Aviation Investigation Final Report

Location:	Houston, Texas	**Incident Number:**	CEN09IA294
Date & Time:	May 12, 2009, 19:45 Local	**Registration:**	N371SW
Aircraft:	Boeing 737	**Aircraft Damage:**	Minor
Defining Event:	Fire/smoke (non-impact)	**Injuries:**	2 Minor, 51 None
Flight Conducted Under:	Part 121: Air carrier - Scheduled		

Analysis

Prior to the flight, the flight crew and dispatcher were aware that the anti-skid system was inoperative. They had requested and were granted use of the longest runway for landing. The captain made a normal landing in the target area. After touchdown, he reduced the thrust levers to idle, rapidly brought the speed brake to the full-up detent, employed reverse thrust, and applied manual wheel braking. Marks on the runway showed that about 550 feet after initial touchdown, the right main landing gear tires blew. The tower controller and other aircraft advised the flight crew that there was a fire in the area of the right main landing gear. After the airplane came to a stop, the captain initiated an emergency evacuation on the runway. All 54 persons on-board exited the airplane in 57 seconds, and the fire was extinguished soon after. Two passengers reported minor injuries. The airplane sustained minor damage to the right main landing gear and a portion of the right flap. Examination of data retrieved from the flight data recorder showed that during the touchdown and landing roll, at 19:45:31, the recorded left brake pressure was 770 pounds per square inch (psi). The maximum recorded right brake pressure was 1430 psi at 19:45:32. The maximum recorded left brake pressure was 990 psi. With the anti-skid system disabled, the pilot applying excessive braking during touchdown would cause the wheels to lock and the associated tires to blow. The airplane's quick reference handbook states "Use minimum braking consistent with runway conditions to reduce the possibility of a tire blowout."

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this incident to be: The pilot's inadvertent application of excessive braking after touchdown, which caused the right wheels to lock and several tires to blow and resulted in a subsequent brake fire.

Findings

Aircraft	(general) - Incorrect use/operation
Personnel issues	Incorrect action performance - Pilot
Aircraft	Brake - Not specified
Aircraft	Tire casing - Not specified

Factual Information

History of Flight

Prior to flight	Miscellaneous/other
Landing-landing roll	Fire/smoke (non-impact) (Defining event)
Post-impact	Fire/smoke (post-impact)
Post-impact	Evacuation

HISTORY OF FLIGHT

On May 12, 2009, at 1945 central daylight time, a Boeing 737-3H4 airplane, N371SW, operated by Southwest Airlines Company as Flight 519,
experienced a fire in the area of the right main landing gear when three of the four main landing gear tires blew-out during the landing on runway 22 at the William P. Hobby Airport (HOU), Houston, Texas. The airplane sustained minor damage. The 2 flight crew, 3 flight attendants, and 48 passengers evacuated the airplane on to the runway. Two passengers suffered minor injuries during the evacuation. The domestic scheduled passenger flight was being operated under the provisions of 14 Code of Federal Regulations Part 121. Visual meteorological conditions prevailed and an instrument flight rules flight plan was filed. The flight originated from the Louis Armstrong New Orleans International Airport (MSY), New Orleans, Louisiana, at 1830.

The airplane had been dispatched with several inoperative items as permitted on the minimum equipment list (MEL), including an inoperative automatic brake system. A landing on runway 22 was required because of MEL operational requirements. The captain provided a statement that he made a stabilized flaps 40 final approach with a normal landing in the target area. After touchdown, he took the thrust levers to idle, rapidly brought the speed brake to the full-up detent, employed reverse thrust, and applied manual wheel braking. Both flight crewmembers reported they thought the tires blew soon after touchdown.

Television news helicopter video of the entire event shows that flight 519 touched down in the touchdown zone of runway 22 and came to a stop on the runway approximately 3,300 feet from the touchdown point. Smoke and fire in the area of the right main landing gear area appeared on the video soon after touchdown while the airplane was still moving.

After the airplane came to a stop, the crew got confirmation of fire and smoke from the control tower and, were told that aircraft rescue fire fighting (ARFF) units were enroute. Other aircraft also confirmed the presence of fire and smoke. The captain conferred with the first officer and the flight attendants, and ordered an emergency evacuation from the left side doors.

The flight attendants opened only the forward entry door and the aft entry door on the left side

of the airplane. The associated emergency slides inflated. The ARFF units arrived and began to extinguish the fire as the passengers were evacuating down the slides.

