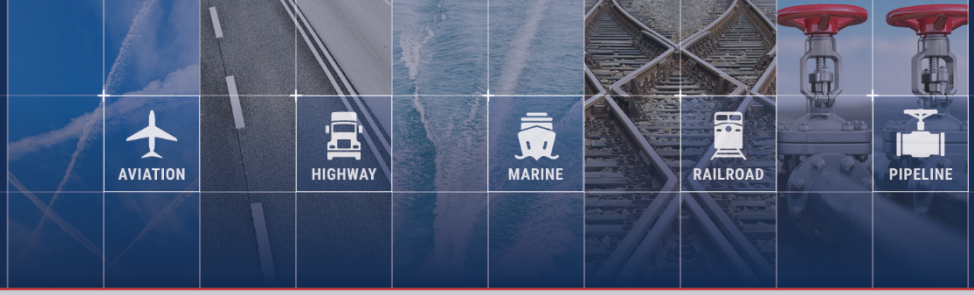


# Aviation Investigation Final Report

| | | | |
|---|---|---|---|
| **Location:** | Ridgeland, South Carolina | **Accident Number:** | ERA21LA208 |
| **Date & Time:** | May 5, 2021, 10:33 Local | **Registration:** | N22ST |
| **Aircraft:** | ISRAEL AEROSPACE INDUSTRIES LTD GULFSTREAM G150 | **Aircraft Damage:** | Substantial |
| **Defining Event:** | Landing area overshoot | **Injuries:** | 5 None |
| **Flight Conducted Under:** | Part 91: General aviation - Executive/Corporate | | |

## Analysis

The pilot in command (PIC) and second-in-command (SIC) completed an uneventful positioning flight to pick up passengers and then continued to the destination airport. Cockpit voice recorder (CVR) information revealed that, while en route, the PIC expressed a desire to complete the flight as quickly as possible and arrive at the destination before another airplane that was also enroute to the destination airport, presumably to please the passengers. The PIC compared the flight with an automobile race, and the airplane's overspeed warning annunciated multiple times during the descent.

The flight crew elected to conduct a straight-in visual approach to land. Throughout the final approach, the airplane was high and fast, as evidenced by the SIC's airspeed callouts. When the SIC asked whether s-turns should be made, and the PIC responded that such turns were not necessary. An electronic voice recorded by the CVR repeatedly provided "sink rate" and "pull up" warnings while the airplane was on final approach, providing indications to the crewmembers that the approach was unstable, but they continued the landing. The airplane touched down about 1,000 ft down the 4,200-ft-long runway.

The PIC described that the airplane's wheel brakes, thrust reversers, and ground air brakes did not function after touchdown, but witness and video evidence showed that the thrust reversers deployed shortly after touchdown. In addition, tire skid marks indicated that wheel braking occurred throughout the ground roll and increased heavily during the final 1,500 ft of the runway when the antiskid system activated. The ground air brakes did not deploy. The airplane overran the runway and came to rest about 400 ft past the departure end of the runway in marshy terrain. The fuselage and wings sustained substantial damage.

The switch that controlled the automatic deployment of the ground air brake system was found in a position that should have allowed for their automatic deployment upon landing. There was no evidence to indicate a preaccident mechanical malfunction or failure with the hydraulic system, wheel brakes, thrust reversers, and weight-on-wheel switches, or electrical issues with either air brake switches. The airplane's ground air brake deployment system logic required that both throttle levers be below 18° (throttle lever angle) in order to activate. The accident airplane's throttle lever position microswitches were tested after the accident. The left throttle microswitch tested normal, but the right throttle microswitch produced an abnormal electrical current/resistance during initial testing. When the throttle was touched and then further manipulated by hand, the electrical resistance tested normal. The investigation was unable to determine whether the intermittent right throttle microswitch resistance prevented the ground air brakes from deploying because the testing was inconclusive.

Landing performance calculations showed that, without ground air brakes, the landing ground roll exceeded the runway that was available from the airplane's touchdown point about 1,000 ft down the runway. Mobile phone video evidence revealed that a quartering tailwind of about 10 to 15 knots persisted during the landing, which exceeded the manufacturer's tailwind landing limitation of 10 knots for the airplane, and thus would have further increased the actual ground roll distance beyond that calculated.

