

AI2015-3

**AIRCRAFT SERIOUS INCIDENT  
INVESTIGATION REPORT**

**HONDA AIRWAYS CO., LTD.  
JA4000**

April 23, 2015



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

HALT OF ENGINE IN FLIGHT  
HONDA AIRWAYS CO., LTD.  
CESSNA TU206G, JA4000  
OVER AKITA CITY, AKITA PREFECTURE, JAPAN  
AT ABOUT 11:43 JST, NOVEMBER 16, 2013

April 10, 2015

Adopted by the Japan Transport Safety Board

Chairman Norihiro Goto  
Member Shinsuke Endoh  
Member Toshiyuki Ishikawa  
Member Sadao Tamura  
Member Yuki Shuto  
Member Keiji Tanaka

## SYNOPSIS

### <Summary of the serious Incident>

On Saturday, November 16, 2013, a Cessna TU206G, registered JA4000, operated by Honda Airways Co., Ltd., which had been heading to a photography location over Noshiro City, Akita Prefecture for an aerial survey, experienced a low oil pressure, and then at about 11:43 Japan Standard Time (JST: UTC +9 hours, all times are indicated in JST on a 24-hour clock), experienced engine halt; consequently, made a forced landing to the site of closed Akita Airport in Akita City, Akita Prefecture.

The aircraft sustained slightly damage. No one was injured.

### <PROBABLE CAUSES>

It is probable that this serious incident occurred due to the fact that the engine of JA4000 continued to be operated in a state where the oil was leaking and had become insufficient; accordingly, the engine was broken, leading to engine halt in flight.

It is probable that the cause of the oil leakage was due to the fact that engine vibration was being transmitted to the loose connection between the hose of the housing extension and the oil gage rod housing on the engine body, and then the hose detached from the housing.

It is somewhat likely that the hose had come loose at the connection to the oil gage rod housing because the hose clamp had been installed in a state where it was out of position toward the end of the hose and juttred out toward the engine body; accordingly, uniform and adequate clamping of the hose was not achieved.

The main abbreviations used in the report are as follows.

FAA : Federal Aviation Administration  
FSC : Flight Service Center  
GPS : Global Positioning System  
ILS : Instrument Landing System  
IMC : Instrument Meteorological Conditions  
NTSB : National Transportation Safety Board  
SIL : Service Information Letter  
VFR : Visual Flight Rules

#### Unit conversion table

1 lb : 0.4536kg  
1 ft : 0.3048m  
1 nm : 1.852km  
1 kt : 1.852km/h  
1 in : 2.54cm  
1 psi : 0.07031kgf/cm<sup>2</sup> (6894.76Pa)  
1 quart : 0.9464 liters (l)

# 1 PROCESS AND PROGRESS OF THE INVESTIGATION

## 1.1 Summary of the Serious Incident

On Saturday, November 16, 2013, a Cessna TU206G, registered JA4000, operated by Honda Airways Co., Ltd., which had been heading to a photography location over Noshiro City, Akita Prefecture for an aerial survey, experienced a low oil pressure and then at about 11:43 Japan Standard Time (JST: UTC +9 hours, all times are indicated in JST on a 24-hour clock), experienced engine halt; consequently, made a forced landing to the site of closed Akita Airport in Akita City, Akita Prefecture.

The aircraft sustained slightly damage. No one was injured.

## 1.2 Outline of the Serious Incident Investigation

The occurrence covered by this report falls under the category of “continued halt of engine in flight” as stipulated in Clause 7, Article 166-4 of the Ordinance for Enforcement of Civil Aeronautics Act of Japan, and is classified as a serious incident.

### 1.2.1 Investigation Organization

On November 16, 2013, the Japan Transport Safety Board(JTTSB) designated an investigator-in-charge and an investigator to investigate this serious incident.

### 1.2.2 Representatives of the Relevant State

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

### 1.2.3 Implementation of Investigation

November 17 and 18, 2013	On-site investigation, aircraft examination and interviews
November 26 and 27, 2013	Aircraft examination
March 25, 2014	Engine teardown examination
April 2, 2014	Oil leak reproduction test

### 1.2.4 Provision of Factual Information to the Civil Aviation Bureau

On June 11, 2014, the JTTSB provided the Civil Aviation Bureau(CAB) of the Ministry Land, Infrastructure, Transport and Tourism with factual information obtained in the aircraft examination pertaining to the state of attachment of the connecting hose between the oil gage rod housing and the housing extension; and oil leakage from that area.

### 1.2.5 Comments from the Parties Relevant to the Cause of the Serious Incident

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

### 1.2.6 Comments from the Relevant State

Comments were invited from the relevant State.

## 2 FACTUAL INFORMATION

### 2.1 History of the Flight

On Saturday, November 16, 2013, a Cessna TU206G, registered JA4000 (hereinafter referred to as “the Aircraft”), operated by Honda Airways Co., Ltd. (hereinafter referred to as “the Company”), with a pilot and a passenger on board, took off from Honda Airport in Saitama Prefecture at 09:09 and headed toward a photography location over Noshiro City, Akita Prefecture for an aerial survey.

The outline of the flight plan filed was as follows:

Flight rules: visual flight rules

Departure aerodrome: Honda Airport

Estimated off-block time: 09:00

Cruising speed: 110 kt

Cruising altitude: VFR

Route: Yurihonjo–Noshiro–Miyako

Destination aerodrome: Hanamaki Airport;

Total estimated elapsed time: 5 hours

Fuel load expressed in endurance: 6 hours 00 minutes

Persons on board: 2

According to the air traffic control communication records, portable GPS device (hereafter, “GPS”) records, as well as statements of the pilot, the passenger, and maintenance engineer, the history of the flight up to the time of this serious incident is as outlined below.

#### 2.1.1 History of the Flight until Landing Based on ATC Communication Records and GPS

##### Records

- 11:03:28 The pilot reported to the Akita Airport Traffic Control Tower (hereinafter referred to as “Akita Tower”) that the Aircraft was flying at a pressure altitude of 3,700 ft approximately 20 nm south of Akita Airport and was going to conduct photography over Yurihonjo.
- 11:20:40 The pilot reported to Akita Tower that photography had been completed and the Aircraft was heading toward Noshiro. Akita Tower instructed the Aircraft to report the abeam of Akita Airport.
- 11:27:04 The Aircraft climbed while travelling north and leveled out at a GPS altitude of 6,365 ft approximately 11 nm west-southwest of Akita Airport.
- 11:27:41 The pilot reported to Akita Tower that the Aircraft was passing abeam of Akita Airport and heading toward Noshiro at a pressure altitude of 6,500 ft.
- 11:28:14 The pilot reported to Sendai Flight Service Center (hereinafter referred to as “Sendai FSC”) that he changed the destination aerodrome from Hanamaki Airport to Odate Noshiro Airport due to engine trouble.
- 11:30:38 The Aircraft headed north-northeast and began descent from a GPS altitude of 6,355 ft approximately 10 nm west-northwest of Akita Airport.
- 11:37:01 Due to change of destination aerodrome from Odate Noshiro Airport to Akita Airport, the Aircraft changed its heading to south-southwest and was descending at a GPS altitude of 4,551 ft approximately 16 nm northwest of Akita Airport.
- 11:37:39 At a pressure altitude of 4,500 ft and approximately 16 nm northwest of Akita Airport, the pilot requested Akita Tower to land at Akita Airport.

- Akita Tower instructed the pilot to report 5 nm northwest of Akita Airport.
- 11:40:47 The pilot reported to Akita Tower that an oil pressure reduction of engine oil (hereinafter referred to as “oil”) and engine vibration had occurred at a pressure altitude of 2,700 ft.
- 11:41:07 The pilot requested Akita Tower a clearance for an emergency landing from approximately 11 nm northwest of Akita Airport .  
Akita Tower issued a clearance for a straight-in approach for emergency landing to runway 10.
- 11:42:15 The pilot reported to Akita Tower that he would be making a forced landing to a seacoast. The Aircraft was making a right descending turn at a GPS altitude of approximately 1,800 ft approximately nine nm northwest of Akita Airport.
- 11:42:48 The Aircraft was descending at a GPS altitude of 548 ft approximately 0.5 nm north of the site of closed Akita Airport.
- 11:43:19 The position of the Aircraft according to GPS was at the site of closed Akita Airport.
- 11:43:32 The pilot reported to Akita Tower that he had made a forced landing.  
Akita Tower reported that the position of the Aircraft was nine nm northwest of Akita Airport.

#### 2.1.2 Statements of Pilot, Passenger and Maintenance Engineer.

##### (1) Pilot

On the day of the incident, the pilot was planning to land at Hanamaki Airport after conducting photography of Yurihonjo, Noshiro and Sanriku. The pilot came to work at about 07:20, performed flight preparation such as checking the weather, and then performed an inspection of the aircraft and confirmed that there were no abnormalities. The oil level at that time was full at 12 quarts.

The aircraft with two persons, the pilot and a cameraman onboard, took off from Honda Airport at 09:09 and flew via Fukushima and Yamagata to Yurihonjo.

After passing Mount Chokai at an altitude of 9,500 ft, the pilot descended to an altitude of 3,200 ft, which was the photography altitude. After shooting over Yurihonjo had been completed, the pilot climbed and headed for Noshiro, which was the next photography site.

After setting a cruising state at an altitude of 6,500 ft, at about 11:27, the pilot performed a cruise check (inspection of engine instruments, and others.), whereupon he noticed that the oil pressure gage indication was outside the normal range, being slightly lower than 30 psi. The pilot was not certain what the numerical value of oil temperature was at that time, but had the awareness that it was within the normal range.

The pilot decided that it was not possible to go to Hanamaki Airport, which was the initial destination aerodrome, in this state, and because Akita Airport, based on communications with other aircraft and Akita Tower, was in instrument meteorological conditions (hereinafter referred to as “IMC”), the pilot informed Sendai FSC that he changed the destination aerodrome to Odate Noshiro Airport, which was close to the next photography site.

The pilot subsequently obtained information that Odate Noshiro Airport had become foggy and was in IMC; therefore, requested instrument approach using ILS. However, the



response was that the ground equipment was not functioning; consequently, ILS approach would not be possible, and moreover, the pilot obtained information that the weather at Akita Airport, which had been in IMC, seemed to be improving. Thus the pilot decided to head for Akita Airport.

After confirming the low oil pressure, the pilot moved the throttle lever to the maximum position, but the engine power started decreasing. Therefore, the pilot left the throttle lever as it was and gradually reduced altitude so as to maintain an air speed of 110 kt.

At about 11:40, in the vicinity of 10 miles northwest Akita Airport, the pilot suddenly noticed engine vibration and thus requested emergency landing to Akita Airport.

When the pilot headed toward Akita Airport for an emergency landing, the manifold air pressure, which indicates engine power, dropped significantly; hence, the pilot judged that he would not be able to reach Akita Airport, and reported to Akita Tower that he was going to make a forced landing to a seacoast, then headed toward the beach on the coastline to the west. The pilot caught sight of empty lot which looked like a paved runway before the coastline and thus headed there and made an approach. The engine halted right before entering final approach at the end of the base leg.

After entering final approach, the pilot set full flaps (40°) and made the approach at an airspeed of approximately 70 kt.

