

AA2009-10

**AIRCRAFT ACCIDENT
INVESTIGATION REPORT**

**FIRST FLYING CO., LTD.
J A 3 7 2 1**

November 27, 2009

Japan Transport Safety Board

The investigation for this report was conducted by the Japan Transport Safety Board, JTSB, about the aircraft accident of First-Flying Co., Ltd, Cessna TU206F registration JA3721 in accordance with the act for the Establishment of the Japan Transport Safety Board and Annex 13 to the Convention on the International Civil Aviation for the purpose of determining causes of the aircraft accident and contributing to the prevention of accidents/incidents and not for the purpose of blaming responsibility of the accident.

This English version of this report has been published and translated by the JTSB to make its reading easier for English speaking people who are not familiar with Japanese. Although efforts are made to translate as accurately as possible, only the Japanese version is authentic. If there is any difference in the meaning of the texts between the Japanese and English versions, the text in the Japanese version prevails.

Norihiro Goto,
Chairman,
Japan Transport Safety Board

AIRCRAFT ACCIDENT INVESTIGATION REPORT

FIRST FLYING CO., LTD.
CESSNA TU206F, JA3721
SHIKI-CHO, YAO CITY, OSAKA PREFECTURE, JAPAN
AT ABOUT 10:08 JST, AUGUST 19, 2008

November 6, 2009

Adopted by the Japan Transport Safety Board
(Aircraft Sub-committee)

Chairman	Norihiro Goto
Member	Yukio Kusuki
Member	Shinsuke Endo
Member	Noboru Toyooka
Member	Yuki Shuto
Member	Akiko Matsuo

1. PROCESS AND PROGRESS OF AIRCRAFT ACCIDENT INVESTIGATION

1.1 Summary of the Accident

On August 19 (Tuesday), 2008, a Cessna TU206F, registered as JA3721, operated by First Flying Co., Ltd., took off from Yao Airport for an aerial photography flight. On the return approach to Yao Airport after the photography sessions, the engine stalled and, at about 10:08 JST, the aircraft made a forced landing on a road in Shiki-cho, Yao City, Osaka Prefecture.

The Captain and one passenger were on board the aircraft, and the passenger sustained minor injuries.

The aircraft was destroyed, but there was no outbreak of fire.

1.2 Outline of the Accident Investigation

1.2.1 Investigation Organization

On August 19, 2008, the Aircraft and Railway Accidents Investigation Commission (ARAIC) designated an investigator-in-charge and another investigator for investigation of this accident.

1.2.2 Representative from Foreign State

An accredited representative of the United States of America, as the State of Design and Manufacture of the aircraft involved in this accident, participated in the investigation.

1.2.3 Implementation of the Investigation

August 19–22, 2008	On-site investigation, aircraft examination and interviews
September 3 and 4, 2008	Aircraft examination and interviews

1.2.4 Comments from Parties Relevant to the Cause of the Accident

Comments were invited from parties relevant to the cause of the accident.

1.2.5 Comments from the Participating State

Comments were invited from the participating State.

2. FACTUAL INFORMATION

2.1 History of the Flight

On August 19, 2008, the Cessna TU206F, registered as JA3721 (hereinafter referred to as “the Aircraft”), operated by First Flying Co., Ltd. (hereinafter referred to as “the Company”), was planned to depart from Yao Airport (hereinafter referred to as “the Airport”) with the Captain and one passenger on board for an aerial photography flight over Osaka and Mie Prefectures before returning to the Airport.

The flight plan for the Aircraft submitted to the Osaka Airport Office is outlined below.

Flight rules:	Visual flight rules (VFR)
Departure aerodrome:	Yao Airport
Estimated off-block time:	09:00 JST(Japan Standard Time, unless otherwise indicated, all time JST, UTC+9h)
Cruising speed:	115 kt
Cruising altitude:	VFR
Route:	Chihaya-Akasaka – Meiwa
Destination aerodrome:	Yao Airport
Total estimated elapsed time (EET):	4 h and 30 min
Purpose of flight:	Aerial photography
Fuel load expressed in endurance:	5 h
Persons on board:	2

The Aircraft took off from the Airport at 09:05. Statements about the history of the flight up to the time of the accident and other relevant matters as gathered from the interviews are outlined below.

(1) Captain

The purpose of the flight on that day was for an aerial photography flight over Osaka and Mie Prefectures. Before departure, my boss advised me that it would be better to turn on the auxiliary fuel pump ^{*1} during landing, as the Aircraft had experienced occasional engine stalls during the landing after throttling down the engine power.

After takeoff, we finished the part of our photography flight over Osaka Prefecture, but we had bad weather in Mie Prefecture where we planned to head next, so we decided to fly back to the Airport. At about 10:04, I contacted the Yao ATC at a point just west of the PL point (position reporting point), and then joined the traffic pattern for Runway 27 at an altitude of about 900 ft. Upon entering the base leg, I began a descent, pulling the throttle knob until the reading of the manifold pressure gauge agreed with the lowest point of the green arc (normal operating range), moving both the propeller knob and the mixture knob fully forward (to HIGH RPM and FULL RICH, respectively) and setting

^{*1} The auxiliary fuel pump has low and high flow rate modes. With the START switch (ON/OFF) in the “ON” position and the throttle knob at a position lower than the cruise power setting, the pump operates in the low flow rate mode. With the START switch in the “ON” position and the throttle knob exceeding the cruise power setting, or with the EMERG switch (HI/OFF) set to “HI”, the pump operates in the high flow rate mode. Holding the EMERG switch in the “HI” position automatically causes the START switch to trip to the “ON” position. When the EMERG switch is released, the inside spring automatically returns it to the original position.

the flaps to 20°. As advised by my boss, I set the START (yellow) switch for the auxiliary fuel pump to ON. During the final turn, I felt that the engine was not producing any power. When the Aircraft faced the runway squarely at about 500 ft, I pushed the throttle knob forward to increase power, but there was no increase in power, and I realized that the engine had stalled.

I concluded that we would not be able to make it to the Airport and started looking for a place to make a forced landing. There were only a few places that seemed appropriate for a forced landing. I first found a vacant lot ahead on the left side and I turned the nose toward it. While doing so, I tried to restart the engine by cycling the START switch of the auxiliary fuel pump and operating the throttle knob while setting the EMERG (red) switch to “HI”, but the engine never restarted. The vacant lot where I first headed turned out to be farther away than expected, so I turned the nose back toward the Airport. Right then, I found a wide road with light traffic just in front, which I thought would be the only choice left. Conditions were such that I could scarcely manage to push the Aircraft there.

The passenger escaped from the Aircraft as soon as it came to a stop. I smelled gasoline, so I set the master switch to OFF and escaped by the left door. Once outside, I saw fuel leaking from the Aircraft, so I asked a nearby car dealer for fire extinguishers that would be ready to use and then set the fuel selector valve to OFF. After that, I reported the forced landing to the Company and the Yao Airport Office.

