National Transportation Safety Board
Aviation Accident Final Report

Location:	Superior, WI	**Accident Number:**	CEN14LA036A
Date & Time:	11/02/2013, 1750 CDT	**Registration:**	N70520
Aircraft:	CESSNA 182L	**Aircraft Damage:**	Destroyed
Defining Event:	Midair collision	**Injuries:**	1 Minor, 4 None
Flight Conducted Under:	Part 91: General Aviation - Skydiving		

Analysis

A Cessna 182L (182), the lead airplane, and a Cessna 185F (185), the trail airplane, collided during a formation skydiving flight. Both pilots flew the airplanes in a rectangular pattern until they reached the jump altitude of 12,700 ft mean sea level. The 182 pilot established a jump heading and visually confirmed that the 185 was to the left side and aft of the 182. The 182 pilot then called out "door open" and jumpers "climbing out." Subsequently, the four skydivers on board the 182 climbed out onto the airplane's right wing strut and right wheel step. Almost immediately, the 182 was struck by the 185. The 182's windshield was shattered, and the airplane entered an uncontrollable descent. During the descent, the right wing separated from the airplane, and the right wing fuel tank exploded. The 182 pilot exited the airplane and parachuted safely to the ground. The 185 pilot reported that "when it was time for the skydivers to climb out, the two planes began to drift together and in seemingly no time at all, the two were colliding." After the collision, the skydivers on board the 185 jumped from the airplane as it inverted; the pilot was able to recover the airplane and land.

During postaccident interviews, the pilots of both airplanes and the operator's chief pilot reported that, before the flight, they briefed that the trail airplane would be positioned on the left side of the lead airplane. However, each of the three pilots differently described the expected lateral and vertical separation between the trail airplane and the lead airplane. The 182 pilot described the trail position as 20 to 30 ft aft of the lead airplane on a 45-degree bearing and lower than the lead airplane. The 185 pilot described the trail position as one to two airplane lengths (about 26 to 52 ft) aft and left of the lead airplane and at the same altitude as the lead airplane. The chief pilot described the trail position as three airplane lengths (about 78 ft) aft and left of the lead airplane and slightly lower than the lead airplane. Even though none of the pilots stated that the trail airplane should be flown higher than the lead airplane, a video taken of the flight showed that the trail airplane pilot flew the trail airplane higher than the lead airplane until impact.

The Federal Aviation Administration (FAA) does not provide any guidance to pilots on how to fly skydiving formation flights nor does it require skydiving operators to provide skydiving pilot training or skydiving formation pilot training. The skydiving operator did not provide its

pilots skydiving formation flight training, and it did not keep records of pilot training nor was it required to do so by the FAA. The United States Parachute Association published an article titled, "Formation Flying 101: A Guide for Jump Pilots" that provided guidelines for skydiving formation flights, including, in part, that the trail airplane should be within 100 ft of the lead airplane; however, it did not specify that the trail airplane should be lower than the lead airplane. The article did state that altitude separation is the No. 1 way to avoid a collision and that the trail airplane pilot has only one thing to do–hold position relative to the lead aircraft and never lose sight of it. It is essential that pilots flying skydiving operation formation flights have adequate training to conduct the flights properly and ensure the safety of their passengers. If both pilots had received adequate skydiving formation flight training, they might have had a consensus about how the formation flight should have been flown. If the trail airplane pilot had received such training, he might have been more vigilant about maintaining adequate lateral and vertical separation from the lead airplane during the flight.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The failure of the pilot who was flying the trail airplane to maintain separation from the lead airplane. Contributing to the accident was the inadequate pilot training for formation skydiving operations.

Findings

Personnel issues	Incorrect action performance - Pilot of other aircraft (Cause) Type/qual of instruct/training - Pilot of other aircraft (Factor) Type/qual of instruct/training - Pilot (Factor)
Organizational issues	Upgrade training - FAA/Regulator (Factor)