After all 48 passengers, including one lap child, had exited from the airplane, two flight attendants evacuated down the slides and began to gather the passengers, direct them away from the airplane, and screen for injuries. The remaining crewmembers made a sweep through the cabin to confirm no one was left on-board and then also evacuated down the slides. All passengers and all crewmembers successfully exited the airplane 57 seconds after the evacuation began.

The ARFF units were able to “knock down” the fire approximately 32 seconds after the emergency evacuation began. The ARFF commander declared that the fire was out four minutes later. After an initial on-scene triage by emergency medical services, the passengers and crew were bused to the airport terminal.

FLIGHT RECORDERS

Immediately after the incident the airplane's cockpit voice recorder (CVR) and flight data recorder (FDR) were removed and sent to the National Transportation Safety Board's Vehicle Recorder Division, in Washington, D.C., for readout.

FDR data was recorded during the May 12, 2009 event. During the touchdown and landing roll, at 19:45:31 the recorded left brake pressure was 770 pounds per square inch (PSI). The maximum recorded right brake pressure was 1430 PSI at 19:45:32. The maximum recorded left brake pressure was 990 PSI at 19:45:57 and at 19:46:03.

AIRCRAFT INFORMATION

N371SW, a model 737-3H4 transport category airplane, serial number (S/N) 26598, was manufactured by the Boeing Company in 1993. It was equipped with two CFM 56 series turbofan engines, each developing 20,000 pounds of thrust. At the time of the incident, the airplane had accumulated a total of 52,892 hours. The most recent inspection had been performed on January 8, 2009.

The airplane was equipped with four crewmember seats in the cockpit, four cabin crew seats, and 137 passenger seats, giving a total capacity of 145 persons.

METEOROLOGICAL INFORMATION

At 1950, an aviation weather report (SPECI) at Houston, Texas, reported wind from 150 degrees at 11 knots, gusting to 16 knots, 10 miles visibility, few clouds at 2,700 feet, scattered clouds at 25,000 feet, temperature 27 degrees Celsius, dew point 22 degrees Celsius, and an altimeter setting of 29.90 inches of Mercury.

AIRPORT INFORMATION

The Airport/ Facility Directory, Southwest U. S., indicated that runway 22/04 at the HOU airport was 7,602 feet long and 150 feet wide. The runway surface was composed of grooved concrete.

An additional runway 12R/30L at the HOU airport was 7,602 feet long and 150 feet wide. Runway 12R had a displaced threshold with landing distance available of 6,568 feet. The runway surface was composed of grooved concrete.

WRECKAGE AND IMPACT INFORMATION

Investigators from the Safety Board, Federal Aviation Administration (FAA), and Southwest Airlines examined the marks on the runway and the damage to the airplane at the incident location on May 13, 2009.

Touchdown marks for the right main landing gear, approximately 20 feet long, were observed 15 feet to the right of the runway centerline 1,300 feet from the approach end of runway 22. Another set of solid skid marks for the right main landing gear were observed 15 feet to the right of runway centerline beginning at 1,550 feet from the runway end. The solid skid marks continued for 300 feet where marks were observed consistent with blown tires for both the inboard and outboard main tires. Uninterrupted skid marks were observed from that point to the final resting location. Marks on the runway show that the right main tires stopped 20 feet to the right of the runway centerline, 4,650 feet from the approach end of runway 22.

Examination of the airplane showed the left main landing gear outboard tire ruptured and sections of it were separated. The left inboard tire was inflated and undamaged. The right inboard tire ruptured and there was minor damage to the wheel rim. The right outboard tire was ruptured and about 3 inches of the wheel rim and the brake assembly were ground away. Both right main landing gear tires, wheels, and brake assemblies were observed to have minor thermal damage. The wing flap section behind the right main landing gear was observed to have sustained minor damage from the tire debris.

MEL labels for 27-7 (Auto Speed Brakes), 32-2 (Auto Brake System), and 46-2 (On-board Performance Computer) were observed in the cockpit.

No pre-event anomalies were discovered that would have prevented normal operations.