The propeller continued turning throughout the flight. From the time when I noticed the engine stall to the time when I made the forced landing, I could not afford to make any ATC contacts to report the emergency conditions. In the course of the forced landing, I think the left wing touched some electric lines first. I did not operate the propeller knob and mixture knob after I had made their settings while flying the base leg. I did not feel anything unusual with the Aircraft at any point prior to the final turn.

Since I had previously experienced engine stalls with aircraft of the same-type series while taxiing on low power to the apron after landing, and also since my boss had advised me before departure about the use of the auxiliary fuel pump when the power was reduced during landing, I instantly thought of the occurrence of vapor lock ^{*2} when I noticed the engine stall up in the air. This led me to take the recovery actions for ensuring fuel supply. I used the auxiliary fuel pump prior to landing because I thought this would be effective in avoiding an engine stall, since I had previously experienced stalls immediately after landing.

(2) Passenger

When I was stowing the camera set as usual after deciding to cancel the photography job in Mie Prefecture and thus fly back to the Airport, the Captain instructed me to move to the front right seat, so I sat down there and fastened the seat belt. Even after moving to the front seat, I was looking back to check the condition of the camera set. It was not until I heard the Captain saying something that I saw a brown condominium building

^{*2} “Vapor lock” occurs when fuel is vaporized in the fuel lines, pumps and other fuel system components and the fuel in a vapor state blocks the flow of fuel.

just in front of us. I could not help closing my eyes until the aircraft had made its forced landing. Although I do not remember anything that would have occurred during the forced landing, I escaped earlier than the Captain as prompted by him. There was a smell of gasoline around. After getting out of the plane, I noticed blood oozing from my injured right arm.

(3) Eyewitness

I was working in front of my company warehouse past ten o'clock in the morning when the Aircraft, with no engine sounds, slowly passed just over me from east to west at a height slightly above the utility poles. Within a short time, the Aircraft hit its right wing on a utility pole near the car dealer, turned right as if pivoting on the pole and kind of softly fell down. During the Aircraft's fall, sparks flew out with a crackling sound, probably because the power lines had broken. I saw a man coming out from the right side of the Aircraft. I called out to my colleague in the warehouse, and he came out and took photos of the accident with his mobile phone. The time recorded on the photos was 10:09. I think it was about one minute after the accident that my colleague took the photos.

(4) Captain's Boss in the Flight Operations Department

During a recent flight on the Aircraft, I experienced its engine beginning to rotate roughly and ending up in a stall when I reduced the engine power on my way to the ramp after landing. When I verbally consulted the Maintenance Department on this matter, the person in charge told me that the department had already taken all possible countermeasures including raising the idle speed setting to the upper limit, and he suggested using the auxiliary fuel pump as a possible measure to be taken by the Flight Operations Department to help deal with the problem.

Adopting this suggestion, I advised the Captain before the departure of the Aircraft on that day to use the auxiliary fuel pump before landing to prevent the engine from stalling. The Captain confirmed this, saying, "The yellow switch, right?"

My advice to the Captain to use the auxiliary fuel pump before landing was based on my thinking that the use of the pump would be effective in dealing with rough engine operation at slow speed while on the ground, so I had envisioned a situation immediately before touchdown.

From my piloting experience with other aircraft types, I knew that the landing procedure for certain types of aircraft specified turning on the fuel system pumps. However, I did not particularly note the reason why it was not specified that the auxiliary fuel pump be turned on during landing for the Aircraft.

(5) Maintenance Engineer

Rough engine rotation after landing of the Aircraft and other aircrafts of the same-type series was a problem for which the Flight Operations Department had consulted with the Maintenance Department. The Maintenance Department had taken measures against the problem on all operating aircrafts in the fleet, including the replacement of engine-driven fuel pumps. As vapor lock was known to occur during hot seasons and immediately after flights when the cooling performance drops, the Maintenance

Department adjusted the engine speed setting for low-speed operation to the upper limit. Also, as the Maintenance Department understood that vapor lock occurred after landing, it suggested the use of the auxiliary fuel pump to the Flight Operations Department as a measure to prevent vapor lock.

The accident occurred at about 10:08 on a road about 900 m east of the approach-end threshold of Runway 27 of the Airport (34°35'44"N, 135°36'56"E).

(See Figure 1 – Estimated Flight Route, Figure 2 – Sketch of the Accident Site, Figure 3 – Fuel System, Photo – Accident Aircraft.)

2.2 Injuries to persons

The passenger sustained minor injuries.

2.3 Damage to the Aircraft

2.3.1 Extent of Damage

Destroyed

2.3.2 Damage to the Aircraft Components

- (1) Fuselage: Broken
- (2) Wings: Both wings broken off
- (3) Landing gears: Right main and nose landing gears broken
- (4) Engine: Damaged
- (5) Propeller: Damaged

2.4 Other Damage

Six power and communication lines (hereinafter referred to as “the Overhead lines”) running on the utility poles were broken, one utility pole had a scratch mark, a billboard was broken, a support pole for the billboard had scratch marks, two fences were broken, and some vehicles and several trees had scratch marks.

Due to the broken power lines, power was out until around 16:00 for ten of the households in the neighborhood.

2.5 Personnel Information

2.5.1 Captain Male, aged 34

Commercial Pilot Certificate (Airplane)

Type rating for single-engine aircraft (land)

December 24, 2003

Class 1 Aviation Medical Certificate

Term of validity

Until September 27, 2008

Total flight time

1,214 h 05 min

Flight time in the last 30 days

29 h 49 min

Total flight time on this type of aircraft	345 h 05 min
Flight time in the last 30 days	29 h 26 min

2.5.2 Pilot Appointments by the Company

The Captain was qualified as a commercial pilot after receiving pilot training at the Company on Cessna 172 series aircraft, and was subsequently hired as a pilot by the Company. His pilot appointments in the Company are as follows:

After receiving training and passing the qualification examination, he was appointed as a captain on Cessna 172 series aircraft for aerial work on January 31, 2005, and then as a captain on Cessna 172 series aircraft for air transport services on August 15, 2006. He subsequently received training for type transition to Cessna 206 series aircraft, and after passing the examination thereof, was appointed as a captain on Cessna 206 aircraft for both aerial work and air transport services on July 26, 2007.

2.6 Aircraft Information

2.6.1 Aircraft

Type	Cessna TU206F
Serial number	U20602485
Date of manufacture	November 29, 1974
Certificate of airworthiness	DAI-20-065
Term of validity	April 27, 2009
Category of airworthiness	Airplane Normal Category or Aircraft Category X
Total flight time	5,971 h 26 min
Time in service since last periodical check (100-hour check on August 15, 2008)	3 h 46 min
(See Figure 4 – Three Dimension Views of Cessna TU206F)	

2.6.2 Engine

Type	Continental TSIO-520-C
Serial number	178637-R
Date of manufacture	October 10, 2005
Total time in service	781 h 51 min
Time in service since last periodical check (100-hour check on August 15, 2008)	3 h 46 min

2.6.3 Weight and Balance

When the accident occurred, the Aircraft's weight is estimated to have been about 1,480 kg and the position of the center of gravity is estimated to have been 109.8 cm aft of the reference point, both of which are estimated to have been within the allowable limits (i.e., maximum landing weight of 1,633 kg and center-of-gravity range of 102.3–126.2 cm based on the estimated Aircraft weight at the time of the accident).

