Department of Trade

ACCIDENTS INVESTIGATION BRANCH

Strojirni Prvni Potiletky Super Aero 145 G-ASWS Report on the accident at Lydd Airport, on 9 July 1978

LONDON
HER MAJESTY'S STATIONERY OFFICE

List of Aircraft Accident Reports issued by AIB in 1979

No.	*Short Title*	*Date of Publication*
1/79	Piper PA32R (Cherokee Lance)PH–PLY Holly Hill Snodland Kent April 1978	May 1979
2/79	Vickers Viscount Series 802G–AOJF Leeds/Bradford Airport November 1978	January 1980
3/79	Piper PA24 Comanche 180G–ARSC Preston Hitchin Herts December 1978	February 1980
4/79	Rockwell Commander 114HB–NCM Waterloo Farm Nr. Dundry Bristol Sept. 1978.	Awaiting release
5/79	Cessna 337A (Skymaster)G–ATNY Moel Siabod, North Wales June 1979	February 1980

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1/80	Strojirni Prvni Potiletky Super Aero 145 G–ASWS Lydd Airport July	

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Department of Trade
Accidents Investigation Branch
Kingsgate House
66-74 Victoria Street
London SW1E 6SJ

11 February 1980

The Rt Honourable John Nott MP
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 Strojirni Prvni Potiletky Super Aero 145 G-ASWS which occurred at Lydd Airport, on 9 July 1978.

I have the honour to be
Sir
Your obedient Servant

W H Tench
Chief Inspector of Accidents

Accidents Investigation Branch
Aircraft Accident Report No. 1/80
(EW/C631)

Registered Owner and Operator:		W H Grimes
Aircraft:	*Type:*	Strojirni Prvni Potiletky
	Model:	Super Aero 145
	Nationality:	United Kingdom
	Registration:	G – A S W S
Place of Accident:		Lydd Airport Latitude 50°57'N Longitude 000°56'E
Date and Time:		9 July 1978 at 1142 hrs All times in this report are GMT

Synopsis

The accident was reported by Lydd Air Traffic Control on 9 July and the investigation was commenced on the same day.

The accident occurred following a total loss of power on the right hand engine during the initial climb shortly after becoming airborne. Directional control was progressively lost and the aircraft descended steeply from about 100 feet and crashed in a corn field about 400 metres beyond the end of the runway. All four occupants were killed and the aircraft was destroyed.

No defect was found to account for the power loss but it is possible that there was a deliberate closure of the fuel cock. It is not known which of the two front seat occupants was controlling the aircraft before or after the power loss occurred but it is concluded that the accident was caused by a loss of directional control during asymmetric powered flight.

The report draws attention to the difficulties arising from the attendance of fire service appliances when an accident occurs outside the aerodrome boundary.

1. Factual Information

1.1 History of the flight

The intended flight was to have been from Elstree to Le Touquet via Lydd, returning the same day. The aircraft, G-ASWS, landed at Lydd at 1046 hrs; it was refuelled to max - mum capacity then, after a flight plan was filed and Customs and Immigration formalities were completed, the pilot and three passengers boarded the aircraft.

Taxi clearance was obtained at 1135 hrs and after a brief stop in the run-up area the aircraft lined up on runway 22. It is not known whether an engine run-up was carried out or not. The aircraft was then cleared to take-off and make a right turn and climb to 3,000 feet. The take-off run, which was observed by the duty air traffic control officer (ATCO) in the control tower, started from a point on the runway about 180 metres after the beginning of the paved surface. The ground run appeared normal and the aircraft became airborne approximately 122 metres before the intersection of runway 14/33. The ATCO looked away to log its airborne time and when he saw it again it was abeam the control tower at an estimated height of 100 feet to 150 feet above the near edge of the runway with its right hand propeller 'windmilling' and its landing gear retracted. The machine was also drifting to the right and gradually losing height as it approached the upwind boundary of the aerodrome; on seeing this the ATCO sounded the crash alarm. As it passed the control tower it was also observed from ground level by two occupants of a light aircraft which was parked on the apron near the control tower and facing the runway. According to these witnesses, one of whom was a pilot, the aircraft was in a tail down attitude at about 150 feet, not climbing and 'its attitude was too steep for its speed'. As it approached the upwind end of the aerodrome there was a radio telephone (RTF) call: 'this is Whisky Sierra we have an engine failure on take-off'. The ATCO acknowledged the call, cleared the aircraft to land and to 'advise direction of turn'. This RTF message was not acknowledged but a switched microphone click was heard. As the aircraft passed the aerodrome boundary the right hand propeller stopped. The aircraft rolled slowly to the right until it was vertically banked, it then pivoted on its normal axis and dived at a steep angle into a field approximately 400 metres from the end of the runway and 330 metres to the right of the extended centre line. There was no fire but all four occupants were killed instantly.

1.2 Injuries to persons

Injuries	*Crew*	*Passengers*	*Others*
Fatal	1	3	None
Non-fatal	-	-	-
Minor/None	-	-	

1.3 Damage to aircraft

The aircraft was destroyed by ground impact.

1.4 Other damage

Some standing crops were destroyed by the aircraft impact and the subsequent movements of rescue and recovery vehicles.

