AI2018-5

AIRCRAFT SERIOUS INCIDENT INVESTIGATION REPORT

PRIVATELY OWNED
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August 30, 2018

Japan Transport Safety Board

The objective of the investigation conducted by the Japan Transport Safety Board in accordance with the Act for Establishment of the Japan Transport Safety Board and with Annex 13 to the Convention on International Civil Aviation is to prevent future accidents and incidents. It is not the purpose of the investigation to apportion blame or liability.

Kazuhiro Nakahashi
Chairman
Japan Transport Safety Board

Note:

This report is a translation of the Japanese original investigation report. The text in Japanese shall prevail in the interpretation of the report.

AIRCRAFT SERIOUS INCIDENT INVESTIGATION REPORT

CONTINUOUS LOSS OF ENGINE POWER PRIVATELY OWNED BEECHCRAFT A36, JA3842, AT AN ALTITUDE OF ABOUT 300 M AND 4 KM NORTHWEST OF FUKUI AIRPORT AT ABOUT 15:36 JST, OCTOBER 15, 2017

July 27, 2018

Adopted by the Japan Transport Safety Board

Chairman Kazuhiro Nakahashi
Member Toru Miyashita
Member Toshiyuki Ishikawa
Member Yuichi Marui
Member Keiji Tanaka
Member Miwa Nakanishi

1. PROCESS AND PROGRESS OF THE INVESTIGATION

1.1 Summary of the Serious Incident	On Sunday, October 15, 2017, a privately owned Beechcraft A36, registered JA3842, made a forced landing and ditched in the river at about 15:36 (JST: UTC + 9hrs, unless otherwise stated all times are indicated in JST on a 24-hour clock) due to continuous loss of engine power while flying at an altitude of about 300 m about four km northwest of Fukui Airport.
1.2 Outline of the Serious Incident Investigation	This event falls under the case of "Continuous loss of engine power in flight" as stipulated in Item (vii), Article 166-4 of the Ordinance for Enforcement of Civil Aeronautics Act (Ordinance of Ministry of Transport No. 56 of 1952), and was classified as a serious incident. On October 15, 2017, the Japan Transport Safety Board (JSTB) designated an investigator-in-charge and an investigator to investigate this serious incident. Although this serious incident was notified to the United States of America, as the State of Design and Manufacture of the Aircraft involved in this serious incident, the State did not designate its accredited representative. Comments were invited from the parties relevant to the cause of the serious incident and the Relevant State.

2. FACTUAL INFORMATION

2.1 History of the Flight	 Photo 1: Serious Incident Aircraft According to the statements of the Pilot and the passengers who were on board the privately owned Beechcraft A36, registered JA3842, the records provided by the Civil Aviation Bureau, the records on a portable GPS receiver and the images and voices on a drive recorder for vehicles (hereinafter referred to as "the Recorder") installed in the Aircraft, the history of the flight is summarized as follows: On October 14, 2017, the Aircraft made a leisure flight for about one hour and 50 minutes from Fukui Airport to Shonai Airport, with the Pilot and other three passengers on board. At the time of departure from Fukui Airport, each right and left of the fuel tanks of the Aircraft was loaded with about 150 liters of fuel respectively which was the maximum allowable quantity, the total was about 300 liters fuel onboard. The Pilot expected that because he estimated the fuel consumption rate as about 60 liters per hour, there would be fuel remained for the Aircraft to be able to fly further for about three hours 10 minutes at the arrival of Shonai airport and no refueling would be required for the flight to Fukui airport on the next day. However, taking into account the weather conditions on the flight route and around Fukui Airport, which was confirmed before departure on the next day, October 15, the Pilot decided to refuel at Niigata Airport. At 13:10, the Aircraft took off from Shonai Airport, and at 13:43, arrived at Niigata Airport. While the Pilot was visiting the Niigata Airport Office, the Passenger A asked a refueler to refuel 40 liters into each right and left fuel tank respectively to be 80 liters in total. However, when supplying 36 liters of fuel in the left tank, the tank was fully filled. Therefore, the Passenger A asked the refueler to supply 44 liters in the right tank so that the total fuel quantity should be 80 liters in total. Although the Pilot had not confirmed visually the loading quantity of fuel during the exterior inspection, he expected the Aircraft would be able to fly for about five hours long with looking at the fuel quantity indicators. At 14:24, the Aircraft took off from Niigata Airport. As confirmed before departure, because there were a lot of clouds on the flight route and the Pilot was paying more attention to the avoidance of those clouds, the awareness for the fuel quantity indicators was reduced. The Pilot obtained information on the meteorological condition from the Fukui Remote Air-ground Communication Facility (hereinafter referred to as "the Fukui Remote") at about 18.5 km north of Fukui Airport as well as confirmed that the using runway was runway 36. The Pilot was going to switch the position of the fuel selector valve before landing when the Aircraft approached the traffic pattern.

