No. 95-010

Fletcher FU24A-954

ZK-EMU

35 km South-East of Blenheim

7 June 1995

Abstract

At approximately 1100 hours on Wednesday 7 June 1995 a Fletcher FU24A-954, ZK-EMU, collided with the face of a hill during a sowing run and caught fire. The aircraft was destroyed, and the pilot lost his life in the accident. Pilot incapacitation was the probable cause of this accident. The incapacitation was sufficient to cause loss of situational awareness and loss of aircraft control at a critical phase of flight. No safety issues were identified as a result of this investigation.

Transport Accident Investigation Commission

Aircraft Accident Report No. 95-010

Aircraft type, serial number: and registration:	Fletcher FU24A-954, 274, ZK-EMU
Number and type of engines:	One Lycoming IO-720-A1B
Year of manufacture:	1980
Date and time:	7 June 1995, 1100 hours*
Location:	35 km south-east of Blenheim Latitude: 41° 47.5′ S Longitude: 174° 08.5′ E
Type of flight:	Aerial work, 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:	39
Pilot-in-Command's total flying experience:	4930 hours aeroplane 35 hours helicopter 235 hours on type
Information sources:	Transport Accident Investigation Commission field investigation
Investigator in Charge:	Mr K A Mathews

* All times in this report are in NZST (UTC + 12 hours).

1. Factual Information

1.1 At around 0700 hours on Wednesday 7 June 1995 ZK-EMU departed Omaka Aerodrome, near Blenheim, for an airstrip located 38 km to the south-east, near Ward. On board were the pilot and loader driver.

1.2 The aircraft had been refuelled to capacity the previous evening at Omaka. The pilot completed a normal pre-flight inspection of the aircraft, including a check of the fuel tanks for water, that morning before leaving for the airstrip.

1.3 The flight proceeded uneventfully and took approximately 12 minutes to complete. At the airstrip the loader driver prepared the loader truck, which had been positioned on the airstrip the previous day, for the day's operation. This included a check of the aviation fuel in its bowser for contamination.

1.4 Arrangements had been made to sow 40 tonnes of superphosphate onto a property some 3.5 km to the north-west of the airstrip. The superphosphate had been stored in a covered bin on the airstrip and was dry and free-flowing. On the day before the accident the pilot and loader driver had flown in ZK-EMU over the property for an aerial reconnaissance of the area to be sown.

1.5 19 hundredweight (966 kg) of superphosphate was loaded into ZK-EMU's hopper for the first sortie of the day. The aircraft departed normally and returned without incident. Subsequent loads increased to 21 hundredweight (1067 kg) as the work progressed and fuel was consumed. The turn-around time between loads was approximately 3.5 minutes, and about 29 loads were flown uneventfully before the first refuelling stop. It was the normal procedure for the pilot to fly for 2 hours, then have a break and refuel the aircraft. In this case the pilot had been sowing for about 1 hour and 50 minutes in addition to the positioning flight.

1.6 The aircraft was refuelled to capacity and then the loader driver and pilot had morning tea together. The tea break was for about 20 minutes, and during this time the pilot discussed the weather and the work with the loader driver. He commented to the loader driver that the weather was ideal for sowing and that he was enjoying the work. The loader driver recalled that the pilot was pleased with the way the work was progressing and was not having any difficulties. He said the pilot appeared to be his usual happy self. He also noted that the pilot did not appear to be rushed, and was impressed by the way he methodically carried out his checks and preparation. He also noted that the pilot handled the aircraft very "smoothly" and flew in a safe manner. During the sowing sorties that he could observe, he assessed that the pilot was flying "quite high" and well clear of terrain.

1.7 The aircraft departed again normally and returned without incident. A further seven loads were sown uneventfully and the loader driver noted that each time the pilot pulled the aircraft in to be loaded he "had a grin on his face". He had not indicated to the loader driver that he was experiencing any difficulty.

1.8 On the accident flight the loader driver watched the pilot sow for about two minutes before the aircraft turned toward a boundary fence and disappeared from view behind a ridge. During this time the aircraft sounded normal to him and it did not appear to be in any difficulty.

1.9 A short time later the loader driver noticed black smoke coming from the area the aircraft had turned towards. Since it was then overdue by several minutes he feared the worst and raised the alarm by telephoning a colleague in Blenheim, who alerted the Police.