The Aircraft touched down with somewhat insufficient flare, bounced twice, and halted without using the brakes much.

The weather in the vicinity of the forced landing site was clear, with good visibility and calm wind.

## (2) Passenger

The passenger was seated as the cameraman in the seat to the right of the pilot.

When heading for Noshiro after completing photography in Yurihonjo, the passenger was informed by the pilot that the photography in Noshiro would be cancelled and the Aircraft would be heading for Odate Noshiro Airport because of a low oil pressure, and thus closed the shutter door at the bottom of the fuselage for the vertical photography camera. According to later information, it was decided to head for Akita Airport because Odate Noshiro Airport had poor weather.

The passenger felt that a strong rattling vibration occurred when in the vicinity of Akita City, and white smoke came out from the front of the nose of the airplane.

The passenger then heard the pilot notified that they were going to make a forced landing to a seacoast beach, and while heading there, the passenger informed the pilot that he had found a wide paved surface. A little before aligning with the paved surface, the engine and propeller halted.

After touching down, the aircraft bounced several times, kicking away over safety cones, and then slid and halted in front of a fence.

## (3) Maintenance engineer

The maintenance engineer performed a pre-flight inspection of the Aircraft and found no abnormalities. At the time, the oil quantity was 11.5 quarts, nearly at the upper limit, then no oil was added.

This serious incident occurred in the air (altitude above ground level approximately 500 ft)

approximately 1 km north of the site of closed Akita Airport in Akita City, Akita Prefecture (39°42'46" N, 140°03'48" E) at about 11:43 JST on November 16, 2013.

(See Figure 1: Estimated flight route; Figure 2: Forced landing site; Photo 1: Forced landing site; Photo 2: Serious incident aircraft; Photo 3: Condition of engine)

## 2.2 Injuries to persons

No one was injured.

## 2.3 Damage to the Aircraft

### 2.3.1 Extent of Damage

The Aircraft was slightly damaged.

### 2.3.2 Damage to the Aircraft Components

The results of investigation of the state of damage and so on, to the Aircraft after occurrence of the serious incident were as follows.

#### (1) Engine

##### ① Crankcase, Cylinders and Pistons

A circular fracture about 10 cm in diameter was found on the top of the crankcase, a rectangular fracture was found near the pushrod at the bottom of the fifth cylinder in the crankcase, and scratches were found on the cylinder liners.

The connecting rods of the fourth and fifth cylinders were also fractured.

##### ② Oil Gage Rod Housing and Housing Extension

The hose of the housing extension (hereinafter referred to as “extension”) forming part of the oil gage used for checking the oil level was detached from the oil gage rod housing (hereinafter referred to as “housing”) on the engine body.

As shown in Photo B, the fitting which clamps the hose that joins the extension to the housing on the engine body was out of the position; therefore, the clamp jutted out toward the engine body, and the hose connection was loose.

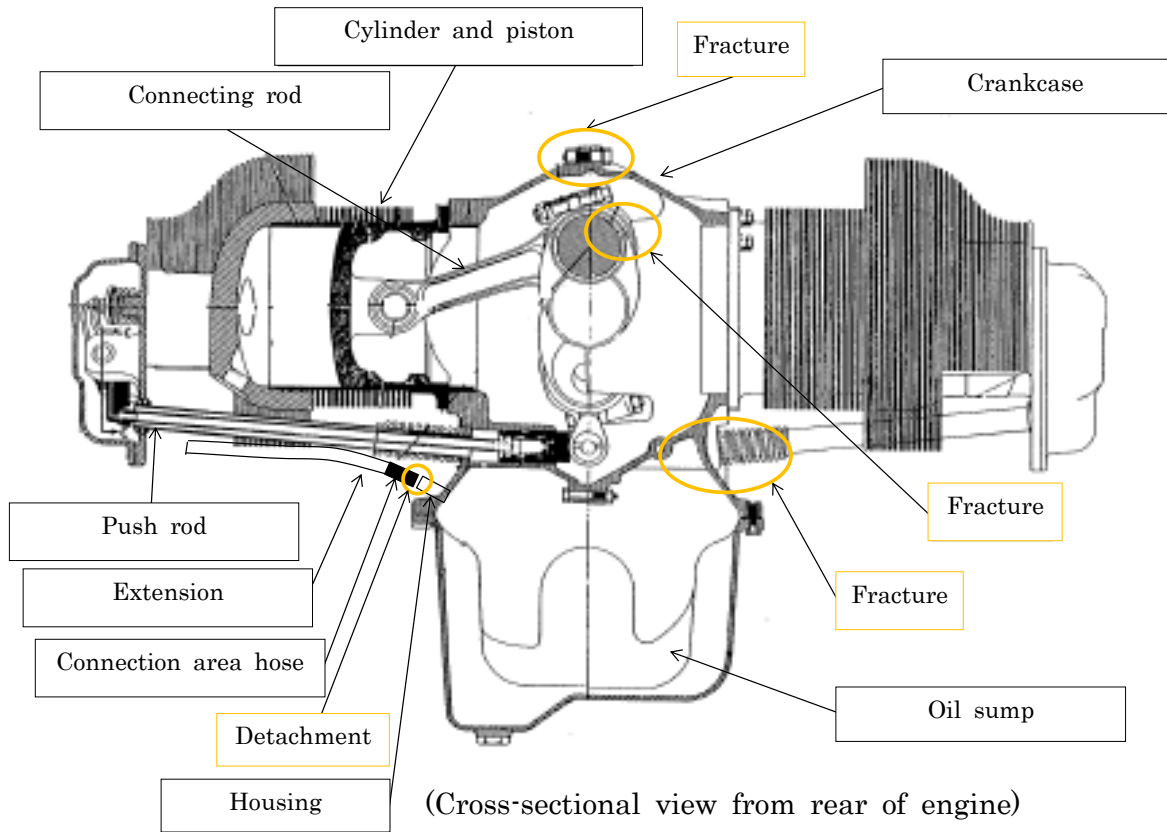


Figure 1: Engine damage

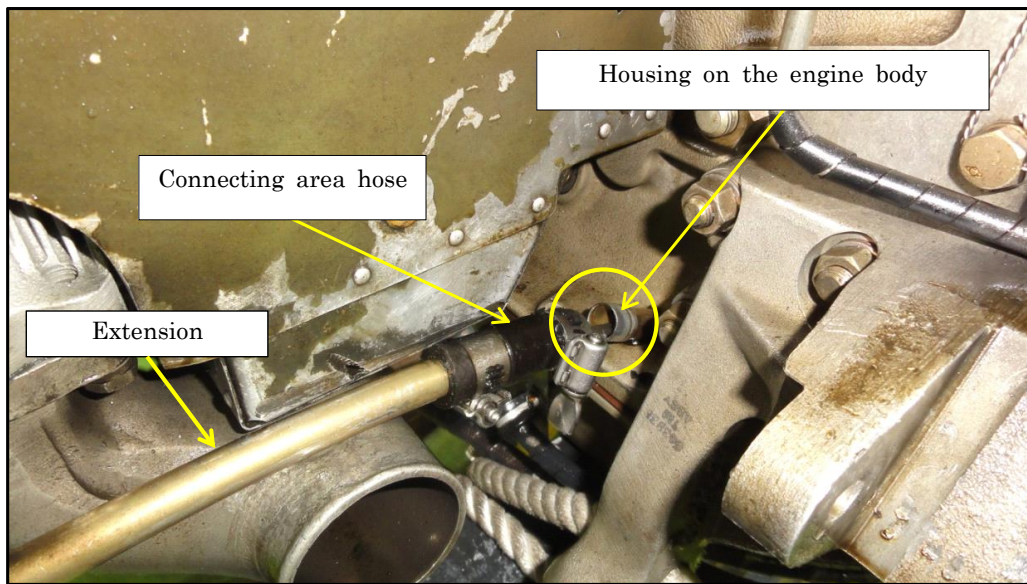


Photo A: Reproduction of detachment of hose from housing on the engine body  
(Different from the condition at time of occurrence of the serious incident)

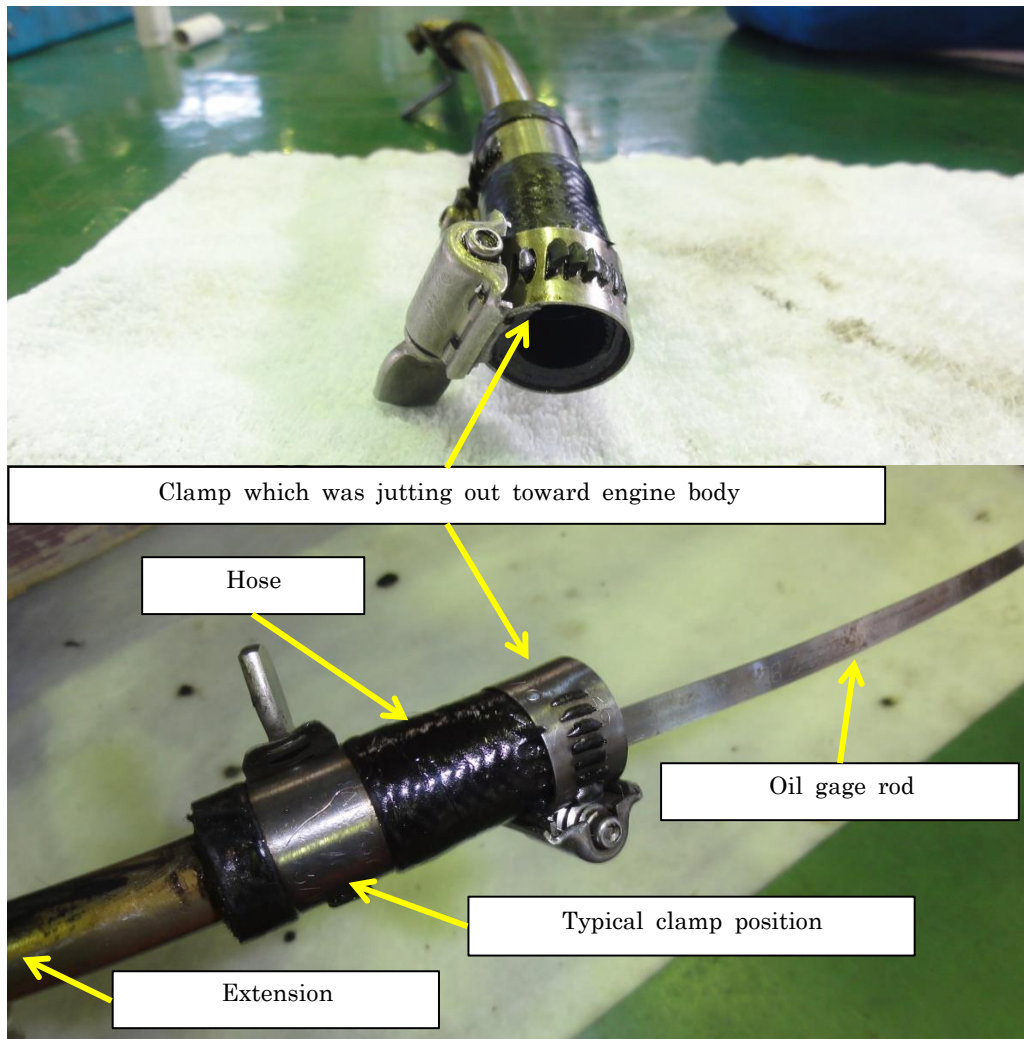


Photo B: Condition of hose clamping fittings

③ Remaining Oil Quantity in Oil Sump

The remaining amount of oil quantity as measured with the oil gage at the forced landing site was approximately three quarts.