2.6.4 Fuel and Lubricating Oil

The Aircraft used the aviation gasoline 100 as the fuel and the AeroShell W SAE15W-50 as the lubricating oil.

Fuel was found to have leaked out from the Aircraft wreckage but there was fuel remaining in the Aircraft that contained no foreign substances and was about 136 liters (36 gal) in quantity. About 11 liters of lubricating oil remained in the Aircraft.

The Aircraft normally consumes fuel at a rate of about 14 gal/h; as calculated from the fuel load of about 300 liters (80 gal) before takeoff and the duration of the flight, the quantity of fuel on board at the time of the accident is estimated to be about 250 liters (66 gal).

2.7 Meteorological Information

The aviation routine weather report (METAR) for the Airport around the time of the accident was as follows:

10:00 Wind direction 250°; Wind velocity 8 kt; Wind variable between 210°-280°
Visibility 20 km
Cloud: Amount 1/8; Type Cumulus; Ceiling 2,500 ft
Amount 4/8; Type Cumulus; Ceiling 4,000 ft
Amount 6/8; Type Cumulus; Ceiling 8,000 ft
Temperature 33°C; Dew point 22°C; Altimeter setting (QNH) 29.69 inHg

2.8 Information on the Accident Site and Wreckage

2.8.1 Conditions at the Accident Site

The Aircraft was found resting stationary on National Route 170, about 900 m east of the approach-end threshold of Runway 27 of the Airport, with the nose pointing to the north.

The road on which the Aircraft made its emergency landing runs east-west with warehouses, workshops, a car dealer, apartment houses and other buildings in the vicinity. There are utility poles standing along both sides of the road. Six of the Overhead lines on the north side poles were broken, and the separated outer portion of the Aircraft's left wing was found entangled in the hanging electric lines.

A utility pole to the west of the broken Overhead lines had scratch mark at a height of about 3 m and the square support pole of a billboard about 1.2 m to the north of the utility pole had scratch mark at a height of about 2 m, respectively, and there were white and light-blue paint remainings on these scratch marks. The billboard was broken. Of the two fences located on the east and west sides of the utility pole, the east fence showed signs of being pushed toward the south from above and the west fence was damaged with separated portions of the right wing resting on it. Broken pieces of the airframe were found scattered all over the area.

2.8.2 Details of Damage to the Aircraft

The condition of the Aircraft is described below.

(1) Fuselage

The fuselage was bent to the right at a point near the main landing gear mountings and bent to the left at a point forward of the horizontal tail. The right bottom surface of the nose was dented and the exhaust pipe was broken. The left and right frames for the cockpit front windshield had broken off and fuel was found leaking from the fuel supply line running through the left frame.

(2) Wings

The outer portion of the left wing had broken off at the strut mounting. The outer wing portion was found lying on the ground, entangled in broken Overhead lines.

The right wing had broken off at its joint to the fuselage. The detached right wing had further split into portions at a point near the strut upper mounting and the leading edge of each split half had a square indent. Fuel was observed leaking from the vent.

(3) Tail

There were damages to the right horizontal tail structure, the vertical tail structure and the top end of the rudder.

(4) Landing gears

The gear spring of the right main landing gear was found bowed and the wheel was detached. The fork of the nose landing gear had broken off and the wheel was detached.

(5) Engine and propeller

The lubricating oil cooler was deformed and the No. 5 (right foremost) cylinder head and the right exhaust manifold were dented. One of the three propeller blades was bent aft at a point about 8 cm from the blade tip; the second blade showed an abnormally large pitch angle and was entirely bowed aft; and the third blade remained intact.

(6) Positions of the power controls

The propeller knob and the mixture knob were both in the foremost position, while the throttle knob was moved about 1 cm aft from the foremost position.

(7) Power system functions

The engine rotated normally when it was turned manually. All of the following were also found to be normal: the engine-driven fuel pump, auxiliary fuel pump, fuel filter, air filter, ignition system and engine controls.

2.9 Operation of the Aircraft

2.9.1 Publications Issued by the Manufacturer of the Aircraft and Their Approval by the State of Manufacture

The manufacturer of the Aircraft has issued an Owner's Manual (D1025-13) that covers the following items of content concerning operation of the Aircraft. The manual has not been approved by the State of Manufacture and is not subjected to updating control*³.

(1) OPERATING CHECKLIST

*³ The Aircraft is a 1974 model Cessna TU206. Instead of the Owner's Manual applied to this model, the Pilot Operating Handbook is applied to all Cessna TU206 aircraft beginning with the 1976 model. The Pilot Operating Manual is subject to updating control and the limitations included in the manual are required to be approved by the State of Manufacture.

- (2) DESCRIPTION AND OPERATING DETAILS
- (3) EMERGENCY PROCEDURES
- (4) OPERATING LIMITATIONS
- (5) CARE OF THE AIRPLANE
- (6) OPERATIONAL DATA
- (7) OPERATIONAL SYSTEMS

The State of Manufacture requires that the Aircraft be equipped with placards describing limitations and other relevant matters.

In 1985, the manufacturer of the Aircraft issued a Pilot Safety and Warning Supplement (D5099-13) for paid distribution to operators and distributors of its products, which lists safety and aircraft control information for pilots that has repeatedly been overlooked or forgotten. The Company obtained a copy of this publication. In 1998, the manufacturer issued a recompiled edition (D5139-13) of the publication, which the Company has not purchased, but there are no differences in effect between the two publications in terms of the auxiliary fuel pump that is discussed in 2.10.1 (2).

2.9.2 Flight Manual

In the Flight Manual that the applicant produced at the time of airworthiness certification for the Aircraft in Japan, the limitations and emergency procedure sections were given approval by the Osaka Regional Civil Aviation Bureau. The limitations section of the manual covers the placards of which installation is required by the State of Manufacture. As to the items concerning aircraft control, the manual covers only those that have been specified by the relevant Technical Circular Directives (TCD: equivalent to FAA AD) issued by JCAB (Japan Civil Aviation Bureau).

A translated Japanese version of the manufacturer-issued Owner's Manual (hereinafter referred to as "the Japanese Owner's Manual") was attached as a "reference" to the Flight Manual. The Japanese Owner's Manual was handed over to the Company by the former user of the Aircraft, and the Company started to use it as was.

