

Accidents Investigation Branch

Department of Trade

**Report on the accident to
Maule M-5-235C G-LOVE
at Cranfield Aerodrome, Bedfordshire,
on 4 September 1981**

LONDON

HER MAJESTY'S STATIONERY OFFICE

List of Aircraft Accident Reports issued by AIB in 1982

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3/82	Maule M-5-235C G-LOVE Cranfield Aerodrome Beds September 1981	
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Department of Trade
Accidents Investigation Branch
Bramshot
Fleet
Aldershot
Hants GU13 8RX
14 July 1982

*The Rt Honourable Lord Cockfield
Secretary of State for Trade*

Sir,

I have the honour to submit the report by Mr J S Owen, an Inspector of Accidents, on the circumstances of the accident to a Maule M-5-235C - G-LOVE which occurred at Cranfield Aerodrome, Bedfordshire on 4 September 1981.

I have the honour to be
Sir
Your obedient Servant

G C WILKINSON
Chief Inspector of Accidents

Accidents Investigation Branch

Aircraft Accident Report No 3/82
(EW/C766)

<i>Operator:</i>		Capital Aviation Ltd
<i>Aircraft:</i>	<i>Type:</i>	Maule M-5-235C
	<i>Nationality:</i>	British
	<i>Registration:</i>	G-LOVE
<i>Place of Accident:</i>		Cranfield Aerodrome, Bedfordshire
		Latitude 52° 04'N
		Longitude 000° 37'W
<i>Date and Time:</i>		4 September 1981 at 1326 hrs
		All times in this report are GMT

Synopsis

The accident was reported to the Accidents Investigation Branch by Cranfield Air Traffic Control (ATC) at 1400 hrs on 4 September 1981 and the investigation commenced the same day.

A Maule aircraft was carrying out a demonstration flight with the pilot and two passengers aboard at the Flight Business and Light Aviation Show, Cranfield. Whilst demonstrating steep turns at low altitude over the airfield the aircraft entered a spin to the right and crashed into the used aircraft park killing all three occupants and severely damaging a Piper Cherokee 180 G-BFMV. Both aircraft caught fire and a spectator standing on the wing of the Cherokee was injured.

The accident was probably caused by the commander manoeuvring his aircraft in a very tight turn such that it entered a spin from which he was unable to recover in the height remaining.

The report contains four safety recommendations.

1. Factual Information

1.1 History of the flight

On the day of the accident the Maule was flown by the same commander for the four demonstration flights which preceded the accident flight. At

1. Factual Information (Cont)

1320 hrs it took off from the grass to the north of runway 26 at Cranfield and was seen to climb away very steeply, level out at about 500 feet and begin a right hand circuit. When in the "downwind" position the pilot called the tower and asked for clearance to do some figure of eight turns over runway 26. He was instructed to continue downwind as there was another aircraft on wide right hand base leg and the pilot of the Maule was later informed that he was number 2 in the landing pattern. Shortly afterwards, when the Maule was approximately on base leg, it was cleared to the overhead at 300 feet for "a couple of tight turns" before continuing for a normal circuit.

According to eye witnesses the Maule then executed a figure of eight over the used aircraft park, using a very steep angle of bank in the turn and so executing the manoeuvre in a very small volume of airspace. After the figure of eight was completed two bangs were heard from which point eye witness accounts of the train of events differ. Some witnesses consider that the aircraft continued in a very steep right hand turn and then flicked into a spin or incipient spin to the left before crashing. Another group of witnesses thought that whilst in the right hand turn "the aircraft's nose dropped and it slid or spiral dived into the ground." Several witnesses saw the Maule enter either a fully developed or incipient spin to the right before hitting the ground, at a very steep angle, with right wing tip and propellor. At about the same time as the Maule's nose hit the ground it is probable that its left landing gear struck the starboard mainplane of a Cherokee G-BFMV parked in the used aircraft area. Both aircraft caught fire. The three occupants of the Maule were killed instantly and a person standing on the wing of the Cherokee was injured and taken to hospital.

