service (ATIS) Information Echo was current at the time of the accident. The weather information contained in Information Echo included weather from the aviation routine weather report (METAR) taken at 0654. The weather at that time was recorded as:

Wind: 340 degrees at 6 knots
Visibility: 1 ½ statute miles
Runway 3L rvr 5,500 feet variable to 6,000 feet
Light snow and mist
Vertical Visibility 1,000 feet
Temperature: -2 degrees Celsius
Dew Point: -3 degrees Celsius
Altimeter: 30.04 inches of mercury (Hg)

The local controller reported that after issuing the ATIS information to NW985, he noticed the visibility was decreasing. He stated that he used the visibility chart and determined that the current visibility was $\frac{3}{4}$ (three quarters) of a mile.

Another METAR was issued at 0710. The weather at that time was reported as:

Wind: 350 degrees at 8 knots
Visibility: $\frac{3}{4}$ statute miles
Runway 3L rvr 4,500 feet variable to 5,000 feet
Light snow and mist
Vertical Visibility 700 feet
Temperature: -2 degrees Celsius
Dew Point: -3 degrees Celsius
Altimeter: 30.04 inches of Hg

The first officer reported that it was snowing lightly as they were taxiing to the runway. He stated that he could not estimate the visibility.

COMMUNICATIONS

At 0645:23, NW985 contacted Detroit, Metro, Ground Control Northwest requesting a taxi clearance, stating that they would need to be de-iced. NW985 was told to contact the Detroit, Metro, Ground Control Northeast Controller (GNE) during taxi.

At 0647:37, NW985 contacted the GNE controller and was told to hold short for three center at foxtrot for the deice pad. NW985 was then cleared to the deice pad and was told to call when they were finished.

At 0702:53, NW985 contacted the GNE controller stating they were ready to taxi. NW985 was cleared to taxi to runway 3C and was informed that information Echo was current. After stating that they did not have information Echo, the controller read it to them.

At 0705:28, N985 was cleared into position and hold on runway 3C.

At 0707:14, N985 was cleared for takeoff and to fly a heading of 050 after takeoff.

At 0708:34, N985 transmitted "evacuate, evacuate."

At 0708:55, NW985 informed the tower, "tower nine eighty five we're down."

At 0708:59, the local controller acknowledged the transmission.

At 0709:14, the local controller transmitted "northwest nine eighty five uh metro tower can you say your position due to the visibility."

At 0709:18, NW985 informs the tower "nine eighty five we're down off the end of the runway send a truck we're off three center we're crashed."

In his Personnel Statement, the local controller stated that after clearing NW985 for takeoff, he had a discussion with his supervisor regarding the decreasing visibility. He reported, "I then looked up at the radar, to determine the position of NW985. I did not see NWA985 on the D-Brite. I checked to see if the equipment (D-Brite) was functioning normally. I informed the cab coordinator. I then heard, "evacuate, evacuate." It was during this time that tower supervisor instructed the cab coordinator to activate the crash alarm.

AIRPORT INFORMATION

The takeoff was initiated on runway 3C (8,500 feet by 200 feet, wet asphalt). Friction testing was not performed on the runway either prior to or after the accident.

At 0700, another aircraft requested a braking action report. The braking action at that time was issued as fair on runway 3R and good on runway 3L. The information for runway 3R was 15 minutes old and the information for runway 3L was 30 minutes old. At 0703, the condition of runway 3C was reported as wet 50 feet either side of the centerline and a trace of snow between the wet area and the edge of the runway. At 0706, the braking action on runway 3L was reported as good.

FLIGHT RECORDERS

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

CVR and DFDR Factual Reports are included in the public docket of this report.

The CVR, a Sunstrand model 6020-001, contained four channels of good quality audio information. The CVR group was formed and met in Washington, D.C. on October 21, 2001.

The only reference to the stabilizer trim recorded on the CVR was when the flight crew performed the taxi checklist after the airplane was deiced. During that exchange, the first officer calls out "turimm" and one second later, the captain responds with "we have a uh, zero and a negative one point seven."

The DFDR, a L3COM model F1000, was undamaged, and the data regarding the accident flight was retrieved. The data retrieved from the DFDR was acquired from a variety of sources and was sent to the Flight Data Interface Unit (FDIU). The data was then multiplexed into a serial data stream, which was recorded by the DFDR. The processing delays associated with the various data sources can be from 700 to 1,500 ms before the data arrived at the FDIU. These data latencies and processing delays were taken into account during the review of the data.

