CIVIL AVIATION AUTHORITY
OF NEW ZEALAND

AIRCRAFT ACCIDENT REPORT

OCCURRENCE NUMBER 04/3396

CESSNA A188

ZK-CSM

OMIHI STATION

23 OCTOBER 2004

Glossary of abbreviations used in this report:

C	Celsius
CAA	Civil Aviation Authority
CAR	Civil Aviation Rule(s)
E	east
ECG	electrocardiogram
ELT	emergency locator transmitter
hPa	hectopascals
m	metre(s)
M	magnetic
MCTOW	maximum certificated takeoff weight
mm	millimetre(s)
NZDT	New Zealand Daylight Time
PMO	Principal Medical Officer
S	south
UTC	Coordinated Universal Time

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Aircraft type, serial number and registration:	Cessna A188 Agwagon, 10011424, ZK-CSM
Number and type of engines:	One Continental IO-520-D
Year of manufacture:	1966
Date and time:	23 October 2004, 1630 hours[1] (approx)
Location:	Omihi Station, North Canterbury Latitude[2]: S 43° 03.89' Longitude: E 172° 49.97'
Type of flight:	Agricultural
Persons on board:	Crew: 1
Injuries:	Crew: 1 fatal
Nature of damage:	Aircraft destroyed
Pilot-in-command's licence:	Commercial Pilot Licence (Aeroplane)
Pilot-in-command's age:	63 years
Pilot-in-command's total flying experience:	20,480 hours, 5000 (approx) on type
Information sources:	Civil Aviation Authority field investigation
Investigator in Charge:	Mr S J Walker

[1] Times are NZDT (UTC + 13 hours)

[2] WGS 84 co-ordinates

Synopsis

The Civil Aviation Authority was notified of the accident at 1800 hours on Saturday 23 October 2004. The Transport Accident Investigation Commission was in turn notified shortly thereafter but declined to investigate. A CAA site investigation was commenced the next day.

The pilot was conducting an agricultural operation engaged in spreading solid fertiliser in suspension with water. The pilot appeared to commence his take off normally and continue out of line of sight of the ground crew, who were alerted to the accident by smoke coming from the direction of the end of the sloping airstrip. The first persons on the scene found that the aircraft was on fire and could see no signs of life.

1. Factual information

1.1 History of the flight

1.1.1 At approximately 0920 hours ZK-CSM took off normally from the pilot's home base at Rangiora aerodrome with the pilot and loader driver on board. They arrived at Crofts airstrip on Omihi Station, where the pilot commenced spreading RPR (reconstituted powdered rock) on a nearby 300-hectare block.

1.1.2 During the morning's operation, without the pilot's knowledge, the ELT in the aircraft had activated. The Rescue Coordination Centre dispatched the Christchurch rescue helicopter to investigate. This was the second recent occurrence of a spurious ELT transmission from this aircraft.

1.1.3 The product being applied was mixed in a specialised hydraulically-powered mixer unit at a ratio of one 780 kg bag of dry product to 400 litres of water. The mixture was loaded into the aircraft by attaching a hose to the rear fuselage adaptor and pumping the mixture into the hopper via an internal pipe. Once the hopper was full the pilot signalled to the ground crew to shut off the supply tap.

1.1.4 The pilot had completed 28 loads before the lunch break at about 1230 hours. The last load of the morning was a weak mixture containing approximately 100 kg of dry product. This was intended to flush the aircraft spray equipment and ground mixing unit, thus preventing blockage caused by product settling out of suspension during the lunch break. After the pre-lunch cleaning flight the pilot checked the hopper and remarked on the performance of the product, as it had not blocked or clogged the hopper. The hopper emergency jettison door was also opened and cleaned at this time.

1.1.5 The aircraft was then refuelled by the crew chief, with fuel decanted from two 200-litre drums through a chamois leather filter. These drums were filled at the aviation fuel company's pumps at the pilot's home base the previous evening. The total fuel in the aircraft after refuelling was estimated to be approximately 90 litres.

1.1.6 It was reported by the ground crew that during the lunch break the pilot was seen to be generally in good spirits. However, he had been complaining of a stiff neck and shoulder throughout the day. He was seen to be smoking cigarettes occasionally during his time outside the aircraft.

