National Transportation Safety Board
Office of Aviation Safety
Washington, DC 20594

DCA23LA125

OPERATIONAL FACTORS/HUMAN PERFORMANCE

Group Chair's Factual Report

October 17, 2023

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INCIDENT

Location:	John F. Kennedy International Airport, (JFK), New York, New York
Date:	January 13, 2023
Time:	2044 eastern standard time (EST)[1] January 14, 2023, 0144 coordinated universal time (UTC)
Airplane 1:	N754AN, American Airlines B777-200
Airplane 2:	N914DU, Delta Air Lines B737-900

GROUP

Group Chair	William Bramble National Transportation Safety Board (NTSB) Washington, D.C.
Group Chair	Warren Abrams[2] National Transportation Safety Board Washington, D.C.
Group member	Bryan Holliday[3] Allied Pilots Association (APA) Dallas, Texas
Group member	George Griffin American Airlines Dallas, Texas
Group Member	Mitch Mitchell Federal Aviation Administration (FAA) Washington, D.C.

DETAILS OF THE INVESTIGATION

On January 14, 2023, an operations and a human performance Investigator were assigned and began collecting information. Crew statements were requested from American Airlines and Delta Air Lines.

[1] All times are eastern standard time (EST) unless otherwise noted.
[2] Warren Abrams took over for Jim VanDerKamp on July 1, 2023
[3] Brian Holliday took over for Craig Stroup on February 13, 2023.

On January 17, 2023, a joint operations/human performance group was formed. The group listened to FAA Air Traffic Control (ATC) tower audio recordings. Because AAL106 continued its scheduled flight to London Heathrow Airport (LHR), the cockpit voice recorder exceeded its two-hour limit[4] and all event information was overwritten.

The operations/human performance group arranged through American Airlines for pilot interviews to be conducted at an American Airlines facility in Dallas, Texas on January 25, 2023. The group informed the pilots about its intent to make audio recordings of the interviews to support transcription so that the most accurate record of the interviews could be created. All three pilots said that they were willing to be interviewed but they were not willing to participate in recorded interviews. Next, the group requested that the pilots come to Washington, D.C. on February 8, 2023, so a court stenographer could record and transcribe the interviews. All three again declined to participate in recorded interviews.[5] On February 10, 2023, the NTSB issued subpoenas to the pilots who traveled to Washington D.C. on February 17, 2023, and participated in interviews that were recorded and transcribed by a court stenographer.

FACTUAL INFORMATION

1.0 History of Flight

The flight crew of American Airlines flight 106 (AAL106) consisted of a captain, a first officer (FO), and a relief first officer (FB).[6] They met in a crew room and reviewed the flight plan, weather, and some new procedures issued in an American Airlines "Fleet Harmonization" memo, dated January 3, 2023.[7] The FO and FB had not previously used the new procedures, which involved some changes to crew responsibilities. The captain recalled that the FO and FB were somewhat new to the B777 and to LHR. He told them he had operated many flights to LHR. He offered the FO the option to serve as pilot flying or pilot monitoring. She expressed interest in flying, so they decided she would serve as the pilot flying.

The crew arrived at the airplane, which was parked at gate 18. The FB conducted the exterior preflight inspection. Based on Automatic Terminal Information Service (ATIS)[8] information, the captain and FO anticipated and briefed a runway 31L

[4] The cockpit voice recorder installed in N754NA works on a continuous loop that records over previous data after 2 hours of operation.
[5] Source: DCA23LA125 OPS-HP Factual - Attachment 4 - AAL pilots' statements refusing to be recorded.
[6] American Airlines utilizes and additional first officer for certain flights who is designated as an FB. FB/FC duties are assigned by the captain to include flying as relief pilot during captain and FO enroute rest breaks.
[7] See DCA23LA125 OPS-HP Factual - Attachment 6 - American Airlines Fleet Harmonization Quick Reference Page
[8] Automatic Terminal Information Service (ATIS) is an automated service that provides current aerodrome information to departing and arriving aircraft.

departure. The FO programmed the flight management system (FMS). In an interview, the FO said she briefed the taxi, and the captain briefed "the details of the taxi". The captain recalled that his briefing was "Tango-Alpha, left on Bravo, and hold short at Juliet." The FO recalled that the departure plate and airport diagram were out and referenced during these discussions.

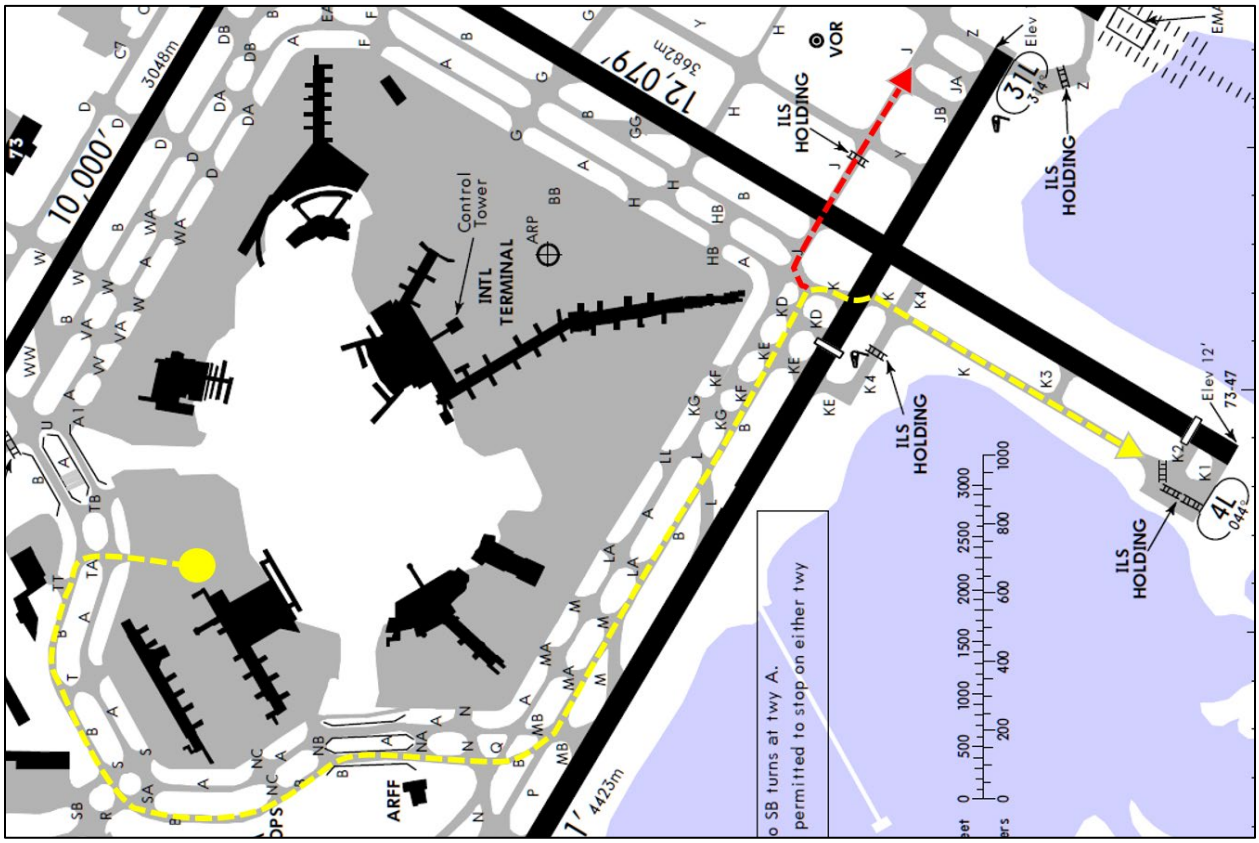

Figure 1. Jeppesen JFK airport diagram dated January 6, 2023, provided to NTSB by American Airlines with NTSB markings that show the intended taxi route of AAL106 from Terminal 8 gate 18 to runway 4L as a dashed yellow line and the deviation from that route as a dashed red line.

The captain produced some pages from the Fleet Harmonization Memo that contained a list of the new procedures and placed them on a console for the flight crew's ready reference. He told the other pilots they would discuss the changes enroute to LHR. The captain recalled asking the FO and FB if they were aware of any threats to the safety of the flight. The FO asked the captain to keep an eye on her when she was flying the approach into LHR because she was unfamiliar with it. The captain recalled telling the FB to monitor the "big picture" and speak up if he had any concerns. He recalled telling the FB he would not be offended if the FB did so.

AAL106 received its instrument clearance via the Aircraft Communications Addressing and Reporting System (ACARS)[9] at 2013:07. The clearance indicated they would depart runway 4L, so the captain and FO obtained a new ATIS, decided whether the wind was acceptable for runway 4L (it was), reprogrammed the FMS, and re-briefed the departure procedure and taxi. According to the FO, the revised taxi briefing was "same taxi route up until Bravo short of Kilo." The captain recalled, "I did re-brief that we were probably going to -- you know, they'll have you come up Kilo, and then as you get closer, they'll tell you when to cross." In post-incident interviews, all three pilots said they understood at that time that AAL106 would be departing runway 4L.[10]

The captain briefed the passengers on the public address system while the airplane was still parked at the gate. As he was doing this, an airline employee handed the flight crew a dangerous goods (DG) form.[11] The FO and FB noted that an item on the form was circled with a handwritten note indicating the item had not been loaded.[12] According to the captain, the FO asked if a handwritten notation was acceptable, and the captain said it was. The FO asked if they should include something about the notation in their ACARS acknowledgement indicating receipt of the form, and captain said that it was unnecessary to do so. The crew acknowledged their receipt of the DG form via ACARS at 2017.

