DATA SUMMARY

LOCATION

Date and time	**5 July 2005; 16:30 local time**
Site	**Near Castellbisbal (Barcelona)**

AIRCRAFT

Registration	**EC-GUF**
Type and model	**AIR TRACTOR AT-802**
Operator	**Avialsa**

Engines

Type and model	**PRATT & WHITNEY CANADA PT6A-67AG**
Number	**1**

Crew

Pilot in command

Age	**54 years**
Licence	**Commercial aircraft pilot**
Total flight hours	**12,000 h**
Flight hours on the type	**57:45 h**

INJURIES

	Fatal	Serious	Minor/None
Crew			**1**
Passengers			
Third persons			

DAMAGE

Aircraft	**Destroyed**
Third parties	**Minor (public street lamp and vegetation)**

FLIGHT DATA

Operation	**Aerial work – Firefighting**
Phase of flight	**Maneuvering – Low altitude flight**

REPORT

Date of approval	**25 April 2007**

1. FACTUAL INFORMATION

1.1. History of the flight

The event took place during a flight carried out by the aircraft, registration EC-GUF, with only the pilot at the controls, while taking part in a firefighting effort to extinguish a blaze declared in the vicinity of the town of Castellbisbal, in the province of Barcelona.

The aircraft had been contracted for that year's fire prevention and firefighting season, and was based at Sabadell airport, some 30 km NE of Castellbisbal.

The flight took off from said airport at 16:15 and was scheduled to land at the same airport. It was the aircraft's second flight that day, the first having been completed by the same pilot, taking off from and landing at the same airport, with a duration of 1.5 hours. The first flight had taken off at 13:30.

The accident occurred when the aircraft failed to regain altitude after performing a water drop at the leading edge of the fire. The drop had been executed at a very low altitude, after which the aircraft entered a column of smoke, losing altitude while flying over several streets within the Castellbisbal urban area before crashing into a public street lamp and impacting the terrain beyond the road surrounding the town. It then slid down a hillside and through some orchards, coming to rest at the bottom of a streambed in Can Cases de la Iglesia, where it caught on fire.

The aircraft was completely destroyed and the pilot emerged under his own power with injuries, which were classified as minor.

1.2. Personnel information

The accident pilot was 54 years old and had a Commercial Aircraft Pilot license. He had VFR-HJ, single-engine and and firefighting ratings.

The pilot had a total of 12,000 flying hours, approximately 57:45 of which were on the type of aircraft involved in the accident. Of those, 17:35 had been logged in the 30 days prior to the accident and, of those, 1:45 hours on the day of the accident in the flight immediately prior.

1.3. Aircraft information

1.3.1. *Aircraft*

Manufacturer:	Air Tractor; Inc.
Model:	AT-802

Serial number:	802-0059
Year of manufacture:	1997
Registration:	EC-GUF
Date of registration:	22-07-1998
Maximum takeoff weight:	7,260 kg (16,000 lb)
Maximum discharge weight and capacity:	3,032 l (800 USG) / 3,992 kg

1.3.2. *Airworthiness certificate*

Number:	4.256
Class:	Restricted
Issue date:	24-05-2005
Expiration date:	04-05-2006
Operator:	Avialsa, S. L.
Endorsements:	— Extinguishing forest fires — Aerial applications — Observation and patrol flights

1.3.3. *Aircraft maintenance record*

Total flight hours:	1,971:25 h on 05-07-2005 (including accident flight)
Hours and date of the last periodic inspection (100 h):	1,912:50 h; 12-05-2005[1]
Hours until next inspection:	41:25 h

1.3.4. *Engine*

Manufacturer:	Pratt & Whitney Canada
Model:	PT6A-67AG
Power:	1,350 SHP

[1] Includes engine and propeller.

