NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Western Pacific Region

August 20- 21, 2015

WRECKAGE EXAMINATION SUMMARY

WPR15MA243AB

This document contains 22 embedded images.

A. ACCIDENT

Location:	San Diego, California
Date:	August 16, 2015
Aircraft A:	Cessna 172M, N1285U
Aircraft B:	Sabreliner NA-265-605C, N442RM

B. PARTICIPANTS

Andrew Swick-NTSB IIC
Bob Hendrickson-FAA AVP-100
Mark T. Morter-BAE Systems, TSS
Brad Thiele-BAE Systems, TSS
Brian Weber-Textron Aviation

C. SUMMARY

On August 16, 2015, about 1100 Pacific daylight time, a Cessna 172M, N1285U, and a North American Rockwell NA265 Sabreliner, N442RM, were both destroyed after they collided midair approximately 1 mile northeast of Brown Field Municipal Airport (SDM), San Diego, California. The private pilot of the Cessna, the sole occupant of the airplane, was fatally injured. The two pilots and two mission specialists aboard the Sabreliner were also fatally injured. The Cessna was registered to a private individual, and operated by the Plus One Flyers. The airplane was rented by the pilot for a personal flight under the provisions of 14 Code of Federal Regulations Part 91. The Sabreliner was registered to BAE Systems Technology Solutions & Services, Inc. and operated as a public aircraft by the U.S. Department of Defense in support of the U.S. Navy on an experimental airworthiness certificate. Visual meteorological conditions prevailed at the time of the accident.

The Cessna 172 departed Gillespie Field Airport (SEE), San Diego/El Cajon, California, and established radio contact with the local controller at SDM about 1050, with a plan to remain in the traffic pattern to practice touch-and-go landings. The Sabreliner departed SDM at 0830 and planned to return about 1100. No flight plan was filed for either flight.

Examination of the recovered wreckage was conducted on August 20 and 21, 2015 at the facilities of Air Transport in Phoenix, Arizona, by the National Transportation Safety Board (NTSB) investigator-in-charge (IIC), Federal Aviation Administration (FAA), BAE Systems TTS, and Textron Aviation. The examination revealed no evidence of any pre-collision mechanical malfunctions or failures that would have precluded normal operation.

D. DETAILS OF THE INVESTIGATION

1.0 Wreckage Examination of the Sabreliner

Figure 1-Sabreliner No. 1 (Left) Engine

The engines had separated from the fuselage, and both had impact and thermal damage at the nacelles.

The left engine was crushed lengthwise. The left engine's first stage compressor blades had leading edge damage that was consistent with rotation during the accident sequence.

Figure 2-Sabreliner No. 2 (Right) Engine

The right engine was crushed from its side, leaving the thrust reverser assembly vertically flat. The turbine section revealed damage consistent with ground impact. Internal components were identified through openings in the turbine case section. Damaged and loose turbine blades were found in the turbine case section.

The empennage revealed damage consistent with ground impact. The vertical stabilizer was separated from the rear fuselage during the recovery efforts. The rudder attach points had impact damage, and the rudder was removed from the vertical stabilizer during the recovery efforts. The left horizontal stabilizer was buckled upwards near its mid-span point, and the elevator remained attached to the stabilizer at the middle and inboard hinges. The left elevator was bent downward about 2 feet from the tip.

The right horizontal stabilizer was crushed, consistent with ground impact, from the tip to the inboard root area, with accordion style buckling. Flight controls were identified, but control continuity could not be determined due to impact damage.

Figure 3-Sabreliner Right Wing Inboard Root Section

The fracture-separated right wing root section displayed thermal discoloration and impact damage.

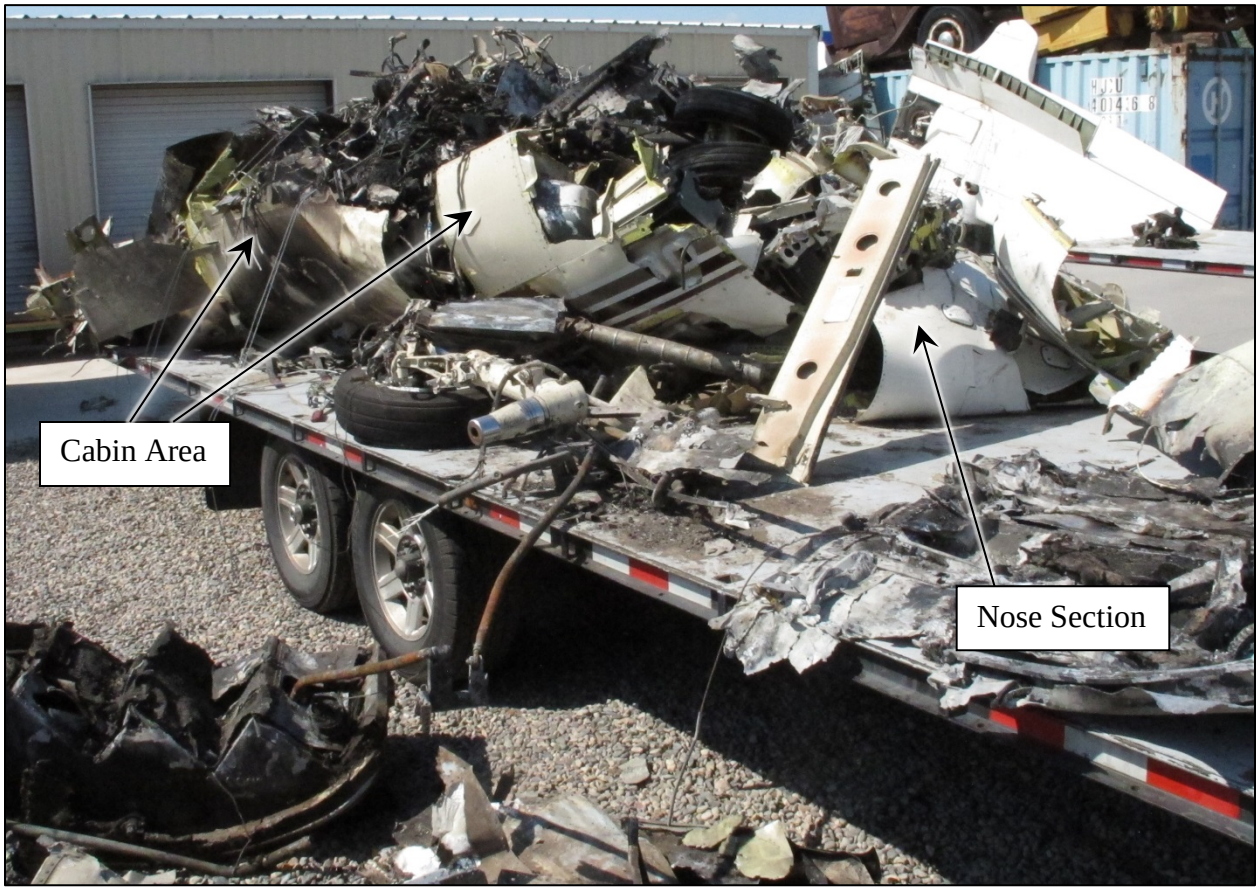

Figure 4-Sabreliner Main Fuselage and Cabin Area

The main fuselage and forward cabin area were crushed laterally, consistent with ground impact. The right side of the fuselage, including the right aft side of the cabin area, was substantially damaged by postimpact fire. The forward nose section revealed impact damage consistent with ground impact.

