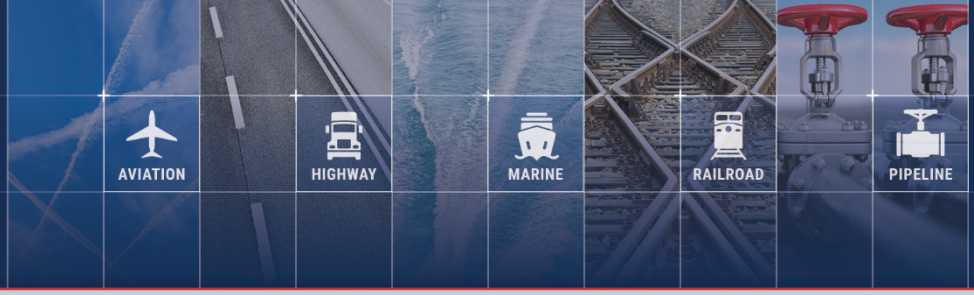

Aviation Investigation Factual Report

Location:	Lander, Wyoming	**Accident Number:**	WPR11FA032
Date & Time:	October 25, 2010, 13:52 Local	**Registration:**	N201HF
Aircraft:	Mooney M20J	**Aircraft Damage:**	Substantial
Defining Event:	Inflight upset	**Injuries:**	4 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Factual Information

HISTORY OF FLIGHT

On the afternoon of November 1, 2010, the wreckage of a Mooney M20J, N201HF, was located by ground searchers in the Wind River mountain range near Lander, Wyoming. The airplane became the subject of a week-long search after it was lost from ground-based radio communications and radar tracking facilities about 45 minutes after it departed from Jackson Hole Airport (JAC), Jackson, Wyoming, on October 25, 2010. The instrument rated owner/pilot and his three sons were fatally injured. The four had flown from the Minneapolis, Minnesota, area to JAC on October 21, 2010, and the accident flight was the first leg of the return trip to Minnesota. The personal flight was operated under the provisions of Title 14 Code of Federal Regulations (CFR) Part 91, on an instrument flight rules (IFR) flight plan.

According to information from Lockheed Martin Flight Services (LMFS) and the Federal Aviation Administration (FAA), on the morning of the accident, the pilot obtained his initial telephone weather briefing about 0918 mountain daylight time. About 1037, he telephoned again, obtained an abbreviated weather briefing, and filed an IFR flight plan. Both weather briefings included AIRMETs (Airmen's Meteorological Information) for mountain obscuration, turbulence, and icing along the planned flight routes and altitudes.

The 1037 flight plan specified a planned departure time of 1130, and a destination of Rapid City Regional Airport, (RAP) Rapid City, South Dakota. The filed route of flight was Dunoir (DNW) very high frequency omni-range (VOR) navigation facility, Boysen Reservoir (BOY) VOR, Muddy Mountain (DDY) VOR, and then direct to RAP. DNW, the initial navigation fix in that flight plan, was located about 22 miles north of JAC.

About 1237, the pilot used the internet to file another IFR flight plan, which again specified JAC as the origination airport. The filed departure time was 1247, and the filed route was DNW, Riverton (RIW) VOR, DDY, Newcastle (ECS) VOR, Rapid City (RAP) VOR, and Philip (PHP) VOR. The destination was Pierre Regional Airport (PIR), Pierre, South Dakota, and the filed altitude was 9,000 feet. About 1258, the JAC air traffic control tower (ATCT) controller issued the pilot his clearance, with some revisions. The altitude was amended to 16,000 feet, and the route of flight was to the KICNE intersection, then direct RIW, and then as filed by the pilot. The controller finished issuing the clearance by asking the pilot if he could accept 16,000 feet, and then informed the pilot that 9,000 feet was an "unavailable IFR altitude." The pilot responded that he would prefer 14,000 feet, and the clearance was then amended to 14,000 feet. KICNE, the initial navigation fix in the ATC-amended flight plan, was located about 26 miles south of JAC.

The airplane departed JAC runway 19 about 1306, and was in communication with, and

tracked by, FAA air traffic control (ATC) at Salt Lake City Air Route Traffic Control Center (ARTCC). About 1340, the pilot filed a pilot report with LMFS which stated that he was 72 miles west of "Riverton" (the RIW VOR) at 14,000 feet, and that he was encountering "light chop," with a "trace of rime" icing.

The first radar target was recorded about 1309, and the airplane was tracked until about 1336, when it was at an altitude of 14,000 feet. The airplane was reacquired by ground radar about 1346, still at 14,000 feet. About 1347, the controller advised that the minimum IFR altitude in that sector was 16,000 feet, and asked if the pilot was climbing to that altitude, to which the pilot responded "..wilco." Two minutes later, the pilot reported that he might not be able to reach 16,000 feet. The controller responded that the minimum instrument altitude in that region was 15,800 feet, and asked the pilot whether he could maintain his own terrain clearance for the next 10 minutes. The pilot responded in the affirmative. About 1351, the pilot reported that he was in a "severe mountain wave" and that he was "descending rapidly out of 13,700" feet. About 1352, the last radar target associated with the airplane was recorded, with an indicated altitude of 13,300 feet. There were no further communications with the airplane.

The victims were recovered on November 2, 2010. Due to terrain elevation, topography, and seasonal conditions, the wreckage was recovered on August 24, 2011.

