



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

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Specialist's Report

OPERATIONAL FACTORS

DCA19CA213

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A. ACCIDENT

Location: Approximately 25 miles Northeast of Fort Myers, Florida
Date: September 6, 2019
Time: Approximately 1606 Eastern Daylight Time (EDT) ¹
Flight No. Spirit Flight 967
Airplane: Airbus A319-132, Registration N515NK

B. AIR SAFETY INVESTIGATOR

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C. SUMMARY

On September 6, 2019, about 1600 EDT, Spirit Airlines flight 967 A319-132, N515NK, was on descent into Fort Myers Southwest Florida Airport (RSW), Fort Myers, Florida, at about 12,000 ft, when the captain gave the final arrival call to the flight attendants. Shortly thereafter, while the flight attendants were conducting final compliance checks, the aircraft encountered turbulence resulting in an injury to the ankle of one flight attendant. The flight attendant was transported to a local hospital after arrival for treatment and was diagnosed with a fractured ankle. The flight was operating as a 14 *Code of Federal Regulation* part 121 flight scheduled domestic flight from the Cleveland Hopkins International Airport (CLE), Cleveland, Ohio to RSW. There were 2 flight crew, 3 flight attendants and 103 passengers on board. No other injuries were reported nor damage to the airplane.

D. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board (NTSB) Operational Factors investigator was assigned to the accident on September 7, 2019 and did not travel to the accident location. The Operational Factors investigator requested manuals and other various items for the investigation, from the operator. Pilot certification information was obtained from the pilots, operator, and the Federal Aviation Administration (FAA).

¹ All times in the report will be Eastern Daylight Time except as otherwise noted. At the time of the accident Greenwich Mean Time, also known as Zulu (Z) time, was UTC -4 hours.

E. FACTUAL INFORMATION

1.0 History of Flight

Spirit Airlines flight 967 had departed CLE at 1330 EDT. The flight's planned arrival time was 1615 EDT.

According to the crew statements, the flight was on a descent passing through 12,000 ft and the Captain gave the arrival PA² to the flight attendants. Shortly thereafter, while the flight attendants were conducting their final compliance checks, the aircraft encountered turbulence resulting in an injury to one of the flight attendants.

According to the captain, he stated the seat belt sign was illuminated at 20,000 ft and the arrival PA to the flight attendants was made at 12,000 ft in preparation for landing and "in anticipation of encountering turbulence due to a scattered layer of cumulous clouds." He further stated they encountered turbulence passing through approximately 10,000 ft.

The first officer stated that passing through 10,500 ft, they encountered momentary turbulence during which a flight attendant fell and was injured.

The "B" flight attendant who was injured stated that after receiving the arrival PA from the captain, she got up from her jumpseat and was conducting compliance checks in the aft cabin when the short turbulence encounter occurred causing her to fall to the galley floor. She was unable to return to her jumpseat due to her injury and was seated in a passenger seat in the aft cabin per company policy

According to flight attendant statements, the lead flight attendant, who was in the forward galley, stated the turbulence encounter occurred during the arrival PA and they were informed of the injured flight attendant via the cabin interphone from the other cabin crew member in the aft cabin. The lead flight attendant then notified the flightcrew of the injury and requested to have the EMTs³ standing by at the gate for their arrival.

The "C" flight attendant who was working in the aft cabin reported that she was exiting the aft lavatory when the turbulence was encountered. After exiting the lavatory, she noticed the "B" flight attendant on the aft cabin floor and proceeded to help the injured flight attendant into an unoccupied passenger seat for landing.

After landing and parking at the gate the EMTs attended to and subsequently transported the injured flight attendant to the hospital. It was later determined that the flight attendant had broken her ankle.

² Public/Passenger Address system

³ Emergency Medical Technicians

2.0 Flight Crew Information

The accident flight crew consisted of 2 pilots and 3 cabin crew members. The captain was the pilot flying (PF) on the accident flight and the first officer was the pilot monitoring (PM).

2.1 Captain

The captain was 52 years old and held an Airline Transport Pilot (ATP) certificate with a rating for airplane multiengine land and type ratings on the A320⁴, DC-9 and Learjet. He held a commercial pilot certificate for airplane single-engine land. He held an FAA first-class medical certificate dated June 19, 2019, with a limitation of “Must wear corrective lenses. Not valid for any class after 6/30/2020.” At the time of the accident he was based at Fort Lauderdale (FLL).