1.2 Injuries to persons

Injuries	Crew	Passengers	Other
Fatal	1	2	—
Serious	—	—	1
Minor/None	—	—	—

1.3 Damage to aircraft

The Maule was destroyed by the ground impact and ensuing fire.

The Cherokee was substantially damaged by the impact of the Maule and the subsequent fire.

1.4 Other damage

Nil

1.5 Personnel information

Commander : Male aged 39 years

Licence: Private Pilot's Licence (permanent) including an Instructor's Rating, Night Rating and IMC Rating

Last medical examination:	Class 1 renewed 28 July 1981
Certificate of experience:	13 month certificate of experience signed 8 July 1981
Flying experience:	Total hours 2068
	Total hours on type: 41
	Total hours in last 30 days: 1955.

1.5.1 *Relevant information*

The commander was employed as a flying instructor by Capital Aviation at Staverton. He volunteered to fly the Maule G-LOVE on such demonstration flights as necessary for the duration of the Cranfield Show. For this undertaking he received no payment or expenses and was therefore acting within the privileges of his licence.

The right hand seat passenger, who had access to the dual controls, was a Private Pilot of Belgian nationality who spoke English.

1.6 **Aircraft information**

1.6.1 *General*

Manufacturer:	Maule Aircraft Corporation Moultrie, Georgia USA
Year of manufacture:	1981
Constructor's number	7365c
Registered owner:	Capital Aviation Sales (UK) Limited
Certificate of Airworthiness:	United Kingdom Private Category valid until 1 September 1984
Total airframe hours:	45 hours
Total engine hours:	45 hours
Hours since last inspection:	2 hrs 20 min

1.6.2 *Weight and balance*

Weight and centre of gravity calculations were based on the established weights of the occupants, the estimated fuel quantity and the information contained in the weighing report dated 28 August 1981. The aircraft was refuelled to full inboard tanks in the morning and it is estimated that approximately 10 galls had been consumed on the previous four flights.

Maximum weight authorised:	2500 lb (1134 Kg)
Estimated weight at take-off:	2300 lb (1043 Kg)
Estimated weight at impact:	2294 lb (1041 Kg)

Centre of gravity limits: 13.2" to 20.5" aft of datum
Estimated centre of gravity on impact: 16.76" aft of datum
Fuel type: AVGAS 100LL

1.6.3 *Aircraft handling and limitations*

The Maule M-235C is a tail wheel high wing aeroplane that achieves a STOL performance by virtue of its high power weight ratio and low wing loading. The accident aircraft, G-LOVE, was the first of this type to be imported into the United Kingdom with flap settings increased by 5° and with a fuel injected engine. The Flight Manual permits only 'Normal Category Manoeuvres, including Lazy Eights and Chandelles involving bank angles not greater than 60°'. Aerobatics and intentional spins are prohibited. The maximum flight load factor is +3.8g but only +1.9g with the flaps down. A stall warning system comprising a vane transducer, warning light, and buzzer was fitted to G-LOVE. [NB The flaps down limiting load factor would be reached in a steady turn with 58° of bank].

1.7 **Meteorological information**

The Cranfield 1300 hrs weather was given as:

Surface wind: 200°/5 knots
Visibility: 15 kilometers
Weather: CAVOK
Temperature: plus 21.5°C
QFE: 1015.3

One minute before the accident the surface wind velocity of 190/8 was passed to an aircraft by Cranfield tower.

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

1.8 **Aids to navigation**

Not applicable

1.9 **Communications**

Cranfield tower was operating on 123.2 MHz and the commander of the Maule was in contact with the tower on this frequency. The RTF recording revealed a high level of traffic at the time of the accident and at most times throughout the Show. The pilot of the Maule was presumably using the hand microphone, which was hung on the left cockpit sidewall, as there were no headsets evident in the wreckage and photographs taken as the aircraft taxied out showed the commander without a headset.