The captain reported holding half forward stick until 80 knots as per Northwest Airlines procedures. The takeoff run was normal to this point. As the forward stick neared neutral at FDR time 204690 seconds (sec), the nose wheel lifted off the ground and the aircraft pitched up to about 5 degrees. Forward stick was applied at about FDR time 204696 sec followed by neutral stick. The pitch angle during this time decreases to 2.5 degrees with the nose gear remaining in the air. Aft stick was applied for approximately 0.75 seconds at FDR time 204701 sec and the pitch attitude rises to 7.8 degrees. This time roughly correlates with the "rotate" callout by the first officer. The aircraft then began a series of pitch oscillations between FDR time 204701 sec and 204708 sec. During this time, the pitch angle varies between a low of 3.2 degrees and a high of 12.7 degrees, and the side stick is moved several times between the forward and aft limit stops. Also during this time the crew retarded the throttles to abort the takeoff at FDR time 204705 sec. The aircraft then became airborne for about 2 seconds. The aircraft returned to the ground in a nose high attitude striking the tail at FDR time 204708 sec producing an impact of approximately 3 G's. The aircraft then decelerated on the runway and came to rest off the end of the runway.

A takeoff Trajectory Study was performed using the DFDR data. That study is included in the public docket of this report.

WRECKAGE AND IMPACT INFORMATION

The first marks visible on the runway were tire marks, which started approximately 4,950 feet from the approach end of the runway. These marks were about 30 feet in length and were located just left of the runway centerline.

The second mark visible on the runway was a gouge/scrape, which fanned out on the runway. Blue paint transfer matching the paint on the lower aft fuselage was visible in the gouge. This

mark was just left of the runway centerline and it was approximately 20 feet in length. The mark began about 5,180 feet from the approach end of the runway.

The last set of marks visible on the runway were tire marks. These began about 7,500 feet from the approach end of the runway. They started just left of the runway centerline then gradually continued left matching the airplanes path off the departure end of the runway. The tire marks indicate that the right main gear was approximately 50 feet left of the runway centerline when the airplane departed the pavement at the end of the runway. The airplane came to rest approximately 400 feet off the departure end of the runway in a muddy open field.

The airplane sustained substantial structural damage to the lower aft portion of the fuselage. The damage occurred approximately between fuselage stations 64 and 78. The bottom portion of the aft pressure bulkhead was crushed.

SURVIVAL ASPECTS

Flight attendant (F/A) "B" was stationed in and aft facing jumpseat in the rear galley during the takeoff. Her assigned exit was door 2 left (2L), which is the aft door on the left side of the airplane. F/A "B" stated that the takeoff initially seemed normal. She stated, "After takeoff, about 30 feet in the air, the aircraft did not lift up properly and hit the ground a short while later. She stated it "hit really hard and it felt like it broke into pieces." She stated she began yelling to the passengers to "bend over and stay down." She stated that after the airplane slid off the runway and came to a stop the captain made the announcement to evacuate the airplane. F/A "B" reported that she assessed the conditions outside of the 2L door, then she opened the door. She stated that the door felt like it opened normally, but it would not lock against the airplane. She stated she then noticed that the slide did not inflate and that the slide pack must have fallen on the ground because there was no red inflation handle on the floor. F/A "B" stated that she blocked the door and directed the passengers toward the 2R door. She stated that after all of the passengers were out of the airplane, she exited through door 2R. F/A "B" stated that once outside the airplane she assisted the passengers. She also stated that the police and other emergency vehicles arrived quickly.

F/A "C" was stationed in a forward facing jumpseat in the rear of the airplane during the takeoff. He stated that during the takeoff, the airplane contacted the runway with "tremendous force." He reported the impact was such that several of the oxygen mask panels opened. He reported he began yelling the command to "bend over, stay down" to the passengers. F/A "C" stated that some of the passengers in the mid-cabin area were getting out of their seats prior to the evacuation order being given. He reported that they continued to direct the passengers to bend over and stay down until several seconds later when the captain initiated the evacuation. F/A "C" reported that he opened the 2R door and the slide deployed and inflated normally. He stated the door functioned easily except that it did not lock against the fuselage as he expected it would. He stated F/A "B" then informed him that there was no slide at the 2L door. He stated he went to that door, pushed on it and noticed the slide pack was on the ground outside the airplane. F/A "C" stated he blocked the 2L door and passengers were

directed out of the 2R door.

Three of four door emergency slide exits operated as designed. The evacuation slide pack on the fourth door (2L) disconnected from the airplane and the slide/raft did not inflate as the door was opened. In addition, all four overwing exits had been opened and both overwing exit slide/rafts had deployed.

N357NW had a telescopic girt bar that attached to the slide/raft by a fabric skirt. The girt bar attaches the slide/raft to the airplane structure. The telescopic girt bar is used on Airbus A319, A320, and A321 airplanes that are certified for over water operations. The telescopic girt bar allows the slide/raft to be quickly disconnected from the airplane in the event of a ditching or emergency evacuation in water. When the girt bar is "armed" it is attached to the floor fitting in the airplane so that when the door is opened, the girt bar will pull the slide/raft and initiate its deployment. When the door is "disarmed", the girt bar remains attached to and moves with the door, preventing the deployment of the slide/raft. The telescopic end of the girt bar is locked in the extended position by a spring-loaded trigger. Squeezing the trigger causes the trigger locking mechanism to retract, shortening the overall length of the girt bar so that the slide/raft can be removed from the floor fittings.

