AIRCRAFT ACCIDENT REPORT 6/81

DEPARTMENT OF TRADE

Report on the accident to Edgar Percival Prospector G-AOZO near Ashford Aerodrome, Kent, on 2 July 1980

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28 July 1981

The Rt Honourable John Biffen MP
Secretary of State for Trade

Sir

I have the honour to submit the report by Mr C C Allen, an Inspector of Accidents, on the circumstances of the accident to an Edgar Percival Prospector G–AOZO which occurred one mile west of Ashford Aerodrome, Kent, on 2 July 1980.

I have the honour to be
Sir
Your obedient Servant

W H Tench
Chief Inspector of Accidents

Accidents Investigation Branch

Aircraft Accident Report No 6/81
(EW/C 705)

Operator:		Eagle Parachute Centre Ltd, Ashford Aerodrome, Kent
Aircraft:	*Type:*	Edgar Percival Prospector
	Model:	EP9
	Nationality:	British
	Registration:	G–AOZO
Place of Accident:		One mile west of Ashford Aerodrome, Kent Latitude 51° 05′ North Longitude 001° 01′ East
Date and Time:		2 July 1980 at 1818 hrs All times in this report are GMT

Synopsis

The accident was notified to the Department of Trade by Lydd ATC at 1855 hrs on 2 July 1980 and an investigation was commenced the following day.

The aircraft was engaged in a parachuting training exercise and took off from Ashford aerodrome with six persons on board. It failed to achieve normal circuit height and proceeded downwind at about 500 feet. During the downwind leg the engine cut six or seven times causing the aircraft to lose height. The aircraft then appeared to commence a turn towards the aerodrome, dived towards the ground and, on impact, burst into flames. All six occupants were killed and the aircraft was destroyed.

The accident was caused by the aircraft stalling at a height from which recovery was impossible. Water-contaminated fuel and the absence of the mandatory stall warning system were probable contributory factors.

1. Factual Information

1.1 History of the flight

The aircraft was normally used for parachuting training; it had remained on the ground at Ashford aerodrome for approximately four weeks immediately prior to the accident whilst rectification work was carried out consequent upon a series of engine defects. On the day of the accident the engine was declared to be serviceable after a ground run. The engineer, who had completed the servicing, carried out a final external inspection but there is no evidence to suggest that either he or the pilot had carried out a water drain check, although the engineer had apparently checked the locking wire on the fuel drain cocks.

The meteorological conditions were suitable for parachuting so the pilot, the engineer, a parachuting instructor and three students boarded the aircraft which was taxied out to the threshold of runway 34. The aircraft took off shortly before 1815 hrs.

After a normal take-off, the aircraft climbed away on the first leg of the circuit used for parachuting training. This circuit is designed so as to achieve about 1500 feet when down wind abeam of the runway, and 2500 feet at the start of the run-in, parallel with the direction of the runway in use. During this initial climb, which was observed to be less steep than that normally achieved by the EP9, the aircraft appeared to be rocking its wings and the engine sounded rather 'flat' but did not misfire.

At a height of about 500 feet the aircraft was seen to turn downwind and the engine was heard to cut and restart; it did this six or seven times during which time the aircraft lost height. Apart from the misfiring and subsequent loss of altitude, the aircraft was reported as flying normally.

When it was approximately abeam the downwind end of the runway, the EP9 banked sharply to the left, the nose dropped and the aircraft dived to the ground. It immediately burst into flames and all the occupants were killed.

Two witnesses hurried to the scene but seeing and hearing no sign of survivors, and being unable to approach the wreckage because of the severity of the fire, they called the emergency services, which arrived seven minutes later. The Fire Brigade succeeded in extinguishing the fire after approximately twenty minutes.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	1	5	–
Non-fatal	–	–	–
Minor/none	–	–	

1.3 Damage to aircraft

The aircraft was destroyed by the combined effects of ground impact and post-impact fire.

1.4 Other damage

A small area of barley crop and fallow land suffered from the impact of the aircraft and the passage of rescue and recovery vehicles.