According to information provided by Spirit Airlines, the captain had approximately 6,696 total hours of flight experience. He had flown 228 hours in the last 90 days, 80 hours in the last 30 days and 4 hours within the preceding 24-hours prior to include the accident flight.

His most recent flight review was conducted on July 10, 2019.

•	Date of Hire at Spirit	11/23/1999
•	Most Recent Continuous Qualification /Distant learning	05/29/2018
•	Upgrade to Captain (Captain only)	06/18/2004
•	Most Recent FAA Observation	06/18/2004
•	Most Recent Recurrent Ground School	12/11/2018
•	Most Recent Recurrent CRM	12/11/2018
•	Most Recent Maneuvers Validation	12/13/2018
•	Most Recent LOE	12/11/2018
•	Most Recent Line Check	12/22/2018
•	Most Recent Weather Radar Training	12/11/2018

2.2 First Officer

The First Officer was 31 years old and had an Airline Transport Pilot (ATP) certificate with a rating for airplane multiengine land and a type rating on the A320. He also held a FAA first class Medical dated July 17, 2019 with no limitations. At the time of the accident, he was based in FLL.

⁴ Airbus SAS A-318 Series, A-319 Series, A-320 Series, A-321 Series, includes all models on Type Certificate Data Sheet A28NM. Source FAA Order 8900.1, Figure 5-88, dated July 15, 2019,

According to information provided by Spirit Airlines, the first officer had approximately 3,200 hours of total time with 1,454 hours of flight experience on the A-320 aircraft. He had flown 131 hours in the last 90 days, 47 hours in the last 30 days and 4 hours within the preceding 24-hours prior to include the accident flight.

His most recent flight review was conducted on September 10, 2019.

•	Date of Hire at Spirit	08/20/2016
•	Most Recent Continuous Qualification / Distant Learning	08/07/2018
•	Most Recent Recurrent Ground School	08/07/2018
•	Most Recent Recurrent CRM	08/07/2019
•	Most Recent Maneuvers Validation	08/20/2018
•	Most Recent LOE	08/19/2018
•	Most Recent Line Check	08/18/2018
•	Most Recent Weather Radar Training	08/07/2019

3.0 Airplane Information



Photo 1: Accident Airplane, N515NK (Courtesy of Airliners.net)

The accident airplane (Registration N515NK, Serial No. 2698) was an Airbus A319-132. The airplane was manufactured in 2006, registered to, and operated by Spirit Airlines Inc. The aircraft held a transport category airworthiness certificate dated March 01, 2013. The airplane was powered by 2 IAE International Aero Engines V2524 engines, each were rated at 24,480 pounds

of thrust. The airplane was configured with 2 pilot seats, 1 cockpit observer seat, 4 flight attendant seats, and 142 passenger seats⁵.

According to the Spirit Airlines, Pilot's Operating Manual, "Limitations" the following limitations applied to the accident aircraft:

Turbulence Penetration Speed

250 knots up to FL 200, 275 Knots up to FL 310 and then transition to M.76

4.0 Accident Flight Dispatch Release and Weather Packet

4.1 Dispatch Release

Spirit Airlines Domestic Dispatch Release⁶ for the accident flight, was 7 pages in total length and contained information for the accident flight such as, fuel required, route of flight, Grid Mora⁷ check for one engine out drift down, departure and destination airports, RAIM⁸, MEL/CDLs⁹, planned departure and arrival weights, enroute winds and a wind summary that included SPOT Winds¹⁰ for the climb out, cruise winds as well as winds aloft for the descent.

4.1 Weather Packet

The Spirit Airlines Briefing packet for the accident flight was generated on September 6, 2019 at 1617Z (1217 EDT). The weather packet was 25 pages in length and contained the departure, enroute, and destination weather and NOTAMs¹¹, and any SIGMETs,¹² AIRMETs¹³ or PIREPS¹⁴ that were available.

A review of archived PIREP information from 1 hour prior to 1 hour after the accident did not contain any pertinent turbulence reports. There was one PIREP around the Sarasota area reporting light turbulence below 5,000 ft which was not a factor for the accident flight.

⁵ The passenger seating configuration consisted of 10 business class and 132 economy class seats.