The Pilot reported his position to the Fukui Remote at about 9.3 km north of Fukui Airport. Afterward, at 15:36:20 when the Aircraft was approaching the west traffic pattern for Runway 36 at an altitude of about 300 m with its landing gears extended, one of the passengers' voice notifying any abnormality on the engine was recorded in the Recorder. After this, the records on the Recorder had been done intermittently. At 15:36:31, the Pilot had switched the position of the fuel selector valve from the right tank to the left tank, however, the status of the engine did not improve.

Judging that it was impossible to make a landing at Fukui Airport, the Pilot conducted several operations for propeller lever, mixture lever and starter switch while looking for a possible forced landing site. During those operations, the Pilot did not use the auxiliary fuel pump. In addition, the Pilot had never switched the position of the fuel selector valve during the flight until the abnormality on the engine occurred.

Deciding to make a forced landing and ditch in the river, the Pilot lowered the flaps down to 15 degrees and retracted the landing gears. In addition, at 15:36:59, the Pilot notified the Fukui Remote that he was going to make a forced landing and ditch in the river. The propeller of the Aircraft had been rotating up to 15:37:07 when the Recorder stopped recording.

At 15:37:22 when the Recorder restarted recording, the propeller of the Aircraft had already stopped rotating. And then, at 15:37:46, the Aircraft made a forced landing and ditched in the river. After the forced landing to ditch in the river, all persons on board evacuated from the Aircraft by themselves and swam to the river bank.

The Pilot had never confirmed the emergency procedures provided in the Aircraft flight manual.

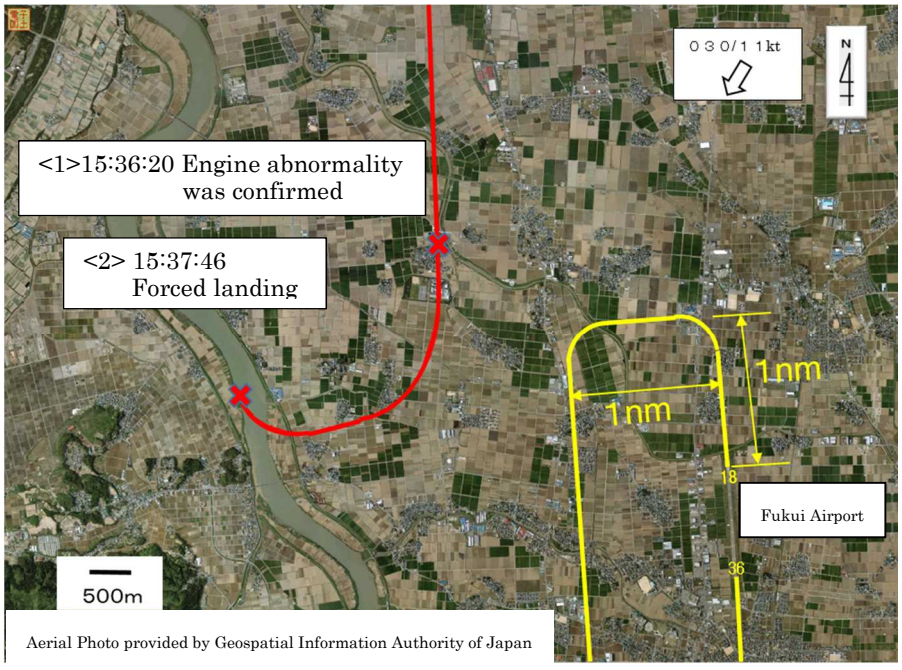

Photo 2 Estimated flight route based on records on the GPS
(<1> and <2> were what estimated based on records on the drive recorder for vehicles installed in the Aircraft.)