2.0 Wreckage Examination of the Cessna

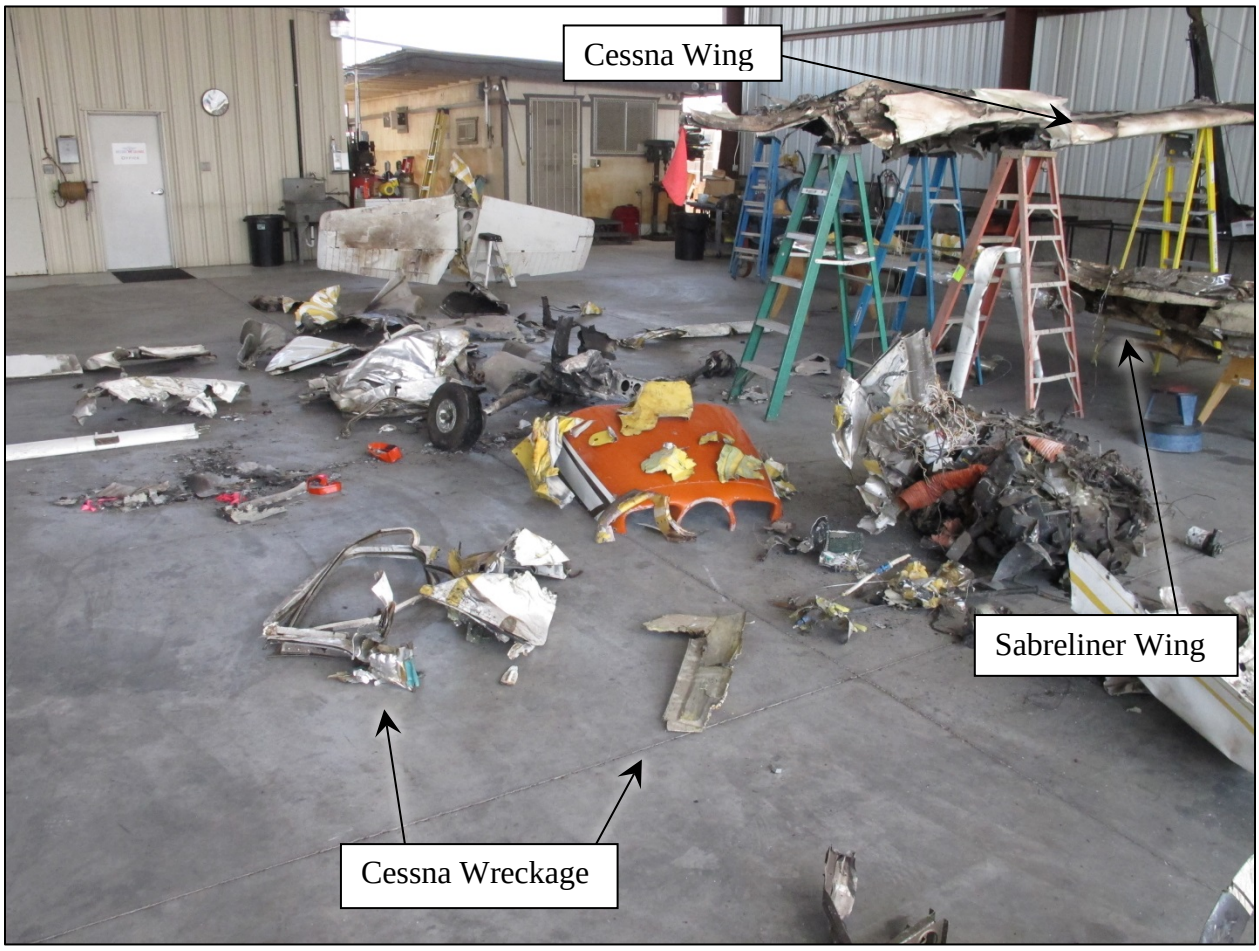

Figure 5-Cessna Wreckage and Sabreliner Right Wing Layout

The Cessna wreckage was laid out on the floor of an examination area. The Cessna left wing and cabin roof section, and the Sabreliner right wing were supported off the floor for visualization purposes. An exemplar orange-colored upper cowling was used during the examination to identify fragmented cowling sections.