2.9.3 Operation of the Aircraft by the Company

The Company has established the operating procedures of the Aircraft in the form of the Cessna TU206F Aircraft Operations Guideline (hereinafter referred to as "the Operations Guideline"), which is based on the Flight Manual and other relevant documents. Since the Flight Manual covers only the aircraft operation information specified by the relevant TCDs, the Company supplemented the Operations Guideline with descriptions concerning general aircraft operation procedures that were excerpted from the Japanese Owner's Manual.

2.9.4 Measures Taken by the Manufacturer against Vapor Lock

JCAB has issued a TCD (TCD-1777-79: equivalent to FAA AD 79-15-01) concerning the measures against vapor lock on aircraft of the same type as the Aircraft. The Company completed incorporation of the measures in the Aircraft.

The required measures consisted of installation of placards indicating the following contents and revision to the Flight Manual.

Placards:

“MAJOR FUEL FLOW FLUCTUATIONS/POWER SURGES”

1. *AUX FUEL PUMP ON ADJUST MIXTURE*
2. *SELECT OPPOSITE TANK*
3. *WHEN FUEL FLOW STEADY, RESUME NORMAL OPERATIONS SEE THE FLIGHT MANUAL FOR EXPANDED INSTRUCTIONS.*

Flight Manual: Addition to Chapter 3 Emergency Procedures

“FUEL FLOW STABILIZATION PROCEDURE”

If fuel flow fluctuations of 5 lbs./hr. -- 1 gal/hr. or more or power surges occur, the following procedures are recommended to eliminate vapor and stabilize fuel flow.

1. *Switch auxiliary fuel pump to “On” or “Hi” position (as applicable for your model).*
2. *Reset the mixture as required.*
3. *If symptoms of vapor continue, turn the fuel selector to the opposite tank.*
4. *The auxiliary fuel pump may be used as long as necessary to eliminate and avoid fuel vapor accumulation.*
5. *When fuel flow has remained steady for several minutes, the auxiliary fuel pump can be turned off and the mixture reset.*

Anytime after the fuel vapor is eliminated and the fuel flow stabilized, the other tank can be selected provided there is fuel in the tank.

NOTE

If the opposite tank cannot be used because of a lack of fuel, then retarding the throttle quickly to 10 inches or less of manifold pressure for 30 seconds will also aid in eliminating vapor in the system.

“IN-FLIGHT ENGINE RESTARTING PROCEDURES”

In the very unlikely event of power interruption due to fuel vapor accumulation, immediately perform the following procedures.

1. *Switch the auxiliary fuel pump to “On” or “Hi” position (as applicable for your model).*
2. *Turn fuel selector to the opposite tank.*
3. *Position throttle at least half open.*
4. *When the fuel flow is in the green arc range with a windmilling propeller, turn the auxiliary fuel pump off.*
5. *Lean the mixture from full rich until restart occurs.*
6. *Reset mixture.*
7. *Adjust power as required.*

The other tank may be used again any time after vapor is eliminated and fuel flow is stabilized.

The manufacturer issued Service Information Letter *⁴ No. SE79-25 (dated April 30, 1979) and related Supplement #1 (dated June 4, 1979) to inform aircraft users of the specific actions to take to prevent vapor lock. The letter and its supplement describes that fuel vapor indications are most likely to appear during climb and the first hour of cruise on each tank especially when operating at higher altitudes or in unusually warm temperatures.

2.10 Usage of the Auxiliary Fuel Pump

2.10.1 Usage of the Auxiliary Fuel Pump and Related Instructions in the Manufacturer-issued Documents

- (1) The Japanese Owner's Manual

The "Aircraft Control Checklists" describing normal procedures in the Japanese Owner's Manual contains an instruction to temporarily use the auxiliary fuel pump before engine start, but the before-landing checklist does not include, as shown below, any instructions to check that the auxiliary fuel pump switch is in the OFF position.

1-9 BEFORE LANDING.

(1) Fuel Selector -- Fuller tank.

(2) Mixture -- Rich.

(3) Propeller -- High RPM.

(4) Wing Flaps -- Down 0°– 10°(below 160 MPH), 10°– 40°(below 120 MPH).

(5) Airspeed -- 85 – 95 MPH (flaps retracted), 75 – 85 MPH (flaps extended).

NOTE: Use the faster of the MPH ranges under adverse air current conditions.

(6) Elevator Trim -- Adjust for landing.

The "Description and Operating Details" section of the Japanese Owner's Manual includes the following description regarding the auxiliary fuel pump.

2-1 Fuel system

(A) General

(Skipped)

Fuel from each wing tank flows through a fuel reservoir tank to the fuel selector valve. Depending upon the setting of the selector valve, fuel from the left or right tank flows through a by-pass in the electric auxiliary fuel pump (when it is not operating) and fuel strainer to the engine-driven fuel pump. From here fuel is distributed to the engine cylinders via a fuel control unit and manifold.

(Skipped)

(C) Auxiliary Fuel Pump Switch

The auxiliary fuel pump switch is a yellow and red split-rocker type switch. The

*⁴ The manufacturer's Service Information Letters are issued to notify users of improvements to products, changes to service information, and changes to aircraft operation information that are made for improvement of safety, reliability, durability and performance of the aircraft concerned. In January 1985, the title of the document was changed to Service Bulletin.

yellow right half of the switch is labeled “START”, and its upper “ON” position is used for normal starting and minor vapor purging during taxi. The red left half of the switch is labeled “EMERG”, and its upper “HI” position is used in the event of an engine-driven fuel pump failure during take-off or high power operation. The “HI” position may also be used for extreme vapor purging.

(Skipped)

When the engine-driven fuel pump is functioning and the auxiliary fuel pump is placed in the “ON” position, a fuel/air ratio considerably richer than best power is produced unless the mixture is leaned.

(Omitted)

(2) Pilot Safety and Warning Supplements

The Pilot Safety and Warning Supplements (D5099-13) that the Company had obtained include the following descriptions regarding the usage of the auxiliary fuel pump.

“FUEL PRESSURE SWITCH OPERATION – NORMAL AUXILIARY FUEL PUMP OPERATION”

(Skipped)

Usually, in the case of single-engine, high wing airplanes, gravity assists the fuel flow to the engine-driven fuel pump and pilots are cautioned that if the engine-driven fuel pump is functioning and the auxiliary fuel pump switch is other than off, an excessively rich fuel/air ratio is produced unless the mixture is leaned. Therefore, the auxiliary fuel pump switch should not be turned on during takeoff (unless takeoff fuel flow is slightly deficient) or during approach and landing. During cruise, the auxiliary fuel pump(s) may be used at any time to clear excessive fuel vapor, as evidenced by an unstable fuel flow indication; however, the auxiliary fuel pump(s) should be turned off prior to descent. Failure to turn off the auxiliary fuel pump(s) could cause a power failure at reduced throttle settings or with a rapid throttle advance due to an excessively rich mixture, especially if the throttle switch rigging or fuel pressure switch settings are out of tolerance.