At 2017:06 and 2017:11, an American Airlines dispatcher sent AAL106 two ACARS messages (an original and a duplicate) advising of moderate turbulence during departure and enroute. The first message requested crew acknowledgment. The FO responded with a confirmation code. The captain and FO recalled that the FO printed and briefed the captain on each message as it arrived. The FB recalled that he retrieved each printed message from the printer and handed it to the other pilots.

The crew recalled completing all required preflight checklists and closing the exterior door. At 2028, AAL106's ACARS unit sent an automated message to dispatch indicating the brakes had been released. The airplane was pushed back, and the crew started the engines. At 2033, the FO requested taxi clearance. A controller instructed AAL106 to taxi to runway 4L via taxiway B and hold short of taxiway K. The FO read back "Bravo short of Kilo American one zero six". The captain and the FO recalled having the airport diagram up on their iPads (one mounted on each side of the cockpit) for reference. The captain later told investigators that he generally wrote down taxi clearances, and that pen and paper were available to him, but he did not recall writing down the taxi instructions for AAL106. He began to taxi.

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[9] ACARS is a digital datalink system for transmission of short messages between aircraft and ground stations via airband radio or satellite.
[10] Source: DCA23LA125 OPS-HP Factual - Attachment 1 - AA pilots' transcripts.
[11] NOTOC was the abbreviation for NOTIFICATION TO CAPTAIN which informed him of hazardous material (HAZMAT) loaded in the cargo hold. Note: The terms NOTOC and DG form are used interchangeably.
[12] The circled item was a load of lithium batteries.

The captain recalled that the ACARS load closeout, which he normally received right after pushback, had not yet been received.[13] The captain was concerned that the delay in receiving the load closeout had something to do with the handwritten note on the DG form. He recalled that he slowed his taxi and, as the airplane approached taxiway NC and he asked the FO to request the load closeout via ACARS. At 20:34:47, the FO sent an ACARS message to dispatch requesting it. AAL106 received an automated reply stating "STANDBY- -LOAD AGENT NOTIFIED".

The captain later told investigators that when he worked two-pilot flights from JFK to LHR he normally told the FO they were "not going anywhere" until they received their load closeout. If the load closeout was delayed, he would stop the airplane in "the Tango Alpha alley" near the gate, and they would "take care of the closeout, the TPS, and all the flap settings and everything else, have it all done before we move the airplane." In this case, he decided to go ahead with the taxi because he had a third crew member to work the load closeout while they were taxiing.

The captain recalled telling the FB, "You better call and get us a closeout because I don't want to be holding up the line." During an interview the FB also recalled this and explained, "We didn't want to block up the traffic for ground, cause any issues getting delayed getting off the runway." The FB stopped listening to ground control and used the observer's radio panel to make a radio call on company frequency. The frequency was busy, so it took a while to transmit. When he eventually reached a company operations agent, she told him she needed to call a crew chief to determine the status of the load closeout. The FB waited.

At 2040:13, ATC recordings indicate that AAL106 received the following clearance from ground control, "American 106 heavy, cross 31Left at Kilo." The FO replied, "Cross 31Left at Kilo for American 106 heavy."[14] An Airport Surface Detection System – Model X (ASDE-X)[15] animation and ATC recordings provided by the FAA indicate that the airplane was on taxiway B approaching taxiway N. AAL106 was about 5,700 feet from taxiway K at the time and, in an interview, the FO said she thought the clearance was a bit early because she expected to receive it closer to taxiway K.

The company operations agent contacted the FB on the radio and told him the closeout had been delayed by cargo, but it would be coming shortly. The FB relayed this to the captain. According to the FB, this occurred as the airplane was approaching taxiway M (about 2041:39 according to ASDE-X).

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[13] The load closeout contained the final numbers confirming passenger numbers and fuel and cargo weights. See DCA23LA125 OPS-HP Factual - Attachment 7 - AAL106 Load Closeout

[14] Source: FAA ATC tower GC1 audio recording

[15] Airport Surface Detection System – Model X (ASDE-X) is a surveillance system using radar, multilateration and satellite technology that displays ground traffic and alerts air traffic controllers of potential runway conflicts by providing detailed coverage of movement on runways and taxiways.

Between 2042:12 and 2042:14 (between taxiways M and L), AAL106 received three identical ACARS messages warning of moderate to severe turbulence in their area of departure. ACARS records indicate that no acknowledgement of these messages was requested by dispatch or provided by the crew. As previously stated, the captain and FO recalled during interviews that the FO printed each weather message they received and briefed the captain on them, and the FB recalled retrieving each weather message from the printer and handing them to the other pilots.

The flight crew recalled that the captain asked the FB to call the number one flight attendant and tell them to make sure the flight attendants remained seated after takeoff until they were notified that it was safe to get up, and the FB recalled doing this. The captain then recalled asking the FO to make an announcement over the public address system telling the flight attendants to be seated for departure (in accordance with the new fleet harmonization procedures), and the FO recalled doing this. The FO recalled that the load closeout arrived while she was making this announcement. ACARS data indicate that the load closeout was electronically sent to AAL106 at 2043:06, shortly after the airplane crossed taxiway L (according to ASDE-X).

The FB recalled that he removed the load closeout paperwork from the printer, folded it, and handed it to the FO. A pile of paperwork remained on the center pedestal, covering his radio panel and other controls and displays, so he began cleaning up the pile so he could access the radios. After that, he selected his number one radio, which was tuned to ground control frequency, but the company frequency was still audible on his number two radio. He recalled that transmissions from the two radios were "muddying up" his audio.

At 2043:06 and 2043:20, respectively, ACARS data indicated that an updated zero fuel weight and center of gravity were transmitted electronically to AAL106's flight management computer (FMC). At 2043:38 and 2043:48, respectively, ACARS data indicated that the crew accepted these values in the FMC. These time stamps indicate that this occurred as AAL106 was crossing taxiway KE (according to ASDE-X).

The FO recalled that she began performing required crosschecks comparing the load closeout with calculations on the American Airlines Takeoff Performance System (TPS) application on her iPad. She had previously been using her iPad to display the airport diagram, but after opening the TPS application, the airport diagram was no longer visible. She recalled removing the iPad from its Velcro mount and placing it on her knee for about one minute while she discussed the numbers with the captain.

The captain recalled the FO reading the performance numbers aloud from her iPad.[16] He recalled telling her he could not see the information on her iPad and asking for the printed load closeout. One of the pilots handed him the printed copy and he began using it to confer with the FO. The captain recalled that he was conferring with the FO about the takeoff performance numbers as the airplane approached taxiway K.

About 2044:16, ASDE-X data indicated that the airplane passed taxiway K and continued along taxiway B, which curved to the left. About 2044:30 the airplane made a right turn on taxiway J and continued on taxiway J toward runway 4L. According to ASDE-X data, the airplane's speed on taxiway J was between 10 and 13 knots.

The FO recalled being head-down and talking about takeoff performance numbers as the captain turned toward a runway. She recalled hearing the captain say, "Cleared to cross." She recalled looking up, leaning forward, gazing down the runway to the right, and checking the runway and the final approach area for conflicting traffic. She recalled seeing no airplane on the runway. The captain recalled looking left and right to clear the runway before entering it. He recalled that he could see "a certain amount" to the right, and he did not see an airplane on the runway. According to all three pilots, the captain said, "clear left" and the FO responded, "clear right."

The captain recalled activating the airplane's runway turnoff lights, both landing lights, and the nosewheel light before entering runway 4L.[17] In an interview, the FO stated, "I know [the captain] had his taxi light on, and then I know when we did cross the runway, he reached his hand up to turn on the lights to cross. At that time, we were heads back and forth. So I don't know exactly what lights he had on, but I know he had crossing lights on." The FB recalled that the captain turned on the "taxi light, nose lights and the wing lights." He added, "I was probably just coming up from heads down at that point."

According to a runway status light (RWSL) system animation provided by the FAA,[18] DAL1943 began its takeoff roll about 2044:28. The GPS position of AAL106 crossed the runway 22R/4L hold short marking (where an airplane must stop if it has not been cleared to cross a runway) between about 2044:39 and 2044:42.[19] For more precise information about the timing of the movements of DAL1943 and AAL106, the activation of the RWSL system, see the aircraft performance study for this incident.

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[16] The FOM, section 1c.3.2. stated that crews were to "compare the TPS and load closeout against documents obtained from operations for reasonableness (e.g., ZFW, TOGW, V speeds). In an interview, the FO stated, "When the load closeout comes out, you have to show your TPS data and compare it to the closeout and with the temperatures and you have to make sure that everything checks as far as flap settings and runways and the SEC okays, passenger count."

[17] He stated that only the night taxi and beacon lights were on beforehand during the taxi.

[18] File provided by FAA labeled *JFK_01142022_0144z_RWSL.avi*.

[19] These locations have been estimated by comparing a depiction of taxiway J and runway 4L on the ASDE-X replay with the airport diagram and an overhead view of pavement markings dated June 19, 2022, that was retrieved from Google Earth.

In a written statement, the captain stated, “Crossing the centerline of the runway, I saw red lights illuminate.” In a subsequent interview, he added more specifically that the nose of the airplane was crossing the center of the runway when the red lights appeared. He stated, “It crossed my mind that it's a runway light, but… I was thinking I was at the right place, so I was thinking I don't know why that -- I'm seeing that red glow. And then I also decided I'm getting off this runway because I don't know why those lights came on.” The captain recalled adding power to expedite the crossing.

In a written statement the FO recalled, “we started across [the runway] as the red lights came on.” In an interview, she said the red lights appeared after they crossed the runway “stop lines”. She recalled that they appeared behind her shoulder, as if she was “sitting on them”. She stated that both she and the captain realized something “wasn't right”, and the captain added power and “pushed across the runway.” She recalled that as he did so, she was “still looking down the runway and didn't see.”