1.5 Personnel Information

1.5.1	Pilot	Male aged 58
	Licence	Private pilot's licence (PPL) including a twin-engine rating, instrument rating, night rating and IMC rating.
	Medical certificate	Class 3 renewed 14 December 1977
	Certificate of experience	13 month certificate of experience signed 10 October 1977
	Flying experience	Total hours: 1212 hours Total on type: 678 hours 15 minutes Total in last 90 days: 19 hours 05 minutes. Total in last 30 days: 8 hours 15 minutes.

1.5.2 Relevant background information

The pilot was a member of the St John's Ambulance Air Wing and had carried out a number of flights in this role in the United Kingdom and overseas; in these activities he was frequently accompanied by the Wing's co-ordinator who was also a professional pilot and an experienced flying instructor who periodically checked the pilot in his engine failure and propeller feathering drill. The method used to simulate an engine failure was to close the appropriate engine fuel cock. In these and other aspects of aircraft handling and pilotage the pilot demonstrated a higher than average ability and his cockpit and emergency drills were always meticulously carried out. Examination of the pilot's personal flying log books showed that he had carried out a number of practice instrument flying and asymmetric powered flight exercises following his twin engine conversion course on G-ASWS. The most recent check on his ability to manoeuvre the aircraft on asymmetric power was ten weeks before the accident.

It is understood that the pilot was frequently accompanied in G-ASWS by the passenger, aged 21, who also occupied the co-pilot's seat on the accident flight. Although designated as a passenger on the aircraft's documentation, he held a private pilot's licence on single engined aircraft for which he qualified in June 1977. His personal flying log book showed that he had flown a total of 54 hours 30 minutes dual and solo on the Piper Cherokee 140 and he had recorded 45.00 hours as co-pilot on twin engined aircraft which were flown by the same pilot who commanded G-ASWS when it crashed. This included a flight of 2 hours 30 minutes as co-pilot in G-ASWS. He had received no formal twin engined flying instruction and was not qualified as pilot-in-command on these types. According to club members he had controlled G-ASWS from the co-pilot's seat under the supervision of the pilot-in-command, who had also encouraged him to obtain a PPL.

1.6 Aircraft information

1.6.1 General

Manufacturer:	Strojirni Prvni Potiletky Czechoslovakia
Year of manufacture:	1964
Constructors number:	1720-04
Registered owner :	W H Grimes

Certificate of airworthiness:	United Kingdom, General Purpose category, valid until 23 June 1979, last renewed on 24 June 1977 following a check 4 inspection.
Total airframe hours:	1028 hours at last log book entry on 12 April 1978.
Total engine hours:	1028 hours each.
Hours since last maintenance check:	No hours were recorded in the aircraft log book since 12 April 1978, but according to the pilot's log book the aircraft had flown for 21 hours 30 minutes between 15 April and 1 July 1978.

1.6.2 Weight and balance

Weight and centre of gravity calculations were based on the established weights of the occupants, the known fuel quantity and the information contained in the Weight Schedule (SWS/2 dated 11 November 1973).

Maximum weight authorised:	3530 lb
Estimated weight at take-off:	3542 lb
Estimated weight at impact:	3538 lb
Centre of gravity limits:	34.1" to 41.8" aft of datum
Estimated centre of gravity at take-off:	37.9" aft
Fuel type:	AVGAS 100LL

1.6.3 Performance and handling characteristic of G-ASWS

The following data were extracted from a report which was compiled when G-ASWS was test flown on 23 June 1977 after its last inspection for the renewal of its certificate of airworthiness.

Climb performance (engine out)

Configuration:	Normal for engine out en route climb, landing gear and flaps retracted.
Power:	With air intake 'cold' or 'ram' air position; propeller: 2500 rpm. Inoperative engine: propeller feathered, cooling flaps closed.
Altitude:	4,500 feet (1013 mbs)
Airspeed:	68 knots IAS (correct en route climb airspeed for weight)
Weight:	3325 lb
Temperature:	plus 10°C
Rudder trim:	Full left

The achieved rate of climb over the five minute period was 0 (zero) feet per minute: this was 45 feet per minute less than the (Flight Manual) scheduled rate of climb for the weight altitude and temperature conditions existing.

Stalling tests

With both throttles closed and the landing gear and flaps retracted the aircraft stalled at 55 knots IAS in level flight. The stalling speed quoted in the Flight Manual for its weight at the time (approximately 3300 lb) was 52 knots IAS.

Propeller feathering and landing gear retraction times

The time taken to feather the right hand propeller was 12 seconds.
Landing gear retraction time: 8 seconds.

1.6.4 Scheduled performance

The data given below were obtained from the approved Flight Manual for this type of aircraft:

1.6.4.1 Take-off performance - both engines operating, flaps retracted.

For the conditions of wind, temperature and aircraft weight existing at the time of the accident, the scheduled take-off distance to 50 feet was 2330 feet with zero flaps following a take-off run of 1720 feet. These distances are consistent with the estimated point on the runway at which G-ASWS was seen to become airborne after a ground run of approximately 1930 feet.

