Aviation Investigation Final Report

Location:	Point Mugu, California	**Accident Number:**	WPR17FA146
Date & Time:	July 8, 2017, 16:47 Local	**Registration:**	N2812
Aircraft:	CHICCO MIGUEL E QUICKSILVER SPORT II	**Aircraft Damage:**	
Defining Event:	Loss of engine power (partial)	**Injuries:**	1 Fatal, 1 Minor
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The two pilots, who were both qualified to fly the experimental light sport airplane, were conducting a local flight with two other similar airplanes from the same flight club. After takeoff, the three airplanes proceeded to the ocean shoreline and then flew slightly offshore along the coast. The flight was conducted at a low altitude, which, once over the ocean, was about 300 ft. Soon after reaching the ocean, both pilots noted a "skip" in the engine. They decided to climb for safety and turn around to return to their departure airport. Despite moving their respective throttles to the full throttle position, neither pilot was able to obtain full power from the engine to effect a climb, and the engine rpm began slowly decreasing. Because the airplane was no longer able to maintain altitude, control of the airplane was transferred to the pilot who held a flight instructor certificate. Due to the rocky coastline and traffic on the road along that coastline, the pilots determined that they would have to ditch in the ocean. After the ditching, both pilots escaped from the airplane, and, when the airplane began to sink, they began to swim to shore, which was about 200 ft away. Neither pilot appeared injured. No personal flotation devices were aboard the airplane or worn by the pilots. One pilot successfully swam to shore, but the other pilot drowned.

The airplane washed ashore the following morning and was heavily damaged by wave action, contact with rocks, and the salt water immersion. Postaccident examination did not reveal evidence of any preaccident mechanical failures but obscuration or destruction of such evidence due to the ditching and subsequent environmental damage could not be ruled out.

The examination revealed several maintenance-related discrepancies. The type of fuel line clamps used and the installation of the fuel pumps were not in accordance with the engine manufacturer's specifications, and this could have affected fuel delivery to the carburetors. After the accident, the throttle cable was found disconnected from the cockpit control, and it could not be determined whether that was a result of a partial slippage during flight, which would have limited or eliminated pilot control of the engine rpm and power.

Although a similar airplane in the flight did not report any carburetor icing, the symptoms described by the surviving pilot were consistent with carburetor icing, and the ambient temperature and dew point values allowed for the possibility of carburetor icing. Despite such equipment being recommended by the engine manufacturer, the lack of carburetor heat provisions on the accident airplane prevented the pilots from being able to prevent carburetor icing, or counter carburetor icing if it did occur.

Finally, although the engine manufacturer specified an overhaul interval of 300 hours, the flight club elected to adhere to a 450-hour overhaul interval advocated by a repair facility that was not approved by the engine manufacturer. At the time of the accident, the engine was about 127 hours beyond the manufacturer-recommended 300-hour overhaul interval. Although none of these discrepancies discovered during the investigation was able to be definitively linked to the accident, all were potential factors, and all were maintenance-related.

The low glide ratio of the airplane (about 5:1) limited its range in the event of a loss of engine power, reducing the forced landing site options available to the pilots. The forced landing site options were further reduced by the pilots' decision to operate at 300 ft, a very low altitude. The pilots' over-water route and low cruise altitude were reported to be common for pilots in the flight club. Even though the altitude and route combination increased the likelihood of an ocean ditching in the event of a loss of engine power, neither the pilots nor the airplane were equipped for an ocean ditching. Precautions such as higher over-water cruise altitudes and water-ditching equipment, such as personal flotation devices, may have prevented this event from becoming a fatal accident.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: A partial loss of engine power for reasons that could not be determined during postaccident examination in combination with the low cruise altitude selected by the pilots, which resulted in an ocean ditching. The lack of personal flotation devices likely contributed to the drowning of one of the pilots.