1.5 Personnel information

Commander:	Male; aged 46
Licence:	Private Pilot's Licence (PPL); expired 2 June 1979
Ratings:	Group A; issued 3 June 1974
Most recent certificate of test:	11 June 1974
Most recent certificate of experience:	5 August 1979; validity 12 months
Last medical examination:	1 March 1976; validity 12 months
Total flying hours:	Approximately 2000. Final log-book entry 24 September 1979
Total hours on type:	Approximately 500.

Whilst serving in the army, the pilot founded a weekend parachuting club called 'Eagle Parachute Centre Limited'. When he left the army in late 1973, he organised this club as a full time occupation. He also took flying lessons, gaining a Private Pilot's Licence on 3 June 1974, which had a validity of 5 years. Since that time, the requirements have changed so that new or renewed licences are permanent, conditional upon the holder being in possession of a valid medical certificate.

1.6 Aircraft information

1.6.1 General

Type:	Edgar Percival EP9 Prospector
Date of manufacture:	1957
Certificate of Airworthiness (C of A):	Private Category, re-validated until 19 July 1982. A condition of the C of A was that the aircraft should be maintained in accordance with an approved schedule.
Airframe:	A high wing, high tailboom, single engined monopolane, with a tail wheel undercarriage. The aircraft had been modified in 1979, after it had been bought by the pilot, for use in the parachuting role.
Airframe hours:	Approximately 1200 at the time of the accident.

Engine:	Lycoming GO–480–G1A6, manufactured in 1959 and installed in G–AOZO in 1973, with nil engine hours since manufacture.
Engine hours:	Approximately 500 at the time of the accident.

In order to comply with the requirements of the airworthiness authority* at the time of manufacture, the aircraft was equipped with a stall warning system. A mandatory modification was carried out in 1970, which substituted a stick-shaker for the warning horn which had been previously fitted as part of the system. Witness evidence, substantiated by the presence of two blanked-off wires, indicates that the stick-shaker had been removed at some indeterminate time prior to the accident.

Since the last 100 hour check, in mid February 1980, the aircraft log-books record only 11 hours of flying, the last recorded flight having taken place on 9 March 1980. Although the aircraft is known to have flown since that date, the number of hours involved is believed to be small.

The aircraft's documentation had not been kept up to date since March 1980, but other records show that the routine maintenance had been carried out in accordance with an approved schedule. Some unscheduled maintenance work is also shown as having been carried out, much of which is not recorded in the log-books. One item which is recorded, is the replacement of a distorted inlet valve in No 4 cylinder. This work had been completed immediately prior to the accident flight.

The recent history of minor maintenance work which had not been recorded, concerns hot starting difficulties in April 1980, a starter motor change in early June, a magneto change on 10 June followed on 24 June by a very rough running engine. Between 26 June and the date of the accident a number of engineers individually carried out corrective maintenance work and culminating in the replacement of the No 4 cylinder valve. The latter is the only work recorded in the log-book covering this period.

1.6.2 *Weight and balance*

Maximum weight authorised:	3700 lb
Estimated take-off weight:	3700 lb
Centre of gravity range:	1.84 ins forward of datum to 8.96 ins aft of datum
Estimated centre of gravity:	2.17 ins aft of datum.

The calculation of centre of gravity was made using the assumption that the port fuel tank was full and the starboard three-quarters full, the fuel state noted when the aircraft last flew.

* The Air Registration Board (ARB), now incorporated in the Civil Aviation Authority (CAA)

1.6.3 *Fuel*

The standard fuel for the aircraft type, designated 100 LL, was in use at the time of the accident. The aircraft was normally refuelled at other airfields but, sometimes, by means of jerrycans filled from other aircraft at Ashford aerodrome. When not in use, these cans were left standing empty. It proved impossible to establish which method of refuelling had been used prior to the accident flight, but it was established that the aircraft had remained unused and had not been refuelled for about four weeks; it is believed that the starboard tank was partially empty. The weather during this period had been exceptionally wet and the hangar is reported to suffer from dampness.

1.6.4 *Configuration*

In accordance with the requirements which apply when the aircraft is used in the parachuting role, the port side main door had been removed, the rear cargo door had been sealed and the control cables 'boxed in'.

1.7 Meteorological information

The weather at the time of the accident was reported as being good and ideal for parachuting. The aftercast provided by the Meteorological Office is as follows:

Surface wind:	300 degrees 5 knots
Visibility:	10 kilometres
Cloud:	2 octas at 2400 feet, 6 octas at 8000 feet
Temperature:	Plus 16°C
Dew Point:	Plus 12°C

At 1000 feet above ground level the wind was 330 degrees at 10 knots, the temperature plus 12°C and the dewpoint plus 9°C.