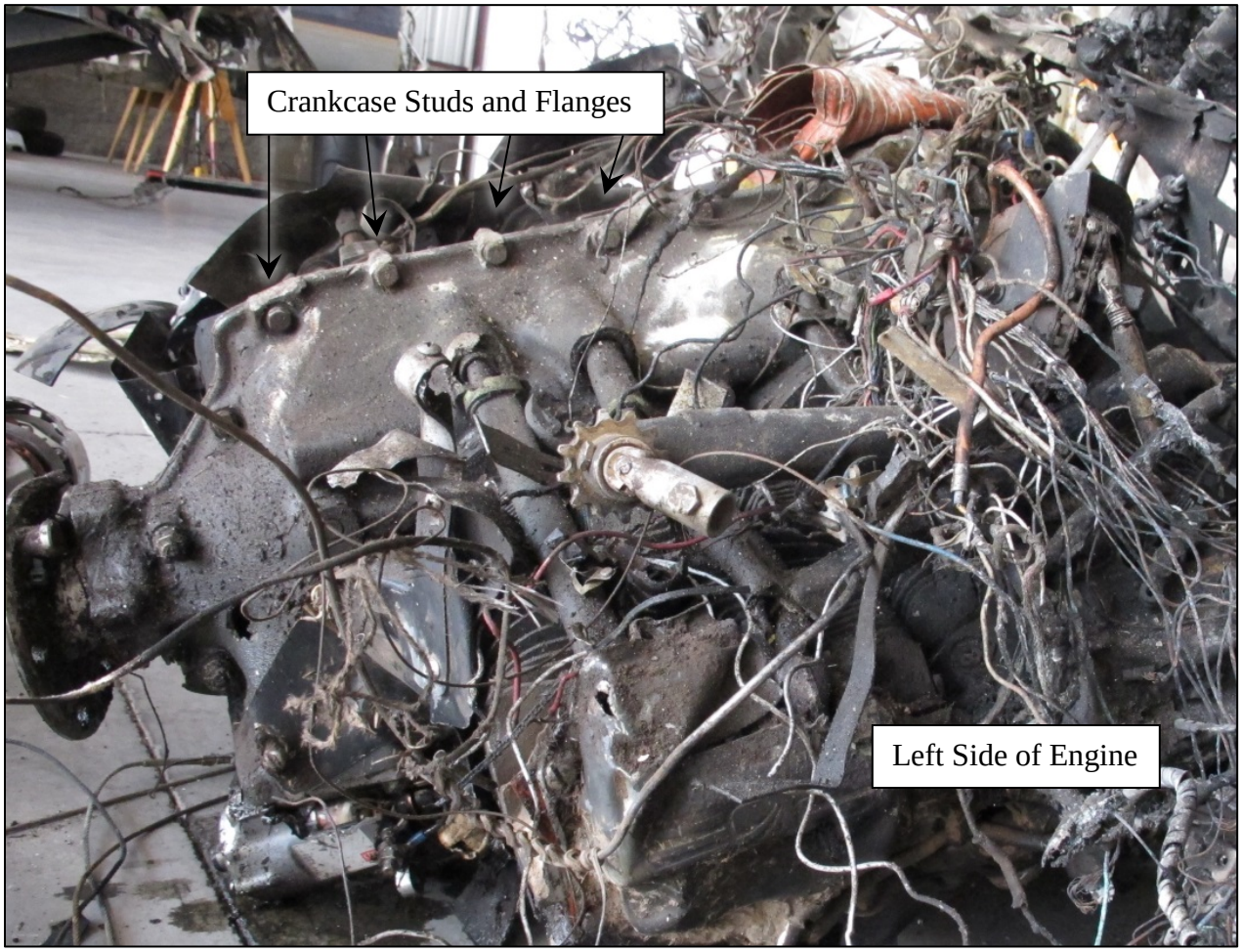

Figure 6-Cessna Engine (Left Side View)

The engine crankcase had impact damage consistent with being impacted from the left side. The upper crankcase support stud flanges were distorted and flattened on the top side. The stud spacing was measured to be about 2 1/2 inches from center to center. The spacing was consistent with marks identified on the lower inboard side of the Sabreliner right wing. The valve covers on the left bank of cylinders exhibited crush damage. The upper engine cowling had separated from the lower engine cowling, and was fragmented.

Figure 7-Cessna Propeller

The propeller was fracture-separated from the engine. For examination purposes, the blades were arbitrarily marked “A” and “B”. Blade A was bent aft with an S-type bend, and exhibited leading edge gouging and chordwise scratches. Large gouges were present through the hub of the blade and continuing diagonally through blade B. Blade B exhibited leading edge and diagonal gouges. Blade B was fracture-separated near the tip.

Figure 8-Cessna'a Left Entry Door

The Cessna left entry door was fractured into three major portions. The left door window frame had separated from the lower door structure, which separated into two additional pieces. The main separation between the left door window frame and lower door structure exhibited inboard deformation. The forward portion of the left door frame was deformed in the inboard direction, consistent with a wing striking the frame.

Figure 9-Cessna Left Wing Side Strut

The Cessna left wing strut was bent inboard approximately 3.5 feet from the top of the strut, and fracture-separated from the left wing and fuselage. The radius of the left wing strut bend was consistent with the profile of the Sabreliner right wing leading edge.

Figure 10-Cessna Right Wing Side Strut

The right wing strut was bent outboard approximately 1 1/2 feet from the top of the strut, and separated from the right wing and fuselage. The radius of the right wing strut bend was consistent with the radius of the Sabreliner main landing gear strut.

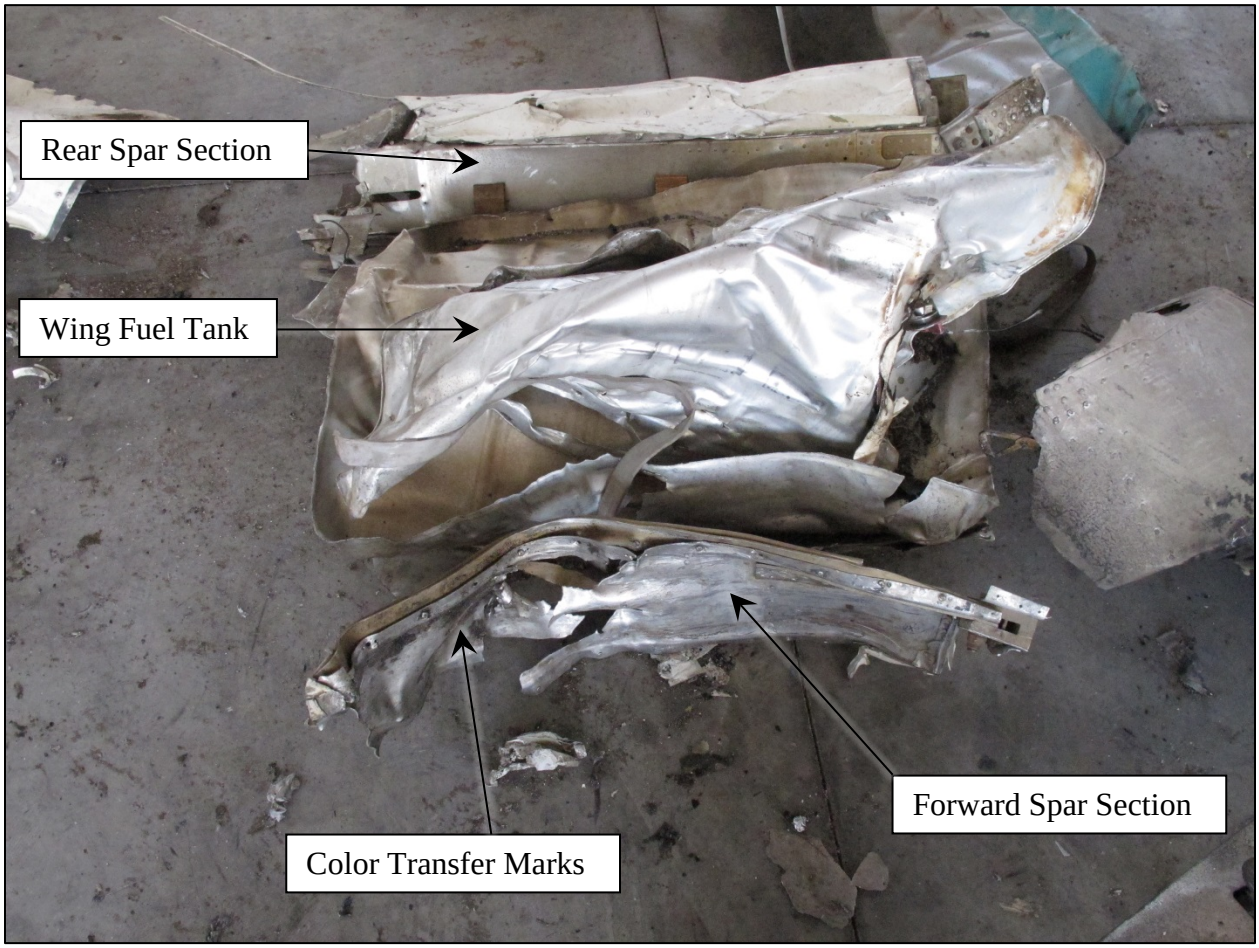

Figure 11-Cessna Right Wing Section and Fuel Tank

A separated inboard portion of the Cessna right wing forward spar exhibited lateral scratches and orange colored material transfer marks, and was bent consistent with contact with the Sabreliner right wing leading edge. See figure 12. The fuel tank, located behind the forward spar portion, was hydraulically deformed with the upper and lower halves of the tank separated at the welds.