Findings

Not determined	(general) - Unknown/Not determined
Personnel issues	Decision making/judgment - Flight crew
Aircraft	Altitude - Not specified
Aircraft	Life jacket - Not used/operated
Aircraft	(general) - Incorrect service/maintenance
Organizational issues	Adequacy of safety program - Operator
Environmental issues	Conducive to carburetor icing - Effect on operation
Environmental issues	Conducive to carburetor icing - Ability to respond/compensate

Factual Information

History of Flight

Enroute-cruise	Loss of engine power (partial) (Defining event)
Enroute-cruise	Ditching

HISTORY OF FLIGHT

On July 8, 2017, about 1647 Pacific daylight time, a Quicksilver MXL-II Sport experimental light sport airplane, N2812, sustained unknown damage when it ditched in the Pacific Ocean near Point Mugu, California. The two pilots on board escaped from the airplane before it sank. One pilot successfully swam to shore, but the other pilot died during his attempted swim to shore. The airplane was owned by Sky Knights Flight Club (SKFC) and was operated by the pilots under the provisions of 14 Code of Federal Regulations Part 91. Visual meteorological conditions prevailed, and no flight plan was filed for the personal flight that departed from Camarillo Airport (CMA), Camarillo, California, about 1630.

According to the surviving pilot, he and the other pilot were both members of SKFC, which was based at CMA. Each of the pilots was qualified by the club to operate the airplane on his own. The club also owned two other experimental light sport airplanes similar to the accident airplane. These were a Quicksilver Sport IIS airplane, N1712, and a Quicksilver MXL Sport single-place airplane, N7712. On the day of the accident, a total of five persons, including the two accident pilots, planned to fly the three airplanes in loose formation south to the shoreline and then proceed southeast from there for a local flight.

The accident airplane was equipped with side-by-side seats and dual controls. According to the surviving sport pilot, he took the left seat and the other pilot, who was a private pilot and a certificated flight instructor (CFI) for light sport aircraft, took the right seat, but this was not an instructional flight. They departed CMA via the "southeast pattern," which was one of three pre-specified routes to exit the CMA traffic area. They departed with about 10 gallons of fuel on board, and the sport pilot was the pilot flying. He estimated that it took about 15 minutes to reach the shoreline, which was about 7 miles south of CMA. At the shoreline, the three airplanes turned left, which put the shoreline off their left sides.

Shortly after they passed a large rock outcrop known locally as "Mugu Rock," the sport pilot felt a "skip" in the engine. At that time, they were cruising off the shoreline and above the ocean at an altitude of about 300 ft. The skip repeated a few times, and the sport pilot then asked the private pilot whether he felt it too; the private pilot replied in the affirmative. They decided to reverse course and return to CMA and also advised the other two airplanes of their situation and intentions. They reversed course, the engine irregularity continued, and the two agreed that they should climb to gain altitude in case the situation deteriorated. At that time, the sport pilot advanced the throttle to climb, but the rpm only went to about 5,900, instead of the desired target value of 6,200 to 6,300 rpm. The sport pilot asked the private pilot to advance his throttle to increase the rpm. The private pilot pushed on his throttle but was unable to increase the rpm above 5,900. The rpm then slowly decreased. The airplane could not climb

and then became unable to maintain altitude. Due to their different experience levels, the two pilots agreed that the private pilot should now become the flying pilot, and a transfer of control was effected.

The rpm continued to decrease slowly over a period of 4 to 5 minutes, and it became apparent to the pilots that they would have to conduct a forced landing. Due to the rocky coast, hilly terrain, and crowded highway that paralleled the shoreline, the pilots realized that they would have to either continue flight to reach a sandy beach or ditch the airplane in the water.

The continued decrease in rpm combined with the lack of a suitable landing location forced the pilots to ditch the airplane just offshore. The airplane touched down slowly and under control, and it initially remained afloat. The two occupants both successfully escaped from the airplane and stayed with it until it began to sink. They then began swimming to shore, which was about 200 ft away. The sport pilot was ahead of the private pilot, and they maintained verbal contact as they made their way to shore. The sport pilot kept verbally checking on the private pilot; initially the private pilot said he was fine, but later during the swim, the private pilot said that he was "getting tired." The sport pilot reached the shore, climbed out onto a rock, and then turned to see that the private pilot was face down in the water and was not moving. A bystander swam to the private pilot and pulled him to shore, where he and the pilot then pulled the private pilot from the water. The sport pilot and the bystander attempted to resuscitate the private pilot, as did the paramedics who arrived shortly thereafter.

At least one of the other two airplanes in the formation orbited the ditching site for a short time, and both of those airplanes returned safely and uneventfully to CMA. Photographs indicated that the accident airplane appeared to remain intact after it ditched and then submerged in the water. The morning after the accident, the airplane was found washed ashore. The airplane incurred substantial damage as a result of exposure to the rocky coast and wave action. The airplane was recovered later that morning and transported to CMA for examination by NTSB and FAA personnel.