(Omitted)

(See Figure 3 – Fuel System)

2.10.2 Usage of the Auxiliary Fuel Pump Specified by the Company

Chapter 5 “Normal Procedures” and Chapter 6 “Emergency Procedures” of the Operations Guideline contain the descriptions excerpted from the Flight Manual and the Japanese Owner’s Manual concerning the usage of the auxiliary fuel pump, which include the instructions on the use of the auxiliary fuel pump during engine start, when the engine-driven fuel pump fails, when the fuel flow rate fluctuates by more than 1 gal/h, when restarting the engine after an in-flight engine stall due to vapor lock, and in the event of fire on the ground. However, the before-landing checklist in Chapter 5 “Normal Procedures” of the Operations Guideline does not include any items for the

“Auxiliary fuel pump - - OFF” check. In addition, Chapter 10 “Systems and Equipment” of the Operations Guideline does not include the description “When ... the auxiliary fuel pump is placed in the “ON” position, a fuel/air ratio considerably richer than best power is produced unless the mixture is leaned”, which is included in the “Description and Operating Details” section of the Japanese Owner’s Manual.

2.10.3 Information Provided by the Manufacturer on Usage of the Auxiliary Fuel Pump

Regarding the technical inquiry placed to the manufacturer about the Captain’s control operations described in 2.1 (1), the manufacturer responded to the effect that it is considered probable that setting the auxiliary fuel pump to ON on the base leg caused flooding of the intake manifold with fuel.

2.11 Company’s System for Managing Information on Aircraft Problems and Other Special Events Experienced during Flights

The Company makes it a rule that aircraft problems and other special events experienced during flights are to be recorded by the Flight Operations Department in the aircraft logbook and also in the status entry space of the “Aircraft Status Report (Information Sharing Form)” and that the report is to be passed on to the Maintenance Department, which then records the conditions of the maintenance service it has performed in the action entry space of the report. The report is to be passed on to the Flight Operations Department, which then keeps a copy of each report in a file at the Operations Control Desk for information sharing.

However, there are neither records in the logbook nor entries in the Aircraft Status Report form about the event that occurred prior to the accident, in which the Aircraft, after landing, had shown symptoms of vapor lock during taxiing to the apron due to reduced speed and eventual drop in cooling performance of the engine compartment.

2.12 Other Relevant Information

The Pilot Operating Handbook issued by the manufacturer for the Cessna TU206G, which is the version developed from the TU206F and shares the same fuel flow control mechanism with the TU206F, includes the “Auxiliary fuel pump - - OFF” check for both the “Descent” and “Before-landing” checklists in the normal procedures. However, the Flight Manual for the Cessna TU206G aircraft used by the Company does not include this check item.

3. ANALYSIS

3.1 The Captain possessed a proper airman competence certificate and a valid aviation medical certificate.

3.2 The Aircraft had a valid airworthiness certificate and had been maintained and inspected as prescribed.

3.3 It is estimated that the prevailing meteorological conditions at the time of the accident did not contribute to the occurrence of the accident.

3.4 Conditions on the Approach to the Airport

3.4.1 Conditions of the Aircraft

The Captain did not feel anything abnormal with the Aircraft up until immediately before starting the final turn as indicated by his statement in 2.1 (1) and the power system had been functioning normally as described in 2.8.2 (7). It is therefore considered highly probable that, up until the auxiliary fuel pump switch was set to ON, the engine had been running normally, the throttle knob had been set to the low power position, the propeller knob had been set to the high speed position, the mixture knob had been set to the full-rich position, the propeller and engine had been turning and the engine-driven fuel pump had been delivering fuel normally.

3.4.2 Use of the Auxiliary Fuel Pump, Engine Stall, and Recovery Attempts

Under conditions in which the Aircraft's engine is running normally during an approach for landing, there is no need to take anti-vapor-lock actions and the auxiliary fuel pump should be left in the OFF state. However, it is considered highly probable that because the Captain set the auxiliary fuel pump switch to ON as suggested by his boss' advice and the fuel flow rate increased, therefore, the fuel/air ratio turned excessively rich as described in 2.10.1, preventing fuel from igniting and eventually causing the engine to stall.

It is considered probable that the advice from his boss immediately before departure would have given the Captain a hint that engine power might have been lost because of vapor lock, so the Captain attempted to increase the fuel flow rate by operating the auxiliary fuel pump switch and the throttle knob while keeping the mixture knob in the full rich position although the action that he should have taken was to operate the controls to discharge excessive fuel rather than to increase the fuel flow rate. It is also considered probable that there was not enough time left for the Captain to take recovery actions by discharging fuel before restarting the engine, which had stalled during the final approach in which the power had been reduced and the Aircraft had already descended to a low altitude.

3.4.3 Forced Landing Site

It is considered unavoidable that the Captain selected the wide road with light traffic that

he saw in front as the only site on which to land, due to the extremely limited area that the Aircraft in its final approach with a stalled engine could have reached from a height of about 500 ft.

3.5 Damage to the Aircraft

Based on the statements in 2.1 (1) and (3), the conditions of the damage to the Aircraft described in 2.8.2, and the conditions of the broken Overhead lines and the scratch marks on the utility pole and billboard support pole described in 2.8.1, it is considered probable that the Aircraft glided with a stalled engine, the left wing first hit the Overhead lines, the Aircraft banked to the right, and then it struck the utility pole with the right side of the fuselage and the root of the right wing. It is considered probable that the right wing broke off at the root, the fuselage broke and the right wing hit the billboard support pole in the middle and the outer half broke off. On the other hand, it is considered probable that the left wing cut the Overhead lines, became entangled in the broken lines and eventually broke off. It is considered highly probable that the propeller, which would have been wind-milling until then, stopped immediately after hitting objects on the ground as suggested by its damage conditions.

With regard to the breakage of the right main and nose landing gears and the dent of the engine's No. 5 cylinder and right exhaust pipe, it is considered highly probable that these were caused by the impact produced when the Aircraft, after hitting the utility pole, fell with the fuselage tilted to the right and hit the road surface and other objects.

3.6 Operating Criteria for the Aircraft

3.6.1 Operation of the Aircraft by the Company

As described in 2.10.1 (1), the Japanese Owner's Manual for the Aircraft describes how the use of the auxiliary fuel pump during normal operation of the engine-driven fuel pump produces an excessively rich fuel/air mixture. However, this description is not included in the Operations Guideline as described in 2.10.2. Furthermore, neither the Operations Guideline nor the Flight Manual, the documents the Company was using for operating the Aircraft, clearly states that the auxiliary fuel pump should be set to OFF before landing. It is therefore considered probable that it was rather difficult for the Captain, who received training at the Company, to be fully aware of the precautions regarding handling of the auxiliary fuel pump.

