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NATIONAL TRANSPORTATION SAFETY COMMITTEE

Aircraft Accident Investigation Report

PT. Sabang Merauke Raya Air Charter
CASA 212 - 100 ; PK–ZAI
30km North of Raja Haji Fisabilillah Airport,
Bintan Island, Riau
Republic of Indonesia

12 February 2011

NATIONAL TRANSPORTATION SAFETY COMMITTEE
MINISTRY OF TRANSPORTATION
REPUBLIC OF INDONESIA
2012

This Final Report was produced by the National Transportation Safety Committee (NTSC), Ministry of Transportation Building 3rd Floor, Jalan Medan Merdeka Timur No. 5 Jakarta 10110, INDONESIA.

The report is based upon the investigation carried out by the NTSC in accordance with Annex 13 to the Convention on International Civil Aviation Organization, the Indonesian Aviation Act (UU. No. 1/2009) and Government Regulation (PP. No. 3/2001).

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GLOSSARY OF ABBREVIATIONS

AGL	:	Above Ground Level
AOC	:	Air Operator Certificate
ATC	:	Air Traffic Control
ATPL	:	Airline Transport Pilot License
BMKG	:	*Badan Meteorologi Klimatologi dan Geofisika* (Meteorological, Climatological and Geophysical Agency)
CAMP	:	Continuous Airworthiness Maintenance Program
CASR	:	Civil Aviation Safety Regulation
CMM	:	Company Maintenance Manual
CPL	:	Commercial Pilot License
CSN	:	Cycles Since New
CVR	:	Cockpit Voice Recorder
DGCA	:	Directorate General Civil Aviation
FCU	:	Fuel Control Unit
FDR	:	Flight Data Recorder
ICAO	:	International Civil Aviation Organization
KNKT / NTSC	:	*Komite Nasional Keselamatan Transportasi* (National Transportation Safety Committee)
NTS	:	Negative Torque System
PIC	:	Pilot in Command
RII	:	Required Inspection Items
SAR	:	Search and Rescue
SB	:	Service Bulletin
SDO	:	Spatial Disorientation
S/N	:	Serial Number
SMAC	:	Sabang Merauke Raya Air Charter
SPV	:	Slow Phase Velocity
TBO	:	Time Between Overhaul
TSN	:	Time Since New
TSO	:	Time Since Overhaul
UTC	:	Universal Time Coordinate
VNG	:	Video Nystagmography

SYNOPSIS

On 12 February 2011, a CASA C212-100 aircraft, registered PK-ZAI, operated by Sabang Merauke Raya Air Charter (SMAC), departed from Hang Nadim Airport, Batam (BTH/WIDD) at 1318 LT (0618 UTC)[1] for a test flight following an engine replacement to the engine number one. The test flight was conducted over Tanjung Pinang Island area. There were five persons on board consisted of two pilots, and three company engineers.

At 0628 UTC the aircraft appeared on Tanjung Pinang Approach radar display and was flying toward Tanjung Pinang area. Tanjung Pinang Approach controller informed that the aircraft was identified flying over Tanjung Pinang at 2000 feet.

At 0633 UTC the aircraft received clearance to climb to 4000 feet.

At 0644 UTC the aircraft disappeared from Tanjung Pinang radar display. The last position of the aircraft identified on the radar display was on 16 miles radial 010º from Tanjung Pinang airport. Tanjung Pinang Approach controller could not communicate with the PK-ZAI.

At 0705 UTC, the controller requested relay by another aircraft to search PK-ZAI. The other aircrafts could not communicate with PK-ZAI.

At 0706 UTC Tanjung Pinang Approach controller received information from Indonesian Air Force Base at Gunung Bintan that an aircraft had crashed at Gunung Kijang forest, Bintan Island. After receiving the information, Tanjung Pinang Airport staff coordinated with SAR Bureau, local police, and Indonesian Army for search and rescue operation.

The aircraft was found at Gunung Kijang forest, Bintan Island at coordinate 1° 10’ 45” N; 104° 34’ 22” E, about 30 km north of Tanjung Pinang Airport.

All occupants were fatally injured in this accident. The aircraft was substantially damaged.

As a result of this accident investigation, a number of safety actions have been taken to prevent a recurrence. These include:

- Directorate General of Civil Aviation (DGCA) conducted a special safety audit for PT. Sabang Merauke Raya Air Charter (SMAC);
- PT. Sabang Merauke Raya Air Charter (SMAC) replaced some managerial position to improve their safety management and procedures.

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1 The 24-hour clock in Coordinated Universal Time (UTC) is used in this report to describe the local time as specific events occurred. *Waktu Indonesia Barat* (WIB) is UTC +7 hours.

1 FACTUAL INFORMATION

1.1 History of the Flight

On 12 February 2011, a CASA C212-100 aircraft, registered PK-ZAI, operated by Sabang Merauke Raya Air Charter (SMAC), departed from Hang Nadim Airport, Batam (BTH/WIDD) at 1318 LT (0618 UTC) for a test flight following an engine replacement to the engine number one. The test flight was conducted over Bintan (Tanjung Pinang) Island area. There were five persons on board consisted of two pilots, and three company engineers.

At 0628 UTC the aircraft appeared on Tanjung Pinang Approach radar display and was flying toward Tanjung Pinang area. Tanjung Pinang Approach controller informed that the aircraft was identified flying over Tanjung Pinang at 2000 feet.

At 0633 UTC the aircraft received clearance to climb to 4000 feet.

At 0644 UTC the aircraft disappeared from Tanjung Pinang radar display. The last position of the aircraft identified on the radar display was on 16 miles radial 010º from Tanjung Pinang airport. Tanjung Pinang Approach controller could not communicate with the PK-ZAI.

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The aircraft was found at Gunung Kijang forest, Bintan Island at coordinate 1° 10’ 45” N; 104° 34’ 22” E, about 30 km north of Tanjung Pinang Airport.

All occupants were fatally injured in this accident. The aircraft was substantially damaged.

