



National Transportation Safety Board Aviation Accident Final Report

Location:	SILOAM SPRINGS, AR	Accident Number:	FTW98FA186
Date & Time:	04/18/1998, 2030 CDT	Registration:	N996DT
Aircraft:	Foster/Hilsman Q2	Aircraft Damage:	Destroyed
Defining Event:		Injuries:	2 Fatal
Flight Conducted Under:	Part 91: General Aviation - Personal		

Analysis

The amateur-built experimental Quickie airplane, occupied by a commercial pilot and a pilot-rated passenger, who were the co-owners/builders of the airplane, impacted the ground in a steep left bank during a forced landing following a partial loss of engine power. Disassembly of the engine revealed that six cylinder head hold-down nuts were loose, and combustion gases had been leaking between the cylinder heads and the barrels of the #2, #3, and #4 cylinders. The escaping gases cut a passage about 3/4 inch in diameter through the #4 cylinder head, resulting in the partial loss of engine power. Maintenance records indicated new cylinder heads were installed 33 hours before the accident in May 1997. A condition inspection of the airplane, which would have included a cylinder compression check, was due in November 1997, but had not been performed. According to a family member, the two owners were in the process of performing a condition inspection on the day of the accident; however, neither owner held a repairman certificate for the airplane or was a certificated airframe and powerplant mechanic.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot's failure to maintain aircraft control during the forced landing. Factors were the failure of the #4 cylinder head which resulted in a partial loss of engine power and the co-owners/builders' failure to perform a condition inspection of the airplane, which would have detected the leaking cylinder heads prior to the failure of the #4 cylinder head.

Findings

Occurrence #1: LOSS OF ENGINE POWER(PARTIAL) - MECH FAILURE/MALF
Phase of Operation: CRUISE

Findings

1. ENGINE ASSEMBLY,CYLINDER - LOOSE
 2. ENGINE ASSEMBLY,CYLINDER - LEAK
 3. (F) MAINTENANCE,INSPECTION - NOT PERFORMED - OWNER/BUILDER
 4. (F) ENGINE ASSEMBLY,CYLINDER - FAILURE,TOTAL
-

Occurrence #2: FORCED LANDING
Phase of Operation: DESCENT - EMERGENCY

Occurrence #3: LOSS OF CONTROL - IN FLIGHT
Phase of Operation: DESCENT - EMERGENCY

Findings

5. (C) AIRCRAFT CONTROL - NOT MAINTAINED - PILOT IN COMMAND
-

Occurrence #4: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: DESCENT - UNCONTROLLED

Factual Information

HISTORY OF FLIGHT

On April 18, 1998, approximately 2030 central daylight time, a Foster/Hilsman Q2 amateur-built experimental airplane, N996DT, impacted terrain following a loss of control during a forced landing approximately 1/2 mile north of Smith Field Airport, Siloam Springs, Arkansas. The two occupants, a commercial pilot and a pilot-rated passenger, who were the co-owners and builders of the airplane, received fatal injuries. The airplane was destroyed. No flight plan was filed and visual meteorological conditions prevailed for the Title 14 CFR Part 91 local personal flight that originated from Smith Field about 2000.

According to family members, the two occupants were planning to sell the airplane and had gone to the airport on the day of the accident to prepare the airplane for showing to prospective buyers. Receipts dated April 18, 1998, for the purchase of oil, valve cover gaskets, and other items were found by family members in the commercial pilot's vehicle. During post-accident examination of the hangar where the airplane was kept, several empty 1-quart oil containers were found. Additionally, hand tools, cleaning supplies, and the airplane's maintenance logbooks were found on a bench at the back of the hangar.

A witness at the airport reported that approximately 1930, the commercial pilot borrowed a tire pressure gage from him and returned the gage "about 15 to 20 minutes later." Several witnesses at the airport observed the airplane takeoff on runway 36 and reported times for the takeoff varying from 1935 to 2030. One of the witnesses reported that the airplane took off "right at sunset," which, according to the U.S. Naval Observatory, occurred at 1954.

A witness saw and heard an airplane fly over his residence, located approximately 2 miles north-northwest of the accident site, about 1930 to 2000. The witness positively identified the airplane flying over as N996DT due to having previously seen it at the airport. According to the witness, the airplane was approximately 300 feet above the ground, headed west, and then made a "tight" left turn toward the south. He stated that the airplane's engine did not sound like it was running at full power and estimated that it was operating at 60 to 75 percent power. He further stated that the engine was running smoothly and was not missing.

