KOMITE NASIONAL KESELAMATAN TRANSPORTASI
REPUBLIC OF INDONESIA

FINAL

KNKT.16.06.21.04

Aircraft Accident Investigation Report

Nusa Flying School
Cessna 172P; PK-NIV
Demak, Central Java
06°48.094'S, 110°35.011'E
Republic of Indonesia
20 June 2016

2017

This final investigation report was produced by the Komite Nasional Keselamatan Transportasi (KNKT), 3rd Floor Ministry of Transportation, Jalan Medan MerdekaTimur No. 5 Jakarta 10110, Indonesia.

The report is based upon the investigation carried out by the KNKT 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. 62/2013).

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ABBREVIATIONS AND DEFINITIONS

AD	:	Advisory Directives
AVGAS	:	Aviation Gasoline
C of A	:	Certificate of Airworthiness
C of R	:	Certificate of Registration
DGCA	:	Directorate General of Civil Aviation
ft	:	Feet
KNKT	:	*Komite Nasional Keselamatan Transportasi/* / National Transportation Safety Committee
NM	:	Nautical Mile
PF	:	Pilot Flying
PM	:	Pilot Monitoring
PPPTMGB	:	*Pusat Penelitian dan Pengembangan Teknologi Minyak dan Gas Bumi* (Research and Development Technology Center of Natural Oill and Gas
POH	:	Pilot Operating Handbook
psi		Pound per Square Inch
PPL		Private Pilot License
rpm	:	Rotation per Minute
RON	:	Research Octane Number
SP	:	Student Pilot
SPL	:	Student Pilot License
STC	:	Supplement Type Certificate
UTC	:	Universal Time Coordinated

SYNOPSIS

On 20 June 2016, a Cessna C172 aircraft registered PK-NIV was being operated by Nusa Flying School on a mutual flight training area from Ahmad Yani International Airport (WAHS), Semarang to Wedung area, Demak.

Before commencing the flight, the student pilots conducted preflight check and there was no abnormality of the aircraft systems detected. The fuel quantity indicator indicated 120 liters of fuel which was sufficient for two-hour flight. No additional fuel tanked at Semarang.

At 1249 LT (0549 UTC), the aircraft departed from Semarang with two student pilots on board which one of the student pilot acted as Pilot Flying (PF), the other acted as Pilot Monitoring (PM). The flight from departure until Wedung Area was uneventful.

After conducted area training exercise for approximately 55 minutes, the pilots were about to return to Semarang and was instructed to hold over Wedung Area and maintain 1,000 feet as there was an aircraft returning from Jepara Area to Semarang at altitude 2,000 feet.

While holding, the pilot noticed engine problem indicated by decreasing of the propeller rotation and aircraft vibration. The pilot performed procedure for identifying the cause and checked the ignition position on BOTH, master switch was ON, carburetor heater on position STAND BY, mixture on FULL RICH position and the fuel valve selector was slightly on the right of ON/BOTH position.

The pilot was unable to restart the engine by cranking several times and then elected to make emergency landing. The PM then informed to the Semarang Approach controller that they were making emergency landing. Another training aircraft then relayed to the Semarang Approach controller that PK-NIV performed emergency landing on Wedung Area.

At approximately 0636 UTC, the aircraft landed in a fishpond on Wedung Area, at coordinate 6°48’5.64” S 110°35’0.66” E, at approximate 16 NM from Semarang on radial 050°.

Both student pilots evacuated with minor injury. The aircraft was substantially damaged. The fishpond was contaminated with aircraft fuel.

The investigation concluded that the contributing factors to this accident were:

- The engine failure in flight was caused by improper fuel flow to the engine as the fuel selector valve was on intermediate position between BOTH and RIGHT.
- The deviation of understanding to the fuel system had caused the engine failure inflight and did not reselect to the proper position when performing check for cause procedure and resulted in the failure to restart the engine.

Prior to publish this investigation report, KNKT has been informed safety actions taken by Nusa Flying Institute.

The KNKT issued several safety recommendations to Nusa Flying Institute and Directorate General of Civil Aviation (DGCA) to address safety issues identified during the investigation.

1 FACTUAL INFORMATION

1.1 History of the Flight

On 20 June 2016, a Cessna C172 aircraft registered PK-NIV was being operated by Nusa Flying School on a mutual flight training area from Ahmad Yani International Airport (WAHS), Semarang[1] to Wedung area, Demak[2].

Before the accident flight, the aircraft was flown on a dual cross country training from Budiarto Airport, Tangerang to Semarang. Prior to depart Budiarto Airport, the aircraft loaded fuel up to full tank capacity. The flight from Budiarto Airport to Semarang took about two hours 55 minutes. On board in this flight was one flight instructor, two student pilots and one company engineer.

Upon arrival in Semarang, all occupants from Budiarto disembarked and the aircraft was scheduled for a mutual flight training area.

Figure 1: The archive photo of PK-NIV aircraft

Before commencing the flight, the student pilots conducted preflight check and there was no abnormality of the aircraft systems detected. The fuel quantity indicator indicated 120 liters of fuel which was sufficient for two-hour flight. No additional fuel tanked at Semarang.

At 1249 LT (0549 UTC[3]), the aircraft departed from Semarang with two student pilots on board which one of the student pilot acted as Pilot Flying (PF), the other acted as Pilot Monitoring (PM).

The flight from departure until Wedung Area was uneventful. After conducted area training exercise for approximately 55 minutes, the PM requested to the Semarang Approach controller to leave Wedung Area and to return to Semarang. There was an aircraft returning from Jepara Area[4] to Semarang at altitude 2,000 feet, therefore the pilot was instructed to hold over Wedung Area and maintain 1,000 feet.