Map courtesy of Google Earth

Figure 1: PK-ZAI Flight as appeared on Tanjung Pinang Radar

Figure 2: PK-ZAI aircraft after the accident

1.2 Injuries to Persons

Injuries	Flight crew *	Passengers **	Total in Aircraft	Others
Fatal	2	3	5	-
Serious	-	-	-	-
Minor/ none	-	-	-	-
TOTAL	2	3	5	-

Note:

* the crew consisted of two pilots.

** the passengers consisted of three flight engineers.

1.3 Damage to Aircraft

The aircraft was substantially damaged.

1.4 Other Damage

There were several damages to trees around the accident site due to impact with the aircraft.

1.5 Personnel Information

1.5.1 Pilot in command

Gender	:	Male
Age	:	61 years
Nationality	:	Indonesian
License type	:	ATPL
Valid until	:	31 May 2011
Aircraft type rating	:	F-28, CASA 212
Instrument rating	:	Valid until 30 November 2011
Medical certificate	:	First Class The Pilot shall wear lenses that correct for distant vision and poses glasses that correct for near vision.
Date of medical check	:	2 February 2011
Valid until	:	1 August 2011
Last proficiency check	:	27 June 2010

Flight Time

Total hours	:	13,027 Hours 15 minutes
Last 90 days		208 Hours 10 minutes
Total on this type	:	3,311 Hours 14 minutes
on this type last 90 days	:	208 Hours 10 minutes
on this type last 30 days	:	29 Hours 34 minutes
on this type last 24 days	:	about 32 minutes

The PIC did not have training or qualification in test flight.

1.5.2 Pilot in Command Medical review

The routine medical examination for PIC had been conducted at The Aviation Medical Centre of Directorate General Civil Aviation on 2nd February 2011. The Director (DGCA) decree No 30/II/2009 issued on 20 February 2009 stated that for issuing medical certificate for pilot after 60th birthday require several additional medical examination items, such as videonystagmus graph (VNG), physiological and visus parameter test. The Aviation Medical Centre did not have facility to conduct these three additional examinations and the examinations were conducted in other facilities.

The examination for VNG was conducted in Aerospace and Aviation Medical Institute "dr. Saryanto" of Indonesia Air Force, physiological examination was conducted in Medical Faculty of University of Indonesia, and for visus parameter examination was conducted in Pantai Indah Kapuk hospital.

The VNG examination is to determine any abnormality of the vestibular system. This decree did not include the tolerance from the normal value.

The VNG examination for the PIC was conducted in Indonesia Air Force medical facility, The Aerospace and Aviation Medical Institute "dr. Saryanto". The examination was conducted at 19 January 2011 and the result showed that the PIC caloric response was 116% weakness on the right ear.

The SPV of warm caloric stimulation on the right ear was 3 deg/s and SPV of cold caloric stimulus on the right ear was 1 deg/s.

The result of PIC VNG examination showed that the PIC suffered severe pareses or paralysis (peripheral vestibular lesion) on the right vestibular organ.

The vestibular system is the system that regulates the balance or sensing the position and attitude of the human body. The system consists of three sensory organs which are eye, skin sensory (propioceptive), right and left vestibular organ.

Paralyses or paresis one or both the vestibular organ may cause people feel dizzy if they do not have any visual reference for example during a dark night or in the dark space. The other condition that may disturb the balance is if people experiencing three dimensional movement such as in flying (rolling, yawing, and pitching movement).

According to the ICAO Doc 8984 "*Practices Manual of International Aviation Medicine*", the examination for unilateral weakness using Video Nystagmus Graph (VNG) equipment, the maximum differences between left and right vestibular organ is 20%. Refer to the document Manual of Electronystagmography 2nd edition (Hugh O Barber. Charles W Stockwell), the normal value slow phase velocity-SPV (is the rate of movement of the eye when the vestibular stimulated with caloric test) of warm caloric stimulation is between 11-80 degree/s and SPV of Cold Caloric stimulation is between 6-50 deg/s.

The subject with pareses or paralysis vestibular organ or system could not response normally to the three dimensional motion or movement.

1.5.3 First Officer

Gender	:	Male
Age	:	50 years
Nationality	:	Australian
License type	:	CPL
Valid until	:	31 October 2011
Aircraft type rating	:	Cessna 172, CASA 212
Instrument rating	:	Valid until 30 April 2011
Medical certificate	:	First Class
Date of medical	:	17 September 2010
Valid until	:	17 March 2011
Last proficiency check	:	13 October 2010
Flight Time		
Total hours	:	2,577 Hours 22 minutes
Last 90 days		77 Hours 22 minutes
Total on this type	:	152 Hours 23 minutes
on this type last 90 days	:	77 Hours 22 minutes
on this type last 30 days	:	2 Hours 20 minutes
on this type last 24 days	:	about 32 minutes

1.6 Aircraft Information

1.6.1 General

Aircraft Registration	:	**PK-ZAI**
Manufacturer	:	Indonesian Aerospace (*PT. Dirgantara Indonesia*) under license from CASA,

		Spain
Type/ Model	:	CASA N/C 212 - 100 (A4)
Serial Number	:	18N / 120
Year of Manufacture	:	1980
Certificate of Airworthiness		
Valid until	:	31 March 2011
Certificate of Registration		
Valid until	:	23 August 2012
Time Since New (TSN)	:	29,990.82 hours
Cycles Since New (CSN)	:	35,128 cycles

1.6.2 Engines

Engine type	:	Turbo-propeller engine
Manufacturer	:	Garret
Model	:	TPE-331-5-251C
Left engine		
Serial Number	:	P-22327
Time Since New (TSN)	:	19,941 Hours 50 minutes
Time Since Overhaul (TSO)	:	0 Hours
Engine Time Between Overhaul	:	6,000 Hours
Right engine		
Serial Number	:	P-06217C
Time Since New (TSN)	:	7,192 Hours 45 minutes
Time Since Overhaul (TSO)	:	2,675 Hours 51 minutes
Engine Time Between Overhaul	:	6,000 Hours

1.6.3 Propellers Information

Propeller type	:	Variable Pitch Propeller
Manufacturer	:	Hartzell Propeller
Model	:	HC-B4TN-5FL
Left propeller		
Serial Number	:	CDA 4959
Time Since New (TSN)	:	568 Hours
Time Since Overhaul (TSO)	:	49 Hours 48 minutes

Time Between Overhaul (TBO)	:	3,000 Hours

Right propeller

Serial Number	:	CDA 3906
Time Since New (TSN)	:	5,373 Hours 32 minutes
Time Since Overhaul (TSO)	:	898 Hours 29 minutes
Time Between Overhaul (TBO)	:	3,000 Hours

1.6.4 Weight and Balance

In this flight, a recently overhauled engine was carried on board. The engine was packed in a wooden box and strapped on the middle cabin. The reason of carrying an engine as a cargo is not clear yet; more specifically whether it was intended as a counter balance, or for any other purposes.