Engine out performance

In the temperature conditions existing, the net gradient of climb at sea level with one power unit failed should be approximately 2% with a 10 knot headwind or 1.8% in still air. At 71 knots IAS in still air this would be equivalent to a net increase in height of 129 feet per minute. In order to achieve this performance the following conditions would need to be fulfilled:

Aircraft weight:	Not exceeding the maximum authorised (3530 lb)
Power units:	Operating power unit at maximum take-off power, full throttle, supercharger 'on', 2,700 rpm.
Propeller pitch:	Operating propeller set to 'Climb' position, propeller of the inoperative engine feathered.
Air intake:	'Ram' air.
Landing gear:	Retracted.
Wing flaps:	Retracted.
Airspeed:	Take-off safety speed appropriate to weight; this is 71 knots at maximum authorised weight 3530 lb.

Take-off safety speeds

The take-off safety speeds given in the Flight Manual ensure that there are sufficient margins above the stall and above minimum control speeds whichever power unit might fail.

Minimum control speed

The minimum airspeed for directional control on asymmetric power when away from ground effect is 60 knots IAS with the flaps retracted and 56 knots with the flaps in the 15° take-off position. The 'single engine safety speed' given in the pilots' check list carried in the aircraft is quoted as 65 knots.

Stalling speed

The power off stalling speed in level flight at the maximum weight authorised is 54 knots with the flaps retracted.

1.7 Meteorological information

A post-accident observation of weather conditions at Lydd airport was recorded at 1150 hrs as follows:

Surface wind:	240°/10 knots.
Cloud:	2 oktas stratus at 800 feet. 4 oktas cumulus at 1,800 feet. 6 oktas stratocumulus at 5,000 feet.
Weather:	Nil
Surface temperature:	17°C
Visibility:	11 kilometres
Barometric pressure:	QFE 1012.3 QNH 1012.7
Observation height:	30 feet agl
Light conditions:	Good daylight

Surface wind velocities prior to accident were obtained from RTF transcript, these were:

1135 hrs: 240°/10 knots

1138 hrs: 240°/14 knots

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

1.8 Aids to navigation

Not applicable

1.9 Communications

Speech recording equipment is installed at Lydd and was serviceable. A playback of the transmissions to witnesses who were familiar with the voices of the pilot and the occupant of the right hand pilot's seat established that the latter was operating the radio just

before the aircraft crashed. On the basis of the corrected time injections the accident occurred about 15 seconds before 1142 hrs.

1.10 Aerodrome information

1.10.1 Lydd is a licensed aerodrome owned by Silver City Airways Ltd, operated and administered by Airwork Services Ltd. At the time of the accident the runway in use was 22/04 which was 1504 metres long and 37 metres wide. At the upwind end of runway 22 the ground was obstruction-free for about 100 metres beyond the end of the runway paving and with a further 200 metres of scrub before a raised railway embankment.

The ground beyond the railway and to the right and left of the extended centre line consisted of cultivated fields with a network of drainage ditches or dykes.

The runway mean elevation was 10 feet amsl, there was no significant gradient and it had a macadam surface. At the time of the accident it was dry.

1.10.2 Airport Fire Services (AFS)

There were four appliances which were serviceable and manned by five duty crew/ firemen disposed as follows:-

One radio equipped Rapid Intervention Vehicle (RIV) (Land Rover), one fireman;

One Foam Tender, two firemen;

One Foam Tender, one fireman;

One Water Tender, one fireman.

None of the crew on duty at the time of the accident had completed the course at the CAA Fire Service Training School at Stanstead but they had undergone a regular programme of training at Lydd under the supervision of personnel who had completed the CAA course.

All four appliances were alerted shortly before the aircraft crashed and they moved off within a minute of the crash occurring; on reaching the 04 end of the runway they were instructed by ATC to return to their station. The recording of RTF messages on 121.9 MHz between 1141 hrs and 1146 hrs included the following information:

1141.30 Communication established between ATC and Crash One

1143 'Crash one would you return to the dispersal the crash has happened outside the airport'.
(From Crash One) 'Is there any way we can reach it at all?'.

1143.30 (From ATC) 'Er negative come back to the ..... erm No I can't release you from the airport I'm afraid the local facilities will have to deal with it come back to dispersal'.

1144 (From 'Crash One') 'Can we try to get a skeleton crew with the Landrover we should be able to do some help over s'bloody ridiculous not being able to do a thing'.

1144.30 (From ATC) 'Now now don't get excited just return to dispersal'.

Having been thus instructed the airport fire service took no further part in the rescue attempt. Although it was found during the investigation that there was a feasible route from the end of the runway to the accident site, the evidence indicated that neither the

crash crew nor the controllers on duty in the tower were aware that it existed. However, the driver of 'Crash One' tried to reach the scene on his bicycle by a roundabout route and in doing so intercepted the Lydd town appliance and rendered what assistance he could. The response by the Kent Fire Brigade and others is dealt with in paragraph 1.15 'Survival aspects'.

1.10.3 Accidents occurring outside the aerodrome boundary

In August 1976 the Director of Aerodrome Standards (DAS) of the Civil Aviation Authority (CAA) requested aerodrome licencees to provide information as to what arrangements there were for 'off-aerodrome incidents'. DAS reminded them 'that the CAA cannot compel airport fire services (AFS) to operate outside aerodrome boundaries, all that could be done in this respect is to encourage arrangements to be made'.

One of the objections raised by aerodrome licencees was that in order to operate legally outside of their boundaries their vehicles would have to be properly insured for this risk, also, whilst their vehicles would be exempt from Road Fund Licensing requirements whilst being so engaged, their drivers would be required to be properly licensed to drive heavy goods vehicles (HGV). Experience has shown that when an AFS driver becomes HGV qualified he has to be paid more since he would be able to command a higher wage for driving such a vehicle if employed elsewhere. A further problem that arises when an AFS operates beyond its aerodrome boundaries is right of access to or through private property.