As described in 2.10.1 (2), the Pilot Safety and Warning Supplement that the Company owns clearly states that the auxiliary fuel pump should not be turned on during takeoff, approach or landing, but it is considered probable that this information had not been duly used. It is considered probable that the Company should have kept its staff fully aware of all information necessary or useful for safe aircraft operations and should also have controlled such information in a way that ensured its accessibility to the staff.

As described in 2.10.2, the Operations Guideline does not include any instructions for setting the auxiliary fuel pump switch to ON "before landing" as part of the normal procedures. However, when the statement in 2.1 is taken into account, it is considered highly probable that the Captain operated the switch as suggested by the advice from his boss. It is considered probable that the Company should have provided educational instruction so that any operations not specified in

the relevant manuals or other documents would not casually be performed during aircraft operations.

3.6.2 Sharing of Information about Aircraft Problems

As described in 2.1 (4) and (5), the person in charge at the Flight Operations Department made a verbal report to the Maintenance Department about the vapor lock events experienced on the Aircraft after its landing, and then received verbal answers from the Maintenance Department without keeping a record in the aircraft logbook or making entries in the Aircraft Status Reports as described in 2.11. It is highly probable that this absence of written records led to a perception gap between the Maintenance Department and the Captain's boss regarding the timing for using the auxiliary fuel pump, i.e., the Maintenance Department understood that the pump should be used during taxiing while the Captain's boss believed, based on his experience with other aircraft types, that the pump could also be used immediately before touchdown. In addition, it is highly probable that the verbal interchange of information between the Captain and his boss about the timing for using the auxiliary fuel pump also caused a perception gap, the boss having meant "immediately before touchdown" by his phrase "before landing," and the Captain having understood the phrase "before landing" as meaning "during the before-landing check."

As described above, it is highly probable that the perception gap about the timing for using the auxiliary fuel pump led the Captain to set the auxiliary fuel pump switch to ON while in flight. It is considered probable that the Company should have strictly enforced their rule of distributing and sharing failure information in writing, such as through the aircraft logbook and Aircraft Status Reports, not through verbal communication.

3.6.3 Owner's Manual

As described in 2.12, the Pilot Operating Handbook for the aircraft version developed from the same model as the Aircraft includes a procedural step for checking that the auxiliary fuel pump is in the OFF position before both the descent and landing phase as part of the normal procedures, clearly stating that the pump should be set to OFF during the final approach. It is considered probable that the pump would not have been used during the approach for landing had the Owner's Manual of the Aircraft included an instruction requiring the pilot to check the OFF state of the pump.

4. PROBABLE CAUSE

In this accident, it is considered highly probable that the Captain used the Aircraft's auxiliary fuel pump during the approach for landing, which produced an excessively rich fuel/air ratio and the eventual engine stall, and this forced the Captain to make an forced landing, during which the Aircraft was destroyed as it collided with objects on the ground.

With regard to the use of the auxiliary fuel pump by the Captain during the approach for landing, it is considered highly probable that the following factors contributed to this action: Safety information from the manufacturer had not been thoroughly distributed to the staff of the Company and this prevented the staff from fully understanding the correct use of the auxiliary fuel pump of the Aircraft; information on the problem that had previously occurred with the Aircraft was communicated only verbally and incorrectly; and a control operation not specified in the Operations Guideline was casually implemented.

5. OPINIONS

This accident involved a situation that the surrounding community would be worried, as the Aircraft on its approach to the Airport made a forced landing on a road in a crowdedly built-up area. In this accident, it is highly probable that the engine of the Aircraft stalled despite its all-normal functions because the Captain used the auxiliary fuel pump during the approach based on incorrect information on a problem that had previously occurred with the Aircraft although the manufacturer's safety information stated that the pump should not be used during approaches.

To prevent the recurrence of similar accidents, companies of small aircraft operating should notice that it is important that safety information from the manufacturer or other sources is distributed to all staff concerned and information on problems is thoroughly shared by the staff in an appropriate manner.

6. REFERENTIAL MATTERS

Following this accident, the Company took the following recurrence-prevention actions.

(1) Reinforcement of safety management system

The Company established a safety management manual and assigned two board members as supervising officers, one for the Flight Operations Department and the other for the Maintenance Department.

(2) Review of operation and maintenance related matters

Of the Operations Guideline for Cessna TU206 aircraft, the guideline for the TU206F has been revised by complementing it with the information that is missing in the Japanese Owner's Manual and the guideline for the TU206G has been revised by incorporating the amendments to the Flight Manual in it.

The pilot training and examination procedures have been revised to introduce newly established classroom sessions on the characteristics of aircraft into the type transition training.

The rule for managing the problem-related documents (the aircraft logbook and the Aircraft Status Report) used by the Flight Operations Department has been reinforced so that all matters that require maintenance actions must be recorded in these documents.

A new procedure has been established for processing those events that are reported by Aircraft Status Reports in order to ensure sharing of information on problems between the Maintenance Department and Flight Operations Department.