Factual Information

HISTORY OF FLIGHT

On November 2, 2013, about 1750 central daylight time, a Cessna 182L, N70520, was destroyed when it was struck by a Cessna 185F, N94059, during a formation skydiving flight near Superior, Wisconsin, and subsequently had an in-flight breakup. The four skydivers and the pilot in the Cessna 182L jumped free of the airplane and deployed their parachutes. The pilot received minor injuries and the four skydivers were not injured. The Cessna 185F sustained substantial damage during the collision, but the pilot was able to maintain control of the airplane and land at the Richard I. Bong Airport (SUW), Superior, Wisconsin. The five skydivers in the Cessna 185F jumped free of the airplane during the collision and deployed their parachutes. One parachutist received serious injuries and four parachutists received minor injuries. Both airplanes were registered to a private individual and operated by Skydive Superior under the provisions of the 14 Code of Federal Regulations (CFR) Part 91 and Part 105 as a formation skydiving flight. Visual meteorological conditions prevailed at the time of the accident. A flight plan was not filed; however, the flight was in contact with the Duluth Approach Control. Both airplanes departed SUW about 1720.

Both pilots had flown about seven jump flights before the formation flight, which was to be the last of the day. The pilots stated that they briefed the formation flight before departure along with the skydive operator's designated chief pilot. The C-182 was the lead airplane and the C-185 was to be the trail airplane since it had more power to maneuver. The C-185 had two radios installed in it so that pilot made the radio calls to the Duluth Approach Control. All calls between the airplanes were made on the Unicom frequency, 122.7. The pilot of the C-182 was to make the call outs for "door open," jumpers "climbing out," and "jumpers away." The C-182 pilot reported that it was briefed that the C-185 was to maintain separation on the left side and 20 to 30 feet aft the C-182, at an altitude at or below that of the C-182 until it reached the jump altitude and through the time of the jump. After the jump was completed, the C-182 was to make a descending right turn to the northeast, and the C-185 was to make a descending left turn to the southwest. If the C-185 pilot lost sight of the lead airplane at any time during the flight, he was to break off the flight and maintain separation from the C-182.

Both airplanes departed from runway 32 and climbed at 90 mph using a rectangular pattern until they reached the jump altitude of 12,700 feet above mean sea level. The C-182 pilot established a heading of 330 degree magnetic and visually confirmed that the C-185 was to the left side and aft of the C-182. The C-182 pilot called out "door open" and jumpers "climbing out." The four skydivers on board the C-182 climbed out onto the right wing strut and right wheel step of the airplane. Almost immediately afterward, the C-182 was struck by the C-185. The C-182's windshield was shattered and the airplane went into an uncontrollable descent. The right wing separated from the airplane and the right wing fuel tank exploded. The C-182 pilot stated that the flight controls were unresponsive and the airplane appeared to be in a flat counterclockwise spin. The C-182 pilot exited the airplane and parachuted safely to the ground. All nine skydivers safely parachuted to the ground.

The C-185 pilot reported that, "When it was time for the skydivers to climb out, the two planes began to drift together and in seemingly no time at all, the two were colliding. The bottom of the 185 and the top of the 182 met." After the collision, the skydivers jumped free of the C-185 as it went inverted. The pilot was able to recover the airplane and land at SUW. The C-185 pilot

reported that he had forgotten to wear a parachute during the formation flight, but had worn it for the earlier flights.

Five of the skydivers had video cameras attached to their helmets during the jump and recorded the collision and subsequent skydive. The cameras worn by the skydivers in the C-185 showed the five skydivers preparing to exit the airplane with the door open. The C-182 can be seen to the right of the C-185, but at a lower altitude and on about a 45 degree bearing. When the chief pilot climbed onto the strut, the C-185 was still aft and slightly higher than the C-182. The video images showed that the chief pilot climbed in front of the strut as the second jumper climbed onto the step. Much of the lateral separation between the airplanes was lost by this time and the C-185 was visibly higher than the C-182. The two airplanes continued to get closer together with the C-185 almost abeam and higher than the C-182. The video images showed the two airplanes colliding and the two skydivers getting wedged between the C-185's strut and wing and the top of the C-182's wing and cabin. As the airplanes began to separate, the skydivers were falling away from the airplane as the C-182's right wing's fuel tank exploded. All the skydivers jumped free of the airplane. The video images showed the skydivers free falling as the C-182 descended out of control with its separated right wing on fire and the C-185 inverted. The video images showed the skydivers landing safely at the landing zone, and the C-185 landing safely back at SUW.

PERSONNEL INFORMATION

The C-182 pilot held a commercial certificate with a single-engine land rating and an airplane instrument rating. He held a first-class medical certificate with no waivers that was issued on December 19, 2012. He had 428 total flight hours with 65 hours in make and model.