1.1.7 After lunch, the ground crew moved more bags of product to the loading area and replenished the water tanks on the truck from a nearby water source. This took some two hours, with the pilot recommencing the spraying operation at approximately 1515 hours.

1.1.8 During the turnaround for the fourth load after the break, the pilot asked the crew chief how many loads were left; the crew chief said that there were perhaps eight left, and that he would check this estimate in time for the next loading. The pilot acknowledged this by advising that "we'd better make that 10 or 12". At this time the crew chief noticed that the hopper quantity was now reading 480-500 litres on the sight gauge in the cockpit. The crew chief then walked around the tail of the aircraft and saw the loaders select the loading valve to "off", in response to the pilot's signal.

1.1.9 Once the supply hose was disconnected, the ground crew saw the pilot commence his take off run normally, but did not watch the aircraft further as they were busy preparing for the next load. The duration of the spreading flights was approximately six minutes.

1.1.10 After the aircraft had departed, two members of the ground crew walked along the airstrip to satisfy their curiosity about the terrain beyond. It was at this time that they saw smoke rising from beyond the threshold of the airstrip.

1.1.11 The alarm was raised, and a number of the ground crew went to see if they could render assistance to the pilot; however it was soon apparent that the pilot had been killed in the accident.

1.1.12 The accident occurred in daylight, at approximately 1630 hours NZDT, at Omihi Station, North Canterbury, at an elevation of 1000 feet. Latitude: S 43° 03.89', longitude: E 172° 49.97'; grid reference 260-N34-964936.

1.2 Injuries to persons

Injuries	*Crew*	*Passengers*	*Other*
Fatal	1	0	0
Serious	0	0	0
Minor/None	0	0	

1.3 Damage to aircraft

1.3.1 The aircraft was destroyed.

1.4 Other damage

1.4.1 Two wire fences at the threshold of the airstrip were damaged and about two acres of broom and tussock were burnt.

1.5 Personnel information

1.5.1 The pilot held a Commercial Pilot Licence (Aeroplane) endorsed with an Agricultural Rating. His last biennial flight review was performed on 20 August 2004, in conjunction with his agricultural rating competency check.

1.5.2 His Class 1 medical certificate was valid until 20 December 2004. However, no records of application could be found, either with the CAA or the pilot's regular medical examiner, for the issue of a medical certificate to cover the periods of December 2002 to 11 June 2003 and December 2003 to 16 June 2004. Approximately 130 and 50 flying hours respectively were recorded in the pilot's logbook for these periods.

1.5.3 While, on rare occasions, documents are misplaced, it is unusual for the CAA central medical unit and the pilot's regular medical examiner not to have record of a medical certificate.

1.5.4 The pilot was a very experienced and respected figure in the agricultural aviation industry with a total of 20,480 flying hours, including approximately 5000 on the Cessna A188.

1.5.5 The pilot had been a smoker in the past. He had given up smoking for a period around 2000, but was seen to be smoking again on the day of the accident. It had been noted by acquaintances who worked alongside the pilot that he had been smoking again regularly, but not heavily, for some time prior to the accident, and probably since at least 2003. On his medical certificate application form dated 16 June 2004, in response to the question "How much do you now smoke?" the pilot had declared: "none".

1.6 Aircraft information

1.6.1 Cessna A188 Agwagon serial number 10011424 was manufactured in 1966, and was first registered in New Zealand as ZK-CSM on 20 October 1986. At the time of the accident the aircraft had a valid non-terminating restricted category Airworthiness Certificate. It had been maintained in accordance with Civil Aviation Rules.

1.6.2 Total time in service as recorded in the aircraft logbook up to 6 September 2004 was 11,423 hours. The last annual/100 hour inspection was performed on 14 August 2004, together with an annual review of airworthiness.

1.6.3 A Continental IO-520-D engine and a McCauley D3A32C408-B constant-speed propeller were installed. Up until 6 September 2004, the engine had run 775.4 hours since overhaul and the propeller 614.9 hours since new.