⁶ Source: Attachment 2 - Flight Dispatch Release and Weather Briefing.

⁷ GRID MORA's give at least 2,000 feet clearance in mountainous areas. A GRID MORA also provides "an altitude that provides clearance of terrain and man-made structures within a defined section of latitude and longitude lines." Source: www.jeppesen.com

⁸ Receiver Autonomous Integrity Monitoring assess the GPS signals in a GPS receiver which are critical for navigation.

⁹ Minimum Equipment List/Configuration Deviation List

¹⁰ Spot Winds: In air navigation, wind direction and speed, either observed or forecast if so specified, at a designated altitude over a fixed location.

¹¹ Notices to Airman

¹² Significant Meteorological Information

¹³ Airmen's Meteorological Information

¹⁴ A PIREP is a report of actual weather conditions encountered by an aircraft in flight.

5.0 Spirit Airlines Guidance on Turbulence

The Spirit Airlines, Flight Operations Manual (FOM), Section 6.3.4 “Turbulence”, Revision 19-02, dated July 8, 2019, contained the following guidance regarding Turbulence Limitations and Policies

5.1 Turbulence

The Spirit Airlines FOM Section 6.3.4, Revision 19-02, dated July 8, 2019, contained the following guidance regarding turbulence:

Turbulence is the result of disturbance in the normal smooth airflow.

Enroute turbulence accounts for a substantial number of injuries and can occur at any time and altitude.

Turbulence may be anticipated or unanticipated; intensity can vary and is relative to location of the occupants in the aircraft. Generally, the rear of the aircraft will experience greater turbulence intensity.

The safety of everyone is paramount during turbulent conditions.

5.2 Flight Attendant and Passenger Briefings

The Spirit FOM Section 6.3.4.2, Revision 19-02, dated July 8, 2019, contained the following guidance regarding Flight Attendant and Passenger Briefings.

The Captain must include a weather/turbulence briefing with the standard pre-departure crew briefing. This will also include any anticipated turbulence during and immediately after takeoff, where it may be necessary for Flight Attendants to remain seated even after the 10,000' announcement. This will allow the Lead FA to plan possible service modifications prior to anticipated turbulence encounters and advise the rest of the Flight Attendants accordingly.

During the welcome PA, the Captain may advise the passengers to keep their seat belts fastened during the entire flight while seated.

Flight Attendants will reinforce the Captain's briefing regarding continued use of the seat belts throughout the flight while seated.

5.3 Turbulence Intensity and Procedures

Three levels of turbulence can be encountered:

- *Light*

- Moderate
- Severe

It is important for Flight Crew Members and Flight Attendants to use common terminology to describe the level of turbulence experience in the cabin.

The table below describes the crew actions based on the turbulence level.

Type	Aircraft Reaction	Cabin Reaction	Anticipated	Unanticipated
LIGHT	• Slight changes in altitude/attitude • Slight airspeed fluctuations • Aircraft remains in control	• Occupants may feel slight strain against the seat belts. • Unsecured objects may be displaced slightly. • Liquids in cups will shake but will not splash out. • Walking and maneuvering service carts is still possible.	<i>Flight Crew Actions:</i> • Switch ON the FASTEN SEAT BELT sign. • Make a PA (workload permitting). • Communicate with Lead FA about the duration. <i>LEAD FA:</i> • Deliver fasten seat belts PA, if Flight Crew Members have not. • Initiate ALL CALL to confirm cabin is secured. <i>ALL FAs:</i> • Conduct compliance checks. • FAs may continue cabin service with caution.	<i>Flight Crew Actions:</i> • Switch ON the FASTEN SEAT BELT sign. • Make a PA (workload permitting). • Communicate with Lead FA about the duration. <i>LEAD FA:</i> • Deliver fasten seat belts PA, if Flight Crew Members have not. • Initiate ALL CALL to confirm cabin is secured. <i>ALL FAs:</i> • Conduct compliance checks. • FAs may continue cabin service with caution.