PERSONNEL INFORMATION

General Information

According to FAA records, the pilot held a private pilot certificate with airplane single engine land and instrument airplane ratings. He obtained his private pilot certificate in May 2002, and he obtained his instrument rating in June 2009. Review of his personal flight logs indicated that neither of those flight evaluations, or any of the associated training flights, was conducted in the accident airplane make and model. The pilot became the co-owner of the accident airplane in February 2010, when he had a total flight experience time (TT) of about 760 hours. At the time of the accident, he had a TT of about 940 hours, including about 138 hours in the accident airplane make and model, all of which was in the accident airplane. The remainder of time appeared to be in Cessna 172 and Beech 23 airplanes. Review of his flight logs indicated that the pilot had limited flight experience in mountainous terrain.

The three children were all male. Two were 14 years old, and one was 12 years old.

Pilot's Instrument Time

At the time of the accident, the pilot had logged a total of about 23 hours of actual instrument flight time, and about 22 hours of simulated instrument time. His total logged actual instrument time included about 3 hours in the accident airplane. The pilot's most recent flight

review included an instrument proficiency check that was conducted in two flights on 2 days, about 1 week before the accident. The first flight was on October 16, 2010, and the pilot recorded a flight duration of 1.7 hours in his logbook. The second flight, on the following day, had a logged duration of 4.0 hours. Both flights were conducted in the accident airplane. Prior to those flights, the pilot's most recent logged instrument flight was on August 31, 2009, in a Beech 23 airplane.

Flight Instructor Comments

The certificated flight instructor (CFI) who provided most of the training for the pilot's instrument rating was employed by a company whose primary business was to provide accelerated flight training to pilots located across the United States. The pilot contracted with the company, and the CFI was assigned to provide the flight training to the pilot. Prior to that, neither individual was acquainted with the other. The CFI traveled to the Minneapolis area, provided about 40 total hours of training over a period of 10 continuous days, and provided the pilot with a logbook endorsement to take his instrument rating flight test. The CFI reported that the pilot had obtained some instrument training prior to the CFI's training period with the pilot. The CFI also reported that his training sessions with the pilot were conducted in the pilot's Beech BE-23 Sundowner, a rented Cessna 172, and a ground-based flight training device. Some of the training flights were conducted in actual instrument meteorological conditions (IMC). The CFI noted that the training he provided did include the topic of aeronautical decision-making (ADM).

A few weeks prior to the accident, the pilot again contracted with the same flight training company and the same CFI to provide training for his commercial certificate. The CFI again traveled to the Minneapolis area and provided the flight training over the course of 4 days on two consecutive weekends. That training was conducted in the accident airplane, and the CFI provided the pilot with a logbook endorsement to take his commercial flight test. That endorsement was dated October 17, 2010.

During the course of that training, the pilot informed the CFI of his plans to fly the accident airplane to Jackson Hole in late October, and that he would take the commercial certificate flight test once he returned. The CFI reported that he advised the pilot about the potential hazards of a flight in that airplane in that area at that time of year. The CFI reported that he specifically cautioned the pilot that since the airplane was not turbocharged or pressurized, and was not equipped for flight into known icing, there was a consequent need for the pilot to plan and operate any flights accordingly, in order to provide sufficient safety margins and escape options. According to the CFI, the pilot told him that he had conducted flights to that location several times, and was cognizant of the risks. The CFI reported that the pilot gave him the impression that the pilot would conduct the upcoming flight in compliance with the CFI's suggestions.

In a telephone interview with the National Transportation Safety Board (NTSB) investigator, the

CFI reported that overall, the pilot's performance was typical of the pilots he was familiar with through his employment, and that he recalled "nothing out of the ordinary" from his training sessions with the pilot. When asked, the CFI did not recall any specific strengths or weaknesses of the pilot, and did not recall any specific subject matter areas of difficulty. He stated that the pilot seemed to grasp all that was presented or taught to him, and that the pilot appeared to understand how to use the airplane performance charts. In summary, the CFI said that he had "no complaints" about the pilot.

AIRCRAFT INFORMATION

General Information

The airplane, serial number 24-0152, was manufactured in 1977. It was equipped with a normally aspirated Lycoming IO-360 series piston engine, and retractable, tricycle-configuration landing gear. The maximum certificated weight was 2,740 pounds, and the fuel capacity was 64 gallons. The airplane was not equipped with any ice protection systems, and it was not approved for flight into known icing conditions.

The airplane was manufactured with a ram air induction system, which allowed bypass of filtered air in cruise to provide a slight increase in manifold pressure. Use of that system was prohibited in icing conditions. In 1992, the manufacturer issued Service Instruction M20-93, which permitted the removal of the ram air induction system. The ram air induction system had not been removed from the accident airplane.

According to both the airplane co-owner and the pilot's CFI, the airplane was equipped with the standard mechanical, electric and pneumatic flight instruments, a Garmin 430 communication and navigation radio with global positioning system (GPS) capability, and a Garmin MX20 multifunction navigation display. The airplane owners subscribed to XM weather, a commercial aviation weather datalink product, and that information could be presented on the MX20. A user's manual for a Garmin GPSMap 196 was found in the wreckage. No GPSMap 196 unit was recovered from the wreckage.

Review of the airplane maintenance documentation indicated that the most recent altimeter and encoding system inspection was completed in November 2009. The most recent annual inspection was completed in September 2010. At that time, the airplane had a TT of about 1,842 hours, the engine had a TT of about 1,842 hours, and a time since major overhaul (TSMOH) of about 362 hours. Review of the airframe and engine maintenance records did not reveal any entries that warranted additional investigation.