1 Ahmad Yani International Airport (WAHS), Semarang will be named as Semarang for the purpose.

2 Wedung Area is located at 18 NM from Semarang, on radial 055°.

3 The 24-hours clock in Universal Time Coordinated (UTC) is used in this report to describe the local time as specific events occured. Local time is UTC+7 hours.

4 Jepara Area is located at 30 NM from Semarang, on radial 040°.

While holding, the pilot noticed engine problem indicated by decreasing of the propeller rotation and aircraft vibration.

While identifying the cause, the pilots checked the ignition position on BOTH, master switch was ON, carburetor heater on position STAND BY, mixture on FULL RICH position and the fuel valve selector was slightly on the right of ON/BOTH position.

The PF was unable to restart the engine by cranking several times and then elected to make emergency landing. Wedung area mostly was fishpond and residential area, the PF selected the fishpond area for the emergency landing. The PF asked the PM to conduct the secure engine procedure. The PM then informed to the Semarang Approach controller that they were making emergency landing. Another training aircraft then relayed to the Semarang Approach controller that PK-NIV performed emergency landing on Wedung Area.

The engine secure procedure was not performed as the aircraft was about to land. The pilots noticed activation of the stall warning prior to the aircraft landing.

At approximately 0636 UTC, the aircraft landed in a fishpond on Wedung Area, at coordinate 6°48’5.64” S 110°35’0.66” E, at approximate 16 NM from Semarang on radial 050°.

Both student pilots evacuated with minor injury. A few minutes after the aircraft landed, the local people evacuated the pilots to the nearest medical facility.

The aircraft was substantially damaged. The fishpond was contaminated with aircraft fuel.

1.2 Personnel Information

The Student Pilot 1 (PF) was 21 years old of Indonesian male student pilot, that held valid Student Pilot License (SPL) and valid first class medical certificate. The SP1 had experience with total flying hours of 100 hours 5 minutes and the last 24 hours was 1 hour including the accident flight.

The Student Pilot 2 (PM) was 21 years old of Indonesian male student that held valid Private Pilot License (PPL) and valid first class medical certificate. The SP2 had experience with total flying hours of 140 hours and the last 24 hours was 1 hour including the accident flight.

Both pilots could not recall the shift of the fuel selector to the position between BOTH and RIGHT. They considered that the position between BOTH and RIGHT was normal. This position would allow right-wing fuel tank supplied more fuel to the engine compare to the left-wing fuel tank. This selection intended to balance fuel when the right-wing fuel tank has more quantity than the left-wing fuel tank. While the selector position on BOTH, the left and right wing tanks would supply the fuel to the engine equally.

This understanding was provided by one of the flight instructor, and had been demonstrated several times.

1.3 Aircraft Information

1.3.1 General

The Cessna 172P aircraft manufactured by Cessna Aircraft Company in United States of America with serial number of 172-74213. The aircraft was registered PK-NIV and had valid Certificate of Airworthiness (C of A) and Certificate of Registration (C of R).

The total hour of the aircraft was 13,049 hours 20 minutes. The last major check of the aircraft was Supplement Inspection Program which was conducted on 21 May 2015, while the last minor check was performed on 13 June 2016 (50 hours Inspection).

The engine installed in the aircraft was a piston engine manufactured by Textron Lycoming Company in United State of America with part number of 0-320-D2J and serial number RL-17324-39A. The total hour of the engine since new was 886 hours 26 minutes.

The aircraft was not fitted with flight recorders neither it required by the current Indonesia aviation regulation.

1.3.2 Aircraft fuel system

Refer to Cessna information manual, dated 12 May 1981 applicable for Cessna 172P, this aircraft installed with fuel system mounted on the left and right wing.

The fuel system described as follow:

The airplane may be equipped with a standard fuel system or either of two long range systems. Each system consists of two vented fuel tanks (one tank in each wing), a four-position selector valve, fuel strainer, manual primer, and carburetor. The 68-gallon long range system utilizes integral tanks and the other two systems employ removable aluminum tanks.

The schematic of the fuel system is as follow:

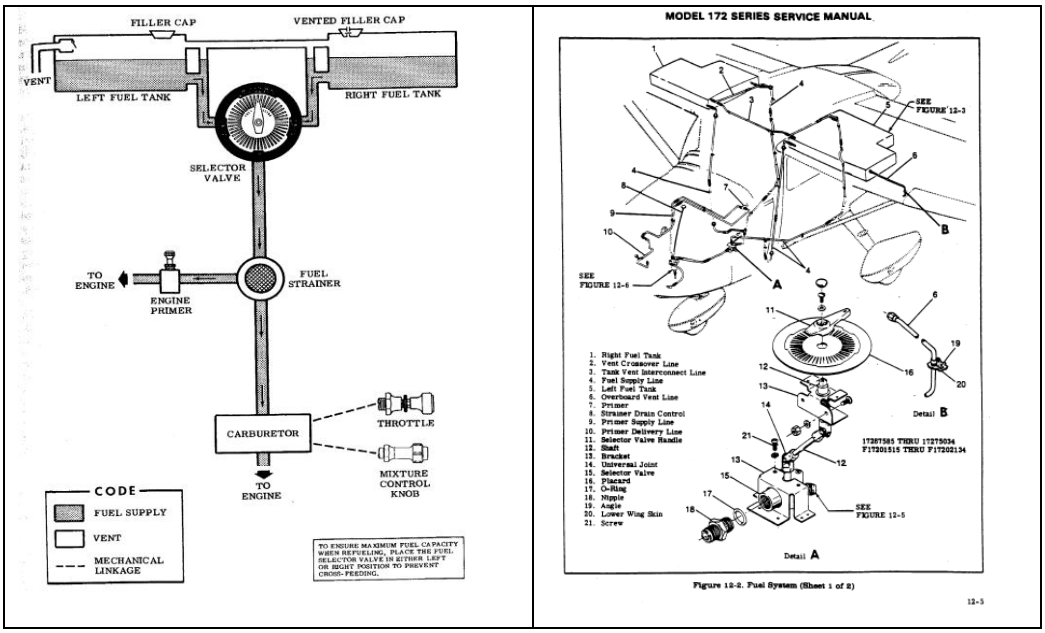

Figure 2: Cessna 172P schematic fuel system

The manual also described the procedure related to fuel selector system as follows:

The fuel selector is used to select the source of fuel to be fed to the engine. The selector has 4 positions: OFF, LEFT, BOTH and RIGHT. When the fuel selector is on OFF position, the fuel supplied to the engine will be cut. When the fuel selector is on LEFT or RIGHT position, the fuel supplied to the engine will be taken from respective fuel tank. When the fuel selector is on BOTH position, the fuel supplied to the engine will be taken from both fuel tanks.

The fuel tank capacity as stated in the Pilot Operating Handbook (POH), of the Cessna Model 172P, revision May 1980 on section one:

Integral tanks:

Total capacity: 68 gallons.

Total capacity each tank: 34 gallons.

Total usable: 62 gallons.

Note:

To ensure maximum fuel capacity when re-fueling and minimize cross-feeding when parked on a sloping surface, place the fuel selector valve in either LEFT or RIGHT position.

The POH, section five: Performance.

Endurance profile including 45 minutes reserve, for aircraft with 62 gallons usable fuel.

Conditions:

- Aircraft weight 2400 pounds
- Recommended Lean Mixture for cruise
- Standard temperature

Note:

This chart allows for the fuel used for engine start, taxi, takeoff and climb, and the time during climb.

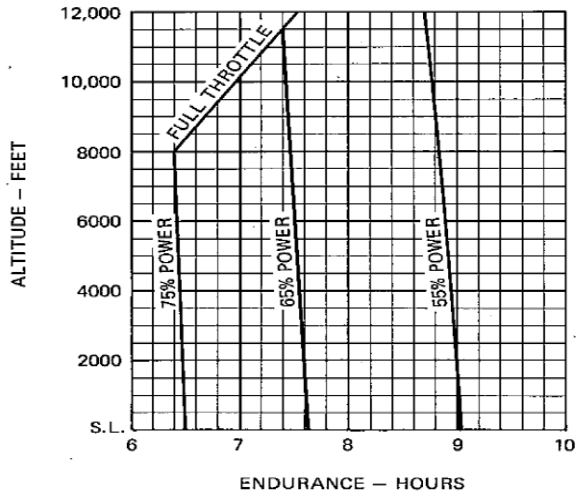

Figure 3: Fuel endurance table

Section 7 of the POH titled: Airplane and Systems Description, stated:

The fuel selector valve should be in the BOTH position for takeoff, climb, landing, and maneuvers that involve prolonged slips or skids. Operation from either LEFT or RIGHT tank is reserved for cruising flight.

Note:

When the fuel selector valve handle is in the BOTH position in cruising flight, unequal fuel flow from each tank may occur if the wings are not maintained exactly level. Resulting wing heaviness can be alleviated gradually by turning the selector valve handle to the tank in the "heavy" wing.

Note:

When the fuel tanks are ¼ full or less, prolonged uncoordinated flight such as slips or skids can uncover the fuel tank outlets. Therefore, if operating with one fuel tank dry or if operating on LEFT or RIGHT tank when ¼ full or less, do not allow the airplane to remain in uncoordinated flight for periods in excess of 30 seconds.

Note:

It is not practical to measure the time required to consume all of the fuel in one tank, and, after switching to the opposite tank, expect an equal duration from the remaining fuel. The airspace in both fuel tanks is interconnected by a vent line and, therefore, some sloshing of fuel between tanks can be expected when the tanks are nearly full and the wings are not level.

The fuel system is equipped with drain valve to provide a means for the examination of fuel in the system for contamination and grade. The system should be examined before the first flight of every day and after each refueling, by using the sampler cup provided to drain fuel from the wing tank sumps, and by utilizing the fuel strainer drain under an access door on the aft right side of the top engine cowling. If takeoff weight limitations for the next flight permit, the fuel tanks should be filled after each flight to prevent condensation.

Refer to Supplement Type Certificate (STC) Petersen, the minimum requirement fuel grade of Research Octane Number (RON) value used for the engine Lycoming is as follow:

ENGINES APPROVED FOR AUTO FUEL

An asterisk denotes 91 octane minimum.

All others are 87 octane minimum, with the exception of some R-1830's.