Throughout the final approach, the flight crew received several indications that the approach was unstable. The flight crew was aware that the airplane was approaching the runway high, fast, and at an abnormal sink rate. Both pilots had an opportunity to call for a go-around, which would have been the appropriate action. However, it is likely that the external pressures that the PIC and SIC accepted to complete the flight as quickly as possible influenced their decision-making in continuing the approach.

## Probable Cause and Findings

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

The flight crew's continuation of an unstable approach and the failure of the ground air brakes to deploy upon touchdown, both of which resulted in the runway overrun. Contributing was the crew's motivation and response to external pressures to complete the flight as quickly as possible to accommodate passenger wishes and the crew's decision to land with a quartering tailwind that exceeded the airplane's limitations.

## Findings

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|---|---|
| **Personnel issues** | Aircraft control - Flight crew |
| **Aircraft** | Airspeed - Not attained/maintained |
| **Aircraft** | Descent/approach/glide path - Not attained/maintained |
| **Aircraft** | Drag control system - Unknown/Not determined |
| **Personnel issues** | Motivation/respond to pressure - Flight crew |
| **Personnel issues** | Decision making/judgment - Flight crew |
| **Environmental issues** | Tailwind - Decision related to condition |

# Factual Information

## History of Flight

| | |
|---|---|
| **Landing-landing roll** | Landing area overshoot (Defining event) |
| **Landing-landing roll** | Sys/Comp malf/fail (non-power) |
| **Landing-landing roll** | Runway excursion |

On May 5, 2021, about 1033 eastern daylight time, an Israel Aerospace Industries Gulfstream G150, N22ST, was substantially damaged when it was involved in an accident at Ridgeland-Claude Dean Airport (3J1), Ridgeland, South Carolina. The two pilots and three passengers were not injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 executive/corporate flight.

According to the PIC, a routine preflight was completed earlier on the morning of the accident, and he and the SIC flew a routine flight from Fort Lauderdale International Airport (FLL), Fort Lauderdale, Florida, to New Smyrna Beach Municipal Airport (EVB), New Smyrna Beach, Florida. The passengers boarded the airplane, and the flight to 3J1 departed.

A review of the airplane's cockpit voice recorder (CVR) revealed that, while en route to the destination airport, the crewmembers discussed the reported wind at nearby airports and noted that the direction was from 240° to 250°, which they said would favor landing on runway 36. When a passenger asked about the estimated arrival time; the PIC replied, "I'll speed up. I'll go real fast here." About 1 minute later, the SIC remarked that the airplane's airspeed was 300 knots and altitude was 9,000 ft. For the next few minutes, the crew discussed how the flight time could be shortened and that another jet on the frequency was also headed to 3J1.

At 1009:52, the PIC stated that the estimated arrival time was 1035 and that the other airplane's arrival was estimated to be 1033. The PIC stated to the SIC, "they'll [the other aircraft] slow to 250 [knots] below 10 [thousand feet] and we won't. We know what we're doing right now we're trying to win a race." The SIC stated, "that's right," and the PIC replied, "this is NASCAR," which was followed by sounds of laughter.

During the descent, the crew discussed that the reported wind at a nearby airport was from 280° at 3 knots. In addition, the CVR recorded the overspeed warning tone multiple times during the descent, starting at 1025:30. During that instance, the tone was heard for 8 seconds. The PIC stated, "goal achieved," and SIC remarked, "final lap."

At 1028:31, the airplane was cleared to 2,000 ft and the flight crew requested a straight-in approach to runway 36. About 2 minutes later, the controller informed the other airplane

inbound to 3J1 that it would be second in line for landing; the PIC expressed excitement and informed the passengers that their flight would be arriving ahead of the other inbound airplane.

At 1031:35, the CVR recorded the sound of the autopilot being disconnected. About 1 minute later, the SIC remarked, “should we s-turn this thing?” The PIC replied, “nah we got it.” At 1032:28, the airplane was on final approach about 900 ft above ground level (agl) and about 1.5 nautical miles from the runway threshold. At that time, the SIC called out an airspeed of 170 knots. (The reference landing speed [$V_{ref}$] was 121 knots). The PIC responded to add full flaps. About 10 seconds later, the airplane’s electronic voice announced “sink rate” and the SIC stated, “we know it.” At 1032:46, the SIC called out an airspeed of 150 knots, and the electronic voice stated, “sink rate, sink rate, sink rate, pull up.”