Another witness, who was inside her residence, approximately 7 miles northeast of the accident site, reported hearing an airplane fly over about 2030. She stated that the airplane's engine was "cutting out, spitting and sputtering." The witness went outside, but did not see the airplane.

Approximately 2050, a Siloam Springs police officer, noticed "a flashing light in the sky," which he estimated to be located "just south" of the airport. The sighting of the light led the officer to go to the airport and "check the activity." Upon arriving at the airport, he observed that the runway lights, which are pilot activated, were not on. He also observed a pickup truck parked next to the hangar where the airplane was kept and noted that the hangar was open, the lights were on, and no one was around the hangar.

There were no reported witnesses to the accident. When concerned family members reported the airplane missing, a search was initiated, and the wreckage was located approximately 0800 on April 19, 1998.

PERSONNEL INFORMATION

Testing of blood samples from the airplane seat belts, performed by the Arkansas State Crime Laboratory, Little Rock, Arkansas, determined that the commercial pilot was occupying the left seat. He held a commercial pilot certificate issued on March 20, 1983, with helicopter, single engine land airplane, and instrument airplane ratings. On the application for his most recent medical certificate, dated August 15, 1996, he reported a total flight time of 950 hours. Review of his current logbook indicated he began flying N996DT on November 10, 1996, and as of April 12, 1998, had logged a total of 77 hours in the airplane. According to the logbook, in the 30, 60 and 90 days before the accident, he flew the airplane 2, 4 and 7 hours, respectively. His last biennial flight review was completed on September 17, 1996, in a Cessna 172.

The passenger, who occupied the right seat, held a private pilot certificate issued on October 29, 1990, with a single engine land airplane rating. On the application for his most recent medical certificate dated August 13, 1996, he reported a total flight time of 70 hours. Review of his logbook indicated he had logged a total flight time of 76 hours of which 4 hours were in N996DT. He had logged flights in N996DT on February 12, August 23, August 25, and October 6, 1997. According to the logbook, he had not flown in the 90 days before the accident. His last biennial flight review was completed on September 1, 1996, in a Cessna 150.

According to FAA records, neither occupant held a repairman certificate for N996DT or was an FAA certificated mechanic with airframe and powerplant ratings.

AIRCRAFT INFORMATION

The canard equipped, two place, composite construction "Quickie" airplane was powered by a 75 horsepower Revmaster model 2100-D engine. Primary cockpit flight controls consisted of a single central control stick operable from either seat and a single set of rudder pedals for the left seat occupant. The airplane was not equipped with gyro instruments, instrument panel lights, or a landing light. Wingtip mounted navigation and strobe lights were installed.

An aircraft registration certificate for N996DT, showing the two occupants as the manufacturers and co-owners of the airplane, was issued by the FAA on October 2, 1996. A Designated Airworthiness Representative (DAR) issued an experimental airworthiness certificate and operating limitations for the airplane on November 6, 1996.

The operating limitations indicated that the airplane's initial 40 hours of test flights were to be conducted within the flight test area of "Washington and Benton Counties Northwest Arkansas." The limitations further indicated that following completion of the initial 40 hours of flight, an entry was to be placed in the airplane's logbook by the test pilot stating the following: "I certify that the prescribed flight test hours have been completed and the aircraft is controllable throughout its range of speeds and throughout all maneuvers to be executed, has no hazardous operating characteristics or design features, and is safe for operation."

After the initial 40 hours of flight were completed, the operating limitations allowed flights outside the flight test area. The list of limitations applicable to flights outside of the flight test area included three items regarding condition inspections:

8. No person shall operate this aircraft unless within the preceding 12 calendar months it has had a condition inspection performed in accordance with FAR Part Part 43, appendix D, and has been found to be in a condition for safe operation. In addition, this inspection shall be recorded in accordance with limitation 10 listed below.

9. The builder of this aircraft, if certificated as a repairman, FAA certified mechanic

holding an Airframe and Powerplant rating and/or appropriately rated repair stations may perform condition inspections in accordance with FAR Part 43, appendix D.

10. Condition inspections shall be recorded in the aircraft maintenance records showing the following or a similarly worded statement:

"I certify that this aircraft has been inspected on (insert date) in accordance with the scope and detail of appendix D of Part 43 and found to be in a condition for safe operation."

The entry will include the aircraft total time-in-service, the name, signature, and certificate type and number of the person performing the inspection.

Review of the commercial pilot's logbook revealed that as of February 2, 1997, he had flown the airplane 40 hours. The logbook further indicated that he flew the airplane outside the flight test area on June 14, 1997, to Butler, Missouri, and on August 30, 1997, to Ottawa, Kansas.