The passenger and cargo manifest stated that there was no cargo on board. However, the manifest included 350 kg weight as tool and spare part (TS) which was quite similar with the weight of the engine.

The aircraft weight and balance document showed an under load of 788 kg. The weight and balance did not include Centre of Gravity calculation. With the available load and configuration it was considered to be within the weight and balance limitation.

1.7 Meteorological Information

Weather conditions at Bintan Island area at 0600-0700 UTC extracted from the Meteorological, Climatology and Geophysical Agency were as follows:

- At 3000 feet, wind northeast about 5 – 10 knots, clear.

1.8 Aids to Navigation

Not relevant to this accident.

1.9 Communications

The communication between flight crew and air traffic control during the flight was reported normal and considered not relevant to this accident.

1.10 Aerodrome Information

Not relevant to this accident

1.11 Flight Recorders

For the type of this aircraft, the FDR was not required by the current Indonesian regulation.

The aircraft was equipped with a Cockpit Voice Recorder (CVR) as follows:

Manufacturer	:	Sundstrand
Model	:	AV – 557B
Part Number	:	980-6005-055
Serial Number	:	7173

Figure 3: The Cockpit Voice Recorder

The CVR casing was damage due to impact. The CVR was downloaded in the NTSC facility.

The CVR contained 30 minutes of recording of poor quality. The CVR recorded only the communication between the SIC and Tanjung Pinang APP. There was no recorded communication between the pilots and all with the observer during this flight.

The last communication recorded between the SIC and Tanjung Pinang Approach recorded when the aircraft reaching the altitude of 4000 feet at 0633 UTC.

Figure 4: the CVR electric cable detached from its connection on central and PIC microphone sensor

1.12 Wreckage and Impact Information

The main wreckage was found in the jungle rich of peat at the northern part of Bintan Island.

The forward fuselage including the nose section and, the propellers and the engines, were sunk down to 4 metres deep into the soft soil. The left wing was broken and disintegrated from the fuselage. The right wing was broken at the middle section in the area of the right engine attachment. The empennage section was broken and folded forward. The propeller blades of both engines were bent rearward.

The aircraft carried in the cabin an engine TPE 331-10 which was packed in a wooden box and strapped to the cabin floor. At the accident site, the engine was found behind the flight compartment. The wooden box in which the engine was packed was destroyed.

The first impact mark was found on the trees about 16 metres to the west of the main wreckage. There was a broken tree at 6 metres above the ground.

For the rescue operation some trees have been cut to clear the area. The investigation did not find any impact mark on the ground.

Figure 5: PK-ZAI aircraft after the accident

1.13 Medical and Pathological Information

The routine medical examination for PIC had been conducted at The Aviation Medical Centre of Directorate General Civil Aviation on 2nd February 2011. This routine medical examination included three additional items required for pilot over 60 years old, such as videonystagmus graph (VNG), physiological and visus parameter test. The Aviation Medical Centre did not have facility to conduct these three additional examinations and the examinations were conducted in other facilities.

The examination for VNG was conducted in the Aerospace and Aviation Medical Institute "dr. Saryanto" of Indonesia Air Force, physiological examination was conducted in Medical Faculty of University of Indonesia, and for visus parameter examination was conducted in Pantai Indah Kapuk Hospital.

After the accident, there was no pathological examination performed to the fatalities.

1.14 Fire

There was no indication of pre or post impact fire.

1.15 Survival Aspects

This accident was un-survivable.

1.16 Tests and Research

Not relevant to this accident.

1.17 Organisational and Management Information

Aircraft Owner	:	PT. Sabang Merauke Raya Air Charter
Aircraft Operator	:	PT. Sabang Nerauke Raya Air Charter
Address	:	Gedung Ariobimo Sentra, 5th Floor
		Jl. HR Rasuna Said Blok X-2 Kav. 5
		Jakarta Selatan 12950, Indonesia

Air Operator Certificate number: AOC/135-015

1.18 Additional Information

1.18.1 Operation

The investigation did not find the procedures and the plan for Test Flight. The passenger and cargo manifest for this flight stated that the airport origin was Batam which was the same for the destination airport Batam. The passenger and cargo manifest stated also that there were two pilots and three flight engineers on board. The aircraft carried a TPE 331-10 engine packed in a wooden box and it was strapped on the cabin floor. The manifest stated that there was no cargo on board. However, the manifest included 350 kg weight as tool and spare part (TS) which was quite similar with the weight of the engine.

The investigation did not find the authorization (assignment) of PIC to perform the flight test from the company.

The Company Maintenance Manual Chapter 13.3, "Maintenance Test Flight-Functional Check" stated that a routine maintenance test flight shall be requested on all aircraft before being Returned to Service when any of the installations, changes, or corrections as indicated in the Table 1 are made. Table 1 stated that a maintenance test flight required for "dual engine change" with a brand new engines. (This statement is attached in Appendix "A").

The CASA 212-100 Maintenance Manual Chapter 5-50-20 page 1 "Unscheduled Maintenance Checks" stated a functional flight test required after engine and/or propeller change (This statement is attached in Appendix "B").

The Garrett TPE331-5 Maintenance Manual Chapter 72-00-00 page 401 "General – Removal/Installation" and page 565 "NTS System Check by Flight Check"; stated that NTS-System Check by flight check shall be performed after replacement of an engine (This statement is attached in Appendix "C").

According to the CASA 212-100 and Garrett TPE331-5 Maintenance Manuals required a flight test (or flight check) requires after the change of only one engine.