At 1032:58, the electronic voice announced 200 ft agl. One second later, the electronic sink rate warning annunciated again, and the SIC called out an airspeed of 130 knots. The PIC stated, “yup, slowing.”

At 1033:04, the electronic voice annunciated the 50-ft callout, and the airplane touched down afterward. At 1033:12, the PIC stated, “come on T-Rs [thrust reversers],” which was followed by an expletive. At 1033:20, the SIC asked if he should apply the brakes as well, to which the PIC stated “yes.” At 1033:26, sounds consistent with a runway excursion were recorded, and the CVR recording stopped shortly afterward. The airplane came to rest about 400 ft past the end of runway 36 in marshy and wet terrain. The airplane sustained substantial damage to the wings and fuselage.

In a postaccident statement, the PIC reported that he observed runway 36 (the intended landing runway) about 25 miles away and planned a visual approach to the runway. During the approach, the SIC completed the before-landing checklist. The approach was completed with full flaps, and the flight air brakes were deployed to slow the airplane further. About 3 miles from the runway, the precision approach path indicator (PAPI) displayed three white lights and one red light (indicating that the airplane was too high on the glidepath). Subsequently, the PIC retracted the flight air brakes and determined that the flight was properly established on the glidepath.

The PIC’s postaccident statement also indicated that, while the airplane was approaching the runway, the engine(s) power was at idle, and the touchdown occurred about 700 to 1,000 ft down the runway at an airspeed between about 120 to 128 knots. Upon touchdown, the PIC applied wheel brakes and thrust reversers, but the ground air brakes did not automatically deploy. As the ground roll progressed, the airplane was not slowing, so the PIC increased power to the thrust reversers and the SIC began braking with about 1,500 ft of runway remaining. When the SIC applied his wheel brakes, he stated “I have no brakes.” The PIC described the airplane’s departure from the runway surface into marshy wetlands and that the crew assisted the passengers in evacuating without incident. When asked if there were any mechanical malfunctions or failures of the airplane, the PIC reported “We did not have brakes, no thrust reversers and no ground air brakes.”

The airplane was equipped with two N1 digital electronic engine controls, which were downloaded. The data from the download indicated that both engines were operating normally and responding to power lever inputs throughout the approach and landing roll. The data also revealed that both thrust reversers deployed about 2 seconds after touchdown and remained deployed for about 21 seconds.

A witness who was type rated on the make and model of the accident airplane observed the airplane touch down near the A4 taxiway, which was near the location of the 1,000-ft markers on runway 36. About 2 seconds after touchdown, he saw both thrust reversers deploy and heard the “roar” of the reversers several seconds later. After several additional seconds, the witness still heard the engines running (even though he could not see the airplane due to ground obstacles between him and the airplane) and became concerned. He then saw that the airplane had departed the runway.

A mobile phone video taken by an individual located at 3J1 captured about 15 seconds of the final approach, all of the landing roll, and a few seconds after touchdown. The video showed that, a few seconds after touchdown, the thrust reverser on the right engine (which was the only engine in the camera’s view at the time) was deployed. The video captured sound that was consistent with thrust reversers deploying. The video also showed that the left engine thrust reverser (which came into view about 11 seconds after touchdown) was deployed. The video indicated that, during the landing roll, neither the ground air brakes nor the flight air brakes deployed on either wing.

The airport did not have an automated weather observing system, but the mobile phone video captured the airport’s windsock when the accident airplane landed. Throughout the airplane’s ground roll, the windsock indicated a quartering tailwind at varying speeds. The windsock was at times nearly fully extended, which corresponded to a wind speed of about 15 knots. The pilot-rated witness also reported that the wind was about 220° or 230° at 11 to 13 knots, as viewed from the windsock at the airport. Another witness at the airport observed a “strong and gusty” southwesterly wind, and the terminal aerodrome forecast for an airport about 31 nautical miles northeast indicated that the wind was from about 210° at 10 knots, gusting to 20 knots.