1.10.4 Arrangement for off-aerodrome incidents at Lydd

In reply to DAS's letter the airport manager at Lydd quoted an extract from 'Lydd Airport Emergency Orders':

> 'Crash action if aircraft is outside the aerodrome perimeter Emergency calls (999) will be made in accordance with 'Crash Action' paragraph 2 in addition to the standard message the duty ATCO will endeavour to give an accurate location of the crash or the possible point of impact if the aircraft is still airborne. The aircraft crash crew and first aid auxiliaries will be unable to assist if the crash occurs a considerable distance from the aerodrome perimeter. In such cases the Incident Officer provided by the Police will set up his own rescue first aid point and evacuation of casualties in co-ordination with the Fire and Ambulance Department'.
>
> 'Obviously in the case of a crash occurring near the aerodrome perimeter the crash crew and staff of Silver City Airways will within reason, endeavour to reach the scene with the fire tenders and other equipment normally used in such emergencies. Action of this nature would be at the discretion of the duty ATCO and with regard to the requirements of other aircraft operating'.
>
> 'We are aware that no duty is chargeable in respect of road fund licences in respect of Fire Engines and Ambulances. It is however understood that our drivers should hold HGV licences. This in effect could legally prevent us from going beyond the aerodrome boundary'.

1.10.5 Aerodrome fire service category

Since the largest aircraft type using Lydd for public transport work is the Vickers Viscount, the requirements laid down by the CAA in CAP 168 (Licensing of Aerodromes) would require a Category 5 fire cover; however, if the total movements during a three month period were less than 700 a Category 4 cover would suffice.

Following an inspection by the CAA Fire Service Officer on 1 June 1978 the attention of the airport authorities was drawn to the general age and condition of the current fleet of vehicles and appliances, these were considered to be below the standard expected

nowadays in aerodrome fire and rescue vehicles, in particular automotive performance and fire fighting ability. The airport authorities were in the process of trying to obtain replacement units to enable them to conform to the more exacting requirements of the revised CAP 168 which in turn implements the requirements of Attachment B to ICAO Annex 14 (Aerodromes); however, because of a reduction in the forecast movement rate for Viscount aircraft, Lydd airport was downgraded from Category 5 to Category 4.

1.10.6 Emergency access roads

The revised CAP 168 contains the following requirements:

> 'Depending on the location of the aerodrome and its topography consideration should be given to the provision of emergency access roads to various areas on the aerodrome and to areas beyond the aerodrome boundary as far as is practicable. Particular attention should be given to the provision of ready access to approach areas up to 1,000 metres from the threshold'.

Following the accident to G-ASWS the Lydd airport authorities have taken steps to obtain access to the area in question and marked out suitable routes which can be negotiated by their fire and rescue vehicles.

1.10.7 Fire Services Act 1947

Chapter 41 of the Fire Services Act 1947 makes provision for mutual assistance between fire authorities and other persons who maintain fire brigades. Arrangements so made could facilitate the deployment of an aerodrome fire service in support of a fire brigade maintained in pursuance of the Act; such an arrangement also confers appropriate powers of entry.

1.11 Flight recorders

Neither required nor fitted.

1.12 Wreckage and impact information

1.12.1 Impact information

Inspection at the scene of the accident showed that the aircraft had struck the ground in a 70° nose down attitude on a heading of 070°(M); it then pivoted clockwise about the left wing tip and came to rest on a heading of about 145°(M). The cabin structure, engine nacelle structure and wing leading edges were severely disrupted during the impact sequence but all the wreckage was contained within the immediate vicinity of the impact point. There was no evidence of post or pre-impact fire; the wing flaps and landing gear were retracted and there were indications that the right-hand propeller was feathered and the left-hand propeller was at a fine pitch setting and being driven under a degree of power at impact.

1.12.2 Subsequent examination

A detailed examination of the wreckage confirmed that the right-hand propeller was feathered and exhibited no evidence of rotation; the left-hand propeller was in the fine pitch (take-off) setting and showed evidence of a power condition at impact with its supercharger still engaged. The elevator pitch trim was set to neutral and the rudder trim tab was deflected two to three degrees to the left. (Full deflection of the tab was 19° left and 17½° right). There was no rudder trim indicator fitted. Examination of the flying controls revealed no evidence of pre-crash failure or malfunction and tests on the pitot-static system revealed no obstruction or leaks. When tested and calibrated the

airspeed indicator was found to be within the specified tolerances of accuracy, it was under-reading by three knots between 60 and 70 knots and was accurate at 80 knots. No stall warning system was fitted.

The fuselage nose section was completely disrupted with failures having occurred in all the transparency support structure. The whole aircraft was structurally complete at impact and it showed no evidence of pre-impact overstressing.

Both left and right-hand engines were subjected to a detailed strip examination and no evidence of failure or malfunction was found.

The magnetos, together with their respective ignition harnesses and sparking plugs were bench tested and found satisfactory. Both engine's ignition switches were found in the 'Off' position and electrical testing of these components showed they were functioning normally; because of their design (latched push-button switches) they had probably sprung to the 'Off' position as a result of the severity of the impact.