The accident occurred in full daylight.

1.8 Aids to navigation

The flight was conducted in visual meteorological conditions and therefore navigational aids are not relevant.

1.9 Communications

There is no evidence that the aircraft made any radio-telephony (RTF) communication. On parachuting flights it is customary to call Lydd Airport shortly after take-off, using the RTF frequency of 120.7 MHz.

1.10 Aerodrome information

This aerodrome is notified in the 'Air Pilot' as an authorised parachute dropping zone. No refuelling facilities are available.

1.11 Flight recorders

Not required and not fitted.

1.12 Wreckage and impact information

1.12.1 Initial investigation

The aircraft crashed on flat terrain, about one mile west of Ashford aerodrome, in a field of cereal crop. The wreckage was contained in a small area and showed little or no evidence of forward ground movement. The aircraft had partially broken up on impact, then burst into flames and there was no indication of pre-impact fire. The general disposition of the wreckage indicated that the impact had taken place with the aircraft in a nose-down, left wing low attitude. Both wings and the tailplane remained attached to the fuselage by the flying control cables. Although the fuselage space frame remained largely intact, its skin had been consumed by the ground fire. The fuel contents of the port wing tank had burned, but the starboard tank was still over half full.

The engine was substantially intact, with only No 2 cylinder severely damaged, but the accessory gearbox and its associated components at the rear of the engine had suffered fire damage. The reduction gear casing was cracked and the propeller governor had become detached. The damage to the propeller blades indicated high engine power on impact; this was substantiated by the tachometer which showed a reading consistent with maximum RPM.

The flying controls showed no evidence of pre-crash malfunction or failure. It was impossible to establish whether the pilot's safety harness had been fastened at the time of impact.

1.12.2 Subsequent examination

A strip examination of the engine revealed that there had been a number of pre-existing defects, as follows:

(a) Loose ring gear, attached to the forward end of the crankshaft,

(b) Worn pistons and rings,

(c) Evidence of 'coil binding' on the valve springs indicating a past overspeed condition,

(d) Local seizing of Nos 2 and 3 main bearings and an excessively tight No 3 camshaft bearing,

(e) Evidence of fretting on Nos 2 and 3 crankshaft bearing support webs.

Prior to a rig function check of the carburettor, during which it functioned to within normal tolerances, the contents of the associated chambers were examined. Most of the carburettor was empty but the fuel found in the accelerator pump chamber, and also in the fuel pressure gauge line, contained a small quantity of water. The fuel in the pressure line is static; that in the accelerator pump chamber is contained by a poppet valve on the inlet side and by the discharge needle valve on the outlet. It is therefore most unlikely that water could have entered these areas subsequent to the accident.

1.13 Medical and pathological information

The post-mortem examination of the passengers who had been in the aircraft showed them to have been in normal health at the time of the accident. Although examination of the pilot revealed pre-existing disease, including moderately severe artherosclerosis (Grade 2) of the left main artery, there was no evidence of recent pathology. The toxicological examination showed the pilot to have a 13.8% carboxy-haemoglobin saturation which could not have been acquired during the fire, as the autopsy showed that he was killed on impact as a result of multiple injuries. Expert medical opinion is that about 5% of the above saturation level could have been due to the fact that he was a cigarette smoker and that a level of 13.8% would have been insufficient to have affected his performance during the period of that short flight.

1.14 Fire

A severe fire occurred on impact. The Fire Brigade received the call at 1824 hrs and the first appliance, a water tender from Aldington, was in attendance at 1831 hrs. In all, six tenders and three wireless cars were mobilised. Two 'Hose Reel Jets' and one 'Foam Branch' were used to extinguish the fire. The vehicles came from Aldington, Hythe, Folkestone, Canterbury, Maidstone, New Romsey and Ashford. The fire was under control at 1854 hrs and the last appliance returned to its station at 2105 hrs.