(2) Airframe

There was no damage to the airframe.

A large quantity of oil was adhering to the area from the rear of the lower engine cowling to left side and bottom surface of the fuselage and shutter door at the bottom of the fuselage for the vertical photography camera.

(See Photo 2: Serious incident aircraft; and Photo 3: Condition of engine)

2.4 Personnel Information

Pilot Male, Age 25 years old

Commercial Pilot Certificate (Airplane)

January 20, 2009

Type rating for Single-Engine Piston Land

January 20, 2009

Instrument Flight Certification (Airplane)

July 30, 2009

Class 1 aviation medical certificate

Validity date

February 23, 2014

Total flight time	854 hours 57 minutes
Flight time in the last 30 days	44 hours 34 minutes
Total flight time on the type of aircraft	55 hours 22 minutes
Flight time in the last 30 days	22 hours 14 minutes

## 2.5 Aircraft Information

### 2.5.1 Aircraft

Type	Cessna TU206G
Serial number	U20604629
Date of manufacture	August 30, 1978
Certificate of airworthiness	No. To-25-053
Validity	May 6, 2014
Category of airworthiness	Airplane, Normal N or Special X
Total flight time	8,711 hours 41 minutes
Flight time since last periodical check (200 - hour inspection on October 22, 2013)	37 hours 37 minutes

### 2.5.2 Engine

Model	Continental TSIO-520-M7
Serial number	1005121
Date of manufacture	August 19, 2011
Date of confirmation of installation completion by the Company	September 24, 2011
Total time in service	582 hours 02 minutes

The oil was Exxon Elite 20W-50 (Continental Standard MHS-24, SAE 50).

The engine manufacturer (hereafter, “manufacturer”) did not attach the extension to the engine body but shipped it as an accessory.

(See Figure 3: Three Angle View of Cessna TU206G)

### 2.5.3 Weight and Balance

When the serious incident occurred, the Aircraft’s weight is estimated to have been 3,134 lb and the position of the center of gravity is estimated to have been 44.07 in to the aft of the reference plane (the bottom of the front surface of the fire wall), both being within the allowable range (maximum takeoff weight 3,600 lb, center of gravity range 38.5 in to 49.7 in for the weight at the time of the incident).

## 2.6 Meteorological Information

### (1) Weather at Departure Aerodrome

The weather observed by Saitama Automated Weather Station of the Japan Meteorological Agency (12 km southeast of Honda Airport, approximately same elevation) at 09:00, which is about when the Aircraft started its engine, was as follows.

Clear, wind direction: northwest, wind speed: approximately 3.5 kt (m/s converted to kt), temperature: 9.4°C

### (2) Wind Direction and Wind Speed at Forced Landing Site

Table 1 shows the observations (average wind direction and average wind speed (m/s

converted to kt) for the past 10 minutes) immediately after occurrence of the serious incident from the anemometer of a wind condition observation pole (wind power generation related equipment) at a height of 39 m above ground, placed approximately 2.5 km north of the site of closed Akita Airport (near the final approach route), which was the forced landing site.

Table 1: Wind direction and wind speed records near forced landing site

Time	11:30	11:40	11:50
Wind direction	094°	093°	096°
Wind speed	5 kt	5 kt	3 kt

## 2.7 Information on the Forced Landing Site

The Aircraft made a forced landing on a motorcycle training range set up using a portion (approximately 800 m long) of a runway\*<sup>1</sup> of the closed Akita Airport. There were touchdown marks on former runway 17, and some of the color cones lined up for motorcycle training had been kicked away.

The Aircraft halted with its nose facing south, approximately over the center line of the former runway approximately 400 m south of the touchdown marks, approximately within 100 m of the south side outer fence.

(See Figure 1: Estimated flight route; Figure 2: Forced landing site; Photo 1: Forced landing site; Photo 2: Serious incident Aircraft)

## 2.8 Information on GPS

Position and altitude information up to the time of the forced landing retained in the GPS (Aera 500), made by Garmin International, Inc. of the United States of America, which had been brought aboard the Aircraft.

(See Figure 1: Estimated flight route.)

## 2.9 Engine Inspection

### 2.9.1 Oil System Inspection

According to the maintenance manual of the Company, the routine maintenance of the Aircraft's engine included a pre-flight inspection, 50-hour inspection and 100-hour inspection.

With regard to the oil system, the 50-hour inspection involved performing a visual inspection of the condition of the piping, and checking for oil leakage after test run of the engine.

In addition, the Company conducted a test run of the engine and checked for oil leaks during each pre-flight inspection.

In the 50-hour inspection conducted 25 days prior to this serious incident and in the test run of the engine conducted prior to the flight on the day of the incident, no oil leakage or other abnormalities were discovered.

### 2.9.2 Oil Consumption

The Company kept an oil filling log to monitor changes in oil consumption. According to data from a month prior to the occurrence of this serious incident, the Aircraft had no tendency for increased consumption in relation to flight time.

## 2.10 Engine Teardown Examination and other Inspection.

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\*1 The "runway of the former Akita Airport" was asphalt-paved, heading 17/35, width 45 m, length 1,500 m.

The results of a teardown examination on the Aircraft's engine and an oil leakage reproduction test, conducted at the manufacturer's facilities with the cooperation of the National Transportation Safety Board (NTSB), and the manufacturer's opinion, were as follows.

- (1) It is probable that, as a result of exhaustion of the engine oil, the fourth and fifth connecting rods fractured and were liberated; these displayed signs of heat damage and discoloration resulting from heat.
- (2) The fractures of the crankcase were probably due to the liberation of the connecting rods.
- (3) During the engine teardown examination, the places where the oil leakage occurred could not be found in the engine body.
- (4) When JTSCB confirmed in the inspection after occurrence of the serious incident that the extension hose had detached from the housing on the engine body, a photograph of taken of the vicinity thereof, based on which traces of oil splattering around the housing were confirmed (see Photo C); consequently, as a reproduction test, test run was performed for three minutes with the extension hose detached from the housing of an engine of the same model. The results revealed leakage of oil around the housing (see Photo D).
- (5) Given that no other places which could have caused an oil leakage were found, it is probable that the exhaustion of oil during the two and a half hour flight was caused by detachment of the extension hose.

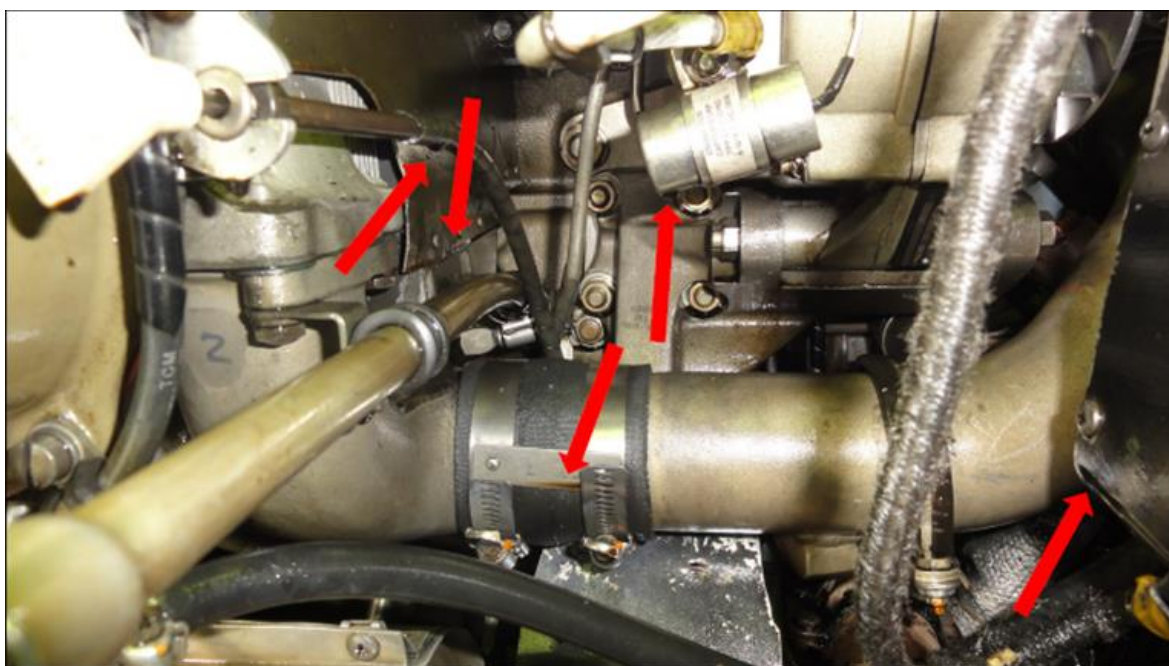


Photo C: Oil splattering around the housing after occurrence of the serious incident  
(The red arrows point to accumulated oil drops and significant oil saturation)

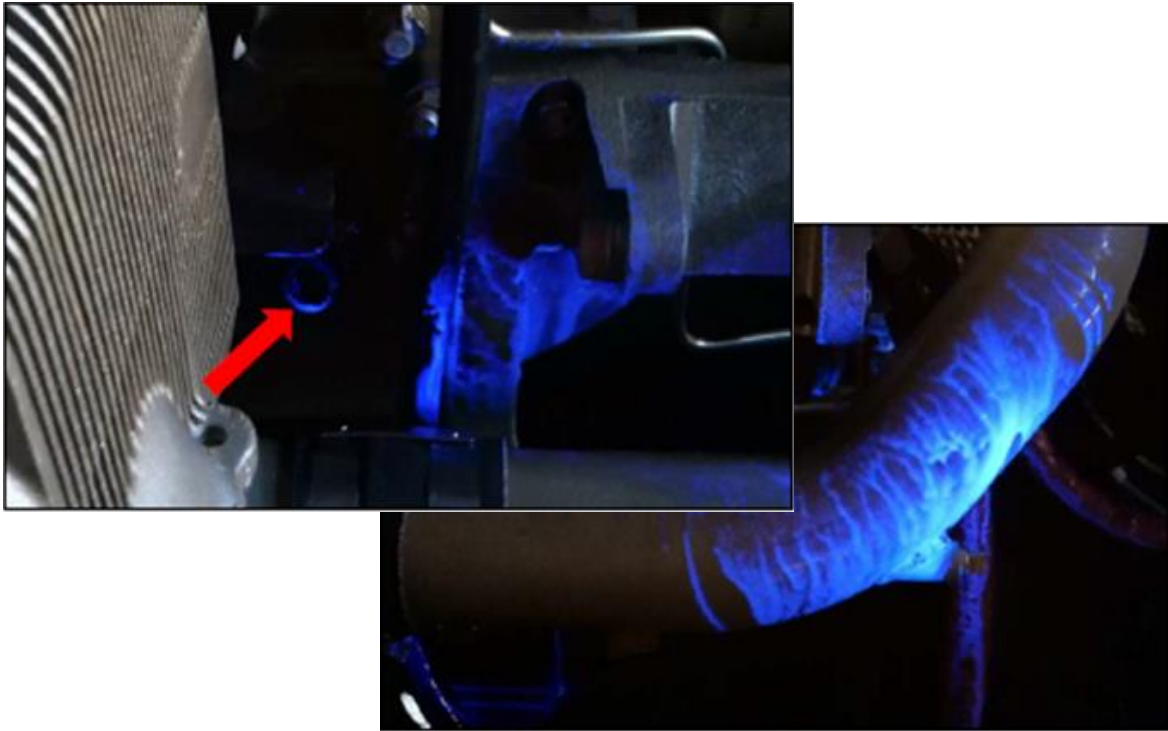


Photo D: Oil splattering during reproduction test  
(Leaked oil has been highlighted with a black light. The red arrow points to normal attach hose.)