The stationary portion of the girt bar is designed to have a chamfer (beveled edge) that measures 0.50 millimeter (mm) on the horizontal surface by 0.50 mm (+/-0.10) on the vertical surface where the end of the trigger locking mechanism contacts the portion of the girt bar. In addition, the end of the trigger locking mechanism is designed to have a 7 degree cutback to provide for better contact with the stationary portion of the girt bar when it is locked in the extended position. Inspection of the 2L girt bar revealed excess chamfer. It was noted that the girt bar would retract with both static and dynamic hand pressure. Examination of the 2L girt bar revealed that its chamfer was 0.77 mm on the horizontal surface by 0.93 mm on the vertical surface. Excess chamfer was also noted on the 2R and 1L door girt bars.

On May 16, 2001, the National Transportation Safety Board issued Safety Recommendations A-01-27 and -28, regarding the trigger locking mechanism on the telescopic girt bars. Additional information can be found in the Survival Factors Group Factual Report, which is included in the public docket of this report.

TESTS AND RESEARCH

Stabilizer Trim

Post accident inspection of the airplane revealed the trim setting for the stabilizer was set at negative 1.7. NWA procedures dictate that it is the responsibility of the first officer to set the stabilizer trim. The captain then cross checks the trim setting as part of the taxi checklist. The ACARS load data printout received by the crew showed the trim setting as "01.7"

The first officer stated he received the load data from an ACARS printout. He stated that

normally they received the data after pushback, but on this particular flight they received the data early. The first officer stated the stabilizer trim was negative 1.7. He said there was nothing unusual about this setting and it was within the green band. He stated that it was his understanding that the airplane should be flyable if the trim is set within the green band. He said he set the stabilizer trim by looking at the ACARS load data while referring to the flight control page on the ECAM display. He stated he moved the trim wheel so that the number on the ECAM display matched the one on the ACARS load data. The trim setting was also given to the crew on the ACARS MGL page. The first officer stated that 60 to 70 percent of the time they will have a negative unit setting for the stabilizer trim. A negative degree trim value correlates to a nose up trim setting as would be used with a forward CG.

During an interview, the captain stated he looked at the MGL sheet and not the load data sheet for the trim setting. He thought there was a negative sign preceding the 1.7, but there wasn't.

Northwest Airlines procedures at the time of the accident were to set the stabilizer trim using units (degrees) of trim instead of the center of gravity (CG) in percent of MAC. The trim setting given to the crew on the load data sheet was printed as "01.7".

Procedures in the Airbus Flight Crew Operating Manual, Standard Operating Procedures After Start Checklist, state that the trim should be set on the trim wheel using the takeoff CG.

N357NW was equipped with two index scales located adjacent to the stabilizer trim wheel. One scale indicated the CG as a percentage of mean aerodynamic chord (MAC). This scale showed the values 10.5, 17, 20, 25, 30, 35, and 41. The CG scale is not graduated and does not show intermediate values. The other scale indicated the number of degrees of stabilizer deflection above or below zero (neutral), followed by "UP" or "DN" to indicated the corresponding pitch direction of the airplane. These values were 4DN, 3DN, 2DN, 1DN, 0, 1UP, 2UP, 3UP ... 13UP, 13.5UP. Like the CG scale, the degree scale is not graduated and does not show intermediate values.

The trim setting (in degrees) is also shown on the flight control page of the ECAM display. This display, which correlates to the degrees scale on the trim wheel, shows the trim in tenths of degrees followed by "UP" or "DN" to show the corresponding pitch direction of the airplane. On the ECAM display, pitch-up trim values are preceded by a minus sign ("-"), but pitch-down trim values are not preceded by a plus sign ("+"). The ECAM display for this accident would have shown the stabilizer trim as "-1.7°UP." If the trim had been set correctly, it would have show as "1.7°DN."

On April 15, 2002, the Safety Board issued Safety Recommendations A-02-06 and A-02-07. These recommendations addressed procedures for setting the stabilizer trim, and the uniformity of data and displays available to the flight crew when setting the trim.

V-Speeds

The flightcrew reported they were unable to find the variable V-speed information in the weight manual for a full length (8,500 feet) runway 3C takeoff given their aircraft configuration. They instead used the speeds for a runway 3C/taxiway F intersection (6,800 feet remaining) takeoff. The speeds used by the flightcrew were V1- 138 knots, V2 - 143 knots, and Vr - 144 knots. The correct speeds for the takeoff should have been V1- 145 knots, V2 - 148 knots, and Vr - 148 knots.