Figure 1 Estimated Flight Route

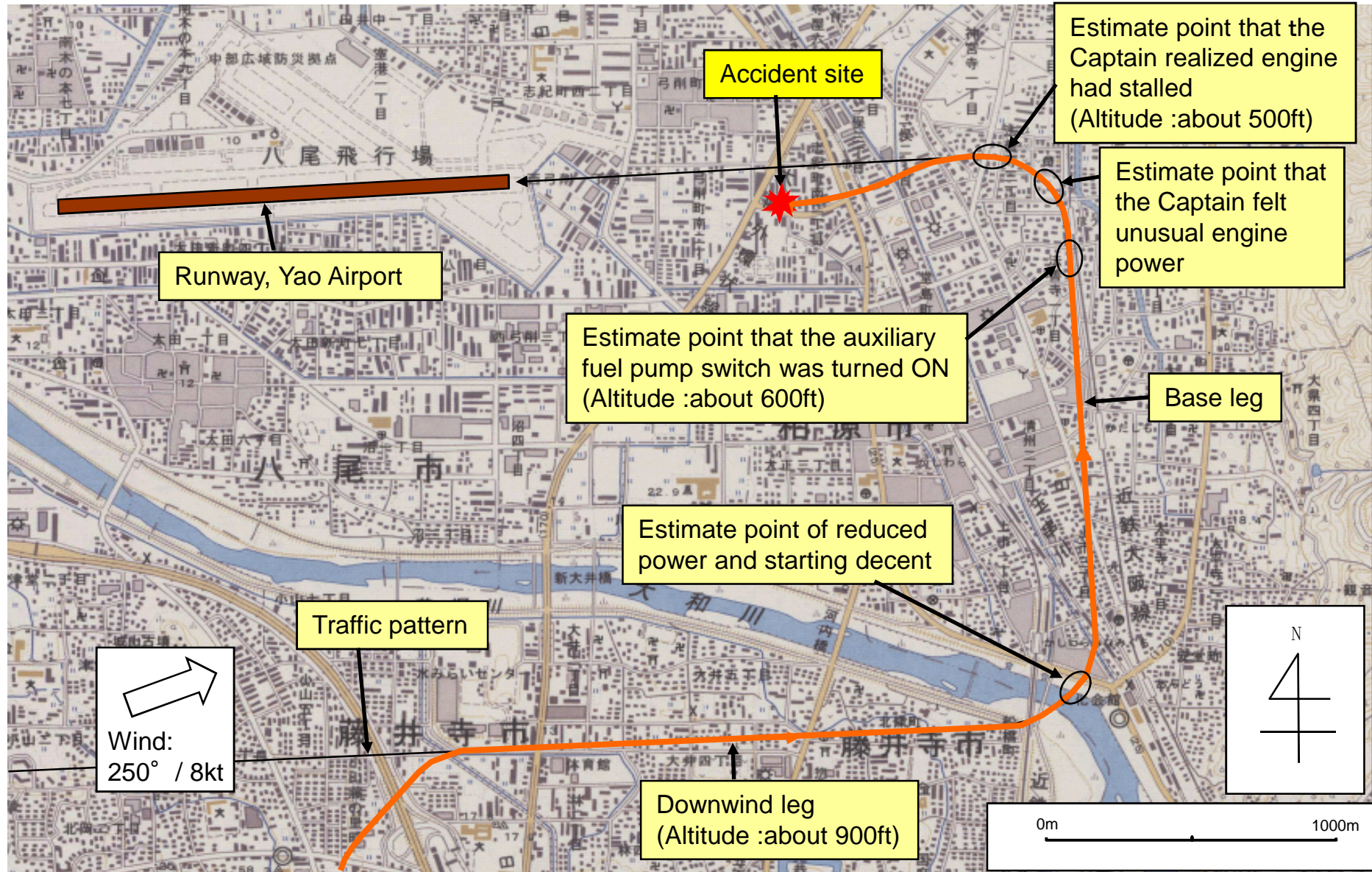
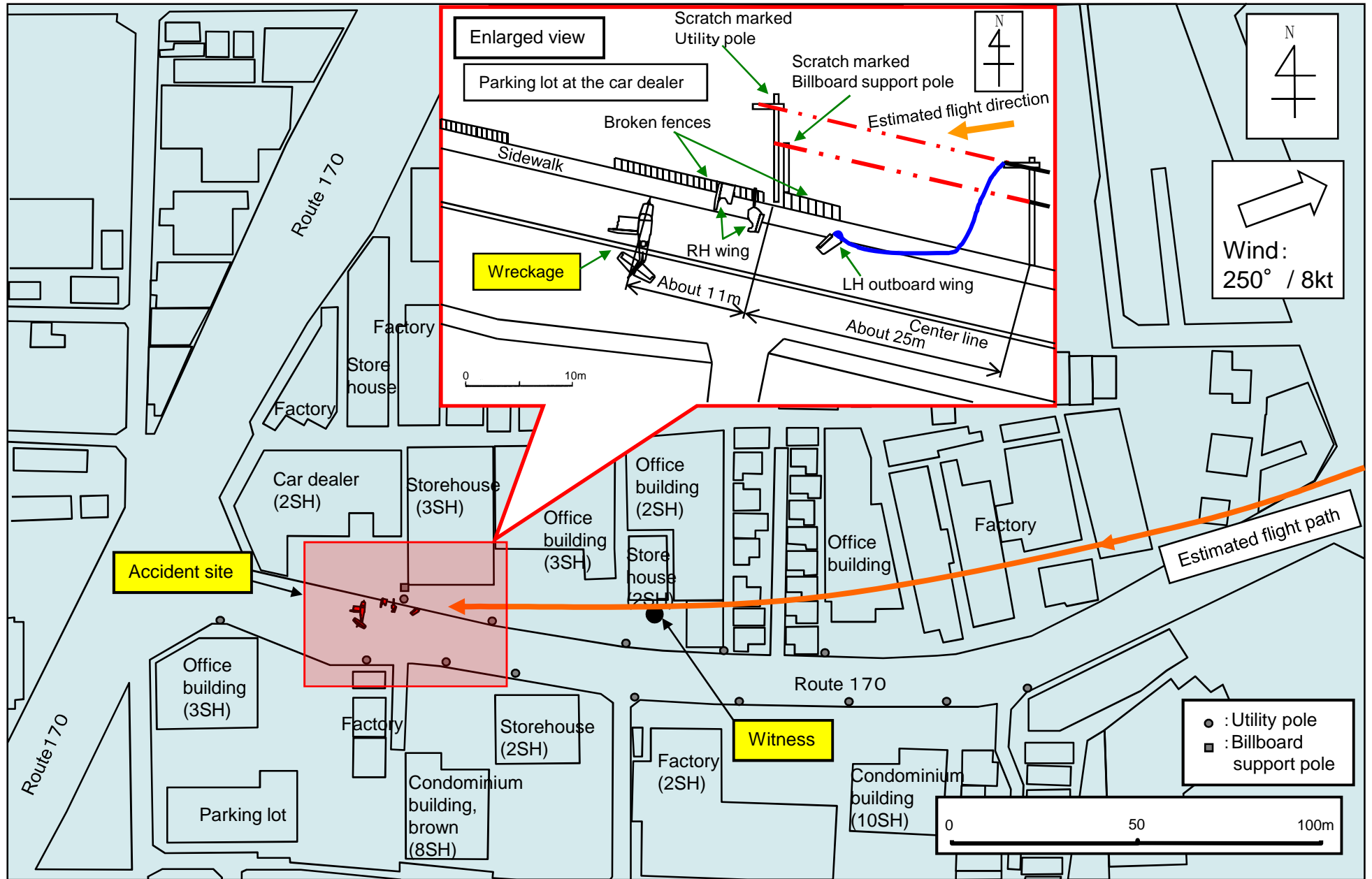