1.6.4 The engine underwent unscheduled maintenance on 2 October 2004, including reconditioning of the number 5 cylinder and replacement of the number 6 cylinder exhaust valve.

1.6.5 The aircraft role equipment consisted of wing-mounted stainless steel spray booms connected to an external air driven centrifugal pump. The pump drew product from the hopper and delivered it under pressure to the spray booms. The supply was activated by selecting the appropriate pitch on the pump propeller blades and pushing the combined spray/jettison lever forward. The stainless steel hopper base included the emergency jettison door and centrifugal pump attachment structure.

1.6.6 Agitation of the hopper contents to prevent the particulate matter in the fertiliser settling out of suspension and clogging the hopper base and spray system was provided by a circulating supply of fertiliser, returning from the centrifugal pump, across the base of the hopper via an angled stack-pipe.

1.6.7 The emergency jettison system comprised an aperture in the hopper base with an associated side-hinged door. The door was locked in place using a single over-centre latch mechanism actuated by a cable connected to the spray/jettison lever which protruded from the fuselage underside. Pushing the lever forward into the "jettison" position would immediately pull the cable and unlock the over-centre latch, allowing the weight of the load to open the door. Throughout the jettison action, if the pump is operating, the spray booms continue to spray until the pump is no longer supplied.

1.6.8 The all-up weight of ZK-CSM at the time of the accident was calculated to be 1874 kg. The flight manual MCTOW limit for agricultural operations is 1814 kg, but the aircraft was being operated at a higher weight as permitted by CAR Part 137 Appendix B. The centre of gravity was found to be within the manufacturer's limits.

1.7 Meteorological information

1.7.1 At the time of the accident there was broken high cloud above Canterbury with the lowest reported base at 7000 feet and no precipitation. The visibility was 30 km, and the prevailing wind was a light north-westerly. This was confirmed by the crew at the airstrip. The air temperature at the airstrip elevation was 16º C and the sea-level pressure was 1012 hPa.

1.7.2 Weather conditions were not considered to be a factor in this accident.

1.7.3 Sun data at the time of the accident were: altitude 38º, azimuth 292° (true). This would have placed the sun in about the pilot's 7-o'clock position on take-off, and thus would not have impaired his view.

1.8 Aids to navigation

1.8.1 Nil.

1.9 Communications

1.9.1 Not applicable.

1.10 Aerodrome information

1.10.1 The airstrip was located on the crest of a ridge, oriented 038°/218° M, and sloped down to the north-eastern end. Total length was approximately 400 m, sloping down 5º to10º for 300 m, then about 20º for the remainder. Normal practice was to take off downhill and land uphill, with loading taking place at the top end. The airstrip surface was in good condition with no obvious deficiencies. During the day's operations, the aircraft was normally airborne 200 to 250m from the start of the take off roll.

1.10.2 Immediately beyond the departure end of the airstrip, a boundary fence (of steel battens and wire) crossed the take-off path at right angles, with a second similar fence beyond, along the top of a large steep gully. Between the fences was a large undulation formed by a stock trail, otherwise the ground between the fences was relatively even.

1.11 Flight recorders

1.11.1 Not applicable.

1.12 Wreckage and impact information

1.12.1 The aircraft struck and demolished the boundary fence, and the right wingtip struck a glancing blow to a gatepost brace at a height of about 200 mm from the ground. This suggests a bank to the right of some 18º. Commencing at the normal lift-off point, the aircraft had deviated some 10º to the right of the strip centreline where it struck the fence.

1.12.2 The aircraft was bounced into the air by the undulation in the ground beyond the boundary fence, and clipped the top wire of the second fence. It continued to descend for a further 100 metres down a steep scrub-covered gully, while rolling to the right, topping at least two pine saplings, and striking the ground left wingtip first, in an inverted attitude.

1.12.3 At this point, the left wingtip separated from the left wing, and the aircraft "cartwheeled", causing the engine and propeller to strike the ground with sufficient force to separate the propeller from the crankshaft. The fully-loaded hopper and fuel tanks ruptured, dispersing the contents widely. Fire broke out as a result of the release of the fuel from the tanks.