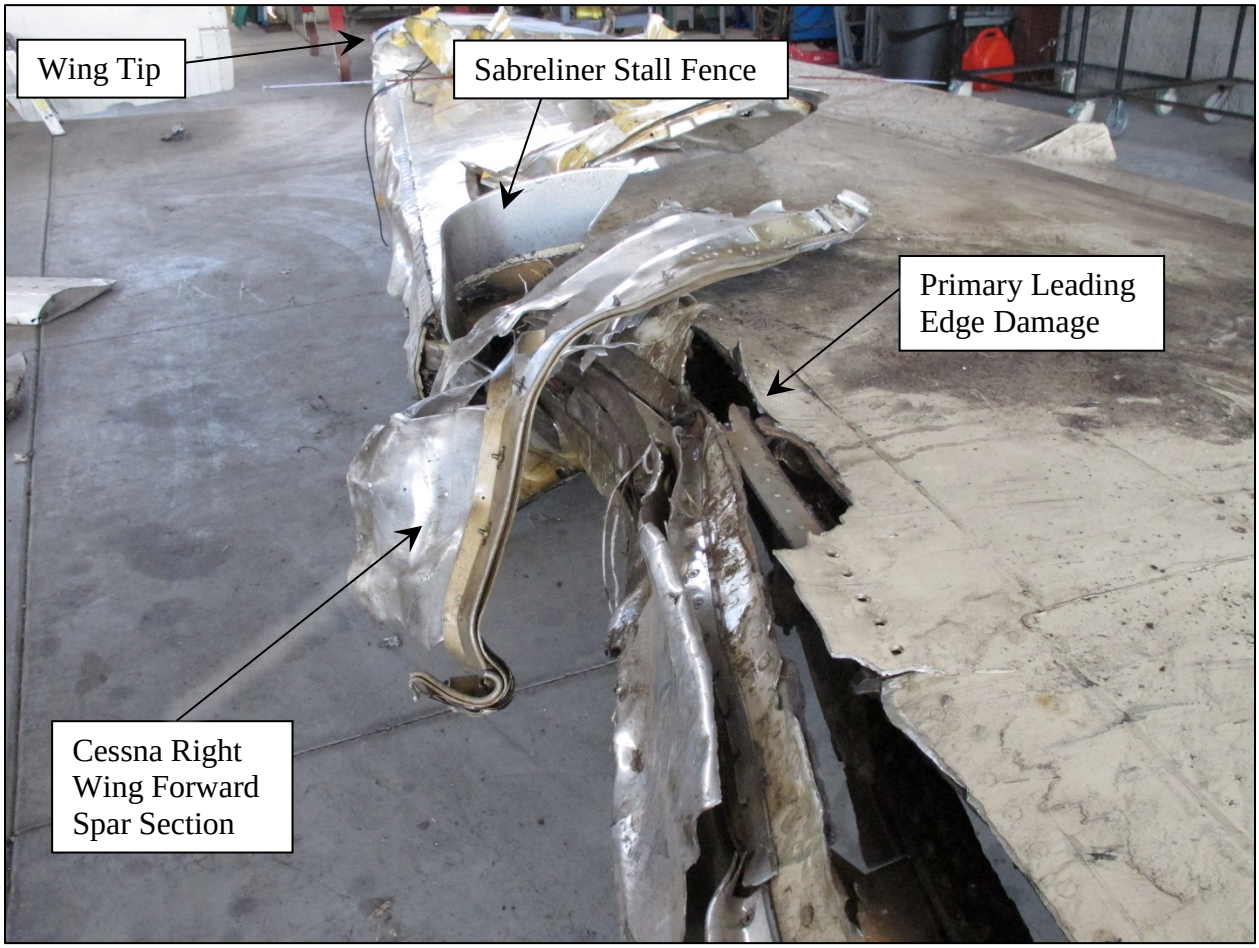

Figure 12-Sabreliner Right Wing and Cessna Right Wing Forward Spar Section

The Cessna right wing forward spar section was laid on the Sabreliner wing for reconstruction purposes. The Cessna right wing forward spar section exhibited signatures consistent with the impact of portions of the Sabreliner right wing leading edge.

Orange colored material transfer marks were present on the Cessna left wing leading edge, and the color was consistent with that of a material found inside the leading edge of the Sabreliner right wing.

Figure 13-Cessna Left Side Fuselage Skin Section

The Cessna left fuselage side skin section, including the painted registration number, was fracture-separated from the fuselage.

Figure 14-Cessna Left Side Fuselage Skin Section and Sabreliner Right Wing Leading Edge

The Cessna left fuselage side skin section was laid on the Sabreliner wing for reconstruction purposes. The section conformed to the leading edge of the Sabreliner wing, and revealed multiple folds consistent with forward to aft movement of the skin during impact.

Figure 15-Cessna Baggage Door

The upper portion of the baggage door on the left side of the fuselage was also deformed inboard, consistent to the shape of the leading edge of the Sabreliner wing. The door skin also exhibited lapped folds consistent with forward to aft movement during impact.

