



Republic of the Philippines
DEPARTMENT OF TRANSPORTATION
CIVIL AVIATION AUTHORITY OF THE PHILIPPINES
MIA Road, Pasay City 1300

AIRCRAFT ACCIDENT INVESTIGATION AND INQUIRY BOARD

FINAL REPORT

RP-R5380
AGCAT G-164A

OPERATOR: AEROWURKZ AERIAL SPRAYING SERVICES

TYPE OF OPERATION: AGRILCUTURAL SPRAYING

DATE OF OCCURRENCE: DECEMBER 17, 2022

***PLACE OF OCCURRENCE: STA FE, TABIGNA, SURIGAO DEL SUR,
PHILIPPINES***

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FOREWORD

This report was produced by the Aircraft Accident Investigation and Inquiry Board (AAIIB), Civil Aviation Authority of the Philippines, MIA Road, Pasay City, Philippines.

The report is based upon the investigation carried out by the AAIIB in accordance with Annex 13 to the Convention on International Civil Aviation, Republic Act 9497 Section 42 and Philippine Civil Aviation Regulation Part 13.

Readers are advised that the AAIIB investigates for the sole purpose of enhancing aviation safety. Consequently, AAIIB reports are confined to matters of safety significance and may be misleading if used for any other purpose. It should be noted that the information in AAIIB reports and recommendations is provided to promote aviation safety and in no case is it intended to imply blame or liability.

Furthermore, No part of AAIIB report or reports relating to any accident or investigation shall be admitted as evidence or used in any suit or action for damages arising out of any matter mentioned in such report or reports.



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FINAL REPORT

TITLE: An accident involving an AGCAT G-164A type of aircraft, with registry number RP-R5380 owned and operated by Aerowurkz Aerial Spraying Services that sustain substantial damage due to engine failure while on an aerial spraying operation at Sta Fe, Tagbina, Surigao del Sur, Philippines, on December 17, 2022/0900H.

Notification of Occurrence to National Authority

The notification of accident to AAIIB CAAP was relayed by the Operator of the aircraft at 1130H (LOCAL) on December 17, 2022.

Identification of the Investigation Authority

The Aircraft Accident Investigation and Inquiry Board (AAIIB), the mandated accident investigation organization within the Civil Aviation Authority of the Philippines (CAAP) as the state of Occurrence/Registry/ Operator conducted the investigation.

Organization of the Investigation

In accordance with provisions of Philippine Civil Aviation Regulation (PCAR) Part 13, an Investigator-In-Charge.

Authority Releasing the Report

The Final investigation report was released by Aircraft Accident Investigation and Inquiry Board (AAIIB) and published at the CAAP website on **21 March 2023**.

Synopsis:

On December 17, 2022 at about 0900H, an AGCAT G-164A type of aircraft, with registry number RP-R5380 sustained substantial damage due to engine failure while on an aerial spraying operation at Sta Fe, Tagbina, Surigao del Sur. The pilot who was the sole occupant did not sustain any injury. The cause of the occurrence was attributed to contaminated fuel strainer assembly blocking the fuel supply that leads to engine failure.

LIST OF ACRONYMS AND ABBREVIATIONS

AAIIB	: Aircraft Accident Investigation and Inquiry Board
AMO	: Approved Maintenance Organization
AAOC	: Agricultural Aircraft Operator Certificate
CAAP	: Civil Aviation Authority of the Philippines
CHT	: Cylinder Head Temperature
GOI	: General Operating Instructions
MC	: Memorandum Circular
OFSAM	: Office of the Flight Surgeon and Aviation Medicine
SOP	: Standard Operating Procedures
VFR	: Visual Flight Rules
VHF	: Very High Frequency
VMC	: Visual Meteorological Condition



1. FACTUAL INFORMATION

Aircraft Registration No.	: RP-R5380
Aircraft Type/Model	: Agcat G164 A
Operator	: Aerowurkz Aerial Spraying Services
Address of Operator	: Old International Airport, Sasa, Davao City
Place of Occurrence	: Sta Fe, Tagbina, Surigao del Sur, Philippines
Date/Time of Occurrence	: December 17, 2022 / 0900H/0100H UTC
Type of Operation	: Agricultural Spraying
Phase of Flight	: Cruise
Type of Occurrence	: Turbine engine - fuel starvation

1.1 History of Flight

On December 17, 2022 at about 0900H, an AGCAT G-164A type of aircraft, with registry number RP-R5380 sustained substantial damage due to engine failure while on an aerial spraying operation at Sta Fe, Tagbina, Surigao del Sur. The pilot who was the sole occupant did not sustain any injury. The aircraft is being operated by Aerowurkz Aerial Spraying Services.

