

AI2012-2

**AIRCRAFT SERIOUS INCIDENT  
INVESTIGATION REPORT**

**KAWASAKI AIR Co., Ltd.**

**J A 3 8 1 8**

**March 30, 2012**

**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.

Norihiro Goto  
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

KAWASAKI AIR CO., LTD  
CESSNA TU206G, JA3818  
2,000 FT OVER THE BUILT-UP AREA  
2 KM SOUTHEAST OF YOKOTA AIRFIELD  
AT 14:12 LOCAL TIME, OCTOBER 23, 2010

February 24, 2012

Adopted by the Japan Transport Safety Board

Chairman	Norihiro Goto
Member	Shinsuke Endoh
Member	Toshiyuki Ishikawa
Member	Sadao Tamura
Member	Yuki Shuto
Member	Toshiaki Shinagawa

# **1. PROCESS AND PROGRESS OF THE INVESTIGATION**

## **1.1 Summary of the Serious Incident**

The occurrence covered by this report falls under the category of “Shortage of fuel requiring urgent measures” as stipulated in Clause 12, Article 166-(4) of the Ordinance for Enforcement of the Civil Aeronautics Act, and is classified as a serious incident.

On October 23 (Saturday), 2010, a Cessna TU206G operated by Kawasaki Air Co., Ltd. took off from Chofu Airfield at 09:05 local time\*<sup>1</sup> for aerial survey. After completing the survey near the river mouth of the Kurobe River it departed for its destination changing it from Niigata Airport to Chofu Airfield; however, it declared a state of emergency due to fuel starvation and landed at Yokota Airfield.

Two persons on board (the pilot in Command (PIC) and a cameraman) suffered no injuries. The airplane sustained no damage.

## **1.2 Outline of the Serious Incident Investigation**

### **1.2.1 Investigation Organization**

On October 24, 2010, the Japan Transport Safety Board (JTSA) designated an investigator-in-charge (IIC) and another investigator to investigate this serious incident. On October 29 another investigator was assigned for this investigation.

### **1.2.2 Representatives From Relevant State**

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

### **1.2.3 Implementation of the Investigation**

October 24, 2010	Site investigation and interview
October 28, 2010	Airplane examination
December 3, 2010	Interview
March 8, 2011	Interview

### **1.2.4 Comments from Parties Relevant to the Cause of the Serious Incident**

Comments were invited from parties relevant to the cause of this serious incident.

### **1.2.5 Comments from the Relevant State**

Comments on the draft report were invited from the relevant State.

---

\*<sup>1</sup> Japan Standard Time (JST). Unless otherwise stated all times are indicated in JST and on a 24-hour clock.

## 2. FACTUAL INFORMATION

### 2.1 History of the Flight

A Cessna 206G, registered JA3818, operated by Kawasaki Air Co., Ltd. (hereinafter referred to as “the Company”) took off from Chofu Airfield for aerial survey at 09:05, October 23, 2010.

The flight plan for the airplane is outlined as below.

Flight rules:	Visual flight rules (VFR)
Departure aerodrome:	Chofu Airfield
Cruising speed:	110 kt
Cruising altitude:	VFR
Route:	Kawagoe – Matsumoto – Kurobe – Niigata
Destination aerodrome:	Niigata Airport
Total estimated elapsed time:	5 hr
Fuel load expressed in endurance:	5 hr and 30 min
Persons on board:	2

#### 2.1.1 Events Generated From the ATC Communication Records and GPS Records Downloaded From the Survey Equipment

09:05	The airplane took off from Chofu Airfield.
09:15	The airplane left Iruma City, Saitama Prefecture and headed for Omachi City, Nagano Prefecture.
12:25	The airplane finished the aerial survey in the vicinity of Omachi City and headed for the river mouth of the Kurobe River.
13:17	The airplane finished the aerial survey in the vicinity of the Kurobe River and headed for Matsumoto Airport.
13:27	The PIC called Tokyo FSC* <sup>2</sup> and requested a destination change to Matsumoto Airport. The FSC called Matsumoto Airport Office and said that he had an airplane requesting a refueling stop there. The Office replied saying that all the ramp slots are booked that day. The FSC, receiving this reply, relayed the message to the airplane and asked its intentions.
13:33	The PIC replied that he would return to Chofu Airfield and changed its heading for Chofu at the point 47 kilometers north of Matsumoto Airport.
13:57	The PIC changed radio frequency to Yokota Airfield at the point 35 kilometers northwest of Chichibu City and established a radio contact with the airfield.
14:10	The PIC declared a state of emergency 4 kilometers northwest of Yokota

---

\*<sup>2</sup> FSC stands for Flight Service Center. It is one of organizations of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and is located at eight major airports in Japan. It provides necessary information for airplane operations.

- Airfield and requested a landing there.
- 14:11 The PIC changed his mind to land at Tachikawa Airfield and withdrawn his emergency declaration.
- 14:12 The PIC changed his mind again and declared a state of emergency again.
- 14:13 The airplane landed at Yokota Airfield.
- (See Figure 1: Estimated Flight Route, Attachment: Radio Communication Records)

### 2.1.2 History of Flight by Statements of PIC

The PIC came to his office at 08:00 and did preflight preparations such as weather check, filing a flight plan, and preflight inspection. The amount of fuel on board was about 86 gallons equivalent to endurance of 5 hours and 30 minutes.