The FB recalled in an interview that he was heads-down as they approached the runway he heard “some confusion about crossing a runway.” He raised his head and saw that they were already “pretty much across the hold short line”, because he could not see any hold position lights or markers. ASDE-X data indicated that the airplane approached runway 4L. The FB recalled that he could not at first see down the runway, but as the airplane “straightened out to perpendicular across the runway” he saw an airplane “down to the right.”

The captain recalled that after they crossed the runway the FB said, “There's somebody on the -- somebody's taxiing on the runway.” The captain looked out the right cockpit window and saw an airplane on runway 4L. It appeared the other airplane was taxiing on the runway. It did not look “that close” from his perspective.

The captain parked the airplane on the other side of runway 4L near the intersection of taxiways J and Z. The FO switched her radio to tower frequency. A tower controller notified the crew about a "possible pilot deviation.” The controller provided a number for them to call. The captain asked, “The last clearance we were given we were cleared to cross is that correct?” The controller replied “American 106 heavy we’re departing runway four left… you are supposed to depart runway four left. You are currently holding short of runway three one left.”

The captain called the telephone number the controller provided. The controller who answered informed him that the tower was reviewing the incident. The controller added that they were in the middle of a runway change, and they needed some time to relieve the involved controllers and do some reporting. The call dropped while the controller was talking, and the captain called back. The captain asked, “Where do we stand at this time,” and he inquired about whether AAL106 should prepare to depart

runway 4L. The controller replied that due to the runway change, AAL106 should expect to depart runway 31L.

The controller added that they were "just trying to figure out what happened" and asked the captain if he could provide a verbal statement. The captain told the controller the crew had briefed a runway 31L departure, but "as we were coming out along on Bravo as we taxied out we got a new… it was runway four left and then we were told to cross at Juliet and… or Kilo or something I don't remember exactly now exactly because we were still trying to get this closeout problem fixed and I guess then we crossed the wrong runway." The controller stated ATC personnel were listening to audio recordings to confirm what clearances had been issued to AAL106. The controller took the captain's name and phone number.

The captain said AAL106 was on the way to LHR with an estimated time enroute of six hours and that his phone would be off until he landed. The controller replied that ATC would facilitate AAL106's departure in a few minutes and they would pass a message to the crew via an air route traffic control center if they needed anything further. The captain asked whether they were "all set then," and the controller said yes. The controller instructed the captain to resume communications by radio, and AAL106 departed JFK.

The crew did not report the incident to American Airlines prior to departure. During an interview, the captain was asked if he was supposed to do so. The captain replied that the tower had informed them about a "possible" pilot deviation and indicated that they were switching AAL106 to runway 31L for departure. He said that he was not aware of any provision in the FOM that prohibited AAL106 from departing at that time. He said that, in addition, the FB called an Allied Pilots Association hotline while they were parked on the taxiway after the incident, and a person on the hotline had confirmed that there was nothing prohibiting their departure. The captain further stated that he asked the FO and FB if they felt okay continuing the flight and they said yes, so he decided to depart.

2.0 Flight Crew Information

The following section provides Information about the flight crews involved in the incident.

2.1 The American Airlines Captain

The American Airlines captain was 61 years old. His date of hire was June 23, 1989. He began flying for American Airlines on the B727[20] and then flew the "Super 80"

[20] The Boeing 727 is a narrow-body airliner that was developed and produced by Boeing Commercial Airplanes.

in Chicago before flying the B777 in Chicago and New York. Prior to American Airlines, he was a corporate pilot for Moog, Inc. He graduated from Embry-Riddle Aeronautical University with a B.S. in Aeronautical Science in 1983. The FO of AAL106 described the captain's proficiency during the incident flight as "excellent" and his leadership as "very good". She said that he seemed well-prepared (having brought along a laminated copy of the new harmonization procedures), and he appeared to be "on his game." The FB also felt the captain's proficiency was "good" and his leadership was "very good."

2.1.1 Pilot Certification Records [21]

FAA records for the American Airlines captain indicated the following:

Private Pilot – Airplane Single-Engine Land - Certificate issued July 21, 1980

Private Pilot – Airplane Single-Engine and Multiengine Land – Certificate issued November 17, 1981.

Commercial Pilot – Airplane Single and Multiengine Land, Instrument Airplane – Certificate issued June 16, 1982.

Airline Transport Pilot – Airplane Multiengine Land; Commercial Privileges Single Engine Land – Certificate issued May 11, 1988.

Airline Transport Pilot – Airplane Multiengine Land; DC-9; Commercial Privileges Single Engine Land; DC-9 Circ Apch -VMC Only; DC-9 SIC Privileges Only – Certificate issued February 13, 2006.

Notice of Disapproval – Airline Transport Pilot; B-777 – Notice of Disapproval issued April 4, 2006.

Airline Transport Pilot – Airplane Multiengine Land; DC-9 B-777; Commercial Privileges Single Engine Land; DC-9 Circ Apch -VMC Only; DC-9 SIC Privileges Only; B-777 Limited to FAR 121.543 (b) (3) (i) – Certificate issued April 16, 2006.

Airline Transport Pilot – Airplane Multiengine Land; DC-9 B-777; Commercial Pilot Privileges; Airplane Single Engine Land; Limitations: English Proficient; DC-9 B-777 Circ Apch -VMC Only; DC-9 SIC Privileges Only; – Certificate issued February 13, 2022.

[21] Source: FAA.

Flight Engineer – Turbojet Powered; Limitation "This certificate is subject to the provisions of Exemption No. 4901[22]." Certificate issued August 15, 1989.

Flight Engineer – Turbojet Powered - Certificate issued September 19, 1989.

2.1.2 Certificates and Ratings Held at Time of the Incident [23]

FAA records for the American Airlines captain indicated the following certificates and ratings held at the time of the incident:

AIRLINE TRANSPORT PILOT (issued April 16, 2006)
Airplane Multiengine Land
DC-9, B-777
Commercial Privileges – Airplane Single-Engine Land
Limitations English Proficient; DC-9, B-777 Circ Apch – VMC Only,
DC-9 SIC Privileges Only
Flight Engineer- Turbojet Powered. (Issued September 19, 1989)

Flight Engineer- Turbojet Powered. (Issued September 19, 1989)

Medical Certificate First Class (issued September 9, 2022)
Limitations: Holder must possess glasses for near and intermediate vision

2.1.3 Training and Proficiency Checks [24]

The American Airlines captain's date of hire and details about his training and proficiency checks are listed below.

Table 1. American Airlines Captain's training and proficiency checks.

American Airlines date of hire	June 23, 1989
Date upgraded to Captain on B-777	February 13, 2022
Date of most recent proficiency check on B-777	February 13, 2022
Date of most recent PIC line check on B-777	March 13, 2022
Date of most recent proficiency training	November 8, 2022

[22] Source: Regulations.gov; The 4901 exemption is for applicants who wish to be issued an unrestricted flight engineer certificate and be exempt from the operating requirements.

[23] Source: FAA.
[24] Source: American Airlines.

2.1.4 Flight Times [25]

The American Airlines Captain's flight times (in hours) are listed below.

Table 2. American Airlines Captain's flight times.

Total pilot flying time at American Airlines	19,995.24
Total pilot-in-command (PIC) time	14,000 EST
Total B777 time	9031.12
Total flying time last 24 hours	7.03
Total flying time last 30 days	35.39
Total flying time last 90 days	85.23
Total flying time last 12 months	376.28 EST

2.1.5 72-hour History [26]

The American Airlines captain resided in a suburb of Buffalo, New York, and commuted by airline to his base at JFK. He said he needed 7 to 8 hours of sleep per night to feel rested when off duty for an extended time.

Tuesday, January 10, he woke between 0700 and 0800 at his residence. He departed Buffalo Niagara International Airport (BUF) at 1330 on a deadhead flight and arrived JFK at 1440. He reached the American Airlines crew office about 1500 and slept on a recliner in a crew rest area until 1730. He served as captain on American Airlines flight 104 which departed at 2244. During the flight, he "slept well" from 0250 to 0455 on a flat bed in crew rest quarters.

Wednesday, January 11, the captain's flight arrived LHR at 0544 (1044 UTC). The captain boarded a shuttle bus to a hotel at 0700 (1200 UTC). He checked into his hotel about 0715 (1215 UTC). He showered, went to bed, and slept until 1300 (1800 UTC). Between 1300 (1800 UTC) and 1600 (2100 UTC) he exercised, ate a meal with fellow crewmembers, and checked email. At 1600 (2100 UTC) he went to bed.

Thursday, January 12, the captain woke at 0630 (1130 UTC). He checked out of his hotel about 0930 (1430 UTC). He boarded a shuttle bus to LHR about 0935 (1435 UTC) and reported for duty as captain of American Airlines flight 107. His flight departed LHR at 1153 (1653 UTC). During the flight he "slept well" from 1430 to 1630 on a flat bed in crew rest quarters. That flight arrived JFK at 1957. The captain

[25] Source: American Airlines.
[26] Information about the captain's sleep and recent activities was obtained via company records, an in-person interview, cell phone records, and written correspondence.

boarded a deadhead flight at 2230 and arrived BUF at 2330. He reached his residence about 2400.

Friday, January 13, the captain recalled going to bed about 0030. He woke about 0900. He exercised from 1100 to 1120. He left his residence for the airport about 1215. He departed BUF on a deadhead flight at 1321. He arrived JFK at 1430. He reached American Airlines offices about 1500. He slept in a recliner in a crew rest area from about 1600 to 1800. After waking, he met the FO and FB and reviewed paperwork for AAL106. The FO and FB also reported that the captain's alertness and mood seemed good.