The pilot while maneuvering after the end of the third (3rd) line of his first load of aerial chemical spray in the area towards the next line, when the aircraft experienced engine failure. The pilot elected to make a forced landing. The aircraft initially collided with two (2) falcata trees before it came to a full stop in a nose down position after the right wing collided with another full-grown tree with a heading of 360 degrees and coordinates of 08° 48'78" N; 126° 13' 45" E (Figure 1). The pilot egress safely after performing engine shutdown. There was no post-crash fire noted and Visual Meteorological Condition (VMC) prevailed at the time of the accident.

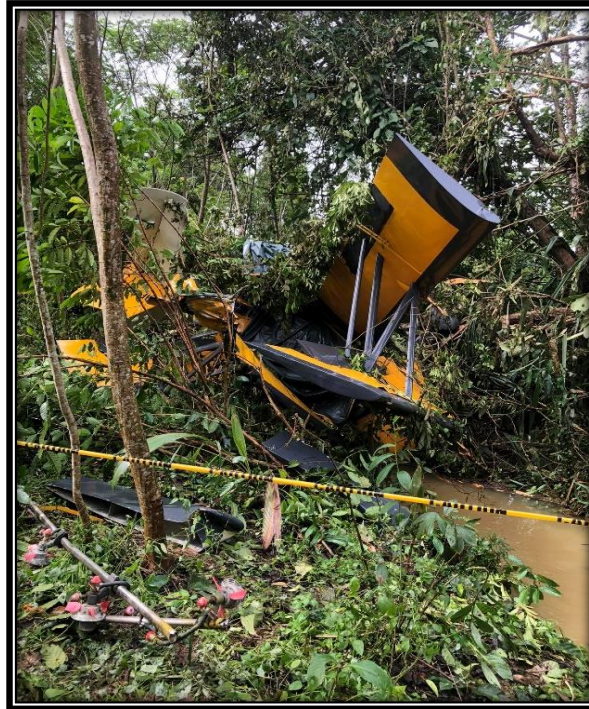


Figure 1: The aircraft came to complete stop in a nose-down position.

1.2 Injuries to Person (s)

Injuries	Crew	Passengers	Others	TOTAL
Missing/Fatal	0	0	0	0
Serious	0	0	0	0
Minor	0	0	0	0
None	0	0	0	0

1.3 Damage to Aircraft

The aircraft sustained substantial damage.

1.4 Personnel Information

1.4.1 Pilot

Gender : Male
 Date of Birth : May 16, 1997
 Nationality : Filipino
 License : CPL# 128886
 Valid up to : October 31, 2023
 Medical Certificate Valid until : Class 1 valid up to October 17, 2023
 Date of last medical : October 13, 2022
 Total Flying Time : 589+00 Hours
 Total Flying Time On type : 400+00 Hours

1.5 Aircraft Information

1.5.1 Aircraft Data

Registration Mark	:	RP-R5380
Manufacturer	:	Allied Ag-Cat Productions, Inc.
Type/Model	:	Agcat G164A
Serial Number	:	671
Date of Manufactured	:	1977
Aircraft Total Time	:	12,560+19 hours
Certificate of Airworthiness valid up to	:	August 09, 2023
Certificate of Registration valid up to	:	September 09, 2027
Gross Weight	:	1,475.36 Kilograms (Kgs.)

1.5.2 Engine Data

Manufacturer	:	Pratt & Whitney
Type/Model	:	R985
Engine Serial Number	:	12311
Time Between Overhaul	:	1,000 hours
Time Since Overhaul	:	536+00 hours
Time Since New	:	1,751+ 07 hours

1.5.3 Propeller Data

Manufacturer	:	Hamiltom Standard
Type/Model	:	2D30-421
Propeller Serial Number	:	W75983
Time Between Overhaul	:	571+31 hours
Time Since Overhaul	:	842+00 hours
Time Since New	:	5,671+57 hours

1.6 Meteorological Information

Visual Meteorological Conditions (VMC) prevailed at the time of the accident

1.7 Aids to Navigation

Aerial spraying operations are being conducted through Visual Flight Rules (VFR). VFR are set of regulations under which a pilot operates an aircraft in weather conditions generally clear enough to allow the pilot to see where the aircraft is going.