Review of the airplane's maintenance records by the NTSB investigator-in-charge (IIC) revealed no entries reflecting completion of the flight test period or the performance of a condition inspection. In a letter to the IIC, a family member stated that she thought that on the day of the accident the two occupants were "in the process of" performing a condition inspection on the airplane.

The maintenance records indicated that on May 3, 1997, at a total time of 53 hours, a new pair of engine cylinder heads, new push rod tubes, and new spark plugs were installed. Impact damage to the hour meter in the airplane precluded determination of its reading at the time of the accident. An advertisement posted in the airport terminal building stated that the total time on the airplane was 86 hours. Based on this total time, the time since installation of the new cylinder heads was calculated at 33 hours.

WRECKAGE AND IMPACT INFORMATION

The accident site was located on uneven grassy terrain in a cow pasture approximately 1/2 statute mile north of the departure end of runway 36 and approximately 1/8 statute mile west of the extended runway centerline. A linear wreckage path extended for a distance of approximately 105 feet on a measured magnetic heading of 175 degrees from the first evidence of ground contact to the main wreckage.

The first evidence of ground contact consisted of two ground scars oriented parallel to the wreckage path. One of these ground scars contained fragments of the red navigation light lens which was mounted on the left main wingtip; this scar measured 1 foot long, 6 inches wide, and 8 inches deep. The other ground scar, which measured 2 feet long, 6 inches wide, and 8 inches deep, was located about 3 feet south and 2 feet west of the first scar and contained white paint chips and fragments of pink foam wing core material.

An oval crater measuring 5 feet long, 3 feet wide, and 1 foot deep was located approximately 13 feet south of the initial ground scars. An area of discolored grass, measuring approximately 50 feet long and 20 feet wide, extended from the crater on a measured magnetic heading of 210 degrees. Linear wood fragments from the airplane's propeller and pieces of fiberglass engine cowling were embedded in the crater. Wood propeller fragments were also embedded in two 3-foot-long parallel slash marks, spaced approximately 1.5 feet apart, that extended from the northeast edge of the crater on a measured magnetic heading of 050. Additional wood propeller fragments were found to the west of the main wreckage path, with the farthest piece

located approximately 120 feet west of the wreckage path centerline.

The Revmaster 2100-D engine separated from the fuselage and was located at the 26 foot mark of the wreckage path. The carburetor separated from the engine and was broken into two pieces. The larger piece consisted of the carburetor throat and throttle control arm, and the smaller piece consisted of the mixture control mechanism and arm. A mounting bracket for the throttle and mixture controls remained bolted to the smaller piece. The throttle control was separated into two sections, a section approximately 4 inches long, which remained attached to the throttle arm on the carburetor, and the majority of the control, which remained attached to the mounting bracket. The entire mixture control remained attached to the mounting bracket and the end of the cable remained attached to the mixture arm on the carburetor.

The wood propeller remained bolted to the crankshaft. One propeller blade was separated approximately 6 inches outboard from the hub, and the entire separation surface consisted of spanwise toothpick-sized splinters. The other blade was separated along a jagged surface angling from a point on the leading edge approximately 2 feet outboard from the hub to a point on the trailing edge approximately 1 foot outboard from the hub.

The right canard (forward wing) separated from the fuselage and was located at the 50 foot mark. The right main wing remained attached to the fuselage. The left canard separated from the fuselage and was located 17 feet west of the main wreckage. The left main wing separated from the fuselage and broke into two pieces. The outboard section of the left main wing was located abeam the 86 foot mark, 28 feet west of the centerline of the wreckage path. The inboard section of the left main wing was located abeam the 100 foot mark, 4 feet west of the wreckage path centerline.

The main wreckage, located at the 105 foot mark, consisted of the fuselage aft of the instrument panel bulkhead with the right aft wing attached, and the tail cone with the vertical stabilizer attached. The tail cone was broken away from the fuselage and remained attached only by the rudder control cables and electrical wires. The instrument panel and both the main and header fuel tanks were destroyed. The left seat lap belt/shoulder harness assembly was fastened, and both of the metal fittings used to attach the lap belt to the fuselage structure were separated. The right seat lap belt/shoulder harness assembly was not fastened, and both lap belt fittings were intact.

The right elevator separated from the right canard and was located at the 74 foot mark. The left elevator separated from the left canard and was broken into two pieces. The outboard section of the left elevator was located 8 feet west of the main wreckage, and the inboard section remained attached to the elevator control system and was located with the main wreckage. Examination of the elevator control system revealed that all bolted connections remained secure, and the separations found in the elevator control tubes displayed evidence of overload failure.