The aircraft took off from the Hang Nadim Airport, Batam under the control of Batam Tower. When the aircraft reached 3,000 feet altitude the pilot requested Tanjung Pinang Approach for a clearance to climb to 4,000 feet. The last communication was when the pilot reported that the aircraft passed 4,000 feet.

1.18.2 Maintenance

The investigation could not find any the aircraft maintenance manual applicable to Casa 212-100.

The investigation could not find the “Required Inspection Items (RII)” release on the engine removal and installation task card.

1.18.3 Power plant

Shut down in Cruise.

1. Shut down with the propeller on feather
   a. Generators-reduce electrical load to below 200 Amps.
   b. R. P. M. and power control levers. - Do not change the position of any of the four.
   c. EMERGENCY SHUTDOWN lever, Set to FEATHER the lever corresponding to the engine to be stopped.
   d Check the ITT and torque. Do not exceed limits.
   e. FUEL BOOSTER PUMPS switches OFF. the switch for the pump nearest to the stopped engine.
   f. FUEL switch- CLOSE, corresponding to the stopped engine.
   g. GENERATOR switch – OFF, corresponding to the stopped engine

Shutdown with Wind milling.

NOTE

propeller wind It is not recommended to shutdown the engine with the propeller windmilling

Engine Shut down on the Ground

1. parking brake in PARK Position
2. Navigation and communication equipment- switches off
3. Engine Shut down procedures

   To engage the propeller blades and the start locks, proceed as follows:

   a. power control lever G.I
   b. FUEL BOOSTER PUMPS Switches- OFF
   c. FUEL switches –CLOSE
   d. Power Control levers.- Pull Back to between G.I and FULL REVERSE

before the engine speed falls below 50% rpm so as to engage blade start locks

e. Power Control levers- F.I after propeller have stopped

If for some special reason it is desirable to leave the propeller in feather, proceed as follows:

a. Power control lever G.I

b. FUEL BOOSTER PUMPS switches OFF

c. FUEL switches –CLOSE

d. Power control levers.- set to F.I before reaching 50% rpm as the engine slow down, the blades will rotate to feather.

(These procedures is attached in Appendix "D")

Left Engine

The left propeller blades were indicated no rotation prior impact,

The propellers piston distance position to the cylinder, the counterweight facing forward, and the propeller pitch were on fine pitch or reverse position.

Figure 6: PK-ZAI Left Engine and Propeller

Figure 7: PK-ZAI Left Propeller Hub

Right Engine

The propellers piston distance position to the cylinder was about normal flight range position and no indication of rotating impact on the blades.

The propeller piston detached from its threads and the propeller

The link arm pushed toward to feather, opposite to the force acting to remove the piston from the hub.

Figure 8: PK-ZAI Right Engine and Propeller

Figure 9: PK-ZAI Right Propeller Piston

1.18.4 Engine Teardown Inspection

Engine serial number P-22327 (previous PK-ZAI engine number 1)

General condition of the engine number 1 was externally indicated damage as result of an impact, the FCU was broken and the starter generator was detached.

During the engine tear down, the investigation found the impeller was blocked by wood and ground debris, the transfer gear shaft was broken, the Hot Section was muddy, and the NTS transfer tube O-ring was damage.

Figure 10: Mud on Hot Section of Engine S/N. P-22327

Figure 11: NTS Tube O-ring of Engine S/N. P-22327

Figure 12: Turbine No. 1 of Engine S/N. P-22327, No sign of hot rotating impact

Figure 13: Turbine No. 2 and Nozzle Guide Vane of Engine S/N. P-22327

Figure 14: Turbine No. 3 of Engine S/N. P-22327

Engine serial number P-06217C (previous PK-ZAI engine number 2)

General condition of the engine number 2 was externally indicated damage as result of an impact. The FCU was broken, and the starter generator was detached.

During the engine tear down, the investigation found the impeller was blocked by wood and ground debris, the transfer gear shaft was broken, the Hot Section was filled by dried mud.