Type	Aircraft Reaction	Cabin Reaction	Anticipated	Unanticipated
MODERATE	- Changes in altitude/attitude - Airspeed fluctuations - Aircraft remains in control	- Occupants feel definite strain against seatbelts. - Unsecured objects may be displaced. - Liquids may splash out of cups. - Walking and maneuvering service carts may become very difficult.	Flight Crew Actions: - Switch ON the FASTEN SEAT BELT sign. - Make a PA instructing passengers and Flight Attendants to be seated until notified otherwise. - Communicate with Lead FA about the intensity and duration of the turbulence.	Flight Crew Actions: - Switch ON the FASTEN SEAT BELT sign. - Make a PA: "All passengers and Crew, please be seated and fasten your seat belt immediately." - When conditions improve, use interphone or PA to advise the FAs that it is safe to resume duties.
SEVERE	- Large abrupt changes in altitude/attitude - Usually large airspeed fluctuations - Aircraft may be momentarily out of control - Maintenance write-up and aircraft inspection required	- Occupants forced violently against seat belts. - Unsecured objects tossed about or lifted from the floor. - Walking is impossible as is standing without holding on to something for support.	LEAD FA: - Initiate ALL CALL to confirm all FAs are secured. - Deliver fasten seat belts PA, if Flight Crew Members have not. ALL FAs: - Secure self in jumpseat as soon as instructed.	ALL FAs: - Cease all duties and secure self in the first available seat. - Remain seated until the FASTEN SEAT BELT sign has been switched OFF or advised by the Flight Crew that it is safe to resume duties.
Clear Air Turbulence (CAT)				
CAT is not an intensity measure, rather a type of turbulence that occurs in various intensities, in clear air, clear of clouds, and therefore usually without warning. A variety of conditions/reactions may occur, depending on the severity of the clear air turbulence.				

Table 1: Turbulence Intensity and Procedures

5.4 Communication and Coordination

The Spirit FOM, Section 6.3.4.4, Revision 19-02, dated July 8, 2019, contained the following guidance regarding “Communication and Coordination:”

The Captain must assess the turbulence intensity and advise the Flight Attendants accordingly.

Turning OFF the FASTEN SEAT BELT sign indicates no turbulence is expected; however, an announcement should be made that passengers should keep their seat belts fastened, while seated, even when the FASTEN SEAT BELT sign is OFF.

Turning ON the FASTEN SEAT BELT sign indicates turbulence is expected and passengers must return to their seats and fasten seat belts; this should, workload permitting, be accompanied by an announcement from the flight deck.

After take-off or following turbulence, the Captain, at his/her discretion, may choose to keep the FASTEN SEAT BELT sign ON, yet release the FAs to resume their duties. Communication must flow two ways; FAs should not wait for the Flight Crew to turn the FASTEN SEAT BELT sign ON. If conditions dictate FAs should make an appropriate PA instructing passenger to return to their seats and fasten their seat belts. The Lead FA should contact the Flight Crew and request the FASTEN SEAT BELT sign to be switched ON. If the FASTEN SEAT BELT sign remains illuminated and conditions have improved, the Lead FA should contact the Flight Crew to determine if it is safe to resume cabin duties.

If moderate or severe turbulence persists on initial descent and FAs have already been instructed by the Flight Crew to be seated, they must remain seated and make a compliance PA to the passengers.

Turbulence injury prevention takes a combination of teamwork and personal responsibility. The utmost important responsibility for preventing turbulence-related injuries will continue to rest with each individual Crew Member Flight Attendants should keep each other informed of conditions and take appropriate actions to avoid injuries.

5.5 Anticipated Turbulence

The Spirit FOM, Section 6.3.4.5, Revision 19-02, dated July 8, 2019, contained the following guidance regarding “Anticipated Turbulence.”

If the Captain determines that anticipated turbulence would require Cabin Crew be seated, a PA announcement will be made, and Flight Attendants must be seated with seat belt and shoulder harness secured.

Example: “Ladies and Gentlemen we are going to be experiencing some turbulence, the seat belt sign has been turned on. Please remain seated with your seat belts fastened. Flight Attendants, please be seated.”

5.6 Unanticipated Turbulence

The Spirit FOM, Section 6.3.4.6, Revision 19-02, dated July 8, 2019, contained the following guidance regarding “Unanticipated Turbulence:”

If there is sudden moderate to severe unanticipated turbulence requiring immediate action, the Flight Crew ON the FASTEN SEAT BELT sign. The Flight Crew will make an announcement:

*“All passengers and crew please be seated and fasten your seat belts **immediately**.”*

NOTE: Immediately is the key word that communicates the urgency of the situation to the Cabin Crew.