The airplane took off from Chofu Airfield at 09:05 with its destination—Niigata Airport. It was scheduled to have aerial surveys in the vicinity of Iruma City, Saitama Prefecture, Omachi City, Nagano Prefecture, Kurobe River mouth, Toyama Prefecture and Niigata City before landing at the destination. Because of erroneous data input into the survey equipment for Iruma area, he skipped the area and headed for Omachi City. The survey took more than expected in Omachi area due to reentries of survey flight course. His plan at this time was: if the weather was favorable for the flight over the Kurobe River mouth he would cancel flight to Niigata Airport and land at Matsumoto Airport for refueling; if the survey near Kurobe River mouth was impossible, he would take a direct course to Niigata. He had no intention of landing at Toyama Airport because it has no available fuel service for the airplane.

Thanks to favorable weather over the Kurobe River mouth he did a survey flight and did not fly to Niigata Airport. At 13:30 he made a radio contact with Tokyo FSC and requested a destination change to Matsumoto Airport for refueling service there; however, his request was denied due to fully booked ramp slots. He confirmed the remaining fuel as follows: left tank, 16 to 17 gallons; right tank, almost empty. Considering the ground speed (GS) obtained from the onboard GPS aerial survey equipment, elapsed time and corresponding consumed fuel, and fuel flow indication, his calculation was that the airplane consumed fuel as planned so that he could fly for another hour. At that moment the distance to Niigata Airport or Chofu Airfield was almost the same. Calculation said it would take 45 minutes to either Chofu or Niigata. He chose to return to Chofu. He made a destination change to Chofu and extended estimated flight time to 5 hours 15 minutes. He decided to take a direct course at 9,500 feet.

The PIC made a radio contact with Yokota Airfield and requested a radar advisory service<sup>\*3</sup>. At about 14:00 when he was flying near Ohme City, engine run became unsteady due to fuel starvation so that he instinctively changed fuel selector from the left tank to the right tank and the symptom disappeared. At 14:05 the engine got the same symptom so he changed the selector from the right to the left but the symptom remained. He decided to make an emergency landing at Yokota Airfield and called the Advisory to declare a state of

---

<sup>\*3</sup> Radar Advisory Service is a service provided to an airplane with useful information or advice based on radar screen readouts.

emergency. He flew southward on the left downwind for runway 36. Fuel indication at this moment was: left tank about 10 gallons; right tank almost zero.

He felt engine condition recovered so that he withdrew the emergency landing and headed southeast for Tachikawa Airfield for landing. But the engine condition got worse somewhere between Yokota and Tachikawa Airfields, he made an emergency call to Yokota Advisory and made a final turn to runway 36 and landed. After the landing he was instructed to enter a taxi way. The engine stopped less than one minute after entering the taxi way.

The PIC was not allowed to check the quantity of remaining fuel by himself; military personnel did that with a fuel quantity measuring stick and both fuel tanks revealed empty. The fuel indications then were: left tank about 10 gallons; right tank almost zero. The PIC was instructed to move the airplane to the apron in front of a flying club hanger.

This serious incident occurred 2,000 feet above the built-up area (35° 33' 12" N, 139° 46' 52") about 2 kilometers southeast of Yokota Airfield at 14:12.

(See Photo 1: The Airplane, Photo 2: Fuel Quantity Indicator)

## 2.2 Flight Crew Information

PIC: Male, Age 57

Commercial Pilot Certificate (airplane)	September 7, 1975
Type rating for land-use single engine	December 3, 1974
Class 1 Aviation Medical Certificate	
Validity	Until April 17, 2011
Total flight time	10,015 hr 43 min
Flight time in the last 30 days	21 hr 40 min
Total flight time on the type of airplane	1,955 hr 39 min
Flight time in the last 30 days	21 hr 40 min

## 2.3 Airplane Information

### 2.3.1 Airplane

Type	Cessna TU206G
Serial number	U20604670
Date of manufacture	November 3, 1978
Certificate of airworthiness	Dai Tou-22-024 Go
Validity	Until April 15, 2011
Category of airworthiness	Airplane, Normal N or Special X
Total flight time	6,155 hr 50 min
Flight time since last periodical check	12 hr 15 min

(Six month period check on October 6, 2010)

(See Figure 2: Three Angle View of Cessna TU206G)

### 2.3.2 Engine

Type	Continental TSIO-520-M
------	------------------------

Serial number	283267-R
Date of manufacture	August 3, 1992
Total time in service	1,243 hr 58 min

### 2.3.3 Weight and Balance

When the serious incident occurred, the airplane's weight was estimated to have been 3,050 pounds and its center of gravity (CG) was estimated to have been 48.4 inches aft of datum line, both of which were estimated to have been within the allowable range (maximum takeoff weight of 3,600 pounds, and CG 42.5 to 49.7 inches corresponding to the weight of the airplane at the time of the serious incident).

## 2.4 Meteorological Information

The aerodrome routine meteorological reports (METAR) for Yokota Airfield close to the time of the serious incident were as follows:

13:55      Wind direction 070°, Wind velocity 3 kt, Visibility more than 10 km  
 Cloud: Amount FEW (1/8 - 2/8), Cloud base 18,000 ft  
 Temperature 18°C, Dew point 9°C  
 Altimeter setting (QNH) 30.25 inHg

## 2.5 Information on the Fuel and Lubricant

The fuel used in the airplane was aviation fuel 100. The lubricating oil was Exxon 20W-50 (MIL-L-22851D).

## 2.6 Study on Fuel Starvation and Fuel Quantity Indication

### 2.6.1 Fuel Starvation and Engine Competence

The IIC confirmed the both wing fuel tanks empty on the hanger in Yokota Airfield next day. When he turned on the battery switch, both fuel quantity indicators showed zero. Both fuel tank drain bolts were unscrewed and remaining fuel was collected amounting to be about 100 milliliter both tanks combined.