Lycoming:

0-145-B1, -B2, -B3, -C1, -C2, GO-145-C1, -C2,-C3, -A1, -A2 0-235-C, -C1, -C1B, -E1, -E1B, -C1C, -C1A, -H2C, -C2A, -C2B, -E2A, -E2B, -L2A, -L2C*, -M1*, -M2C*, -M3C*, -N2A*, -N2C*, -P1*, -P2A*, -P2C*, -P3C* 0-290, -A, -AP, -B, (0-290-1), -C, (0-290-3),-CP, -D, (0-290-11), -D2, -D2A, -D2B, -D2C 0-320, 0-320-A1A, -A1B, -A2A, -A2B, -A2C,-A2D, -A3A, -A3B, -A3C, -B1A*, -B1B*, -B2A*,-B2B*, -B2C*, -B3A*, -B3B*, -B3C*, -C1A, -C1B, -C2A, -C2B, -C2C, -C3A,-C3B, -C3C, -D1A*, -D1B*, -D1C*, -D1D*, -D1F*, -D2A*, -D2B*, -D2C*, -D2F*, -D2G*, -D2H*, -D2J*, -D3G*, -E1A, -E1B,- E1C, -E1F, -E2A, -E2B, -E2C, -E2D, -E2F, -E2G,-E2H, -E3D, -E3H,-E1J.*

1.4 Wreckage and Impact Information

The aircraft was found in a fishpond, located approximately 16 NM on radial 050 from Semarang, at location of 6°48'5.64" S 110°35'0.66" E. The nose section including part of the cockpit submerged in the water.

On the fishpond access road, toward the direction of the flight, found mark on heading approximately 130°.

Figure 4: Wheel mark on the fishpond access road and aircraft final position

Figure 5: Propeller condition

The propeller blades found intact and no evidence of impact damage.

The remaining fuel in the wing tank was drained and found approximately 60 litters.

The investigation found that the fuel selector was on 2 o'clock position between position BOTH and RIGHT.

Figure 6: The fuel selector valve position found after impact

1.5 Test and Research

1.5.1 Fuel Test

On 7 September 2016, the KNKT conducted fuel test on two liters of fuel sample which was taken from the fuel tank of the PK-NIV aircraft. Refer to company policy, the fuel was mixed of Avgas and Shell VPower with the mixture ratio of 25% Avgas and 75% Shell VPower.

The test was conducted on *Pusat Penelitian dan Pengembangan Teknologi Minyak dan Gas Bumi*/PPPTMGB (Research and Development Technology Center of Natural Oil and Gas) laboratory.

The fuel tested was intended to check the value of Research Octane Number (RON). The result of the test found that the octane number was 88.7

Detail of the test is described in the appendix of this report.

1.5.2 Engine Examination

The engine of the accident flight Lycoming O-320-D2J with Serial Number (S/N) RL-17324-39A was sent to Research Octane Number (AIT) in Bandung for examination. The examination was performed on 20 and 21 July 2016 by KNKT investigators. The examination intended to identify the cause of the engine shut down by performed the following test:

1. Engine compression test
2. Carburetor test
3. Spark plug and magneto check
4. Tear down engine to examine the condition of piston, cylinder, and intake and exhaust valves.

Investigation observed the engine conditions when arrived at the workshop were:

- The engine was in the box.
- The spark plug cable from magneto was cut
- Oil tank was empty
- There was indication of corrosion on several parts of the engine

The results of the engine examination are as follows:

1. Engine compression test

Engine compression test was performed by inserting 80 psi of air pressure into the cylinders through the spark plug hole. The output pressures from the cylinders were measured to determine any leakage. During the examination mud were found on all of the cylinders that might have been sucked through the carburetor intake during the evacuation process while the propellers were rotated.

The measurement results were roughly between 20 psi to 58 psi. It was concluded that the leakage was expected due to there were several corrosions inside of the cylinder and piston ring.

2. Carburetor test

Carburettor found dirty and corroded at several parts. Intake casing found dent. The position of arm connected to the throttle was stuck at the position approximately 1,000 rpm – 1,200 rpm, and the mixture arm was stuck nearly at the RICH position, therefore the carburettor cannot be tested.

It concluded that the deformation of carburettor and the stuck of arm position were due to impact.

3. Magneto Test

Investigation observed that the magnetos were in at good condition externally and able to rotate when the propeller rotated, but there were no evident of ignition at the spark plugs. There were also no evident of ignition during the magnetos were rotated on the test bench. Subsequently the magnetos were dismantled and found there were corrosion and sand deposit inside the magnetos.

It concluded that the missing of ignition of the magnetos due to corrosion and sand deposit when immerse in the fish pond.

4. Spark plug test

All eight spark plugs were tested on the engine and subsequently placed to the test bench.

It concluded that the spark plugs were operates properly.

5. Engine dismantling

The engine was dismantled to expose the cylinders and pistons. The observation found that all cylinders found corroded. There were carbon and mud deposit on top of the piston crown. Subsequently all pistons were clean to remove to deposit to find any evidence of any deformation. Observation found there were no evident of deformation to the piston.

It concluded that all cylinders and pistons were in normal condition.

Conclusion

The engine examination did not find any abnormality to the engine condition. The carbon deposit on the piston crown was considered normal for such engine time. The observation also found there was no evident of fuel system abnormality or detonation. It was concluded that the engine failure in flight was not caused by internal damage, system abnormality or improper fuel air mixture.

1.5.3 Ground run test

The investigation performed engine ground run test on a similar aircraft of the operator. The ground run test was intended to determine the effect of the fuel selector position to the engine performance.

The test was conducted by perform engine run on the ground with idle power at approximately of 1200 rpm and the mixture positioned at RICH. The fuel selector selected to position between BOTH and RIGHT position similar to the position of the fuel selector found on the accident site.

The result was the engine started to decelerate and stop at about 56 seconds after the fuel selector selected to the position between BOTH and RIGHT.

1.5.4 Observation of Fuel Selector valve

The fuel selector valve was described in Cessna 172 Service Manual revision 3 dated 1 July 1995, in section 12 as follow:

FUEL SELECTOR VALVE. (See figure 12-5.)

12-13. DESCRIPTION. A four positions fuel selector valve is located beneath the floorboard just aft and slightly to the left of the pedestal structure. A shaft links the valve to a handle mounted on the pedestal structure. The positions of the handle are labeled "OFF, LEFT, BOTH and RIGHT".