1.10 The first persons on the scene were the loader driver, the wife of the farmer whose property was being sown, and the owner of the airstrip. They found that ZK-EMU had collided with the face of

a hill and had caught fire. They were not able to render assistance to the pilot due to the intensity of the fire . The pilot had been suitably restrained during the impact sequence and was wearing a protective helmet.

1.11 The loader driver said that it was a clear still morning with bright sunshine, and he thought the weather conditions were ideal for sowing. Local farmers also reported that they believed the weather conditions were perfect for sowing that morning and that there was no wind blowing.

1.12 There were no eyewitnesses to the final flight path of ZK-EMU, but a number of local farmers had seen the aircraft flying that morning. Several farmers were interviewed and they all commented that the aircraft appeared to be sowing from a higher altitude than normal for agricultural aircraft. They thought the aircraft was being flown conservatively and safely, and had not noticed anything to cause them concern. One farmer however believed that he had seen the aircraft fly overhead prior to the accident and thought its engine sounded rough. It was determined later that he had heard this after the time of the accident and probably heard the engine of an aircraft searching for the wreckage. This other aircraft had a distinctive engine note different from the Fletcher and was in the area approximately 25 minutes after the accident. The loader driver reported that ZK-EMU had sounded normal to him throughout the morning, and he had not had any reason to be concerned.

1.13 The aircraft had collided with the western face of a hill on the eastern side of a wide valley which ran in a north-west to south-east direction. The aircraft had been flying in an easterly direction away from the valley and along a boundary fence, which ran up the hill face toward the east. The collision occurred about halfway up the 26° slope. The aircraft had squashed onto the ground with its nose raised to approximately the angle of the slope. The ground strike marks showed that the left wing was about 16° down at the time of impact. About one quarter of the load remained in the hopper and there was no evidence that the pilot had attempted to jettison this load. The aircraft had struck the ground heavily and slid up the slope for 41 m before coming to rest in an upright attitude. An intense fire broke out shortly afterwards and consumed most of the aircraft.

1.14 Examination of the wreckage was not conclusive due to the extensive fire damage, but no evidence was found of any defect or failure of the control systems or structure which may have caused the accident. The propeller showed signs of having power on at impact. The magneto switch was selected to both magnetos and the master switch was "ON". The fuel system integrity and tank selection could not be verified. No fuel sample was available from the aircraft, but a sample taken from the bowser on the loader truck confirmed that the fuel was free of contamination and was the correct fuel for the aircraft.

1.15 The topography of the surrounding area was such that it would have presented few problems for the pilot during his sowing, especially at the altitude he had been flying. The valley he had been sowing prior to the accident was relatively wide and there were no obstructions to the flight path such as trees, poles or wires. Had an engine failure or loss of power occurred, the valley floor would have been suitable for a forced landing. There was no evidence that the pilot had attempted to position the aircraft for a forced landing and examination of the wreckage suggested that the flaps were in the up position. (See Figure 1)

1.16 The aircraft's maintenance records showed that ZK-EMU had been maintained in accordance with the operator's approved Inspection Schedule and was certified for aerial work and private operations. The last maintenance inspection was a Check 2 completed on 21 April 1995. It had been flown regularly up to the time of the accident flight and there was no evidence that it was not airworthy at the time.