Then the wing tanks were filled with fuel: left tank, 6.9 gallons (about 26 liters); the right tank, 9.5 gallons (about 36 liters). The corresponding fuel indicator readings were more than 5 GALS for the left tank and a little less than 10 GALS for the right tank.

The engine was started per the normal procedures and engine run-up showed no anomalies.

### 2.6.2 Fuel Quantity Indication

In order to examine the fuel quantity indication the airplane was placed in level attitude per the instruction of the service manual of the manufacturer.

Fuel quantity is measured by two float-type fuel quantity transmitters. The picture here shows the fuel quantity indication of a filled-up fuel tank.





The Pilot's Operating Handbook stipulates the empty indication and unusable fuel quantity as follows:

*An empty tank is indicated by a red line and the letter E. When an indicator shows an empty tank, approximately 2.0 gallons remain in the tank as unusable fuel.*

When both drain bolts are unscrewed and tanks were emptied, the left tank indicator showed 5 GALs and the right tank indicator touched the red line.

Next, after filling 3 gallons of fuel, each amount of fuel shown here was added and each indication was recorded. The discrepancy between the usable fuel quantity and indication for usable fuel was largest for the left tank at 1 gallon and 12.5 gallons, as shown here.

Added amount	Total	Usable (Total - 2)	Indication	
			Left	Right
3	(2)	(0)	—	—
	3	1	5	1
11.5	14.5	12.5	17	13
11.5	26	24	25	23
11.5	37.5	35.5	35	35
8.5	46	44	F	F

The fuel quantity transmitters are not adjustable.

### 2.6.3 Record of Fuel Quantity Calibration

The Company did fuel gage calibration on April 2, 2010 just before airworthiness inspection and the result is shown here (its original table structure was converted to conform to the one shown in 2.6.2). This table shows that when the indicators show empty, the airplane has about 1 gallon of usable fuel in each tank.

Added amount		Total		Usable		Indication
				(Total - 2)		
Left	Right	Left	Right	Left	Right	Both
2.9	3	2.9	3	0.9	1	E
9.1	8.5	12	11.5	10	9.5	11.5
11	12	23	23.5	21	21.5	23
11.5	12.5	34.5	36	32.5	34	34.5
11	10	45.5	46	43.5	44	F

Certain amount of fuel was filled to get indication "E" first, then each amount was added to get indication shown in farthest right column.

Cessna Specification (CES-1210G, 1 November, 1973) stipulates installation errors as follows:

*The combined error of the instrument and transmitter installed in the airplane with the aircraft in level flight attitude shall be no greater than ±3 percent of total dial scale from "Empty to ¼" tank and ±5 percent of total dial scale at other points. However, in no case shall the instrument read more than "Empty" when the amount of fuel left in the tank is equal to the unusable fuel supply of the tank with the aircraft in level flight attitude.*

When above mentioned values are compared to CES-1210G, allowable error is zero at empty, ±1.2 gallons at points less than indication 11.5 gallons, ±2 gallons at other points, meaning that the indications of both fuel indicators were out of standard at empty and 11.5 gallons.

## 2.7 Additional Information

### 2.7.1 Quantity of Fuel Onboard

The Company's Airplane Operational Standard for Cessna TU206G stipulates the onboard fuel\*<sup>4</sup> as follows: (excerpts).

#### *7-5 Calculation of onboard fuel*

*Onboard fuel at the time of departure is calculated as follows:*

*VFR: Ground taxi fuel + Climb fuel + Cruise fuel + Reserve fuel (45 minutes)*

*Example for a cruise at 8,000 feet (2,400 rpm, 24inHG, Standard Air Temperature -1°C)*

	<i>TIME</i>	<i>QUANTITY</i>
<i>TAXI</i>		<i>2.6 GAL</i>
<i>CLIMB</i>	<i>13 min</i>	<i>4.4 GAL</i>
<i>CRUISE</i>	<i>5 hr 26 min</i>	<i>71.2 GAL</i>
<i>RESERVE</i>	<i>45 min</i>	<i>11.3 GAL</i>
<i>TOTAL</i>	<i>6 hr 24 min</i>	<i>88.9 GAL</i>

### 2.7.2 The Airplane's Fuel Consumption Rate for Ordinary Flight Operations

- a. The PIC's fuel consumption rate (FCR) (taxi fuel inclusive) based on his experience was 15 gallons per hour.

The PIC flies for 30 minutes with the fuel selector set to the tank at the time of takeoff. Then he changes tanks every hour afterwards.

- b. Usable fuel

One wing tank stores 46 gallons of fuel with 2 gallons of unusable fuel making the total usable fuel 88 gallons.

- c. Record of fuel feed.

The airplane was filled up on October 16. No flight was made until 23rd except an engine run-up by a mechanic on 18th. The PIC believed that the onboard fuel at the time of his engine start on 24th was about 86 gallons because about 2 gallons of fuel was consumed by engine run-ups on 18th and 24th.

- d. FCR calculated from the flight time and the consumed fuel amount

The airplane's FCR was calculated to be 17.6 gallons per hour from the accumulated flight time of 13 months (from August 2010 to August 2011) and consumed fuel amount thereof.

### 2.7.3 Occupation of Ramp Slots at Matsumoto Airport

- a. There are 14 ramp slots at Matsumoto Airport: three for scheduled airlines (No. 1 to No.3) and 11 for small aircraft (No.1 to No.11).

Among slots for small aircraft, No.1 is reserved for the Nagano Prefectural Police Aviation Unit, No. 3 for a helicopter of Nagano Prefectural Fire-Disaster Prevention Aviation Unit. Slots No.4, No.5 and No.11 are for twin-engine airplanes.