The illustrated fuel selector that stated as figure 12.5 in the manual is as follow:

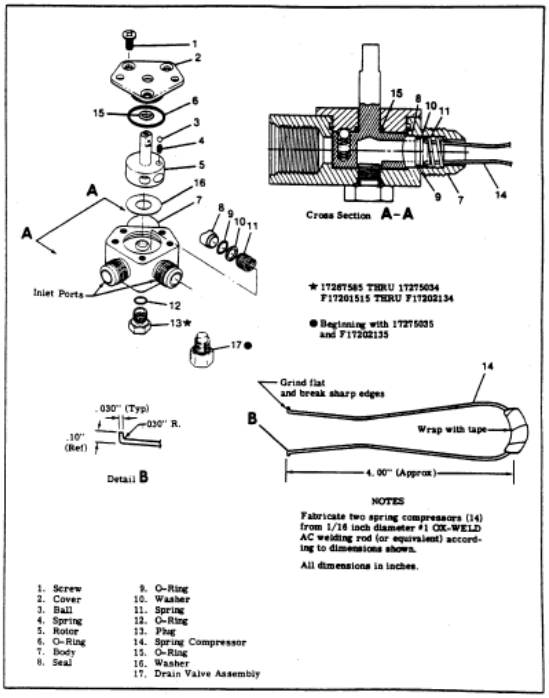

Figure 7: Fuel Selector Valve and Spring Compressor

Refer to the Cessna 172P illustrated part catalog dated 1 August 1996 the aircraft was installed with fuel selector valve part number 9851095-1.

The fuel selector valve collected from the wreckage is as follow:

Figure 8: Fuel selector valve

The label of the fuel selector valve is as follow

Figure 9: Fuel selector label positions

KNKT conducted the observation of fuel selector valve in KNKT facility to define the fuel flow related to the selection of the selector valve handle. The fuel selector valve handle can be rotated in any direction. At each selected label, there was detent on the selector to make sure the proper selection of the valve.

The observation concluded as follow:

1. The selector was normal in any selected label with firm detent.
2. If the selector handle was positioned in between of any selected label (e.g. between "LEFT and BOTH", "RIGHT and BOTH", "LEFT and OFF", and "RIGHT and OFF") the valve was partially open or even totally close in certain position.

1.6 Organizational and Management Information

Aircraft Owner	:	PT. Nusa Flying International
Address	:	Jl. Inspeksi Saluran Kalimalang No.99 Kel. Pondok Bambu, Kec. Duren Sawit Jakarta 13430
Aircraft Operator	:	PT. Nusa Flying International
Address	:	Jl. Inspeksi Saluran Kalimalang No.99 Kel. Pondok Bambu, Kec. Duren Sawit Jakarta 13430
Certificate Number	:	PSC 141/007

1.7 Useful or Effective Investigation Techniques

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

2 ANALYSIS

Refer to the data collected and the result of the examination the analysis will discuss the relevant issues associated with the engine failure and the pilot understanding to the aircraft fuel system.

2.1 Engine failure

Prior to conduct the flight, both student pilots performed preflight check including check the amount of remaining fuel, which was indicated approximately 120 litters and was sufficient for two-hour flight. After the accident, the remaining fuel in the wing tank was drained and collected approximately 60 litters. It can be concluded that the engine failure was not caused by fuel exhaustion.

The aircraft operator used mixed fuel of Avgas and Shell VPower with the mixture ratio of 25% Avgas and 75% Shell VPower. The fuel test found that the octane number of the mixed fuel was 88.7, while the minimum octane number for the Lycoming O-320-D2J installed on the aircraft was 91 refer to STC Petersen.

The engine examination concluded that the engine failure in flight was not caused by internal damage, system abnormality or improper fuel air mixture. The engine examination concluded that the engine failure was not caused by the usage of the mixed fuel.

According to the POH 172P, the fuel selector should be positioned to BOTH at take-off, climb, descend and landing. When unequal fuel occurs, the fuel selector valve may be selected to LEFT or RIGHT.

The selector cannot move inadvertently in any position because the valve was equipped with detents to ensure the valve properly selected on the desired position. The examination found that the fuel selector valve was working properly.

On the accident site, the investigation found that the fuel selector was on 2 o'clock position between BOTH and RIGHT. The student pilot noticed this condition while conducted the procedure to identify the cause of the engine failure.

The fuel selector valve is mechanically controlled and selecting the valve on intermediate position between any detent will cause the fuel valve partially open or even totally close. This resulted to improper fuel flow to the engine. The engine ground run test with the fuel selector position in between BOTH and RIGHT concluded the engine stopped not more than one minute.

The investigation concluded that the cause of the engine failure in flight was improper fuel flow to the engine as the fuel selector valve was on intermediate position between BOTH and RIGHT. The fuel test was found that the octane number was below the minimum required however, the engine examination did not find any indication of improper combustion to the engine.

2.2 Crew Understanding of Aircraft Fuel System

The student pilot noticed that the fuel valve selector was slightly on the right of ON/BOTH position and the fuel selector was found on two o'clock position. The engine examination concluded that the cause of the engine failure in flight was due to improper fuel flow to the engine as the fuel selector valve was on intermediate position between BOTH and RIGHT.

The Cessna 172P POH described: The fuel selector valve should be in the BOTH position for takeoff, climb, landing, and maneuvers that involve prolonged slips or skids. Operation from either LEFT or RIGHT tank is reserved for cruising flight.