Tire marks located on the runway were measured and correlated to the accident airplane’s main landing gear (MLG) orientation and tire width. Initial touchdown tire marks showed that the airplane landed about 1,000 to 1,200 ft down the runway. Most of the tire tread marks were light and not consistent with heavy braking or antiskid operation except for those tire tread marks that were located about 1,000 ft from the end of the runway. At that point, heavy braking tire marks appeared intermittently and continued off the runway toward the accident site.

## Airplane Information

According to Gulfstream Aerospace documentation, the ground and flight air brakes had four control surfaces on each wing that were electrically controlled and hydraulically operated. The

flight air brake system could be operated via the inboard surfaces and on the ground via the inboard and outboard surfaces. The ground air brakes were selected using the ground A/B switch, set to the land position. The system requirements for ground air brake deployment included airplane electrical power, main system hydraulic pressure, at least one of two MLG weight-on-wheel switches in ground mode, both throttle quadrant angle levers below 18°, and the ground A/B switch set to land. If these parameters were met, the ground air brakes would deploy automatically upon landing.

According to the airplane flight manual, if the ground air brakes were inoperative for landing, landing performance would be affected. If all ground air brakes were inoperative, the landing distance must be increased by 30%. Gulfstream Aerospace completed a landing distance performance calculation with data that were consistent with those from the accident flight. The performance application had a 10-knot maximum tailwind speed given that 10 knots was the limiting tailwind speed in the airplane flight manual. The calculated unfactored landing distance was 3,034 ft. The landing distance with a 30% increase (due to inoperative ground air brakes), along with a 10-knot tailwind resulted in a ground roll landing distance of 3,944 ft. The accident airplane was observed landing about 1,000 ft down the 4,200-ft-long runway.

Wreckage and Impact Information

Postaccident examination of the airplane revealed that the nose landing gear and right MLG had partially sheared from the airplane. The left MLG remained attached to the airplane. The right MLG weight on wheels and wheel speed sensors were damaged due to impact forces. The hydraulic lines connecting to the right MLG were sheared, which would have compromised the hydraulic system. The flaps were found set to 40°, and all air brakes remained stowed.

Inside the cockpit, the flight A/B air brake switch was found in the retract position, and the ground A/B air switch was found set to land. The air brake switches were tested with an electrical multimeter and produced normal currents.

The electrical currents for the throttle quadrant microswitches were also tested and measured with an electrical multimeter. The left throttle microswitch electrical reading was normal, but the right throttle microswitch testing was inconclusive. The right throttle microswitch, when initially tested without manipulating the throttle, measured a resistance of about 600 ohms, which was higher than normal resistance and not consistent with the left throttle microswitch reading. When the right throttle was touched slightly, its resistance was lowered to a reading closer to normal resistance. Further manipulation of the right throttle by hand continued to lower the electrical resistance until normal readings were achieved.

Additional Information

According to the FAA airplane flying handbook, chapter 16, transition to jet-powered airplanes, several parameters must be considered when evaluating whether an approach is stabilized.

Stabilized Approach

*The basic elements to the stabilized approach are listed below as follows:*

- ? *The airplane should be in the landing configuration by 1,000 feet AGL in the approach. The landing gear should be down, landing flaps selected, trim set, and fuel balanced. Ensuring that these tasks are completed helps keep the number of variables to a minimum during the final approach.*
- ? *The airplane should be on profile before descending below 1,000 feet. Configuration, trim, speed, and glidepath should be at or near the optimum parameters early in the approach to avoid distractions and conflicts as the airplane nears the threshold window. An optimum glidepath angle of about 3° should be established and maintained.*
- ? *Indicated airspeed should be between zero and 10 knots above the target airspeed by 500 feet AGL. There are strong relationships between trim, speed, and power in most jet airplanes, and it is important to stabilize the speed in order to minimize those other variables.*
- ? *The optimum descent rate is dependent upon ground speed. A rule of thumb is to multiply half of ground speed by 10. For example, a 130-knot ground speed should result in a (65 times 10) 650 feet per minute descent rate. Typical descent rates fall between 500 and 700 feet per minute. An excessive vertical speed may indicate a problem with the approach.*