METEOROLOGICAL INFORMATION

General

The pilot's original plan was to depart JAC on Sunday October 24, but according to his wife, he did not depart due to "weather." No additional details were obtained by the investigation regarding the October 24 meteorological conditions for the planned route of flight. Refer to the accident docket for detailed meteorological information.

Pilot's Weather Briefing Information

About 0918 on October 25, the pilot first contacted LMFS to obtain a weather briefing. At the beginning of that conversation, the pilot specifically requested information from pilot reports (PIREPs) "or whatever you've got to see whether or not I can get up and out of here." The pilot was provided with two PIREPs from the JAC area. The first one, time 0812, was from an airplane over JAC, which reported cloud tops above 15,000 feet with light turbulence and no icing. The next one, time 0820, was from an airplane that departed JAC. That report included cloud tops at 18,000 feet with "light chop" and a trace of mixed icing from 10,000 to 18,000 feet.

The pilot then requested, and was provided with, the JAC terminal area forecast (TAF), which is a report established for the 5-statute-mile radius around an airport. The briefer and pilot discussed the fact that the then current conditions would exist until about noon, and then improve somewhat, primarily through an increased ceiling height (to 5,000 feet), and an end of the precipitation. They then discussed the surface conditions at RIW, and the briefer noted that it was slightly better than forecast. The pilot then mentioned that he was considering taking a commercial flight "because the weather was so crappy," but that flight was delayed or cancelled due to non-weather-related reasons, and he was therefore, "rethinking." The briefer then provided AIRMET information for mountain obscuration, turbulence, and icing along the proposed route of flight. The call ended about 0928.

About 1037, the pilot recontacted LMFS to file a flight plan and obtain an "updated briefing." His proposed departure time was 1130. After the pilot filed the flight plan, the briefer asked what weather briefing type the pilot wanted, and the pilot responded "abbreviated," with updated AIRMET information. The briefer provided the same AIRMET information as before, and added some information about AIRMETs further east than those in the previous briefing. The briefer then relayed a PIREP (time 1020) from an airplane that departed JAC, which reported "light chop" and cloud tops above 14,000 feet.

The briefer provided METAR (an aviation surface weather observation) and TAF information for several airports along the route of flight. Since the winds at the pilot's proposed destination of RAP were currently 21 knots gusting to 30 knots, and were forecast to become 27 gusting to 40, the pilot asked about conditions at PIR. The briefer informed him that PIR winds were 22 gusting to 30, and were forecast to remain at about those same values about the time of the pilot's planned arrival. The pilot then asked about Casper (Casper/Natrona County International Airport, CPR) and was told that the winds were 16 gusting 21, and forecast to

become 15 gusting 25. The briefing ended about 1046.

JAC Surface Observations

On the morning of the flight, the JAC weather was changing continuously. The 0851 observation reported visibility 2 miles in light snow and mist, and an overcast cloud layer at 1,100 feet above ground level (agl). A special observation 14 minutes later reported 5 miles visibility in light snow, with a broken layer at 3,400 and an overcast layer at 4,100 feet. The 0953 JAC weather observation, which was current when the pilot filed his first flight plan, indicated that the weather was visual meteorological conditions (VMC), with light wind, 10 miles visibility, no precipitation, and broken cloud layers at 4,600 and 6,000 feet agl. The 1051 observation included 4 miles visibility, light snow, a broken layer at 3,100 and an overcast layer at 3,900 feet. The JAC observation 15 minutes later included 2 miles visibility, light snow, broken layers at 1,500 and 2,200 feet, and an overcast layer at 3,600 feet.

The 1151 observation indicated that conditions had improved slightly, with 3 miles visibility, light snow, a broken layer at 2,700 feet, and an overcast layer at 3,600 feet. The 1200 observation, which was current when the pilot filed his second flight plan about 1237, with a proposed 1247 departure time, included 10 knot winds, 1 mile visibility, light snow, a broken layer at 1,000 feet, and an overcast layer at 1,500 feet.

The 1254 observation, which was issued about the time that the pilot was in his airplane at JAC, included winds at 11 gusting to 17 knots, 1 mile visibility in light snow, a broken layer at 1,000 feet, and an overcast layer at 1,600 feet. The observation recorded about the time the airplane took off included winds gusting to 14 knots, 4 miles visibility in light snow, a broken layer at 1,500 feet, and an overcast layer at 4,500 feet.

Area Forecast

The aviation area forecast (FA) provides a picture of clouds, general weather conditions, and VMC expected over a large area encompassing several states. The 0745 area forecast for initial route of flight over the northern portion of Wyoming, current for the time of the accident, included broken ceiling at 12,000 feet above mean sea level (msl) with tops to 16,000 feet msl, isolated snow showers, and northwest winds with gusts to 30 knots. The eastern portion of Wyoming, east of the accident location, was forecast to have similar winds, with a broken ceiling at 14,000 feet msl, and cloud tops to flight level (FL) 240. Review of the pilot's recorded weather briefings with LMFS indicated that the pilot did not receive this information directly from the briefer. The investigation was unable to determine whether the pilot accessed that information via the internet.

Multiple AIRMETs for IFR, mountain obscuration and icing conditions were active over the western portion of the United States below FL 180 during the time of the flight, and three were

active for the accident location. The "Sierra" (obscuration/IFR conditions) AIRMET forecast that mountains would be obscured by clouds, precipitation and mist, with those conditions ending between 0800 and 1100. The "Tango" (turbulence) AIRMET forecast that moderate turbulence could be expected below FL180, and that those conditions were forecast to exist until 2000. The "Zulu" (icing) AIRMET forecast moderate icing between the freezing level and FL 200, with a freezing level between 7,000 and 10,000 feet. Those conditions were forecast to exist until 2000. Review of the pilot's recorded weather briefings with LMFS indicated that the pilot was provided with this information.