The aircraft's fuel system and the fuel injector systems of both engines were examined in detail. Both main tanks electric booster pumps functioned normally and met the specification flow rates. All the fuel lines were unobstructed and there was no pre-impact fuel leakage. Because of the disruption of the nacelle structure it was not possible to establish the position or setting of the fuel cock selector valves at impact; however, their positions as found were: left engine - between 'Auxiliary' and 'Main'; right engine between 'Off' and 'Auxiliary'. The linkages to the fuel selector levers in the cockpit and the levers themselves were completely disrupted by the impact to an extent which rendered a pre-impact setting impossible to assess. The fuel line from the starboard fuel selector cock to the starboard engine fuel injector system was broken by disruption and it was not possible to tell if the lines were primed with fuel at impact. The fuel injector units of both engines were strip-examined; all fuel and servo oil passages were clear and no evidence of failure was found. In the case of the right engine injector, its fuel inlet banjo union was a non-standard part and, as assembled, had obstructed two of the inlet ports. The partially obstructed inlet union from the right engine injector was removed and replaced with the left engine injector union and the flow tests repeated; a flow rate of 139.2 litres per hour was recorded and this was the same flow rate as that previously recorded with the non-standard union fitted. Since the fuel flow to these engines at take-off power is quoted in the engine manual as 50 litres per hour the fitment of the non-standard union and its partial obstruction was therefore not a significant factor and would not have caused a power loss due to fuel starvation.

1.12.3 Fuel tanks and fuel

There were four fuel tanks located in the wings: two Main (outer tanks) and two Auxiliary (inner tanks) and all four tanks were filled prior to taking-off from Lydd, the uptake was recorded as 38 imperial gallons of AVGAS 100LL. The tanks were therefore approximately half full when the aircraft landed at Lydd from Elstree. Analysis of samples taken from the left Main and Auxiliary tanks and the right Auxiliary tank revealed no evidence of any fuel condition which could have led to a power failure. No sample was obtained from the right Main tank because it had ruptured on impact and the fuel had drained away. No evidence was found of water contamination of the fuel. This type of contamination can occur if an aircraft has stood for a long period with little fuel in its tanks. However in the case in question the pilot carried out a pre-flight check of the aircraft and its engines including an engine run-up before leaving Elstree without incident.

1.12.4 Propellers

The propeller feathering system fitted to this aircraft required a feathering selection by the pilot and the feathering switches are 'guarded' against inadvertent operation. Examination of the propeller control system revealed no evidence of any malfunction or defect that could have led to an uncommanded feathering input.

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 at impact. There was no evidence of pre-existing disease and tests for alcohol, drugs and carbon monoxide intoxication proved negative.

The pattern of injuries to the occupants of the two front seats were very similar and each had sustained injuries caused by impact with the control column. The injuries to both hands of the pilot-in-command in the left seat are consistent with his having had his hands on the control wheel at impact. However, the injuries to the left hand of the occupant of the front right-hand seat were more severe: they indicated that he was gripping the right-hand co-pilot's control wheel very firmly at the time of impact; the characteristics of the fracture of the right-hand control wheel supports this medical evidence.

1.14 Fire

There was no fire.

1.15 Survival aspects

1.15.1 Because of installation difficulties no upper torso restraint was fitted to the front seats but all four occupants were secured with lap type seat belts. The front seat belts were intact but one strap on each of the rear seat positions had failed at its attachment to the aircraft structure. The angle of impact with the ground was very steep and the accident was non-survivable because of the distortion and extreme crushing of the cabin.

1.15.2 *Response by the County Fire Brigade*

The aircraft crashed about a quarter of a mile outside the aerodrome boundary and, in accordance with Airport Emergency Instructions, the County Fire, Ambulance and Police services were activated by ATC. According to the Senior Air Traffic Controller (SATCO), who was in the control tower when the accident occurred, he informed Fire Brigade HQ that the aircraft had crashed in a position 'south of the Dungeness road'. He afterwards corrected this position to 'south of the railway' whilst the County appliances were in transit. The response by all units was instantaneous but for reasons which have not been established the Lydd town appliance was directed to proceed to the airport as a result of a message from Divisional HQ: 'aircraft accident at Lydd airport four persons'. Notwithstanding that the Lydd firemen are not on continuous standby but are alerted by radio-paging, they arrived with their appliance at the airport about eight minutes after the crash occurred but were redirected back towards Lydd town by an airport security guard at the aerodrome barrier.

The wreckage was difficult to locate because it had fallen into a crop of standing grain, however, having once located the position whilst proceeding along the Lydd-Dungeness road, the Lydd firemen had to abandon their vehicle and proceed on foot with portable equipment across fields and ditches and they reached the scene between 18 and 22 minutes after the crash occurred. An appliance from New Romney arrived about five minutes later and other units from Rye, Folkestone, Dymchurch and a foam tender from Canterbury concentrated within half a mile of the scene by Jacks Court Farm 26 minutes after being alerted. The convoy of rescue appliances were then guided through the crops and over a bridged dyke by a farm hand; the senior fire officer then took charge at the scene 32 minutes after the crash. A rescue helicopter at Manston was alerted in case it was necessary to remove casualties to hospital.