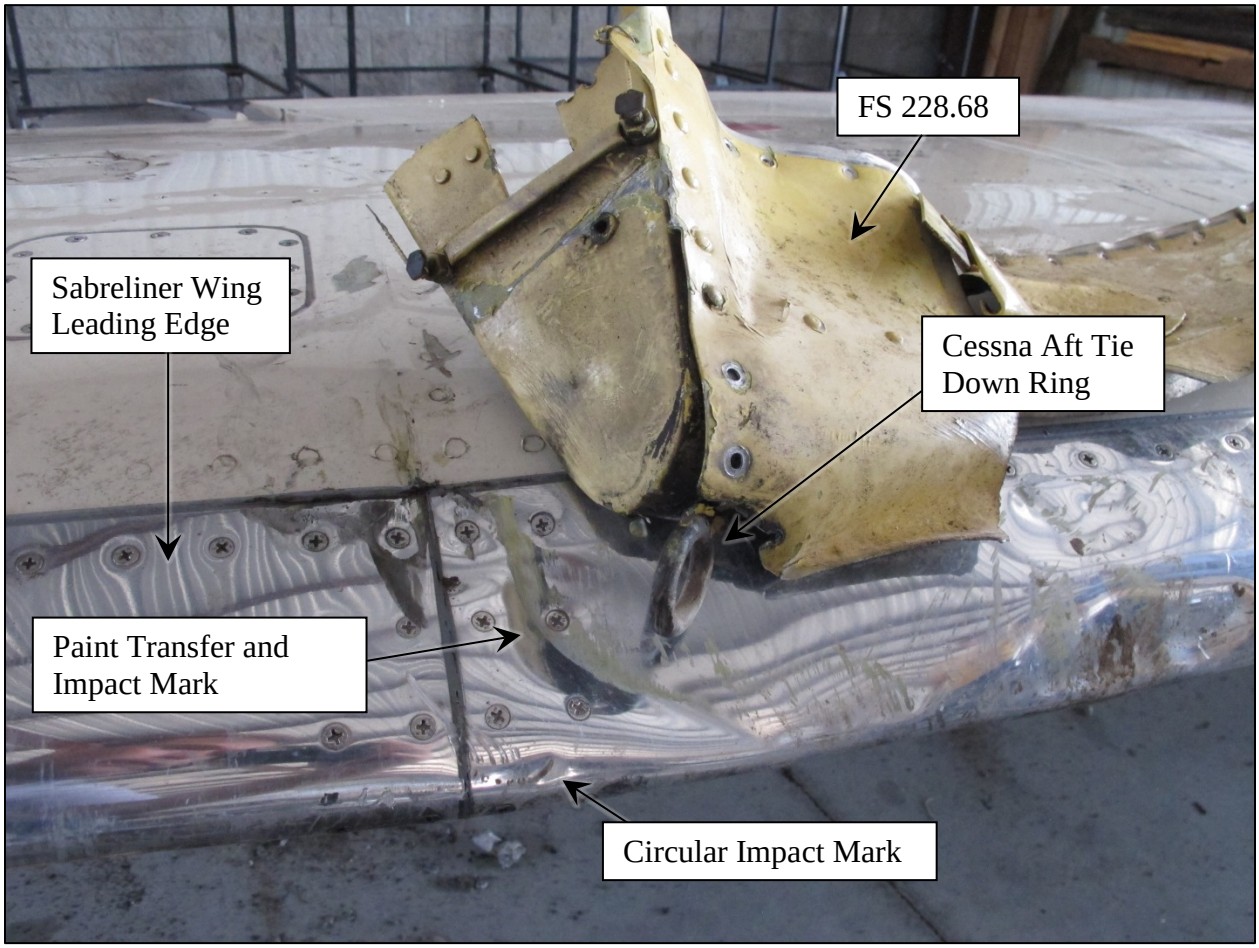

Figure 16-Cessna Aft Tiedown Ring and Supporting Structure and Sabreliner Right Wing Leading Edge

The lower portion of the Cessna bulkhead at FS 228.68 was separated from the fuselage structure. Impact signatures consistent with the FS 228.68 bulkhead and aft tiedown ring were present on the Sabreliner right wing at approximately WS 254. The upper portion of the Cessna FS 228.68 bulkhead remained attached to the Cessna empennage.

The Cessna flight control continuity could not be determined due to impact damage. The aileron balance cable continuity was confirmed from the left to the right aileron bellcranks. The left and right aileron control cables were fractured. The elevator control cables were fractured in multiple locations. The rudder control cables were fractured in multiple locations. The rudder bellcrank was separated from the fuselage structure. The flap actuator was separated from the wing structure.

A GPS unit was found in the Sabreliner wreckage and was sent to the NTSB Recorders Laboratory for nonvolatile memory (NVM) download.

3.0 Summary of the Airplane Contact Geometry Examination

The right wing of the Sabreliner was positioned with the Cessna wreckage, and an examination for contact signature evidence between the airplanes was accomplished. Evidence was observed in the form of impact marks found on the Sabreliner. The Sabreliner right wing had intrusions that are consistent with impact of the Cessna engine continuing through the Cessna left entry door post and the aft fuselage.

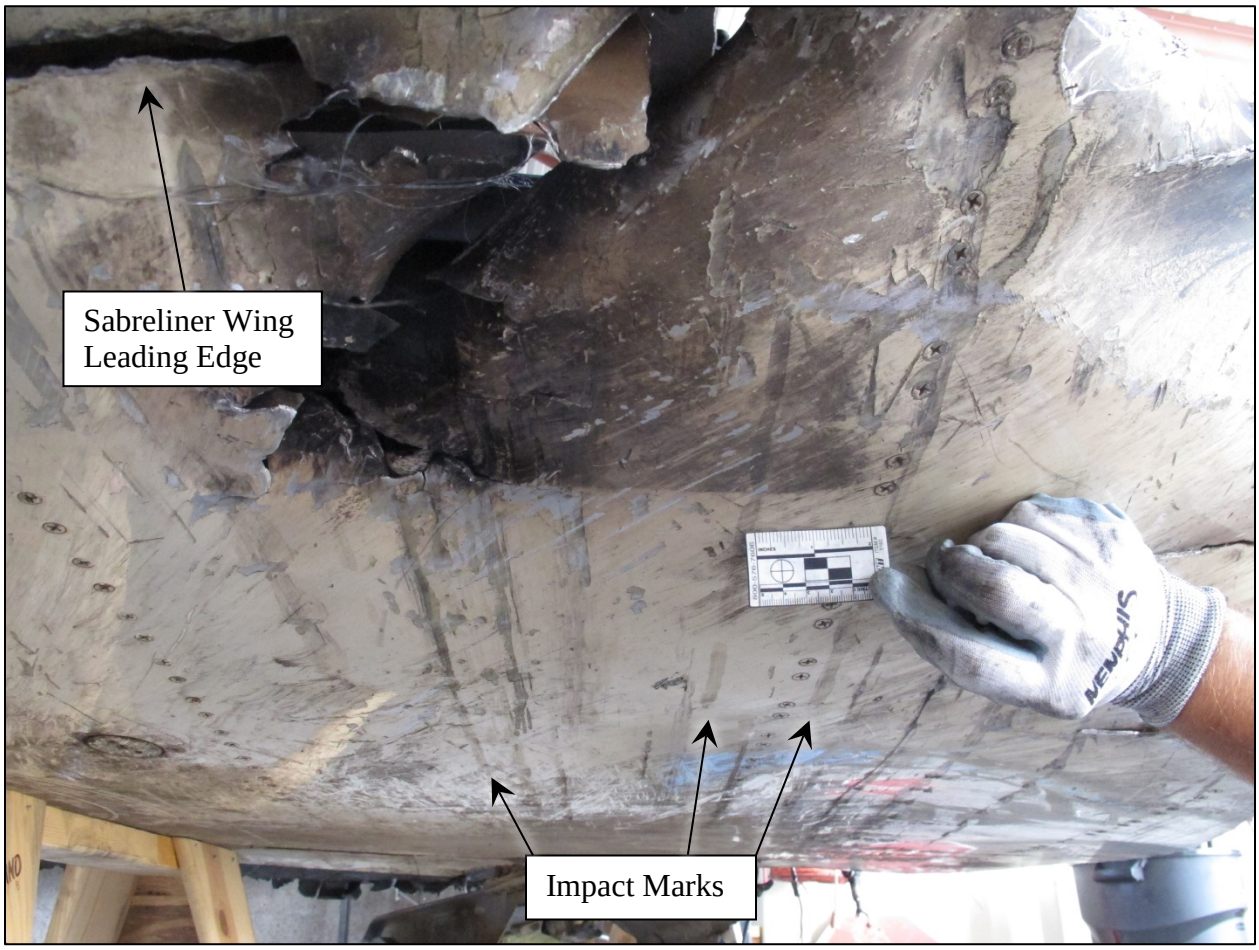

Figure 17-Sabreliner Right Wing Lower Surface

The spacing of the impact marks on the Sabreliner right wing inboard lower surface were consistent with the spacing of the Cessna engine crankcase upper studs and flanges and engine lifting eye. The angle of the marks was about 30 degrees, as measured from the Sabreliner's longitudinal axis. The damage on the crankcase upper studs and flanges and engine lifting eye was consistent with impact from its left side. Based upon the orientation of the evidence, the respective collision and convergence angles were calculated.

