



AVIATION



HIGHWAY



MARINE



RAILROAD



PIPELINE

# Aviation Investigation Final Report

<b>Location:</b>	San Diego, California	<b>Incident Number:</b>	OPS21LA003
<b>Date &amp; Time:</b>	June 10, 2021, 17:45 Local	<b>Registration:</b>	N8674B (A1); N197SY (A2)
<b>Aircraft:</b>	Boeing 737-8H4 (A1); EMBRAER S A ERJ 170-200 LR (A2)	<b>Aircraft Damage:</b>	None (A1); None (A2)
<b>Defining Event:</b>	Comm system malf/failure	<b>Injuries:</b>	177 None (A1); 77 None (A2)
<b>Flight Conducted Under:</b>	Part 121: Air carrier - Scheduled (A1); Part 121: Air carrier - Scheduled (A2)		

## Analysis

On June 10, 2021, about 1745 Pacific Daylight Time (PDT) a runway incursion occurred at the San Diego international airport when a SkyWest flight was positioned on Runway 27 for takeoff at the same time a Southwest flight was cleared to land on the same runway.

The SkyWest flight was instructed to Line Up and Wait (LUAW) on Runway 27.

According to FAA recordings, the Southwest flight was instructed to go around on an approximate 0.84-mile final (about 1.2 miles from the runway 27 displaced threshold); however, the transmission was blocked and the instruction was not heard by the crew. The air traffic control tower controller instructed the SkyWest flight to exit the runway at taxiway C2 about 11 seconds prior to instructing the Southwest flight to go around and to not overfly the SkyWest airplane. The Southwest flight maneuvered around the SkyWest flight exiting the runway and subsequently landed on Runway 27. The closest proximity was 0.18 miles laterally and 200 feet vertically.

A review of the FAA audio recordings indicated that the tower controller informed the Southwest flight that there would be traffic holding in position for takeoff on the runway following a preceding arrival aircraft. The controller then issued instructions to other uninvolved aircraft, including a helicopter that was transitioning the airspace. Just after the controller issued instructions for the SkyWest flight to exit the runway, and when the Southwest flight was on an approximate 1.2-mile final, the ASDE-X provided a mandatory go-around alert, and the controller issued go-around instructions to Southwest. The Southwest flight subsequently maneuvered and offset to the left of Runway 27, and then back to the right, and the aircraft aligned with and

landed on Runway 27. The SkyWest crew did not hear the air traffic controller’s transmission to the Southwest flight to go around. The SkyWest crew reported they did hear the Southwest flightcrew’s query about the airplane on the runway.

According to the FAA, the tower controller was communicating with a helicopter transitioning the airspace after they had instructed SkyWest to LUAW. This additional communication likely distracted the controller from monitoring the position of the SkyWest and Southwest airplanes.

Although the FAA reported that tower communication was working normally at the time of the event, they were requested to conduct testing on the strength of the radio signal from the tower cab at various distances away from the airport. However, there was no indication that the FAA was able to conduct such testing and therefore it could not be conclusively determined if the control tower’s frequency strength was adequate to overpower an airborne aircraft’s transmission for other aircraft operating on the airport. Therefore, it is likely that the air traffic controller and the Southwest flightcrew’s simultaneous transmissions canceled each other with no indication to the controller, the arriving aircraft, nor any other aircraft on the frequency.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this incident to be:

The blocked go-around radio instruction from the air traffic control tower to the arrival aircraft which resulted in the arrival aircraft continuing the landing approach. This led to a loss of separation between the landing aircraft and the aircraft awaiting departure on the runway. Contributing to the loss of separation was the controller’s distraction communicating with a helicopter transitioning the airspace.

Findings	
Environmental issues (A1)	VHF/HF radio - Timing of related info
Environmental issues (A1)	VHF/HF radio - Ability to respond/compensate
Not determined (A2)	(general) - Unknown/Not determined

## Factual Information

### History of Flight

<b>Approach (A1)</b>	Comm system malf/failure (Defining event)
<b>Landing (A1)</b>	Air traffic event
<b>Landing (A1)</b>	Runway incursion veh/AC/person
<b>Landing-flare/touchdown (A1)</b>	Abrupt maneuver
<b>Landing (A1)</b>	Course deviation
<b>Taxi-from runway (A2)</b>	Air traffic event

On June 10, 2021, about 1745 Pacific Daylight Time (PDT), a runway incursion occurred at the San Diego International Airport (SAN), San Diego, California, when air traffic control cleared Southwest flight 1648 to land on runway 27 and subsequently instructed SkyWest flight 3371 to line up and wait on the same runway. Both flights were being operated under Title 14 *Code of Federal Regulations (CFR)* Part 121. There were no injuries reported to the occupants of either flight or damage to either airplane. Daytime visual meteorological conditions (VMC) prevailed at the time of the incident.