The right aileron remained attached to the right main wing. The left aileron separated from the left main wing, but remained attached to the aileron control system and was located with the main wreckage. Aileron control continuity was confirmed from both control surfaces to the single central control stick.

The rudder remained attached to the vertical stabilizer. Continuity was confirmed for the left rudder cable from the rudder horn to the left rudder pedal and for the right rudder cable from

the rudder horn to the shackle at the cockpit end of the cable. The right rudder pedal separated from the fuselage and was found under the engine.

On April 20, 1998, following completion of the on scene investigation, the airplane wreckage was released to a representative of the owners for removal to secure storage pending further examination.

MEDICAL AND PATHOLOGICAL INFORMATION

Autopsies on both occupants were performed by Daniel J. Konzelmann, M.D., Assistant Medical Examiner, at the Arkansas State Crime Laboratory in Little Rock, Arkansas. Toxicological tests on both occupants were performed by the FAA's Civil Aeromedical Institute (CAMI) in Oklahoma City, Oklahoma. The passenger's test results were negative for carbon monoxide, cyanide, ethanol, and drugs. The pilot's test results were negative for carbon monoxide, cyanide, and ethanol. Diphenhydramine, an antihistamine, was detected at 0.049 ug/g in the pilot's blood and 0.578 ug/g in the pilot's urine. Sedating antihistamines, such as diphenhydramine, are not approved by the FAA for use by pilots while flying.

TESTS AND RESEARCH

On June 30, 1998, the engine was partially disassembled under the supervision of the IIC at Smith Field Airport in the hangar where the airplane was secured. The following discrepancies were found:

1. The lower intake manifold had been modified from the original configuration. Larger diameter pipes were welded to the ends of the "T" which divides the fuel-air mixture flowing out of the carburetor into two streams, one for each cylinder head.
2. The clamp used to secure the housing of the mixture control cable to the bracket attached to the carburetor was large enough that the mixture control could be slid out of the clamp without loosening the nut holding the clamp.
3. All of the exhaust valve clearance adjustment screws were positioned so that the end of each screw was flush with the face of its respective rocker arm, resulting in the rocker arms, rather than the screws, making contact with the valve stems.
4. The nuts securing the intake pipes to the intake ports on both the right and left cylinder heads were tightened to less than the engine manufacturer's specification of 16 ft. lbs. torque. Both intake port gaskets were wet with 100LL aviation fuel, indicating that both gaskets had been leaking.
5. Two of the four lower hold-down nuts securing the left cylinder head (cylinders #1 and #2) were tightened to less than the engine manufacturer's specification of 18 ft. lbs. torque. Black deposits on the lower forward portion of the inward-facing surface of the cylinder head indicated combustion gases had been leaking between the head and the #2 cylinder barrel.
6. All four of the lower hold-down nuts securing the right cylinder head (cylinders #3 and #4) were tightened to less than the engine manufacturer's specification of 18 ft. lbs. torque. Black deposits on the lower portion of the inward-facing surface of the cylinder head indicated combustion gases had been leaking between the head and the barrels of both cylinders. A passage approximately 3/4 inches in diameter was eroded through the area of the cylinder head surrounding the #4 cylinder barrel at the 6 o'clock position. Additionally, a circular groove approximately .025 inches deep was cut into the cylinder head at the location where the

top of the #4 cylinder barrel contacted the head.

After the cylinder heads were removed from the engine, the crankshaft was rotated by hand and continuity was confirmed to all four pistons and to the magneto, which sparked at all terminals. No further disassembly of the engine was performed.

Examination of the Rev-Flow floatless carburetor revealed that when the mixture control mechanism separated from the body of the carburetor, the needle attached to the guillotine slide was bent aft approximately 90 degrees, trapping the slide in approximately a 50% open or partial power position.

ADDITIONAL INFORMATION

Appendix D of Title 14 CFR Part 43 lists the items to be checked during performance of an annual or 100 hour inspection. The items to be inspected on the engine include "studs and nuts - for improper torquing and obvious defects," "engine controls - for defects, improper travel, and improper safetying," and "internal engine - for cylinder compression." If weak cylinder compression is found, the engine is to be inspected "for improper internal condition and improper internal tolerances."

The two occupants possessed a manual published by the engine manufacturer which contained assembly, service and operating instructions. A section of the manual entitled "Torque Tension Loss of Cylinder Head Nuts" stated, in part:

Cylinder head nuts have been torqued to 18 ft. lbs. at 70 degrees F. When applied to the nut, this 18 ft. lbs. of torque will generate approximately 2000 lbs. of tension per stud ($8 \times 2000 = 16,000$ lbs. of clamping force per cylinder head or 8000 lbs. per cylinder).