## 2.11 Additional Information

### 2.11.1 Oil System

#### (1) Overview of the Oil System

In addition to being used for lubrication of the engine components, the oil of the Aircraft is also used as hydraulic fluid for propeller and turbocharger control.

The oil is drawn up from an oil sump located at the bottom of the engine by an engine-driven oil pump. The oil discharged from the oil pump passes through an oil filter and goes through the turbocharger control and right crankcase oil galley to lubricate the parts on the right side of the engine, and is fed to an oil cooler.

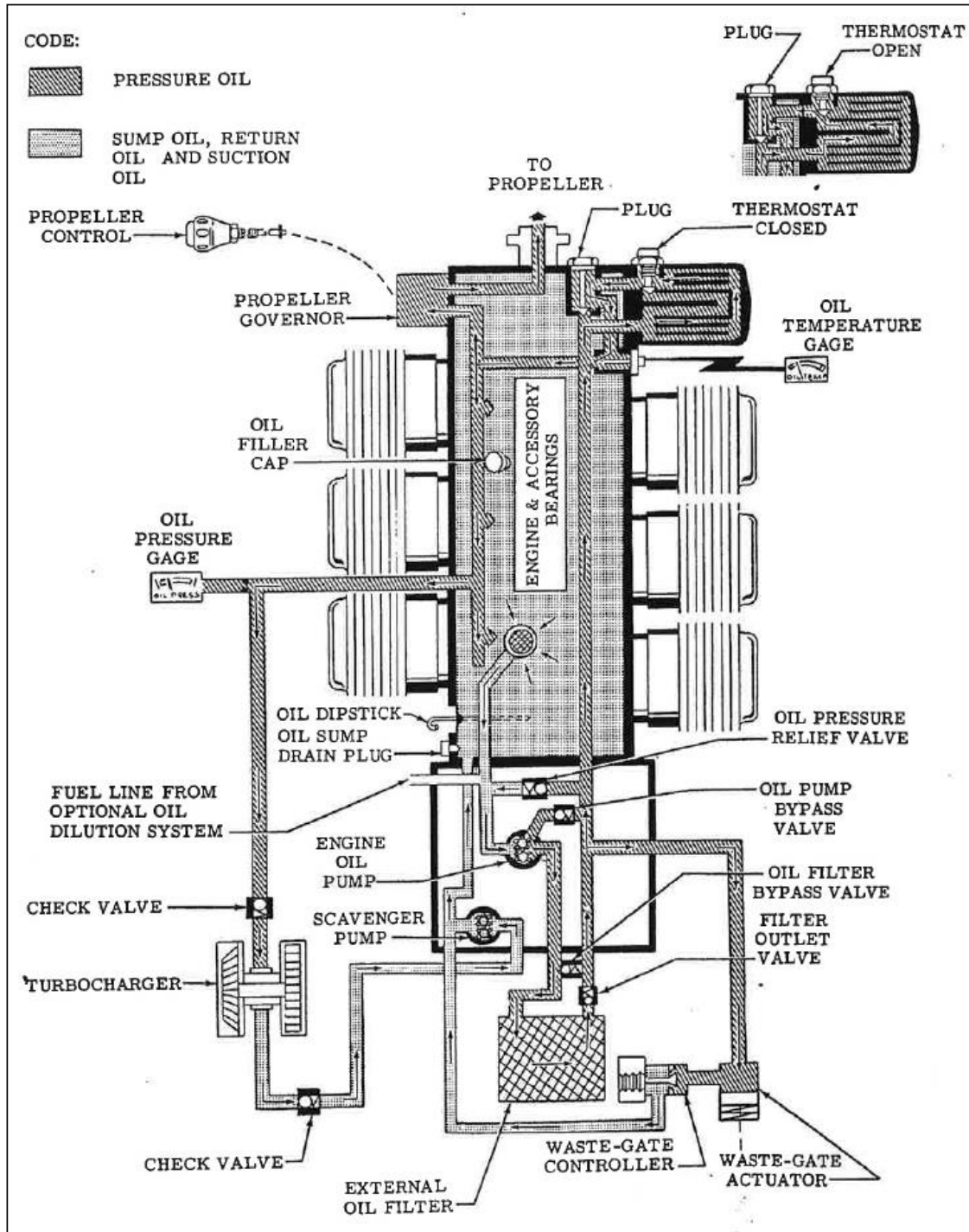


Figure 2: Engine oil system

Oil which has been brought to a suitable temperature in the oil cooler is fed to the propeller control and left crankcase oil gallery.

Oil which has entered the left side circuit of the crankcase oil gallery lubricates the components on the left side of the engine and the inside of the turbocharger.

Oil which has been used for engine lubrication returns to the oil sump under its own weight, and oil which has been used for turbocharger control and lubrication returns to the oil sump by means of a scavenger pump.

With this oil system, there is no oil quantity indicator inside the cockpit.

(2) Use of Oil

- ① The flight manual for the Aircraft contains the following description regarding use of oil. (excerpt)

*2-6. Power plant limitations*

(Omitted)

*4. Oil Grade*

(Omitted)

*Continental Motors specification MHS-24 Ashless Dispersant oil: must be used after 50 hours of total operating time, or after oil consumption has stabilized.*

*(2) Oil viscosity appropriate for temperature range*

*SAE 50: above 4°C (40°F)*

*SAE 10W30 or SAE 30: below 4°C (40°F)*

*4-3-1. Pre-flight Inspection*

(Omitted)

*⑤ Nose*

(Omitted)

*(7) Engine oil quantity*

*Do not operate with less than nine quarts.  
Fill to 12 quarts for extended flight.*

- ② CONTINENTAL AIRCRAFT ENGINE OPERATORS MANUAL (FAA APPROVED) contains the following statements regarding oil quantity. (excerpt)

*SECTION II SPECIFICATION AND LIMITS*

(Omitted)

*LUBRICATION SYSTEM:*

(Omitted)

*Sump Capacity, Quarts Maximum (Except TSIO-520-R, P)*

*12*

(Omitted)

*Usable Oil Quarts Nose Up ..... 6.1*

*Usable Oil Quarts Nose Down ..... 6.1*

(3) Installation Instructions

- ① Installation Instructions at Time of Occurrence of the Serious Incident

At the time of occurrence of the serious incident, there were no Installation Instructions for connecting the extension and housing described in the manufacturer's engine manual or other manuals, and according to the manufacturer, the connection was to be made on the basis on the following standard procedure from the AVIATION MAINTENANCE TECHNICIAN HANDBOOK (FAA-H-8083-30) (hereafter "handbook"), edited by the Federal Aviation Administration of the United States. However, "Koukuuki

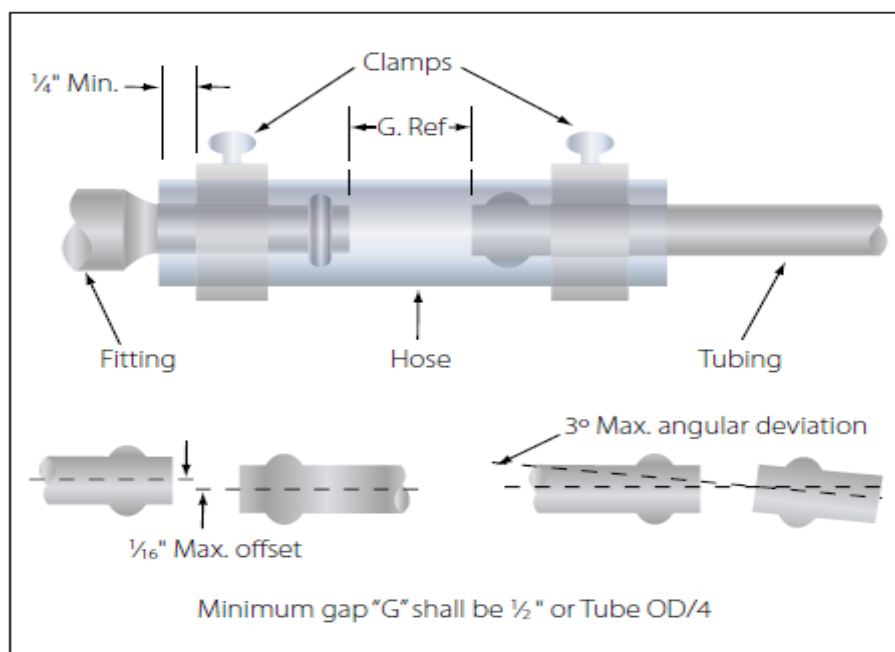
no Kihon Gijutsu (Koukuu Seibishi Kyotsu Jitchi Shiken Kijun)” [Aircraft Basic Techniques (Aircraft Maintenance Engineer Common Field Test Standards)], which is widely used in Japan for aircraft maintenance engineer, contains no description of such a standard procedure.

U.S. Department of Transportation Federal Administration Flight Standards Service “AVIATION MAINTENANCE TECHNICIAN HANDBOOK GENERAL 2008” pp.7–15.

*When repairing a low-pressure line using a flexible fluid connection assembly, position the hose clamps carefully to prevent overhang of the clamp bands or chafing of the tightening screws on adjacent parts.*

*If chafing can occur, the hose clamps should be repositioned on the hose.*

*Figure 7-25 illustrates the design of a flexible fluid connection assembly and gives the maximum allowable angular and dimensional offset.*



**Figure 7-25. Flexible fluid connection assembly.**

② Installation Instructions issued by the Manufacturer

The Installation Instructions for extension and housing (excerpt) of the Service Information Letter (hereafter, "SIL")14-6 issued for operators by the manufacturer after the occurrence of this serious incident are as below, and are applicable when installing or replacing.

*Center the hose over the connection joint (see Figure 7).*

*Slide both hose clamps over the 0.50 ID hose ensuring a minimum 0.25 inch of hose extends beyond each clamp. Torque both hose clamps to 25-35 inch-pounds.*

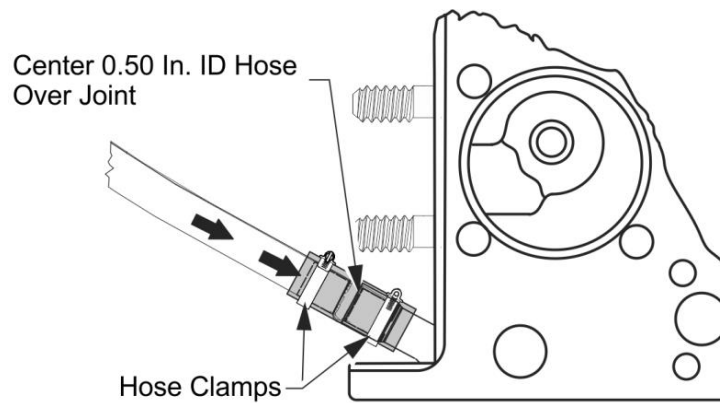


Figure 7: Secure Hose over Connection Joint

(4) The Connection between Extension and Housing

The appearance of the connection between the extension and housing is as follows.