Southwest flight 1648 push backed from the gate at Phoenix Sky Harbor International Airport (PHX), Phoenix, Arizona about 1647 and was airborne about 1656. The original departure time was 1630. According to the flight crew interview transcripts there were no issues with their airplane that would affect their landing and that everything was “normal.” For the event flight the first officer was the pilot flying and the captain was the pilot monitoring.

The Southwest flight’s arrival into SAN was the LUCKI1 arrival and then the Area Navigation (RNAV) Z approach to runway 27 (see section 5.0 for details on the arrival and approach). According to the flight crew “it was VMC, clear” and they were going to follow the RNAV approach for lateral and vertical guidance to the airport. Air traffic control (ATC) was going to sequence another aircraft in front of them on the approach; however, after the other aircraft went south of the extended final to the runway, the ATC controller vectored that flight off the approach and the incident flight became the number one aircraft for the airport. They were cleared to the initial approach fix for the approach to runway 27 “near the end” of the LUCKI1 arrival. The flight crew stated that once they reported the airport in sight, they were cleared for the visual approach to runway 27.

At 1741:54, the Southwest flight contacted the SAN ATC tower inside of the VYDDA waypoint. The ATC tower controller cleared Southwest flight 1648 to land on runway 27 and informed them that there was going to be an airplane in the takeoff position on runway 27. The flight crew

accepted the landing clearance and acknowledged that there was to be an airplane in position on the runway.

At 1744:00 the ATC tower controller advised the SkyWest flight that Southwest was on a 5-mile final and instructed them to line up and wait on runway 27. As the Southwest flight got closer to the runway, they observed the SkyWest airplane at the beginning of the displaced threshold for runway 27 and they had not heard the tower controller issue a takeoff clearance to the SkyWest flight.

At 1745:47 the tower controller instructed SkyWest to exit the runway, first at Bravo then corrected the clearance to Charlie 2 (C2) which was read back by the SkyWest flightcrew.

At 1745:58, the Airport Surface Detection System – Model X (ASDE-X) alerted the tower controller that runway 27 was occupied and provided a mandatory go-around alert. The FAA audio recording captured the pilot of the Southwest flight starting to transmit with “Ah” followed by the tower controller instructing the Southwest flight to go around. However, immediately after the tower controller stopped transmitting the audio recording captured the Southwest flight crew stated, “Southwest sixteen forty-eight.” However, LiveATC audio recording of the event captured the pilot of SWA1648 transmitting, “*Ah, is that an airplane on the runway, for Southwest sixteen forty-eight.*” Radar data of the event indicated that the Southwest flight was less than 1 nautical mile from the end of runway 27 at the time of those transmissions.

At 1746:02 The ATC tower controller stated, “*do not overfly the aircraft on the runway.*” According to the Southwest pilots’ interviews, the pilot monitoring unknowingly keyed the transmit button and stated, “*how are we going to do that.*”

According to written statements from the SkyWest flight crew, the captain, after receiving clearance from the controller to line up and wait on runway 27 and that there was traffic on a 5-mile final, taxied into position for departure. The flight crew reported hearing several transmissions from the tower to several other aircraft including an aircraft requesting a clearance into the airspace and to fly near “*Petco Park.*” They heard several airlines receive a landing clearance after they reported on the frequency with the tower controller. However, there was no takeoff clearance issued to them and the next instruction they were issued was to exit the runway. While their flight began moving to exit the runway, they heard the Southwest plane ask if that was a plane on the runway. The controller transmitted that the airplane was exiting and not to overfly them, to which Southwest queried about how they are going to do that. The crew reported that the controller’s response was “*just off-set.*” After they exited the runway, they heard several transmissions between the controller and the Southwest flight crew. After the SkyWest flight stopped and was holding short of runway 27, they informed the tower controller that they did not hear a go-around instruction for Southwest.

According to the flight crew interview transcripts, the Southwest first officer, who was flying, queried the captain if he wanted him to move a little to the left to not fly over the SkyWest airplane, which the captain agreed. Prior to landing, the ATC controller queried the flight with

*"are you going around."* However, according to the crew, the transmission trailed off just as the main landing gear was touching down. The flight landed on the runway and the first officer reported he applied *"normal thrust reversers"* and at some point, prior to exiting the runway onto a taxiway, he transferred control to the captain to taxi. During the rollout, the ATC controller told Southwest 1648 *"I told you to go around"* to which the captain responded they did not hear him say that and that they were only told not to overfly the aircraft. The controller then told them to go ahead and contact ground control. The flight taxied to the gate uneventfully.

The first officer reported that after they returned to Dallas that night, he listened to a publicly available transmission recording of their flight. He stated that on one recording he could hear the controller issue a go-around to their flight and as soon as the controller's transmission ended the remainder of the captain's transmission was heard, which was their call sign only. He further heard another recording in which he could not hear the controller's transmission but only the captain's transmissions.

