

SOUTH AFRICAN



Section/division

Accident and Incident Investigations Division

Form Number: CA 12-12a

## AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:	CA18/2/3/9360	
<b>Aircraft Registration</b>	ZS-TBW	<b>Date of Accident</b>	15 September 2014		<b>Time of Accident</b>	1309Z
<b>Type of Aircraft</b>	Air Tractor AT-802A		<b>Type of Operation</b>	Fire Fighting (Part 137 )		
<b>Pilot-in-command Licence Type</b>	Commercial Pilot		<b>Age</b>	65	<b>Licence Valid</b>	Yes
<b>Pilot-in-command Flying Experience</b>	Total Flying Hours		19796.1		Hours on Type	68
<b>Last point of departure</b>	Piet Retief Airfield (FAPF) -Mpumalanga Province					
<b>Next point of intended landing</b>	Piet Retief Airfield (FAPF)-Mpumalanga Province					
<b>Location of the accident site with reference to easily defined geographical points (GPS readings if possible)</b>						
Mondi Vrede Farm at GPS coordinates S 27°00'96.7" E 030°53'29.5 Elevation 4347feet AMSL in Mpumalanga Province						
<b>Meteorological Information</b>	Wind direction: 45°-54°; Wind speed: 8 knots; Temperature: 31.5°C; Dew Point: -0.9°C; Visibility: Fine. Cloud cover: CAVOK					
<b>Number of people on board</b>	1+0	<b>No. of people injured</b>	0	<b>No. of people killed</b>	1	
<b>Synopsis</b>	<p>On 15 September 2014 at approximately 0834Z, the Air Tractor fire-fighting aircraft ZS-TBW (Bomber 9) and another Air Tractor fire-fighting aircraft (Bomber 95) were dispatched from Piet Retief Airfield (FAPF) on a fire-fighting mission at the Speenkoppies Mondi Vrede Farm in Mpumalanga Province. At the same time another set of Air Tractor fire-fighting aircraft (Bomber 10 and Bomber 11) were also dispatched from the Piet Retief Municipal airstrip also in Mpumalanga Province on the same fire-fighting mission at Speenkoppies Mondi Vrede Farm in the Piet Retief area. Earlier on 15 September 2014, Bomber 9 failed to release the fire retardant load on the fire at the plantation area as a result of the gate box doors failing to open. Shortly thereafter, the pilot reported that there was a problem with Gen I FRDS (Fire Retardant Dispensing System) was sorted out and successfully released the hopper load at the designated fire area. The FRDS is used to control the fire-fighting/bombing system of the aircraft. The aircraft then landed back at the same airfield where they took off from after the fire-fighting mission was completed and the Incident Commander instructed them to stand down.</p> <p>At approximately 1036Z, another forest fire was reported at the Mondi Vrede farm area whereupon the same four (4) Air Tractor fire-fighting aircraft and a Cessna spotter aircraft were dispatched to the designated fire area.</p> <p>The pilot of Bomber 95 which was flying behind the accident aircraft (Bomber 9) stated that the accident aircraft gatebox doors did not open to release the fire retardant load. The aircraft then descended to low level of about 50ft AGL with the aircraft in a nose up attitude before the aircraft impacted pine trees ahead that severed the right-hand wing from the aircraft. The aircraft subsequently rolled over to the right hand side into an inverted attitude and impacted the ground in a nose-down attitude of approximately 70°. The aircraft was destroyed and the pilot sustained fatal injuries as a result of this accident.</p> <p>The investigation revealed that the aircraft right wing collided with trees during a right bank in an attempt to avoid collision with the trees during a fire bombing operation and following a failure to dump the hopper load. The cause of the failure could not be determined following the testing of dump system. It is likely that the FRDS system was operated prior to reaching the required operating pressure of 3000 pounds per square inch (psi).</p>					
<b>Probable Cause</b>						
The aircraft right wing collided with trees during a right bank in an attempt to avoid collision with the trees.						
<b>Contributory Factors:</b>						
<ul style="list-style-type: none"> <li>• It is likely that the FRDS system was operated prior to reaching the required operating pressure of 3000psi</li> <li>• The aircraft operating at low speed as required by the AFM</li> <li>• The hilly terrain which the aircraft was successful in avoiding collision with but collided with trees planted on the terrain</li> </ul>						
SRP Date	24 May 2018		Release Date	21 January 2022		



## AIRCRAFT ACCIDENT REPORT

**Name of Owner/Operator** : FFA Aviation (Pty) Ltd  
**Manufacturer** : Air Tractor Inc.  
**Model** : AT-802A  
**Nationality** : South African  
**Registration Marks** : ZS-TBW  
**Place** : Mondi Vrede Farm -Mpumalanga Province  
**Date** : 15 September 2014  
**Time** : 1309Z

*All times given in this report are Co-ordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.*

### Purpose of the Investigation:

*In terms of Regulation 12.03.1 of the Civil Aviation Regulations (2011) this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and **not to establish blame or liability.***

### Disclaimer:

*This report is produced without prejudice to the rights of the CAA, which are reserved.*