He reported that he learned to fly skydivers at another skydiving operation. He received training from a pilot at that operator who provided 5 to 6 training flights. He flew 5 to 6 flights as the lead airplane, and then he moved to the trail airplane. The instructor provided training for about 3 flights as the trail airplane. The pilot reported that he felt comfortable flying formation and that he liked flying in the trail position.

He described the trail position as being about 20 to 30 feet from the lead – close enough to read the N-number at a 45 degree bearing. He stated that the trail airplane should be lower than the lead, because it provides a better field of vision.

He started flying at Superior Skydiving in July of 2013. He did not receive any training at Superior Skydiving because they were aware that he was experienced flying skydivers, and that he had experience flying formation for skydive operations. His first formation flight at Superior Skydiving was on the day of the accident.

The C-185 pilot held a commercial certificate with a single-engine land rating and an airplane instrument rating. He held a second-class medical certificate with no waivers that was issued on November 5, 2012. He had 535 total flight hours with 72 hours in make and model.

He started flying at Superior Skydiving in March of 2012; however, due to military commitments, he did not fly for much of the 2012 jump season. He started flying regularly again in the spring of 2013.

The C-185 pilot reported that he had flown several formation flights, but most of the time he was the lead airplane. He stated that the chief pilot usually flew the trail airplane since he had more experience. He stated that during the accident flight, he flew the trail airplane and

planned to remain positioned 1 to 2 airplane lengths behind the C-182 and attempt to be at the same altitude. Prior to the door opening, he thought they were exactly where they were supposed to be. After the jump door was opened, he thought they were slightly higher than the C-182.

The chief pilot held a commercial certificate with single-engine and multi-engine land ratings with an airplane instrument rating. He also held a current certified flight instructor certificate with airplane single-engine and airplane instrument ratings. He had over 2,200 hours of flight time with much of it accrued as a pilot for skydiving operations. He reported that he started sport skydiving when he was 18 years-old and started flying when he was 28 years-old. He flew for numerous skydiving operations, but when he was hired at Superior Skydiving in January of 2010, he primarily provided skydiving instruction, although he would also fly jump flights and provide flight training for skydiving operations as required.

According to the chief pilot, the C-185 pilot initially flew 100-hours in the C-182, and then started flying the C-185 since he already had his tailwheel endorsement. He was the only pilot who the chief pilot would allow to fly the C-185. He flew the C-185 throughout the jump season. The chief pilot considered the C-185 pilot as being a very competent pilot. The chief pilot reported that he did not train the C-185 pilot to fly formation. The C-185 pilot did fly formation flights at Superior Skydiving; however, it is unknown how many formation flights he flew as lead airplane and how many he flew as the trailing airplane. The operator did not keep training records for the pilots, so it remains uncertain how much experience the C-185 pilot had flying formation with skydivers on board.

According to the chief pilot, new pilots did not initially fly with skydivers on board. He estimated that it took 10 hours of training before they were allowed to carry skydivers without supervision. The 10 hours of training included: 1) operation of the modified airplane door 2) aircraft performance with jumpers "on step" 3) establishing a stable climb speed 4) returning to the airport with a full load of skydivers still on board. Once the chief pilot felt comfortable with the pilot's performance, he would supervise an actual jump flight, where he stayed on board and observed the pilot's actions. If that flight was satisfactory, he would schedule another flight where he would go up with the pilot, but depart the airplane as one of the jumpers. Pilots were also required to undergo skydiving training.

The chief pilot reported that formation flight training was not provided. Instead, a pilot was expected to fly about 100 hours of flying for Superior Skydiving before flying formation flights. As a result, the first time pilots at Skydive Superior operated in formation, they were carrying skydivers. He stated that the ideal trail airplane position was 3 airplane lengths behind and slightly lower than the lead airplane in order to keep the lead airplane in sight.

AIRCRAFT INFORMATION

The Cessna 182L, serial number 18259286, was manufactured in 1968. The airplane's tachometer was not located after the accident. The last documented annual maintenance inspection was conducted on February 8, 2013, with a tachometer time noted as 4,960.1. Pilot and maintenance records indicated that the airplane flew about 339 hours since the last annual inspection, and had a tachometer time of about 5,299.0 hours at the time of the accident flight.