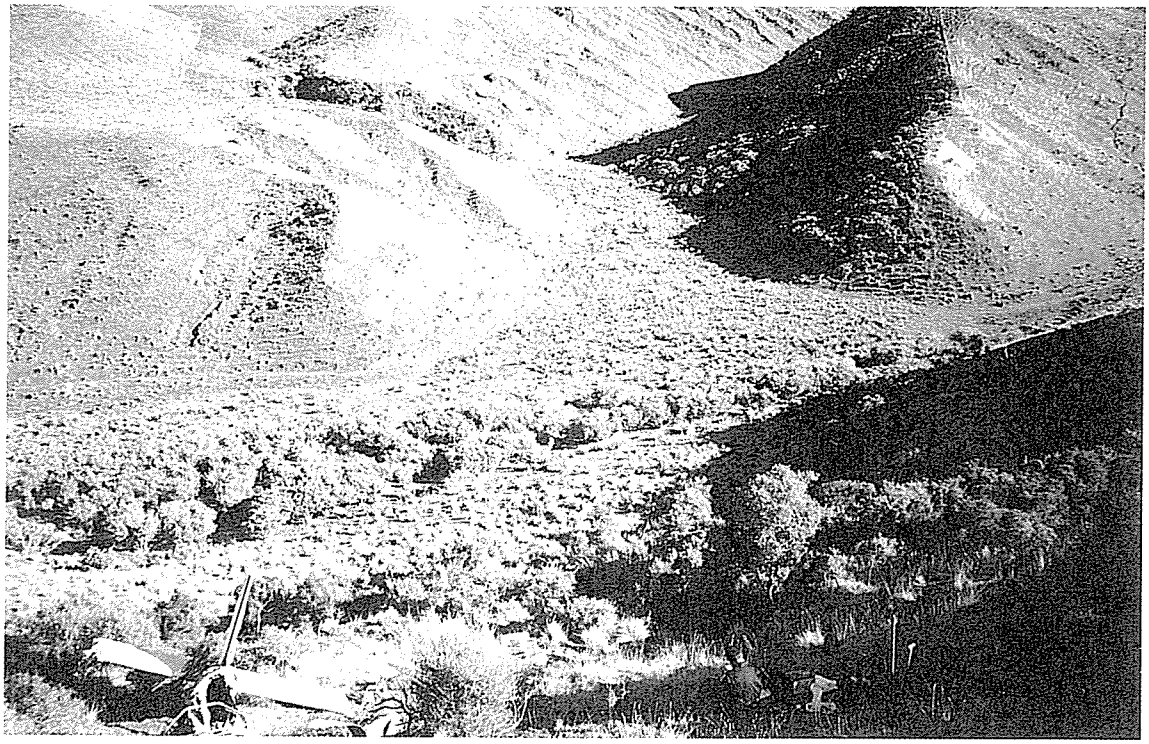

Figure 1

1.17 The pilot held a valid lifetime Commercial Pilot Licence (Aeroplane) and Class 1 Medical Certificate. He was rated on the aircraft type and held an Agricultural Rating.

1.18 At the time of the accident he was acting as a relieving pilot for ZK-EMU's regular pilot who was on extended leave overseas. Normally the pilot was employed as Chief Pilot and Operations Manager for another company and was not engaged in regular agricultural flying. That company operated Beaver and Cessna 206 float equipped aircraft, mainly on tourist and air transport operations. He was in current flying practice and was considered by other pilots to be a very safe and professional pilot. He was experienced and competent, having flown a number of different aircraft types for various companies since he qualified for his Commercial Pilot Licence in 1985. He gained his Agricultural Rating in 1985 and shortly afterwards consolidated his experience by flying some 200 hours on agricultural work in FU24 aircraft.

1.19 As the pilot had not been in recent agricultural flying practice the usual pilot for ZK-EMU, who was an experienced instructor and agricultural pilot, worked extensively with him on refresher training. This comprised some 8 to 10 hours of flying in ZK-EMU which was equipped with dual flying controls. The instructor was satisfied with the ability of the pilot and had no doubts as to his suitability to fly for him as a relief pilot. Prior to the instructor going on leave he had briefed the pilot on the required work.

Medical and pathological information

1.20 The pilot suffered extensive injuries in the accident but these were not of sufficient severity to cause fatal injury. He died in the severe post-impact fire. There is a strong probability that the pilot was dazed or knocked out on impact which would have prevented his exit from the aircraft.

1.21 The pilot had been medically examined regularly and passed all such examinations. There were no indications from his previous medical history, recent personal health or from any premonitory

symptoms reported on the day of the accident, that he was likely to have any serious medical condition.

1.22 The pilot was found to have significant narrowing of the left anterior descending (LAD) coronary artery, although the other coronary arteries were normal. The LAD artery supplies a significant part of the heart and plays a critical role in coronary circulation. The LAD artery was narrowed in one place four centimetres from the origin of the artery and showed signs of having been completely obstructed at some time previously (probably some months). The artery had been reopened through recanalisation, and while there was still flow through the repaired segment, the blood supply recovered by recanalisation would have remained significantly reduced from the normal level.

1.23 Despite the previous spontaneous healing and repair of the narrowed segment, active arterial disease persisted in the LAD artery. Active disease of the coronary arteries is associated with abnormalities of the interior surface of the artery leading to possible clot (thrombus) formation, or with the muscle wall of the artery leading to arterial spasm. It is possible that one such event may have occurred at the time of this accident leading to a sudden further reduction in blood flow to the 'myocardium' (heart muscle) supplied by the LAD coronary artery.