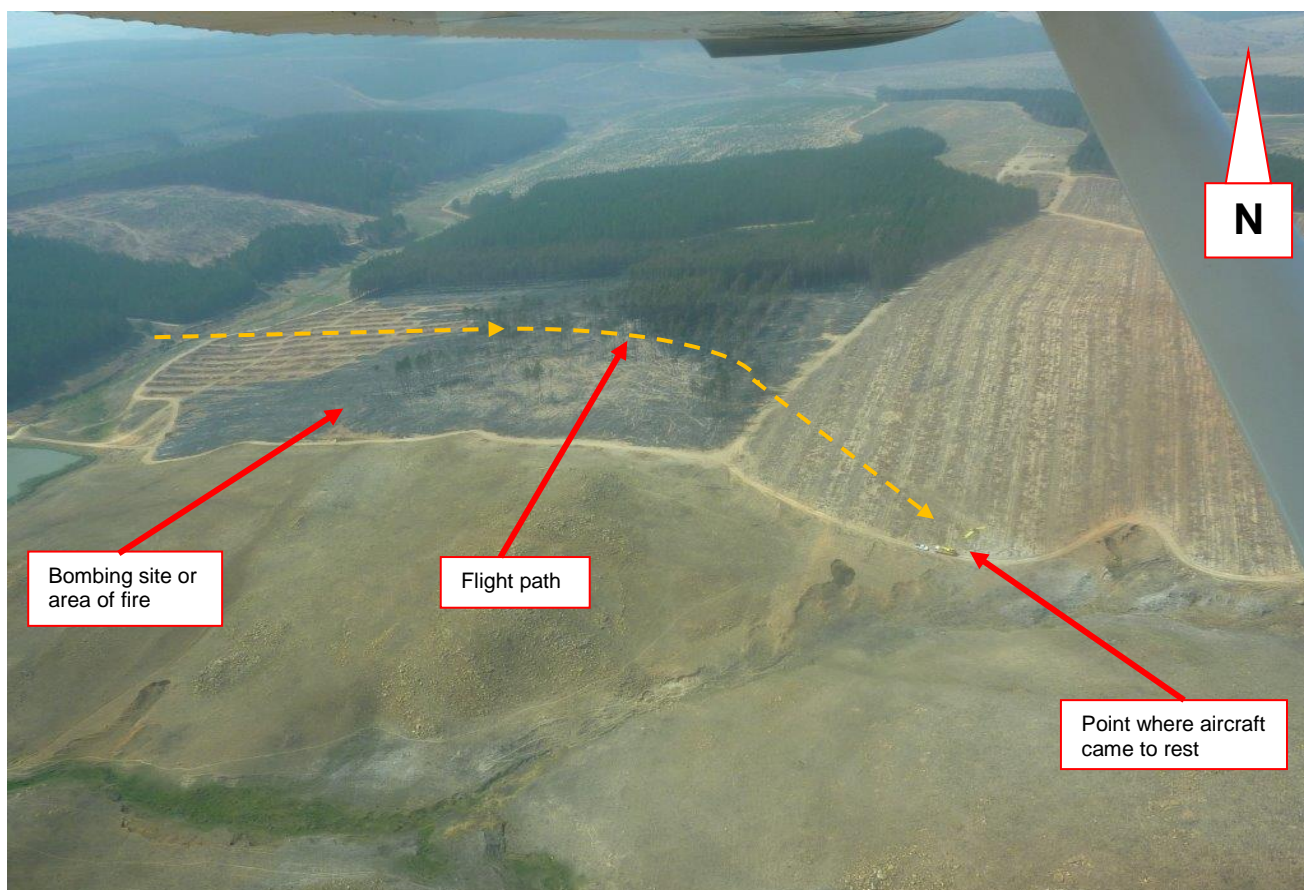
## 1. FACTUAL INFORMATION

### 1.1 History of Flight

- 1.1.1 On 15 September 2014 at approximately 0834Z, the Air Tractor fire-fighting aircraft ZS-TBW with call sign Bomber 9 and another Air Tractor fire-fighting aircraft with call sign Bomber 95 were dispatched from Piet Retief Airfield (FAPF) on a fire-fighting mission at the Speenkoppies Mondi Vrede Farm in Mpumalanga Province.
- 1.1.2 During that time another set of Air Tractor fire-fighting aircraft with call sign Bomber 10 (ZS-SPV) and Bomber 11 were dispatched from the Piet Retief Municipal airstrip also in Mpumalanga Province on the same fire-fighting mission at Speenkoppies Mondi Vrede Farm in the Piet Retief area.
- 1.1.3 Earlier on 15 September 2014, the pilot of Bomber 9 reported that he couldn't release the fire retardant load due to the gatebox doors not opening. Shortly thereafter, the pilot reported that the problem with Gen I FRDS was resolved and the aircraft successfully released the hopper load at the designated fire area. These facts were confirmed by the Dispatcher. The FRDS is used to control the fire-

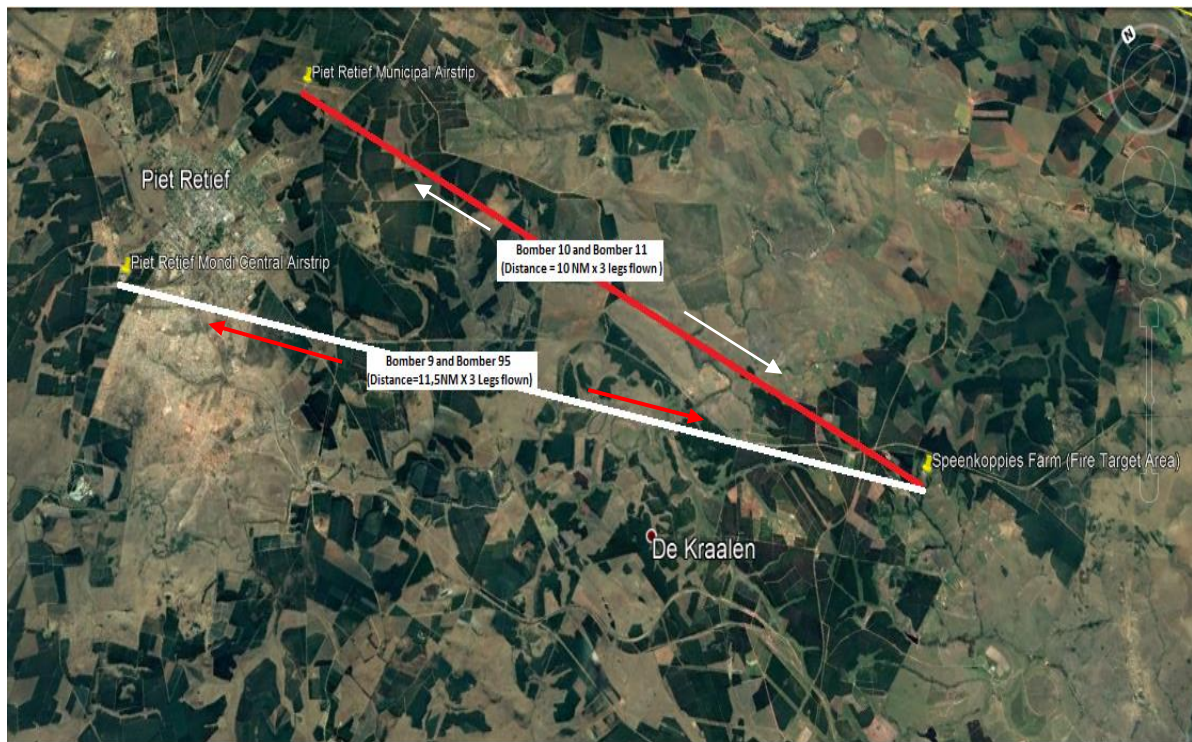
fighting/bombing system of the aircraft. The aircraft then landed back at the FAPF and all four aircraft were instructed by the Incident Commander to stand down.