The Cessna 185R, serial number 18503275, was manufactured in 1977, and had a total airframe time of 4,241 hours at the time of the accident. The airplane's maintenance records indicated that the last 100-hour maintenance inspection was conducted on September 25, 2013, with a

tachometer time of 4,198.6 hours. The last annual maintenance inspection was conducted on September 23, 2012, with a tachometer time of 4,012.7 hours, which was 14 months prior to the accident.

On November 13, 1981, the Cessna 185R's door was modified for skydiving operations per the Supplemental Type Certificate (STC) SA462WE. One of the provisions of the STC stated, "Pilot shall wear a parachute."

The C-182 pilot reported that he did not have access to the airplane's logbooks. He reported that the chief pilot assured him that all required maintenance such as the annual and 100-hour maintenance inspections had been completed. The C-182 pilot reported that there was no aircraft status sheet or status board that would inform the pilots of any upcoming maintenance inspections.

METEOROLOGICAL INFORMATION

At 1755, the surface weather observation at SUW was wind light and variable, visibility 10 miles, sky clear, temperature 4 degrees C, dew point -3 degrees C, altimeter 30.06 inches of mercury.

ADDITIONAL INFORMATION

According to Federal Aviation Administration (FAA) regulations, whenever there is compensation for a flight, that flight is considered a "commercial" operation. By FAA standards, skydiving flights are commercial operations. When an aircraft is used in a commercial operation, the aircraft is subject to 100-hour and annual inspections. Pilots must hold at least a commercial pilot certificate, along with a second class medical certificate. Skydiving flights are conducted in accordance with 14 CFR Part 91 and 14 CFR Part 105 regulations.

The 14 CFR Part 91.111 regulation "Operating near other aircraft" states the following:

1. No person shall operate an aircraft so close to another aircraft as to create a collision hazard.

2. No person may operate an aircraft in formation flight except by arrangement with the pilot in command of each aircraft in the formation.

3. No person may operate an aircraft, carrying passengers for hire, in formation flight.

On July 31, 1992, Donald P. Byrne, Assistant Chief Counsel for the FAA Regulations and Enforcement Division, wrote in a letter the following:

"Without further action by the agency, Section 91.111(c) should not be viewed as prohibiting formation flight carrying parachutists on the basis of a conclusion that they are passengers."

The FAA Advisory Circular No. AC 105-2E, "Sport Parachuting" provides suggestions to improve sport parachuting safety and disseminate information to assist all parties associated with sport parachuting to be conducted in compliance with 14 CFR Part 105. As such, AC 105-2E provides information related to jump pilot training. The FAA recommends that pilots flying aircraft for the purpose of sport parachuting have appropriate initial and recurrent training. The training program should include testing to ensure a high level of competence in the jump aircraft being flown. The recommended ground training should include: preflight inspection

specific to jump aircraft, aircraft limitations, placards, weight and balance, seat belts and approved loading, low speed operations for jump runs, emergency procedures, aircraft airworthiness determination, parachute packing, oxygen requirements, drop zone and airspace familiarization, and altitude reporting. The recommended flight training should include: takeoff and landings with representative loads, center of gravity shift with jumper exit, stall-spin prevention and recovery, and configuration for jump run and jumper exit including procedures for tail strike avoidance. The AC 105-2E does not provide any guidance concerning skydiving formation flights or pilot training for skydiving formation flights.

According to the FAA, the United States Parachute Association (USPA) is a FAA-accepted, nationally recognized skydiving organization that licenses skydivers in the United States. Many local skydiving clubs, schools, and drop zone operators (DZO) require documentation of experience and competency before using their equipment and/or parachuting facilities. This documentation usually consists of a logbook with endorsements and/or a skydiving license issued by a nationally recognized organization. Superior Skydiving was a member of the USPA.

The USPA's "2014 – 2015 Skydiver's Information Manual" provides basic skydiving standards and recommendations agreed upon by USPA members for the conduct of safe and enjoyable skydiving. It also describes the programs USPA administers to recognize individuals for their expertise, ability to train others, and proficiency or tenure in the sport. The 247-page manual includes the 14 CFR Part 105 and FAA AC 105-2E in their entirety. The manual does not provide any guidance concerning skydiving formation flights or pilot training for skydiving formation flights.