1.24 There was no indication of complete coronary artery obstruction that would have caused death of a distinct area of heart muscle (myocardial infarction, usually known as heart attack or coronary thrombosis). However, the full pathological changes of myocardial infarction require several hours to become observable after its clinical onset. The possibility of the pilot being affected by early myocardial infarction cannot be discounted, as the development of the diagnostic changes of infarction would have been interrupted by the pilot's death in the accident.

1.25 A more probable effect of a sudden reduction in blood flow from thrombus formation or spasm, would be myocardial ischaemia (inadequate blood supply) causing oxygen starvation of the heart muscle. Common effects of acute (sudden onset) myocardial ischaemia would be chest pain, breathlessness, faintness due to impaired heart pump action, and reduced blood pressure, or irregularities of the heart rhythm. Any event of this type would have caused significant temporary pilot impairment, which would be more likely to cause partial functional pilot incapacitation.

1.26 The pilot's medical records and personal history showed the pilot had no risk factors for developing coronary artery disease and no symptoms or clinical examination findings indicating coronary artery disease, which should have been detected by the clinical examinations required by the CAA medical certification system.

1.27 Arterial disease is common in the adult male population and minor changes in some part of the cardiovascular system are almost universal. These changes are usually minor and in non-critical areas such as the aorta (in wider blood vessels, small changes in diameter will have very little effect on blood flow). The risk factors for developing artery disease (family history, smoking, gender, age, and cholesterol) predict the probability that disease will develop, namely how many abnormal areas would arise and how severe/progressive the changes might be. However, there is a non-specific element to the development of local arterial abnormalities, and in this case the pilot was affected by a severe abnormality in a critical area. This development would not have been predicted by the known risk factors.

1.28 Routine medical testing includes resting electrocardiography, which is acknowledged to produce false negative results in the presence of significant arterial disease. This has occurred in the case of medical surveillance of this pilot. Alternative methods of testing (stress ECG's and heart scans) are more invasive and their value is limited by a high false positive rate. Routine use of these tests in a non-symptomatic aircrew is only justified on the basis of excessive artery disease risk indicated on the basis of risk factors and clinical examination findings. These were not present according to the pilot's medical records.

2. Analysis

2.1 The probable final flight path of the aircraft suggests the possibility that the pilot had lost situational awareness. This might be explained by distraction, loss of concentration, or pilot impairment or partial incapacitation.

2.2 No operational reason could be found to suggest that distraction or loss of concentration had occurred. The proximity to the ground of the aircraft and conduct of the flight up to the 20 second period prior to impact indicated that the pilot would have been paying full attention to control of the aircraft and its position relative to the terrain.

2.3 The history of the flight and previous activity/rest patterns did not indicate that excessive fatigue was likely.

2.4 The likelihood that this accident was caused by partial pilot incapacitation is determined by the probability that sudden development of medical complications occurred during the conduct of the flight. The behaviour of the aircraft in its final flight and its examination following the accident indicated normal operation of aircraft systems and controls. The pilot was very experienced and competent in the type of operation being undertaken. Aircraft mishandling or lack of concentration were discounted.

2.5 The anatomical and pathological changes in the abnormal segment of the LAD coronary artery had been present for some time without causing any apparent symptoms. The development of the arterial disease was dynamic, as demonstrated by the occlusion and recanalisation of the damaged segment. Further changes in the structure and function of the abnormal segment were likely to continue. Further development, or complications such as thrombosis and spasm, were likely to cause symptoms, either suddenly or progressively.

2.6 No other cause for pilot distraction was identified. If however, the pilot experienced disabling or distracting symptoms, it is possible that situational awareness and aircraft control would be lost, for at least a period of time. The pathology findings, and the apparent attempt to recover the aircraft just before impact, indicate that the pilot was able to identify the danger and attempt to recover control but too late to recover the situation. This would support the suggestion of a temporary period of partial incapacitation.

2.7 Despite the evidence of serious coronary artery disease, it is also possible that intercurrent illness, such as gastrointestinal upset might have been an alternative cause.

2.8 Confirmation that pathological changes did cause partial incapacitation was prevented by the effects of the post-impact fire.

3. Findings

3.1 The aircraft had a valid Maintenance Release and Certificate of Airworthiness.

3.2 The aircraft had been maintained correctly.

3.3 There was no evidence of any malfunction with the aircraft.

3.4 The pilot was experienced, appropriately licensed and rated, and had been authorised to conduct the flight.

3.5 The pilot had an established reputation for a safe and professional approach to his flying.

3.6 The topography of the area would have presented little difficulty to the pilot.

3.7 The weather conditions at the time were ideal for sowing.

3.8 The aircraft collided heavily with the face of a hill, in a nose up attitude, and caught fire.

3.9 Pilot incapacitation was the probable cause of this accident.

3.10 The incapacitation of this pilot was an unusual event, and could not have been predicted or prevented by any reasonable or effective medical screening process.