- 1.1.4 At approximately 1036Z on the same day, another forest fire was reported at the Monti Vrede Farm area whereupon all four aircraft including a fifth aircraft (Cessna 182 - ZS-JOT) which was a spotter aircraft were dispatched to Mondi Vrede Farm.
- 1.1.5 The pilot of Bomber 95 which was flying behind the accident aircraft stated that the accident aircraft gatebox doors did not open to release the fire retardant load. The aircraft then descended to a height of about 50ft (15.2m) above ground level (AGL) with the aircraft in a nose up attitude before the aircraft impacted pine trees ahead which severed the right-hand wing tip from the aircraft. The aircraft subsequently rolled over to the right hand side through 180° (inverted attitude) and impacted the ground in a nose-down attitude of approximately 70°.
- 1.1.6 The aircraft skidded for several metres and it ground looped through 180° before it came to rest facing the direction of approach. The pilot sustained fatal injuries and the aircraft was destroyed during the impact sequence.
- 1.1.7 The accident occurred during daylight meteorological conditions at geographical positions determined to be 27°00'96.7" S 030°53'29.5" E, at an elevation of 4347 feet above mean sea level (AMSL).



**Figure 1:** The aerial view of the fire area, flight path and accident site

- 1.1.8 The operator confirmed the two tasking's or fire fighting operations. The dispatcher transcript also indicates that the accident aircraft Bomber 9 was allocated position 1 to dump the hopper loads during the fire-fighting operation at the target area and the Bomber 95 was allocated position 2 behind Bomber 9.



**Figure 2:** Fire-fighting operation to and from Speenkoppies Farm

1.1.9 According to the dispatchers and spotter transcripts, all four fire-bombing aircraft flew a total of twelve (12) uneventful legs between Piet Retief Mondl Central Airstrip and Piet Retief Municipal Airstrip to the fire target areas in Mondl Vrede farm during 2<sup>nd</sup> operation. During the 13<sup>th</sup> approach to the fire-fighting target area, the pilot of Bomber 10 (ZS-SPV) was in position 1 for the run-in. The Spotter's Log indicate that at about 1306Z, Bomber 10 dropped the load along the right flank and returned to base to refuel.

1.1.10 Bomber 9 couldn't drop the fire retardant load due to gate-doors not opening, the aircraft was observed descending to a height of approximately 50ft (15.2m) above ground level (AGL) in a nose up attitude before impacting with the pine trees ahead which severed the right-hand wing tip from the aircraft. The aircraft subsequently rolled over to the right hand side through 180<sup>o</sup> (inverted attitude) and impacted the ground in a nose-down attitude of approximately 70<sup>o</sup>.



Figure 3: Fire-bombing operation to and from Mondri Vrede Farm

1.2 Injuries to Persons

Injuries	Pilot	Crew	Pass.	Other
Fatal	1	-	-	-
Serious	-	-	-	-
Minor	-	-	-	-
None	-	-	-	-

1.3 Damage to Aircraft

1.3.1. The aircraft was destroyed.



Figure 4: Showing the main wreckage of the aircraft at the accident site

## 1.4 Other Damage

### 1.4.1. Damage caused to the trees.



**Figure 5:** Showing impact damage caused to the trees.

## 1.5 Personnel Information

Nationality	South African	Gender	Male	Age	65
Licence Number	0270061047	Licence Type	CPL		
Licence valid	Yes	Type Endorsed	Yes		
Ratings	Instrument, Instructor Grade 2, Test Pilot Class 2, and Agriculture Pilot.				
Medical Expiry Date	30 November 2014				
Restrictions	Corrective Lenses, Myocardial Infection (MI)/PTCA/CABG Protocol and provide annual cardiologist report				
Previous Accidents	None				

- 1.5.1 The Operator kept the flying experience of the pilot on the pilot's personal file during his employment since December 2011 as a fire-fighting/bombing pilot.
- 1.5.2 According to the Operator's Pilot Induction Records (OPIR) the pilot received a briefing to familiarise himself with the Operator's Standard Operations Procedures (SOP's) and Operations Manual in January 2012.
- 1.5.3 According to the Operator's Fire Bomber Pilot Assessment Report (OFBPAR), prior to the pilot started with fire-fighting duties and responsibilities, the Operator did an assessment of the pilot's knowledge, skills and experience and the pilot was found competent. He was then given the required authority to do fire-fighting operations.

- 1.5.4 According to the Pilot's Logbook and Aircraft Class Rating Application, the pilot travelled to Avialsa TRTO (ATO) at Castillo in Spain to receive an aircraft class rating course on the aircraft type in June 2013. The pilot successfully completed the training and was issued with the AT-802A aircraft class rating which was endorsed on his licence.
- 1.5.5 According to the Pilot's Training Records, after the AT-802A aircraft type rating was endorsed on the licence, he went to Valencia to receive fire-fighting training to operate the Fire Retardant Delivery System (FRDS) during December 2013. After successful completion of the FRDS training he returned back to South Africa to carry out fire-fighting operations with the AT-802A aircraft fitted with the FRDS.

1.5.6 Flying Experience:

Total Hours	19796.1
Total Past 90 Days	9.5
Total on Type Past 90 Days	9.5
Total on Type	68.0

- 1.5.7 The pilot's logbook could not be located during the accident investigation. As a result a copy of the pilot's logbook submitted during the last renewal was obtained in order to calculate the pilot's flying experience. The copy indicated that the pilot logbook was last updated on the 29 December 2013.
- 1.5.8 The aircraft flight folio was used to further determine the pilot flying experience post 29 December 2013. According to the flight folio, the pilot flew a total of 9.0 hours between January and April 2014. A total of 3.0 flying hours were flown on the 18-28 July 2014 and 5.2 hours during 07-31 August 2014.
- 1.5.9 The radio communication transcript on the day of the accident was obtained from the operator and indicated that the pilot flew approximately 1.3 hours on the day of the accident, this resulted in the total of 9.5 hours past 90 days in accordance with calculations made on the table above.
- 1.5.10 Based on the information above, the pilot's total flying hours were approximately 19796.1 hours and the total on type approximately 68.0 hours.
- 1.5.11 According to the Operator's Proficiency Check Records, the pilot received his last proficiency check for aerial fire-fighting operations on the Air Tractor 802 aircraft type on 01 June 2014 that was valid until 30 November 2014.