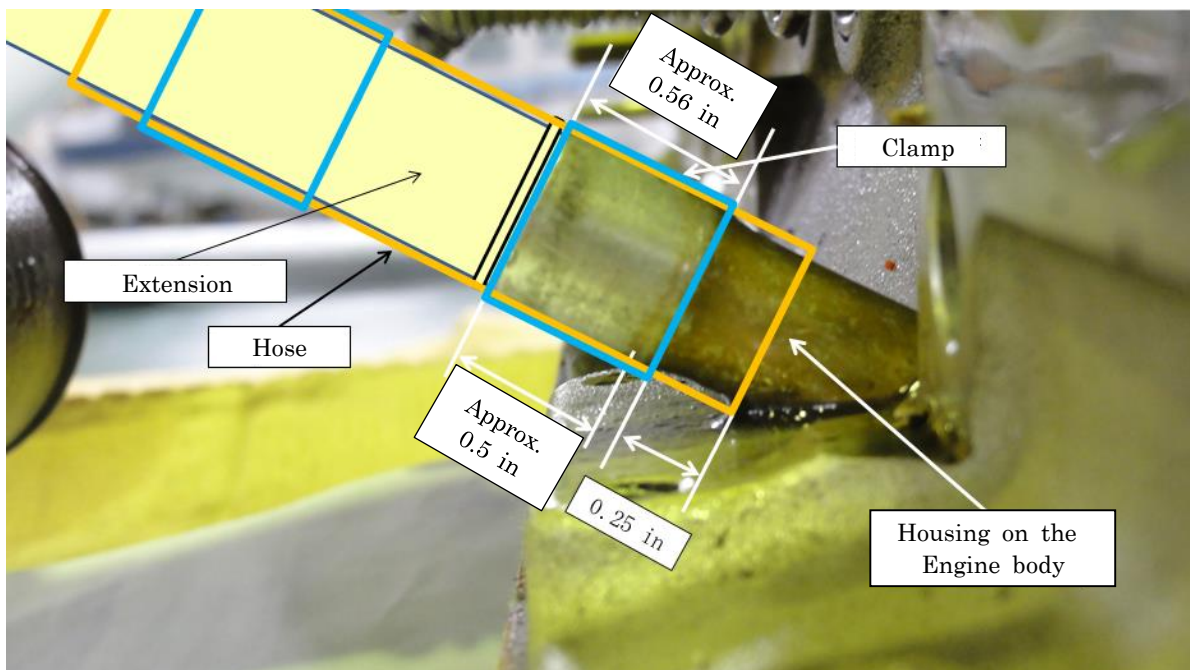
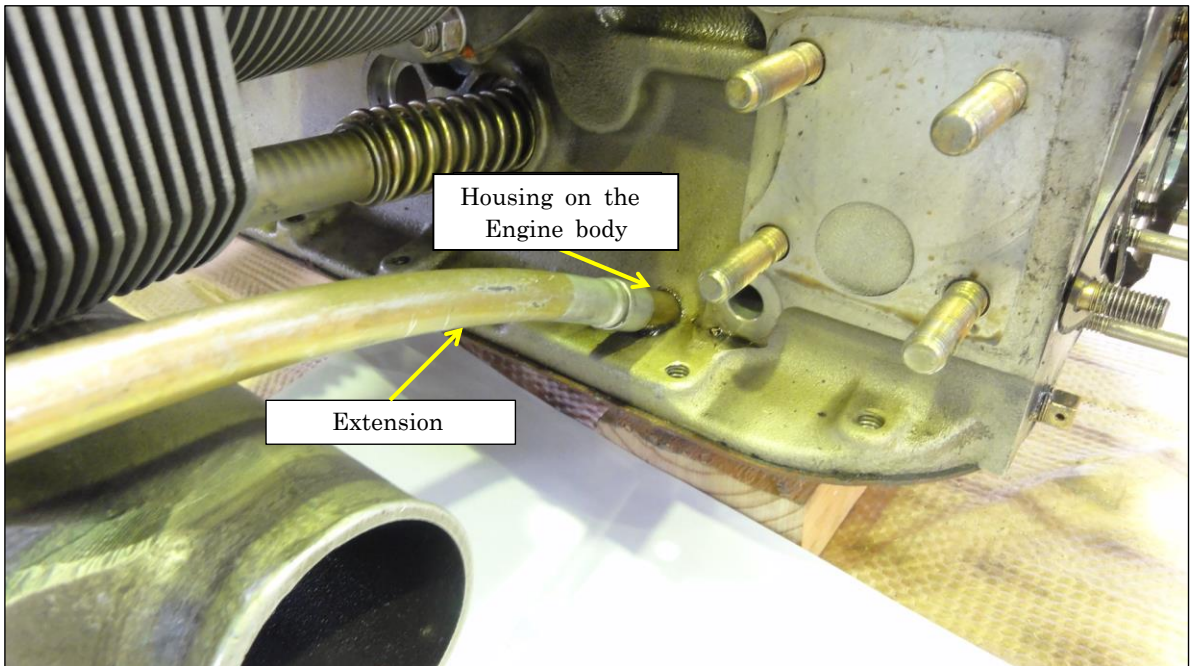


Photo E: Connection area

When connected in accordance with the manufacturer's Installation Instructions described in (3)②, the position of the clamp of the hose (hose is shown by the orange box) is in the area where the diameter of the housing on the engine body becomes thick, as shown by the blue box; therefore, there is no bead to serve as a catch mechanism for preventing detachment of the hose on the inside of the clamp as shown in Figure 7-25 described in (3)①.

2.11.2 Emergency Procedures

The flight manual for the aircraft contains the following description regarding emergency

procedures.

- (1) Matters concerning emergency procedures in case of rough engine operation or loss of power (excerpt)

#### *4. Low Oil Pressure*

*If low oil pressure is accompanied by normal oil temperature, there is a possibility the oil pressure gage or relief valve is malfunctioning. A leak in the line to the gage is not necessarily cause for an immediate precautionary landing because an orifice in this line will prevent a sudden loss of oil from the engine sump. However, a landing at the nearest airport would be advisable to inspect the source of trouble.*

*If a low oil pressure is accompanied by a rise in oil temperature, there is good reason to suspect an engine failure is imminent. Reduce engine power immediately and select a suitable forced landing field. Use only the minimum power required to reach the desired touchdown spot.*

- (2) Matters concerning emergency operation in case of engine failure (excerpt)

#### *3-4-1 Engine Failure*

(Omitted)

*After an engine failure in flight, the best glide speed (omitted) should be established as quickly as possible. While gliding toward a suitable landing area, an effort should be made to identify the cause of the failure. If time permits, an engine restart should be attempted as shown in the checklist. If the engine cannot be restarted, a forced landing without power must be completed.*

(Omitted)

The best glide speed mentioned above is estimated to have been approximately 70 kt at the estimated weight of the Aircraft at the time of engine halt.

#### 2.11.3 Condition of Camera Lens Cover

A ground operator belonging to the same company as the passenger removed the vertical camera from the Aircraft at the forced landing site. The glass surface of the lens cover of the vertical camera was contaminated with oil at the time; consequently, the ground operator wiped the oil off. The amount of adhering oil was not that large and a portion of surface was dry.

After returning to the office, the passenger discovered that all images starting with a test image taken at about 11:05, prior to arriving in Yurihonjo, had a blur which seemed to be due to an oil film.

## 3 ANALYSIS

### 3.1 Qualification of Personal

The pilot held a valid airman competence certificate and a valid aviation medical certificate.

### 3.2 Airworthiness Certificate

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

### 3.3 Meteorological Conditions

As described in 2.6(1), since the temperature when the Aircraft's engine was started is estimated to have been approximately 9°C, the Aircraft's oil described in 2.5.2 met the oil grade of the flight manual as described in 2.11.1(2)①; consequently, it is highly probable that the viscosity of the oil did not contribute to engine halt.

Moreover, based on the statement in 2.1.2(1) and the anemometer observations in the vicinity of the forced landing site described in 2.6(2), it is highly probable that the weather at the location of this serious incident at the time of its occurrence was clear, good visibility, calm wind of easterly approximately 4 kt; accordingly, it is probable that meteorological phenomena did not affect the forced landing of the Aircraft.

### 3.4 Aircraft Damage

#### 3.4.1 Engine

Based on the results of the engine teardown examination described in 2.10 and other information, among the engine damage described in 2.3.2(1), it is highly probable that the scratches to the cylinder liners and the fracture of connecting rods occurred due to continued operation of the engine in a state of insufficient oil. Moreover, it is probable that the fracture on the crankcase were formed due to violent collision with the fragments generated through fracturing of the connecting rods and other parts.

#### 3.4.2 Hose of Extension

As described in 2.5.2, since the manufacturer ships the extension unattached to the engine body, it is highly probable that the attachment work was performed during installation of the engine by the Company as described in 2.5.2.

As described in 2.3.2(1)②, the fitting which clamps the hose connecting the extension to the housing on the engine body was out of position; therefore, the clamp jutted out toward the engine body, the hose connection came loose, and the hose detached from the housing on the engine body .

In the statements described in 2.1.2(1) and (3), the pilot and maintenance engineer claim to have found no abnormalities in the aircraft during the pre-flight inspection.

Based on these facts, it is somewhat likely that when the Aircraft's engine was started and while the Aircraft was flying, engine vibration was transmitted to the loosened connection between the hose of extension and the housing on the engine body, and then the hose detached from the housing. Moreover, it is somewhat likely that the hose at the connection with the housing was loose because the hose clamp was installed in a state where it was out of position toward the end of the hose and jutted out toward the engine body, and was thus unable to uniformly and

adequately clamp the hose.

Incidentally, as described in 2.11.1(3)①, at the time of occurrence of this serious incident, the manufacturer's engine manual and other manuals contained no guidelines or instructions for the connection of the extension to the housing, but according to the manufacturer, the clamp was to be connected with a margin of 0.25 inches or more from the end of the hose, based on the standard procedure of handbook. As shown in 2.3.2(1)② Photo B, the clamp on the extension side, which is the opposite connecting part to the connecting part on the engine body side, in which a problem was found during the aircraft examination, is mounted with a similar margin from the hose end, and no problems were found in other parts of the hose connection. Based on this, as described in 2.11.1(3)①, while there is no specific description regarding such a margin at the connection in "Koukuuki no Kihon Gijutsu (Koukuu Seibishi Kyotsu Jitchi Shiken Kijun)" [Aircraft Basic Techniques (Aircraft Maintenance Engineer Common Field Test Standards)], which is widely used in Japan for aircraft maintenance engineer, it is probable that connecting such a part with a certain margin would be common knowledge for an aircraft maintenance engineer, and it is highly probable that the parts other than the connecting part which had the problem had been connected with such a margin in accordance with such common-sense knowledge.