ADDITIONAL INFORMATION

The airplane was released to NWA on March 18, 2001.

Parties to the investigation were the FAA, NWA, the Air Line Pilots Association, and the National Air Traffic Controllers Association. The Bureau Enquetes - Accidents (BEA) assigned an accredited representative to the investigation. Airbus Industrie provided technical advisors for the BEA.

As a result of this accident the National Transportation Safety Board issued safety recommendations A-02-06 and A-02-07 which addressed the elevator trim, and recommendations A-01-27 and A-01-28 which addressed the emergency evacuation slide/raft.

Pilot Information

Certificate:	Airline transport; Commercial	Age:	48, Male
Airplane Rating(s):	Single-engine land; Multi-engine land	Seat Occupied:	Left
Other Aircraft Rating(s):	None	Restraint Used:	
Instrument Rating(s):	Airplane	Second Pilot Present:	Yes
Instructor Rating(s):	None	Toxicology Performed:	Yes
Medical Certification:	Class 1 Valid Medical--w/ waivers/lim	Last FAA Medical Exam:	December 7, 2000
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	January 26, 2001
Flight Time:	15600 hours (Total, all aircraft), 7198 hours (Total, this make and model), 155 hours (Last 90 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Co-pilot Information

Certificate:	Airline transport; Commercial; Flight engineer; Flight instructor	Age:	37, 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):	Airplane single-engine; Instrument airplane	Toxicology Performed:	No
Medical Certification:	Class 1 Valid Medical--w/ waivers/lim	Last FAA Medical Exam:	June 2, 2000
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	April 26, 2000
Flight Time:	12500 hours (Total, all aircraft), 131 hours (Last 90 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Airbus Industrie	Registration:	N357NW
Model/Series:	A320-200	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	
Airworthiness Certificate:	Transport	Serial Number:	830
Landing Gear Type:	Retractable - Tricycle	Seats:	148
Date/Type of Last Inspection:	March 7, 2001 Continuous airworthiness	Certified Max Gross Wt.:	166400 lbs
Time Since Last Inspection:	85 Hrs	Engines:	2 Turbo jet
Airframe Total Time:	9346 Hrs	Engine Manufacturer:	CFM International
ELT:	Not installed	Engine Model/Series:	CFM56-5-A3
Registered Owner:	Northwest Airlines	Rated Power:	26500 Lbs thrust
Operator:		Operating Certificate(s) Held:	Flag carrier (121)
Operator Does Business As:		Operator Designator Code:	NWAA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument (IMC)	Condition of Light:	Day
Observation Facility, Elevation:	DTW,646 ft msl	Distance from Accident Site:	0 Nautical Miles
Observation Time:	07:10 Local	Direction from Accident Site:	0°
Lowest Cloud Condition:		Visibility	0.75 miles
Lowest Ceiling:	Indefinite (V V) / 700 ft AGL	Visibility (RVR):	
Wind Speed/Gusts:	8 knots /	Turbulence Type Forecast/Actual:	/
Wind Direction:	350°	Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	30.04 inches Hg	Temperature/Dew Point:	-2°C / -3°C
Precipitation and Obscuration:	Light - None - Snow		
Departure Point:	Detroit, MI (DTW)	Type of Flight Plan Filed:	IFR
Destination:	Miami, FL (MIA)	Type of Clearance:	IFR
Departure Time:	07:05 Local	Type of Airspace:	Class B

Airport Information

Airport:	Detroit Metropolitan, Wayne Co DTW	Runway Surface Type:	Asphalt
Airport Elevation:	646 ft msl	Runway Surface Condition:	Slush covered;Wet
Runway Used:	3C	IFR Approach:	None
Runway Length/Width:	8500 ft / 200 ft	VFR Approach/Landing:	None

Wreckage and Impact Information

Crew Injuries:	6 None	Aircraft Damage:	Substantial
Passenger Injuries:	3 Minor, 144 None	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	3 Minor, 150 None	Latitude, Longitude:	42.212501,-83.33889

Administrative Information

Investigator In Charge (IIC):	Sullivan, Pamela
Additional Participating Persons:	Jason Fedok; NTSB; Washington, DC Dennis Crider; NTSB; Washington, DC Steve Magladry; NTSB; Washington, DC Dennis Grossi; NTSB; Washington, DC Kenneth Egge; NTSB; Washington, DC Tony James; FAA; Washington, DC Sylvain Ladiesse; BEA; Le Bourget France Ed Davidson; Northwest Airlines; St. Paul, MN Jean Daney; Airbus Industrie; Blagnac France Lindsay Fenwick; Northwest Airlines; Bloomington, MN Darren Gaines; NATCA; Green, OH
Original Publish Date:	November 25, 2003
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.nts.gov/Docket?ProjectID=51932

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

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