## 1.6 Aircraft Information

### Airframe:

Type	Air Tractor AT-802A	
Serial Number	802A-0208	
Manufacturer	Air Tractor Inc.	
Date of Manufacture	2005	
Total Airframe Hours (At time of Accident)	1528.8	
Last MPI (Date & Hours)	14 May 2014	1435.70
Hours since Last MPI	93.1	
C of A (Issue Date)	19 December 2013	
C of R (Issue Date) (Present owner)	15 November 2013	
Operating Categories	Standard Part 137	

### Engine:

Type	Pratt & Whitney PT6A-67AG
Serial Number	PCE-105040
Hours since New	3149.32
Hours since Overhaul	2539.02

### Propeller:

Type	Hartzell HC-B5MA-3D
Serial Number	HBA-1400
Hours since New	1004.15
Hours since Overhaul	303.25

- 1.6.1 The aircraft documentation on board the aircraft were found to be valid.
- 1.6.2 All aircraft maintenance documents were reviewed and found to be in order.
- 1.6.3 The flight folio was checked for any pre-accident defects or system malfunction reported by the pilot and none were recorded.
- 1.6.4 The Airframe, engine and propeller logbooks were found certified with applicable maintenance inspection information as required by regulations. The last maintenance work-pack was checked and no anomalies found evident. According to the work pack, the responsible AMO conducted a 100 hour MPI inspection on the aircraft and found it airworthy and released it back to service in accordance with applicable regulations. The Certificate of Release to service was issued with an expiry date of 13 May 2015 or at 1535.7 hours.
- 1.6.5 The aircraft was refuelled with Jet A1 fuel. The aircraft is certified to carry a total quantity of 380 US gallons (1436.4 litres) of fuel. In accordance with the Aircraft Flight Manual (AFM), the aircraft consumes 320-350 litres/hour. According to the operator's procedure, pilots are required to refuel the aircraft between 950-1100 litres of fuel at the end of each flight. The investigators could not determine the actual quantity of fuel at the start of the operation. However, the pilot flew a total of approximately 1.3 hours on the day of the accident. The remaining fuel after the flights was calculated to be approximately 564.5 litres if 1100 litres of fuel was carried on board at the start of the operation. The remaining total quantity of fuel carried on board the aircraft was found to be sufficient for the flight.



## Gen I FRDS Defects

- 1.6.6 The pilot reported a defect/problem with the fire retardant load release system during the flight of the first operation before the accident occurred on the 15 September 2014 during the 2<sup>nd</sup> operation. In order to resolve the problem with the Gen I FRDS, he indicated that he was returning back to base where after a minute, he reported that the issue with the system was resolved.
- 1.6.7 According to available information, the Gen I FRDS operated without any incident for eight flights from the time that the pilot reported that the defect was resolved.
- 1.6.8 Below is the picture of the gatebox doors which are situated below the aircraft when in a closed position and opened position.

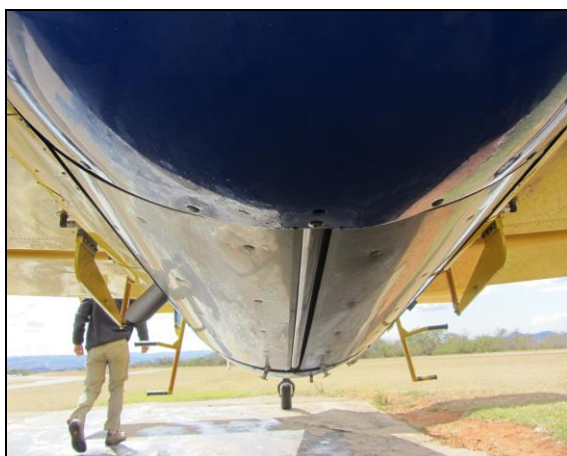


Figure 6: showing gatebox doors in a closed position



Figure 7: showing gatebox doors in an open position  
(Courtesy of Air Tractor website)

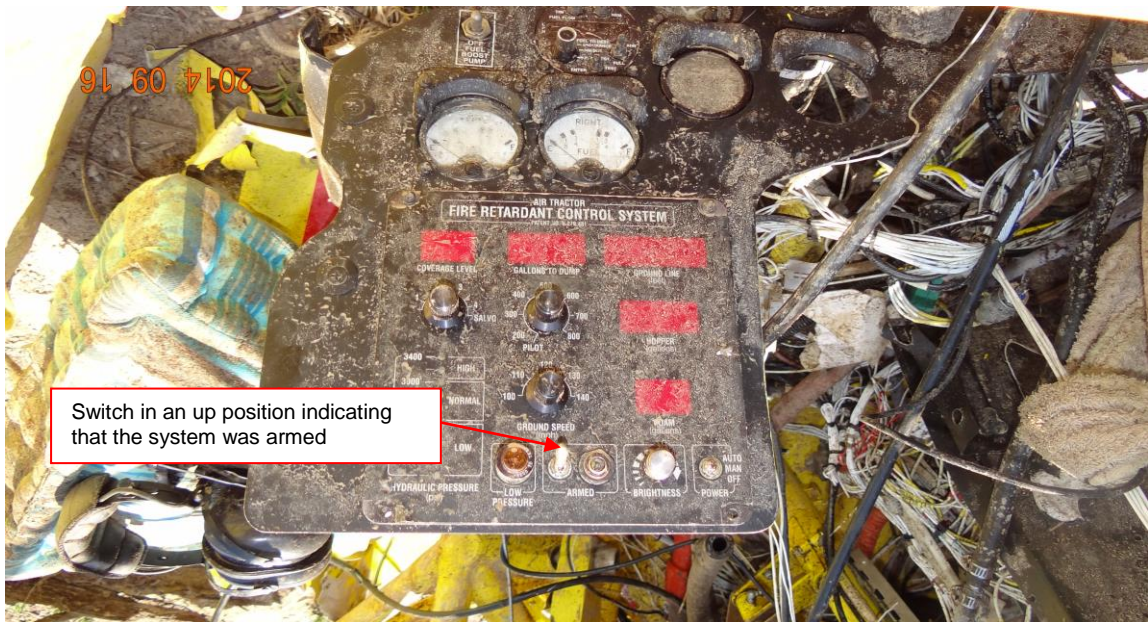
- 1.6.9 The accident aircraft was equipped with a Gen I Fire Retardant Delivery System (FRDS). The FRDS consisted of three modes of operations during fire-bombing operations to open and close the gatebox doors. The following modes of operation are as follows:

### Automatic Operation (Normal):

- 1.6.9.1 According to the aircraft manufacturer, the automatic mode is the normal operating mode for the FRDS, which is the first mode of operation used to open or close the hopper doors. The investigation determined that automatic mode of operation malfunctioned when the trigger button was pressed by the pilot during flight whilst attempting to dump his load.