---

\*<sup>4</sup> Civil Aeronautics Act of Japan requires air transport airplane and IFR airplane to carry certain amount of reserve fuel in article 63. On the other hand, Part II 2.2.3.6, ICAO Annex 6 and FAR 95.151 stipulate that a VFR airplane should carry reserve fuel for 30-minute daytime flight and 45-minute nighttime flight after arriving its destination. (FAR 91 applies to all the airplanes which fly in the U.S.A. while the Annex 6 Part II to all the airplanes for international general aviation (except air transport and aerial work airplane).)

However, slots No.4 and No.11 are usually not in use: No. 4 due to downwash generated by helicopter parked at No.3 slot; No.11 due to a blast generated by an airplane which taxis out after being pushed back from No.3.

For a visiting aircraft it is necessary to book a ramp slot.

- b. During one hour and half timeframe on and after 13:30, slot No.4 which was kept open was available and one of slots for scheduled airlines was available.

(See Figure 3: Ramp Diagram at Matsumoto Airport)

#### **2.7.4 Matsumoto Airport Office**

- a. The Office is manned by prefectural employees and they are not aviation specialists.
- b. The person who attended the refueling request from the Tokyo FSC stated as follows:

When he answered the request from the FSC, he had some difficulties to understand the whole message due to quick manner of talking; however, he interpreted it as a destination change for refueling. But the whole ramp slots had been booked already. Destination changes for refueling were common and he did not confirm the urgency each time. As the request was not urgent, he declined it.

### **3. ANALYSIS**

#### **3.1 Crew Qualifications**

The PIC held valid airman competence certificate and valid aviation medical certificate.

#### **3.2 Airworthiness Certificate**

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

#### **3.3 Meteorological Conditions**

The weather conditions at the time of the serious incident had no bearing with the occurrence of the serious incident.

#### **3.4 Fuel Consumption and Fuel Indicator Indication**

##### **a. Fuel consumption**

Judging from the PIC's statement in 2.1.2, it is probable that he decided to fly back to Chofu Airfield at 13:30—4 hours and 25 minutes into the flight. With the FCR 15 gallons per hour described in 2.7.2 a, it is calculated that 66.3 gallons of fuel had been consumed then and the remaining fuel was 19.7 gallons. The PIC stated that he thought the airplane could fly about one hour with the remaining fuel judging from the fuel indicator reading of 16 to 17 gallons because the fuel was consumed as he calculated. Without knowing the fuel indicator error which read more than actual quantity, he thought it possible to fly back to Chofu Airfield as the fuel quantity indication and his calculation result matched.

However, the fuel ran out in 43 minutes so that the airplane could not make it to the airfield which was 45 minutes away. With 83.4 (= 86 - 2.6) gallons of usable fuel quantity (onboard fuel at takeoff subtracted by taxi fuel) and 5 hours and 8 minutes of airborne time (takeoff at 09:05, landing at 14:13) we get the actual FCR as 16.2 gallons per hour. With this FCR, actually consumed fuel and remaining fuel at 13:30 becomes 71.6 gallons and 11.8 gallons, respectively. This means that the remaining fuel was about 8 gallons fewer than the PIC's calculation and fuel quantity indication.

As described in 2.7.2 d, average FCR for 13 months from August 2010 was 17.6 gallons per hour. Given this fact it is possible that the FCR at the time of the serious incident occurrence was bigger than that of PIC's.

##### **b. Fuel quantity indication**

As described in 2.6.2, the fuel quantity measuring system incorporates floats and the reading scale is as shown in 2.6.2, it is difficult to get an accurate reading. The Company did a fuel gage calibration in April 2010 as described in 2.6.3. It is probable that the Company continued airplane operation because the reading of usable fuel was almost the same as the filled amount.

However, as described in 2.6.2 the fuel indication study showed that the discrepancy between the usable fuel quantity and indication was 4 gallons and 4.5 gallons for left tank at 1 gallon and 12.5 gallons usable fuel; right indicator was

accurate at 1 gal usable fuel.

Assuming the PIC changed fuel tanks alternately as described in 2.7.2 a. and disregarding the amount of unusable fuel considerably used in the actual flight, fuel consumption was calculated as the table below.

With the fact that fuel was fed from left tank at about 14:00 and the day's average FCR value was 16.2 gallons per hour, the left and right fuel tanks were calculated to have been filled

Unit: gal

Time	Tank in use	Left fuel tank		Right fuel tank	
		Consumed	Remaining	Consumed	Remaining
1335-1413	Left	10.3	0		0.2
1235-1335	Right			16.2	0.2
at 1330			10.3	14.85	1.55
1135-1235	Left	16.2	10.3		
1035-1135	Right			16.2	16.4
0935-1035	Left	16.2	26.5		
0905-0935	Right			8.51	32.6
at 0905			42.7		40.7

As the right fuel tank remaining quantity at 14:13 was unknown, right tank fuel quantity at 09:05 was obtained by subtracting left tank fuel quantity from 83.4.

with 42.7 and 40.7 gallons of fuel, respectively at the time of takeoff.

Although the accurate amount of fuel loaded at the time of takeoff was unknown, the actual amount did not probably differ much from the above calculation only with the minor difference of how much fuel was consumed for daily engine run-up. Judging from this usable fuel at 13:30 was probably 10.3 gallons for the left tank and 1.55 gallons for the right tank. Taking the error characteristics of both indicators into consideration, the fuel indication then was possibly close to what the PIC mentioned (left tank usable fuel, 16 to 17 gallons; right tank, near empty).