Serial number:	PCE-RD 0006
Total flying hours:	1,971:25 h on 5-07-2005
Hours on the last hot section inspection (HSI):	1,149:22 h
Hours until the next HSI:	677:57 h

1.3.5. *Propeller*

Manufacturer:	Hartzell Corp
Model:	HC-B5MA-3D / M11276N
Serial number:	HBA-1270
Number of blades:	5
Mounted on the aircraft:	18-01-2005 with the aircraft at 1,813:50 h
Hours until next propeller overhaul:	2,842:25 h

1.4. Meteorological information

No data are available for the location of the fire, but the INM (Instituto Nacional de Meteorología – National Weather Institute) reported that, based on data from nearby weather stations, maps and satellite images, the most likely weather conditions at the place and time of the accident included good visibility, light winds from the SE at 6 to 7 knots and low, scattered clouds. No precipitation was recorded at any of three stations within 15 km of the site.

1.5. Wreckage and impact information

A visual inspection carried out at the crash site has allowed for a reconstruction of the flight path up until the time of the accident. This was made possible by noting the condition of the street lamp with which the aircraft collided, the trail of damage caused by the aircraft to trees, shrubs and orchards located beyond the roadway and, finally, by the position of the wreckage at the bottom of the streambed in which it fell after sliding down an embankment and where it caught on fire. Figure 1 shows a diagram of this path overlaid on a map of Castellbisbal.

The labeled points on the diagram indicate the position of the leading edge of the fire which the aircraft was attempting to extinguish during the accident flight and the aircraft's trajectory.

The street lamp against which the aircraft collided was 9 meters high and was bent at the base by the force of the impact with its top part. The lamp was located some 200 m away from wreckage site.

The remains (Fig. 2) were confined to one area except for a few panels and pieces that detached as the aircraft moved along the ground. These were found within 50 m of the site. As shown in Fig. 2, the wreckage, particularly in the area of the engine and the forward and middle fuselage, was practically consumed by the fire which broke out following the accident. The fire was quickly put out by some of the aircraft which were taking part in extinguishing the forest fire that initiated the operation.

A visual inspection of the remains confirmed that all the engine controls, tubing and accessories, especially those for the fuel, were destroyed or severely damaged by the fire, along with the cockpit controls, especially those situated on the left side. No accurate determination could be made of the position of any of the flight control levers, located in the cockpit's left quadrant, although when the quadrant was recovered, the start control lever seemed to be slightly aft of the RUN position. The propeller was feathered.