- *The Cabin Crew must cease all duties, secure themselves in the first available seat and remain seated until advised by the Flight Crew or until the FASTEN SEAT BELT sign is switched OFF.*
- *When the conditions improve, the Flight Crew Members should use the cabin interphone or PA to advise the cabin crew that they may resume their duties and if passengers may move about in the cabin.*

If a reasonable amount of time has elapsed without turbulence and the FASTEN SEAT BELT sign remains illuminated, initiate contact with the Flight Crew Members in order to determine whether it is safe to resume cabin duties.

- *Cabin Crew may then leave their seats, check conditions of the cabin, passengers and Crew Members, and inform the Flight Crew if injuries or damages have occurred.*

5.7 Following a Turbulence Encounter

The Spirit FOM, Section 6.3.4.7, Revision 19-02, dated July 8, 2019, contained the following guidance regarding “Following a Turbulence Encounter:”

Following moderate or severe turbulence and when the FASTEN SEAT BELT sign has been switched OFF, the following shall be accomplished:

- *The Flight Crew is encouraged to make a PA to reassure the passengers, as appropriate.*
- *The Lead FA shall make a PA if directed by the Flight Crew or if the Flight Crew has not.*

Flight Attendants shall check passenger and cabin conditions to ensure there are no adverse effects arising from the turbulence encounter and advise the Flight Crew accordingly.

5.8 Flight Briefing

The Spirit FOM, Section 2.5.5, Revision 19-02, dated July 8, 2019, contained the following guidance regarding “Flight Briefings”

The flight briefing (FB) accompanies the Operational Flight Plan and includes the following items:

- *SIG¹⁵ Chart*
- *Route Chart*
- *NOTAMs*
- *MET (Weather)*
- *AFP (ATC Flight Plan)*
- *Critical Terrain Scenario (if necessary)*

5.8.1 Significant Weather Prognostic Chart

The Significant Weather Chart or SIG Chart included with each Flight Plan Manager Flight Briefing package is a standard National Weather Service High Level Significant Weather chart. The chart does, however, include an overlay of the filed route for the flight as planned by the Dispatcher. In the example below the route is in red. In the production Flight Briefing the route overlay will be black.

¹⁵ Significant weather prognostic chart

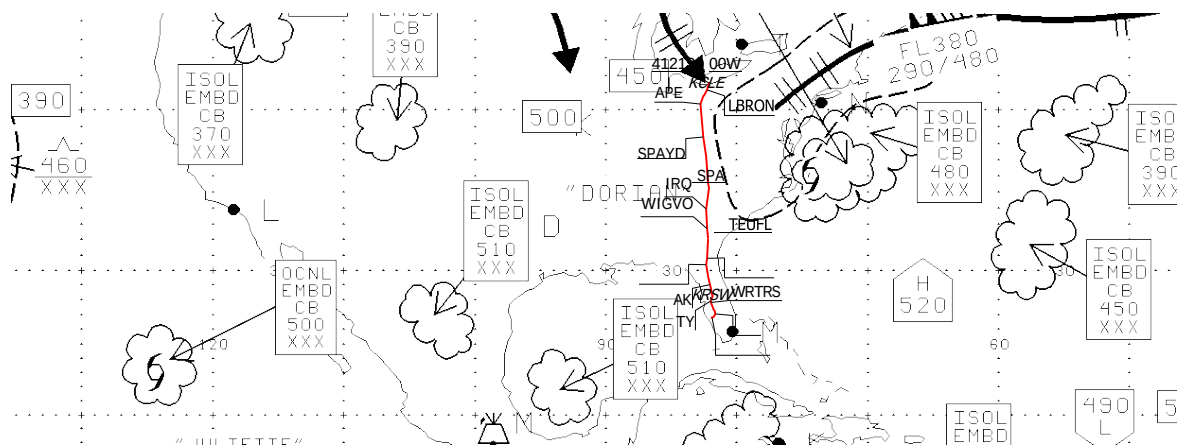


Figure 1: Significant Weather Prognostic Chart (Source Spirit Airlines)

5.8.2 Route Chart

The Route Chart is included with each flight briefing. The Route Chart includes a graphical map overlay of upper level winds, any(in black here) including any drift down escape points and depressurization profiles as well as all drift down alternates and all fixes on the planned STAR and all FIR boundaries.