### 3.5 Flight Plan

a. Planned flight time and actual flight

The PIC made a flight plan with 5 hours 00 minutes of total estimated elapsed time and 5 hours 30 minutes of fuel quantity expressed in endurance time. As this does not meet the 45 minutes of reserve fuel stipulated in the Company's Airplane Operational Standard described in 2.7.1, it is probable that the Standard was not enforced in an all-out manner.

It was 13:30 when the PIC requested a refueling stop at Matsumoto Airport—4 hours and 25 minutes into the flight. In order to meet the 45 minutes reserve fuel standard he had to land within 20 minutes and at that moment Matsumoto Airport was the only destination which met the Standard, to which the airplane could reach in about 15 minutes if flown at 110 knot.

However, because PIC's remaining fuel calculation was almost the same as the fuel gage indication, it is probable that he thought it would be possible to fly back to Chofu Airfield although some of the reserve fuel would be consumed.

b. Fuel management

The fuel gage should indicate the remaining fuel quantity with reasonable error margin; however, with possibilities of indication system malfunction and fuel leak, pilots have to, without relying on fuel indication, check remaining fuel based on elapsed time and FCR, have a refueling plan at alternate aerodrome, and

decide where to get it sooner in order to have enough reserve fuel.

### **3.6 Response of Tokyo FSC and Reception of Matsumoto Airport**

#### **a. Response of Tokyo FSC**

Tokyo FSC working as an intermediary between the PIC and Matsumoto Airport Office, conveyed the PIC's request to the Matsumoto Airport Office, made coordination, and conveyed the Office's response to the PIC; however, it is probable that the FSC was not able to recognize the urgency of the PIC's request because the PIC did not show strong necessity of refueling.

#### **b. Matsumoto Airport Office**

The person who was in charge of ramp slot management probably did not feel the urgency for the airplane's refueling while all ramp slots but No.4 were booked, so that he replied to the FSC saying that all the slots are booked. It is probable that the PIC's intention of refueling was not strong enough.

On the other hand, booked slots do not mean they are parked with aircraft all the time, some booked ones may be unoccupied depending on timeframe.

It is desirable that each airport office's flexible acceptance of refueling request when they receive a refueling destination change even aircraft does not declare a state of emergency.

### **3.7 Recurrence Preventive Measures**

In this serious incident the airplane went into a fuel starvation because the PIC did not know the actual FCR was bigger than his value of calculation and he did not notice that the fuel indicators read larger amount than the real one. In order to prevent a fuel starvation from happening, it is important for airplane operators to maintain accuracy of fuel gage reading and share latest FCR information among the concerned.

On the other hand, when a PIC requests a landing for refueling he has to convey clear message for sooner refueling and maintain larger amount of fuel for remaining flight. In addition, the FSC and airport office concerned should be attentive to provide refueling for a requesting aircraft which wants it due to unexpected fuel consumption even if it does not declare a state of emergency.

#### 4. **PROBABLE CAUSE**

The airplane's flight with erroneous fuel indication resulted in "shortage of fuel requiring urgent measures."

The indication error very likely obscured the PIC's recognition of erroneous fuel indication although the actual FCR was bigger than the calculation value.

The following two elements are considered to be probable contribution factors to the occurrence:

- Proper amount of reserve fuel was not integrated into PIC's fuel plan; and
- PIC's intention of refueling was not clear or strong enough when he requested a refueling landing through the FSC.

## 5. ACTIONS TAKEN

### a. The Civil Aviation Bureau (CAB)

Responding to this serious incident, the Civil Aviation Bureau, MLIT issued the directive titled “Ramp Operation” (Koku Ku Yo No.242, December 22, 2010) to prefectural/municipal airport offices, instructing to be attentive as follows:

*Considering the fact that some airports lack some types of fuel service, when an airport office receives a request of refueling landing, even if an aircraft does not declare a state of emergency, try to secure a temporary refueling slot. In case of no available slot, try to create a temporary one with the suggestion of CAB personnel.*

### b. The Company

The Company has taken the following measures to prevent recurrences.

- (1) The Company issued oral and documented direction to its flight crew, enforcing that 45 minutes subtracted from a standard endurance time calculated from the Airplane Operational Standard to be the airplane’s endurance time. It also encouraged them to manage fuel and land at the destination without fear of fuel shortage, not to heavily depend on the fuel gauge indication or initial fuel plan while considering weather condition and aerial survey flight profile and such.
- (2) The Company did fuel gage calibration for all airplanes and installed new indicators to some airplanes to get more accurate fuel indication.
- (3) The Company instructed its flight crew to get advance approval of destination change as early as possible during an aerial survey flight and send clear message of refueling in a radio transmission with an air traffic controller.