PERSONNEL INFORMATION

Sport Pilot (Left Seat)

Federal Aviation Administration (FAA) records indicated that the person seated in the left seat held a sport pilot certificate with an airplane single-engine land rating that was issued in May 2012. He did not hold an FAA medical certificate, nor was he required to hold one to exercise the privileges of his sport pilot certificate. Despite several requests of the pilot, the National Transportation Safety Board (NTSB) investigator-in-charge was unable to obtain information regarding the pilot's flight experience.

Private Pilot (Right Seat)

FAA records indicated that the person seated in the right seat held a private pilot certificate with an airplane single-engine land rating and a flight instructor certificate with a sport rating. His most recent FAA third-class medical certificate, which was issued in April 2008, had expired; he was not required to hold a medical certificate to fly as a sport pilot.

Copies of some of the most recent pages of the private pilot's flight logbook were provided to the investigation. The most recent entry in the flight logbook was dated April 1, 2017. As of that date, the private pilot had logged about 377 total hours of flight experience, including about 64 hours in light

sport aircraft. The logbook also indicated that he had logged about 34 hours as a flight instructor. The private pilot's most recent flight review was completed in September 2016.

SKFC Mechanic

One individual at SKFC was primarily responsible for the maintenance and inspection activities on the three SKFC airplanes. He reported that he had been a full-time member of SKFC for about 3 to 4 years and that he was not compensated by SKFC for his services as the SKFC mechanic. He held a private pilot certificate, an aircraft mechanic certificate with airframe and powerplant ratings, and a light sport aircraft repairman certificate. In the spring of 2017, he successfully completed two Rotax-approved training courses, one for two-stroke engines and one for four-stroke engines.

AIRCRAFT INFORMATION

The airplane was a high-wing ultralight-like design with conventional flight controls. The structure consisted of an uncovered aluminum and steel tube framework with two side-by-side seats and a tricycle-configuration wheel landing gear. It was powered by a Rotax 582 model 99-series engine that was mounted atop the airframe in a pusher configuration. The airplane was not equipped with any type of whole-airplane emergency parachute.

FAA records contained conflicting information regarding when the airplane was built. One document indicated that the airplane was built in 2001, while several other documents indicated a 2007 or 2008 build year. The builder of the airplane was a member of SKFC.

The airplane was purchased by and registered to SKFC in April 2013. In June 2013, the airplane was involved in a non-fatal engine power loss accident (NTSB accident WPR13LA318). That power loss was caused by a mechanically deficient muffler.

Maintenance Records Information

Review of the maintenance records indicated that the most recent annual condition inspection was completed in January 2017. As of that inspection, the airframe had a total time (TT) in service of about 3,111 hours, and the engine had a time since major overhaul of about 349 hours.

According to the engine maintenance records, the engine serial number was 4655502. The engine was installed on the airplane on August 23, 2015. The records indicated that at that time the engine had "0 hours since M/O/H" [major overhaul], and that the "Hobbs" hour meter indicated a time of 2,756.7 hours. The records indicated that the previous time on the engine was unknown.

At the time of the accident, the engine had accumulated a TT of 427.9 hours since its most recent overhaul. The Rotax Maintenance Manual (MM) specifies a major overhaul interval of 300 hours.

The 2015 overhaul, as well as a previous 2013 overhaul, were accomplished by a repair facility in Naples, Florida. According to several representatives of SKFC, including the SKFC mechanic, and independently confirmed with the Naples facility, the SKFC-adopted overhaul interval of 450 hours was the interval recommended by that repair facility for Rotax 582-series engines. According to Rotax, that repair facility is not a Rotax-approved service facility for Rotax engines.

METEOROLOGICAL INFORMATION

The 1656 automated weather observation from Point Mugu Naval Air Station (NTD), located about 3 miles northwest of the accident site, included winds from 260° at 8 knots, visibility 9 miles, few clouds at 6,500 ft, temperature 25°C, dew point 17°C, and an altimeter setting of 29.81 inches of mercury.

The above temperature and dew point values indicated that the relative humidity was about 60%. When the intersection of the two temperature values was located on an FAA-provided chart that depicted carburetor ice envelopes, the point was in the region denoted as "Serious Icing at Glide Power." When plotted on another FAA-provided icing potential chart, the point was in the region denoted as "carburetor icing possible."