Atmospheric Soundings

The 0600 RIW atmospheric sounding indicated the freezing level was at approximately 8,000 feet. No temperature inversions were noted in the troposphere. Calculations made by the RAwinsonde OBservation Program (RAOB) indicated scattered and broken stratiform and cumulus clouds may have existed at altitudes between 8,200 to greater than 15,500 feet. The vertical wind profile indicated a northwest wind at the surface of about 5 knots. At about 9,400 feet the wind had increased in magnitude to 31 knots. The vertical wind profile from this level through 15,000 feet consisted of a generally northwest wind between 22 and 32 knots. RAOB calculations of clear-air turbulence (CAT) indicated light to moderate turbulence potential existed between the surface and about 17,500 feet.

Icing type and severity calculations made by RAOB, based on United States Air Force studies, indicated a moderate to severe clear and rime icing potential between 12,000 and 19,400 feet.

A North American Mesoscale model sounding for the accident location at 1500 indicated the entire lower-troposphere was below 0°C. Calculations made by RAOB indicated scattered cumulus clouds may have existed between at these altitudes. The vertical wind profile indicated a westerly wind of 19 knots near the surface, and shifted to the west-northwest and increased to 37 knots at 17,900 feet. Calculations made by RAOB indicated severe/extreme CAT near the surface, with light to moderate values of CAT above 11,500 feet.

Satellite Observations

Geostationary Operational Environmental Satellite (GOES)-13 and GOES-11 data indicate the accident site and the surrounding mountains were under cloudy skies. GOES-11 data from 0930 indicate that cloud-top heights in the vicinity of the accident were 13,500 to 14,900 feet. GOES-13 data from 0955 data indicated that cloud-top heights were between 14,500 and 17,300 feet in the vicinity of the accident site.

Weather Radar Data

The ground-based WSR-88D weather radar data at RIW, located about 48 miles east of the

accident site, captured base reflectivity and velocity data at altitudes between about 12,200 and 17,000 feet near the accident site. The 1353 data indicated light to light-moderate values of reflectivity (a measure of precipitation) near the accident site. Base velocity information indicated wind magnitudes of approximately 30 to 40 knots from about 275 degrees at 14,300 feet in the vicinity of the accident.

Mountain Wave

According to FAA Advisory Circular AC-00-6A (Aviation Weather), "When strong winds blow across a mountain range, large "standing" waves occur downwind from the mountains…While the waves remain about stationary, strong winds are blowing through them. The air "dips sharply immediately to the lee of a ridge, then rises and falls in a wave motion downstream." A strong mountain wave requires marked stability in the airstream disturbed by the mountains, wind speeds of at least 15 to 25 knots, and wind direction within 30 degrees normal to the range. The AC continued "Amplitude of a wave is the vertical dimension, and is half the altitude difference between the wave trough and crest…Greatest amplitude is roughly 3,000 to 6,000 feet above the ridge crest."

AIRPORT INFORMATION

According to FAA Airport/Facilities Directory information, JAC was equipped with a single runway, designated 1/19, which was paved, and measured 6,300 feet long. Airport elevation was 6,451 feet above mean sea level (msl). The airport was equipped with an ATCT, which was operating at the time of the flight.

WRECKAGE AND IMPACT INFORMATION

Search Effort Information

As a result of the loss of ATC communications and radar returns, the airplane was reported as missing on Monday October 25. The following day a winter storm moved through the area, and precluded most search activities. On Wednesday, October 27, ground and aerial search activity, under the direction of the Fremont County Sheriff's Office (FCSO) and FC Search and Rescue (SAR), concentrated on a 9-square-mile area in the vicinity of the last radar return. An FCSO press release characterized the search area as "one of the most remote areas of the lower 48 states." Terrain elevations ranged from 11,000 to 13,000 feet, and searchers reported "fresh and deep snow." Participating agencies included FCSO, United States Air Force, Wyoming Civil Air Patrol, Park County SAR, Sublette County SAR, National Outdoor Leadership School, and others. On Thursday, October 28, a weak emergency locator transmitter (ELT) was detected, but due to the topography and signal strength, the unit's location could not be determined.

The wreckage was found in a small steep drainage on the side of a mountain in a boulder field 7 days after the airplane departed from JAC. A ground search team comprised of technical mountaineers was traversing down the side of the mountain for airlift out of the area when they spotted the wreckage. The wreckage was located at the geographic coordinates of 43 degrees 9.708 minutes north latitude, 109 degrees 33.595 minutes west longitude. The terrain elevation of the site was about 11,000 feet (msl).

On-Site Wreckage Information

Fremont County law enforcement and rescue personnel, and one FAA inspector from the Casper Wyoming FSDO, documented the accident site and wreckage on November 2, 2010, concurrent with victim recovery. The impact location was a rocky slope of about 25 degrees, and the airplane nose was oriented in the upslope direction on a magnetic heading of 332 degrees. For reference purposes, the on-course magnetic heading from KICNE to RIW was 082 degrees.