Figure 1: Estimated Flight Route

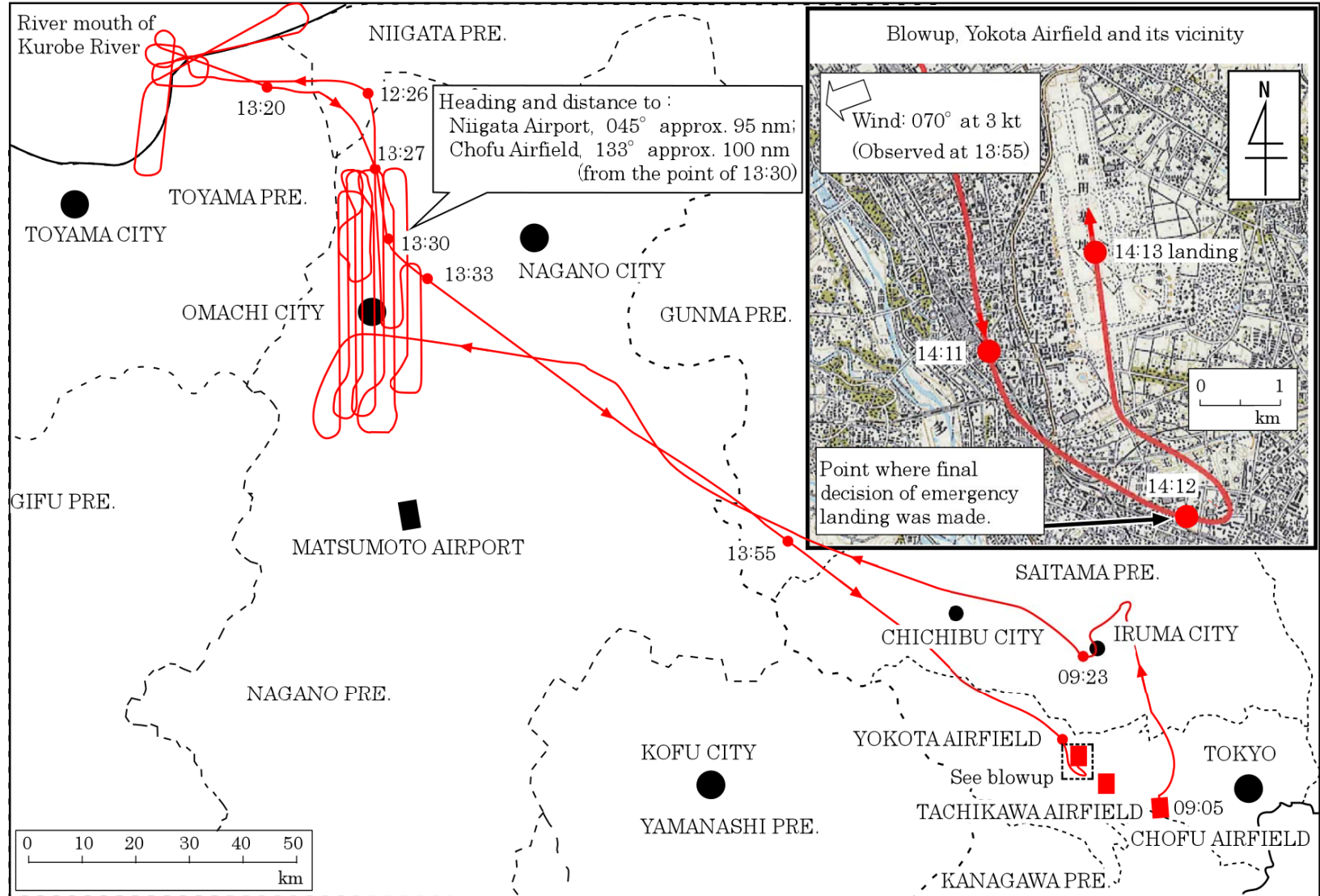


Figure 2: Three Angle View of Cessna TU206G

Unit: m

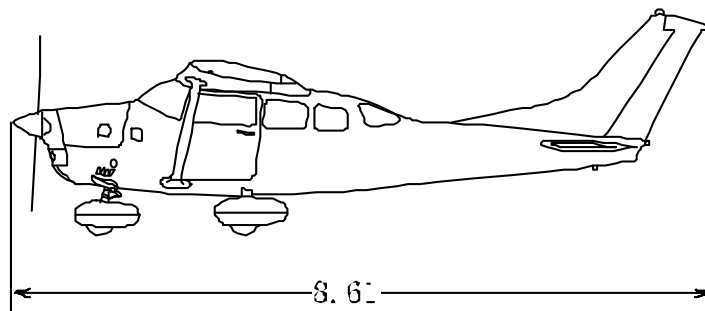
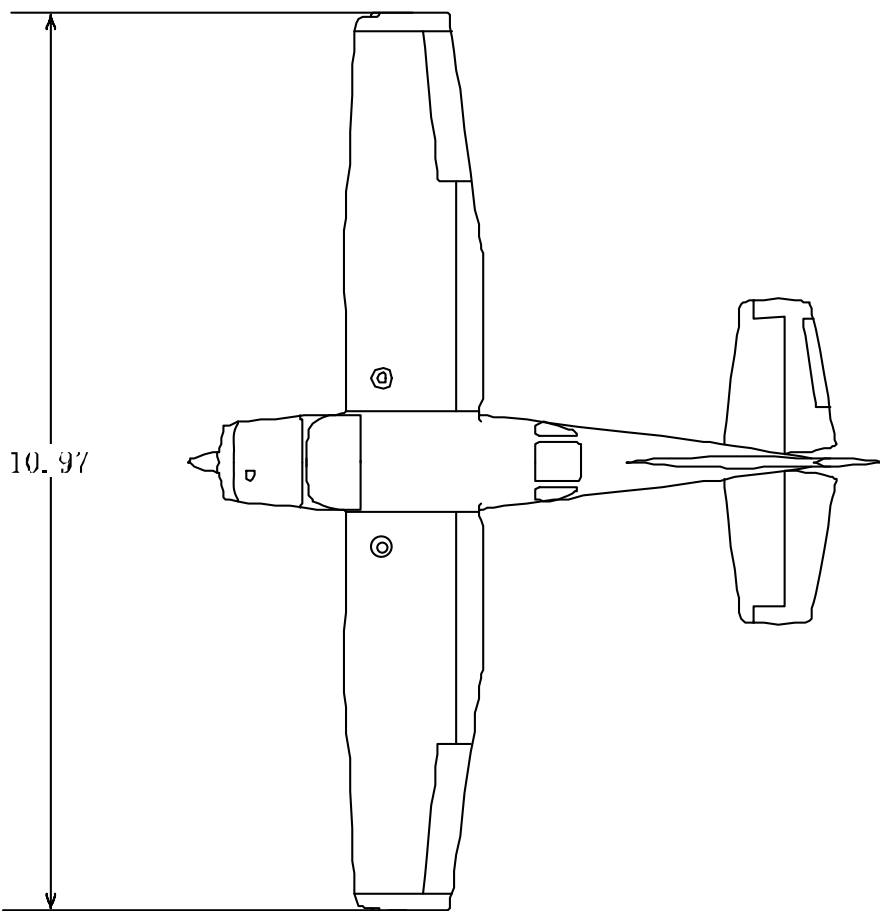
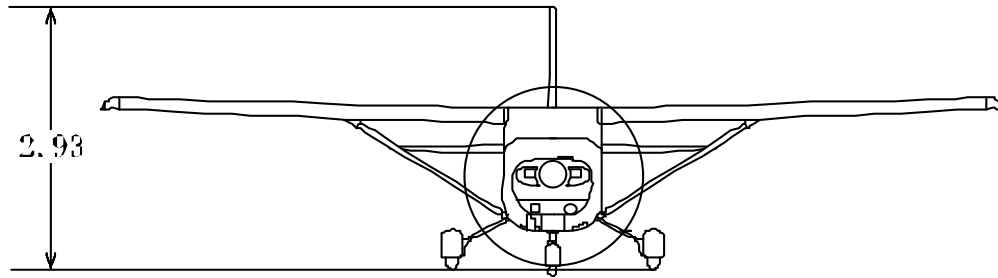