1.12.4 Both wings and the engine separated from the fuselage in the impact sequence, and the majority of the wreckage came to rest about 200 m from the end of the airstrip. The fuselage centre section, including the cockpit area was extensively fire-damaged.

1.12.5 All parts of the aircraft were accounted for at the accident site. Due to the destruction of the aircraft, pre-impact flight control integrity could not be

positively established, nor could pre-accident positions of the engine and flight controls.

1.13 Medical and pathological information

1.13.1 Post-mortem examination found that the pilot had sustained fatal injuries associated with a high-energy impact. Also discovered was "profound pulmonary oedema and evidence of a component of chronic congestive heart failure". The pathologist explained in his report: "while the pulmonary oedema might in part or entirely represent neurogenic pulmonary oedema in response to head injury, the time course is very short. I prefer the interpretation that there has been an acute cardiac event, most likely cardiac arrhythmia, resulting in sudden onset (acute), severe congestive cardiac failure prior to impact. Such an event would likely render him incapable of control of the aircraft in the take off run".

1.13.2 The report also stated: "Lungs show oedema and mild emphysema. There are many intra-alveolar pigment-laden microphages some of which contain carbon pigment only (as a consequence of cigarette smoking) but many of which contain significant quantities of haemosiderin. This indicates that there has been a significant element of pre-existing pulmonary micro-haemorrhage most likely due to chronic congestive cardiac failure".

1.13.3 The CAA assesses the risk of an incapacitating cardiac event, in pilots who have no past history of cardiovascular disease, using accepted risk assessment models based on studies of large populations. In the case of this pilot:

- **Assessed as a non-smoker**: The New Zealand College of General Practitioners risk assessment calculator indicates a 5-year risk of a CVS (cardio-vascular system) event of 8%, and the New Zealand Heart Foundation risk table indicates a 5-year risk in the range 5 – 10%.

- **Assessed as a smoker**: these two 5-year risk figures would increase to 14% and 15 – 20% respectively.

1.13.4 In the absence of any other medical conditions, a Class 1 medical certificate applicant with a 5-year CVS risk of less than 10%, and no clinical factors suggesting the presence of coronary artery disease, is unlikely to be required to undertake any further investigations to confirm the absence of reversible myocardial ischaemia.

1.13.5 However, an applicant with a 5-year CVS risk of 10% or more would be required to demonstrate the absence of reversible myocardial ischaemia before the issue of a medical certificate was seriously considered. This is usually established by means of an exercise stress ECG.

1.14 Fire

1.14.1 An intense fire consumed the centre section of the aircraft, including the cockpit area and instrumentation.

1.14.2 Fuel was released from the fuel tanks at impact, and potential sources of ignition included the hot exhaust, and arcing from disrupted electrical wiring.

1.15 Survival aspects

1.15.1 The pilot was wearing a protective helmet and combination lap and shoulder harness, but the severity and nature of the impact sequence exceeded the level of protection available.

1.15.2 The aircraft was fitted with a Pointer 3000 ELT, the functionality of which had been demonstrated conclusively earlier in the day. However, even had it activated during the accident, its output would have been short-lived, as it was destroyed in the fire.

1.16 Tests and research

1.16.1 The engine and propeller were removed from the wreckage and inspected in detail at an engine overhaul facility. There was no evidence of any pre-existing mechanical discrepancy which could have contributed to the accident. There were numerous indications that the engine was running and propeller rotating, probably at a high power setting, prior to the impact. These indications included main bearing "pickup", indicative of engine running at a high power setting with little or no oil pressure (consistent with inverted flight), and extensive cracking of the crankshaft particularly around the propeller driving dowel holes.

1.16.2 The contents of the fuel drums and containers were inspected and found to be free from moisture and contamination.

1.17 Organisational and management information

1.17.1 The pilot was the owner and chief executive of an agricultural aviation organisation certificated under CAR Part 137.

1.18 Additional information

1.18.1 Nil.

1.19 Useful or effective investigation techniques.

1.19.1 Nil.

2. Analysis

2.1 Post-accident examination of the aircraft, propeller and engine, as far as possible, revealed no pre-existing mechanical anomaly which could have contributed to the accident.