The Cessna 172P information manual described that the fuel selector is used to select the source of fuel to be fed to the engine. The selector has 4 positions: OFF, LEFT, BOTH and RIGHT. When the fuel selector is on OFF position, the fuel supplied to the engine will be cut. When the fuel selector is on LEFT or RIGHT position, the fuel supplied to the engine will be taken from respective fuel tank. When the fuel selector is on BOTH position, the fuel supplied to the engine will be taken from both fuel tanks.

Both student pilots assumed that when the fuel selector is selected between both and right, the engine will be supplied mainly from the right fuel tank and some from the left fuel tank, therefore the right tank will decrease more than the left tank and balance the fuel tank quantity. This knowledge was based on the description of an instructor.

The manual did not describe of the positioning fuel selector between BOTH and LEFT or RIGHT. The fuel selector valve is mechanically controlled and selecting the valve on intermediate position between any detent will cause the fuel valve partially open or even totally close. Therefore, the understanding of the two student pilots different with the procedure.

The student pilots had the knowledge of the fuel selector position based on the description and demonstration of the flight instructor which was deviate from the aircraft fuel system.

The deviation of the understanding to the fuel system had made the student pilot did not consider the fuel selector valve position was the cause of the engine failure in flight and did not reselect to the proper position when performing check for cause procedure and resulted in the failure to restart the engine.

3 CONCLUSION

3.1 Findings[5]

According to factual information during the investigation, the findings are as follows:

1. The aircraft had a valid Certificate of Airworthiness;
2. The pilots held valid licenses and medical certificates;
3. There was no pilot report of any aircraft system malfunction before the occurrence;
4. The wreckage was found at the fish pond in a fishpond on Wedung Area at approximate 16 NM from Semarang on radial 050° at coordinate 6°48'5.64" S; 110°35'0.66" E.
5. There was no evidence of engine and fuel system abnormalities.
6. The aircraft operator used mixed fuel of Avgas and Shell VPower with the mixture ratio of 25% Avgas and 75% Shell VPower. The fuel test found that the octane number of the mixed fuel was 88.7, while the minimum octane number for the Lycoming O-320-D2J installed on the aircraft was 91 refer to STC Petersen.
7. After the accident, the remaining fuel in the wing tank was drained and collected approximately 60 litters.
8. On the accident site, the investigation found that the fuel selector was on 2 o'clock position between BOTH and RIGHT. The student pilot noticed this condition while conducted the procedure to identify the cause of the engine failure.
9. The fuel selector test found that if the selector handle was positioned in between of any selected label (e.g. between "LEFT and BOTH", "RIGHT and BOTH", "LEFT and OFF", and "RIGHT and OFF") the valve was partially open or even totally close in certain position.
10. The ground run test showed when the fuel selector valve positioned in between BOTH and RIGHT the engine stopped less than one minute.
11. The engine examination concluded that the engine failure in flight was not caused by internal damage, system abnormality or improper fuel air mixture and was not caused by the usage of the mixed fuel.
12. The investigation concluded that the cause of the engine failure in flight was improper fuel flow to the engine as the fuel selector valve was on intermediate position between BOTH and RIGHT.
13. Both student pilots assumed that when the fuel selector is selected between both and right, the engine will be supplied mainly from the right fuel tank and some

5 Findings are statements of all significant conditions, events or circumstances in the accident sequence. The findings are significant steps in the accident sequence, but they are not always causal, or indicate deficiencies. Some findings point out the conditions that pre-existed the accident sequence, but they are usually essential to the understanding of the occurrence, usually in chronological order.

from the left fuel tank, therefore the right tank will decrease more than the left tank and balance the fuel tank quantity. This knowledge was based on the description of an instructor.

14. The deviation of the understanding to the fuel system had made the student pilot did not consider the fuel selector valve position was the cause of the engine failure in flight and did not reselect to the proper position when performing check for cause procedure and resulted in the failure to restart the engine.

3.2 Contributing Factors[6]

- The engine failure in flight was caused by improper fuel flow to the engine as the fuel selector valve was on intermediate position between BOTH and RIGHT.
- The deviation of understanding to the fuel system had caused the engine failure inflight and did not reselect to the proper position when performing check for cause procedure and resulted in the failure to restart the engine.

6 Contributing factors is defined as events that might cause the occurrence. In the case that the event did not occur then the accident might not happen or result in a less severe occurrence.

4 SAFETY ACTION

At the time of issuing this draft final report, the Komite Nasional Keselamatan Transportasi (KNKT) had been informed safety actions taken by related parties.

4.1 Nusa Flying International

The Nusa Flying School issued internal memo on 23 June 2016 which contained the recommendations as follows:

- To review NFI fuel policy with policy to;
  - Use 100% AVGAS,
  - Full tanking at any sequence of flight training
- Review all engines maintenance issue concerning SB, AD if necessary
- Review all training area for conditions
- Approach both students involved for having coaching and counseling
- Give coaching and counseling course to all instructors by competent institution

4.2 Airnav Indonesia Branch Office Semarang

The Airnav Indonesia Semarang has carried out review of Standard Operation Procedure (SOP) regarding to the training area in accordance to Director of Air Navigation Letter number AU.301/10/13/DJPU-DNP 2016, dated 20 July 2016 about follow up accident PK-NIV:

a. Review Letter of Coordination Agreement (LOCA) between Airnav Indonesia and flying school operates at Semarang area.

b. Review internal SOP related to navigation services for training flight.

5 SAFETY RECOMMENDATIONS

According to factual information and initial findings, the Komite Nasional Keselamatan Transportasi issued safety recommendations to address safety issues identified in this report.