*Every approach should be evaluated at 500 feet. In a typical jet airplane, this is approximately 1 minute from touchdown. If the approach is not stabilized at that height, a go-around should be initiated.*

*The guidance further stated that jet engines response at low rpm is slower. This characteristic requires that the approach be flown at a stable speed and power setting on final so that sufficient power is available quickly if needed.*

## Pilot Information

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|---|---|---|---|
| **Certificate:** | Airline transport | **Age:** | 41,Male |
| **Airplane Rating(s):** | Single-engine land; Multi-engine land | **Seat Occupied:** | Left |
| **Other Aircraft Rating(s):** | None | **Restraint Used:** | 4-point |
| **Instrument Rating(s):** | Airplane | **Second Pilot Present:** | Yes |
| **Instructor Rating(s):** | None | **Toxicology Performed:** | |
| **Medical Certification:** | Class 1 None | **Last FAA Medical Exam:** | September 17, 2020 |
| **Occupational Pilot:** | Yes | **Last Flight Review or Equivalent:** | February 19, 2021 |
| **Flight Time:** | 9100 hours (Total, all aircraft), 100 hours (Total, this make and model), 7390 hours (Pilot In Command, all aircraft), 115 hours (Last 90 days, all aircraft) | | |

## Co-pilot Information

| | | | |
|---|---|---|---|
| **Certificate:** | Commercial | **Age:** | 32,Male |
| **Airplane Rating(s):** | Single-engine land; Multi-engine land | **Seat Occupied:** | Right |
| **Other Aircraft Rating(s):** | None | **Restraint Used:** | 4-point |
| **Instrument Rating(s):** | Airplane | **Second Pilot Present:** | Yes |
| **Instructor Rating(s):** | Airplane multi-engine; Airplane single-engine | **Toxicology Performed:** | |
| **Medical Certification:** | Class 1 None | **Last FAA Medical Exam:** | February 17, 2021 |
| **Occupational Pilot:** | Yes | **Last Flight Review or Equivalent:** | April 30, 2021 |
| **Flight Time:** | 1500 hours (Total, all aircraft), 32 hours (Total, this make and model), 1300 hours (Pilot In Command, all aircraft), 50 hours (Last 90 days, all aircraft), 36 hours (Last 30 days, all aircraft), 3 hours (Last 24 hours, all aircraft) | | |

## Passenger Information

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|---|---|---|---|
| **Certificate:** | | **Age:** | |
| **Airplane Rating(s):** | | **Seat Occupied:** | Left |
| **Other Aircraft Rating(s):** | | **Restraint Used:** | Lap only |
| **Instrument Rating(s):** | | **Second Pilot Present:** | Yes |
| **Instructor Rating(s):** | | **Toxicology Performed:** | |
| **Medical Certification:** | | **Last FAA Medical Exam:** | |
| **Occupational Pilot:** | No | **Last Flight Review or Equivalent:** | |
| **Flight Time:** | | | |

## Passenger Information

| | | | |
|---|---|---|---|
| **Certificate:** | | **Age:** | |
| **Airplane Rating(s):** | | **Seat Occupied:** | Left |
| **Other Aircraft Rating(s):** | | **Restraint Used:** | Lap only |
| **Instrument Rating(s):** | | **Second Pilot Present:** | Yes |
| **Instructor Rating(s):** | | **Toxicology Performed:** | |
| **Medical Certification:** | | **Last FAA Medical Exam:** | |
| **Occupational Pilot:** | | **Last Flight Review or Equivalent:** | |
| **Flight Time:** | | | |

## Passenger Information

| | | | |
|---|---|---|---|
| **Certificate:** | | **Age:** | |
| **Airplane Rating(s):** | | **Seat Occupied:** | Right |
| **Other Aircraft Rating(s):** | | **Restraint Used:** | Lap only |
| **Instrument Rating(s):** | | **Second Pilot Present:** | Yes |
| **Instructor Rating(s):** | | **Toxicology Performed:** | |
| **Medical Certification:** | | **Last FAA Medical Exam:** | |
| **Occupational Pilot:** | | **Last Flight Review or Equivalent:** | |
| **Flight Time:** | | | |