The captain recalled getting good quality sleep during his nap in the crew rest area. He said that he felt rested and was in a good mood when he reported for duty. The captain's cellular telephone records contained no activity that overlapped any of the sleep opportunities described above.

2.2 The American Airlines FO

The American Airlines FO was 52 years old. Her date of hire was April 14, 2014. She was based at LaGuardia Airport (LGA). She was transitioning to the position of FO on the B777. She had completed operating experience (OE) and the incident flight was the last flight of her consolidation period.[27] Her previous position was captain on the B737, also based at LGA. Prior to American Airlines, she had flown for Alaska Airlines and ExpressJet Airlines. She had flown out of JFK on 4 previous occasions, and on those occasions, she had served as FB or FC The captain of AAL106 described the FO's proficiency during the incident flight as "very good." The FB described her proficiency as "good."

2.2.1 Pilot Certification Records [28]

FAA records for the American Airlines FO indicated the following:

Private Pilot – Airplane Single-Engine Land certificate issued on March 25, 1998

Private Pilot – Airplane Single-Engine Land, Instrument Airplane - Certificate issued April 8, 1999.

[27] Per 14 CFR Part 121.434 Operating Experience, Operating Cycles, and Consolidation of Knowledge and Skills, an airline transport pilot serving as first or second in command who receives an additional type rating must receive 100 hours of experience within 120 days or complete requalification training.
[28] Source: FAA.

Commercial Pilot- Airplane Single Engine Land, Instrument Airplane – Certificated issued May 14, 1999.

Airline Transport Pilot, Airplane Multiengine Land, Commercial Pilot privileges Airplane Single Engine Land. – Certificate issued November 2, 2000.

Airline Transport Pilot, Airplane Multiengine Land, Commercial Pilot privileges Airplane Single Engine Land and Sea. – Certificate issued April 30, 2002.

Airline Transport Pilot, Airplane Multiengine Land, EMB-145; Commercial Pilot privileges Airplane Single Engine Land and Sea; EMP-145Circ. Appc. – VMC Only; – Certificate issued December 31, 2005.

Airline Transport Pilot, Airplane Multiengine Land, EMB-145; Commercial Pilot privileges Airplane Single Engine Land and Sea; English Proficient; EMB-145 Circ Appc – VMC Only – Certificate issued January 9, 2012.

Airline Transport Pilot, Airplane Multiengine Land, EMB-145; B-737; Commercial Pilot privileges Airplane Single Engine Land and Sea; English Proficient; B-737 SIC Privileges Only; EMB-145, B-737 Circ Appc – VMC Only – Certificate issued October 23, 2012.

Airline Transport Pilot, Airplane Multiengine Land, A-320, EMB-145, B-737; Commercial Pilot privileges Airplane Single Engine Land and Sea; English Proficient; B-737 SIC Privileges Only; A-320 B-737 EMB-145, Circ Appc – VMC Only – Certificate issued May 24, 2014.

Airline Transport Pilot, Airplane Multiengine Land, B-757: B-767: A-320: EMB-145: B-737; Commercial Pilot privileges Airplane Single Engine Land and Sea; English Proficient; B-737 SIC Privileges Only; B-757: B-767: A-320: B-737: EMB-145, Circ Appc – VMC Only – Certificate issued September 3, 2015

Airline Transport Pilot, Airplane Multiengine Land, B-777: B-757: B-767: A-320: EMB-145: B-737; Commercial Pilot privileges Airplane Single Engine Land and Sea; English Proficient; B-737 SIC Privileges Only; B-777: B-757: B-767: A-320: B-737: EMB-145, Circ Appc – VMC Only – Certificate issued December 14, 2019.

Airline Transport Pilot, Airplane Multiengine Land, B-777: B-757: B-767: A-320: EMB-145: B-737; Commercial Pilot privileges Airplane Single Engine Land; Airplane Single Engine Sea; Limitations: English Proficient; B-737: EMB-145, Circ Appc – VMC Only – Certificate issued November 21, 2020.

Flight Instructor, Airplane Single Engine – Certificate issued July 8, 1999

Flight Instructor, Airplane Single Engine, Instrument Airplane – Certificate issued August 4, 1999.

Flight Instructor, Airplane Single Engine, Airplane Multiengine, Instrument Airplane – Certificate issued January 21, 2001.

Flight Instructor, Airplane Single and Multiengine, Instrument Airplane – Certificate issued January 27, 2003.

Flight Instructor, Airplane Single Engine; Airplane Multiengine, Instrument Airplane – Certificate issued March 18, 2019.

Flight Instructor, Airplane Single and Multiengine, Instrument Airplane – Certificate issued February 4, 2021.

2.2.2 Certificates and Ratings Held at Time of the Incident [29]

FAA records for the American Airlines FO indicated the following certificates and ratings held at the time of the incident:

AIRLINE TRANSPORT PILOT (issued November 21, 2020)
Airplane Multiengine Land
A320, B-737, B-757, B-767, B-777, MB-145
Commercial Privileges – Airplane Single-Engine Land; Airplane Single Engine Sea
Limitations English Proficient; B-737, EMB-145, Circ Apch VMC Only

Medical Certificate First Class (issued August 18, 2022)
Limitations: None

2.2.3 Training and Proficiency Checks [30]

The American Airlines FO's date of hire and details about her training and proficiency checks are listed below.

Table 3. American Airlines FO's training and proficiency checks.

American Airlines date of hire	April 14, 2014
Date qualified at FO on B-777	December 12, 2019
Date of most recent proficiency check on B-777	February 13, 2022

[29] Source: FAA.
[30] Source: American Airlines.

Date of most recent PIC line check on B-777	September 11, 2022
Date of most recent proficiency training	August 25, 2022

2.2.4 Flight Times [31]

The FO's flight times (in hours) are listed below.

Table 4. American Airlines FO's flight times.

Total pilot flying time at American Airlines	1,188.21
Total pilot-in-command (PIC) time	149.45
Total B777 time	126.20
Total flying time last 24 hours	7.03
Total flying time last 30 days	6.54
Total flying time last 90 days	92.49
Total flying time last 12 months	234.59 EST

2.2.5 72-hour History [32]

The American Airlines FO resided in Manasquan, New Jersey and commuted by car to her base at LGA. She stated that she needed six hours of sleep per night to feel rested when she was not working for an extended time.

The FO was on reserve duty at home on Tuesday, January 10, through Thursday, January 12. She estimated that she woke at 0700 and went to sleep at 2200 each day. She recalled exercising, running errands, and engaging in routine activities at home on each of those days.

Friday, January 13, the FO woke at 0700, exercised and engaged in routine activities at home. She took a nap of unknown duration; however, she told investigators it was her usual practice to nap for at least an hour and a half before every late-night or transatlantic trip. She departed her residence at 1700 and drove to JFK, arriving about 1830. She recalled feeling rested and being in a good mood when she reported for duty. The captain of AAL106 described her as appearing rested and in a good mood.

[31] Source: American Airlines.
[32] Information about the FO's sleep and recent activities was obtained via company records and an in-person interview.

2.3 The American Airlines FB

The American Airlines relief first officer (FB) was 50 years old. He had flown for Envoy Air before joining American Airlines. The captain of AAL106 described the FB's proficiency during the incident flight as "very good." The FO described his proficiency as "excellent".

2.3.1 Pilot Certification Records [33]

FAA records for the American Airlines FB indicated the following:

Private Pilot – Airplane Single-Engine Land certificate issued July 29, 1994

Private Pilot – Airplane Single-Engine and Multiengine Land – Certificate issued January 10, 1995.

Private Pilot – Airplane Single-Engine and Multiengine Land, Instrument Airplane – Certificate issued November 30, 1995.

Commercial Pilot – Airplane Single-Engine Land; Instrument Airplane – Certificate issued July 15, 1996.

Commercial Pilot – Airplane Single and Multiengine Land; EMB-145; Limitations, EMB-145 SIC Privileges Only; EMB-145 Circ. Apch – VMC Only – Certificate issued March 21, 2006.

Airline Transport Pilot; Airplane Multi-Engine Land; EMB-145: Commercial Pilot Privileges; Airplane Single Engine Land; Limitations: English Proficient; ATP Circ Apch – VMC Only; EMB-145 Circ Apch VMC Only.- Certificate issued March 2, 2013.

Airline Transport Pilot; Airplane Multi-Engine Land; A-320; EMB-145: Commercial Pilot Privileges; Airplane Single Engine Land; Limitations: English Proficient; ATP Circ Apch – VMC Only A320, EMB-145; Circ Apch VMC Only.- Certificate issued November 13, 2016.

Airline Transport Pilot; Airplane Multi-Engine Land; A-320; B-777; EMB-145: Commercial Pilot Privileges; Airplane Single Engine Land; Limitations: English Proficient; ATP Circ Apch – VMC Only.; A320 B-777 EMB-145, Circ Apch VMC Only.- Certificate issued June 9, 2022

Flight Instructor; Airplane Single Engine; Instrument Airplane – Certificate issued July 28, 1997

[33] Source: FAA.

Mechanic; Airframe; Powerplant – Certificate issued December 9, 1993

2.3.2 Certificates and Ratings Held at Time of the Incident [34]

FAA records for the American Airlines FB indicated the following certificates and ratings held at the time of the incident:

AIRLINE TRANSPORT PILOT (issued June 9, 2022)
Airplane Multiengine Land
A-320, B-777, EMB-145
Commercial Privileges – Airplane Single-Engine Land
Limitations English Proficient; A-320, B-777, EMB-145 Circ Apch – VMC Only, ATP Circ Apch VFR Only
Flight Instructor; Airplane Single Engine; Instrument Airplane. (Issued July 28, 1997)
Mechanic; Airframe; Powerplant (issued December 9, 1993)

Medical Certificate First Class (issued September 9, 2022)
Limitations: Holder must possess glasses for near and intermediate vision

2.3.3 Training and Proficiency Checks Completed [35]

The American Airlines FB's date of hire and details about his training and proficiency checks are listed below.