4.0 Collision and Convergence Angles

The collision (impact) angle describes the angle between the two airplanes' corresponding body axis (longitudinal, lateral, and vertical) at impact. For example, if one airplane is on a 90 degrees (east) heading when a collision occurs with an airplane that is on a 360 degrees (north) heading, the collision angle would be 90 degrees.

Another angle, called the convergence angle, describes the relationship (in degrees left or right) between the airplane's heading and the location of the converging airplane. The convergence angle represents how far left or right the pilot would have to look to see the other airplane. In essence, it is the relative bearing from a forward-looking pilot to the converging airplane. The convergence angle is dependent on the relative speed of each airplane and effects of wind on the heading of the airplane. Also, if two airplanes are on a constant heading, the convergence angle remains fixed, and the other airplane does not appear to move in the field of view of the pilot. This will change if one of the airplanes is turning or maneuvering in flight.

5.0 Measured Collision and Convergence Angles

Evidence of the convergence angle between the airplanes was provided by the parallel marks left on the Sabreliner right wing inboard lower surface. The marks were about 30 degrees to the right of the Sabreliner centerline, as shown in Figure 18. In addition, the conformity between the Sabreliner structure and damage to the Cessna fuselage, wing struts, and wing spar described above indicates that the Sabreliner right wing impacted the Cessna as depicted in Figure 19. Based on this evidence, the positions of the airplanes relative to each other at the time of collision would have been as depicted in Figures 20-22.

The reconstruction of the airplanes' flight paths, based on radar data, is described in the Aircraft Performance Study for this accident. The collision geometry resulting from the reconstruction is consistent with that depicted in Figures 20-22.

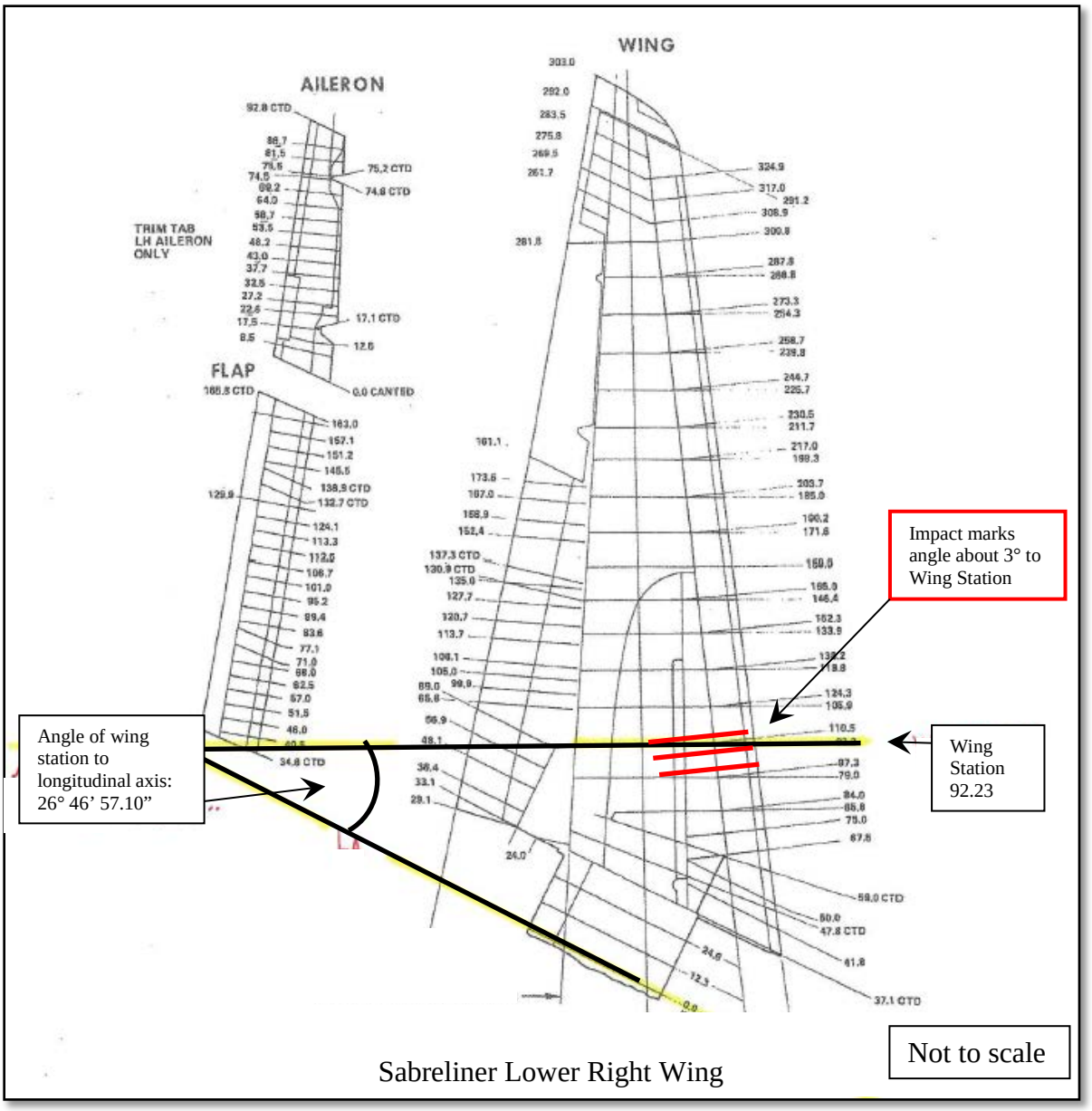

Figure 18 – The diagram used to determine the convergence angle discussed above.