Figure 3: Ramp Diagram at Matsumoto Airport

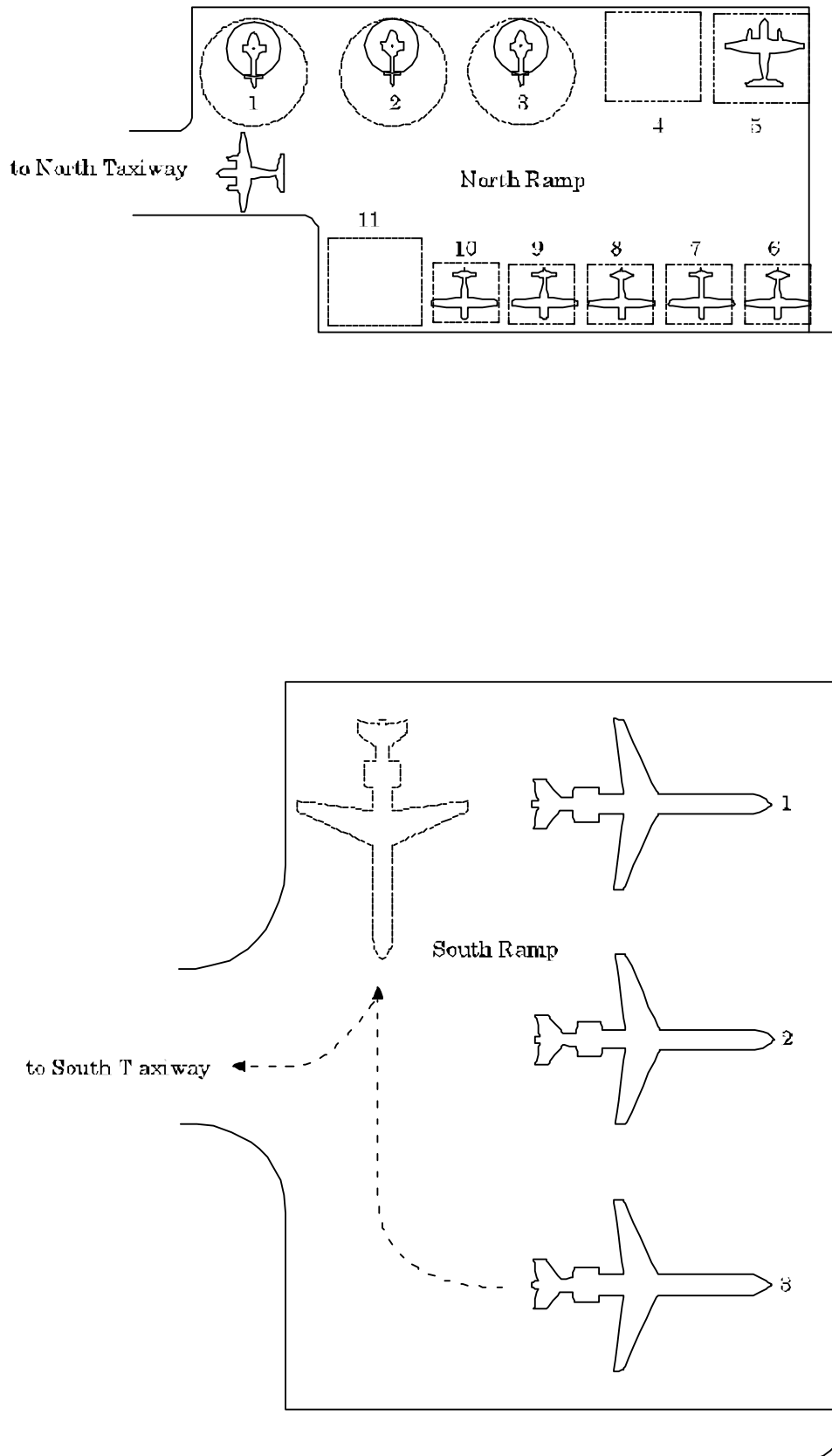


Photo 1: The Airplane



Photo 2: Fuel Quantity Indicator



## Attachment Records of Radio Transmission

Legend Tokyo Info.:Tokyo Information (Tokyo FSC's call sign)  
Yokota A/D:Yokota Approach/Departure

Note: The aircraft's radio transmission with Yokota Tower is omitted because it took place after the landing.