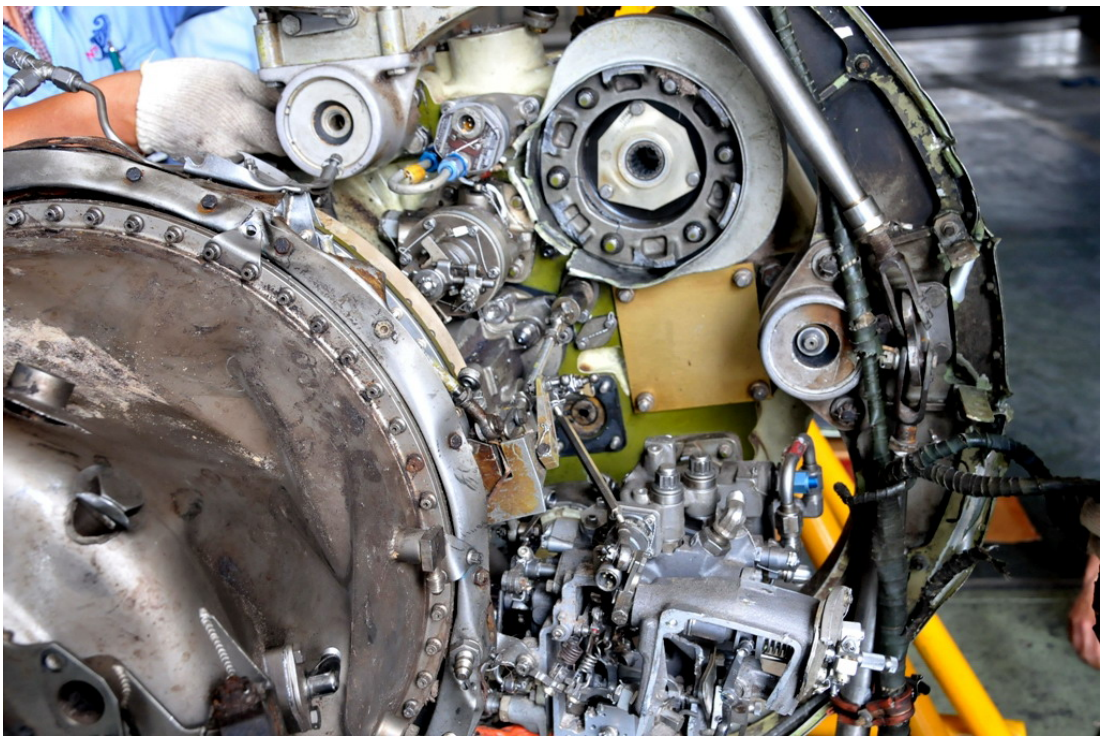


Figure 15: Engine S/N. P-06217C, Starter Generator detached and FCU was Broken

Figure 16: Mud on Hot Section of Engine S/N. P-06217C

Figure 17: Turbine and Nozzle Guide Vane of Engine S/N. P-06217C

1.18.5 Aircraft Certification

This aircraft was certified by Spain authority as a military aircraft model CASA 212-100 (A4) with serial number 120; and certified by Indonesian DGAC as a civil aircraft model CASA N/C 212-100 (A4) with serial number 18N by issued a Certificate of Airworthiness No. 1014 valid up to 31 March 2011.

The investigation could not find the Indonesian DGAC Production Certificate.

1.18.6 Anti Reverse

CASA Service Bulletin No. 212-76-07 Revision 1 issued dated 23 December 1991, a modification instruction to provide the aircraft with a system for blocking power levers in order to avoid these to be intentionally set to reverse when in flight. This SB No. 212-76-07 was effective for the CASA 212-100 civil configuration.

1.19 Useful or Effective Investigation Techniques

The investigation is being conducted in accordance with the NTSC approved policies and procedures, and in accordance with the standards and recommended practices of Annex 13 to the Chicago Convention.

2 ANALYSIS

2.1 Pilot Medical review

According to the ICAO Doc 8984 unilateral weakness is considered normal than 20%. The Director (DGCA) decree No 30/II/2009 issued on 20 February 2009 stated that for issuing medical certificate for pilot after 60th birthday require several additional medical examination items. Point 1.b of this decree states the Video Nystagmography examination.

Refer to the document Manual of Electronystagmography 2nd edition (Hugh O Barber. Charles W Stockwell), the normal value slow phase velocity-SPV (is the rate of movement of the eye when the vestibular stimulated with caloric test) of warm caloric stimulation is between 11-80 degree/s and SPV of Cold Caloric stimulation is between 6-50 deg/s.

The VNG examination for the PIC caloric response was 116% weakness on the right ear and the SPV of warm caloric stimulation on the right ear was 3 deg/s and SPV of cold caloric stimulus on the right ear was 1 deg/s.

The result of PIC VNG examination showed that the PIC suffered severe pareses or paralysis (peripheral vestibular lesion) on the right vestibular organ.

The PIC with pareses or paralysis vestibular organ or system could not response normally to the three dimensional motion or movement.

This condition may the subject more sensitive to suffer Spatial Disorientation (SDO). The SDO is the pilot could not perceived rightly his position motion and attitude to the earth horizontal or to his aircraft or other aircraft and could as the dangerous precondition for unsafe action.

2.2 Operation

The pilot in command was not assigned to perform the flight test.

Prior the accident, the engine number one was changed, the installed engine Serial Number P-22327.

Referred to the CMM Chapter 13.3, stated that the maintenance test flight was required after dual engine change. This CMM is dissimilar the According to the CASA 212-100 and Garrett TPE331-5 Maintenance Manuals that stated the change of only one engine does require a flight test.

The pilot in command was submitted the Flight Plan to Hang Nadim International Airport to conduct a test flight with altitude 3,000 feet.

The investigation could not find any detail of the flight test plan.

The last aircraft altitude was reported 4,000 feet over Tanjung Pinang area.

The investigation found that the aircraft carried one spare TPE 331-10 assembly but the cargo manifest did not mentioned any cargo on board.

The investigation found the spare engine was not at the original position but at behind the flight compartment without the wooden box.

The company most likely did not well prepared the flight test plane for this accident in conjunction with un-proper pilot qualification and test flight procedure.

2.3 Maintenance

The investigation could not find the Required Inspection Items (RII) release on the engine removal and installation task card.

The investigation could not find any the approved Company Maintenance Program applicable to CASA 212-100.

The investigation found that CMM Chapter 13.3 is dissimilar with the According to the CASA 212-100 and Garrett TPE331-5 Maintenance Manuals

2.4 Power plan

The left engine shut down likely operated on beta mode

The left propeller blades indicated of no rotation prior impact, and the propellers piston distance position to the cylinder, the counterweight facing forward, and the propeller pitch were on fine pitch or reverse position.

It was indicated that prior the impact the propeller pitch angle was already on fine pitch.

This condition would be produced by shut down engine using normal/ ground shut down procedure. It used the fuel shut off switches off followed by pulling the Power Lever rearward to reverse, while if the shut down engine using shut down engine on the Ground procedure.

The right engine propellers piston distance position to the cylinder was about normal flight range position and lock indication of the impact on the blades.

It most likely the pitch of the propeller was moving from a cruising pitch angle due to shut down by wind milling prior the impact.

2.5 Engine Teardown

The investigation of the left engine found the impeller was blocked by wood and ground debris, the transfer gear shaft was broken, and the Hot Section was muddy, It most likely the engine was on wind milling in a fine pitch blade propellers for some periods of time.

The investigation of the right engine found the impeller was blocked by wood and ground debris, the transfer gear shaft was broken, the Hot Section was filled by dried mud.

Those most likely indicated that the left engine was shutting down ahead than the right one, the mud on the right engine was more dry than the mud one the left one.

2.6 Aircraft Certification

This aircraft was certified by Spain authority as a military aircraft model CASA -212-100 (A4) with serial number 120; and certified by Indonesian DGAC as a civil aircraft model CASA N/C-212-100 (A4) with serial number 18N by issued a Certificate of Airworthiness No. 1014 valid up to 31 March 2011.

As the aircraft was in a military Type Certificate, the modification configuration control might be lost from the civilian modification configuration.