### Pilot Information (A1)

<b>Certificate:</b>	Airline transport; Flight instructor	<b>Age:</b>	56, Male
<b>Airplane Rating(s):</b>	Single-engine land; Multi-engine land	<b>Seat Occupied:</b>	Left
<b>Other Aircraft Rating(s):</b>	None	<b>Restraint Used:</b>	5-point
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	Yes
<b>Instructor Rating(s):</b>	Airplane multi-engine; Airplane single-engine; Instrument airplane	<b>Toxicology Performed:</b>	
<b>Medical Certification:</b>	Class 1 With waivers/limitations	<b>Last FAA Medical Exam:</b>	February 23, 2021
<b>Occupational Pilot:</b>	Yes	<b>Last Flight Review or Equivalent:</b>	October 1, 2020
<b>Flight Time:</b>	(Estimated) 23500 hours (Total, all aircraft), 14500 hours (Total, this make and model), 16000 hours (Pilot In Command, all aircraft), 110 hours (Last 90 days, all aircraft), 38 hours (Last 30 days, all aircraft), 3 hours (Last 24 hours, all aircraft)		

### Co-pilot Information (A1)

<b>Certificate:</b>	Airline transport; Commercial; Military	<b>Age:</b>	41,Male
<b>Airplane Rating(s):</b>	Single-engine land; Multi-engine land	<b>Seat Occupied:</b>	Right
<b>Other Aircraft Rating(s):</b>	None	<b>Restraint Used:</b>	5-point
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	Yes
<b>Instructor Rating(s):</b>	None	<b>Toxicology Performed:</b>	
<b>Medical Certification:</b>	Class 1 Without waivers/limitations	<b>Last FAA Medical Exam:</b>	February 1, 2021
<b>Occupational Pilot:</b>	Yes	<b>Last Flight Review or Equivalent:</b>	March 13, 2021
<b>Flight Time:</b>	(Estimated) 8000 hours (Total, all aircraft), 5500 hours (Total, this make and model), 2500 hours (Pilot In Command, all aircraft), 230 hours (Last 90 days, all aircraft), 45 hours (Last 30 days, all aircraft), 3 hours (Last 24 hours, all aircraft)		

### Pilot Information (A2)

<b>Certificate:</b>	Airline transport; Commercial	<b>Age:</b>	41,Male
<b>Airplane Rating(s):</b>	Single-engine land; Multi-engine land	<b>Seat Occupied:</b>	Left
<b>Other Aircraft Rating(s):</b>	None	<b>Restraint Used:</b>	
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	Yes
<b>Instructor Rating(s):</b>	Airplane multi-engine; Airplane single-engine; Instrument airplane	<b>Toxicology Performed:</b>	
<b>Medical Certification:</b>	Unknown	<b>Last FAA Medical Exam:</b>	
<b>Occupational Pilot:</b>	Yes	<b>Last Flight Review or Equivalent:</b>	
<b>Flight Time:</b>			

### Co-pilot Information (A2)

<b>Certificate:</b>	Airline transport; Commercial	<b>Age:</b>	30,Male
<b>Airplane Rating(s):</b>	Single-engine land; Multi-engine land	<b>Seat Occupied:</b>	Right
<b>Other Aircraft Rating(s):</b>		<b>Restraint Used:</b>	
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	Yes
<b>Instructor Rating(s):</b>	Airplane single-engine	<b>Toxicology Performed:</b>	
<b>Medical Certification:</b>		<b>Last FAA Medical Exam:</b>	
<b>Occupational Pilot:</b>	Yes	<b>Last Flight Review or Equivalent:</b>	
<b>Flight Time:</b>			

## **Southwest Flight Crew Information**

Documentation provided by Southwest Airlines indicated that since 2015 the pilots had flown with each other on 10 flights, including the incident flight. The most recent time they flew together before the day of the incident was on December 7, 2019; however, other than the incident flight no other flights they operated together were to SAN. Documentation further indicated that since 2010 the captain had operated flights into SAN a total of 88 times including the incident flight. The most recent flight into SAN prior to the incident was on September 27, 2020. The first officer had operated flights into SAN a total of 42 times, including the event flight, with the most recent prior to the incident being on May 15, 2021.

### **Captain**

The captain was 56 years old and held an Airline Transport Pilot (ATP) certificate with rating for multiengine land, commercial privileges airplane single-engine land, and type ratings on the B-737, CE-500, DC-9, HS-125, and LR-JET which included limitation of DC-9 Circling approach – VMC only, CE-500 Second in Command required. He held a flight instructor certificate with airplane single and multiengine, and instrument airplane rating, and a mechanic certificate with an airframe and powerplant rating. He held an FAA first-class medical certificate dated February 23, 2021, with a limitation of *"must wear corrective lenses"*. At the time of the incident, he reported that he was wearing contacts. His date of hire with Southwest Airlines was May 10, 2000. He was based at Dallas Love Field Airport (DAL), Dallas, Texas.

His most recent training event occurred in January of 2021 with a return-to-service training on the B-737 Max. Prior to that his most recent recurrent training was accomplished in October 2020. The Captain further provided that he had approximately 9,000 total hours of flight experience as a captain in the B737 series aircraft.