In addition, as described in 2.11.1(4), the housing on the engine body side, as shown in Figure 7-25 of 2.11.1(3)①, had no catch mechanism which would prevent detachment of the clamp in the event that it became loose. It is somewhat likely that this contributed to the detachment of the loosened extension hose from the housing on the engine body.

### 3.5 Condition of the Oil System

#### 3.5.1 Oil Leakage and Lubrication Status

According to the statement in 2.1.2(1), the pilot noticed an oil pressure reduction during a cruise check at about 11:27, engine power began to decrease even though the throttle lever was moved to the maximum position, engine vibration was perceived at about 11:40, and engine power declined greatly while heading to Akita Airport for an emergency landing; consequently, the pilot determined that he could not reach Akita Airport and decided to make a forced landing to the seacoast.

As described in 2.11.3, after returning to the office, the passenger discovered that there was a blur which appeared to be due to an oil film in the all images taken from the Aircraft starting at 11:05. Moreover, according to the statement in 2.1.2(2), the passenger closed the shutter door at the bottom of the fuselage for the vertical photography camera upon being informed by the pilot that filming will be cancelled due to a low oil pressure. Subsequently, when a strong vibration occurred in the vicinity of Akita City, the passenger says that he thought white smoke was coming out from the front.

As described in 2.11.3, when the ground operator removed the camera from the Aircraft, he wiped off oil adhering to the glass surface of the lens cover. He stated that the amount adhering was not that large and a portion of the surface was dry.

As described in 2.3.2(2), a large amount of oil was adhering to the shutter door at the bottom of the fuselage for the vertical photography camera, just as to the outer skin of the fuselage.

Based on these facts, it is probable that by about 11:05, when approaching the Yurihonjo photography location, the oil of the Aircraft had already leaked to the extent that it adhered to the lens cover of the camera, but the leakage was not so large that it spread over the entire lens



cover.

Moreover, it is probable that at about 11:27, when the pilot noticed a low oil pressure, the quantity of oil which could be used in the oil system was below the 6.1 quarts usable oil described in 2.11.1(2)②.

It is probable that, as a result of continued operation without reducing engine power in a state where oil had leaked out and become insufficient, at about 11:40, vibration occurred in the engine due to insufficient lubrication.

It is probable that thereafter, while heading to Akita Airport for an emergency landing, fragments of connecting rods and other parts which had fractured due to insufficient oil, violently collided with the crankcase, damaging the engine, and a large amount of oil leaked through the resulting fractures and contacted high temperature parts of the engine, due to which white smoke was generated and power declined greatly. Moreover, it is probable that, while attempting a forced landing at the site of closed Akita Airport, the engine became seized due to the fragments and other parts, and halted.

### 3.5.2 Location of Leakage

As described in 2.3.2(1)②, in the aircraft examination after the serious incident, it was confirmed that the hose of extension had become loose and detached from the housing on the engine body.

As described in 2.10, based on the results of engine teardown examination, the location where the oil leakage occurred could not be found in the engine body, and oil leakage was observed around the housing in an oil leakage reproduction test performed after removing the extension from the housing.

Based on these facts, it is probable that, during flight, the oil from inside the engine leaked out gradually through a gap formed by detachment of the hose, and was released outside the aircraft.

## 3.6 Inspection of Extension and Housing

As described in 2.9.1, an inspection of the condition of the oil system piping of the Aircraft is to be conducted in the 50-hour inspection, and this inspection had been performed by the Company, but no looseness of the hose at the connection between the extension and the housing was found.

In addition, as described in 2.9.2, from at least one month before, there was no tendency for increased oil consumption relative to flight time of the Aircraft; therefore, it is probable that no oil leakage occurred in the Aircraft from the hose connection between the extension and housing prior to the day of occurrence of this serious incident.

In this way, since no adhesion of oil or other substances on the pipes was considered to be observed at the stage before the oil leakage began, it is probable that it would have been difficult to detect the looseness of the hose connection through a visual inspection.

## 3.7 Situation up to Forced Landing of the Aircraft

### 3.7.1 Decision at Time of Oil Pressure Reduction

As described in 2.11.2(1), according to the flight manual of the Aircraft, if low oil pressure is accompanied by normal oil temperature, this does not immediately lead to precautionary landing situation, but if possible, it is preferable to land at the nearest airport and to inspect source of trouble. However, if low oil pressure is accompanied by a rise in oil temperature, there

is good reason to suspect an engine failure is imminent. Reduce the engine power immediately and select a suitable forced landing field. Based on this, the seriousness of a low oil pressure is to be judged on the basis of oil temperature. Thus, in the event that the Aircraft's engine had insufficient oil and adequate lubrication could no longer be provided, it is highly probable that oil temperature would rise as a sign of imminent engine failure. Moreover, as described in 2.10(1), since signs of heat damage and discoloration resulting from heat were observed on the fourth and fifth connecting rods which were liberated, it is highly probable that there was a rise in oil temperature as described in the flight manual before the engine failure, and it is somewhat likely that this was indicated on the instruments.

According to the statement in 2.1.2(1), in the cruise check performed upon assuming a cruising state, the pilot found that the oil pressure gage reading was low, and changed the destination aerodrome from Hanamaki Airport to Odate Noshiro Airport. Besides, the pilot stated that he is not sure what the numeral value of oil temperature at this time was, but he was aware that it was within the normal range. Moreover, after confirming low oil pressure, the pilot placed the throttle lever in the maximum position, but engine power began to decrease; consequently, the pilot left the throttle lever as it was and headed for Odate Noshiro Airport while descending altitude in order to maintain speed, but having obtained information that there was fog and the airport was in IMC, the pilot requested instrument approach using ILS. However, the response was that the ground equipment was not functioning and thus ILS approach would not be possible; furthermore, the pilot obtained information that the weather at Akita Airport, which had been in IMC, seemed to be improving; therefore, the pilot again changed the destination aerodrome to Akita Airport. Subsequently, due to the sudden occurrence of engine vibration, the pilot requested emergency landing to Akita Airport, but immediately thereafter, engine power dropped significantly and the pilot decided to make a forced landing to the seacoast, but made a forced landing to empty lot found while on the way to the seacoast. In this statement, the pilot was aware that the oil temperature was within normal range at the time of discovering low oil pressure, but did not mention subsequently performing selection of a forced landing field or throttle operation in light of a change involving oil temperature increase, as described in the flight manual. In addition, as described in 2.1.1, since the pilot was heading for Akita Airport until making the report regarding forced landing to the seacoast from approximately nine nm northwest of Akita Airport at a GPS altitude of approximately 1,800 ft, it is highly probable that he did not reduce the engine power up to the moment of engine failure and being broken. Thus, the pilot had the awareness of oil temperature being within the normal range when low oil pressure occurred, but subsequently continued the flight without reducing engine power in light of a change involving oil temperature increase, and it is somewhat likely that this contributed to the engine being broken and halt before landing.

### 3.7.2 Situation at the Time of Forced Landing

According to the statement in 2.1.2(1), after vibration occurred in the engine, the manifold air pressure dropped significantly; therefore, the pilot decided on a forced landing, and while approaching an empty lot found before the coastline, immediately before beginning the final approach, the engine halted. The pilot also said that after beginning the final approach, he set the flaps to 40° and made the approach at an airspeed of approximately 70 kt, and came to a stop without using the brakes much.

Based on this, it is probable that the pilot decided on a forced landing after engine damage,

and the engine halted during the approach, but the pilot properly executed an emergency landing without power as described in 2.11.2(2), and avoided damage that would qualify as an accident.

### 3.8 Prevention of Engine Halt in Case of In-flight Oil Leakage

The following measures may be considered for preventing engine halt in case of an in-flight oil leakage.

#### (1) Proper Installation of Oil System Piping

Different from multi-engine aircraft, for a single-engine aircraft which does not allow a malfunctioning engine shutdown immediately, an in-flight oil leak creates highly dangerous situation. The proper installation of oil system piping is extremely important for preventing engine oil leakage. Therefore, when installing oil piping, including the hose of extension and housing, it is necessary to do the work carefully and perform a proper inspection after the installation.

#### (2) Countermeasures for Preventing Detachment of Connecting Hose between the Extension and Housing

To prevent detachment of the connecting hose between the extension and housing, it is necessary to clarify the appropriate installation instructions, to specify the tightening torque of the hose clamp, and avoid attaching the hose in an improper state.

In addition, it is preferable to provide a detachment prevention mechanism, such as by providing a bead on the inside of the clamp in order that the hose will not detach readily even if the clamp becomes loose.

#### (3) Inspection of Oil Piping during Scheduled Inspections and other Inspections

It is probably difficult to discover looseness of piping at the stage where there are no signs of leakage such as adhesion of oil; however, if the position of the clamping fittings is improper, or if slip marks are out of place and other evidences, it is probable that this could be confirmed through a visual inspection.

During scheduled inspections, it is necessary to inspect not to miss such signs of abnormalities.

#### (4) Decisions focusing on changes in oil temperature

When the oil pressure of a single engine airplane with no oil quantity indicator drops during flight, it is necessary to carefully monitor the state of oil temperature and decide the severity of the situation by observing signs of oil exhaustion.

In particular, cases where oil temperature has started to rise require decisions and procedures to immediately reduce power and reduce engine load, select a suitable forced landing field while there is altitude to spare, and perform a safe forced landing before the engine halts, if at all possible.

## 4 PROBABLE CAUSES

It is probable that this serious incident occurred due to the fact that the engine of the aircraft continued to be operated in a state where the oil was leaking and had become insufficient; accordingly, the engine was broken, leading to engine halt in flight.

It is probable that the cause of the oil leakage was due to the fact that engine vibration was being transmitted to the loose connection between the hose of extension and the housing on the

engine body, and then the hose detached from the housing.

It is somewhat likely that the hose had come loose at the connection to the housing because the hose clamp had been installed in a state where it was out of position toward the end of the hose and jutted out toward the engine body; accordingly, uniform and adequate clamping of the hose was not achieved.

## 5 SAFETY ACTIONS

### 5.1 Safety Actions Taken by the Civil Aviation Bureau

On the basis of information provided by the Japan Transport Safety Board, the Civil Aviation Bureau noticed the All Japan Air Transport and Service Association and the Japan Aircraft Pilot Association on June 13, 2014 that they would make the content of the information to the members under their associations from the viewpoint of prevention of aircraft accident.

### 5.2 Safety Actions Taken by the Company

The Company took the following measures as safety actions following the occurrence of this serious incident.

#### (1) Operation related matters

① To reconfirm all pilots in knowledge of emergency procedures, special training was conducted in classroom, focusing on the following matters, divided into a common part and information specific to each type-related aircraft model.

- a General emergency procedures
- b Procedures in case of engine failure, engine trouble and engine power loss
- c Procedures in case of forced landing
- d Important points for having leeway when gliding to make a forced landing (e.g., selecting a flight route taking the forced landing field into account, and accurately ascertaining location during flight.)

#### ② Survey and Selection of Suitable Forced Landing Sites

Review and selection of suitable forced landing sites covering the area of operation of aircraft was performed.