The RTF recording established that at 1322 hrs, when in the downwind position, the Maule G-LOVE (Call sign Victor Echo) called the tower and requested "CAN WE DO SOME FIGURE OF EIGHT TURNS OVER TWOSIX"? The tower replied "CONTINUE DOWNWIND RIGHT HAND FOR TWOSIX FOR THE MOMENT THERE'S TRAFFIC POSITIONING ON A WIDE RIGHT BASE AT THE MOMENT". The Maule replied "ROGER WE HAVE CONTACT" and the tower responded "THAT'S FINE YOU'RE NUMBER TWO". This was acknowledged by G-LOVE.

At 1324.30 hrs Cranfield tower controller transmitted, on seeing the Maule on base leg "VICTOR ECHO YOU'RE CLEARED TO POSITION INTO THE OVERHEAD WHAT'S YOUR MINIMUM HEIGHT RANGE"? The Maule replied "WE'RE CURRENTLY AT FIVE HUNDRED FEET WE'D LIKE TO COME DOWN TO THREE PLEASE". The tower then cleared the Maule: "OKAY YOU'RE CLEARED DESCENT AND I'LL KEEP AN EYE ON YOU I HAVE A HELICOPTER DEPARTURE ADJACENT TO THE TOWER WHICH I WILL DO SO BEHIND YOU". The Maule replied: "ROGER WE'LL ONLY BE ABOUT A MINUTE OR SO ANYWAY JUST A COUPLE OF TIGHT TURNS THEN WE'LL DO JOIN FOR A NORMAL CIRCUIT AGAIN". Cranfield Tower responded "OKAY".

This was the last communication with the Maule which crashed at 1326 hrs. However, just before the crash, a Robinson R22 helicopter was warned by Cranfield Tower of the presence of the Maule manoeuvring at low level.

1.10 Aerodrome and ground facilities

Cranfield is a licensed aerodrome with two in-use paved runways 22/04 and 26/08. For the period of the show the light aircraft landing area had been withdrawn by Nofam as most of the area to the north and west of the two runways was occupied by aircraft parks or exhibition stands and material (see Appendix 1). At the time of the accident runway 22 was in use for arrivals (main instrument runway) and runway 26 was being used for take-off. The Maule G-LOVE was given special permission to operate from the grass parallel to runway 26 and to the south of the parked aircraft. The normal circuit direction was left hand but the Maule was operating right hand circuits.

The Maule aircraft crashed into the line of aircraft closest to the runway in the "Used Aircraft Park". The position of the crash 190 feet from the runway centre line was within the strip area for this type of runway (260 ft). It is a licensing requirement that this strip should be kept clear of obstructions.

1.11 Flight recorder

A flight recorder was neither required nor fitted.

1.12 Wreckage and impact information

Inspection at the accident site indicated that the aircraft had struck the ground in a very steep nose down attitude with the propeller and right hand wing tip impacting almost simulataneously. A Piper Cherokee, G-BFMV, which had been parked in line with several other aircraft was struck by the Maule during the impact, causing the outer section of the Cherokee's left wing to be severed. The intense ground fire which ensued caused further damage to

the Cherokee and consumed a large part of the Maule wreckage. Initial examination of the wreckage revealed the Maule to have been structurally intact at the time of impact and the extent of the fire damaged grass indicated that a significant quantity of fuel had been carried.

Detailed examination of the wreckage at the AIB facility at Farnborough did not reveal any pre-impact failure or malfunction of the flying controls or flight instruments. The stall warning sensing vane and switch were still operable but the remainder of the system was too badly burned to function. No evidence of pre-impact malfunction was found. The flap surfaces and operating mechanisms were found in the up position in the wreckage and the flap selector in the cockpit was found overtravelled in the fully down position. The flap selector had broken off in upward bending (fully down). The flaps are held in the down position by cable tension and any distortion of fuselage is likely to cause them to change their position. It was therefore not possible to determine the position of the flaps prior to impact from examination of the wreckage.