	The serious incident occurred at about 15:36 on October 15, 2017, at an altitude of about 300 m and about four km northwest of Fukui Airport (36°10' 18" N, 136°11'13" E).
2.2 Damage to the Aircraft	Extent of Damage to the Aircraft: Minor damage • The Aircraft: Submerged. • Nose landing gear door: Deformed • Right main landing gear: Detached
2.3 Personnel Information	(1) Pilot Male, Age 66 Private pilot certificate (Airplane) August 11, 2005 Pilot competence assessment Expiry of practicable period for flight March 8, 2018 Type of rating for single-piston engine (land) August 11, 2005 Class 2 aviation medical certificate Validity date: September 27, 2018 Total flight time 770 hours 24 minutes Flight time in the last 30 days 1 hour12 minutes Flight time on the same type of aircraft 60 hours18 minutes Flight time in the last 30 days 1 hour12 minutes
2.4 Aircraft Information	(1) Airplane Type: Beechcraft A36 Serial number: E-1566 Date of manufacture: August 17, 1979 Certificate of Airworthiness: No. DAI-2016-610 Validity date: February 1, 2018 Category of airworthiness: Airplane, Utility U Total flight time 3,673 hours 37 minutes (Records up to October 8, 2017) (2) Type of the engine Continental IO-520-BB (3) Weight and Balance When the serious incident occurred, the weight and the position of the center of gravity (CG) of the Aircraft were both estimated to have been within the allowable range.
2.5 Meteorological Information	The meteorological information in Fukui Airport provided by the Fukui Remote was as follows: Wind direction: 030°; Wind velocity: 11 kt; Temperature: 17°C; QNH: 30.23 inHg
2.6 Additional Information	(1) History of the Flight The history of the flight was recorded on a portable GPS receiver. And the images of scenery outside of the Aircraft, both radio communications and the voice in the cabin were recorded on the Recorder. The time data in the Recorder was calibrated by correlating the time signals in the communication records provided by the Civil Aviation Bureau with VHF radio transmission signal sound in the Recorder. (2) History of the Flight of the Aircraft on October 14 and October 15

The following shows the take-off / landing time of the Aircraft according to the records on October 14 and 15 provided by the Civil Aviation Bureau, the person in charge of flying and the selected position of fuel selector valve based on statements.

Table 1: History of the flight on October 14 and October 15

Date	October 14	October 15	October 15
Departure aerodrome	Fukui Airport	Shonai Airport	Niigata Airport
Person in charge of flying	Passenger A	Pilot	Pilot
Seating position	Left seat	Left seat	Left seat
Position of fuel selector valve	Right	Left	Right
Take-off time	14:29	13:10	14:24
Destination	Shonai Airport	Niigata Airport	Fukui Airport
Landing time	16:19	13:43	15:36[1]
Flight time	1 hour 50 minutes	0 hour 33 minutes	1 hour 12 minutes

(3)Condition of the Aircraft after Salvage

As the Aircraft had become submerged in water, the operation checks requiring energization were not able to be performed. However, in checking fuel system, engine, propeller, ignition system, and magnetos, there were no observed abnormalities with the engine other than some corrosion parts.

(4) Remaining Fuel after Salvage

The remaining fuel after salvaged the Aircraft from the river were about 1 liter in the right fuel tank and about 154 liters in the left tank. There was no evidence of water mixing in those tanks.

(5) Fuel systems of the Aircraft

<1> Fuel tanks

According to the flight manual, the Aircraft is equipped with a rubber fuel cell in each wing, which is capable of filling 40 gal (about 151 liters) of fuel (the amount of usable fuel: 37 gal (about 140 liters)).

[1] The time when the passengers noticed the abnormality in the engine.

<2> Fuel quantity indicators

The Aircraft is equipped with fuel quantity indicators corresponding to the right tank and the left tank respectively in the middle of the instrumental panel, and a fuel flow indicator just above the left fuel quantity indicator.

<3> Fuel Pumps

The Aircraft is equipped with an engine-driven main fuel pump and an electrically-driven auxiliary fuel pump.

(6) Confirmation of loading quantity of fuel

It is stipulated in Chapter 4 Normal procedures of the flight manual of the Aircraft, which states that the fuel level in each tank should be checked visually on the exterior check during the preflight inspection, and the amount of fuel should be also checked with fuel quantity indicators before starting the engine, other than in items (v) under paragraph (1), Article 164-14 of the Ordinance for Enforcement of Civil Aeronautics Act of Japan.