Time	Radio Station	Transcription
13:26:29	JA3818	Ah, Tokyo Information. This is JA3818, Good afternoon.
13:26:36	Tokyo Info.	3818, Tokyo Information. Go ahead.
13:26:39	JA3818	3818, present position about 20 nm northwest of Nagano city, 9,500 ft, operation normal. Request destination change from Niigata to Matsumoto. Also requests ramp use permission. Over.
13:27:01	Tokyo Info.	JA3818, 20 nm north-west of Nagano. Destination change from Niigata to Matsumoto. Standby for the permission.
13:27:14	JA3818	Roger. Matsumoto ETA will be 0450.
13:27:23	Tokyo Info.	Matsumoto ETA 0450, roger.
13:28:07	Tokyo Info.	JA3818, let me confirm. Destination change due to the weather?
13:28:15	JA3818	3818, ah, due to refuel. Survey flight took more than expected. Over.
13:28:24	Tokyo Info.	Due to refuel, roger that.
The following coordination was done over telephone.		
13:29	Airport office	Hello, this is AAAA, Matsumoto airport office.
	Tokyo FSC	Hello, this is BBBB, Tokyo FSC
	Airport office	Yes, what can I do for you?
	Tokyo FSC	Well, I've received a permission request for you.
	Airport office	Yes.
	Tokyo FSC	Well, the registration is JA3818.
	Airport office	3818
	Tokyo FSC	Ah, airplane type is Cessna 206.
	Airport office	206
	Tokyo FSC	Matsumoto ETA is 0450.
	Airport office	At 50.
	Tokyo FSC	That's the ETA. The airplane's original destination was Niigata.
	Airport office	Yes.
	Tokyo FSC	The airplane wants to land at Matsumoto for refueling.
	Airport office	I understand. Ah, I'm afraid all ramp slots are booked today.
	Tokyo FSC	Oh.
Airport office	Yes.	
Tokyo FSC	Ok. I'll convey your message to the pilot.	
Airport office	Yes. Thank you.	
Tokyo FSC	Ok. Good day.	
13:30	Airport office	Thank you.
The radio transmission between the airplane and Tokyo Info.		
13:30:16	Tokyo Info.	JA3818, Tokyo Info., over.
13:30:18	JA3818	This is 3818, go ahead.
13:30:22	Tokyo Info.	Well, I've confirmed that the ramp slots are all booked at Matsumoto and it can not accept your request. May I have your intention?
13:30:34	JA3818	Stand by, please.
13:32:38	JA3818	Tokyo Information, 3818.
13:32:42	Tokyo Info.	Tokyo Information.
13:32:45	JA3818	Ah, I've decided to fly back to Chofu. ETA is 0515.
13:32:57	Tokyo Info.	JA3818 flies back to Chofu, understood. ETA 0515. Ah, have a nice flight.

13:33:03	JA3818	Thank you.
Radio transmission between the airplane and Yokota A/D.		
13:56:49	JA3818	Ah, Yokota Radar, JA3818, good afternoon.
13:57:04	Yokota A/D	JA3818, Yokota Departure, squawk five four six zero.
		(Irrelevant portions omitted)
13:57:41	Yokota A/D	JA3818, Radar contact four zero miles northwest of Yokota. Maintain VFR. The Yokota altimeter three zero two four. Say type aircraft.
		(Irrelevant portions omitted)
14:09:49	JA3818	Uh, 3818, uh, at this time, uh, low fuel, uh, request emergency landing.
14:09:57	Yokota A/D	JA3818, roger. Verify requesting emergency landing at Yokota.
14:10:01	JA3818	Affirm. Uh, Yokota landing, please.
		(Irrelevant portions omitted)
14:11:09	JA3818	Uh, 3818, uh, at this time cancel Yokota landing, uh, proceed to Chofu Airport.
14:11:15	Yokota A/D	JA3818, roger, maintain VFR for Chofu Airport. Say your fuel on board.
		(Irrelevant portions omitted)
14:11:56	JA3818	Uh, at this time emergency. I need stop, uh, uh, Yokota landing, please.
14:12:04	Yokota A/D	JA3818, roger, you are approved for landing at Yokota if you are an emergency. Confirm you are declaring an emergency.
14:12:10	JA3818	Roger, thank you.
14:12:15	Yokota A/D	JA3818, Yokota Airport landing runway three six current winds are zero six zero at four, runway three six, cleared to land.
14:12:21	JA3818	Uh, roger, 3818. We're cleared to land.
		(Irrelevant portions omitted. GPS altitude information revealed that the aircraft landed at 14:13)
14:14:09	Yokota A/D	JA3818, how do you read?
14:14:12	JA3818	Uh, 3818, go ahead.
14:14:14	Yokota A/D	Contact Yokota Tower one three four point three.
14:14:21	JA3818	Uh 3818, sorry say again frequency.
		(Irrelevant portions omitted)

The following abbreviations and unit conversions are used in this report.

#### Abbreviations

NTSB:	National Transportation Safety Board
QNH:	Altimeter setting
VFR:	Visual flight rules

#### Unit conversions

1 inch (in):	2.54 centimeter
1 knot (kt):	0.5144 meters per second
1 pound (lb):	0.4536 kilograms
1 US gallon (gal):	3.785 liter