A strip examination of the engine, propeller and associated controls showed that the engine had been rotating and delivering a significant amount of power at the moment of impact. The throttle was set at just below full power, the propeller control was to maximum RPM and the engine intake was found in the cold filtered air position. Components from the fuel system were found to contain small quantities of fuel and they were internally clean and free from signs of water contamination. Analysis of a fuel sample taken from the aircraft's last known point of refueling showed it to conform to the specification for Avgas 100LL.

1.13 Medical and pathological information

Post Mortem examination of the occupants showed that, in all cases, death was instantaneous and was due to multiple injuries sustained on impact. There was no evidence of a pathological nature that could have caused the accident. Tests for alcohol, drugs and carbon monoxide intoxication proved negative in the case of the commander and the front seat passenger. The rear seat passenger had a low alcohol level which is not thought significant.

1.14 Fire

The Rapid Intervention Vehicle (RIV) had been pre-positioned adjacent to runway 26 in order to ensure a rapid response to any emergency involving aircraft on runway 22 and 26. On observing the crash the RIV crew moved their vehicle towards the scene and began knocking down the fire in the cockpit area, using all the 200 gallons of light water available to them. Meanwhile, the remainder of the fire section had manned the Thorneycroft foam tender and were moving towards the crash. Some witnesses felt that the fire crews were slow in reacting to the emergency but evidence from a video tape taken during the crash/rescue action did not support this view. The Thorneycroft tender was at the crash site 34 seconds after impact and at 2 min 6 seconds the fire had been extinguished although the Cherokee windscreen re-ignited again for a brief period. Rescue action for the occupants of the Maule was terminated when they were certified dead by the doctor. A spectator standing on the wing of the Cherokee was injured and taken to hospital in the crash ambulance.

1.15 Survival aspects

This accident was not survivable due to the high decelerative forces of the near vertical impact.

1.16 Tests and research

1.16.1 *Photographs and models*

Photographic evidence taken at a distance just before the crash showed the elevators to be in the up position and the rudder approximately in the centre position. From the photograph of the mainplane it was not easy to determine the position of the flaps and ailerons, so a scale model of the mainplane was constructed and photographs were taken from the same angle of various deflections of flap and ailerons and a comparison was made with the original photograph. The closest correlation between the photograph of the model and the photograph of the real aircraft was achieved when 20° of flap were selected and the ailerons were deflected appropriately for control column fully to the left.

1.16.2 *Flight Tests*

A Maule aircraft of the same series as the accident aircraft was not available in the United Kingdom. The flight tests were conducted on a Maule that had a carburettor rather than an injector and with flap settings at 15° and 35° rather than 20° and 40° obtainable on the accident aircraft. As the engine horsepower on both types is the same the different fuel system was not thought to be a significant problem and the difference in flap settings was overcome by holding the flap selector lever in the 20° position. These suppositions were later confirmed by the manufacturers and they confirmed that the additional 5 degrees of flap would have reduced the stalling speed by 6 MPH.

The aircraft was loaded such that the weight and centre of gravity were representative of the accident condition and the aeroplane was manoeuvred at a safe height to attempt to reproduce the conditions observed by the witnesses of the accident. The Maule was easy to fly in a steep turn with 20° flap selected and could be flown accurately and without undue effort. As the turn was progressively steepened the stall warning light illuminated but the handling of the aircraft was unchanged. On further steepening of the turn without further warning the aircraft flicked rapidly to the left. Immediate centralisation of the controls prevented further departure but the loss of height was, on all three occasions, in excess of the height available to G-LOVE for recovery.

The tests showed that, whilst in a turn and in the same configuration as G-LOVE, penetration into the stall regime past the stall warning visual/audio indication is extremely hazardous as no further warning occurs before the aeroplane flicks.

After the flight the rigging of the test aircraft was checked to ensure that there was no obvious aerodynamic reason why it should always depart to the left. The rigging was found to be satisfactory.