2.7 Anti Reverse

CASA Service Bulletin No. 212-76-07 Revision 1 issued dated 23 December 1991, a modification instruction to provide the aircraft with a system for blocking power levers in order to avoid these to be intentionally set to reverse when in flight. This SB No. 212-76-07 was effective for the CASA 212-100 civil version.

This Service Bulletin was not incorporated to the PK-ZAI aircraft prior to accident, since the manufacturer version was a military aircraft configuration.

3 CONCLUSIONS

3.1 Findings

- The aircraft departed for a test flight following an engine replacement to the number 1 engine. The test flight was conducted over Tanjung Pinang, Bintan island area and crashed at Gunung Kijang forest, Bintan Island.
- The investigation could not find any detail of the flight test plan.
- The investigation did not find the authorization (assignment) of PIC to perform the flight test from the company.
- Referred to the CMM Chapter 13.3, stated that the maintenance test flight was required after dual engine change. This procedure is dissimilar with the According to the CASA 212-100 and Garrett TPE331-5 Maintenance Manuals.
- The left propeller blades indicated of no rotation prior impact, and the propellers piston distance position to the cylinder, the counterweight facing forward, and the propeller pitch were on fine pitch or reverse position.
- It was indicated that prior the impact the propeller pitch angle was already on fine pitch.
- The right engine propellers piston distance position to the cylinder was about normal flight range position and lock indication of the impact on the blades.
- It most likely the pitch of the propeller was moving from a cruising pitch angle due to shut down by wind milling prior the impact.
- The company most likely did not well prepared the flight test plane for this accident in conjunction with un-proper pilot qualification and test flight procedure.
- The aircraft was in a military Type Certificate, the modification configuration control might be lost from the civilian modification configuration (the applicability of civilian Service Bulletin might not included the serial number of the military aircraft configuration)
- According to the ICAO Doc 8984 unilateral weakness is considered normal than 20%. The Director (DGCA) decree No 30/II/2009 issued on 20 February 2009 stated that for issuing medical certificate for pilot over 60 years old require several additional medical examination items. Point 1.b of this decree states the Video Nystagmography examination.(differed the ICAO Doc 8984).
- The PIC suffered severe pareses or paralysis (peripheral vestibular lesion) on the right vestibular organ.
- The PIC with pareses or paralysis vestibular organ or system could not response normally to the three dimensional motion or movement.

3.2 Factors to the Accident

Factors contributed to the accident are as follows:

- The flight test was not properly well prepared; there was no flight test plan.
- The current and applicable CMM is dissimilar the According to the CASA 212-100 and Garrett TPE331-5 Maintenance Manuals related to flight test requirement after the change of only one engine.
- The left engine was shut down using normal/ ground shut down procedure. It used the fuel shut off switches off followed by pulling the Power Lever rearward to reverse, as indicated by the propeller pitch.
- The right engine most likely shut down by wind milling prior the impact, it was indicated the propellers piston distance position to the cylinder was about normal flight range position and no indication of rotating impact on the blades.
- The Casa Service Bulletin No. 212-76-07 Revision 1 issued dated 23 December 1991 (Anti Reverse) that applicable for Casa 212 -100/200, was not incorporated to this aircraft.
- The PIC with pareses or paralysis vestibular organ or system could not response normally to the three dimensional motion or movement. This condition may the subject more sensitive to suffer Spatial Disorientation (SDO). The SDO is the pilot could not perceived rightly his position motion and attitude to the earth horizontal or to his aircraft or other aircraft and could as the dangerous precondition for unsafe action.
- The Director (DGCA) decree No 30/II/2009 issued on 20 February 2009 stated that for issuing medical certificate for pilot after 60^{th} birthday require several additional medical examination items. Point 1.b of this decree states the Video Nystagmography examination.(differed the ICAO Doc 8984)

4 SAFETY ACTIONS AND RECOMMENDATIONS

At the time of issuing this Final Report, the National Transportation Safety Committee had been informed concerning several safety actions performed:

4.1 Directorate General of Civil Aviation (DGCA)

- DGCA issued Safety Circular No. AU.2089/DKUPPU.1001/EK/VII/III/2011 dated 4 March 2011, and instructed all Indonesia ("PK" registers aircrafts) operators to ensure all safety precaution was evaluated before they conduct a maintenance practices on airport area.
- DGCA conducted a special safety audit for PT. Sabang Merauke Raya Air Charter (SMAC).

4.2 PT. Sabang Merauke Raya Air Charter (PT. SMAC)

- PT. Sabang Merauke Raya Air Charter (SMAC) replaced some managerial position to improve their safety management and procedures

5 SAFETY RECOMMENDATIONS

As a result of this accident investigation, the National Transportation Safety Committee made the following recommendation prevent similar occurrence in the future.

The National Transportation Safety Committee with letter no. KTU / 5 / 13 / KNKT 2011 dated 10 October 2011 issued three safety recommendations to the Directorate General of Civil Aviation and two safety recommendations to the PT. Sabang Merauke Raya Air Charter.

5.1 Recommendation to Directorate General of Civil Aviation

The National Transportation Safety Committee recommends that Directorate General of Civil Aviation (DGCA) should:

1. Ensure the Aviation Medical Centre conducts addition medical examination for the pilot over 60 years old in according with:
   - DGCA CASR 67 "*Medical Standard and Certification*",
   - DGCA Decree No. SKEP/131/VII/2007 "Revision of DGCA Decree No. SKEP/62/V/2004 about Flight Crew Medical Certification",
   - DGCA Decree No. SKEP/30/II/2009 "Additional Examination for Pilot Over 60 years old",
   - ICAO Doc 8984 "*Manual of Civil Aviation Medicine*".
2. Reinforce and review the procedure for test flight.
3. Reinforce and review the requirement for company test pilot.

5.2 Recommendation to PT. Sabang Maerauke Raya Air Charter

The National Transportation Safety Committee recommends that PT. Sabang Merauke Raya Air Charter (SMAC) should:

1. Use an approved procedure to perform a test flight.
2. Ensure the test pilot have capability and approved license to perform the test flight

During the investigation review and analysis, the National Transportation Safety Committee issued the following recommendations to address safety issues identified in this report.