COMMUNICATIONS

The pilots communicated with the CMA air traffic control tower (ATCT) to depart from CMA, and then with the NTD ATCT for clearance to transit south to the east of NTD. The pilots were not in communication with these or any other air traffic facilities at the time of the power loss or ditching.

WRECKAGE AND IMPACT INFORMATION

Summary

The remnants of the airplane were removed from the shore on the morning of July 9, transported to the SKFC hangar, and rinsed with fresh water. Detailed examination of the engine, as well as some airframe components, was conducted by NTSB and FAA personnel at the hangar on July 10, 2017. No evidence of preimpact mechanical malfunction was noted during the examination, but it was determined that the ocean immersion and wave action obscured or destroyed a significant amount of evidence.

Airframe

The recovered airframe was a large mass of fractured tubing held together by some connectors, the wing cloth, and numerous structural and control cables. The fuselage and wing structures had lost all their shape due to the numerous fractures and bends of the structural tubing. Some components (such as the instrument panel) were missing, and some (such as the seats, propeller, and fuel tank) sustained scrapes, cracks, dents, or crushing damage. The wing cloth was shredded, and the engine bore numerous impact marks on all exposed sides. Corrosion and salt and sand infiltration were extensive.

The airplane was equipped with a center-mounted overhead console unit that housed several components, including the engine hour meter, electric fuel pump, and electrical switches. Damage to the console precluded reliable determination of the pre-impact settings or functionality of the switches.

Engine General

Because the engine was mounted upright in a pusher-configuration, in this report, left, right, up, down, fore, and aft denote orientation with respect to the airplane's longitudinal axis. Rotax uses the following abbreviations to refer to the cylinder and engine aspects:
- PTO denotes the power take-off end, which is where the propeller gearbox and propeller attach
- MAG denotes the magneto end, which is the opposite end from the PTO.

The engine data plate was no longer attached to the engine, but the engine's appearance and configuration were consistent with a Rotax 582 Model 99 "Blue Head" series liquid-cooled, two-cylinder, two-stroke cycle version, which the maintenance records indicated was installed in the airplane.

The engine remained attached to its mounting pad, which remained attached to the fuselage structure. The propeller hub remained attached to the engine gearbox flange, but all three composite blades were fracture-separated from the propeller hub. The engine exhibited significant impact damage, corrosion, and sand infiltration. The engine could not be rotated manually. There was no external evidence of any catastrophic failure of any engine component.

Engine Controls

Each pilot station was provided with a separate throttle lever located outboard of each seat. A throttle lever was attached to each end of a transversely-mounted control rod. The rod was attached to the fuselage so that in normal operation, it would rotate about the rod's central axis. A single throttle push-pull control cable attached to a fitting near the lateral center of the throttle control rod.

The throttle control rod was partially fracture-separated from its fuselage pivot mount. Both throttle levers remained securely affixed to their respective ends of the rod. The throttle control cable had been pulled from its connection to the rod, but its swaged end remained captive in the connector on the rod. The investigation was unable to determine the pre-accident security of the throttle cable to rod attachment, or when the cable disconnected from the rod. The throttle mechanical stop arms remained securely attached to the rod, but, due to damage, their functionality and range adjustments could not be determined.

Representatives of SKFC reported that the occupant lap restraint belts could droop down between the seats if not properly secured and stowed, and interfere with throttle control travel. Occupant egress and damage precluded determination of whether such a condition occurred during the flight. In an email communication to the NTSB, the surviving pilot wrote "4 Point seat belt secured, adjusted and checked. Any excess strap after adjustment is tucked under the lap belt to keep from flapping in the wind."

Ignition System

The breakerless dual capacitor discharge ignition incorporated an integrated generator that separately powered two ignition coils. Each coil powered one spark plug in each cylinder. Spark/ignition timing was a function of crankshaft rotation angle, and was not user adjustable. The integrated generator was not examined. Both coils remained attached and appeared intact. The ignition leads to the spark plugs were partly damaged and/or separated from the engine.

All four spark plug bases were found securely installed in the engine. All four spark plugs were missing the bulk of their upper insulator sections, which were fracture-separated, consistent with rock impact damage. No spark plug model numbers were available on the remaining portions. The four spark plug bases were removed and examined. All were contaminated and/or corroded, consistent with salt water immersion. The electrode gaps were found to be larger than the Rotax specifications, but the reasons for this, which included corrosion, wear, or improper maintenance, could not be determined.