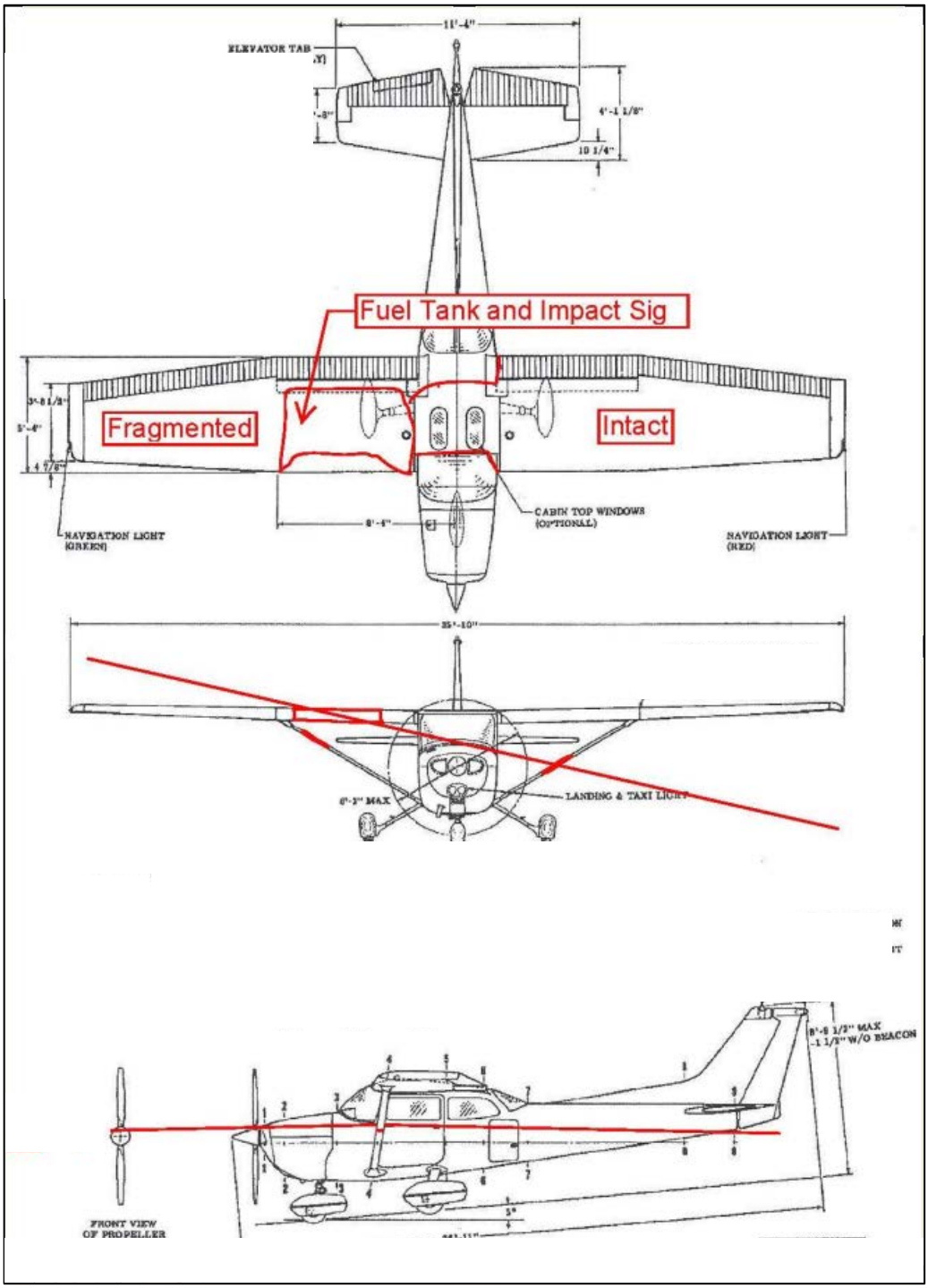

Figure 19-Profile Images of Cessna with Red Lines Indicating Impact Areas

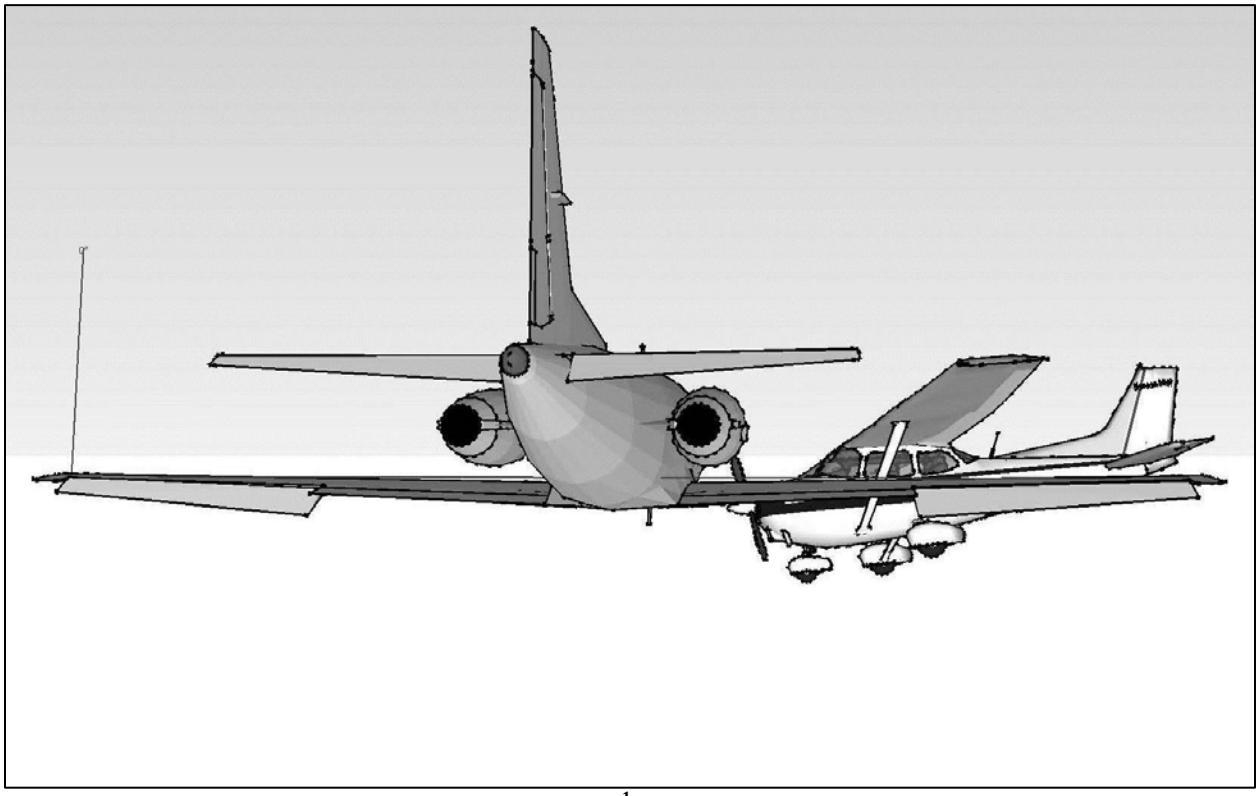

Figure 20-Illustration of Approximate Collision of Airplanes[1]