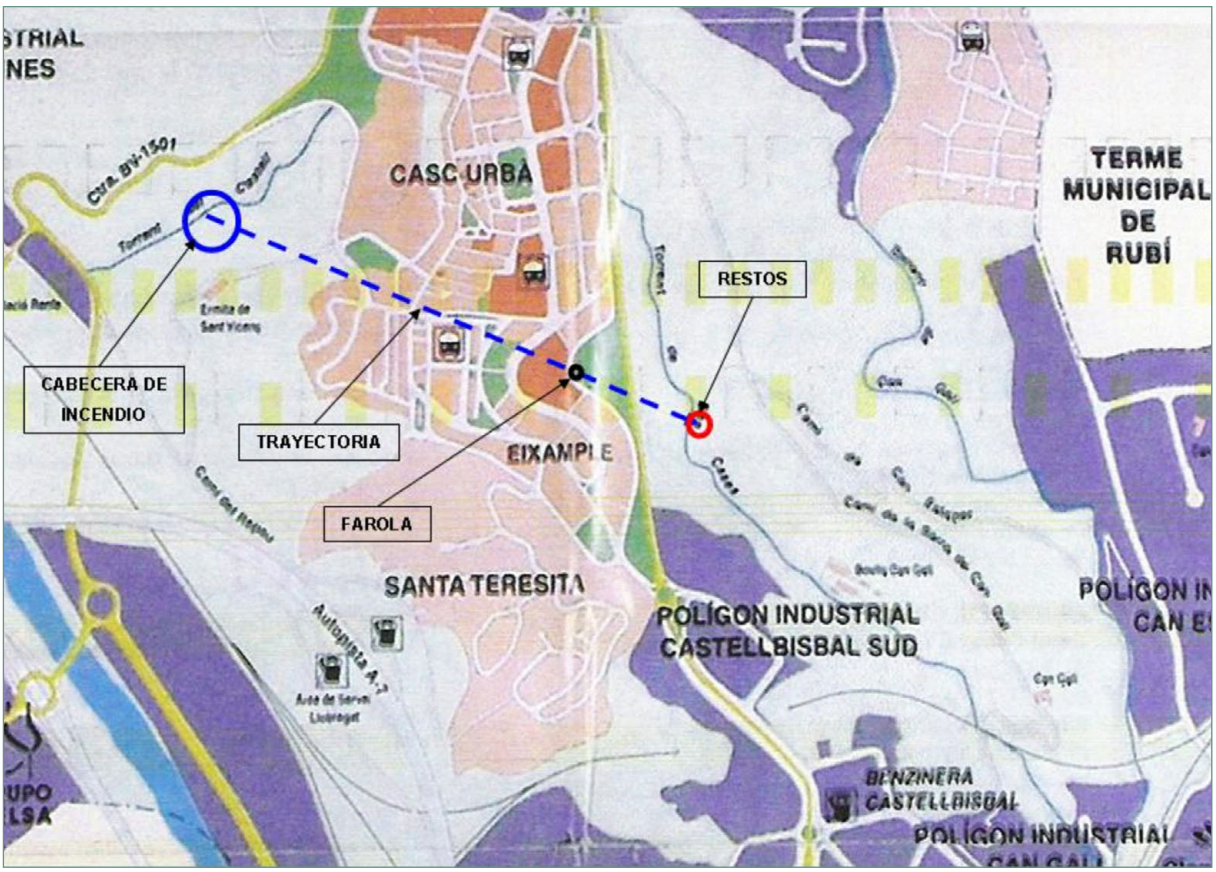

Figure 1. Final flight path superimposed on a map of Castellbisbal

Figure 2. Main wreckage (front part)

1.6. Survival aspects

According to his own statement, the pilot left the aircraft after the accident when it started to burn, and reported to the emergency fire and rescue personnel who had rushed to the site. The pilot suffered minor injuries, though he was hospitalized as a precaution.

1.7. Tests and research

1.7.1. *Pilot's statement*

The pilot stated that he made the water drop without incident after reconnoitering the drop site and determining the direction of the fly-by.

There was abundant smoke from the fire and after the drop, he inadvertently flew into an area of smoke. He was in the area for a short time (about two seconds by his own estimate) and, once outside, he tried to increase power and found the engine unresponsive. He supposed the engine had stopped, possibly due to a lack of oxygen in the turbine.

He reported the engine failure by radio (according to information from firefighting personnel, the message received was unintelligible) and simultaneously tried to restart

the engine, without success. He then impacted the street light and, a short time later, the ground. The aircraft then started to burn and he was able to get out under his own power.

1.7.2. *Powerplant inspection and disassembly*

A detailed inspection of the powerplant and propeller components was performed, and included a complete disassembly and analysis of the parts at the engine manufacturer's facilities in Canada.

The engine was heavily damaged by the fire, especially the accessory housing, which was practically consumed, and the engine fuel system's controls and accessories.

The conclusions from the inspection were as follows:

— None of the engine components showed any signs of a malfunction prior to the accident which would have prevented the engine from operating normally
— At the time of impact, the engine showed signs of rotating under low or no power
— Heat and fire damage prevented an operational analysis of the controls and engine accessories, especially those involving the fuel system.

1.8. Additional information

1.8.1. *Operation and function of the engine control levers*

The engine on an AT 802 aircraft is controlled by way of throttle, propeller and start control levers which are located on the quadrant on the cockpit's left console. The first two levers are practically the same length, while the start control lever is shorter.