### Manual Operation (Backup):

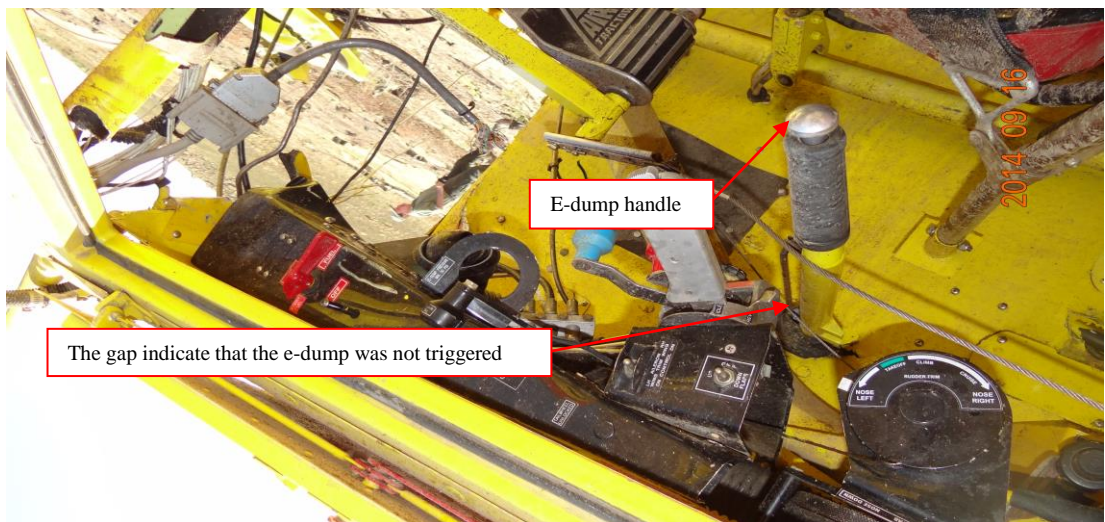
- 1.6.9.2 According to the aircraft manufacturer, the manual mode of operation is provided as a backup to the automatic mode of operation as the first method for performing an emergency dump. The investigation indicated that the pilot did not attempt to select the manual operation when the automatic mode of operation became unserviceable. See below figure indicating that the auto mode operation was selected and armed.



**Figure 8:** Showing FRDS Gen I automatic control panel taken at the accident site

**Emergency Dump Operation (Emergency):**

1.6.9.3 According to the aircraft manufacturer, the E-Dump mode of operation is the third method for performing an emergency dump for FRDS actuate the airframe emergency dump handle. The investigation indicated that E-Dump handle was not actuated to open the gatebox doors by the pilot during the flight. The figure below shows the E-Dump handle in the aft position not triggering the pneumatic emergency dump system.



**Figure 9:** showing E-Dump Handle taken at the accident site

**Note:** According to the aircraft documentation (work-pack) the maintenance on the FRDS was performed at the Maintenance Periodic Inspection (MPI) prior to the accident and no defects or anomalies with FRDS were recorded.

1.6.10 FRDS Operational Procedure: The AT-802A Airplane Flight Manual (AFM), page 22E-22G describes the operational procedure of the FRDS Gen I comprehensively to pilot.

1.6.11 Based on the AFM, the approach dump procedure that becomes applicable is tabled below:

**Table 1: Approach Dump Site Procedure**

Procedure	Achieved or Not Achieved
Slow aircraft to 125mph	Achieved
Select flaps 10 <sup>0</sup>	Not achieved as the flaps were found selected at 15 <sup>0</sup> during the onsite investigation.
Unlock dump handle stop in preparation for dump	Achieved
Line up aircraft for the load drop	Achieved
Be aware that during the load release there will be a sudden pitch up	Warning Statement for pilots
Apply forward motion on the control stick as soon as the dump handle is moved forward	Not applicable as the load did not release.
Keep aircraft relatively level during the drop phase	Achieved
After the drop, pull back on the dump handle to lock the hopper doors if possible	Not applicable as the load did not release.
Retract the flaps and re-trim the aircraft for normal flight.	N/A

### Aircraft Load:

1.6.12 The accident aircraft maximum certificated take-off weight (MTOW) is 16000lbs/ 7257.48 kg and the empty mass is 7207.9lbs/ 3269.5kg. The calculation showed the mass and balance of the accident aircraft was as follows:

Aircraft Weight at Take-Off During the Morning	Aircraft weight at the time of accident
3269.5 kg (empty weight)	3269.5 kg (empty weight)
90.0 kg (pilot weight)	90.0 kg (pilot weight)
0.0 kg (baggage)	0.0 kg (baggage)
3032.0 kg (hopper load/water tank)	3032.0 kg (hopper load/water tank)
798.9 kg (fuel load)	451.0 kg (fuel load)
<b>7190.4 kg (take-off weight)</b>	<b>6842.5 kg (accident weight)</b>

**Note:** based on the above calculations, the aircraft weight was calculated to be within the MTOW limit.

## 1.7 Meteorological Information

1.7.1 The following weather information below was obtained from South African Weather Services (SAWS). The SYNOP report information below was recorded at Vryheid (FAVY) at 15:00 UTC and contains the most likely surfaces conditions within the estimated period in the vicinity of the occurrence:

Wind direction	45° -54°	Wind speed	8 knots	Visibility	CAVOK
Temperature	31.5° C	Cloud cover	Nil	Cloud base	Nil
Dew point	-0.9° C				

## 1.8. Aids to Navigation

1.8.1. The aircraft was equipped with standard navigation equipment. Additional navigation equipment found installed were included on the approved equipment list. There were no reported defects with the navigation equipment prior to the accident. The navigation equipment on-board the aircraft were serviceable.

## 1.9 Communications.

1.9.1 The aircraft was equipped with a King KY 97A type of radio communication equipment. No defects to this equipment were recorded prior to the accident.

1.9.2 The pilot used the radio communication equipment to broadcast his intentions on VHF frequency 123.15 MHz to other aircraft in the air, Cessna 182 type, ZS-JOT the spotter and the dispatcher.

## 1.10 Aerodrome Information

1.10.1 The accident did not occur at or near an aerodrome but at the Mondi Vrede Farm in Piet Retief area at the following GPS coordinates S27°00'56.9" & E030°53'18.0" at an elevation of 4743 feet AMSL.