1.17 Additional information

1.17.1 *Air Show Organisation*

The 'Flight' 8th Business and Light Aviation Show was organised on behalf of Flight Magazine by IPC Exhibitions Ltd, a company set up within the IPC group to organise exhibitions for any of the companies within the group. In

accordance with their normal practice at all specialised events they delegated the "organisation and legal liabilities arising out of the operation of the Control Tower" to the Cranfield Institute of Technology who accepted these responsibilities. Several meetings were held at Cranfield before the event to co-ordinate various aspects of the show. These meetings were attended by representatives from Cranfield, IPC Exhibitions and the CAA.

The CAA had written to Cranfield after the 1979 Show pointing out that there was "evidence that some of the events during the Show did not demonstrate good airmanship or even commonsense", and that aircraft were starting engines, taxiing amongst members of the public and also overflying the crowd. The CAA called for a greater degree of control of aircraft parking and movement at future Shows.

The organisers of the 1981 Show attempted to overcome these criticisms by inserting into the "Exhibitors' Information and Order Form" a paragraph which consisted of:

"4. AIRCRAFT MOVEMENTS

ATC must be advised in advance of all aircraft movements. Aircraft parked in front of exhibition chalets must be towed and not taxied. Aircraft that will require towing must carry the appropriate towbars.

NO AIRCRAFT MAY START ENGINES UNTIL THEY ARE CLEAR OF THE VISITOR AND CHALET AREAS".

There was no mention in the brochure of a ban on overflights of the crowd and the CAA did not either point this out to the organisers or insist that an instruction to this effect be given in writing to each exhibitor. The organisers did, however, agree that "their Air Traffic Control Staff would be exercising constant supervision over all aspects of Show aircraft operation".

1.17.2

Legal aspects

There is no legal requirement for the organisers of an Air Show or Event to inform the CAA that such an event is going to take place. In the case of the Cranfield Flight Show the organisers did not submit the Air Show Notification Form contained in CAP 403 (an advisory document on "Safety Arrangements at Flying Displays and Rallies") as they did not consider that the event constituted a display. They did however write to the CAA requesting that Class 2 Notam be issued and the CAA was aware that the show was taking place because of the correspondence outlined in paragraph 1.17.1.

Rule 5 of the Rules of the Air and Air Traffic Control regulations 1981 is the rule that deals with Low Flying. The parts of rule 5 that are pertinent to this accident are quoted in full at Appendix 2.

In effect the low flying rules require that no person shall fly within 3,000 ft of a crowd of 1,000 persons or more, unless written permission is granted by the CAA, and furthermore shall not fly closer than 500 ft to any person, vessel, vehicle or structure. However, in the case of flying displays and events these rules do not apply provided the flight is made with the consent in

writing of the organisers. There is also exemption from the low flying rules for aircraft flying in accordance with normal aviation practice in taking-off and landing at an aerodrome.

Articles 45 and 46 of the Air Navigation Order also require that a person shall not act recklessly or negligently in such a way as to endanger an aircraft, or its occupants or persons or property.

1.17.3 *Maule Flying at the Cranfield Show*

Considerable evidence was adduced from witnesses that throughout the Show the Maule G-LOVE, which was flown exclusively by the same pilot, was being operated in a very spirited manner. The demonstration flights usually consisted of a very steep slow speed climb, often stepped to regain flying speed, and followed by a tight circuit. On some flights a steep relatively high speed dive followed by a near vertical climb would be flown and on other steep small radius turns or figures of eight were carried out at low level. Evidence from witnesses who flew on these demonstration flights revealed that the audio and visual stall warning was activated for significant periods of the flight when the aircraft was being manoeuvred and when brought to the attention of the pilot he replied that it did not matter. There seemed to be little attempt to avoid flying or manoeuvring over the crowd and several witnesses expressed considerable displeasure about the "antics of the Maule".