Table 5. American Airlines FB's training and proficiency checks.

American Airlines date of hire	September 20, 2016
Date qualified at FO on B-777	June 9, 2022
Date of most recent proficiency check on B-777	June 9, 2022
Date of most recent PIC line check on B-777	June 27, 2022
Date of most recent proficiency training	June 9, 2022

2.3.4 Flight Times [36]

The American Airlines FB's flight times (in hours) are listed below.

[34] Source: FAA.
[35] Source: American Airlines.
[36] Source: American Airlines.

Table 6. American Airlines FB's flight times.

Total pilot flying time at American Airlines	2,836.43
Total pilot-in-command (PIC) time	No PIC time at American Airlines
Total B777 time	110.18
Total flying time last 24 hours	7.03
Total flying time last 30 days	16.55
Total flying time last 90 days	131.06
Total flying time last 12 months	187.09

2.3.5 72-hour History [37]

The American Airlines FB resided in Poughkeepsie, New York and commuted by car to his base at JFK. He stated that he needed 6.5 to 7 hours of sleep to feel rested when he was off duty for an extended time.

Tuesday January 10 through Thursday January 12, the FB was off duty. He reported waking at 0700 and going to bed at 2130 or 2200. He said it took him a maximum of 30 minutes to fall asleep when he went to bed. During the day he engaged in routine activities with his family.

On Friday, January 13, he woke about 0700. He engaged in routine activities at home. He departed his residence at 1400 or 1500 and drove to JFK. He recalled feeling rested and being in a good mood when he reported for duty. The captain also described him as appearing rested and in a good mood.

2.4 The Delta Air Lines Captain

The Delta Air Lines captain was 61 years old and resided in the New York area at the time of the incident. He was hired at Delta on February 1, 1999. He started his flying as a copilot on the DC-9 before making his way to the right seat on the B-757/767. After eight years on those aircraft, he transitioned to the right on the B-767-400. In October 2018 he checked out on the B-737 as a captain.

2.4.1 Pilot Certification Records [38]

FAA records for the Delta Air Lines captain indicated the following:

[37] Information about the FB's sleep and recent activities was obtained via company records and an in-person interview.
[38] Source: FAA.

Commercial Pilot – Airplane Single Engine Land: Rotorcraft Helicopter; Instrument Airplane and Helicopter – Certificate issued on September 20, 1987.

Commercial Pilot – Airplane Single Engine Land: Rotorcraft-Helicopter; Instrument Airplane and Helicopter; SK-65[39] – Certificate issued on May 8, 1992

Commercial Pilot – Airplane Single and Multiengine Land; Rotorcraft-Helicopter; Instrument Airplane and Helicopter; SK-65 – Certificate issued October 14, 1993.

Airline Transport Pilot- Airplane Multiengine Land; NA-265[40], BE-200[41]; Commercial Privileges; Airplane Single Engine land; Rotorcraft-Helicopter- Certificate issued May 10, 1995.

Airline Transport Pilot- Airplane Multiengine Land; NA-265, BE-200; Commercial Privileges; Airplane Single Engine land; Rotorcraft-Helicopter; SK-65 - Certificate issued August 9, 1995.

Airline Transport Pilot- Airplane Multiengine Land; B-757, B-767, NA-265, BE-200, CE-500; Commercial Pilot Privileges; Airplane Single Engine land; Rotorcraft-Helicopter; Instrument Helicopter; SK-65; English Proficient – Certificate issued September 17, 2009.

Airline Transport Pilot- Airplane Multiengine Land; B-757, B-767, NA-265, BE-200, CE-500, G-280; Commercial Pilot Privileges; Airplane Single Engine land; Rotorcraft-Helicopter; Instrument Helicopter; SK-65; English Proficient – Certificate issued March 10,2013.

Airline Transport Pilot- Airplane Multiengine Land; B-737, B-757, B-767, NA-265, BE-200, CE-500, G-280; Commercial Pilot Privileges; Airplane Single Engine land; Rotorcraft-Helicopter; Instrument Helicopter; SK-65; English Proficient; B-737 Circ Apch – VMC Only – Certificate issued November 13, 2018.

2.4.2 Certificates and Ratings Held at Time of the Incident [42]

FAA records for the Delta Air Lines captain indicated the following certificates and ratings held at the time of the incident:

[39] Source: Sikorsky: The SK-65 helicopter is a 72 foot long, 6 bladed main rotor and 4 blade tail rotors powered by two 2,850 shp. General Electric turbine engines.
[40] Source: North American Sabreliner: The NA-265 designation is the military numbering for a Sabreliner Sabre-60 corporate jet.
[41] Beechcraft King Air.
[42] Source: FAA.

AIRLINE TRANSPORT PILOT (issued November 13, 2018)
Airplane Multiengine Land
B-737, B-757, B-767, Be-200, CE-500, N-265, G-280, SK-65.
Commercial Privileges – Airplane Single-Engine Land
Rotorcraft Helicopters
Instrument Helicopters
Limitations English Proficient; B-737 Circ Apch – VMC Only,

Medical Certificate First Class (issued August 9, 2022)
Limitations: None listed

2.4.3 Training and Proficiency Checks Completed [43]

The Delta Air Lines captain's date of hire and details about his training and proficiency checks are listed below.

Table 7. Delta Air Lines captain's training and proficiency checks.

Delta Air Lines date of hire	February 1, 1999
Date qualified as captain on the B-737	October 3, 2018
Date of most recent proficiency check on B-737	February 13, 2022
Date of most recent PIC line check on B-737	November 22, 2022
Date of most recent proficiency training	September 21, 2022

2.4.4 Flight Times [44]

The Delta Air Lines captain's flight times (in hours) are listed below.

Table 8. Delta Air Lines captain's flight times.

Total pilot flying time at Delta Air Lines	11,453
Total pilot-in-command (PIC) time	2,906
Total B737 time	3,258.47
Total flying time last 24 hours	4
Total flying time last 30 days	60.54
Total flying time last 90 days	231
Total flying time last 12 months	434 EST

[43] Source: Delta Air Lines.
[44] Source: Delta Air Lines.

2.5 The Delta Air Lines FO

The Delta Air Lines FO was 33 years old and resided in San Juan, PR at the time of the incident. He was hired by Delta on June 14, 2022. As a new hire he had started his flying as a copilot on the B-737.

2.5.1 Pilot Certification Records [45]

FAA records for the Delta Air Lines FO indicated the following:

Notice of Disapproval- Private Pilot Single Engine Land - Notice of Disapproval issued August 29, 2007.

Private Pilot- Airplane Single Engine Land – Certificate issued November 11, 2007.

Airplane Single Engine Land, Instrument Airplane - Notice of Disapproval issued February 9, 2012.

Private Pilot- Airplane Single Engine land; Instrument Airplane; English Proficient – Certificate issued April 3, 2012.

Commercial Pilot- Airplane Multiengine Land; Instrument Airplane; Private Pilot Privileges; Airplane Single Engine Land; Limitations: English Proficient – Certificate issued August 20, 2012.

Commercial Pilot- Airplane Single and Multiengine Land; Instrument Airplane; Limitation: English Proficient – Certificate issued September 14, 2012.

Commercial Pilot- Airplane Single and Multiengine Land; Instrument Airplane; SD-3 Second in Command Privileges Only. Limitation: English Proficient – Certificate issued February 22, 2015.

Airline Transport Pilot- Airplane Multiengine Land; EMB-145 SD-3; Commercial Pilot Privileges, Airplane Single Engine Land. Limitation: English Proficient; SD-3 SIC Privileges Only; EMB-145 Circ. Apch. – VMC Only - Certificate issued March 30, 2018.

Airline Transport Pilot- Airplane Multiengine Land; B-737, EMB-145, SD-3; Commercial Pilot Privileges, Airplane Single Engine Land. Limitation: English Proficient; SD-3 SIC Privileges Only; B-737, EMB-145 Circ. Apch. – VMC Only - Certificate issued August 10, 2022.

[45] Source: FAA.

2.5.2 Certificates and Ratings Held at Time of the Incident [46]

FAA records for the Delta Air Lines FO indicated the following certificates and ratings held at the time of the incident:

AIRLINE TRANSPORT PILOT (issued October 10, 2022)
Airplane Multiengine Land
B-737, EMB-145, SD-3
Commercial Privileges – Airplane Single-Engine Land
Limitations English Proficient; B-737 EMB-145 Circ Apch – VMC Only, SD-3 SIC Privileges Only.

Medical Certificate First Class (issued September 22, 2022)
Limitations: None listed.

2.5.3 Training and Proficiency Checks Completed [47]

The Delta Air Lines FO's date of hire and details about his training and proficiency checks are listed below.

Table 9. Delta Air Lines FO's training and proficiency checks.

Delta Air Lines date of hire	June 14, 2022
Date qualified as first officer on the B-737	August 10, 2022
Date of most recent proficiency check on B-737	September 7, 2022
Date of most recent line check on B-737	September 7, 2022
Date of most recent proficiency training	September 21, 2022

2.5.4 Flight Times [48]

The Delta Air Lines FO's flight times (in hours) are listed below.

Table 10. Delta Air Lines FO's flight times.

Total pilot flying time at Delta Air Lines	203
Total B737 time	203
Total flying time last 24 hours	4

[46] Source: FAA.
[47] Source: Delta Air Lines.
[48] Source: Delta Air Lines.