Damage precluded the testing of the ignition system, or of any of its individual components.

Fuel System

The fuel system, particularly the fuel lines, had been significantly disrupted by the accident and/or subsequent environmental exposure. Excluding the fuel tank cap, all primary components of the fuel system were recovered, and all were damaged and/or contaminated by environmental exposure. Excluding the fuel tank, none of the components were in a condition to determine their pre-accident condition or functionality.

The engine-driven fuel pump was intact but contained sand and water, and was corroded. The electric fuel pump did not operate when external electrical power was applied; it was not opened for further examination. The fuel filter glass case was absent, consistent with postaccident environmental exposure. The filter element appeared intact.

The two carburetors were found separated from the engine at their flexible boot ("socket") connections but remained attached to the engine by cables and fuel lines. Both carburetors were missing their bowls, and their internal float mechanisms and other components were crushed, deformed, and corroded, consistent with post-accident environmental exposure. The main jets of both carburetors were unobstructed and were the correct size for this engine and carburetor installation. Removal of the cover plate on each carburetor revealed no failed springs or other abnormalities. The two sockets remained attached to the engine, and both were intact and flexible.

One Bowden (throttle-actuating) cable was displaced but remained attached to the MAG carburetor, and the other Bowden cable was separated from the PTO carburetor. The carburetor pistons (also known as throttle slides) on both carburetors were firmly stuck in the wide open throttle position.

The single air filter remained attached to the two carburetors. The air filter was crushed and otherwise deformed, contained sand, and exhibited corrosion. The air filter was the correct part for the engine.

Pistons and Cylinder Head

The pistons and cylinders were examined; no evidence of oil starvation, seizure marks, or stuck piston rings was observed. The cylinder head was intact and securely attached. No evidence of any leaks was observed along the head/cylinder joints. The head was removed, and the exposed cylinders, pistons, and head cylinder domes were examined. No evidence of any pre-accident mechanical anomalies was observed.

Exhaust System

The exhaust Y pipe remained securely attached to the engine, and the muffler remained securely attached to the exhaust Y and its other mounting hardware. No exhaust system penetrations, cracks, or re-welds were observed. No obstructions were visible in the tailpipe. The muffler was shaken and rapped to listen for any loose internal parts (baffles); none were detected.

MEDICAL AND PATHOLOGICAL INFORMATION

Private Pilot (Right Seat)

The Ventura County Medical Examiner's Office, Ventura, California, performed an autopsy on the private pilot and determined that his cause of death was drowning. The FAA Bioaeronautical Research Sciences Laboratory, Oklahoma City, Oklahoma, conducted forensic toxicology examinations on specimens from the pilot and detected two sedating antihistamines (chlorpheniramine and diphenhydramine) and one non-sedating antihistamine (loratadine).

Chlorpheniramine (generic and brand name Chlor-Trimeton®) and diphenhydramine (generic and several brand name products such as Benadryl®, Sominex®, Advil® PM) are over-the-counter antihistamines that also may be used as sleep aids. These medications may impair mental and/or physical ability required for the performance of potentially hazardous tasks such as flying. Chlorpheniramine has a long elimination half-life; therefore, FAA recommends a 5-day wait from the last dose before performing airman duties. Diphenhydramine can produce adverse side effects such as somnolence, decreased alertness, and impaired concentration, attention and memory, and the FAA recommends waiting at least 60 hours after the last dose before performing safety related duties.

Loratadine (generic and several brand names including Claritin®, Alavert®, Tavist® Non-Sedating) is an over-the-counter non-sedating antihistamine used to relieve the symptoms of hay fever and other allergies. According to the FAA, this medication is generally acceptable for pilots to use, provided they do not experience any drowsiness or other adverse side effects.

ORGANIZATION AND MANAGEMENT INFORMATION

SKFC was an incorporated non-profit flying club. This flying club structure enabled SKFC's members to fly its multiple airplanes, all of which were experimental. As part of their membership requirements, SKFC members paid initiation, monthly, and airplane usage fees.

ADDITIONAL INFORMATION

Flight Altitude and Glide Ratio

The FAA Airplane Flying Handbook (AFH, FAA-8083) defines glide ratio as "the distance the airplane will, with power off, travel forward in relation to the altitude it loses." According to airplane manufacturer information, the glide ratio of the airplane was about 5:1; thus it would travel 5,000 ft forward while descending 1,000 ft. At the 300 ft accident flight cruise altitude, the airplane would have had a maximum glide distance capability of about 1,500 ft. That distance would have increased with partial engine power.