During the on site examination of the wreckage in the "Used Aircraft Park" AIB Inspectors were frequently overflown by helicopters and light aircraft and several aircraft were observed taxiing amongst the crowd with propellers turning. There were also occasions when helicopters hover-taxied in areas that were not separated from the spectators.

At no time during the 1981 Show did the organisers complain to either the pilot of the Maule or the operating company about the way in which Maule demonstration flights were being carried out.

2. Analysis

2.1 General

There is neither evidence that the accident was caused by any pre-crash failure of the aircraft, its engine or equipment, nor any medical evidence to suggest incapacitation of any of the occupants. It is necessary therefore to examine the operation of the aircraft by its commander at the Cranfield Show.

From eye witness statements it is clear that throughout the Show the commander of G-LOVE had been operating the aeroplane close to the edges of the manoeuvre envelope during his demonstration flights within the visual circuit of Cranfield Aerodrome. Evidence from qualified pilots who flew on these demonstration flights suggests that he paid little regard to the stall warning light or audio indication.

Notwithstanding the pilot's apparent disregard of the stall warning there are four possible conditions that may have caused or contributed to the loss of control of the aircraft.

- (i) The right hand seat passenger could have interfered with the controls.
- (ii) The right hand seat passenger may have been flying the aeroplane and the commander could have been slow in taking over control when he considered that the aircraft was being manoeuvred outside acceptable limits.
- (iii) The commander could have used the hand microphone to acknowledge the presence of the Robinson helicopter below him and became distracted from his flying.
- (iv) The commander could have been dazzled by the sun.

These four possibilities are examined below.

2.2 Interference with the controls

The right hand seat passenger was a Private Pilot of Belgian nationality who spoke English and the possibility exists that he may have either voluntarily or involuntarily interfered with the controls in such a manner that control of the aircraft was lost. However, since there is no pathological evidence or evidence from any other source to support this theory it cannot be regarded as anything more than a possibility.

2.3 Right hand seat passenger in control

The right hand seat passenger may have been allowed to fly the aircraft as part of the demonstration flight and his unfamiliarity with the Maule could have led to the accident. Once again there is no evidence to support this theory but to the contrary, on previous flights the commander had been reluctant to allow potential customers to handle the aircraft, especially in manoeuvres such as figures of eight and steep turns. In any event it would have been the commander's responsibility to ensure that any manoeuvre was safely executed.

2.4 Hand microphone

From photographic evidence and from the wreckage it is apparent that the commander of the Maule was using a hand microphone to communicate with Cranfield Tower (rather than a headset). In the intense RTF environment that existed at Cranfield this may not have been very wise. Just prior to the crash a Robinson helicopter that was hovertaxying was warned of the Maule's presence and he replied that he had the Maule in sight. The possibility exists that the Maule commander reached for the hand microphone at this point to transmit that he had the Robinson in sight and was distracted by the act of picking up the microphone to such an extent that he lost control of the aircraft. This is considered to be an unlikely cause as there is no evidence of any transmission on the RTF tape at this time but the remote possibility exists that the pilot picked up the microphone but did not transmit.

2.5 Dazzle

The weather at the time of the accident was fine and sunny but with a slightly indistinct horizon. The azimuth of the sun at the time would have been approximately south-west and the elevation reasonably high. It is unlikely that the sun had

any bearing on the accident especially as the commander was seen wearing sunglasses on departure.

2.6 Other evidence

There were a large number of eye witnesses to the accident and their recollection of the events differ markedly in some details. However, correlation of eye witnesses reports together with photographic and wreckage/impact information would make the most likely course of events as follows:

The Maule ran in from the north of runway 26 descending to 300 feet at a fairly slow speed and with 20° flap selected; it then entered either a figure of eight or two right hand turns. When turning through approximately north-west the aeroplane entered a spin or an incipient spin from which the commander had insufficient height to recover. The bangs heard by some witnesses were probably caused by rapid throttling of the engine as the aircraft entered the spin. At this point recovery was impossible in the height remaining.