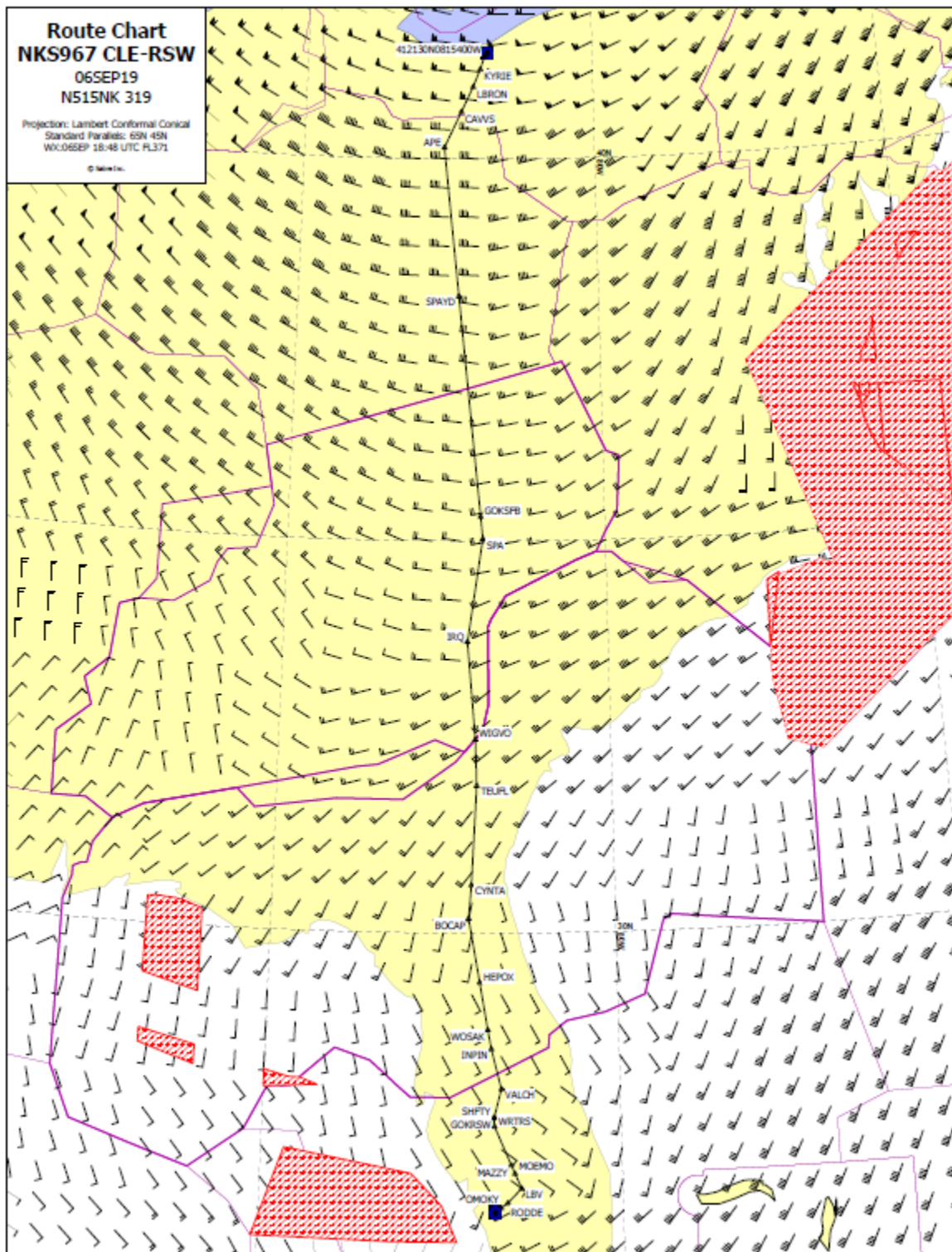


Figure 2: Route Chart (source Spirit Airlines)

5.8.3 Meteorology

The Meteorology or MET section contains information about available runways and their lengths, as well as METARS (SA), TAFs (FT) for all airports and any AIRMET, SIGMET, and Convective SIGMET information associated with the planned route of flight.