### **First Officer**

The first officer was 41 years old and held an ATP certificate with a rating for multiengine land, commercial privileges airplane single-engine land, and a type rating on the B-737. He held an FAA first-class medical certificate dated February 1, 2021, with no limitations. His date of hire with Southwest Airlines was April 2, 2014. He was based at DAL.

Following a voluntary leave of 6-months from Southwest Airlines, he requalified on the B-737 in March of 2021 following a checkride. The requalification training included a day of ground school, maneuver observation training and line observation training, followed by a few days off. Then he did the Southwest Airlines Advanced Qualification Program (AQP) qualification which included a day of ground school, maneuvers in the simulator, a checkride, and then B-737 Max return-to-service training.

### Aircraft and Owner/Operator Information (A1)

<b>Aircraft Make:</b>	Boeing	<b>Registration:</b>	N8674B
<b>Model/Series:</b>	737-8H4	<b>Aircraft Category:</b>	Airplane
<b>Year of Manufacture:</b>	2015	<b>Amateur Built:</b>	
<b>Airworthiness Certificate:</b>	Transport	<b>Serial Number:</b>	36734
<b>Landing Gear Type:</b>	Retractable - Tricycle	<b>Seats:</b>	185
<b>Date/Type of Last Inspection:</b>	June 9, 2021 Continuous airworthiness	<b>Certified Max Gross Wt.:</b>	174700 lbs
<b>Time Since Last Inspection:</b>		<b>Engines:</b>	2 Turbo fan
<b>Airframe Total Time:</b>	19003 Hrs at time of accident	<b>Engine Manufacturer:</b>	CFM INTL
<b>ELT:</b>	C126 installed, not activated	<b>Engine Model/Series:</b>	CFM56-7B27A
<b>Registered Owner:</b>	SOUTHWEST AIRLINES CO	<b>Rated Power:</b>	27300 Lbs thrust
<b>Operator:</b>	SOUTHWEST AIRLINES CO	<b>Operating Certificate(s) Held:</b>	Flag carrier (121)
<b>Operator Does Business As:</b>	Southwest	<b>Operator Designator Code:</b>	SWAA

### Aircraft and Owner/Operator Information (A2)

<b>Aircraft Make:</b>	EMBRAER S A	<b>Registration:</b>	N197SY
<b>Model/Series:</b>	ERJ 170-200 LR	<b>Aircraft Category:</b>	Airplane
<b>Year of Manufacture:</b>	2018	<b>Amateur Built:</b>	
<b>Airworthiness Certificate:</b>	Transport	<b>Serial Number:</b>	17000709
<b>Landing Gear Type:</b>	Retractable - Tricycle	<b>Seats:</b>	88
<b>Date/Type of Last Inspection:</b>		<b>Certified Max Gross Wt.:</b>	
<b>Time Since Last Inspection:</b>		<b>Engines:</b>	2 Turbo fan
<b>Airframe Total Time:</b>		<b>Engine Manufacturer:</b>	GE
<b>ELT:</b>		<b>Engine Model/Series:</b>	CF34-8E5
<b>Registered Owner:</b>	SKYWEST AIRLINES INC	<b>Rated Power:</b>	14510 Lbs thrust
<b>Operator:</b>	SKYWEST AIRLINES INC	<b>Operating Certificate(s) Held:</b>	Flag carrier (121)
<b>Operator Does Business As:</b>	SkyWest	<b>Operator Designator Code:</b>	SWIA



## Meteorological Information and Flight Plan

<b>Conditions at Accident Site:</b>	Visual (VMC)	<b>Condition of Light:</b>	Day
<b>Observation Facility, Elevation:</b>	KSAN, 28 ft msl	<b>Distance from Accident Site:</b>	0 Nautical Miles
<b>Observation Time:</b>	23:51 Local	<b>Direction from Accident Site:</b>	303°
<b>Lowest Cloud Condition:</b>	Clear	<b>Visibility</b>	10 miles
<b>Lowest Ceiling:</b>	None	<b>Visibility (RVR):</b>	
<b>Wind Speed/Gusts:</b>	3 knots / None	<b>Turbulence Type Forecast/Actual:</b>	None / None
<b>Wind Direction:</b>	300°	<b>Turbulence Severity Forecast/Actual:</b>	N/A / N/A
<b>Altimeter Setting:</b>	30.01 inches Hg	<b>Temperature/Dew Point:</b>	17°C / 13°C
<b>Precipitation and Obscuration:</b>	No Obscuration; No Precipitation		
<b>Departure Point:</b>	Phoenix, AZ (KPHX) (A1); San Diego, CA (A2)	<b>Type of Flight Plan Filed:</b>	IFR (A1); IFR (A2)
<b>Destination:</b>	San Diego, CA (A1); San Francisco, CA (SFO) (A2)	<b>Type of Clearance:</b>	IFR (A1); IFR (A2)
<b>Departure Time:</b>	23:47 UTC (A1)	<b>Type of Airspace:</b>	Class B (A1); Class B (A2)