The *throttle lever*, also called the engine lever, is connected to the engine's fuel control unit and basically controls the RPMs on the engine's gas generator. This lever can travel in two directions, separated by a detent that prevents pulling the lever into the reverse position without first actuating a trigger located on the top part of the lever. The lever's forward movement is not limited by the detent. The forward direction is used to select engine thrust, from maximum (forward-most position) to minimum (flight idle position). The aft direction includes «beta» mode, used for taxiing and reverse. In this mode, in addition to generator RPM, the lever controls the «beta» valve. This valve is used to change propeller pitch with lever travel, from positive values to negative ones for reverse.

The *propeller lever* is connected to the propeller's variable pitch governor and controls its rotating speed in this mode of operation, the maximum being in the forward

position, P. In its aft-most position, F, the lever activates the valve used to feather the propeller. The aircraft is not equipped with an automatic feathering system.

The *start control lever* allows for limited fuel to be supplied during engine start and controls the fuel flow to the engine's combustion chamber. In the aft-most position, C, the lever operates a valve that cuts off the fuel to the engine. Moving the lever forward from that position opens the fuel flow and allows the gas generator to be kept at ground idle, the minimum RPM permitted for ground operations and which corresponds to 56%. The RUN position guarantees that this value will be maintained and the lever is prevented from inadvertently shifting backward by a tab. The forward-most position, FLIGHT, corresponds to flight idle and is set for the minimum flight thrust, whose value if 68%. The lever mechanism includes a latch for releasing a nipple that allows the aforementioned tab to be moved.

The ability to maintain ground idle before reaching the RUN position is used to keep the engine running without activating said tab. The lever is also used to readjust the 56% position between the RUN and FLIGHT positions and to compensate for the drop in RPMs which takes place when the electrical generator is connected.

1.8.2. *Information from the aircraft operator*

According to information supplied by the operator:

a) The aircraft had refueled for the accident flight and was carrying 500 gallons (1,892.5 kg) of water.
b) Based on their extensive experience with firefighting missions, they consider the engine to be safe and unaffected by smoke in the atmosphere. The engine faults observed during this type of mission have been due either to mixing water in the fuel, not a factor in this accident since it would have occurred in the turn after takeoff, or due to the presence of air bubbles in the fuel feed, also unlikely in this case since that always occurs with low fuel levels and the aircraft had refueled before the flight.
c) The operation is normally carried out by discharging the water at a very low altitude, so as to increase its effectiveness, and subsequently regaining altitude.
d) Selecting continuous ignition is only required by procedure after discharging the water in turbulent conditions, and on flights with less than a quarter tank of fuel remaining. In practice, the heat from the fire perturbs the air, making it more turbulent. So selecting continuous ignition, though not required, may be advisable.
e) So as to shorten the time to takeoff, pilots usually take on the load, when it is liquid, by approaching the pump and, with the engine running at minimum throttle, feathering the propeller by pulling back the propeller lever to the F position. While this procedure may be fast, the operator does not recommend it since it may

accustom the pilots to moving the lever the full range of travel, from one stop to the other.

f) Some pilots are also in the habit of discharging the load with the propeller at 1,700 RPMs for greater stability and control, and then shifting to the 1,500 RPM cruise position. They effect the change without moving the throttle lever, instead carefully adjusting the propeller lever to select the rotating speed. This requires slight movements of the lever and is completely different from the operation described in the preceding paragraph. Confusing the two modes of operation, one of which requires slight lever movements and the other moving the lever through its full range of motion, would lead to an ill-timed feathering of the propeller. The operator was aware of at least two instances in which such a mistake had taken place.

g) Lastly, the operator also indicated that during maintenance, it is normal to maintain ground idle with the start lever in the section between the C and RUN positions and, therefore, without actuating the tab on the lever. The advantage of this is that the engine can be stopped quickly without having to operate said tab. According to their statement, under engine idle conditions, the engine can be controlled with the engine lever throughout its full range of thrust, from minimum to maximum.