2.2 On earlier flights, the aircraft was normally airborne approximately 150 m (equating to about four seconds) before passing over the first boundary fence. It is possible that, on the accident flight, the aircraft became airborne before reaching the fence, but was only a few feet above the ground when it collided with the fence. The height of the wingtip mark on the gatepost brace suggests that it was in a right bank of up to 20°.

2.3 The undulation in the ground a short distance past the fence would have caused the aircraft to bounce into the air, clipping the second fence at speed. From there, it has rolled to the right until inverted, and descended steeply to collide with the ground in the gully below the strip.

2.4 It was evident from the pilot's comments at lunchtime that the fertiliser had not blocked the jettison door after the morning's 28 loads and was performing well in that respect. The spray systems, hopper and mixing unit had been cleaned and jettison system tested less than an hour's flight before the accident. In the unlikely event of a blocked hopper jettison door or "hung load", after an emergency jettison command during take off, the severe bounce over the second fence would very likely have been of a sufficient magnitude to clear the blockage and release the load.

2.5 The pilot was renowned for encouraging other agricultural pilots to "dump the load and then fix the problem". According to acquaintances, it was the pilot's standard operating procedure to place his left hand on the spray/jettison lever which was unlatched during the take-off run to enable immediate load jettison in the event of any problem. The estimated flight time of about four seconds between the take-off point and the first fence would have normally been more than sufficient for an experienced pilot to have recognised and reacted to a developing emergency. Thus, the absence of any signs of jettison is a significant indication that the pilot probably did not have the ability to initiate an emergency jettison.

2.6 In light of the fact that no medical certificate record could be found for the periods of December 2002 to 11 June 2003 and December 2003 to 16 June 2004 it appears that the pilot may have operated his aircraft for hire and reward without a current Class 1 medical certificate for two periods of 6 months within the 2 years and 3 months preceding the accident.

2.7 Although the pilot had a current medical certificate at the time of the accident, accurate medical assessment of the pilot for risk of an incapacitating cardiac event was not possible, as the pilot had declared on his medical certificate application that he was a non-smoker. The accurate assessment of pilot cardiovascular risk depends on complete information being made available to the CAA medical examiners. Whether or not an applicant for a CAA medical certificate smokes cigarettes is an important factor in the calculation of cardiovascular risk. When an applicant's cardiovascular risk exceeds a certain level further investigations, usually an exercise stress electrocardiogram (stress ECG), are undertaken to exclude the presence of reversible myocardial ischaemia. Had the pilot declared, at the time of his most recent medical certification application in June 2004, that he had continued smoking he would have been required to undertake a stress

ECG. While it may not have been conclusive in predicting the risk of an in-flight incapacitation, a stress ECG may have identified significant cardiac disease.

2.8 The post-mortem report, when read in conjunction with the evidence gathered during the accident investigation, provides grounds to conclude that the pilot suffered a medical incapacitating cardiac event that rendered him unable to maintain control of his aircraft.

3. Conclusions

3.1 The pilot was appropriately licensed and rated for the series of flights.

3.2 The pilot held a Class 1 medical certificate, the validity of which may have been compromised by information provided to support the current medical assessment.

3.3 The aircraft had a valid airworthiness certificate and had been maintained in accordance with the rules currently in force.

3.4 There was no evidence of any pre-existing mechanical defect with the aircraft but this could not be completely ruled out.

3.5 There were indications that the pilot suffered an incapacitating cardiac event during take-off.

3.6 The behaviour of the aircraft suggests that it was not under control before the initial fence collision.

4. Observation

4.1 No new safety actions were developed as a result of this investigation. However, it does highlight the importance of full and frank disclosure of a pilot's medical history when applying for a medical certificate. The requirements are well-documented in legislation, with specific penalties for false or misleading information.

Richard White

Manager Safety Investigation

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Civil Aviation Authority of New Zealand
Aviation House 10 Hutt Road Petone
P O Box 31 441 Lower Hutt New Zealand
Tel: +64-4-560 9400 Fax: +64-4-569 2024
www.caa.govt.nz