The USPA issued an article titled "Formation Flying 101: A Guide for Jump Pilots." Some of the suggested guidelines for formation jump flying described in the article included the following:

1. Planning is the basis for successfully flying aircraft formations. Do all the planning on the ground before you fly.

2. Determine which aircraft is going to be the lead and who is going to fly it. If this is your first formation flight, you should take the lead.

3. Altitude separation is the number-one way to avoid a collision.

4. When flying lead, you are the base. You need to be smooth on the controls. You will be in charge of the radios. You will spot the load and give clear communication to the jumpers as the countdown starts.

5. On the jump run, be very, very smooth. Maintain flying speed, but do not descend to maintain speed!

6. When flying trail you have only one thing to do – hold position relative to the lead aircraft. Your job is to never let your lead aircraft out of your sight.

The article provided this guidance to the trail pilot:

"If you are new to formation flying, you will certainly want to give yourself a little extra room, but don't be so far away that you can't tell whether the lead aircraft is slowing or speeding up. I find it much easier to fly in formation once I've gotten within 100 feet of the other aircraft. When the other aircraft is filling much of my windscreen, I know that I will see the smallest speed or altitude changes. Making small, smooth power adjustments will keep you parked in

your slot relative to the lead."

According to the chief pilot, Superior Skydiving did not provide formation skydiving flight training for its pilots. There was no FAA regulation that required Superior Skydiving to provide formation flight training or keep a record of pilot training.

History of Flight

Enroute-cruise	Midair collision (Defining event)
Uncontrolled descent	Midair collision

Pilot Information

Certificate:	Commercial	**Age:**	23
Airplane Rating(s):	Single-engine Land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 Without Waivers/Limitations	**Last Medical Exam:**	12/19/2012
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:	428 hours (Total, all aircraft), 65 hours (Total, this make and model), 315 hours (Pilot In Command, all aircraft), 75 hours (Last 90 days, all aircraft), 14 hours (Last 30 days, all aircraft), 7 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Manufacturer:	CESSNA	**Registration:**	N70520
Model/Series:	182L	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Normal	**Serial Number:**	18259286
Landing Gear Type:	Tricycle	**Seats:**	1
Date/Type of Last Inspection:	02/08/2013, Annual	**Certified Max Gross Wt.:**	2348 lbs
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:	4960 Hours	**Engine Manufacturer:**	Continental Motors
ELT:	Installed, not activated	**Engine Model/Series:**	O-470-R
Registered Owner:	ANDROSKY CHUCK DBA	**Rated Power:**	230 hp
Operator:	Skydive Superior	**Air Carrier Operating Certificate:**	None

Meteorological Information and Flight Plan

Observation Facility, Elevation:	SUW, 674 ft msl	**Observation Time:**	1755 CDT
Distance from Accident Site:	0 Nautical Miles	**Condition of Light:**	Day
Direction from Accident Site:	0°	**Conditions at Accident Site:**	Visual Conditions
Lowest Cloud Condition:	Clear	**Temperature/Dew Point:**	4°C / -3°C
Lowest Ceiling:	None	**Visibility**	10 Miles
Wind Speed/Gusts, Direction:	Light and Variable, Variable	**Visibility (RVR):**	
Altimeter Setting:	30.06 inches Hg	**Visibility (RVV):**	
Precipitation and Obscuration:	No Precipitation		
Departure Point:	Superior, WI (SUW)	**Type of Flight Plan Filed:**	None
Destination:	Superior, WI (SUW)	**Type of Clearance:**	VFR
Departure Time:	1720 CDT	**Type of Airspace:**	

Airport Information

Airport:	Richard I Bong Airport (SUW)	**Runway Surface Type:**	N/A
Airport Elevation:	674 ft	**Runway Surface Condition:**	Unknown
Runway Used:	N/A	**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	1 Minor	**Aircraft Damage:**	Destroyed
Passenger Injuries:	4 None	**Aircraft Fire:**	In-Flight
Ground Injuries:	N/A	**Aircraft Explosion:**	In-Flight
Total Injuries:	1 Minor, 4 None		

Administrative Information

Investigator In Charge (IIC):	James P Silliman	**Adopted Date:**	07/23/2015
Additional Participating Persons:	David Nelson; FAA Minneapolis FSDO; Minneapolis, MN		
Publish Date:	07/24/2015		
Note:	The NTSB did not travel to the scene of this accident.		
Investigation Docket:	http://dms.ntsb.gov/pubdms/search/dockList.cfm?mKey=88377		

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