## Airport Information

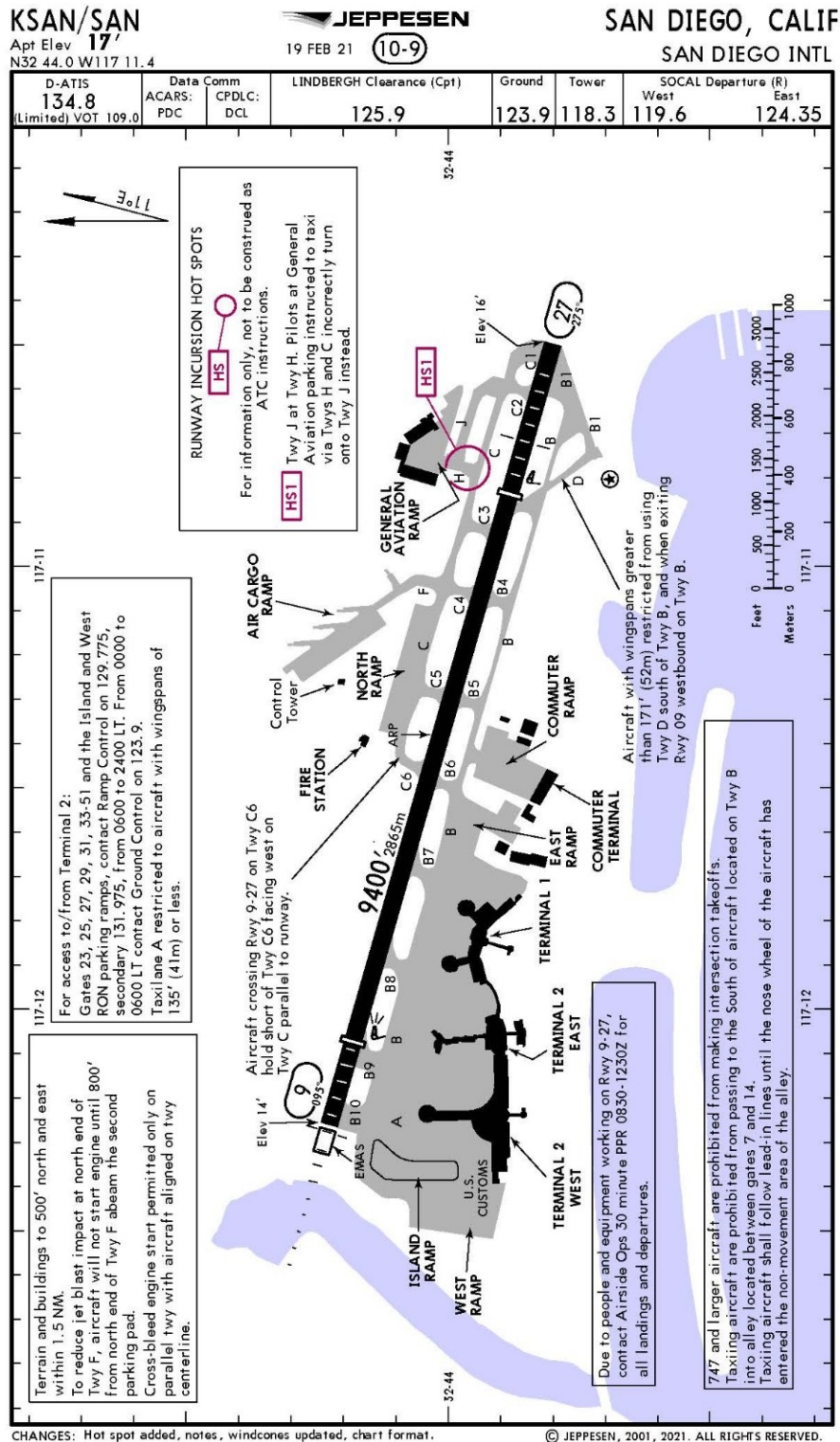
<b>Airport:</b>	SAN DIEGO INTL SAN	<b>Runway Surface Type:</b>	Asphalt; Concrete
<b>Airport Elevation:</b>	16 ft msl	<b>Runway Surface Condition:</b>	Dry
<b>Runway Used:</b>	09/27	<b>IFR Approach:</b>	Visual
<b>Runway Length/Width:</b>	9400 ft / 200 ft	<b>VFR Approach/Landing:</b>	

## Airport Information

San Diego International Airport was located about 2 miles west of San Diego, California. The airspace surrounding the airport was designated as Class B at the time of the incident. It had one paved landing surface for airplanes which was designated as 9/27. The airport had an air traffic control tower that operated 24-hours a day; it was staffed and in operation at the time of the incident.

## Airport Diagram

According to the FAA Chart Supplements, runway 9/27 was a 9,401-foot-long and 200-foot-wide, grooved, asphalt, and concrete runway. Runway 27 was equipped with 4-light PAPI system and had 7,591 ft of runway available for landing and 9,401 ft available for takeoff. The runway had an 1,810-foot displaced threshold.