Mission Preparedness

According to SKFC representatives, it was common for SKFC pilots on personal flights to fly just offshore along the coastline. SKFC did not have any requirements or provide any guidance, suggestions, or recommendations regarding aircraft occupants' clothing or safety/survival equipment, such as helmets or personal flotation devices (PFD). In the accident locale, the Pacific Ocean is relatively cold, even in the summer. In addition, large stretches of that coastline are rocky and/or bounded by cliffs.

Both occupants were wearing normal street clothes. Such clothing does not offer any flotation aid or thermal protection for water immersion, and can impede one's ability to remain afloat or swim/paddle through the water. Neither occupant wore a helmet. Neither occupant wore a PFD, and no PFDs were

carried or stored on the airplane. Neither the accident airplane nor any of the other SKFC airplanes were equipped to land on water, and none were equipped with any flotation augmentation devices for the occupants or the airplane in the event that a ditching was required.

Engine Installation Information

The Rotax Engine Installation Manual (IM) specified that, if possible, the engine-driven fuel pump (EDP) should be located below the fuel tank level. In contrast, the accident airplane's EDP was mounted above the top of the fuel tank.

The Rotax IM stated that "If the fuel tank is considerably lower than the engine an electric pump should be used," but the IM did not define "considerably." The top of the fuel tank was about 4 inches lower than the bottom of the engine. An electric fuel pump was installed on the airplane. It was mounted about 12 inches higher than the fuel tank outlet, and about 6 inches lower than the EDP. The electric pump manufacturer's specification cited an "average wet lift" of 12 inches. "Wet lift" is the distance below the pump that the pump can draw fluid from; a wet lift of 12 inches indicates that the pump can pull fluid from a source 12 inches below the pump.

The IM stated that the electric pump is to be plumbed in parallel with the EDP and that a series connection would yield "excessive" fuel pressure. In contrast, the electric pump was plumbed in series on the accident airplane. The IM specified an allowable carburetor inlet fuel pressure range of 3 to 7 psi. The installed electric pump had a listed output pressure range of 3.0 to 4.5 psi, but no performance specifications for the EDP were able to be located. Therefore, the actual carburetor inlet fuel pressure range could not be determined.

The IM stated that the electric pump must allow fuel to flow freely through the pump, even when the pump is switched off. The investigation was unable to determine whether the installed pump complied with this specification.

The IM specified the installation of a carburetor heat system, but the accident airplane was not equipped with a carburetor heat system.

Fuel Line Clamps

For the model engine installed in the airplane, Rotax specified the use of spring-type ring clamps (PN 938 195) for almost all junctions of flexible fuel lines to other components. The only exceptions were for the two end junctions on the "T-piece" between the fuel tank and the engine primer plunger; those two junctions were to be secured with gear-type worm clamps (PN 951 898).

An examination report prepared by Rotax concerning the airplane's 2013 accident stated that "the fuel lines between the fuel tank and fuel pump…were secured with non Rotax approved gear-type worm clamps…These clamps do not tighten uniformly and could cause air to leak into the fuel system especially when there are multiple connecting joints." That report recommended the replacement of those gear-type worm clamps with the Rotax-specified spring-type ring clamps (PN 938 195). The 2013 accident engine was a Rotax 503-series, which is similar to the Rotax 582-series engine installed on the airplane at the time of this accident. The fuel system plumbing for the 503 is similar to that for the 582, and the fuel line clamp schemes and part numbers are identical for the two engine models. During the

July 2017 examination of the wreckage, all flexible fuel line to component junctions were observed to be secured by gear-type worm clamps, instead of the Rotax-specified spring-type ring clamps.

The SKFC personnel did not initially explain why the incorrect gear-type worm clamps had not been replaced with the correct spring-type ring clamps after the 2013 accident. However, in follow-up communications with the NTSB about the 2017 accident, the SKFC mechanic stated that when he was attaching a fuel line to the fuel filter, he found that the Rotax-approved gear-type worm clamp was "too thin in width and [had] too sharp a radius on the edge [such] that it actually cut into the existing, but quite flexible" fuel line. As noted earlier, Rotax specifies the use of spring-type ring clamps (not gear-type worm clamps) for attaching a fuel line to the fuel filter.