1.8 Communications

Aircraft is equipped with operational Very High Frequency (VHF) transceiver used for communicating with aerodrome personnel and pilots in the area.

1.9 Aerodrome Information

1.9.1 General Information

Aerodrome Name	: Tagbina Aerodrome
Aerodrome Operator Address	: Brgy Sta Fe, Tagbina , Surigao del Sur
Coordinates	: 08° 28'41.6" N ; 126° 08' 02.7" E
Runway Magnitude Bearing	: True North
Azimuth	: RWY 18/36
Runway Length	: 940 meters
Runway Width	: 45 meters
Runway Surface	: Macadam (Graded)
Wind cone	: Operational
CAAP Permit to Operate	: AGA-P-025A-2015

1.10 Flight Recorders

The aircraft is not equipped with flight recorders and neither relevant regulation requires it.

1.11 Wreckage and Impact Information

The engine failure resulted for the aircraft to forced land in wooded area. Before touchdown, it initially collided with two (2) falcata trees and came to a full stop in a nose down position after the right wing collided with another full-grown tree near a creek with final heading of 360 degrees and grid coordinates of 08° 48'78" N; 126° 13' 45" E.

1.12 Medical and Pathological Information

The pilot was subjected to medical and drug test after the incident with no significant findings. He also had undergone the post flight accident medical examination conducted by the Office of the Flight Surgeon and Aviation Medicine (OFSAM), and the Chief Surgeon recommended that there is no warrant for grounding of the pilot from performing flying duties.

1.13 Fire

There was no post-crash fire observed during on-site investigation.

1.14 Search and Survival Aspects

The crash was survivable because the integrity of the cockpit was not impaired. The seat and restraint remained intact after the accident. The pilot egress safely on his own after performing engine shutdown.

1.15 Test and Research

On December 18, 2022, the engine was removed from the crash site and brought to the Aerowurkz hangar. A tear-down inspection was conducted to determine any engine malfunction or failure that might cause the accident. The inspection was performed by the Operator's AMO and witnessed by AAIIB investigators.

1.16 Organizational and Management Information

1.16.1 Operator

The aircraft, RP-R5380 is being operated by Aerowurkz Aerial Spraying Services, with an address of Gen. Aviation Group Area, Old Airport Rd, Sasa, Davao City. Aerowurkz Aerial Spraying Services is a holder of Agricultural Aircraft Operator Certificate (AAOC) number 11-2010006 valid to operate up until September 29, 2027. It is authorized to perform restricted operations that provides agricultural aerial spraying services to the agricultural industries. Based on their Operations Specifications, RP-R5380 is included in the list of authorized aircraft for agricultural operations.

1.16.2 Maintenance

The maintenance function of RP-R5380 is being undertaken by Aerowurkz Aviation, Approved Maintenance Organization (AMO) with a current Certificate number 104-11 with facility located at Gen. Aviation Area, Old Airport, Sasa, Davao City valid to operate until August 31, 2025.

2.0 ANALYSIS

2.1 General

On December 17, 2022 at about 0900H, the pilot was maneuvering towards the next swath line after the third (3rd) line of his first load of aerial chemical spray, when the aircraft experienced engine failure. The pilot made an emergency forced landing. The aircraft initially collided with two (2) falcata trees before it came to a full stop in a nose down position after the right wing collided with another full-grown tree.

During the site investigation, the aircraft fuel strainer assembly located at the left side of the engine firewall was inspected and inside the assembly found to contain substantial amount of foreign particulates. The engine was removed from the crash site and brought to the Operator's hangar. A tear-down inspection was conducted on RP-R5380 to determine any engine malfunction or failure that might cause the accident. The inspection revealed that the cylinder heads, cylinder barrels, and cooling fins have no signs of crack that could contribute to the engine failure. Further, a cylinder compression test was also conducted for any leaks or cracks but shows negative findings. The inspection further revealed that both magnetos are emitting sparks during magneto check and of the retrieved spark plugs, eight (8) are emitting sparks except for one that was impact damaged. The fuel carburetor assembly was also inspected and the carburetor fuel filter screen inside was found to contain foreign particulates (Figure 2 and 3). The substantial amount of foreign particulates in the firewall fuel filter blocked the fuel supply to the engine. Once the fuel supply was cut-off, fuel starvation occurred and led to engine failure.