**Figure 3: SAN Airport Diagram (Source: Jeppesen)**

### Wreckage and Impact Information (A1)

Crew Injuries:	6 None	Aircraft Damage:	None
Passenger Injuries:	171 None	Aircraft Fire:	None
Ground Injuries:		Aircraft Explosion:	None
Total Injuries:	177 None	Latitude, Longitude:	32.730364,-117.1764(est)

### Wreckage and Impact Information (A2)

Crew Injuries:	4 None	Aircraft Damage:	None
Passenger Injuries:	73 None	Aircraft Fire:	None
Ground Injuries:		Aircraft Explosion:	None
Total Injuries:	77 None	Latitude, Longitude:	32.730364,-117.1764(est)

### Additional Information

On February 2, 2021, Southwest Airlines produced a Flight Safety Alert for SAN, specifically for runway 27 approaches. The alert stated that data indicate a potential for “unstable approaches” and “GPWS Terrain/Obstacle Warnings.” It further provided conditions that may result in an unstabilized approach with those conditions being “a steeper glidepath,” “Parking garage approximately 0.4 NM from RWY 27 threshold” and “high gross weight and tailwinds may require vertical speeds in excess of 1000 fpm during final approach segment.”

#### Southwest Airlines General Approach Policies

The Southwest Airlines B737NG Operating Manual, Section 11.1.3.1 provided, in part, the following general approach guidance:

***If available, follow glidepath guidance on final. Use at least one of the following, if available:***

*Electronic glideslope (ILS)*

Glidepath from an RNAV approach in the FMC navigation database

Visual glideslope

Pilots may fly slightly above the glidepath for wake turbulence avoidance during visual approaches.

***(PF) Prior to the final approach segment, position hands and feet on the aircraft controls when the autopilot is engaged and flaps are extended for maneuvering or approach.***

***(PM) Prior to the final approach segment, position hands and feet to immediately assume control of the aircraft if circumstances warrant.***

### **Go-Around/Missed Approach**

The Southwest Airlines B737NG Operating Manual, Section 11.5.1 provided the following guidance:

***The Pilot Flying must execute a go-around/missed approach if any of the following occur:***

*Any Flight Deck Crew Member directs or calls for a go-around.*

*ATC directs a go-around.*

*The approach does not meet stabilized approach criteria.*

*The CDI exceeds a 2-dot deflection while on the FAS in IMC.*

*The expanded LOC pointer becomes "unfilled" while on the FAS in IMC.*

*A 2-dot low glideslope deflection on the FAS in IMC is exceeded.*

*The VOR pointer exceeds 10° from the desired course on a VOR approach inside the FAF in IMC.*

*Sufficient visual references for landing are not present and any of the following occur:*

*(ILS) Radio Altitude display flashes and turns amber.*

*The aircraft altimeter indicates that the DA or DOA is reached.*

*The missed approach point, if applicable, is reached.*

*The Pilot initially has sufficient visual references but then loses them below DA, ODA, or MDA.*

*A landing in the touchdown zone cannot be safely accomplished.*

***Note:*** *The touchdown zone is the area of the runway 500 ft to 3,000 ft beyond the landing threshold not to exceed the first one-third of the usable length beyond the threshold.*

*The aircraft touches down beyond 1,500 ft with an insufficient PWB System-computed stopping margin.*

*Before reaching DA, DDA, or MDA, any required portion of ground equipment/system elements become inoperative, unless adequate and appropriate backup exists for the type of approach being flown.*

*An HGS malfunction occurs during an HGS approach and adequate runway visual references have not been established.*

*An APCH WARN or HGs FAIL occurs and the Captain does not have the runway in sight (actual runway is in sight, not just part of the runway environment, such as lead-in lights or other approach lights).*

*For CAT III operations, if any controlling RVR is reported below the lowest authorized minima.*

*During an RNAV (RNP) or RNAV (GPS) approach, when a visual approach cannot be accomplished:*

*From the IAF to the MAP.*

- o Lateral Navigation Performance Scale ANP bar amber indication or*
- o NPS pointer cannot be maintained at less than 1 x RNP (NPS full scale deflection).*
- o Both Pilots' primary altimeters differ by more than 100 ft at the FAF.*
- o FMC Alert message UNABLE REQD NAV PERF-RNP appears.*
- o Dual FMC failure.*
- o Dual CDU failure.*
- o Dual GPS failure.*
- o Loss of MAP display.*
- o Autopilot failure with RNP less than 0.30 NM.*

*From the FAF to the MAP, unless a safer course of action can be taken.*

- o If any required aircraft equipment fails*
- o Vertical Navigation Performance Scale pointer cannot be maintained between the ANP bar limits.*
- o The following FMC alert messages appear: FMC DISAGREE or any VERIFY POS alerting message.*

- ? For a Predictive Windshear (PWS) caution or warning. On approach, initiate a normal go-around. Be prepared to execute a windshear recovery.
- ? For a Ground Proximity Warning System (GPWS) warning or caution:
  - Warning-Any time, immediately initiate the Terrain Avoidance Maneuver.
  - Caution-On approach, initiate a go-around in any of the following situations:
    - o At night
    - o In IMC
    - o If unable to acquire terrain visually