5.8.4 Familiarity with Weather

(a) *For all operations, the controlling Dispatcher will not release a flight, and the Captain may not begin a flight, unless thoroughly familiar with reported and forecasted weather conditions for the route to be flown.*

(b) *The controlling Dispatcher shall provide the Captain with all available current reports or information on airport conditions and navigational facilities that may affect the safety of flight.*

(c) *The controlling Dispatcher shall provide the Captain with all available weather reports and forecasts of weather phenomena that may affect the safety of flight, including adverse weather phenomena, for each route to be flown and each airport to be used.*

(d) *During a flight, the controlling Dispatcher shall provide the Captain any additional available information of meteorological conditions, including adverse weather phenomena and irregularities of facilities and services that may affect the safety of the flight.*

6.0 FAA Guidance

The FAA defines turbulence as: “air movement that normally cannot be seen and often occurs unexpectedly. It can be created by many different conditions, including atmospheric pressure, jet streams, air around mountains, cold or warm weather fronts or thunderstorms. Turbulence can even occur when the sky appears to be clear.”¹⁶

6.1 FAA Turbulence Fact Sheet

The FAA provided the following guidance titled “Fact Sheet – Turbulence” posted on August 1, 2019 to their website:¹⁷

What is turbulence?

Clear air turbulence is air movement created by atmospheric pressure, jet streams, air around mountains, cold or warm weather fronts or thunderstorms. It can be unexpected and can happen when the sky appears to be clear.

¹⁶ Source: https://www.faa.gov/travelers/fly_safe/turbulence/

¹⁷ Source: https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=20074

What should passengers do to avoid injuries?

Flying is the safest way to travel. Passengers can easily prevent injuries from unexpected turbulence by keeping their seat belt buckled at all times. The FAA's tips for staying safe:

- Listen to the flight attendants. Pay attention to the safety briefing at the beginning of your flight and read the safety briefing card.*
- Buckle up. Keep you and your family safe by wearing a seat belt at all times.*
- Use an approved child safety seat or device if your child is under two.*
- Prevent inflight injuries by adhering to your airline's carry-on restrictions.*

What do airlines do to avoid turbulence and prevent injuries?

Working together through the Commercial Aviation Safety Team (CAST), the FAA developed guidance material to help air carriers and other operators prevent turbulence injuries. CAST develops an integrated, data-driven strategy to reduce the commercial aviation fatality risk in the United States and promotes government and industry safety initiatives throughout the world. Some of the material responds to investigative work from the National Transportation Safety Board. The focus of the material (see additional reading) is to help air carriers avoid the conditions that cause turbulence and minimize the risks when airplanes do encounter it. This impacts the operations and training of flight crews, flight attendants, dispatchers and managers.

The FAA recommends that air carriers:

- improve dispatch procedures by keeping communication channels open full-time.*
- include turbulence in weather briefings.*
- promote real-time information sharing between pilot and dispatcher.*
- reinforce the air carrier's turbulence avoidance policy through dispatcher training.*
- consider rerouting using automation, atmospheric modeling, and data displays; and*
- use all applicable weather data as well as reporting and forecasting graphics.*

The FAA also encourages air carriers to use operating procedures and training to prevent turbulence injuries, emphasize the importance of flight attendant's personal safety, promote communication and coordination, and gather data and review the air carrier's history of turbulence encounters and injuries.

How many people have been injured during turbulence?

<i>Year</i>	<i>Passenger</i>	<i>Crew</i>	<i>Total</i>
2009	74	27	101
2010	35	23	58
2011	4	25	29
2012	4	19	23
2013	2	4	6

<i>Year</i>	<i>Passenger</i>	<i>Crew</i>	<i>Total</i>
2014	19	9	28
2015	11	16	27
2016	29	13	42
2017	9	8	17

Table 2, Number of passengers Reported Injuries

The NTSB requires airlines to report serious injuries and fatalities. A serious injury is “any injury that (1) requires the individual to be hospitalized for more than 48 hours, commencing within seven days from the date the injury was received; (2) results in a fracture of any bone (except simple fractures of fingers, toes, or nose); (3) causes severe hemorrhages, nerve, muscle, or tendon damage; (4) involves any internal organ; or (5) involves second-or third-degree burns, or any burns affecting more than five percent of the body surface.” The FAA tracks these reports, but not general incidents of turbulence.