The airplane came to rest in an upright orientation, and damage patterns were consistent with impact in an upright orientation. The wreckage was tightly contained, and only a small number of components were completely separated from the airframe or engine. All components were located within about 20 feet of the main wreckage. The cockpit/cabin was split and crushed/flattened in the vertical direction. Most items that separated from the airplane, including aircraft components and luggage, and the two front seat occupants, were found to the left side of the airplane. The left wing remained in its approximate design orientation, and the aft chord of the left wing exhibited more damage than the forward chord. The right wing was partially fracture-separated from the fuselage, and displaced aft and down. The forward chord of the right wing exhibited more damage than the aft chord. The engine remained attached to the fuselage, but with its longitudinal axis displaced about 75 degrees nose left of the fuselage longitudinal axis. The aft fuselage was bent up about 70 degrees at a point about 2 feet aft of the wing trailing edge. The ELT external antenna remained in place and relatively exposed. The empennage and aft aerodynamic surfaces were relatively intact. The upper prortions of the vertical stabilizer and rudder were deformed to the left.

Post-Recovery Wreckage Information

Recovery efforts necessitated partial deconstruction of the wreckage for transport to a secure location, where it was examined in September 2011. Examination of the wreckage confirmed that all major components were at, and were recovered from, the accident site. Refer to the accident docket for detailed examination results.

The accident and recovery process resulted in the engine and associated components being separated into two primary sections. One section consisted primarily of the crankcase, cylinders, and propeller hub, and three engine mounts, and the other contained portions of the forward cockpit, firewall, engine mount frame, cowling, lower windshield frame, cockpit floor,

cabin door, nose gear, and some accessories. Most components exhibited significant impact and crush damage. The propeller was fractured, scored and gouged, consistent with powered rotation at the time of impact. The propeller was able to be rotated manually, which enabled confirmation of drive train continuity. Damage precluded the determination of whether the ram air system was in use at impact. Nearly all engine components and accessories were recovered, and no pre-existing mechanical deficiencies or failures that would have precluded normal operation were observed.

Most of the cabin door, portions of the instrument sub-panel, and the front right bottom seat cushion remained attached to the forward fuselage. The nose gear strut assembly was captive in this section of the wreckage. Multiple fractured segments of the aileron, elevator, rudder, and brake pedal control linkage assemblies were also found captive in this section. Damage precluded assessment of any control continuity in the forward fuselage and cockpit. The fuel selector was found set to the left tank. The pilot side instrument panel was found separated from the structure. The master and avionics master switches were found in the "on" position.

All wing sections exhibited significant crush and/or tearing damage. The left aileron and left flap remained attached to the left wing. The right flap was fracture-separated from the wing, and the right aileron remained attached to the wing. Aileron control continuity was established from the ailerons to the center wing/fuselage section. The flap setting at impact could not be directly determined due to the fracture-separation of the actuation linkage, but evaluation of the flap jackscrew indicated that the flaps were retracted at the time of impact.

Both main landing gear assemblies remained attached to the wing structure. The left gear remained captive in the retracted position by wing structure crush and deformation. The right gear was free to pivot between the retracted and extended positions.

The empennage had been cut from the fuselage during the recovery process. The vertical and both horizontal stabilizers remained attached to this segment, and the rudder and both elevators remained attached at all hinge points to their respective stabilizers. Control continuity was established from the elevators and rudder to the recovery cuts of the two longitudinally oriented control tubes in the empennage.

The airplane was equipped with a longitudinal trim system, which varied the angle of incidence of the aft fuselage/empennage (horizontal and vertical stabilizers) with respect to the forward fuselage. The longitudinal trim jackscrew assembly was intact, properly safetied, and remained attached per design. Jackscrew extension enabled determination that the longitudinal trim was about halfway between the normal takeoff setting and the full airplane nose down setting. Damage to the autopilot longitudinal trim system precluded assessment of its pre-impact condition or functionality.

An engine monitor with GPS capability was recovered in the wreckage. It was sent to NTSB Recorders Laboratory in Washington, D.C., where data from the accident flight was downloaded. The data interval was 6 minutes. The GPS ground track was congruent with the

ground-based radar track. The last data point was recorded at 1358:56, when the airplane was 3.3 miles west of the impact location. All recorded engine parameter values were within normal limits for the duration of the flight, and no indications of any abnormalities were observed.

The ELT was a Pointer Model 3000 (TSO C91), with broadcast frequencies of 121.5 & 243.0 megahertz (MHz). Maintenance records indicated that the battery was replaced in August 2009.

ADDITIONAL INFORMATION

Trip Background Information

According to the pilot's wife, the trip was a family vacation to attend a function on Saturday, October 23, in the Jackson area. She stated that they "tend to fly privately whenever it's practical." Due to space limitations, the pilot and three children flew in N201HF, while the remainder of the family scheduled to make the same round trip about the same dates via commercial airline. The October 21 morning departure from Minnesota of four family members in N201HF, and two on commercial airlines, was as planned. The flight of N201HF from Minnesota to JAC was accomplished in two legs. The family stayed together at a hotel in the region. The original plan was for the entire family to depart JAC on Sunday, October 24, with their return to Minnesota that same day. The flight of N201HF from JAC to Minnesota was planned as two legs, to be completed in a single day.

On October 24, the wife and child, who flew to JAC via commercial airline, departed JAC via commercial airline in accordance with their original plan. However, the pilot and three children delayed their departure until at least the following day due to weather. According to the wife, the pilot considered driving and commercial airline service as an alternate means for the return to Minnesota. She stated that on the morning of October 25, the pilot and three children had boarded a commercial flight, but that flight was subsequently canceled due to non-weather related issues. The pilot and three children later departed JAC in N201HF.