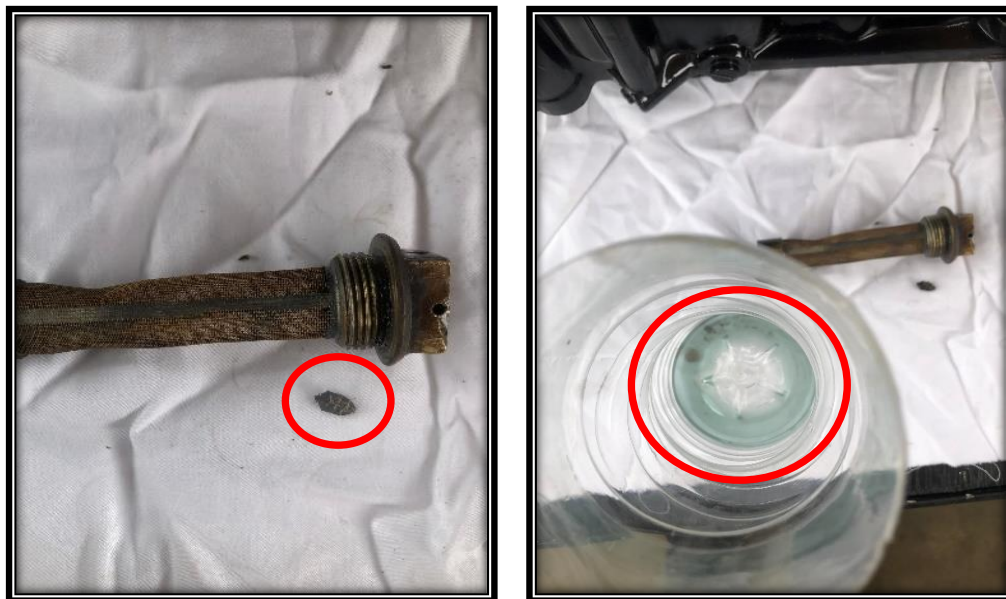


Figure 2 and 3: Foreign particulates found in the fuel carburetor filter screen

It revealed that the aircraft was being serviced before the first flight of the day instead after the last flight of the day. Fuel tanks should be filled after each flight or after the last flight of the day to prevent moisture condensation within the tank. It further revealed that the operator performs multi transfer fueling cycle in performing agricultural aerial spray. This multi transfer fueling cycle is consist of initially transferring of fuel from the operator's underground fuel storage tank to recycled drums (Figure 4) then to plastic containers and finally to the aircraft using plastic funnel with filter. The foreign particulates found in the fuel strainer assembly and fuel carburetor filter could be a result of the operator's traditional way of fueling done by gravity where fuel is transferred from recycled drums to the small plastic containers then to the aircraft using plastic funnel with filter (Figure 5). Review of the Company Operations Manual Standard Operating Procedures (SOP), reveals that there is no comprehensive procedure on dispensing of aviation fuels.



Figure 4 Recycled drums used for multi transfer fueling cycle

This multi transfer fueling cycle to service aircraft in remote locations exposes the fuel and equipment for contamination to occur. Likewise, the use of plastic containers not designed for fuel and recycled drums particularly the cap gasket may pose as a hazard. Apart from falling out of the cap and preventing proper sealing, the gasket will become brittle and degrade wherein the fragments can then be tipped into the aircraft fuel tank along with the fuel. This fragment over time can either clog fuel system filters.

Since fuel was stored in underground tank where full capacity is not maintained for extended periods of time, fuel being a gyrosopic fluid, absorbs moisture from the air around it. This develops into water and mixed with the fuel in suspension. Combined with water from condensation can result in contaminated fuel being introduced into the engine. Available records of the company do not show regular inspection of fuel contaminants in under-ground fuel tanks.

Contaminants in the fuel like water and particulate matters have been known to cause engine failures. Water in the fuel without being visibly obvious and while dissolved may not be a hazard to aircraft operation. However, as temperature changes causes the water to separate out of the fuel and became free water which affects safety. Entrained water is similarly difficult to identify since it consists of tiny droplets that have been agitated into fuel by pumps. This water separates into droplets with settling time where water is identifiable long after the fuel is introduced to the aircraft fuel tank. To minimize the risk of this happening, fuel drain checks from the aircraft should be carried out by the operator before the first flight of the day and after refueling. In the light of this case, the efficacy of the fuel contaminated by the water in the aircraft could not be determined since available records in the technical log page on day of the accident did not display that water drain check was performed and the possibility of the check being omitted.