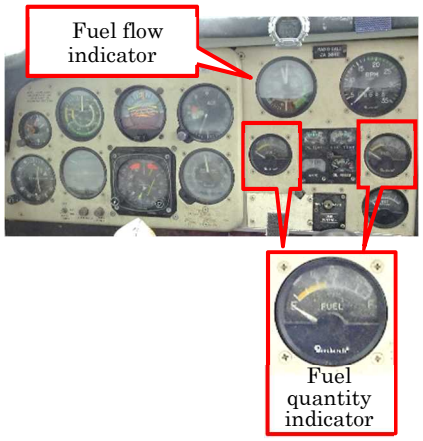

Photo 3 Instrument panel

(7) Fuel tank selection

The fuel selector valve handle, which is installed beneath the left foot of the left hand pilot seat, allows selection of fuel from the left tank, the right tank, and OFF (to stop the fuel feed from tanks). (Photo 4 indicates the state where the left fuel tank is selected.)

The following is stipulated in Chapter 2 Limitations of the flight manual of the Aircraft (excerpts):

WARNING - POSITION SELECTOR IN DETENTS ONLY - NO FUEL FLOW TO ENGINE BETWEEN DETENTS

In addition, at the investigation of the Aircraft, it had been selected the left fuel tank and in its detent position.

Besides, in Chapter 4 Normal procedures, the flight manual of the Aircraft, it is stipulated that the tank more nearly full should be selected before starting the engine, and the tank with more nearly full should be selected before landing.

Photo 4: Fuel selector valve handle

In addition, the Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25B) published by the Federal Aviation Administration (FAA), there is a description regarding the fuel selectors as below (excerpts):

Regardless of the type of fuel selector in use, fuel consumption should be monitored closely to ensure that a tank does not run completely out of fuel. Running a fuel tank dry does not only cause the engine to stop, but running for prolonged periods on one tank causes an unbalanced fuel load between tanks.

	Running a tank completely dry may allow air to enter the fuel system and cause vapor lock,[2] which makes it difficult to restart the engine. On fuel-injected engines, the fuel becomes so hot it vaporizes in the fuel line, not allowing fuel to reach the cylinders. (8) Fuel consumption The Pilot and Passenger A planned their flight as the fuel consumption rate of 60 liters per hour. According to the calculation based on the Aircraft's flight history and the refueling records provided by a refueling agent, an average fuel consumption rate over the past year was about 62.1 liters per hour. (9) Emergency procedures The flight manual of the Aircraft contains the following descriptions in Chapter 3 Emergency Procedure (excerpts): *2. Engine failure* *(4) ENGINE DISCREPANCY CHECKS* *CONDITION: ROUGH RUNNING ENGINE* *1. Mixture - FULL RICH, then LEAN as required* *2. Magneto/Start Switch - "BOTH" position (check to verify)* *CONDITION: LOSS OF ENGINE POWER* *1. Fuel flow gage - CHECK* *If fuel flow is abnormally low:* *a. Mixture - FULL RICH* *b. Auxiliary Fuel Pump - ON (then OFF if performance does not improve in a few moments)* *2. Fuel Quantity Indicator- CHECK for fuel supply in tank being used* *If tank being used is empty:* *Fuel Tank Selector Valve - SELECT OTHER FUEL TANK (feel for detent)*

3. ANALYSIS

3.1 Involvement of Weather	None
3.2 Involvement of Pilots	Yes
3.3 Involvement of Aircraft	None
3.4 Analysis of Findings	(1) Qualification for the Pilot The Pilot held a valid airman competence certificate and a valid aviation medical certificate. (2) Airworthiness certificate The Aircraft had a valid airworthiness certificate and had been maintained and inspected as prescribed.

[2] "Vapor lock" is a phenomenon that disrupts the fuel flow by generating gas bubble in the fuel supply system.

(3) Change on Fuel Loading Quantity and others

Estimating the fuel loading quantity and others of the Aircraft using the average fuel consumption rate of 62.1 liters per hour obtained from its flight history and refueling records are as follows:

The estimated values in Table 2 do not conflict with the fact that the fuel remained about one liter in the right tank and about 154 liters in the left tank of the Aircraft salvaged from the river.