TESTS AND RESEARCH

All four main landing gear tires, wheels and brake assemblies were examined at the Honeywell facility in South Bend, Indiana. Three of the four tires were blown. Both the right inboard and the right outboard wheels sustained damage. The right outboard brake assembly sustained damage. All four brake assemblies were examined and pressure was applied to determine the

pressure required for rotors tight, and rotors loose. The results were nominal. The brakes were then pressurized to 3,000 PSI with no leakage seen. The brake wear pin measurements were nominal. No pre-event anomalies in the tires, wheels, or brakes were discovered that would have prevented normal operations.

ADDITIONAL INFORMATION

The anti-skid system is designed to provide touchdown protection during the air-to-ground transition. Touchdown protection prevents brake application prior to touchdown and wheel spin-up. With the touchdown protection feature operative, brake pressure can reach the brakes only 3 seconds after the air-ground switch logic indicates ground, or once each wheel has spun up to a velocity of 60 knots. The touchdown protection is not available when the antiskid system is in the off position or is not operative.

The manufacturer and the operator's aircraft operating manuals have detailed information and instructions regarding the anti-skid system operation and limitations. The operator's Quick Reference Handbook (QRH) states "Use minimum braking consistent with runway conditions to reduce the possibility of a tire blowout".

Pilot Information

Certificate:	Airline transport	**Age:**	46,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Instrument airplane	**Toxicology Performed:**	No
Medical Certification:	Class 1 With waivers/limitations	**Last FAA Medical Exam:**	December 15, 2008
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	February 26, 2009
Flight Time:	18862 hours (Total, all aircraft), 9500 hours (Total, this make and model), 7765 hours (Pilot In Command, all aircraft), 205 hours (Last 90 days, all aircraft), 78 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft)		

Co-pilot Information

Certificate:	Airline transport	**Age:**	40,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 Without waivers/limitations	**Last FAA Medical Exam:**	March 5, 2009
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	March 11, 2009
Flight Time:	13068 hours (Total, all aircraft), 3640 hours (Total, this make and model), 6219 hours (Pilot In Command, all aircraft), 215 hours (Last 90 days, all aircraft), 71 hours (Last 30 days, all aircraft), 8 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Boeing	**Registration:**	N371SW
Model/Series:	737 3H4	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Transport	**Serial Number:**	26598
Landing Gear Type:	Retractable - Tricycle	**Seats:**	145
Date/Type of Last Inspection:	January 8, 2009 Continuous airworthiness	**Certified Max Gross Wt.:**	13600 lbs
Time Since Last Inspection:		**Engines:**	2 Turbo fan
Airframe Total Time:	52892 Hrs at time of accident	**Engine Manufacturer:**	CFM
ELT:	Installed, not activated	**Engine Model/Series:**	56
Registered Owner:	SOUTHWEST AIRLINES CO	**Rated Power:**	20000 Lbs thrust
Operator:	SOUTHWEST AIRLINES CO	**Operating Certificate(s) Held:**	Flag carrier (121)
Operator Does Business As:		**Operator Designator Code:**	SWAA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	HOU,46 ft msl	**Distance from Accident Site:**	0 Nautical Miles
Observation Time:	19:50 Local	**Direction from Accident Site:**	360°
Lowest Cloud Condition:	Few / 2700 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	11 knots / 17 knots	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	150°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.89 inches Hg	**Temperature/Dew Point:**	27°C / 22°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	New Orleans, LA (MSY)	**Type of Flight Plan Filed:**	IFR
Destination:	Houston, TX (HOU)	**Type of Clearance:**	IFR
Departure Time:	18:30 Local	**Type of Airspace:**	

Airport Information

Airport:	William P. Hobby Airport HOU	**Runway Surface Type:**	Concrete
Airport Elevation:	46 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	22	**IFR Approach:**	Circling;ILS
Runway Length/Width:	7602 ft / 150 ft	**VFR Approach/Landing:**	Full stop

Wreckage and Impact Information

Crew Injuries:	5 None	**Aircraft Damage:**	Minor
Passenger Injuries:	2 Minor, 46 None	**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Minor, 51 None	**Latitude, Longitude:**	29.640556,-95.273887(est)

Administrative Information

Investigator In Charge (IIC):	Latson, Thomas
Additional Participating Persons:	Lester A Farris; FAA SWA Certificate Management Office; Irving, TX Court Goodroe; Southwest Airlines Co; Dallas, TX John Gadzinski; SWAPA; Dallas, TX Gary Parks; FAA SWA Certificate Management Office; Irving, TX Thomas J Rocha; FAA SWA Certificate Management Office; Irving, TX
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