#### ③ Strengthening of Cooperation between Dispatchers and Pilots

The guidelines for information exchange between dispatchers and aircraft in case of an emergency were clarified.

#### (2) Maintenance-related matters

##### ① Special Inspection

After the occurrence of this serious incident, visual inspections of engines and test run to confirm the absence of abnormalities were performed on aircraft equipped with reciprocating engines.

##### ② Installation of Extension and Housing

In addition to the SIL information issued by the manufacturer, an Extension and Housing Installation Standard Operating Procedures were prepared and disseminated to the relevant personnel; these Procedures specified providing a safety wire and slip marks for preventing detachment of the extension from the housing on the engine body.

##### ③ Revision of Maintenance Manual

The following items were added and disseminated to the relevant personnel.

- a Check of slip mark condition during pre and post-flight inspection
- b Important check locations such as safety wire, clamp looseness, hose condition and oil leakages were established for checking in the 50-hour inspection
- c Considering the reduction in friction and other conditions due to degradation of the extension hose, the service life of the hose was limited to one year

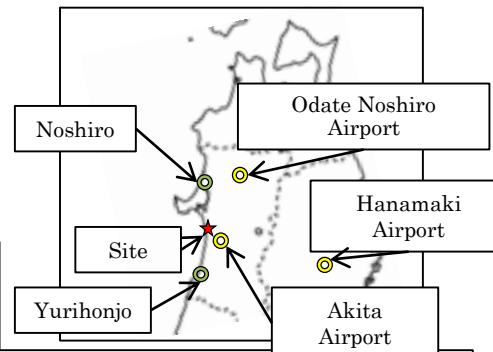
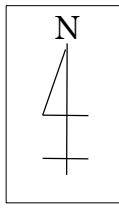
④ Proper operation of oil gage

To prevent the extension from detaching from the housing due to improper withdrawal of the oil gage rod, the proper operation, in which the handle of the gage rod is turned 90° left or right to disengage the lock before the withdrawing, was specified and brought to the attention of the relevant personnel.

### 5.3 Safety Actions Taken by the Manufacturers

In light of the occurrence of this serious incident, as described in 2.11.1(3)②, on September 16, 2014, the manufacturer issued the SIL 14-6 to its engine operators, regarding the installation instructions such as specifying the hose clamping torque when connecting the extension and housing.

Figure 1: Estimated flight route



\* The following drawing shows the positional relationship between GPS records and occurrence of events. Altitude shown is the altitude recorded on the GPS.

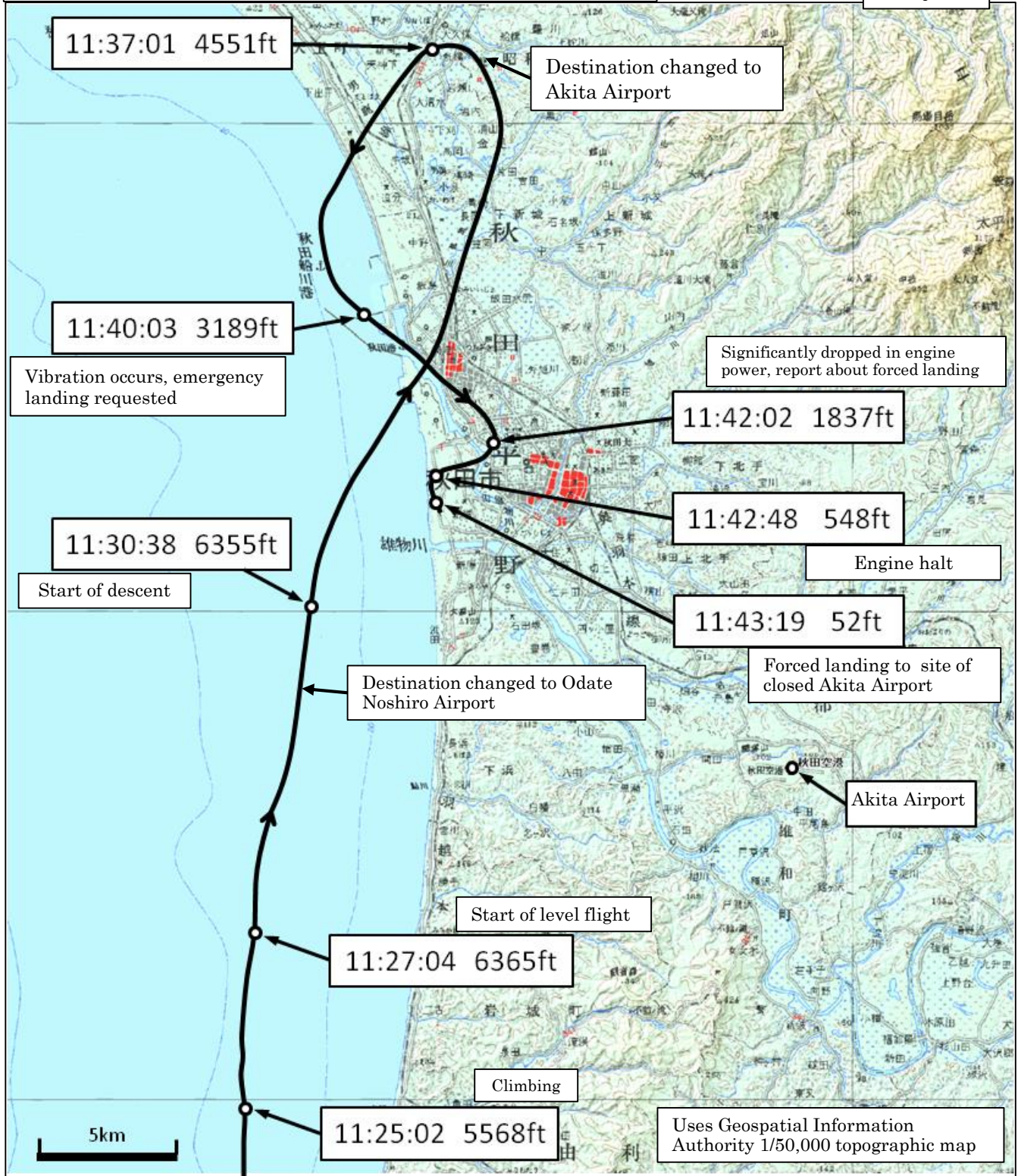


Figure 2: Forced landing site

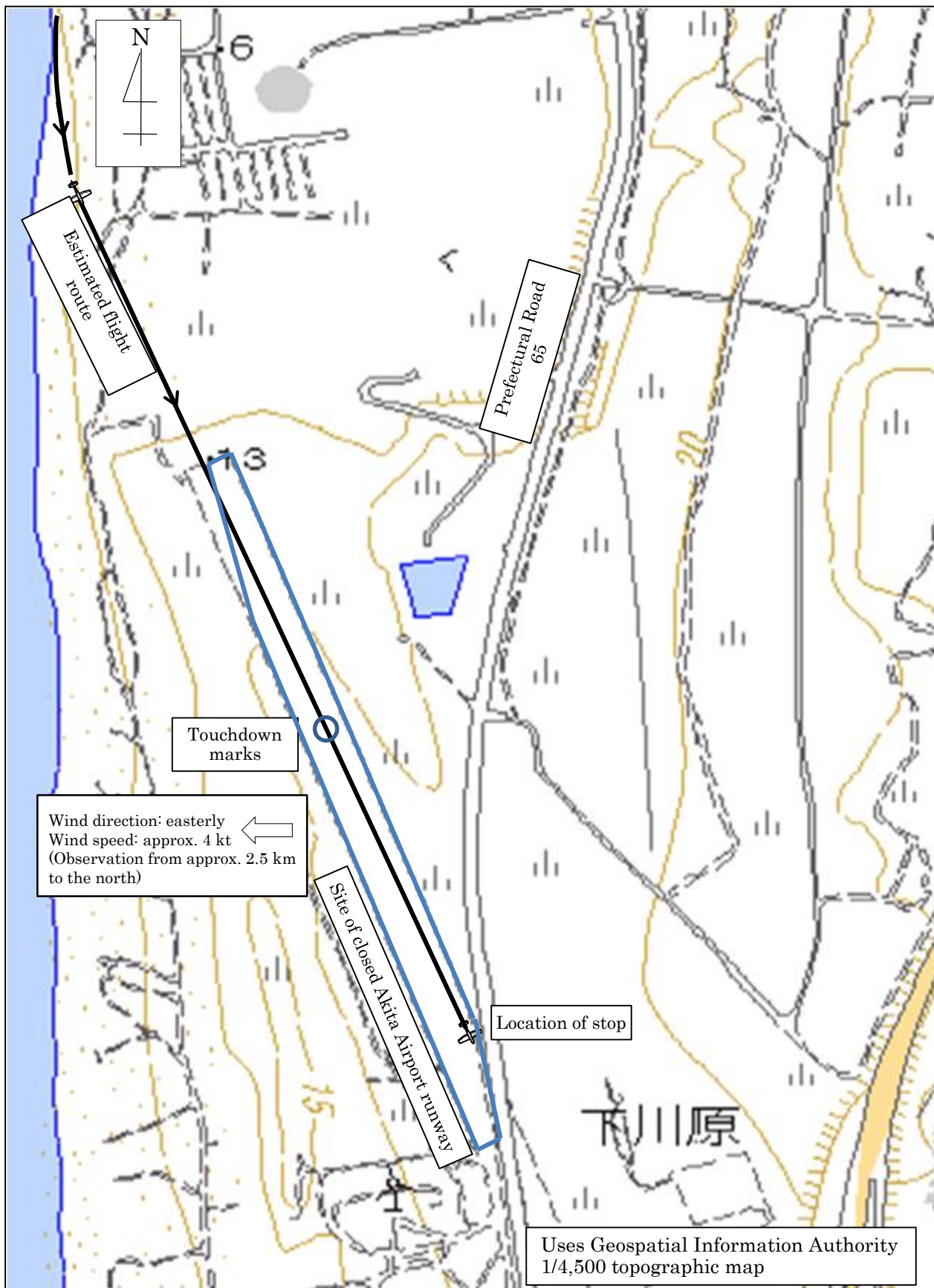
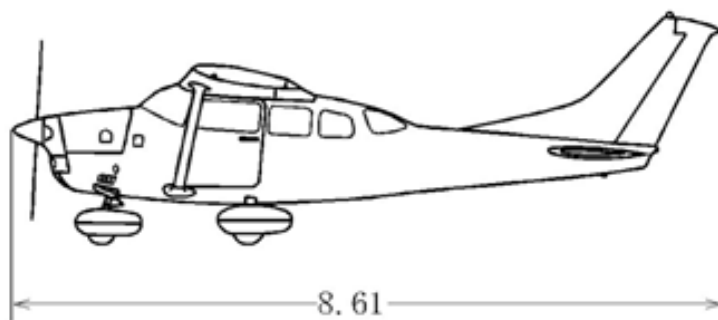
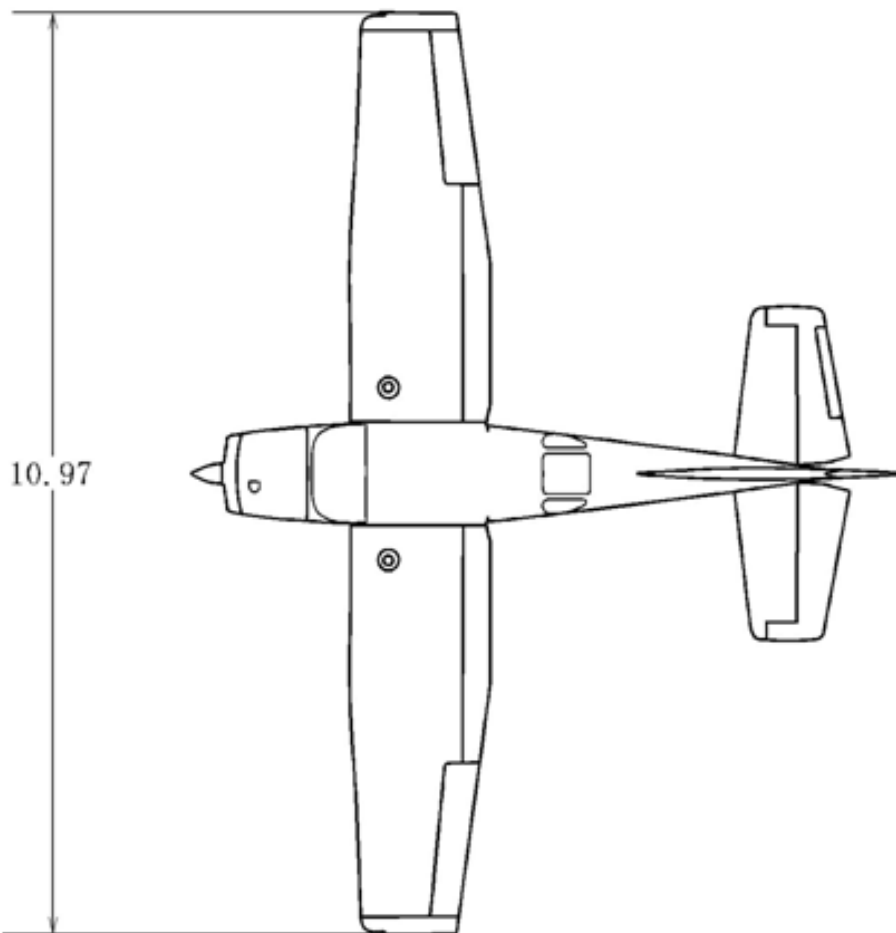
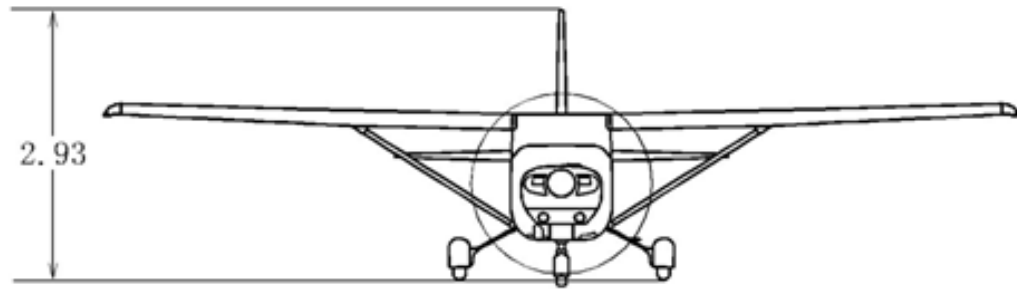