Table 2: Change on Fuel Loading Quantity and others

(Estimated values)

		Fuel consumption (ℓ)	Left fuel tank (ℓ)		Right fuel tank(ℓ)	
			Loading quantity of fuel	Amount of fuel	Loading quantity of fuel	Amount of fuel
Fukui Airport	Take-off (14:29)	113.9	150		150	
Shonai Airport	Landing (16:19)		150	0	36.1	0
	Take-off (13:10)	34.2	150		36.1	
Niigata Airport	Landing (13:43)		115.8	36	36.1	44
	Take-off (14:24)	74.5	151.8		80.1	
At the time of occurrence of the serious incident (15:36)			151.8		5.6	

It is somewhat likely that because the fuel consumption shown in the table as above do not include those fuel to be required for start, run-up, taxi, and takeoff, the remaining fuel quantity could be less than those in Table 2.

(4) Confirmation of Loading Quantity of Fuel

It is probable that as shown in Table 2, the left fuel tank was fully loaded of fuel and the right fuel tank was loaded about 80 liters of fuel when refueling at Niigata Airport.

According to the flight manual of the Aircraft, before starting the engine, a pilot is required to select the fuel tank more nearly full by the fuel selector valve and confirm the fuel quantity with the fuel quantity indicators. However, it is probable that the Pilot selected the right fuel tank which is less amount of fuel without noticing the difference in the fuel quantity between the right and left fuel tanks.

It is also probable that the confirmation with fuel quantity indicators at this point is important to compare the fuel quantity confirmed visually on the exterior inspection and the one shown on each fuel quantity indicator, and confirm the function of fuel quantity indicators.

In addition, pilots should continuously monitor the fuel quantity indicators to grasp the remaining fuel in the tanks.

(5) Switching of Fuel Selector Valve

According to the flight manual of the Aircraft, the tank more nearly full is required to be selected by the fuel selector valve during normal procedures

	before landing. It is probable that while the Pilot, who was reducing the awareness for the fuel quantity indicators, was going to switch the fuel selector valve when the Aircraft approached the traffic pattern, the revolution of engine became unstable before switching the fuel selector valve. Pilot is given a discretion over when to conduct normal procedures, however, it is probable that when an aircraft approaches an airport, in addition to ATC communication and outside watch, judgments and operations required to pilot would increase. It is desirable that the specified procedures including switching the fuel selector valve should be completed well in advance of landing. (6) Loss of Engine Power It is probable that because the fuel quantity in the right fuel tank being selected significantly had reduced, the fuel had not been supplied to the engine, the engine rpm had decreased, and even after switching the position of its fuel selector valve, the situation was not improved and the state of loss of the engine power continued. Regarding the fuel quantity in the right fuel tank significantly reduced, it is probable that because the Pilot had not visually confirmed the fuel quantity during the exterior inspection, and the awareness for the fuel quantity indicators reduced during the flight, the right fuel tank continued to feed fuel, while the Pilot did not grasp the remaining quantity of fuel in the right tank. Besides, regarding the loss of the power continued and the engine stopped eventually even after switching the position of the fuel selector valve, it is somewhat likely that the following occurred. <1> Before the fuel selector valve switched, air had entered the fuel system, which caused vapor lock and prevented fuel supply. <2> Because the fuel in the right fuel tank had been kept supplying to the fuel-injected type of engine of the Aircraft, heated so much to vaporization that it became hard to reach the cylinders. In addition, it is somewhat likely that the situation as above might have been improved and the engine could have been fed, thus the engine failure could have been avoided, if the auxiliary fuel pump could have been used as described in emergency procedure of the flight manual. (7) Restart of the Engine It is probable that because the engine failure occurred at a low altitude, the response to the forced landing had been prioritized, the restart of the engine was not attempted.

4. PROBABLE CAUSES

In this serious incident, it is probable that because the fuel quantity in the right tank being selected had been significantly reduced, the fuel was not supplied and the engine rpm dropped, the situation was not improved even after switching the fuel selector valve, and the state of loss of the power went on.

Regarding the fuel quantity in the right fuel tank significantly reduced, it is probable that because the Pilot had not visually confirmed the fuel quantity during the exterior inspection, and the awareness for the fuel quantity indicators reduced during the flight, the right fuel tank continued to feed fuel, while the Pilot did not grasp the remaining quantity of fuel in the right tank.