## 1.11 Flight Recorders

1.11.1 The aircraft was not fitted with a flight data recorder (FDR) or cockpit voice recorder (CVR) nor was either recorder required by regulations.

## 1.12 Wreckage and Impact Information

1.12.1. The aircraft approached from the west and was flying towards the east. The aircraft impacted the tree span along its flight path during a right bank with its right wing causing it to separate approximately in the middle and whilst attempting to climb to a safe height. The impact with the trees caused the aircraft rotated 180° to the right before impacting with the ground in an inverted attitude facing South. Following the impact with the ground, the aircraft skidded approximately 200-300m before it groundlooped coming to a halt inverted and facing North.

1.12.2. The right-wing of the aircraft collided with pine trees at a distance of approximately 1000m from the main wreckage and half of the right wing separated, fell to the ground and remain at the impact point. The aircraft then impacted the ground in a nose down attitude at approximately 700m from the impact point with trees and skidded for approximately 90 metres where after the aircraft veered sharply to the right and ground looped through 90° before it came to rest 1km from the point of impact with trees. The engine had separated and was found approximately 250m from the point of impact with the ground and the remains of the right wing and left wings were 50m and 150m from the main wreckage respectively.

1.12.3 Several tree stumps of approximately 30-50mm in length together with some aircraft debris were found scattered along the wreckage path. The main structural beams of the wings were found destroyed and the right-wing structural beam was found bent as a result of impact with the trees and the ground during the impact sequence.

- 1.12.4 The cabin area was destroyed during the impact sequence with the ground.
- 1.12.5 The aircraft impacted trees approximately 15 meters tall situated at an uphill at the located fire area.



**Figure 10:** showing right-hand side wing

- 1.12.6 The aircraft was destroyed during the impact sequence with the trees and the ground.
- 1.12.7 The right-wing impact with the trees at an estimated angle of approximately 45°-60° below the crown of the trees. The impact angle imprint on the pine trees was consistent with the aircraft attitude, nose pitched-up during the impact sequence. Debris of the right-wing was observed in the area of the impacted trees. The main wreckage came to rest at GPS reading S 27°00'96.7" E 030°53'29.5

### 1.13 Medical and Pathological Information

- 1.13.1 The post-mortem examination report indicated that pilot cause of death was as a result of head and spinal cord injuries sustained during an aircraft accident.
- 1.13.2 The toxicology examination report result showed no evidence of any anomalies.

### 1.14 Fire

- 1.14.1 There was no evidence of pre or post impact fire.

### 1.15 Survival Aspects

- 1.15.1 At 1309Z, the Dispatch office was informed of the accident and communicated the information to the emergency services (EMS) for response. At 1310Z, a Working on Fire ground team (first responders) from Mondi arrived at the scene to assist. At about 1325Z, the EMS arrived at the scene. For the period, from the time of the accident until the arrival of EMS, the spotter remained in the air circling above the accident site.

1.15.2 The accident was considered not survivable due to the cockpit structure being destroyed during accident sequence. The failure of the cockpit structure resulted in the pilot been fatally injured. According to the first responders when they arrived on scene they found the pilot still strapped inside the wreckage. The pilot was still fastened with the aircraft safety harness. In order to remove his body from the wreckage, the EMS had to cut the safety harness.

## 1.16 Tests and Research

1.16.1 The wreckage was recovered to the Operator's AMO facility in Nelspruit. The investigation team assisted by the AMO technical personnel inspected the FRDS components: Hydraulic motor-pump, Gatebox doors motor, Gen I FRDS auto control panel i.e. light bulbs, switches and indicators.

- The hopper doors hydraulic pump-motor was inspected and subjected to a functional test. The hydraulic pump-motor was found to be functional.
- The hopper doors motor was inspected and subjected to a functional test. The evidence was that the hopper doors motor was functional. However, the Hopper/gatebox doors motor was still in the "doors-closed position". As soon as the gatebox doors motor was energised with hydraulic pressure, the drive gear attachment rotated indicating doors-to-open position.
- The FRDS auto control panel was inspected to verify the positions of switches and indicators. Also to verify whether or not the different light bulbs were illuminated ON or OFF. (Refer to the aircraft information above)
- The Operator performed a functional test on the FRDS fitted to another fire-bombing aircraft to observe how the system operated under normal conditions. The demonstration indicated that when the FRDS is serviceable and selected to auto mode of operation, when the hydraulic pressure has reached 3000 psi which is the operating pressure for accurate gallonage delivery then doors will open fully. If the auto mode fails, the manual mode should be selected as a back-up or e-dump handle actuated to deliver the gallonage accurately.

## 1.17 Organizational and Management Information

1.17.1 The operator responsible for the aerial fire-fighting operation is a South African government-funded, multi-partner organisation. The Operator/organisation managed an integrated fire management programme which includes a series of actions such as, detection, prevention, suppression, dispatch and coordination of fires.

1.17.2 The aircraft was maintained by the approved Aircraft Maintenance Organisation (AMO). The AMO had a maintenance line station facility operating in Piet Retief. All maintenance resources which include personnel, tools, equipment, spares and technical data were supplied by the main AMO based in Nelspruit.

1.17.3 According to available information, whenever any of the operator's aircraft becomes unserviceable during fire-bombing operation such defects shall be reported to the AMO in Nelspruit. In terms of the Operators Maintenance Control

Manual (MCM) all defects experienced with the aircraft should be immediately recorded in the flight folio and corrective action must be taken prior to the next flight. No defects were recorded in the flight folio regarding the FRDS which indicates that the system was fully functional until the day of the accident.

1.17.4 All tested components of the gate box were tested and operated normally when tested.

## 1.18 Additional Information

### 1.18.1 Aircraft performance

#### AT-802A Performance

<i>Cruise Speed at 8,000 ft (2.438 m):</i>	<b>191 mph (166 kts)</b>
<i>Working Speed (Typical):</i>	<b>130-160 mph (113-139 kts)</b>
<i>Range - Economy Cruise at 8,000 ft (2.438 m):</i>	<b>610 mi (982 km)</b>
<i>Stall Speed - Flaps Up:</i>	<b>107 mph (92 kts) at 16,000 lbs (7.257 kg)</b>
<i>Stall Speed - Flaps Down:</i>	<b>91 mph (79 kts) at 16,000 lbs (7.257 kg)</b>
<i>Stall Speed as Usually Landed:</i>	<b>63 mph (54 kts)</b>
<i>Rate of Climb:</i>	<b>780 fpm at 16,000 lbs (7.257 kg)</b>
<i>Take-off Distance:</i>	<b>2,000 ft at 16,000 lbs (7.257 kg)</b>

Referenced: <https://airtractor.com/aircraft/at-802a/> on 24 April 2018

## 1.18.2 FRDS Primary control system and operation procedure:



Figure 12: FRDS primary control panel

## 1.19 Useful or Effective Investigation Techniques

1.19.1 None.

## 2. ANALYSIS

### 2.1 Man:

2.1.1 The pilot was appropriately licenced and qualified to fly the aircraft on the fire-fighting operation. The pilot had a valid Commercial Pilot Licence (CPL) with Air Tractor AT-802A type and agriculture type rating endorsed on it. He accumulated a total of approximately 19796.1 Flying hours on fixed wing aircraft and approximately 68.0 hours flown on the aircraft type.