JAC Customer Service Representative Observations

The airplane had been parked outdoors on the ramp at JAC for the duration of the weekend. According to the customer service representative (CSR) at the FBO, the pilot arrived at the fixed base operator (FBO) on the morning of the accident, and informed her that he planned to fly the Mooney rather than wait for a commercial flight. The CSR did not elaborate on any possible reasons to prompt that statement by the pilot. The pilot then checked the "weather computer," and "watched out the window" for a while. He then requested that the airplane be moved into a hangar to warm up. After that was accomplished, the pilot split his time between the pilot's lounge at the FBO, and occasionally checking on the airplane. After "quite a while,"

the pilot exited the lounge and requested that the airplane be removed from the hangar in preparation for departure. The luggage and passengers were loaded, and the pilot taxied out for takeoff.

Pilot's Flight Preparation Information

Both flight plans filed by the pilot specified DNW as the first navigation fix. The charted minimum en route altitude (MEA) for the segment between DNW and BOY was 14,000 feet, with lower minimum altitudes along the remainder of the route. No minimum obstruction clearance altitude (MOCA) was specified. The charted MEA for the segment between DNW and RIW was 14,000 feet, with a MOCA of 13,500 feet, and lower minimum altitudes along the remainder of the route. In the flight plan, which he filed by telephone at 1037, the pilot requested an initial altitude of 14,000 feet. However, in the flight plan which he filed by computer at 1237, he requested an altitude of 9,000 feet. The reason(s) for the revised route and altitude requests were not determined.

Review of the receipts from the FBO indicated that on October 24, the pilot paid for fuel, oil, oxygen, and three nights of parking. No hangar charges were invoiced on that receipt. An FBO receipt dated October 25 indicated that the pilot paid for one night of parking, plus the hangar fee. Neither receipt bore a time stamp.

Weight and Balance Information

The maximum certificated takeoff weight was 2,740 pounds, and the allowable center of gravity (CG) range at that weight was 45 to 50.1 inches. The weight and balance of the accident flight was estimated using the airplane empty weight, the pilot's weight, estimates of the passenger weights, and a full fuel load, which then enabled determination of the clothing and baggage allowance.

The pilot was seated in the front left seat, the 12-year-old son was in the right front seat, and the two 14-year-old sons were in the rear seat. Since the children's weights could not be obtained, the US Center for Disease Control 50th percentile values of 90 pounds for the 12-year-old, and 110 pounds for the 14-year-olds, were used. The resulting gross weight (less baggage) was 2,659 pounds, which resulted in a CG of 46.58 inches. Those values were within the allowable weight and balance envelope, and allowed for a total of 81 pounds clothing, accessories, and baggage. Based on those values, the takeoff weight was estimated to be the maximum gross weight of the airplane, 2,740 pounds, at a CG of 48.03 inches.

Review of performance charts from the POH indicated that the airplane would have consumed about 9 gallons (54 pounds) of fuel from the time of the takeoff from JAC. Therefore, about the time of the accident, the estimated weight was 2,686 pounds, and the CG was 48.02 inches, which were both within the allowable weight and balance envelope.

Refer to the accident docket for additional information.

Airplane Climb Performance

According to the Pilot's Operating Handbook (POH), the service ceiling (the altitude where the maximum rate of climb is 100 feet per minute) was about 18,700 feet density altitude at a gross weight of 2,740 pounds, and was about 23,200 feet density altitude at a gross weight of 2,300 pounds. POH stall speed in the clean configuration at maximum gross weight was 59 knots calibrated airspeed (KCAS) or 61 knots indicated airspeed (KIAS).

Review of the POH Climb Performance charts indicated that 15 minutes and 4 gallons of fuel were required to climb from JAC to 14,000 feet. The POH-predicted rate of climb at 14,000 feet was about 350 feet per minute (fpm), and decreased to about 250 fpm at 16,000 feet. POH climb speeds were 81 knots true airspeed (KTAS) at 10,000 feet and 79 KTAS at 15,000 feet.

According to the airplane co-owner, he never used the ram air induction system, and neither did the accident pilot. According to a representative of the airplane manufacturer, when the normal induction system is in use (ram air not being used), the air filter canister directs the incoming air around to the back of the filter, and solids like rain or ice are ejected out the bottom of the canister by centrifugal force. The investigation was unable to determine the activation status of the ram air induction system during the flight or at impact, and its possible effects on engine induction icing and airplane climb capability.

Icing Information

According to AC-00-6A (Aviation Weather), "Aircraft icing is one of the major weather hazards to aviation. Icing is a cumulative hazard. It reduces aircraft efficiency by increasing weight, reducing lift, decreasing thrust, and increasing drag."

The AC stated that "Rime ice forms when drops are small, such as those in stratified clouds or light drizzle. The liquid portion remaining after initial impact freezes rapidly before the drop has time to spread over the aircraft surface. The small frozen droplets trap air between them giving the ice a white appearance… Rime ice is lighter in weight than clear ice and its weight is of little significance. However, its irregular shape and rough surface make it very effective in decreasing aerodynamic efficiency of airfoils, thus reducing lift and increasing drag."

Supplemental Oxygen Information

Paragraph 91.211 ("Supplemental Oxygen") of the Federal Aviation Regulations required that the pilot be provided with and use supplemental oxygen for that part of the flight that was of

more than 30 minutes duration at cabin pressure altitudes above 12,500 feet (msl) and up to and including 14,000 feet (msl), and continuously at cabin pressure altitudes above 14,000 feet. In addition, the regulations required that at cabin pressure altitudes above 15,000 feet, each occupant was to be provided with supplemental oxygen.