Figure 2 Sketch of The Accident Site



SH : Stories high

Figure 3 Fuel System

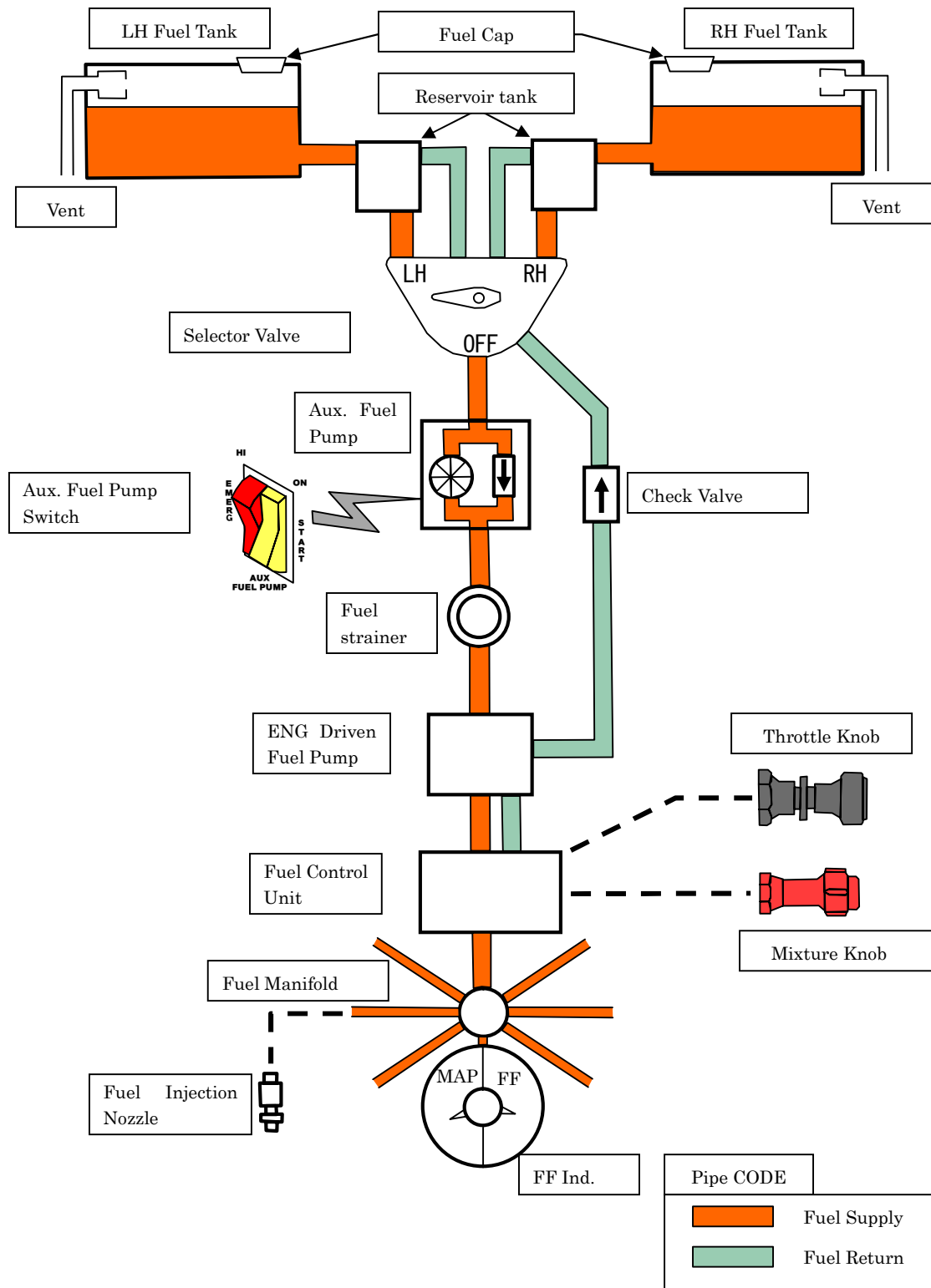


Figure 4 Three Dimension Views of Cessna TU206F

Unit : m

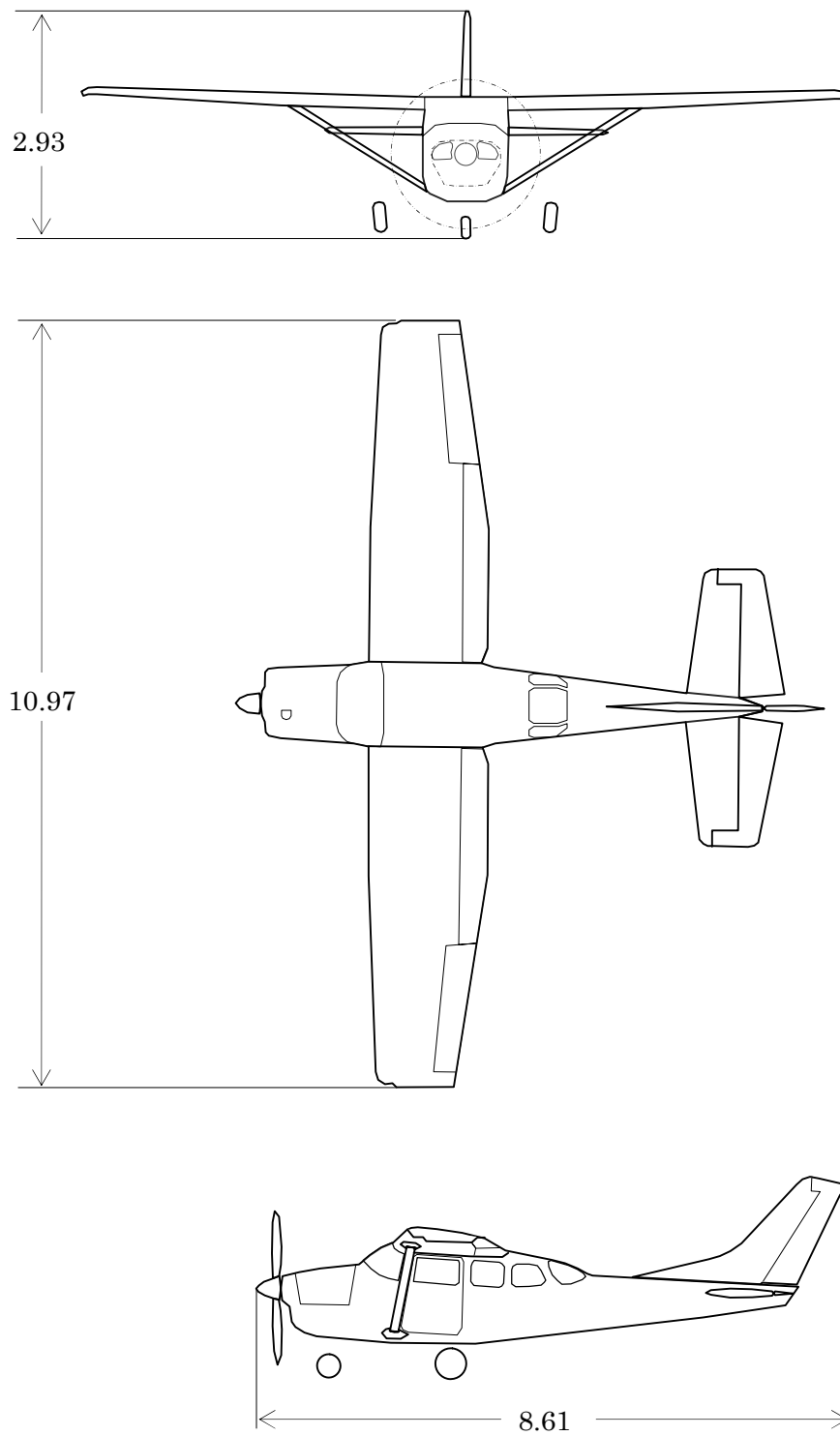


Photo Accident Aircraft