5.3 Recommendation to Directorate General of Civil Aviation

The National Transportation Safety Committee recommends that Directorate General of Civil Aviation (DGCA) should:

1. Review and revise DGCA Decree No. SKEP/30/II/2009 "*Additional Examination for Pilot over 60 Years old*" issued on 20 February 2009 related Video Nystagmography examination to be included the unilateral weakness is considered normal than 20% in according with the ICAO Doc 8984 "*Practices Manual of International Aviation Medicine*".

2. The Aviation Medical Centre of Directorate General Civil Aviation should aware of any medical results or notes from the specialist of other hospital or medical unit, related the Aviation Medical Centre did not have facility to conduct some additional examinations and the examinations for pilot over 60 years old.

3. Control the configuration of the aircraft that converted from the military to the civilian version.

4. Ensure that all installed CVR on the aircrafts were properly maintained.

5. Ensure that the current Company Manuals in according with the current and applicable manufacturer's standard, instructions and/or manuals.

5.4 Recommendation to PT. Sabang Maerauke Raya Air Charter

The National Transportation Safety Committee recommends that Directorate General of Civil Aviation should:

1. Ensure the flight crew has a detail flight plan prior any test flight.

2. Ensure that all critical maintenance tasks required double inspection or required inspection items (RII) must be performed and certified.

3. Ensure that all installed CVR on their fleet were properly maintained.

4. Subscribe and ensure all manufacturer's standard, instructions and/or manuals are current and applicable to the fleet.

APPENDIX "A"

13.1. Reference : CASR Part 21.191, 21.197, 91.407

13.2. General

This chapter describing how to conduct the Maintenance Flight Test and Ferry Flight procedures concerning how can be established and how can be obtained for such authorization, to comply its intended purpose.

13.3. Maintenance Test Flight – Functional Check

a. The purpose of Maintenance Test Flight is to verify an aircraft that has been maintained, rebuilt, or altered in a manner that may have appreciably change its flight characteristics or substantially affected its operation in flight.

NOTE : All test flights shall be accomplished in accordance with applicable CASR, and only personnel essential to the proper and safe conduct of the flight are allowed on the flight.

b. Routine Maintenance Test Flights shall be requested on all aircraft before being Returned to Service when any of the installations, changes, or corrections as indicated in the **Table 1** are made, unless exceptions are noted.

c. Maintenance Test Flights are not required if ground tests or inspections or both show conclusively that repair or alteration has not appreciably changed the flight characteristics or substantially affect the flight operation of the aircraft.

d. It shall be the responsibility of the Chief Inspector, or Supervisor, to determine when a test flight is required other than those specified in **Table 1**.
Test flights shall be required after maintenance, inspection, overhaul, repair, or alteration means as indicated in the following table.
The numbers (1, 2, or 3) immediately following each type work performed refer to notes that define the Test Flight requirements for each aircraft.

e. Maintenance Test Flight / Functional Check Report shall be made on the appropriate A/C Test Flight Report.

TABLE 1

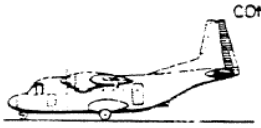
Installation, Changes and Corrections Made	Note No.
Major Airframe, Damage, Alteration or Repair	#1
Major Airframe Overhaul	#2
Serious Pilot Reports	#3
Dual Engine Change	#4

NOTES :

1. Test flights required after major damage, alterations or repairs that may adversely affect the flight characteristics or operations of the aircraft.
2. Test flights shall be required after completion of a major airframe overhaul.
3. Test flights required in case of serious pilot reports where nothing can be detected which might be causing the complaint, or when routine corrective measures fail to correct repeated complaints on stability, rigging, or flying qualities of an aircraft. The Chief Inspector or his designated person shall make determination of test flight requirement.

   EXAMPLE : Buffeting, vibration, flutter or Dutch roll is reported which cannot be accounted for on the ground.
4. Dual engine change with brand new.

APPENDIX "B"



UNSCHEDULED MAINTENANCE CHECKS

Flight Test

General

This part contains the circumstances which require verification of maintenance to be performed by the accomplishment of a functional flight test in order to assure the aircraft is airworthy and capable of accomplishing its mission.

Circumstances requiring a functional flight test

1. Prolonged inactivity of the aircraft
2. Major structural modifications or repairs have been performed.
3. Engine and/or propeller change.
4. Replacement of an essential engine fuel system component
5. Removal or replacement of an outer wing or stabilizer
6. Removal or replacement of any flight control surface.
7. Removal, replacement or rigging of any flight control system components
8. Service Bulletin directive

APPENDIX "C"

GENERAL - REMOVAL/INSTALLATION

1. General

CAUTION: WHEN REMOVING ENGINE FROM AIRCRAFT, TO AVOID DAMAGE TO THE OIL FLOW METAL TUBE ASSEMBLY (BETA TUBE), ALWAYS REMOVE THE BETA TUBE PRIOR TO PROPELLER REMOVAL.

NOTE: Replacement of engine installed on aircraft will require an NTS-System Check by Flight Check. Refer to 72-00-00, Adjustment/Test.

If maintenance procedures require removal of the engine from the aircraft, consult the Aircraft Maintenance Manual for necessary removal and installation procedures.

2. Removal/Installation of Engine From/In Shipping Container

NOTE: Table 401 provides a list of all special tools, fixture and equipment required to perform Removal/Installation.

Table 402 provides a list of all equipment and materials required to perform Removal/Installation.

Table 401. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Source/ Part No.
NOTE: Equivalent substitutes may be used for listed items.			
1.	Hoisting Adapter	Used to mount on propeller shaft to provide a hoisting mount for lifting operation	284357-1-1
2.	Maintenance Stand Engine	Used to support engine during transportation and maintenance.	284493-1-1
3.	Maintenance Stand Adapter	Used to mount engine in stand.	284557-1-1
4.	Maintenance Stand Adapter	Used to support aft end of engine when installed in stand using Adapters Part No. 284557-1-1.	289247-1

R

3. G. NTS System Check by Flight Check

NOTE: This check shall be performed after replacement of an engine or following removal, installation, disassembly of the reduction gear system
R (diaphragm), or first and/or second stage
R impeller.