The pilot's wife stated that that the pilot had a supplemental oxygen system, which she described as an "oxygen canister with nasal cannulas" that he used when flying at high altitudes. She was not familiar with his specific supplemental oxygen usage patterns. She also reported that although one child on the airplane had asthma, his symptoms were controlled by medication, and she was not aware of his ever using oxygen on the airplane. Records obtained from the FBO at JAC indicated that the pilot had paid for an oxygen fill prior to departure. An Aerox brand portable aviation oxygen cylinder with a 2-port outlet was recovered in the wreckage. The valve was found in the open position, the cylinder was unpressurized, and an oxygen line was entangled with the pilot's legs, but it could not be determined whether he was using the oxygen during the flight. There was no evidence to suggest that any of the other occupants were using supplemental oxygen during the flight.

Air Traffic Control Information

The clearance that was issued to the pilot differed in routing and altitude from the one he had requested. The routing difference included an obstacle clearance departure (TETON THREE), which involved a departure to the south instead of the north, and an off-airway segment. On the charted procedure, the fix beyond KICNE was Idaho Falls (IDA) VOR, which was approximately west of KICNE, and approximately opposite the pilot's requested route direction. The issued clearance did not include the leg from KICNE to IDA. Instead, it contained the off-airway segment from KICNE to RIW. The TETON THREE takeoff minimums specified either a minimum climb gradient of 335 feet per nautical mile to 14,000 feet, or a ceiling of 4,400 feet agl and 3 miles visibility. The initial clearance altitude was 7,000 feet above the pilot's requested altitude, but that was amended to an altitude 5,000 feet above his requested altitude.

The pilot filed two different routes and was issued a third, different route. Both filed routes were on defined airways. Review of the low-altitude IFR charts indicated that the first route (JAC-DNW-BOY) had a minimum enroute altitude (MEA) of 14,000 feet between DNW and BOY. The second route (JAC-DNW-RIW) had an MEA of 14,000 feet between DNW and RIW, and a minimum obstruction clearance altitude (MOCA) of 13,500 feet.

The cleared route contained an off-airway segment (KICNE to RIW), and therefore no MEA or MOCA were specified. Instead, pilots were to use the charted off-route obstruction clearance altitude (OROCA) unless otherwise specified by ATC. Review of the chart indicated that the OROCA for the KICNE to DIW leg was 16,100 feet. Review of IFR charts also showed an area east of KICNE where the floor of controlled airspace was 14,500 feet, and therefore flight at 14,000 feet would take the aircraft into class G (uncontrolled) airspace. Review of ATC

communications indicated that the pilot did not question or attempt to change the routing, or the assigned 14,000 foot altitude.

FAA order 7110.65, "Air Traffic Control," provided guidance to controllers regarding route and altitude assignments for IFR aircraft. The order stated that controllers were to include "routes through Class G airspace only when requested by the pilot," that assigned altitudes on established airways must be "at or above the MEA for the route segment being flown," and that where MEAs have not been established, aircraft are to be assigned altitudes "at or above the minimum altitude for IFR operations."

The airplane departed JAC, and was in communication with and tracked by controllers at Salt Lake City Air Route Traffic Control Center (ZLC ARTCC). About 1337, the controller advised the pilot that radar contact was lost. At that point the airplane was at 14,000 feet and about 22 miles east of KICNE, headed for RIW. About 9 minutes later, the controller attempted to assist the pilot, and the pilot attempted to climb to the minimum instrument altitude of 15,800 feet. The last radio communication from the airplane was received about 1352, when the pilot reported that he was descending rapidly.

ZLC Handling Controller

The controller who handled the airplane from shortly after takeoff until it was lost from communications was interviewed by NTSB air traffic specialists. The controller stated that once he was in contact with the airplane, he became engaged in other tasks in his sector, and did not notice that the airplane had gone into handoff status to the next sector. The other sector controller contacted him and advised him that she would take the airplane, but he retracted the handoff, and the airplane then turned east at KICNE. A few minutes later, radar contact with the airplane was lost. During the period that the airplane was not visible on the ERAM display, the controller referred to the backup system to update the flight track. After a few minutes, the controller noted that the airplane was again displaying radar targets in the ERAM system. He restarted the track in ERAM, and the minimum safe altitude warning alert immediately activated. He checked the overhead chart for the minimum altitude for the area and the location of nearby peaks, and then advised the pilot that the minimum instrument altitude for the area was 16,000 feet. After the pilot reported difficulty climbing to the assigned altitude, although he knew it was not an approved procedure, he asked the pilot to maintain his own terrain and obstruction clearance.

The controller stated that he believed that the pilot had filed the route, and that he was not aware that the pilot’s flight plan had been amended by JAC ATCT. He also did not realize that the cleared route passed through uncontrolled airspace. He was aware of the pilot rules for use of oxygen and correctly stated the altitude limitations.

Radar Data and Radar System Status

Radar data for the investigation was obtained from ZLC recordings from radar sites located at Ashton, Idaho (QVA), and Rock Springs, Wyoming (RKS); those two sites had the best available coverage of the flight segment between KICNE and RIW. From 0841 until 1401 on the day of the accident, the RKS radar site experienced some reliability issues, and the RKS data was therefore intentionally made unavailable for display to controllers at ZLC. However, radar data from the RKS site was still being transmitted to and recorded at ZLC. The decision to render the RKS data unavailable to the ZLC controllers resulted in the loss of ATC radar contact with the flight from 1336 to 1347, since during that period the airplane was in an area where no other radar site had coverage.