Total flying time last 90 days	136

3.0 Airplane Information

The American Airlines 777 aircraft is configured with seating for 273 in three cabins including Business Class - featuring 37 seats. The approximate dimension of the airplane is 200 feet long with an approximate wingspan of 200 feet. The 777 is powered by two Rolls Royce Trent engines each capable of producing 95,000 pounds of thrust each. Fully loaded, the 777 has a range of over 5,000 nautical miles.

The incident airplane had Velcro pads on the side panels inside the cockpit to which the pilots attached their iPads for easy viewing. According to American Airlines, airplanes in its B777 fleet, including N754AN, were not equipped with an electronic runway situation awareness tool capable of providing aural annunciations about runways the airplane was approaching.[49]

Figure 2. The first officer's iPad mount in the cockpit of an American Airlines B777.

[49] An example of a Runway Situation Awareness Tool that is installed on some B777 airplanes is the Runway Awareness and Advisory System (RAAS) manufactured by Honeywell Aerospace.

4.0 Meteorological Information

JFK weather observation at 1951 EST, wind from 320 degrees at 18 knots, visibility 10 miles or more, ceiling overcast at 2,700 ft agl, temperature 5 degrees Celsius (C), dew point temperature -1 degrees C, altimeter 29.69 inches of mercury. Remarks, automated station with a precipitation discriminator, sea-level pressure 1005.3-hectopascals (hPa), temperature 5.0 C, dew point -1.1 C.

The raw METAR and TAFs current during the period:

SPECI KJFK 132346Z 32015KT 10SM OVC027 05/M01 A2967 RMK AO2=
METAR KJFK 132351Z 32017KT 10SM OVC027 05/M01 A2967 RMK AO2 SLP047 T00501011 10111 20050 51026=
METAR KJFK 140051Z 32018KT 10SM OVC026 05/M01 A2969 RMK AO2 SLP053 T00501011=
Incursion 0144Z
METAR KJFK 140151Z 32017G26KT 10SM OVC030 04/M02 A2970 RMK AO2 PK WND 34026/0145 SLP058 T00441017=

TAF KJFK 132320Z 1400/1506 32014G20KT P6SM SCT025 BKN035 BKN250
TEMPO 1400/1403 BKN030
FM140400 35013G19KT P6SM BKN040
FM141600 35015G21KT P6SM BKN050=

5.0 American Airlines

American Airlines is a major US-based airline headquartered in Fort Worth, Texas. It is the largest airline in the world. It has over 6,700 daily flights and 10 pilot bases with the DFW hub being the largest base for pilots. Other pilot bases include JFK, Chicago, (ORD), Los Angles (LAX) and Miami (MIA) to name the largest. American has over 15, 000 pilots.[50] Regional service is operated by subsidiary carriers under the brand name American Eagle.

5.1 American Airlines Flight Operations Manual[51]

The following excerpts from the company Flight Operations Manual prescribe the requirements and pilot responsibilities for phases of flight, including taxi.

[50] Source: http://statista.com
[51] Source: DCA23LA125 OPS-HP Factual - Attachment 8 American Airlines Flight Operations Manual [excerpts]

5.1.1 Sterile Flight Deck Period[52]

Definition. *Critical phases of flight include all ground operations involving taxi (when the aircraft is in motion), takeoff and landing, and all other flight operations conducted below 10,000 feet AFL, except cruise flight.*

Do not perform or engage in duties or activities during critical phases of flight that are not required for the safe operation of the aircraft or could distract other crewmembers from performing their duties.

Note: *Do not vacate or switch flightdeck seats during the sterile periods.*

Non-Essential Activities
Do not engage in non-essential activities such as Company communication for nonoperational related purposes, passenger connections, pointing out sights of interest, completing paperwork, eating meals, and non-essential conversations between flightdeck or cabin crewmembers.

5.1.2 Exterior Lights[53]

Operate aircraft exterior lights per the following guidelines unless otherwise noted in the aircraft manual.

Note: *MEL requirements dictate light operations in the case of exterior light deferral.*

At the captain's discretion, all exterior lights may be used for takeoff, approach, and crossing any runway. Ensure the aircraft is visible to other aircraft, particularly during low visibility conditions, when applying the following:

- *– red, green, and white **navigation** lights:*
  - *• night or dusk: on*
  - *• day: may be left off at the captain's discretion*
- *– red **anti-collision** beacon/lights:*
  - *• ground operations: on when an engine is running or when the aircraft is about to be moved or is moving*
  - *• inflight: on at all times*
- *– wing illumination and runway turnoff lights:*
  - *• night or dusk: on from the time the aircraft enters the active runway (crosses the hold short line) for takeoff until reaching FL180*

[52] American Airlines Flight Operations Manual, Section 1g.5, Flightdeck Management, p. 1g-22.
[53] American Airlines Flight Operations Manual, Section 1g.5, Flightdeck Management, p. 1g-24.

and during the descent from FL180 until clear of the active runway after landing

• day: may be left off at the captain's discretion

– taxi light:

• night or dusk:

– when moving or intending to move: on

Exception: The taxi light does not have to be illuminated when in a slow moving taxi line (queue).

– when stopped, to yield, or to avoid impairing the vision of other pilots: off

– when taking position on the runway for takeoff: on (low)

– after takeoff: off

– for landing: on no later than final approach

• day: may be left off at the captain's discretion

– landing lights:

• after takeoff clearance is received and the aircraft is on the active runway (across the hold line): on

• after takeoff: turn off at captain's discretion

• prior to landing at FL180 (or 18,000 feet MSL) or leaving cruise altitude (Airbus 10,000 AFL), whichever is lower: on

• after exiting the active runway: off

– high-intensity (strobe) lights:

• prior to commencing takeoff roll: on (Boeing) or AUTO (Airbus)

• above FL180 (daylight hours): may be turned off at the captain's discretion

• after landing: off (Boeing) or AUTO (Airbus)

– logo lights (if installed and operable): may be used at the captain's discretion to enhance safety at night or during periods of reduced visibility

5.1.3 Clearance Readback[54]

Acknowledge the following ATC clearances/instructions with the full flight number and a verbatim read back of the clearance:

— *general:*

- *initial IFR clearance and flight plan clearance limits/amendments*
- *instructions to initiate contact on a specific radio frequency.*

— *taxi:*

- *taxi clearance and runway assignment*
- *taxi clearance involving hold short clearances restricting runway/taxiway access*
- *taxi clearance to cross any runway surface.*

[54] American Airlines Flight Operations Manual, Section 1c.2, ATC, p. 1c-12.

5.1.4 ACARS[55]

ACARS is the primary means of two-way communications between each aircraft and dispatch when ACARS coverage is available via either ACARS ground station or SATCOM. When away from the gate, ACARS reports:

- *normal transmission of OOOI (Out, Off, On, In) times*
- *enroute position reports*
- *in-range reports*
- *aircraft systems performance data*
- *flight-to-IOC and IOC-to-flight communications*
- *SELCAL used to establish dispatcher-to-captain voice communication ACARS is intended only for*

Company operational communication.

Note: *Non-operational messages are not authorized.*

Verification

Inputs. *Both the captain and first officer will verify the correct flight number, origin, and destination are entered prior to departure.*

Received Messages. *Verify all messages for the correct flight number, date, and aircraft nose number.*

TPS and Load Closeout. *Besides verifying these received messages (see above), compare the TPS and load closeout against documents obtained from operations for reasonableness (e.g., ZFW, TOGW, V speeds). In addition, compare all subsequent TPS and/or load closeout messages against previously received messages.*

Inoperative ACARS. *In the event of an inoperative ACARS, refer to the respective aircraft MEL and appropriate division information.*

5.1.5 Company to Flight Crew Communications[56]

Operational Alert

When disruptive events (such as weather, security-related situations, etc.) affect the operations of the airline, operational messages may be sent via CCI.

[55] American Airlines Flight Operations Manual, Section 1c.3, Dispatch, p. 1c-14.
[56] American Airlines Flight Operations Manual, Section 1c.7, Company to Flight Crew, p. 1c-39.

Priorities/Authorization
CCI messages are categorized in three priorities: read & acknowledge, medium, and low. CCIs follow similar logic to warnings, cautions, and notes, respectively. Priority, action, content, and authorization to issue a CCI message are as follows:

Table 10. Table from American Airlines Flight Operations Manual.

Content:	Authorized By:
Read & Acknowledge Priority: Requires pilot acknowledgment – flight critical:	
— safety and/or security threat	SVP Flight Operations & IOC MD Flight Operations Technical MD Flight Line Operations
Medium Priority: Requires timely action – not flight critical:	
— may cause operational delays — procedural reminders	flight operations management
Low Priority: Requires routine action – not flight critical:	
— information only	flight operations administration
— End —	

Company to Flight Crew

Procedure

When a read & acknowledge message is issued, a pop-up window will appear in mobileCCI. The pop-up window will restrict the use of all other CCI functions (to include signing fit for duty) until the crewmember reads and acknowledges the message.

Note: *Read & acknowledge messages do not prevent crewmembers from using alternate sign-in procedures or restrict access to DECS.*

Connectivity. *Cellular or WiFi connectivity is required to receive read & acknowledge messages in CCI.*

During Ground Movement. *If a read & acknowledge message is received during ground movement, stopping the aircraft to acknowledge the message may be necessary.*

5.1.6 Dangerous Goods/Hazardous Materials[57]

Dangerous Goods Definition and Classification

Dangerous goods (DGs) are articles or substances capable of posing a potential risk to health, safety, or property when transported by air. The terms dangerous goods (DGs), hazardous materials (HAZMATs), and restricted articles (RAs) are synonymous and interchangeable.

Responsibilities

Ground Personnel

Ground personnel are responsible for accepting, inspecting, loading, and notifying the captain/IATA of dangerous goods. Adherence to US DOT and ICAO restrictions by Company cargo handlers has been greatly enhanced by the AUTONOTOC system which uses computer-assisted safeguards, beginning with cargo acceptance, continuing through loading and culminating in notification of the captain with hard copy NOTOC print-outs.