2.1.2 The pilot was issued with a Class 1 aviation medical certificate which was valid until the 30 November 2015. The medical history of the pilot was reviewed in the investigation process, specifically focusing on his medical restrictions.

2.1.3 The pilot was abeam the fire target area in Mondri Vrede farm and on his 13<sup>th</sup> bombing. The pilot was not successful with the bombing of the fire and upon a failure of the hopper to release the load, the pilot initiated a climb which was unsuccessful due to the aircraft impacting with pine trees during a right bank to avoid collision with trees span along his flight path.



2.1.4 The pilot was fatally injured as a result of the accident and damage caused to the aircraft cockpit.

## 2.2 Machine:

2.2.1 The aircraft had a valid Certificate of Airworthiness (C of A) which was issued on the 19 December 2013. All the aircraft documentation carried on board the aircraft were reviewed and found to be in order. Furthermore, there were no recorded defects or malfunction found in the aircraft flight folio. The maintenance documentation from airframe, engine and propeller logbooks, last MPI work-pack were reviewed and no anomalies were found. There was no significant defect or anomaly found with the aircraft and maintenance documentation respectively. The last MPI was carried-out by the approved AMO on the 14 May 2014 at a total of 1435.7 airframe hours and since the last MPI the aircraft was flown 93.1 hours when the accident happened. The aircraft had sufficient fuel on board for the intended operation and the aircraft was considered to have been serviceable for the flight.

2.2.2 The aircraft was fitted with the Gen I FRDS used for aerial fire-fighting operation and which comprises of three modes of operation i.e. Automatic, Manual and E-dump operation. During the fire-bombing operation at Speenkoppies at about 0838Z the pilot reported a problem with the aircraft FRDS in-flight, within a minute he reported again via radio communication that the system malfunction was resolved and went on to complete the fire-bombing operation by dropping the load on the fire target area. The aircraft then continued with the fire-bombing operation at Mond Vrede for approximately 1.3 hours whereby the pilot completed twelve droppings without encountering a problem with the FRDS and on the thirteenth attempt the load drop was unsuccessful.

2.2.3 Though the pilot had reported the failure of the gatebox doors in one of his flight earlier on the day of the accident and later confirmed the system operating normally. The investigation on the Gen 1 FRDS system and the gatebox doors revealed no anomalies with the system which could explain why GEN 1 FRDS or the gatebox doors system failed to operate.

2.2.4 During the investigation, there was no evidence found which would indicate that the pilot made an attempt to use the Manual or Emergency modes of the Gen 1 FRDS system prior to impact. It is thus most likely that he did not operate either of the two systems or did not have sufficient time to engage the two systems prior to the crash due to his attempt to get to a safe altitude.

2.2.5 The aircraft flaps were detained on site to have been selected at 15<sup>0</sup> and not 10<sup>0</sup> as required by the procedure. The pilot flying behind the accident aircraft confirmed that the speed was at about 125mph as required by the procedure.

2.2.6 The failure of the aircraft to release its hopper tank load, the low speed at about 125 mph (see table 1) and the raising terrain contributed to the aircraft inability to clear obstacles span along its flight path along a hilly terrain. In an attempt to avoid collision with trees, the pilot turned right and the aircraft collided with the trees with its right wing.

- 2.2.7 The right wing separated at approximately midpoint before the aircraft impacting the ground in an inverted and nose down attitude. The part of the wing that separated remained in the vicinity of the trees it impacted with.
- 2.2.8 The aircraft then impacted the ground in an inverted attitude and skidded for approximately 150m before the engine separating and continued for another 150m before the cockpit separated in to two and coming to halt.
- 2.2.9 The pieces of the right wing were found some 50m and pieces of the left wing were found 150m behind from the main wreckage.
- 2.2.10 The aircraft was destroyed during impact with the pine trees and subsequently with the ground and tree stumps.

### **2.3 Environment:**

- 2.3.1 The South African Weather Services (SAWS) indicated that the weather conditions were fine, the air temperature 31.5°C, and wind direction North-East (i.e. 45°-54°) at 8 knots. As a result, weather did not contribute to the cause of the accident.
- 2.3.2 The terrain where the fire-bombing operation was conducted was in the vicinity of a pine tree plantation. The direction where aircraft was approaching the fire target area was West on a downhill/sloppy terrain at entry to the drop zone whilst the fire target area was on a raising terrain East on the exit path.
- 2.3.3 It is the opinion of the investigators that the risk assessment of the terrain and did not consider the approach and exit direction with emphasis to the safe exit route in the event of an emergency.

### **2.4 Investigation revealed**

- 2.4.1 No anomalies with the GEN 1 FRDS and the gatebox door operating system and during testing, all components tested operated normally. The investigation could not find any anomaly with the dump system. It is likely that the pilot might have engaged the system prematurely as a result the system failure to operate. This was evidenced by the stretched filament of the hydraulic pressure low light bulb, indicating that the system was operated prior to reaching the 3000psi operating pressure.
- 2.4.2 The failure of the aircraft to release its hopper tank load, the low speed at about 125 mph (see table 1) and the raising terrain contributed to the aircraft inability to clear obstacles span along its flight path along a hilly terrain. In an attempt to avoid collision with trees, the pilot turned right and the aircraft collided with the trees with its right wing.
- 2.4.3 During the right hand turn/bank, the right wing collided with the trees and it separated from midpoint and the aircraft rolled to the right through 180<sup>0</sup> and became inverted before it impacted with the ground.
- 2.4.4 It is likely that the collision with trees and the separation of half the portion of the right wing caused the pilot to lose control of the aircraft resulting on crash.

- 2.4.5 The pilot was fatally injured and the aircraft was destroyed during the accident sequence.
- 2.4.6 No evidence could be found which could indicate that the pilot used the manual or the emergency dump systems, or it is likely that he did not have sufficient time to engage either of the systems before or during his attempt to dump the load.