Flight tests undertaken in a similar aircraft were able to reproduce this train of events except that in the case of G-LOVE normal differences in construction or rigging probably caused a flick to the right rather than to the left as demonstrated on the flight test.

2.7 Control of Air Shows

The crash of the Maule into the used aircraft park at the Flight Cranfield Show thereby injuring a member of the public on the ground has highlighted certain inadequacies in the control and organisation of air shows and events. The Maule aircraft G-LOVE was operating within 500 ft of any person, vessel, vehicle or structure and it was also flying within 3,000 feet of an assembly in the open air of more than 1,000 persons. It was not manoeuvring for the purpose of take-off or landing when it crashed. This would normally mean that it was operating in contravention of the Rules of the Air and Air Traffic Control Regulations 1981 Rule 5(d)(i) and 5e. However, Rule 5(2)(c) gives exemption in this case because the assembly of persons were gathered for the purpose of witnessing an event which consisted wholly or principally of an exhibition of flying and the flight was made with the consent, albeit not in writing, of the organisers of the event. In effect there is nothing within the present legislation to prevent aircraft at air events overflying the public at any height, and in any manoeuvre or configuration that the pilot chooses, providing it is with the permission of the organisers. This places a heavy moral responsibility on the organiser, who, under the law as it is at present, is neither required to inform the CAA that such an event is planned to take place nor has to be approved as a fit and qualified person to run an air show. In effect a totally unsuited and unqualified organiser could give a pilot exemption from the low flying rule for the purposes of his display and there would seem little that could be done to prosecute the pilot unless it could be proved that "he recklessly or negligently caused or permitted his aircraft to endanger any person or property" contrary to Article 45 of the ANO 1980. There is therefore little control possible over the quality of flying at flying displays.

Whilst recognising that the Cranfield show was not actually a display as such and that any exhibition of flying would presumably be carried out under normal aerodrome traffic rules, it is evident that the Maule's commander had repeatedly manoeuvred his aircraft in a less than prudent manner near an assembly of people. The Maule

was allowed to overfly the crowd on a number of occasions despite the letter from the CAA pointing out that the 1979 Show was unsatisfactory and lacking in airmanship and common sense. There were also numerous over-flights of the parking and exhibition areas whilst AIB personnel were investigating the accident. There would seem to be a good case for future legislation to require that:

- (a) Air Shows are properly notified to the CAA.
- (b) Air Show organisers are recognised as being suitably qualified by the CAA.
- (c) The advice on display lines and crowd barriers contained in CAP 403 is mandatory and not advisory.
- (d) That a flying participation committee be set up for each show to approve and if necessary veto each display.

3. Conclusions

(a) Findings

- (i) The pilot-in-command was properly licensed, experienced on type and medically fit.
- (ii) The aircraft had a valid certificate of airworthiness and had been properly maintained.
- (iii) No pre-crash defects were found in the aircraft, the engine or the flying controls.
- (iv) The loading and centre of gravity were within the prescribed limits for the flight.
- (v) The aircraft was being operated in accordance with the regulations but with little regard for good airmanship.
- (vi) The organisers of the Show did not contravene any of the regulations but although not causal to the accident the standard of supervision and control was inadequate to ensure reasonable safety for the spectators and the exhibition participants.

(b) Cause

The accident was most probably caused by the commander manoeuvring his aircraft in a very tight turn such that it entered a spin from which he was unable to recover in the height remaining.

4. Safety Recommendations

It is recommended that:

- 4.1 Air Shows or events involving a significant number of aircraft and/or spectators should be properly notified to the CAA.
- 4.2 Air Show organisers should be approved by the CAA as being suitably qualified to organise the type of event being contemplated.
- 4.3 Suitable weather and crowd separation minima should be agreed and implemented for all displays.
- 4.4 A flying participation committee should be appointed and approved by the CAA to monitor and implement flying discipline at every display or Air Show.

J S Owen
Inspector of Accidents

Accidents Investigation Branch
Department of Trade

June 1982