5.1.7 Policy on Corrections to NOTOC Forms[58]

Notification to Captain (NOTOC)

The notification to captain (NOTOC) requirement is satisfied by presenting a computer-generated AUTONOTOC form or a preprinted OK-333 form. The NOTOC must be readily available to the captain during flight in the event of an incident or emergency where the dangerous goods shipment may become a safety factor.

General

Corrections

Handwritten and initialed corrections to the AUTONOTOC print-out are permitted anytime the location or quantity of dangerous goods is changed or if the DG shipment was not loaded.

5.1.8 Taxi [59]

General

[57] American Airlines Flight Operations Manual, Section 1d, Dangerous Goods/Cargo, p. 1c-39.
[58] American Airlines Flight Operations Manual, Section 3d.2, Notifications, p.3d-4.
[59] American Airlines Flight Operations Manual, Chapter 4, Taxi, p. 4g-1.

Airport surface operations require strict attention and constant situational awareness. Sound flightdeck operating discipline enables the flight crewmembers to properly plan taxi operations with the same level of attention given to planning other phases of flight. For specific phase-of-flight procedures, refer to the appropriate FOM phase of flight chapters and the aircraft operating manual.

Planning

Anticipate airport surface movements by performing a pre-taxi review based on ATIS and previous experience at each airport. Review the expected taxi route on the airport diagram.

Control

The captain will taxi the aircraft. The flight crew's primary task is to safely taxi the aircraft and the flight crew's attention should not be diverted from this task.

Communication

See paragraphs 1c.2.4 Clearance Readback for clearances requiring a read back and 4c.2.1 General for more information.

Coordination

Verbally coordinate all taxi instructions with other flightdeck crewmembers to ensure common understanding. If in disagreement, seek clarification from ATC.

Do not taxi until a taxi clearance is received ***and*** *both the captain and first officer verbally coordinate and agree on the runway assigned, any restrictions, and taxi route.*

Note: *Ensure received (not expected/briefed) taxi route is followed.*

Monitoring

Flight crewmembers should use a continuous loop process for actively monitoring and updating their progress and location during taxi. This includes knowing the aircraft's present location and mentally calculating the next location on the taxi route that will require increased attention. Consider writing down the taxiing instructions and while taxiing:

- *do not allow other flightdeck duties and non-ATC communications to divert attention from the safe movement of the aircraft, especially at critical times, such as runway crossings and transitioning through complex taxiway intersections*
- *maintain sterile flightdeck when the aircraft is moving*

Note: *If uncertain as to location on the airport, taxi clear of any runway, stop the aircraft, advise the tower.*

Both pilots should:

– have the airport diagram readily available and reference it as necessary to ensure the taxi clearance is followed correctly (see paragraph Taxi-Out for iPad EFB guidance)

First officer: advise the captain when accomplishing non-monitoring tasks (e.g., FMS programming, ACARS, company radio calls, etc.)

– monitor the appropriate tower frequency when number one to cross an active runway

– be heads up to visually monitor the aircraft's progress at critical locations on the airport (hold short, crossing runways, etc.)

When approaching an entrance to an active runway, both pilots will ensure compliance with hold short or crossing clearance by discontinuing non-monitoring tasks (e.g., FMS programming, ACARS, company radio calls, etc.)

Airport Markings/Lighting Home[60]

Runway Entrance Lights (RELs)

The REL system is composed of flush mounted, in-pavement, unidirectional fixtures that are parallel to and focused along the taxiway centerline and directed toward the pilot at the hold line. An array of REL lights include the first light at the hold line followed by a series of evenly spaced lights to the runway edge; one additional light at the runway centerline is in line with the last two lights before the runway edge.

When activated, the red lights indicate there is either high speed traffic on the runway or an aircraft on final approach within the activation area.

[60] American Airlines Flight Operations Manual, 4g.5.2 Runway Status Lights System (RWSL), p. 4g-20.

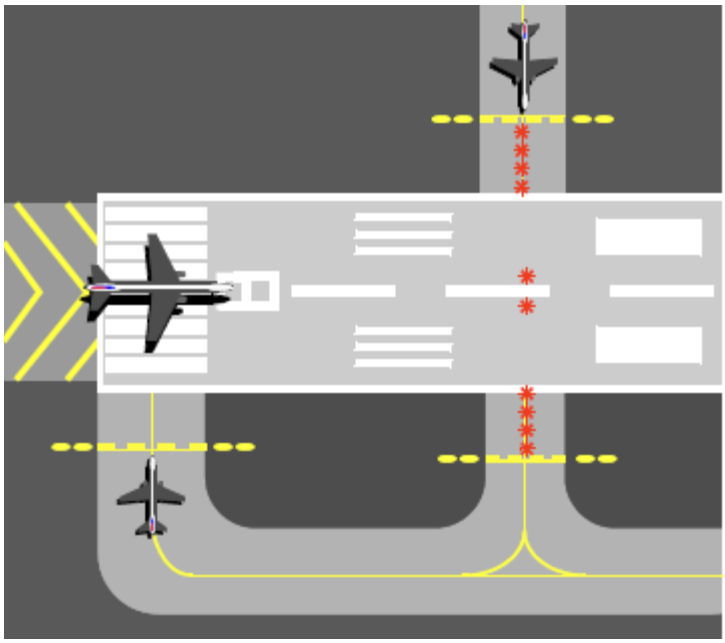

Figure 3. Diagram of runway entrance lights from the American Airlines Flight Operations Manual.

Operating Characteristics.

Departing Aircraft

When a departing aircraft reaches 30 knots, all taxiway intersections with REL arrays along the runway ahead of the aircraft will illuminate. As the aircraft approaches an REL equipped taxiway intersection, the lights at that intersection extinguish approximately 3 to 4 seconds before the aircraft reaches it. This allows controllers to apply anticipated separation to permit ATC to move traffic more expeditiously without compromising safety. After the aircraft is declared airborne by the system, all REL lights associated with this runway will extinguish.

Pilot Observations and Actions.

Observations

A pilot at or approaching the hold line to a runway will observe REL illumination and extinguishing in reaction to an aircraft or vehicle operating on the runway, or an arriving aircraft operating less than 1 mile from the runway threshold.

Actions

Whenever a pilot observes the red lights of the REL, the pilot will stop/remain stopped at the hold line and contact ATC for resolution if the clearance is in conflict with the lights. Should pilots note illuminated lights under circumstances when remaining clear of the runway is impractical for safety reasons (for example, aircraft is already on the runway), the crew should proceed according to their best judgment while understanding the illuminated lights indicate the runway is unsafe to enter or cross. Contact ATC at the earliest possible opportunity.

5.1.9 Electronic Flight Bag (EFB) Operations[61]

Operations During Flight

Taxi-Out

Airport Info charts must be readily available to ensure the taxi clearance is followed correctly. Temporarily selecting another chart (e.g. ##-7, SID, etc.) is authorized providing:

– one pilot is displaying the airport diagram
– current position is known
– aircraft is not taxiing directly toward or across an active runway

Ownship.

Note: *Do not use JeppFD-Pro ownship position as a primary position source, especially during low visibility taxi operations.*

Taxiway signs and markings outside the aircraft remain the primary reference for maneuvering the aircraft. The use of ownship position display on taxi charts is authorized to supplement situational awareness.

6.0 Crew Statements About Positional Awareness

In an interview, the captain asserted that he had maintained an accurate understanding of his location throughout the taxi, but lost awareness of his clearance. He believed he had heard and accurately understood the taxi clearance when it was issued, but subsequently came to believe that AAL106 was cleared to cross runway 4L. He said that his loss of awareness of the actual clearance occurred while he and the FO were reviewing the load close-out, stating, ""I think I just got distracted with all this happening" and "I stopped thinking about Kilo and started thinking about my

[61] American Airlines Flight Operations Manual, Section 25.5 EFB Operations, p. 25-21.

original briefing to 3-1 Left." He further attributed this to "runway bias." In his interview, the captain stated the following about runway bias:

> "The topic's brought up at CRM all the time, so it's not like it's something new. I mean, I guess when we got extra training after this happened, the check airman made us aware of, you know, taxi briefing ahead of time you can develop runway bias and, you know, when the load becomes more, you tend to fall back the way you started with. And I never really gave that a thought till this whole event , so -- it made me very aware of it."

The captain later responded to written follow-up questions, including whether, in his experience, it was more common to take off on runway 31L than runway 4L. He responded no, runway 31L and 4L were both commonly used for takeoff. Asked whether the usual route to runway 31L was via taxiways B and J, and whether the usual route to runway 4L was via taxiways B and K, he said yes. He said neither of these taxi routes was more familiar to him than the other.

The FO said she accurately recalled AAL106's taxi clearance throughout the taxi, but she was unaware of the airplane's position when the captain taxied onto runway 4L. She said she knew they were cleared to cross runway 31L and she knew they were approaching a runway, but she did not realize they were approaching runway 4L.

The FB said he was "heads down" and unaware of AAL106's position as the captain taxied onto runway 4L. He said that when he saw the other airplane on the runway to his right, he initially thought AAL106 might be crossing runway 31L at taxiway K and that the other airplane might have been instructed to taxi onto runway 31L at taxiway KE to follow them. He said he did not know AAL106's most recent taxi clearance at that time because he had been off the ground control frequency for some time while speaking with company operations.