### **Stabilized Approach Criteria**

The Southwest Airlines, Flight Operations Manual, dated July 23, 2020, Section 11.1.1 "Stabilized Approach Criteria – All Approaches" provided the following guidance:

*Good landings start with a stabilized approach. Southwest Airlines uses the following criteria for stabilized approaches.*

*Significant speed and configuration changes during an approach complicate aircraft control, increase the difficulty of safely evaluating an approach as it progresses, and complicate the decision at the decision point (i.e., DA, DDA, MDA). Assess the probable success of an approach before reaching the decision point. This requires both Pilots to determine that the requirements for a stabilized approach have been met and are being maintained.*

***Comply with the following stabilized criteria for all approaches. Deviations within normal limit criteria are acceptable for operational conditions.***

The intention is that the PF completes a stabilized final approach entry by 1,000 ft above touchdown zone elevation (TDZE). Above 1,000 ft, PMs should make necessary informative callouts to assist the PF to achieve stabilized conditions by 1,000 ft above TDZE. Momentary deviations of glidepath, course, airspeed, and sink rate do not require an immediate go-around. Make required deviation callouts.

***By 1,000 ft above TDZE, the aircraft must be in the planned landing configuration (landing gear down and landing flaps).*** For approaches flown in vertical speed, the aircraft must be in the planned landing configuration by the final approach segment.

***By 1,000 ft above TDZE, the aircraft must be in the VTARGET speed range.*** VTARGET speed range is VTARGET + 10 and -5 kt. The PF should clearly communicate adjustments for an updated wind report from tower.

***By 1,000 ft above TDZE, the aircraft must be on appropriate glidepath with a normal descent rate.*** Maintain a stable approach path. Normal glidepath descent rate is 700-800 fpm. Final approach segments with glidepaths greater than 3° and/or high

airspeeds may require a sustained descent rate in excess of 1,000 fpm. This is acceptable as long as this condition is briefed and all other stabilized approach criteria are met. Use 1,000 fpm maximum for normal maneuvering during visual, circling, non-precision, and sidestep approaches. This directive does not restrict Pilots from flying slightly above the glidepath for wake turbulence avoidance during visual approaches.

***For approaches where maneuvering is required, the aircraft is on and maintaining final approach course or runway centerline with wings essentially level by 500 ft above TDZE.*** The intention is for Pilots to comply with the configuration, speed, descent rate, and checklist requirements by 1,000 ft above TDZE, and then continue necessary maneuvering to be essentially wings level by 500 ft above TDZE. Some charted approach procedures may require a turn below 500 ft.

***Once established, stabilized approach criteria must be maintained throughout the rest of the approach.***

***If stabilized approach criteria are not met, execute or direct a go-around/missed approach.***

It is the duty and responsibility of any Flight Deck Crew Member to execute or direct a go-around/missed approach when the stabilized approach criteria are not met. Additionally, any time the approach or landing appears unsafe, execute or direct a go-around/missed approach.

When a go-around/missed approach is called for, the Pilot Flying must immediately execute the go-around/missed approach.

### **Intended Touchdown Point**

Southwest Airlines Flight Operations Bulletin 20-38 dated December 28, 2020 "Intended Touch Down Point," provided, in part, the following guidance:

*The procedural directive regarding touch down is being revised to more accurately reflect the intent of the supporting information following that directive.*

*"Plan to" and "in the Touchdown Zone (TDZ)" have been added to the procedural directive regarding touch down: "Plan to touch down between 1,000 and 1,500 ft from the landing threshold on centerline in the Touchdown Zone (TDZ)."*

*It is still the goal to touch down between 1,000 and 1,500 ft from the landing*

*threshold, but if touchdown occurs past 1,500 ft, Pilots must know the latest touchdown point (LTP) based on the most restrictive of either:*

*? The performance capabilities of the aircraft (i.e., 1,500 ft plus the PWB stopping margin)*

*? The end of the TDZ (i.e., TDZ ends at 3,000 ft or 1/3 of the usable landing length)...*

***Do not make unnecessary changes to flight deck systems below 1,000 ft.***

The intention is for both Pilots to remain focused on flying/monitoring the aircraft. Do not perform discretionary tasks such as making FMC changes or presetting ATC ground control frequencies. Essential changes are permitted (e.g., operating windshield wipers).

***(PF) Maintain any gust correction to touchdown.***

***(PF) Bleed off any steady wind correction as the aircraft approaches touchdown.***

***(PF) Plan to touch down between 1,000 and 1,500 ft from the landing threshold on centerline in the Touchdown Zone (TDZ).***

Keep the aircraft in trim while on final. Avoid rapid control column movements, pumping, or trimming in the flare. These actions could increase the chances for a tailstrike.