1.8.3. *Information from the aircraft Flight Manual*

a) The «In-flight start» section indicates that the best technique for doing this would be to restart, taking the ignition switch to the «continuous ignition» position once the pilot has confirmed the engine stopped due to a flame-out, and not due to some other fault which makes a restart dangerous. The symptoms of a flame-out are a drop in ITT (inter-turbine temperature), torque and RPM indications. A fault would be indicated by noise, vibrations or explosions and a drop in power with a rapid increase in ITT or oil temperature, or a drop in oil pressure or overspeed of the gas generator. In order to be effective, the restart must be made with the gas generator RPMs above 50%. It is not necessary to stop the fuel flow or feather the propeller.

b) If the restart is not effective, an in-flight engine start must follow the same procedure as a ground start, that is, with the propeller feathered and the fuel cutoff.

c) For firefighting operations, the Manual calls for an approach speed of between 109 and 113 kt and recommends using 10° flaps for greater control and stability. This also holds for the discharge. Discharging the load over the fire produces sudden turbulence which must be compensated for by moving the control lever forward.

d) As described in the «ground start» procedures, the start control lever is moved to the RUN position when the generator RPMs stabilize above 18%. Once the start cycle is complete and the propeller lever has been shifted to its maximum position, P, the electrical generator is connected and the position on the start lever is adjusted to maintain generator RPMs at 56%, the minimum allowed, while the

necessary operations are carried out with the aircraft. The start lever is then moved to the FLIGHT position.

e) In addition to the operation indicated, the Manual requires re-checking that the start lever is in the FLIGHT position and leaving it there during taxiing operations, before takeoff, during descent and approach and after takeoff. The Manual's insistence on this point may be indicative of a common oversight.

2. ANALYSIS AND CONCLUSIONS

According to the investigation, the engine's lack of response may have resulted from an engine malfunction, an interruption in the fuel flow or an incorrect manipulation of the engine controls.

The inspection of the engine and its components rules out the possibility of an engine malfunction. As indicated in Section 1.7.2, this inspection concluded that the engine was not impaired by any malfunctions prior to the impact. Heat and fire damage to the engine controls and accessories, especially the fuel system, prevented an operational test of the engine during the inspection. No information has been found to indicate a failure of any of those controls or accessories, but the lack of a prior history of such faults makes them highly unlikely.

As for a fuel flow interruption resulting from a fault in the fuel system, this may happen when air bubbles appear in the fuel feed inlet. This possibility is considered unlikely since the aircraft had been refueled before the flight and it is certain that the tank was more than half full at the time of the accident. In addition, there was no atmospheric turbulence that could have contributed to producing such bubbles, nor is there any reason to think that the turbulence induced by the fire in question was strong enough to produce that effect. An interruption in the fuel flow is therefore unlikely, and so this failure is not being considered as a cause of the lack of engine response.

On the other hand, the possible incorrect manipulation of the throttle and propeller levers, the inspection of the propeller revealed that it was feathered. Since the aircraft did not have an automatic feathering system, the fact that it was feathered is likely attributable to selecting that position with the propeller lever. This action is not required to restart the engine, and thus if it occurred, it may have been caused by either an inadvertent and unintended motion by the pilot, unlikely given that the lever must be pulled all the way back, or by confusion on the part of the pilot which, as the operator has noted, has already occurred when the pilot takes the actions for feathering normally carried out when recharging liquid on the ground, when in fact he wants to adjust the propeller RPM after the discharge from 1,700 to 1,500. If that was the case, any subsequent attempt at a restart would not have been effective since the RPMs would have been reduced below the 50% required for restart.

Another possibility consistent with the full aft position in which the start control lever is believed to have been found after the accident involves having made the flight with this control lever below the RUN position, that is, below the position at which the tab takes effect, as indicated in Section 1.8.2.g. In that case, the lever may have been inadvertently and involuntarily nudged back, either during or after the discharge, thus cutting off the fuel.
The lever may also have been moved back voluntarily before the impact to attempt a mid-air restart. Since it is also necessary to feather the propeller, this hypothesis would explain finding the propeller feathered after the accident.

The two first possibilities put forth concerning operating the control levers would have stopped the engine, although based on the data available it is not possible to reach a more definitive conclusion. The cause of the engine stoppage, therefore, could not be determined.