5.1 Nusa Flying International

a. The student pilot understanding to the fuel system had deviated from the aircraft system based on the one of the instructor description and demonstration. KNKT recommend to review the training syllabus for instructor and student training to ensure correct understanding to the aircraft system.

b. The fuel test found that the octane number (RON) of the mixed fuel was below the minimum requirement for the engine. KNKT recommend to use fuel that meet the engine requirement.

5.2 Directorate General of Civil Aviation (DGCA)

The student pilot understanding to the fuel system had deviated from the aircraft system based on the one of the instructor description. KNKT recommend to DGCA to ensure all instructors have adequate knowledge to the aircraft system.

6 APPENDICES

6.1 Fuel test result

PUSAT PENELITIAN DAN PENGEMBANGAN TEKNOLOGI MINYAK DAN GAS BUMI
LEMIGAS
LABORATORIUM PPPTMGB "LEMIGAS"
JL. CILEDUG RAYA-CIPULIR-KEBAYORAN LAMA-JAKARTA SELATAN 12230-INDONESIA
PO BOX 1089/JKT, JAKARTA 10010, INDONESIA PHONE 7394332 (direct line), 7394422 ext. 1475, 1480, 1499, 1415 TELEX : 47150, 47171 FAX: 021-7246150

LAPORAN HASIL UJI LABORATORIUM
REPORT OF LABORATORY TEST RESULT

No. Arsip/*Archive Number*	:	0947/PPP/8.15/IX/2016	Satuan Kerja	:	BLM 8
Nomor PK/*Work Order Number*	:	0947/PK/8.1/IX/2016	Kelompok/*Group*	:	BLM 8.1

DISIAPKAN UNTUK PELANGGAN/*PREPARED FOR CUSTOMER*:

Nama/*Name*	:	Komite Nasional Keselamatan Transportasi
Alamat/*Address*	:	Jl. Medan Merdeka Timur No. 5, Jakarta 10110
Nomor Telepon/*Phone No(s).*	:	021 – 3517606
Nomor Facsimile/*Fax. No(s).*	:	021 – 3517606
Nomor Surat Permintaan/*No. of service/Work Order Letter*	:	Kru/12/14 KNKT 2016
Tanggal Permintaan/*Date of Order*	:	1 September 2016

IDENTIFIKASI LAPORAN HASIL UJI/*REPORT IDENTIFICATION*:

Lokasi Pengujian/*Place Of Testing*	:	PPPTMGB "LEMIGAS"
Nomor Laporan (LHU)/*Report Number*	:	0947/LHU/8.15/IX/2016
Disiapkan oleh/*Prepared by*	:	Pengelola Laboratorium BBM
Disahkan oleh/*Authorized by*	:	Manajer Teknis BBMG
Tanggal Penerbitan/*Date of Issued*	:	7 September 2016

DATA PERCONTOH/*SAMPLE DATA*:

Nomor/*Number*	:	0947/SPL/2840 s/d 2842/8.1/2016
Jenis/*Type*	:	BBM
Identifikasi/*Identification*	:	Fuel Eks. Pesawat Cessna 172 Reg. PK-NIV20 Juni 2016, 60% Avgas 100LL+40% Shell V-Power 95, Fuel Eks. Pesawat Piper Warrior PA28 Reg. PK-PBG, 18 Agustus 2016, 50% Avgas 100LL+50% Shell V-Power 95, dan Fuel Eks. Pesawat Cessna 172 Reg. PK-WTK, 30 Agustus 2016, Avgas 100LL
Jumlah/*Quantity (volume)*	:	3 Percontoh
Tanggal Sampling/*Sampling Date*	:	-
PPC/*Sampler*	:	-
Metode Sampling/*Sampling Method*	:	-
Tanggal Diterima/*Received Date*	:	2 September 2016
Tanggal Analisis/*Date of Analysis*	:	2 September 2016 s/d 6 September 2016
Jenis Pengujian/*Test Type*	:	Angka Oktana Motor
Metode Uji/*Test Method*	:	ASTM D 2700

LAPORAN HASIL UJI selengkapnya disajikan pada halaman berikut:
The detailed report of the laboratory testing result is presented on the following pages.
Disahkan Oleh/*Authorized by*
Manajer Teknis BBMG

LEMIGAS	PUSAT PENELITIAN DAN PENGEMBANGAN TEKNOLOGI MINYAK DAN GAS BUMI	No. Formulir :
	HASIL UJI	Revisi : Lampiran
		Halaman :

Nomor Seri/ *Serial Number* : 0947/LHU/8.15/IX/2016

Nomor/*Number* : 0947//PK/8.1/IX/2016

Nomor Percontoh/ *Sample Number* : 0947/SPL/2840/8.1/2016

No	Parameter Uji	Unit	Hasil Uji	Metode Uji
			Fuel Eks. Pesawat Cessna 172 Reg. PK-NIV 20 Juni 2016 60% Avgas 100LL + 40% Shell V-Power 95	
1	Angka Oktana Motor	-	88,7	ASTM D 2700

Manajer Teknis BBMG

6.2 Engine examination

The engine of the accident flight Lycoming O-320-D2J with Serial Number (S/N) RL-17324-39A was sent to Aero International Technology (AIT) in Bandung for examination. The examination was performed on 20 and 21 July 2016 by KNKT investigators. The examination intended to perform the following test:

- Engine compression test
- Carburetor test
- Spark plug and magneto check
- Tear down engine to examine the condition of piston, cylinder, and intake and exhaust valves.

Observation to the engine conditions upon arrival at the workshop were as follows:

1. Engine was in the box.
2. The cable connecting the magneto to the spark plug cut
3. Oil tank was empty
4. Corrosions were found on several parts of the engine that might cause by the fishpond water.