R This check is also required anytime the main shaft
R has been stretched using 284196-2-1 multiplier.

(1) Start engine in accordance with Aircraft Flight Manual.

(2) Fly aircraft at safe single engine altitude; refer to Aircraft Flight Manual.

(3) Adjust power on test engine to cruise setting and stabilize engine temperature for 1 minute.

NOTE: The following instructions refer to the engine under test only.

(4) Advance engine speed lever to high rpm.

(5) Actuate engine stop switch to close electrical fuel shutoff solenoid.

(6) Advance power lever to maximum power lever position.

CAUTION: IF AIRCRAFT YAWS EXCESSIVELY FEATHER PROPELLER.

(7) Note time required for engine to decelerate to approximately 35 percent rpm and feather propeller at 30 percent rpm.

CAUTION: DO NOT ALLOW ENGINE TO WINDMILL IN RPM RANGE BETWEEN 18 AND 28 PERCENT.

(8) Engine rpm shall decelerate to approximately 35 percent rpm in less than 60 seconds.

(9) Conduct normal air start in accordance with Aircraft Flight Manual.

(10) If NTS check is not satisfactory, refer to 72-00-00, Trouble Shooting.

APPENDIX "D"

CASA NC212-00 - AFM Engine Shutdown Procedures

ENGINE SHUTDOWN.

Operate at taxi r.p.m. three minutes minimum (taxi time included) prior to shutdown. If necessary, cool oil in F. I. position.

1. Parking brakes. - In PARK position.
2. Navigation and communications equipment. - Switched off.
3. Engine shutdown procedures.

   To engage the propeller blade in the start locks, proceed as follows:

   a. Power control levers. - G. I.
   b. FUEL BOOSTER PUMPS switches. - OFF.
   c. FUEL switches. - CLOSE.
   d. Power control levers. - Pull back to between G. I. and FULL REVERSE before the engine speed falls below 50% r. p. m. so as to engage blade start locks.
   e. Power control levers. - F. I. after propellers have stopped.

   If for some special reason it is desirable to leave the propellers in feather, proceed as follows:

   a. Power control levers. - G. I.
   b. FUEL BOOSTER PUMPS switches. - OFF.
   c. FUEL switches. - CLOSE.
   d. Power control levers. - Set to F. I. before reaching 50% r. p.m. As the engines slow down, the blades will rotate to feather.

4. As indicated in the Interior Inspection part of this Section.
5. Flight control gust lock lever. - On lock.
6. Oxygen. - Close (if it was used by the crewmembers).

BEFORE LEAVING AIRCRAFT.

1. Wheel chocks. - In place.
2. Parking brakes. - On, if necessary.

INTENTIONAL ENGINE SHUTDOWN IN FLIGHT (TRAINING).

Check that the other engine is operating normally.

CAUTION

Do not intentionally shut down an engine if the oil temperature of the other is not in the normal operating range.

Shutdown during Take Off.

1. Shutdown with the propeller on feather.

a. Generators. - Reduce electrical load to below 200 Amps.
b. R. P. M. and power control levers. - Do not change the position of any of the four.
c. EMERGENCY SHUTDOWN lever. - Set to FEATHER the lever corresponding to the engine to be stopped.
d. Check the ITT and torque indications of the operative engine. Do not exceed limits.
e. FUEL BOOSTER PUMPS switches. - OFF, the switch for the pumps nearest to the stopped engine.
f. FUEL switch. - CLOSE, corresponding to the stopped engine.
g. GENERATOR switch. - OFF, corresponding to the stopped engine.

2. Shutdown with propeller windmilling.

a. Generators. -Reduce electrical load to below 200 Amps.
b. R. P. M. and power control levers. - Do not change the position of any of the four.
c. FUEL switch. - CLOSE, the switch corresponding to the engine to be stopped.

NOTE

The engine speed should slow down to 30% r.p.m within 40 seconds.

CAUTION

Monitor the engine speed and do not allow it to decrease below 30% to 28%. Set to feather prior to reaching 28% r.p.m. (See Windmilling Limitations Section V.).

d. Check the ITT and torque indications for the operative engine. Do not exceed limits.
e. FUEL BOOSTER PUMPS switches that correspond to the pumps nearest to the stopped engine. - OFF.
f. GENERATOR switch, that corresponds to the stopped engine. - OFF.
g. EMERGENCY SHUTDOWN lever. -Set the lever corresponding to the windmilling propeller to FEATHER.

Shutdown in Cruise.

1. Shutdown with the propeller on feather.

a. Generators. - Reduce electrical load to below 200 Amps.
b. ITT. - Reduce to 800°C on both engines.

c. EMERGENCY SHUTDOWN lever. - Set the lever corresponding to the engine to be stopped to FEATHER.
d. Stopped engine. - Push the power control lever fully forward.
e. Operative engine. - Power required without exceeding limitations.
f. FUEL BOOSTER PUMPS switch corresponding to the pump nearest to the stopped engine. - OFF.
g. FUEL switch corresponding to the stopped engine. - CLOSE.
h. GENERATOR switch corresponding to the stopped engine. - OFF.

2. Shutdown with propeller windmilling.

NOTE

It is not recommended to shutdown the engine with the propeller windmilling in cruise flight.

AIRSTART.

See AIRSTART (Section III).

COLD WEATHER STARTING.

Starting under temperatures that may cause ice formation.

During certain operating conditions, condensation can form in the Fuel Control pneumatic lines from engine compressed air. The liquid moisture has no effect on the engine operation; however, if the ambient temperature is sufficiently low, the formation of ice inside the pneumatic system may cause abnormal starting conditions, both on the ground or in the air. These abnormal symptoms and the procedures to be followed are outlined below.

Ground start.

1. Slow or hung start:

Observe the starter duty cycle and shutdown engine, if required. (See CAUTION on page 2-10).

NOTE

Under these conditions, the engine requires 5 minutes elapsed time before attempting another start. If a fourth attempt to start the engine is required, then a wait of 15 minutes must be observed after the third failure to comply with the starter duty cycle.