21 February 1996

M F Dunphy
Chief Commissioner

Glossary of Aviation Abbreviations

AD	Airworthiness Directive
ADF	Automatic direction-finding equipment
agl	Above ground level
AI	Attitude indicator
AIC	Aeronautical Information Circular
AIP	Aeronautical Information Publication
amsl	Above mean sea level
AOD	Aft of datum
ASI	Airspeed indicator
ATA	Actual time of arrival
ATC	Air Traffic Control
ATD	Actual time of departure
ATPL (A *or* H)	Airline Transport Pilot Licence (Aeroplane *or* Helicopter)
AUW	All-up weight
°C	Celsius
CAA	Civil Aviation Authority
CASO	Civil Aviation Safety Order
CFI	Chief Flying Instructor
C of G (*or* CG)	Centre of gravity
CPL (A *or* H)	Commercial Pilot Licence (Aeroplane *or* Helicopter)
DME	Distance measuring equipment
E	East
ELT	Emergency location transmitter
ERC	Enroute chart
ETA	Estimated time of arrival
ETD	Estimated time of departure
°F	Fahrenheit
FAA	Federal Aviation Administration (United States)
FL	Flight level
ft	Foot/feet
g	Acceleration due to gravity
GPS	Global Positioning System
h	Hour
HF	High frequency
hPa	Hectopascals
hrs	Hours
IAS	Indicated airspeed
IFR	Instrument Flight Rules
IGE	In ground effect
ILS	Instrument landing system
IMC	Instrument meteorological conditions
in	Inch(es)
ins Hg	Inches of mercury

kg	Kilogram(s)
kHz	Kilohertz
KIAS	Knots indicated airspeed
km	Kilometre(s)
kt	Knot(s)
LAME	Licenced Aircraft Maintenance Engineer
lb	Pounds
LF	Low frequency
LLZ	Localiser
Ltd	Limited
m	Metre(s)
M	Mach number (e.g. M1.2)
°M	Magnetic
MAANZ	Microlight Aircraft Association of New Zealand
MAP	Manifold absolute pressure (measured in inches of mercury)
MAUW	Maximum all-up weight
METAR	Aviation routine weather report (in aeronautical meteorological code)
MF	Medium frequency
MHz	Megahertz
mm	Millimetre(s)
mph	Miles per hour
N	North
NDB	Non-directional radio beacon
nm	Nautical mile
NOTAM	Notice to Airmen
NTSB	National Transportation Safety Board (United States)
NZAACA	New Zealand Amateur Aircraft Constructors Association
NZDT	New Zealand daylight time (UTC + 13 hours)
NZGA	New Zealand Gliding Association
NZHGPA	New Zealand Hang Gliding and Paragliding Association
NZMS	New Zealand Mapping Service map series number
NZST	New Zealand Standard Time (UTC + 12 hours)
OGE	Out of ground effect
okta	Eighths of sky cloud cover (e.g. 4 oktas = 4/8 of cloud cover)
PAR	Precision approach radar
PIC	Pilot in command
PPL (A *or* H)	Private Pilot Licence (Aeroplane *or* Helicopter)
psi	Pounds per square inch
QFE	An altimeter subscale setting to obtain height above aerodrome
QNH	An altimeter subscale setting to obtain elevation above mean sea level
RNZAC	Royal New Zealand Aero Club
RNZAF	Royal New Zealand Air Force
rpm	revolutions per minute
RTF	Radio telephone or radio telephony

s	Second(s)
S	South
SAR	Search and Rescue
SSR	Secondary surveillance radar
^{o}T	True
TACAN	Tactical Air Navigation aid
TAF	Aerodrome forecast
TAS	True airspeed
UHF	Ultra high frequency
UTC	Coordinated Universal Time
VASIS	Visual approach slope indicator system
VFG	Visual Flight Guide
VFR	Visual flight rules
VHF	Very high frequency
VMC	Visual meteorological conditions
VOR	VHF omnidirectional radio range
VORTAC	VOR and TACAN combined
VTC	Visual terminal chart
W	West