1. Engine compression test

Engine compression test was performed by inserting 80 psi of air pressure into the cylinders through the spark plug hole. The output pressure from the cylinders was measured to determine any leakage. The measurement results were as follows:

Cylinder	1	2	3	4
Pressure out	20 psi	34 psi	58 psi	34 psi

Muds were found on all of the cylinders that might have been sucked through the carburetor during while the propellers were rotated during evacuation process.

The measurement results were roughly between 20 psi to 58 psi. It was concluded that the leakage was expected due to there were several corrosions inside of the cylinder and piston ring.

2. Carburettor test

a. Carburettor found dirty and corroded at several parts. Intake casing dent. The position of arm connected to the throttle and mixture were as follows:

   i. Throttle arm (connecting to the throttle lever) found stuck at position approximately 1,000 – 1,200 RPM.

   ii. Mixture arm stuck at close to RICH position.

b. Carburetor test could not be performed due to throttle and mixture arm stuck.

It concluded that the deformation of carburettor and the stuck of throttle and mixture position were due to impact.

3. Magneto Test

a. Physical examination of the magnetos found at good condition.

b. The magnetos test performed by rotating the propeller to check the spark on the spark plug. When the propeller rotated, spark did not appear on the spark plug.

c. On 21 July 2016, the magnetos were opened and found some deposit of white sand in the magnetos.

d. Both magnetos were individually tested used the test bench and no spark appeared during the test. The magnetos were cleaned to remove the corrosion and the sand deposit, and the test were repeated. The second test did not find spark appeared.

It concluded that the missing of ignition of the magnetos due to corrosion and sand deposit when immerse in the fish pond.

4. Spark plug test

a. All eight spark plugs were tested twice. The first test was performed when the spark plugs were still fitted on the engine and performed by rotating the magneto through the propeller shaft. The second test was performed used a test bench.

b. The first test found that no spark appeared on the spark plug.

c. The second test found that all spark plugs were functioning properly.

It concluded that the spark plugs were operates properly.

5. Engine dismantling

a. All cylinders were opened to examine the piston crown and cylinder wall condition.

b. The condition of the cylinders was as follows:

i. Piston

Piston 1 original condition

Piston 1 after being cleaned

Piston 2 original condition

Piston 2 after being cleaned

Piston 3 original condition

Piston 3 after being cleaned

Piston 4 original condition Piston 4 after being cleaned

After the pistons had been cleaned, the crown pistons were visible. The black marks on the pistons were the sign of corrosion that possibly caused by submerged in the water. The corrosion occurred since the coating on the crown piston had eroded.

The coating on the crown piston eroded also might cause by detonation. The eroded on the crown piston led to the exposure of the piston metal to the air and oxidized. The oxidation created the corrosion.

The piston of the accident aircraft was compared to another piston that has 2,000 flight hours.

Figure x: Comparasion of PK-NIV piston with another piston (left side)

ii. Cylinder Bore

Cylinder 1

Cylinder 2

Cylinder 3

Cylinder 4

It concluded that all cylinders and pistons were in normal condition.

Conclusion

The engine examination did not find any abnormality to the engine condition. The carbon deposit on the piston crown was considered normal for such engine time. The observation also found there was no evident of fuel system abnormality or detonation. It was concluded that the engine failure in flight was not caused by internal damage, system abnormality or improper fuel air mixture.

6.3 NFI Inter office memo

PT. Nusa Flying International Jl. Inspeksi Saluran Kalimalang No. 99 Jakarta Timur 13430. Indonesia.	NFI – INTERNAL MEMO

Jakarta 23 June 2016
NFI/IO/01/VI/2016

To: ***All Units Concerned***

Subject: ***PK- NIV Accident Internal Investigation***

Dear All,

In accordance to PK-NIV accident at Wedung Area, here I with Reference to ***"NFI Share"*** *as Internal Safety Concerned Unit for Preventive Investigation, while waiting from NTSC/ KNKT Final Report and Safety Recommendations*

Several items of Safety Recommendation should be priority to take action such as follows;

1. ***Review NFI Fuel Policy with;***
   - ***Use 100% AVIGAS,***
   - ***Full Tanking at any sequence of Flight Training)***
2. ***Review All Engines Maintenance Issue concerning SB, AD if necessary***
3. ***Review All Training Area for conditions***
4. ***Approached Both Students involved for having Coaching& Counseling***
5. ***Give Coaching& Counseling Course to All Instructors by Competent Institution***

We shall take of these unhappy occurrences as a Lesson Learned to All NFI employees to prevent the accident happened again in the future.

Thank you for your kind attention.

Kind regards,
Pilot School Principal

6.4 Airnav Indonesia Branch Office Semarang comment

No	Section of report	Original text	Proposed revision	Remark
1.	Synopsis	The PM then informed to *the* ***Ahmad Yani Tower controller*** that they were making emergency landing.	The area of training was under control ***Semarang Approach controller***	Accepted
2.	Synopsis		***Another training aircraft then informed to the Semarang Approach controller that PK-NIV have done the emergency in a fishpond on Wedung Area.***	Accepted
3	1.1 History of flight	the PM requested to ***the Ahmad Yani Tower controller*** to leave Wedung Area and to return to Semarang.	the PM requested to ***the Semarang Approach controller*** to leave Wedung Area and to return to Semarang	Accepted
4	1.1 History of flight	***The PM then informed to the Ahmad Yani Tower controller that they were making emergency landing.***	***The PM then try to inform to the Semarang Approach controller that they were making emergency landing. However, the limitation of the range of the radio communication, the information is delivered by other aircraft to the Semarang Approach Controller.***	Accepted

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