ZLC was the FAA facility responsible for monitoring and managing the operation of the RKS radar site. Operational radar data from the RKS radar site was also available to Denver Air Route Traffic Control Center (ZDV) for use by controllers there. When the initial service interruption occurred, ZLC notified ZDV of the situation. Since ZDV was already operating with reduced capability because of an unrelated outage, ZDV elected to continue to use the data from the RKS site to preclude a more extensive loss of coverage than ZDV was already experiencing.

Shortly after the RKS data was determined to be unreliable by ZLC, a technician was dispatched to access the radar antenna site. Road conditions prevented him from reaching the antenna. About 5 hours after the initial failure, when it was determined that the technician could not access the site, ZLC personnel began remote diagnostic procedures in an attempt to restore the radar system operation. The system was successfully restored to service, and full functionality was returned to ZLC and ZDV.

Minimum Safe Altitude Warning (MSAW)

The radar data processing software in use at ARTCCs has the ability to detect situations where aircraft are operating below altitudes considered safe for IFR flight. The ZLC En Route Automation Modernization (ERAM) software includes a map composed of polygons referred to as Terrain Alerting Volumes (TAV), each with a defined minimum altitude. When an aircraft that is being tracked is either within a TAV at less than the minimum altitude, or is projected to enter a TAV at less than the minimum altitude within the next 120 seconds, the controller is presented with an alert which must be evaluated and relayed to the pilot as appropriate to the situation. In severe situations, the controller may be required to issue a safety alert, warning the pilot of an imminent hazard. When the situation requires a safety alert, its issuance is a first priority duty equal in importance to separation of IFR aircraft.

During the period that the airplane approached and then entered the 15,800 foot TAV, it was not in radar contact, and was therefore, not eligible for MSAW service. Review of recorded radar data showed that if the RKS radar had been made available to the ZLC ERAM, there would have been no loss of radar contact with the airplane, and it would have remained

continuously eligible for MSAW service.

In April 2011, the NTSB issued Safety Recommendations A-11-32 to A-32-34 to the FAA to address identified ATC related deficiencies. Refer to the accident docket for detailed information.

ELT Information

According to the National Oceanic and Atmospheric Administration (NOAA) website, ELTs were FAA mandated for installation on certain aircraft in the mid 1970s, and those ELTs transmitted on a frequency of 121.5 MHz. That system had several limitations, including frequency clutter, inability to verify the aircraft that was the source of the signal, and the requirement to have another aircraft within range to receive the signal.

In 1982, due to those limitations, implementation began on a satellite based system that operated on an exclusive frequency of 406 MHz. Key aspects included ELTs with a digital signal that uniquely identified each beacon, and global coverage. Although the receiver satellites were primarily designed to receive the 406 MHz beacons, provisions to receive the existing 121.5 MHz beacons were included. On February 1, 2009, in accordance with an international agreement reached in 2000, satellite reception of 121.5 MHz beacons was terminated. As of July 2012, the FAA has not mandated the replacement of 121.5 MHz ELTs with 406 MHz units.

Pilot Information

Certificate:	Private	**Age:**	40,Male
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:**	Yes
Medical Certification:	Class 3 With waivers/limitations	**Last FAA Medical Exam:**	April 4, 2008
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	October 17, 2010
Flight Time:	(Estimated) 940 hours (Total, all aircraft), 138 hours (Total, this make and model), 100 hours (Last 90 days, all aircraft), 24 hours (Last 30 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Mooney	**Registration:**	N201HF
Model/Series:	M20J	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	24-0152
Landing Gear Type:	Retractable - Tricycle	**Seats:**	4
Date/Type of Last Inspection:	September 10, 2010 Annual	**Certified Max Gross Wt.:**	2740 lbs
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:	1842 Hrs as of last inspection	**Engine Manufacturer:**	Lycoming
ELT:	C91 installed, activated, did not aid in locating accident	**Engine Model/Series:**	IO-360
Registered Owner:	On file	**Rated Power:**	180 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument (IMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KPNA,7102 ft msl	**Distance from Accident Site:**	24 Nautical Miles
Observation Time:	13:50 Local	**Direction from Accident Site:**	210°
Lowest Cloud Condition:		**Visibility**	1 miles
Lowest Ceiling:	Broken / 1000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	23 knots / 28 knots	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	290°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.65 inches Hg	**Temperature/Dew Point:**	1°C / -6°C
Precipitation and Obscuration:	In the vicinity - Freezing - Unknown precipitation		
Departure Point:	Jackson, WY (JAC)	**Type of Flight Plan Filed:**	IFR
Destination:	Pierre, SD (PIR)	**Type of Clearance:**	IFR
Departure Time:	13:06 Local	**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:	3 Fatal	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	4 Fatal	**Latitude, Longitude:**	43.161666,-109.559997(est)

Administrative Information

Investigator In Charge (IIC):	Huhn, Michael
Additional Participating Persons:	Bruce J Hanson; FAA FSDO; Casper, WY Troy Helgeson; Lycoming Engines; Williamsport, PA Robert Collier; Mooney Aircraft; Kerrville, TX Bruce Lampert; NATCA
Report Date:	August 6, 2012
Last Revision Date:	July 8, 2024
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=77708