The 8000 lbs. of force is impinged upon the sealing surface between the steel cylinder [barrel] and aluminum cylinder head. As the engine temperature rises, the cylinder and cylinder head expands creating more tension in the assembly. Also, the aluminum cylinder head begins to lose its strength as the temperature rises.

If the temperature becomes excessive the total clamping force accompanied by the reduction of cylinder head strength will cause a recess to form in the aluminum sealing surface. See Figure 1-A and 2-A.

This recess is a dimensional change in the structure allowing the cylinder head to move closer to the engine case, thus relaxing the clamping force when the engine cools back down to 70 degrees F. When relaxed the cylinder head nuts will become loose, particularly the lower row of long studs. If the situation is not corrected eventually the escaping high pressure gases will cut a channel through the cylinder head sealing area. See Figure 3.

Examination of the figures referenced in the text quoted above revealed that the damage to the cylinder heads shown in the figures was similar to the damage found to the right cylinder head on the accident airplane's engine.

The airplane wreckage was released to a representative of the owners on June 30, 1998.

Pilot Information

Certificate:	Commercial	Age:	55, Male
Airplane Rating(s):	Single-engine Land	Seat Occupied:	Left
Other Aircraft Rating(s):	Helicopter	Restraint Used:	Seatbelt, Shoulder harness
Instrument Rating(s):	Airplane	Second Pilot Present:	No
Instructor Rating(s):	None	Toxicology Performed:	Yes
Medical Certification:	Class 3 Valid Medical--no waivers/lim.	Last FAA Medical Exam:	08/29/1996
Occupational Pilot:		Last Flight Review or Equivalent:	
Flight Time:	1028 hours (Total, all aircraft), 77 hours (Total, this make and model), 7 hours (Last 90 days, all aircraft), 2 hours (Last 30 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Manufacturer:	Foster/Hilsman	Registration:	N996DT
Model/Series:	Q2 Q2	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	Yes
Airworthiness Certificate:	Experimental	Serial Number:	2365
Landing Gear Type:	Tricycle	Seats:	2
Date/Type of Last Inspection:	Unknown	Certified Max Gross Wt.:	1100 lbs
Time Since Last Inspection:		Engines:	1 Reciprocating
Airframe Total Time:	86 Hours	Engine Manufacturer:	Revmaster
ELT:	Installed, activated, did not aid in locating accident	Engine Model/Series:	2100-D
Registered Owner:	D.T. FOSTER & D.L. HILSMAN	Rated Power:	75 hp
Operator:	D.T. FOSTER & D.L. HILSMAN	Operating Certificate(s) Held:	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	Condition of Light:	Dusk
Observation Facility, Elevation:	FYV, 1251 ft msl	Observation Time:	1953 CDT
Distance from Accident Site:	19 Nautical Miles	Direction from Accident Site:	120°
Lowest Cloud Condition:	Clear / 0 ft agl	Temperature/Dew Point:	14° C / 4° C
Lowest Ceiling:	None / 0 ft agl	Visibility	10 Miles
Wind Speed/Gusts, Direction:	Calm	Visibility (RVR):	0 ft
Altimeter Setting:	30 inches Hg	Visibility (RVV):	0 Miles
Precipitation and Obscuration:			
Departure Point:	(SLG)	Type of Flight Plan Filed:	None
Destination:		Type of Clearance:	None
Departure Time:	2000 CDT	Type of Airspace:	Class G

Airport Information

Airport:	SMITH FIELD (SLG)	Runway Surface Type:	
Airport Elevation:	1193 ft	Runway Surface Condition:	
Runway Used:	0	IFR Approach:	None
Runway Length/Width:		VFR Approach/Landing:	Forced Landing

Wreckage and Impact Information

Crew Injuries:	2 Fatal	Aircraft Damage:	Destroyed
Passenger Injuries:	N/A	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	2 Fatal	Latitude, Longitude:	

Administrative Information

Investigator In Charge (IIC):	GEORGIA R SNYDER	Adopted Date:	10/24/2000
Additional Participating Persons:	BUDDY M KOELLNER; LITTLE ROCK, AR JOSEPH S HORVATH; HESPERIA, CA		
Publish Date:			
Investigation Docket:	NTSB accident and incident docket serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at pubinq@ntsb.gov , or at 800-877-6799. Dockets released after this date are available at http://dms.nts.gov/pubdms/ .		

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