6.2 Advisory Circular 120-88A

FAA Advisory Circular 120-88A “Preventing Injuries Caused by Turbulence” dated November 19, 2007 provided, in part, the following guidance:

Emphasize the Importance of F/A’s Personal Safety. *F/A injuries occur at a disproportionately high rate compared to other crewmembers and other cabin occupants because F/As spend more time in the passenger cabin unseated and, therefore, unbelted. Effective training emphasizes to F/As that:*

(1) You are not invincible. The overlying objective throughout all crewmember training is to ensure that crewmembers are confident, competent, and in control while conducting their activities in the cabin. However, during a turbulence encounter, the most appropriate first response by a crewmember might be self preservation. Training courseware can make crewmembers aware of their vulnerability in moderate and extreme turbulence. Effective training can incorporate video/digital media, real world scenarios and interviews with crewmembers who have experienced moderate and severe turbulence as a way to demonstrate that “turbulence can be stronger than you are.”

(2) You have tools available to increase your safety and the safety of your passengers. Effective training shows crewmembers how to increase personal safety and passenger safety by identifying tools available to them in a turbulence encounter. Training can include the effective use of the passenger address (PA) system and other methods of communicating with passengers; the location of handholds throughout the airplane (or equipment that could be used as a handhold); and how to secure a service cart or an entire galley in minimum time.

(3) *You need to recognize and avoid a denial reflex. Crewmembers can be made aware of ways in which human psychology might play into a turbulence encounter and might actually increase their risk of injury. For example, on a short flight, with little time to complete a cabin service, crewmembers might be less conservative regarding their personal safety than on a longer flight with no time constraints. crewmembers can also increase risk and compromise their personal safety by trying to adhere to routine procedures normally accomplished on every flight, such as completing seatbelt compliance checks, rather than by responding to the nonroutine situation that a turbulence encounter presents.*

It also provided the following guidance for imminent Turbulence or Turbulence Occurring:

Imminent Turbulence or Turbulence Occurring. Sudden, unexpected or imminent turbulence requiring immediate action to protect cabin crew and passengers.

(1) *Captain turns on seatbelt sign and makes a PA announcement, “F/As and passengers be seated immediately. Passengers please remain seated until this area of turbulence has passed, and I have cleared you to move about the cabin.”*

(2) *Cabin crew take first available seat and secure themselves.*

(3) *No compliance checks are performed, and items are secured only if they present no delay in securing a person in a seat.*

(4) *When conditions improve, captain makes PA announcement advising the cabin crew that they may resume their duties and whether or not the passengers may move about the cabin.*

6.3 FAA Advisory Circular AC 00-30C Clear Air Turbulence Avoidance

FAA AC 00-30C “Clear Air Turbulence Avoidance,” dated March 22, 2016, section 5.1 defines Clear Air Turbulence (CAT) as “sudden severe turbulence occurring in cloudless regions that causes violent buffeting of aircraft...includes turbulence in cirrus clouds, within and in the vicinity of standing lenticular clouds and, in some cases, in clear air in the vicinity of thunderstorms.” The AC further went on to state “CAT is a recognized problem that affects all aircraft operations. CAT is especially troublesome because it is often encountered unexpectedly and frequently without visual clues to warn pilots of the hazard.” The AC, in section 7 “Modern Turbulence Reports and Forecasts” goes on to state “Automated turbulence reporting systems are common on many commercial aircraft using the Aircraft Meteorological Data Relay (AMDAR) system. Airline pilot reports are now being relayed to others by the airline’s aircraft dispatchers and by meteorologists working at the Federal Aviation Administration’s (FAA) air route traffic control centers (ARTCC).”

AMDAR reports turbulence in terms of Eddy Dissipation Rate (EDR) which was the International Civil Aviation Organization (ICAO) standard dimension for automated turbulence reporting. EDR was a state-of-the-atmosphere measure rather than a state-of-the-aircraft measure and thus makes it independent of aircraft type.

In-flight weather advisories such as SIGMET and AIRMET are used to disseminate important information on atmospheric turbulence, both convective and CAT. In-flight weather advisories in the contiguous United States are issued by the Aviation Weather Center (AWC) as well as 20 Center Weather Service Units (CWSUs)

F. LIST OF ATTACHMENTS

Attachment 1: Flight Crew Statements
Attachment 2: Dispatch Release
Attachment 3: Final Weather Briefing
Attachment 4: Spirit Airlines Newsletter on Turbulence

Submitted by:

Warren Abrams
Air Safety Investigator

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