Illustrated Parts Catalog Omissions

Rotax provides a single document to serve as the Illustrated Parts Catalog (IPC) for Rotax engine series 447UL, 503UL, 582UL models 90 and 99, and 618UL. IPC diagram 9.6.2 depicted the typical installation configuration, which consisted of a single fuel tank, a plunger-type primer, and two carburetors. Review of the IPC fuel line clamping scheme revealed that the diagram and associated parts list were incomplete; neither the diagram nor the parts list included clamps for the lines between the fuel pump and the carburetors, for the line between the fuel tank and the fuel filter, or for the fuel pump end of the line from the primer T-piece, and no supplemental or explanatory notes addressed clamp usage for those junctions. The same (clampless) IPC diagram was duplicated in the Rotax IM as well. Discussions with Rotax representatives indicated that all those junctions were to be secured with the spring-type ring clamps.

Carburetor Sockets

Examination of the maintenance records indicated that the carburetor socket for the PTO carburetor was replaced 6 days before the accident by the SKFC mechanic. The SKFC representatives reported that that socket was replaced because it was cracked; that socket was originally installed during the 2015 overhaul. According to the airplane's "Flight Log," the next airplane/engine run (for 0.2 hours) occurred 4 days after the socket replacement, but it could not be determined whether the airplane was flown at that time. The next entry in the Flight Log was for the accident flight.

The maintenance records entry for the PTO carburetor socket replacement did not contain any information regarding an operational check of the new installation. Discussions with the mechanic and another SKFC member revealed that no operational check was conducted and that the newly-installed PTO socket was "not brand new."

The part number on the newly-installed PTO socket matched the part number specified by the Rotax IPC. Comparison of the PTO socket with the MAG socket indicated that the two were slightly different in diameter but of the same height and that the part number on the MAG socket did not match the Rotax-specified part number. The MAG socket did not bear any manufacturer identification, so no cross-check of applicability was able to be accomplished.

Pilot Information

Certificate:	Flight instructor; Private	**Age:**	56,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	None	**Restraint Used:**	4-point
Instrument Rating(s):	None	**Second Pilot Present:**	Yes
Instructor Rating(s):	Sport pilot	**Toxicology Performed:**	Yes
Medical Certification:	Sport pilot	**Last FAA Medical Exam:**	April 24, 2008
Occupational Pilot:	UNK	**Last Flight Review or Equivalent:**	
Flight Time:	377 hours (Total, all aircraft), 64 hours (Total, this make and model)		

Pilot Information

Certificate:	Sport Pilot	**Age:**	60,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	4-point
Instrument Rating(s):	None	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Sport pilot	**Last FAA Medical Exam:**	
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:			

Aircraft and Owner/Operator Information

Aircraft Make:	CHICCO MIGUEL E	**Registration:**	N2812
Model/Series:	QUICKSILVER SPORT II MXL-II	**Aircraft Category:**	Airplane
Year of Manufacture:	2007	**Amateur Built:**	
Airworthiness Certificate:	Experimental light sport (Special)	**Serial Number:**	0001763
Landing Gear Type:	Tricycle	**Seats:**	2
Date/Type of Last Inspection:	January 17, 2017 Condition	**Certified Max Gross Wt.:**	890 lbs
Time Since Last Inspection:	73 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	3184 Hrs at time of accident	**Engine Manufacturer:**	Rotax
ELT:	C91A installed	**Engine Model/Series:**	UL582 DCDI 99
Registered Owner:	On file	**Rated Power:**	65 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	NDT,13 ft msl	**Distance from Accident Site:**	3 Nautical Miles
Observation Time:	16:56 Local	**Direction from Accident Site:**	315°
Lowest Cloud Condition:	Few / 6500 ft AGL	**Visibility**	9 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	8 knots / None	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	260°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.8 inches Hg	**Temperature/Dew Point:**	25°C / 17°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Camarillo, CA (CMA)	**Type of Flight Plan Filed:**	None
Destination:	Camarillo, CA (CMA)	**Type of Clearance:**	None
Departure Time:	16:30 Local	**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	1 Fatal, 1 Minor	**Aircraft Damage:**	
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal, 1 Minor	**Latitude, Longitude:**	34.119167,-119.11972(est)

Administrative Information

Investigator In Charge (IIC):	Huhn, Michael
Additional Participating Persons:	Ray Martin; FAA; Van Nuys, CA
Original Publish Date:	May 9, 2018
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=95527