7.0 Ground Visibility from the Cockpit of the Boeing B-777

A multi-mode receiver (MMR) was the source of the GPS location transmitted by AAL106 and received by the ASDE-X. The GPS location determined by the MMR was based on the position of the GPS-Left and GPS-Right antennas installed on the top centerline of the airplane fuselage. According to information provided by Boeing, the horizontal distance between the nose of the airplane and a midpoint between the GPS-Left and GPS-Right antennas was 552 inches (46 feet) (figure 3).[62] According to the Boeing document *777-200/-300 Airplane Characteristics for Airport Planning*, the horizontal distance between the pilot's eye position and the closest visible point on the ground was 582 inches (48 feet 6 inches). According to the same document, the horizontal distance between the pilot's eye position and the nose gear was 143

[62] https://www.boeing.com/resources/boeingdotcom/commercial/airports/acaps/777_2_2er_3.pdf

inches (11 feet 11 inches) (figure 4). In addition, it indicated that the horizontal distance between the nose gear and the nose of the airplane was 232 inches (19 feet 4 inches) (figure 5). These dimensions indicate that the horizontal distance between the closest point on the ground in front of the airplane that was visible to the pilots and the transmitted GPS location was 1,045 inches (87 feet, 1 inch).

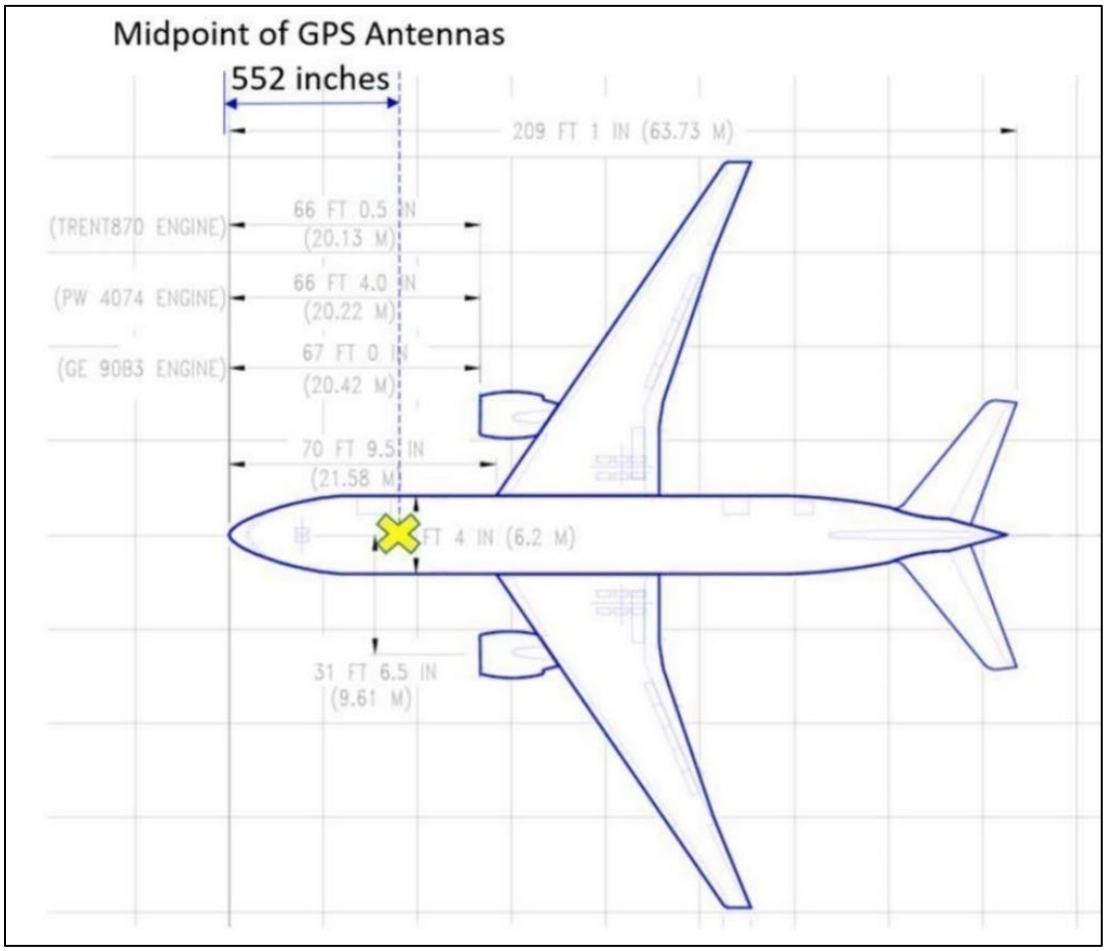

Figure 4. Location of the broadcast GPS position on the fuselage of the B777-200 ER.[63]

[63] Figure provided by Boeing.

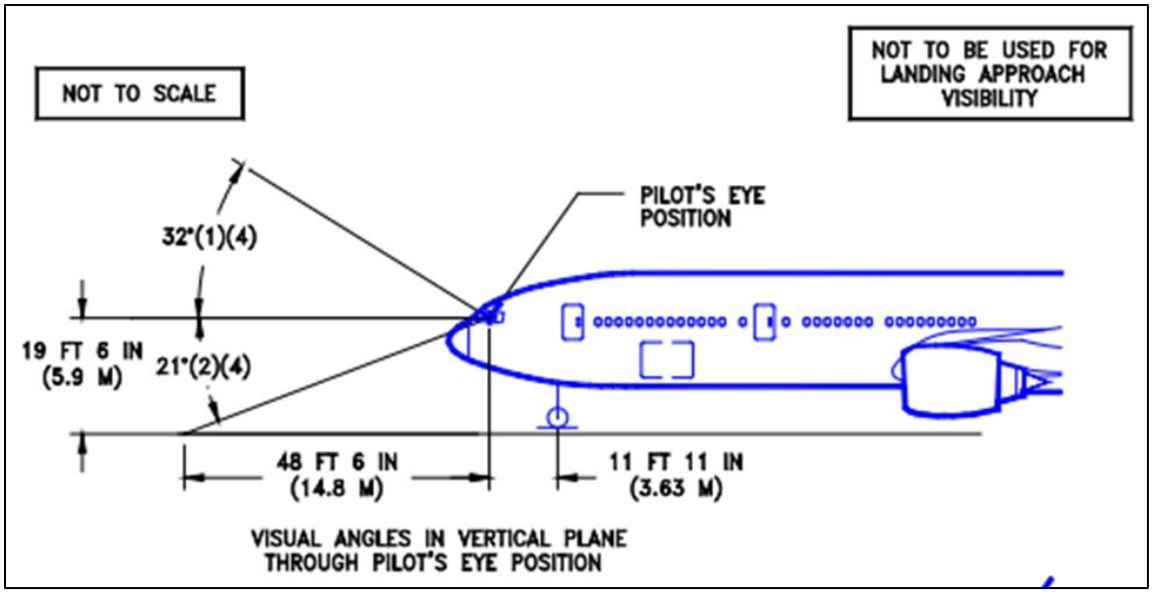

Figure 5. Sightline from the pilot's eye position to the ground for the Boeing 777-200.[64]

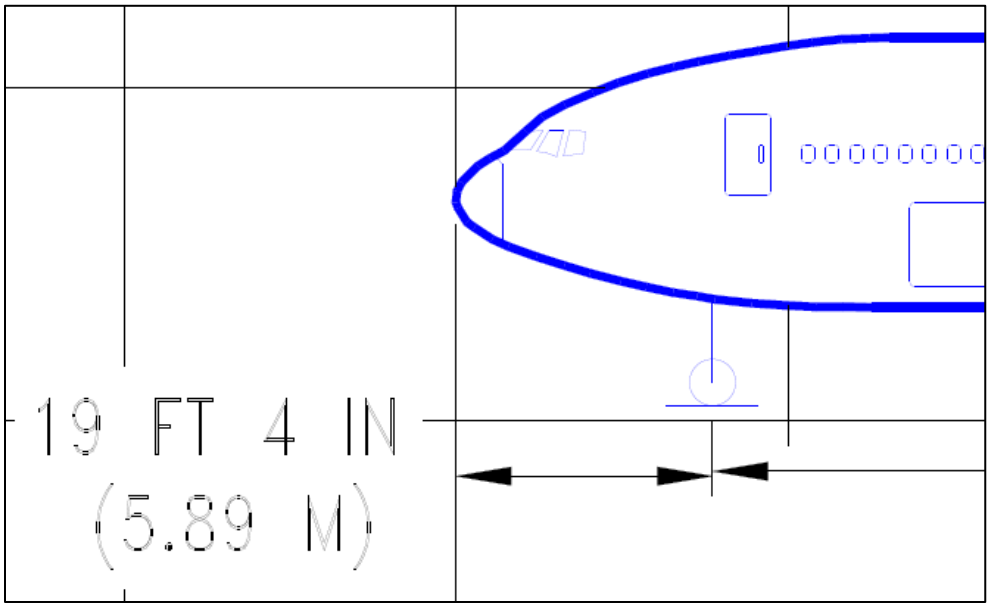

Figure 6. Horizontal distance between the nose and the nose gear of the Boeing 777-200.[65]

[64] 777-200/-300 Airplane Characteristics for Airport Planning, p. 4-6.
[65] 777-200/-300 Airplane Characteristics for Airport Planning, p. 2-8.

LIST OF ATTACHMENTS

Attachment 1 - American Airlines Pilots' Interview Transcripts
Attachment 2 – Delta Air Lines Pilots' Written Statements
Attachment 3 – American Airlines Pilots' Written Statements
Attachment 4 – American Airlines Pilots' Objections to Recorded Interviews
Attachment 5 – American Airlines Notification to Captain (NOTOC)
Attachment 6 – American Airlines Fleet Harmonization Quick Reference Page
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Attachment 8 – American Airlines Flight Operations Manual Excerpts
Attachment 9 – Party Forms
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Attachment 11 – Aircraft Communication Addressing and Reporting System Data
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Attachment 13 – Updated American Airlines Guidance on Taxi Procedures