Figure 5 Plastic containers and plastic funnel used for refueling aircrafts

In the course of investigation moreover, RP-R5380 is equipped with Cylinder Head Temperature (CHT) gauge to monitor the engine temperature, however the pilot revealed that it is defective. Review of the aircraft maintenance logbook does not show any reported defective CHT by the pilot. Accordingly, the Pilot only rely on the oil temperature gauge to monitor the engine temperature and has no other means to monitor the cylinder temperature limitations as prescribed in the General Operating Instructions (GOI) Volume 1. General Operating Instructions (Vol.1) for R985 engines prescribe the specific temperature limitations during ground testing, take-off, climb, cruise and shutdown. It also prescribed that all Agcat G164A/B aircraft should be fitted with Cylinder Head Temperature (CHT) gauge to monitor the engine's temperature as required by the GOI. Adherence to the limitations will reduce problems associated with cylinder head separation. The pilot and maintenance personnel must take necessary preventive measures to avoid operating at excessive cylinder head temperature and excessive manifold pressure or incorrect manifold pressure-rpm ratios. These conditions will likely overstress the cylinders and other engine parts that can lead to failure.

As a result of AAIIB investigation on previous cylinder separation involving P&W R-985 engines, the CAAP issued a Memorandum Circular (MC) No. 28-18 dated October 1, 2018 addressed to all Agricultural Air Operators to strictly comply with the General Operating Instructions (GOI) for R-985 engines on specific temperature limitations to reduce if not eliminate the issues related to cylinder head separation. Additionally, the Operators were also directed to ensure that the visual inspection on the area of the cylinder head cooling fins for exhaust emissions stains and exhaust carbon deposits are incorporated in pre-flight and post flight inspections.

3.0 CONCLUSION

3.1 Findings

- a. Pilot has a valid license and medical certificate issued by Office of Flight Surgeon and Aviation Medicine (OFSAM), CAAP.
- b. Visual meteorological condition prevailed at the time of the accident.
- c. The aircraft was released for flight without any discrepancies noted on its logbook.
- d. The aircraft has a current aircraft registration and certificates of airworthiness.
- e. The pilot while maneuvering towards the next swath line, when the aircraft experienced engine failure.
- f. There are eight (8) spark plugs that are emitting sparks except for one that was impact damaged.
- g. The Operator performs multi-transfer refueling cycle in performing agricultural aerial spray.
- h. Available records of the company do not show regular inspection of fuel contaminants in under-ground fuel tanks.
- i. Fueling containers that are used to facilitate easy transfer of fuel is not in appropriate standard, configuration, and cleanliness.
- j. Review of the aircraft maintenance logbook does not show any reported defective CHT by the pilot.
- k. The operator does not adhere to CAAP Memorandum Circular (MC) No. 28-18 dated October 1, 2018, compliance with the General Operating Instructions (GOI) for R985 engines on specific temperature

3.2 Probable Cause

3.2.1 Primary Cause Factor

Fuel strainer assembly is contaminated with substantial quantity of foreign particulates blocking the fuel supply that leads to engine failure.

3.2.2 Contributory Factor

There are no established procedures on dispensing aviation fuel.

4.0 SAFETY RECOMMENDATIONS

4.1 For CAAP-FSIS to ensure that the Operator:

- a. Include in the Company Operations Manual Standard Operating Procedures (SOP), a comprehensive procedure on dispensing of Aviation Fuels.

- b.** Conduct training/seminar to Pilots and Maintenance personnel on standards, practices, and safety measures to be observed in refueling an aircraft including hazards associated with improper refueling procedures for them to be fully aware of the potential risks.
- c.** Conduct regular inspection of fuel contaminants in under-ground fuel tanks.
- d.** Fueling containers that are used to facilitate easy transfer of fuel must be of an appropriate standard, configuration and cleanliness.
- e.** Logged all aircraft discrepancy in the maintenance logbook (ie Cylinder Head Temperature Gauge, etc.).
- f.** Adhere to CAAP Memorandum Circular (MC) No. 28-18 dated October 1, 2018, compliance with the General Operating Instructions (GOI) for R985 engines on specific temperature.

-END-