### **3. CONCLUSION**

#### **3.1 Findings**

- 3.1.1 The pilot was the holder of valid commercial pilot licence (CPL) with the AT-802A aircraft type and agriculture rating endorsed on it.
- 3.1.2 The pilot had a total flying experience of 19761.9 hours on the fixed wing and 68.0 hours on the aircraft type.
- 3.1.3 The pilot had a valid Class 1 aviation medical certificate with restriction/limitation to wear corrective lenses, myocardial infection (MI)/PTCA/CABG protocol and to provide annual cardiologist reports.
- 3.1.4 It was established that the flaps were selected to 15 degrees at the time of the accident and not 10 degrees as required by the AFM.
- 3.1.5 The aircraft Certificate of Airworthiness was found valid at the time of the accident.
- 3.1.6 No anomalies were found on the aircraft documentation which were on board the aircraft.
- 3.1.7 No defects or malfunction were recorded in the aircraft flight folio or in the aircraft maintenance records prior to this flight.
- 3.1.8 According to available information the pilot completed 12 successful fire-bombing runs on the day before the accident occurred on the 13<sup>th</sup> attempt.
- 3.1.9 There was no evidence of any defect and/or malfunction reported by the PIC with the aircraft in flight. The conclusion was that the aircraft operation and performance was within the design limitations as required by the aircraft flight manual (AFM).
- 3.1.10 The aircraft was carrying sufficient amount of Jet-A1 fuel on board during the aerial fire-fighting operation. The aircraft weight and balance was calculated and found to be within the acceptable operational limits as required by the AFM.
- 3.1.11 No anomalies with the GEN 1 FRDS and the gatebox door operating system and during testing, all components tested operated normally. The investigation could not find any anomaly with the dump system.
- 3.1.12 The failure of the aircraft to release its hopper tank load, the low speed at about 125 mph (see table 1) or appendix A and the raising terrain contributed to the aircraft

inability to clear obstacles along its flight path along a hilly terrain. In an attempt to avoid collision with trees, the pilot turned right and the aircraft collided with the trees with its right wing.

3.1.13 The right wing separated from midpoint and the aircraft rolled to the right through 180° and became inverted before it impacted with the ground.

3.1.14 It is likely that the FRDS system was operated prior to reaching the required operating pressure of 3000psi.

### **3.2. Probable Cause/s**

3.2.1 The aircraft right wing collided with trees during a right bank in an attempt to avoid collision with the trees.

#### **3.2.2 Contributory Factors:**

3.2.2.1 It is likely that the FRDS system was operated prior to reaching the required operating pressure of 3000psi.

3.2.2.2 The aircraft operating at low speed as required by the AFM, and

3.2.2.3 The hilly terrain which the aircraft was successful in avoiding collision with but collided with trees planted on the terrain.

## **4. SAFETY RECOMMENDATIONS**

4.1. None.

## **5. APPENDICES**

5.1. Appendix 1 (dump site procedure)

Appendix 1: dump site procedure

**This report is issued by:**

**Accident and Incident Investigations Division  
South African Civil Aviation Authority  
Republic of South Africa**

## AIR TRACTOR, INC.

Olney, Texas

## FIRE RETARDANT DELIVERY SYSTEM

## GEN I FIRE RETARDANT DELIVERY SYSTEM

OPERATING PROCEDURES

**WARNING**  
DO NOT FLY UPSLOPE TO DUMP ON A FIRE.  
MAINTAIN SUFFICIENT ALTITUDE TO CLIMB AWAY IF DUMP IS ABORTED.

## APPROACHING DUMP SITE

1. POWER SWITCH..... AUTO
2. HYDRAULIC PRESSURE ..... VERIFY NORMAL
3. ARMED SWITCH ..... UP
4. ARMED ANNUNCIATOR (GREEN) ..... ILLUMINATED
5. COVERAGE LEVEL ..... AS REQ'D
6. GALLONS TO DUMP ..... AS REQ'D
7. GROUND SPEED ..... AS REQ'D
8. FLAPS ..... SET 10 DEGRESS
9. AIRSPEED ..... 125 - 130 MPH IAS
10. OVER DUMP SITE ..... PRESS FIRE SWITCH
11. AIRCRAFT ATTITUDE ..... MAINTAIN LEVEL FLIGHT & ALTITUDE  
*If delivering split load:*
  - a. ARMED SWITCH..... OFF
  - b. GALLON TO DUMP..... SELECT FOR 2<sup>ND</sup> DUMP
  - c. GROUND SPEED..... AS REQ'D
  - d. ARMED SWITCH..... UP
  - e. HYDRAULIC PRESSURE ..... VERIFY NORMAL
  - f. OVER 2<sup>ND</sup> DUMP SITE ..... PRESS FIRE SWITCH
  - g. AIRCRAFT ATTITUDE ..... MAINTAIN LEVEL FLIGHT & ALTITUDE
12. ARMED SWITCH ..... OFF
13. POWER SWITCH ..... AS REQ'D

## AUTO MODE INOP – MAN MODE DUMP

1. POWER SWITCH (PRIMARY CONTROL PANEL) ..... MAN
2. MANUAL POWER ON ANNUNCIATOR ..... ILLUMINATED
3. HYDRAULIC PRESSURE ..... VERIFY NORMAL
4. MANUAL ARM SWITCH..... UP
5. MANUAL ARMED ANNUNCIATOR ..... ILLUMINATED
6. FLAPS ..... SET 10 DEGRESS
7. AIRSPEED ..... 125 - 130 MPH IAS
8. OVER DUMP SITE ..... PRESS & HOLD FIRE SWITCH
9. AIRCRAFT ATTITUDE ..... MAINTAIN LEVEL FLIGHT & ALTITUDE
10. HOPPER CONTENTS DUMPED..... RELEASE FIRE SWITCH
11. GATEBOX DOORS..... VERIFY CLOSED
12. MANUAL ARM SWITCH..... OFF
13. POWER SWITCH (PRIMARY CONTROL PANEL) ..... OFF

FAA APPROVED  
FEBRUARY 19, 2009

AT-802A AIRPLANE FLIGHT MANUAL

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AIR TRACTOR, INC.

Olney, Texas

FIRE RETARDANT DELIVERY SYSTEM

GEN I FIRE RETARDANT DELIVERY SYSTEM

SYSTEM SUMMARY

PRIMARY CONTROL PANEL