Having been alerted by witnesses and the crash alarm, members of the Cinque Ports Flying Club at the airport ran across the fields and through a dyke to the wreckage which they reached about 10 minutes after it crashed. They tried to render what assistance they could but found that all the occupants were beyond help. The Lydd town fire personnel and a police patrol car arrived about 10 minutes after the first helpers from the Flying Club.

1.16 Tests and research

Ground running tests on a similar type of aircraft showed that:

1. With the main tank selected (lever forward) closure of the fuel cock selector lever to the right engine at take-off power resulted in the engine stopping 4.8 seconds after the fuel lever was fully closed (lever fully rearwards).

2. It was necessary to move the fuel selector lever to the almost fully closed detent before loss of fuel pressure occurred and the engine cut; various positioning of the lever between 'main' and 'auxiliary' had no apparent effect because the 'auxiliary' port opened as the 'main' port closed.

3. With the fuel selector lever placed in the same position on the quadrant as found in the wreckage the engine continued to run at full take-off power.

1.17 Other information

1.17.1 Assessment of flightpath

The ATC controllers assessed the aircraft's height at 100 to 150 feet as it passed abeam the tower. An estimation of the angle of the duty controller's line of sight above the skyline indicated that the angle was not less than 15° and not more than 20° above the horizontal. Trigonometrical calculations show that the aircraft would have been between 167 and 186 feet above the runway if it were close to the near edge, or at a greater height if it was on the centre line. A height of 170 feet was therefore used as a basis for calculations of airspeeds and gradient achieved from the commencement of the take-off run.

1.17.2 Calculated performance and flightpath

The approximate point along the runway at which the aircraft was seen to become airborne was after a ground run of 1930 feet; this distance is consistent with full power being used during the take-off with 15° of flaps extended, the aircraft then being held in contact with, or close to the runway whilst accelerating to about 74 knots before the climb was started and the landing gear and flaps were retracted. Had the initial climb been made on two engines, at the clean configuration single engine safety speed of 71 knots, it would have passed abeam the control tower at about 100 feet; however, to have reached the height assessed by and calculated from eyewitness observations (150 to 170 feet) the required gradient could only have been achieved by allowing the indicated airspeed to fall to 61 knots during the process. If, during this steeper climb, there was a total loss of power on one engine the aircraft could not in practice accelerate to its best single engine performance speed of 71 knots without losing height. In theory, it could continue indefinitely at 61 knots with a zero gradient of climb but, in practice, it is likely that if the pilot did not make a conscious and positive effort to gain speed at the expense of height (thereby reducing the pitch attitude and induced drag) the airspeed would decay slowly and ultimately directional control would be lost.

It has been calculated, that under the conditions prevailing, if this type of aircraft had started its take-off run from close to the entry point of runway 22 at Lydd it would inevitably arrive at a point abeam the control tower at more or less the same

combination of height and airspeed as was indicated on the accident flight, with very little variation due to the pilot's action in-between; thus, if on becoming airborne the aircraft accelerated to an IAS of 65 knots with 15° flaps extended and climbed with landing gear and flaps retracting from this earlier point, in order to achieve a height of 170 feet by the control tower the airspeed would have to have been reduced. If a power failure occurred during this climb it would reduce the airspeed or the height or both as the aircraft passed the tower.

1.17.3 Engine failure emergency drill

The pilot of G-ASWS, had been taught, in the event of an engine failure, to change the fuel supply immediately to the affected engine before carrying out any other action such as feathering the propeller. This advice was given because a likely reason for the failure could be fuel starvation or 'forgetting to change tanks'.

The feathering drill immediate actions given in the approved Flight Manual are as follows:

Positively identify the engine which has failed, then:

1. Close the throttle
2. Depress the feathering Press Button
3. Switch off the ignition
4. Shut off the fuel cock.

1.17.4 Use of flap for take-off

Club colleagues of the deceased pilot, who were also experienced on this type of aircraft, agreed that he always used 15° flap setting for take-off and left the supercharger engaged until reaching 1,000 feet after take-off.

1.18 New investigation techniques

None.

2. Analysis

2.1 The Flight Path

The take-off run was apparently normal and the aircraft became airborne in a distance which was compatible with its predicted Flight Manual performance for a maximum weight take-off without flaps. Calculations show that if flaps were extended to 15° it would have been able to accelerate to 74 knots IAS in the same distance before commencing its initial climb. Total loss of power to the right propeller was evident when the aircraft was abeam the control tower, by which time it had climbed to between 150 and 170 feet above the runway. To have achieved this height in the horizontal distance covered from the start of its take-off run, using two engines and in a clean configuration after lift-off, it would have been necessary to allow the IAS to reduce from 74 knots to 61 knots, thereby converting kinetic energy into a height increase of some 50 to 70 feet above the height which would have been achieved (100 feet) if its climbing speed had been maintained at the optimum gradient single engine climbing speed of 71 knots.

As this height (150/170 feet) could only have been achieved with full power on two engines, it follows that the observed power loss must have occurred very shortly before the aircraft passed abeam the control tower. Since it was already drifting to the right against the effects of a cross wind it is possible that the pilot experienced directional control difficulties following the power loss at an early stage; this is supported by the performance calculations which suggest that the power loss occurred when the airspeed was reducing towards 61 knots during the climb and had fallen below a value which provides a margin of controllability (65 knots) and was significantly less than the best gradient of climb on one engine (71 knots at maximum take-off weight). The pronounced tail-down attitude, the noticeably low airspeed, the stationary propeller and the steep bank to the right as described by eyewitnesses are indicative of the progressive loss of directional control under conditions of asymmetric power. Non-application of the correct rudder trim to alleviate the foot load probably aggravated the condition.