PWB stopping margin information is based on the assumption that aircraft touchdown occurs at the 1,500-ft mark from the usable end of the runway (or the glideslope intercept point plus 500 ft if that value is greater than 1,500 ft). If touchdown occurs beyond the 1,500-ft mark, the available runway length remaining will be less than the PWB System-computed stopping margin, and in some cases, the remaining runway length will be insufficient to stop the aircraft.

If the AIII mode is selected, the PWB System subtracts 1,150 ft from the stopping margins to account for the possibility of a long landing due to AIII flare guidance.

***Note:*** When using the AIII mode to touch down, follow the HUD guidance cue in the HUD to touch down. Precisely flying the HUD guidance cue in AIII mode to touch down ensures touchdown within acceptable parameters.

If the current conditions are significantly different than the anticipated conditions at the time of PWB programming (e.g., wet runway 5-GOOD vs. runway with standing water 2-MED TO POOR, tailwind vs. calm wind), the PWB System-computed stopping margin may be incorrect for the significantly different conditions.

If a landing is made in either of these situations (i.e., touchdown past 1,500 ft plus the PWB stopping margin or landing conditions are significantly different than anticipated), higher than planned braking may be needed to account for the reduced or insufficient stopping margin.

If touchdown occurs beyond 1,500 ft plus the PWB stopping margin (for the level of autobrakes selected or approximated), the ability to stop on the remaining runway may be compromised. The situation becomes more critical on shorter runways; therefore, a go-around is the better option.



*If touchdown occurs beyond 1,500 ft past the threshold/displaced threshold, the shortest of the following distances is the latest touchdown point (LTP) and a go-around is required if touchdown occurs past the LTP:*

- ? 1,500 ft plus PWB stopping margin (for the level of autobrakes selected or approximated)*
- ? 3,000 ft*
- ? One-third of the usable landing length*

*A go-around is possible until the thrust reverser levers are raised.*

## **FAA Guidance**

The FAA Aeronautical Information Manual, Chapter 4 “Air Traffic Control” Section 2 “Radio Communications Phraseology and Techniques” provided, in part, the following:

### **4-2-2. Radio Technique**

- a. **Listen** before you transmit. Many times you can get the information you want through ATIS or by monitoring the frequency. Except for a few situations where some frequency overlap occurs, if you hear someone else talking, the keying of your transmitter will be futile and you will probably jam their receivers causing them to repeat their call. If you have just changed frequencies, pause, listen, and make sure the frequency is clear.
- b. **Think** before keying your transmitter. Know what you want to say and if it is lengthy; e.g., a flight plan or IFR position report, jot it down.
- c. The microphone should be very close to your lips and after pressing the mike button, a slight pause may be necessary to be sure the first word is transmitted. Speak in a normal, conversational tone.
- d. When you release the button, wait a few seconds before calling again. The controller or FSS specialist may be jotting down your number, looking for your flight plan, transmitting on a different frequency, or selecting the transmitter for your frequency.
- e. Be alert to the sounds or the lack of sounds in your receiver. Check your volume, recheck your frequency, and make sure that your microphone is not stuck in the transmit position. Frequency blockage can, and has, occurred for extended periods of time due to unintentional transmitter operation. This type of interference is commonly referred to as a “stuck mike,” and controllers may refer to it in this manner when attempting to assign an alternate frequency. If the assigned frequency is completely blocked by this type of interference, use the procedures described for en route IFR radio frequency outage to establish or reestablish communications with ATC.
- f. Be sure that you are within the performance range of your radio equipment and the ground station equipment. Remote radio sites do not always transmit and receive on all of a facility's available frequencies, particularly with regard to VOR sites where you can hear but

*not reach a ground station's receiver. Remember that higher altitudes increase the range of VHF "line of sight" communications.*

### **Undetected Simultaneous Transmissions Phenomenon**

Eurocontrol, European Organisation for the Safety of Air Navigation wrote a document titled "Risk Assessment of the Undetected Simultaneous Transmissions Phenomenon" dated April 9, 2010 provided, in part, the following information:

*The phenomenon of Simultaneous Transmissions is not new...have identified more frequent occurrences contributing in some cases to safety related incidents...*

*"Situations arise when two or more radio transmissions occur, simultaneously, on the same frequency. In this context 'simultaneous' is defined as two or more transmissions that overlap in such a way that the controller is not aware that more than one transmission has occurred leading to a potential safety hazard." In the context of this initiative, the notion of "simultaneous" is extended to transmissions that overlap in such a way that the controller or a pilot is not aware that more than one transmission has occurred.*

## Administrative Information

**Investigator In Charge (IIC):** Etcher, Shawn

**Additional Participating Persons:** David Gerlach; FAA AVP-100; Washington  
Tahereh Behbehani; Southwest Airlines; Dallas, TX  
Matthew Cain; Southwest Airlines Pilots Association; Dallas, TX

**Original Publish Date:** September 7, 2023

**Last Revision Date:**

**Investigation Class:** [Class 3](#)

**Note:** The NTSB did not travel to the scene of this incident.

**Investigation Docket:** <https://data.nts.gov/Docket?ProjectID=103275>

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

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