Figure 3: Three Angle View of Cessna TU206G

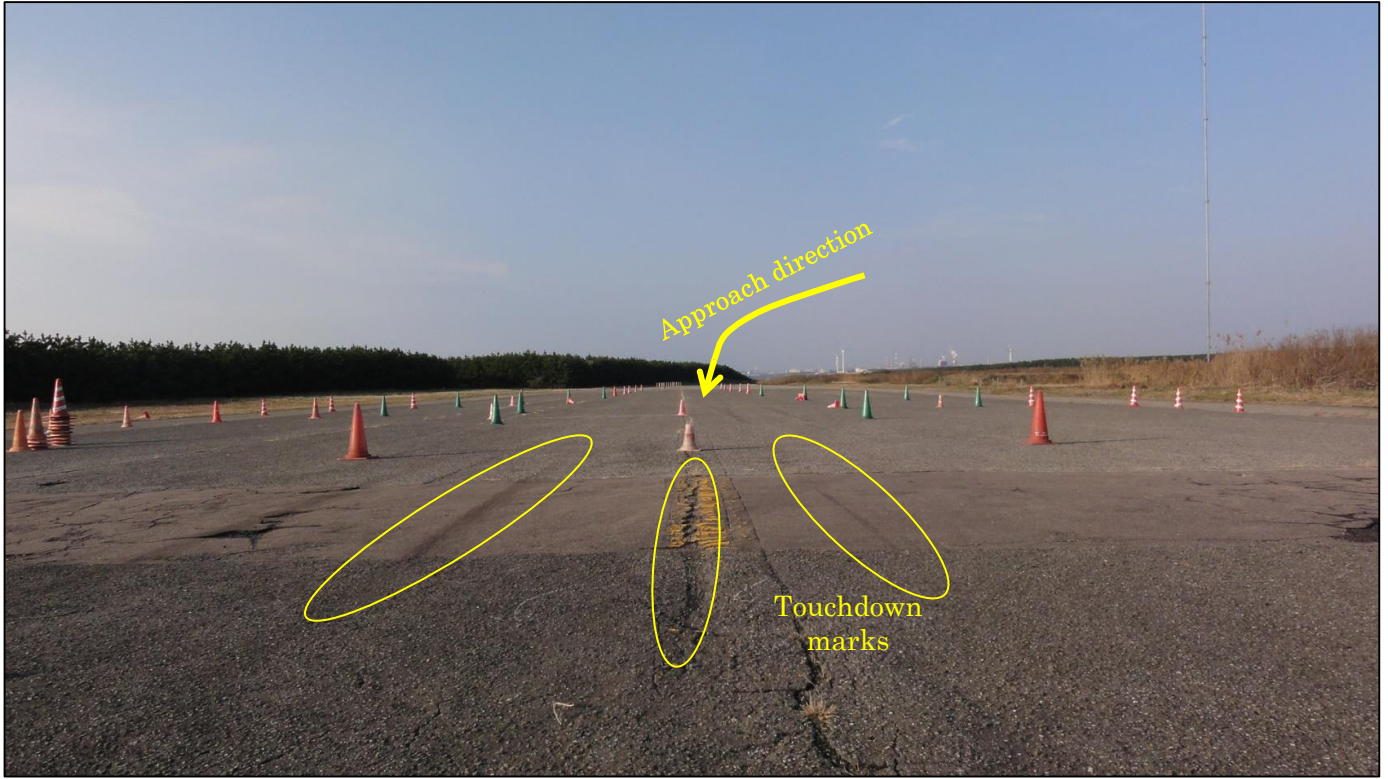
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# Photo 1: Forced landing site

Approach side



Landing side

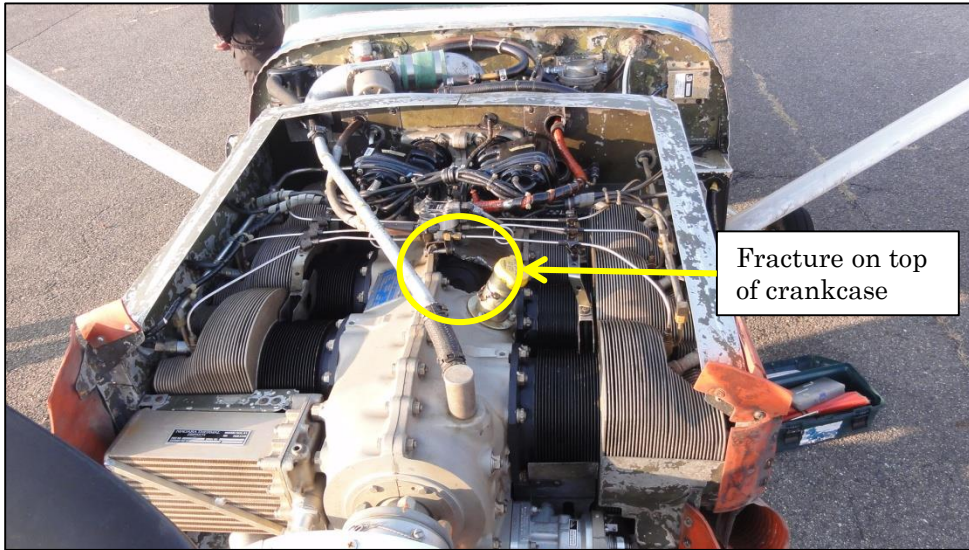


Photo 2: Serious incident Aircraft



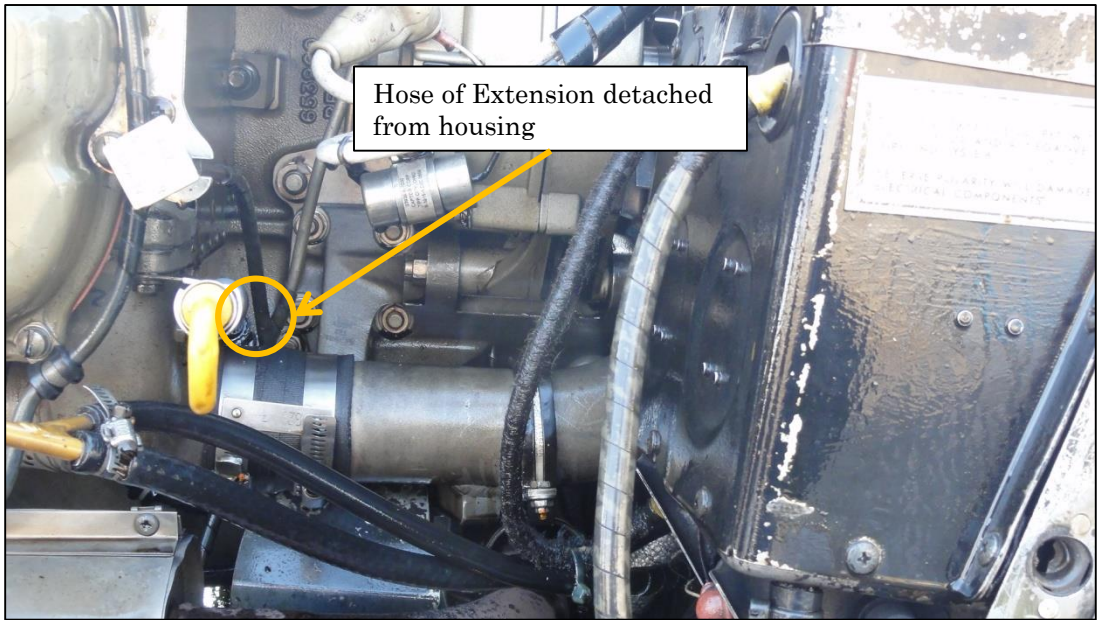
### Photo 3: Condition of engine

(Front)



Fracture on top of crankcase

(Left side)



Hose of Extension detached from housing



(Nose)

Fractured 4<sup>th</sup> and 5<sup>th</sup> connecting rods



4th

5th