It is concluded that the significant feature of this accident was a loss of directional control following a total power loss on one engine which occurred at an airspeed that was too low to maintain height and heading with the remaining engine at full power. Had positive measures been taken to maintain control as soon as the failure occurred, if necessary by increasing speed at the expense of the height available or, ultimately, by reducing power on the live engine, an irretrievable loss of control could have been averted and the worst case would probably have led to an emergency landing straight ahead on the remaining portion of the runway with the landing gear retracted.

Because of his experience and ability it is difficult to understand why this course of action was not followed by the pilot-in-command. It seems likely that other factors contributed to, what appears to have been, an unfortunate lapse in basic airmanship and pilotage on his part. It is therefore appropriate to consider the evidence adduced from the examination of the wreckage, the sequence of the feathering drill, the pilot's history and pathological aspects in an attempt to establish why the right-hand engine was shut down, who was flying the aircraft and what other factors might have contributed to the loss of control.

2.2 Wreckage

Detailed post-crash examination of the power plants, their fuel systems and the fuel failed to reveal any defect which could have caused or contributed to a power loss on the right engine. The residual fuel was free from contamination and the source from which it was last refuelled was also uncontaminated. There was no condensed water found in the

fuel tanks and it is unlikely to have been present in any significant quantity as the aircraft had flown from Elstree with no apparent malfunction. Since it was refuelled to full tanks capacity less than an hour before the accident, the possibility of water condensation is unlikely. Because the engines were equipped with fuel injection systems and the ambient temperature existing also precluded the formation of impact ice on the air intakes the possibility of carburettor icing can be excluded. The fuel injector and the ignition systems were free from fault and there were no pre-crash mechanical defects.

The fuel selector valve to the starboard engine was found in a position between 'off' and 'auxiliary' but its precise impact setting could not be established because the selector levers in the cockpit were disrupted by the impact. The valves and their mounting on the engine bulkhead were also disrupted and corroborative evidence of fuel in the injector lines downstream of the valve was unobtainable because the fuel line from the valve was broken. However, because of the relative positions of the fuel cocks as found, the balance of evidence favours the probability that the starboard cock was 'off' at impact. Whether the cock was placed in this position before or during the feathering drill remains unestablished.

Since no reason for the apparent failure was discovered it is only possible to speculate as to why power was lost on the engine and its propeller feathered before the aircraft crashed. The engine can be stopped quite rapidly by closing the appropriate fuel cock and this might have been done deliberately by either of the occupants of the front seats. During training sessions it is possible for this to be done in an unobtrusive manner by the instructor in the right-hand seat without being noticed by the handling pilot in the left seat. Accidental closure would be most unlikely as the lever would have to be moved to the rear over the whole range of its travel from 'main' tanks (fully forwards) back through the 'auxiliary' tank position midway on the quadrant to the fully aft position. If the lever were only moved part of the way the engine would still run because the auxiliary cock ports in the fuel valve open as the main cock ports close. Another method of stopping the engine would be to switch off the ignition but since these switches are 'latched' an accidental movement of the switch is unlikely and, because of its location, an attempt to do so by either person would most probably be noticed by the other.

Had the fuel tank selector lever to the right engine been closed, for whatever reason, the handling pilot would probably not be aware of its closure until after feathering the propeller if he was correctly following the feathering drill detailed in the Flight Manual. There is no evidence that there was any attempt to unfeather the propeller.

To summarise, no reason was found for the loss of power to the starboard engine; it could have been stopped by a deliberate closure of the fuel cock but was unlikely to have been stopped through accidental closure. In the absence of any defect in the engine or its fuel system which could account for a loss of power, the most likely reason was a deliberate movement of the fuel cock lever to the 'off' position, however, this is pure conjecture and is not supported by any positive evidence because the propeller was subsequently feathered and the fuel cock lever would have been moved to the 'off' position if the correct feathering drill was completed.

2.3 Human aspects

The pilot-in-command was experienced and well qualified as a private pilot. During and following his type familiarisation and twin engine conversion he acquired and maintained a satisfactory level of competency and continuity of experience in excess of that required by regulation; he was conscientious in his procedures and meticulous in his emergency drills. According to his club colleagues he encouraged the occupant of the right-hand seat to qualify for a pilot's licence and they had flown together frequently in G-ASWS and in another twin engined type. Although his younger colleague had not, as yet, received any formal instruction on twin engine aircraft it is understood that he had handled G-ASWS previously from the right-hand seat under the supervision of the pilot who was in command on the accident flight. Whether or not this arrangement existed

during the take-off from Lydd is not known but the person who made the 'engine failure' call on the RTF was identified as the occupant of the right-hand seat. The radio call did not appear to convey a sense of urgency or apprehension and this could indicate that the person making the call was not in control of the aircraft or that he may not have been surprised by the event. Experience suggests that a pilot handling an aircraft in a critical situation such as this would be unlikely to make a radio call at that time because he would be much too busy trying to maintain control and complete the emergency drill immediate actions.