## Aircraft and Owner/Operator Information

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|---|---|---|---|
| **Aircraft Make:** | ISRAEL AEROSPACE INDUSTRIES LTD | **Registration:** | N22ST |
| **Model/Series:** | GULFSTREAM G150 NO SERIES | **Aircraft Category:** | Airplane |
| **Year of Manufacture:** | 2008 | **Amateur Built:** | |
| **Airworthiness Certificate:** | Transport | **Serial Number:** | 251 |
| **Landing Gear Type:** | Retractable - Tricycle | **Seats:** | 11 |
| **Date/Type of Last Inspection:** | January 11, 2021 Continuous airworthiness | **Certified Max Gross Wt.:** | 26100 lbs |
| **Time Since Last Inspection:** | | **Engines:** | 2 Turbo fan |
| **Airframe Total Time:** | 2580 Hrs at time of accident | **Engine Manufacturer:** | HONEYWELL |
| **ELT:** | Installed, activated, did not aid in locating accident | **Engine Model/Series:** | TFE731-40AR-200G |
| **Registered Owner:** | Guiltford Transportation Services LLC | **Rated Power:** | 4420 Lbs thrust |
| **Operator:** | Snider Fleet Solutions | **Operating Certificate(s) Held:** | None |

## Meteorological Information and Flight Plan

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|---|---|---|---|
| **Conditions at Accident Site:** | Visual (VMC) | **Condition of Light:** | Day |
| **Observation Facility, Elevation:** | NONE,84 ft msl | **Distance from Accident Site:** | 0 Nautical Miles |
| **Observation Time:** | 10:33 Local | **Direction from Accident Site:** | 0° |
| **Lowest Cloud Condition:** | | **Visibility** | 10 miles |
| **Lowest Ceiling:** | Overcast | **Visibility (RVR):** | |
| **Wind Speed/Gusts:** | 10 knots / 15 knots | **Turbulence Type Forecast/Actual:** | None / None |
| **Wind Direction:** | 230° | **Turbulence Severity Forecast/Actual:** | N/A / N/A |
| **Altimeter Setting:** | 29.98 inches Hg | **Temperature/Dew Point:** | 28°C / 19°C |
| **Precipitation and Obscuration:** | No Obscuration; No Precipitation | | |
| **Departure Point:** | New Symrna, FL (EVB) | **Type of Flight Plan Filed:** | IFR |
| **Destination:** | Ridgeland, SC | **Type of Clearance:** | IFR |
| **Departure Time:** | 09:45 Local | **Type of Airspace:** | Class G |

## Airport Information

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|---|---|---|---|
| **Airport:** | RIDGELAND-CLAUDE DEAN 3J1 | **Runway Surface Type:** | Asphalt |
| **Airport Elevation:** | 84 ft msl | **Runway Surface Condition:** | Dry |
| **Runway Used:** | 18/36 | **IFR Approach:** | None |
| **Runway Length/Width:** | 4200 ft / 75 ft | **VFR Approach/Landing:** | Straight-in |

## Wreckage and Impact Information

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|---|---|---|---|
| **Crew Injuries:** | 2 None | **Aircraft Damage:** | Substantial |
| **Passenger Injuries:** | 3 None | **Aircraft Fire:** | None |
| **Ground Injuries:** | N/A | **Aircraft Explosion:** | None |
| **Total Injuries:** | 5 None | **Latitude, Longitude:** | 32.504158,-80.992736(est) |

## Administrative Information

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|---|---|
| **Investigator In Charge (IIC):** | Gerhardt, Adam |
| **Additional Participating Persons:** | Jason Arther; FAA FSDO; Columbia, SC<br>Brittnee Kikolski; Gulfstream Aerospace Corp; Savanah , GA<br>David Studtmann; Honeywell Aerospace; Phoenix , AZ |
| **Original Publish Date:** | August 15, 2023 |
| **Investigation Class:** | Class 3 |
| **Note:** | The NTSB did not travel to the scene of this accident. |
| **Investigation Docket:** | https://data.ntsb.gov/Docket?ProjectID=103036 |

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.