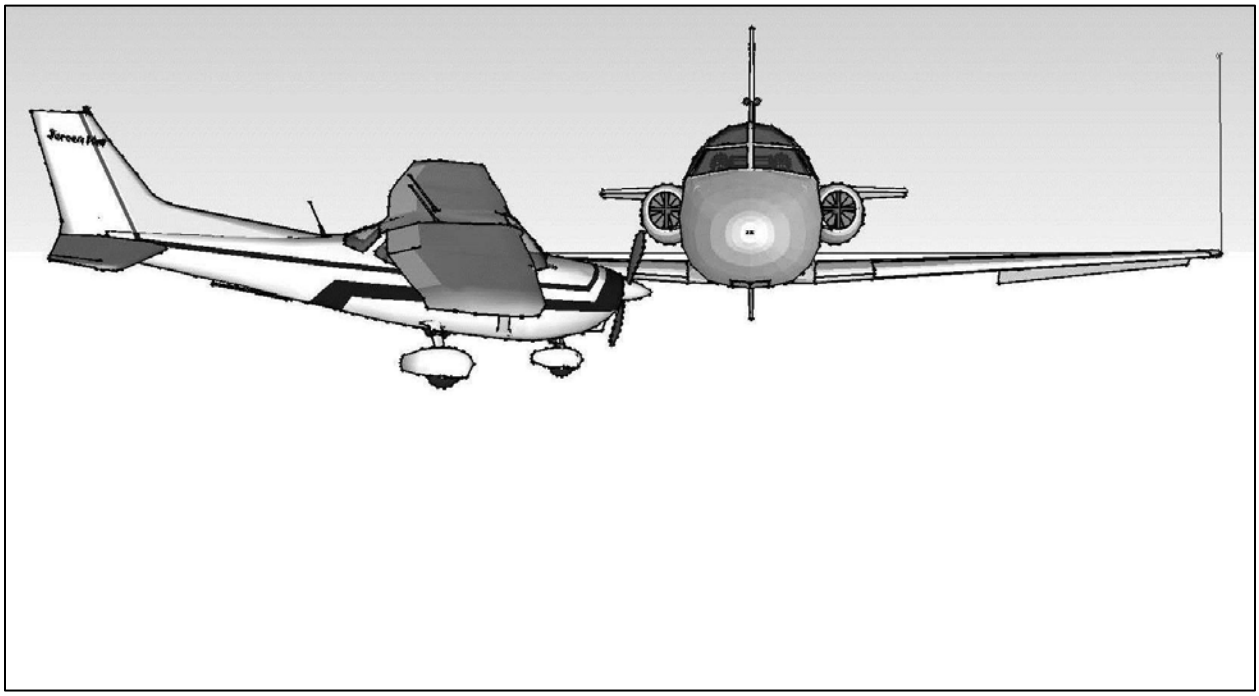

Figure 21- Illustration of Approximate Collision of Airplanes[3]

[1] The illustration is a visual tool that shows the approximate positions and orientations of both airplanes just prior to the collision, but it does not reference the airplanes' attitude relative to the horizon. The depicted positions of the flight controls on both aircraft and the retractable landing gear position on the Sabreliner are not valid.

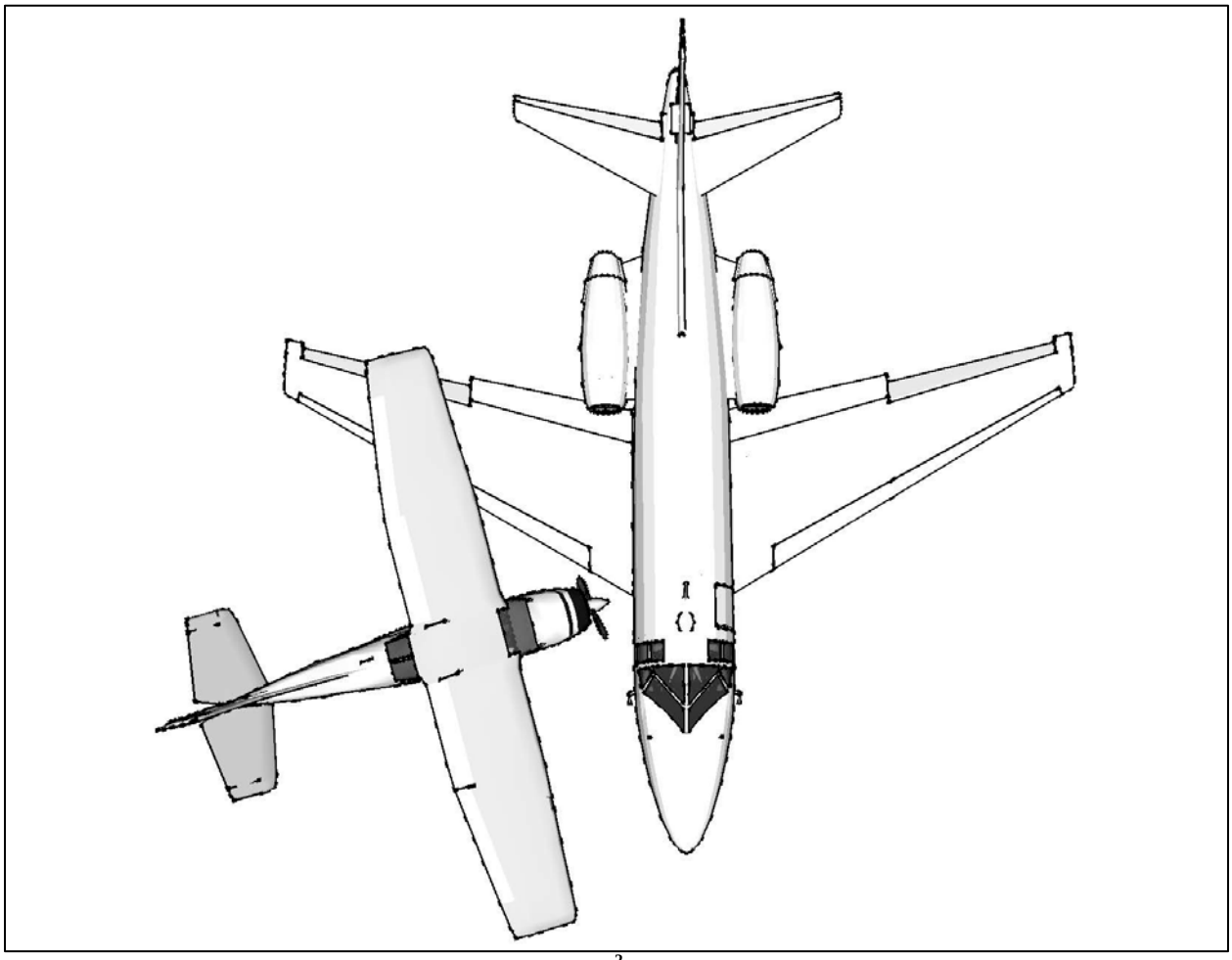

Figure 22- Illustration of Approximate Collision of Airplanes[2]

Submitted by: Andrew Swick

[2] The illustration is a visual tool that shows the approximate positions and orientations of both airplanes just prior to the collision, but it does not reference the airplanes' attitude relative to the horizon. The depicted positions of the flight controls on both aircraft are not valid.