It is not possible to conclude from the pathological evidence which of the two pilots was nominally handling the aircraft during the take-off though both of them had their hands on the control column at impact. This could well have been a reflex action from either of them. However, because of the critical conditions of height and speed at the time of the power loss it would have been difficult for any pilot, regardless of skill and experience, to have retrieved the situation that developed without positive and decisive corrective action which would have been evident to an onlooker.

As there were no survivors there is no evidence as to what actually happened, but in view of his experience and reported sense of good airmanship it is difficult to envisage that the pilot-in-command would have attempted to simulate an engine failure on his less experienced and unqualified colleague during a take-off at maximum weight and wilfully expose the occupants of the aircraft to a significant hazard at so low a height and airspeed. Whilst it has not been possible to determine why the right engine was shut down there is, nonetheless, reason to believe that the accident was caused by a loss of control, possibly as a result of a practice emergency which went sadly wrong.

2.4 Airport fire and rescue services

Lydd airport is licensed for the operation of public transport aircraft up to Viscount size. It is necessary, therefore, when assessing the performance of the fire and rescue services to bear in mind that fairly large aircraft could be involved in an accident at Lydd. During the course of the investigation shortcomings were revealed in the organisation and deployment of the airport fire and rescue services. In the event these shortcomings were not instrumental in causing the loss of lives; however, if a large passenger carrying aircraft had been involved in the accident, the delay experienced in attendance at the site of the emergency services could have been significant.

Although exercises had been carried out on the aerodrome together with the County Fire Brigade the problem of rapid response to accident sites outside the aerodrome boundary had not been pursued, due mainly to the difficult terrain, ranging from large shingle banks to saltings and agricultural land interspersed with deep drainage ditches. Since public transport aircraft up to Viscount size were operating through Lydd before the period embracing the accident, the corrective measures taken subsequently should have been implemented earlier.

Lydd airport has hitherto relied on the timely attendance of units of the County Fire Brigade, particularly in the case of accidents which might occur within the approach and departure sectors of the main runway 22/04. Notwithstanding their excellent response in a supporting role during emergencies which have occurred on the airport, these units are too widely dispersed to enable them to attend an air accident occurring outside the airport boundaries, in the primary rescue role, with the rapidity and scale of effort necessary to ensure the rescue of survivors in the short time usually available. Should an accident occur within the approach and departure sectors at Lydd, survival would depend on rapid intervention by the airport fire and rescue services operating outside of their aerodrome boundaries. However, the CAA cannot compel them to do so and there are long standing problems which might deter or prevent their legal deployment but it is nonetheless felt that these problems could, at least in part, be overcome by the help and cooperation of the County Fire Brigade and the provisions already enshrined in the Fire Services Act 1947.

Although the emergency orders gave him the discretion to act as he saw fit the decision of the ATCO on duty at Lydd not to allow the airport emergency services even to attempt to reach the scene of the accident was wrong. There was nothing to be lost in allowing the firemen to make every effort to reach the crash site. Had there been any survivors from the crash the timely arrival of personnel from the emergency services at the airport might have proved decisive in saving life.

During the five week period subsequent to the accident to G-ASWS there were two non-fatal accidents to public transport aircraft within the aerodrome boundaries at Lydd; on both occasions the airport and county emergency services responded promptly and dealt effectively with both emergencies. However, with regard to the accident under consideration, which occurred 400 metres from the end of runway 22 but beyond the aerodrome boundary, the chain of events which followed the decision not to allow the airport emergency services to attend the scene resulted in a time delay which could have proved disasterous had the accident been potentially survivable or had a public transport aircraft been involved. In the event of the latter, however, it can only be speculated that the controller's reaction might well have been different. The resulting delay was due to:

(a) a lack of topographical knowledge which resulted in an existing route to the scene of the crash not being used by the airport emergency services and, consequently the County fire appliances, and,

(b) the imprecise directions received by the Lydd town firemen.

A time delay of 25 minutes before any rescue vehicle reached the accident site represents a considerable shortfall in the standards to be expected in the event of an accident in such close proximity to an airport associated with a significant number of public transport aircraft movements.

3. Conclusions

(a) *Findings*

1. The pilot-in-command was properly licensed, experienced on type and physically fit.

2. The aircraft had a valid certificate of airworthiness and had been properly maintained.

3. No pre-crash defects were found in the aircraft or its flying controls.

4. No pre-crash mechanical defects were found in the right-hand engine; there was sufficient fuel in the tanks and the fuel was uncontaminated.

5. There was a total power loss on the right engine which occurred during the initial climb and at an airspeed which would have made the aircraft difficult to control.

6. The reason for the loss of power could not be determined but it is possible that there was a deliberate closure of the right-hand fuel cock.

7. It is not known which of the two occupants of the front seats was controlling the aircraft before or after the power loss.

8. The aircraft was marginally overweight at take-off but its C.G. was within permitted limits. The excess weight was not a factor in the accident.

(b) *Cause*

The accident was caused by loss of directional control during asymmetric powered flight.

4. Safety Recommendations

It is recommended that:

1. Aerodrome operators in general should be encouraged to seek an arrangement with County or Municipal Fire Brigades to enable them to operate in an emergency outside their aerodrome boundaries.

2. Further efforts be made by aerodrome authorities, with the encouragement of the CAA, to resolve the problems relating to personnel and vehicle licensing, and insurance requirements for emergency service vehicles during off-airport emergency activity.

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