1.15 Survival aspects

It is remotely possible that one of the parachutists could have survived this accident, had he been able to escape immediately from the crushed cabin, although he would have been dazed by the severe blow which he had received on the left side of his chest. The remaining five occupants were killed instantly from multiple, lethal injuries which, together with the crushing of the cabin, makes this accident largely non-survivable.

1.16 Test and research

The intact starboard fuel tank was bench mounted in an attitude similar to that of a parked EP9, approximately 11° tail down. In this position, the contents of the trailing edge of the tank were unavailable to the engine fuel feed outlet and to the drain tap. Approximately 2 pints of water were poured into the tank before it started to flow into the sump which contains the outlets. This water was retained in the trailing edge area of the tank and would be neither apparent when carrying out a water drain check, nor available to the engine when the aircraft was parked or taxying in a tail down attitude. The exact quantity of water retainable varied with the angle of the wing.

The attention of CAA has been drawn to this matter.

1.17 Additional information

1.17.1 During the design of the EP9 in November 1955, the ARB had informed Edgar Percival Aircraft that 'A sump to contain any separated water should be provided in the base of the tank, at the lowest point, and fitted with an easily operated drain cock'. Subsequently, a sump was fitted in a position such that it was at the lowest point of the tank when the aircraft was in an attitude approximating that of level flight.

1.17.2 *The Eagle Parachute Centre membership*

The Centre has a business arrangement with the 'Deutches Reiseburo', a tour company in Germany, under which the latter send 'activity – holiday' participants to the club. When these parachutists use the club facilities, instructors and aircraft, they are given temporary membership of the club.

1.17.3 *Exemptions from the Air Navigation Order (ANO)*

Under Article 88 of the ANO, the CAA may issue an exemption (Appendix 1) from all requirements of the Order and Regulations which apply to the public transport of passengers and specifically from Article 39(2) (Appendix 2) of that Order, to bona fide parachuting clubs which are usually, but not necessarily, members of the British Parachuting Association. This exemption allows these clubs to train and to carry out the sport of parachuting from a civil aircraft and also allows a PPL holder to fly a Private Category aircraft for the purposes of parachuting. Paragraph 2(a) of the exemption states that no passenger shall be carried on a flight made pursuant to the exemption except members of the club intending to make a parachute descent or carried as jumpmaster or instructor.

1.17.4 *The presence of carbon monoxide*

The pilot had previously noticed the presence of exhaust fumes whilst flying G–AOZO with the door removed. For this reason he had installed a plastic carbon monoxide strip detector in the cockpit. This detector was destroyed by fire at impact.

1.17.5 *Fuel handling*

Instructions in the pilot's handbook, for the management of the fuel system of this aircraft, state that the starboard fuel tank must be used first, when that tank is full.

When one of the fuel tanks is suspected of running dry or of ceasing to supply fuel, the correct action is to select the other tank and use the 'wobble pump' to reinstate the flow from the new tank. In order to do this the pilot's safety harness must be undone. The whole process takes several seconds, during which time the engine often cuts and restarts.

1.17.6 *Previous cases of pilot's licence irregularities*

Five aircraft accident reports published in the UK in the four years prior to the subject accident list 7 irregularities concerning Private Pilot's Licences (Appendix 3).

2. Analysis

2.1 General

The cause of the accident appears to be directly related to the reason why the aircraft banked sharply to the left and dived into the ground when it was abeam the downwind end of the runway. The medical and pathological evidence indicates that, although the pilot was suffering from pre-existing disease and from a degree of carbon monoxide poisoning, he died solely as a result of the impact. Examination of the flying controls revealed no evidence of their failure or malfunction; consequently there remains the possibility that the aircraft stalled and the pilot lost control of it. During the period before the sharp bank to the left, the engine was heard to cut and restart six or seven times and the aircraft lost height. During this time it is likely that there was a loss of airspeed and, if the pilot did not lower the nose sufficiently to maintain adequate airspeed, a stall, quite possibly accompanied by a wing drop to the left, would be the inevitable outcome.

2.2 The intermittent loss of power

Evidence displayed by the post-crash strip-down of the engine suggests that local seizure of the main bearings had occurred and that this almost certainly accounted both for the difficulty in starting that had been experienced and also the subsequent starter motor failure. This defect and the other mechanical and ignition problems, which eventually led to the discovery of the distorted inlet valve, are not considered to be contributory to the cause of the accident, except in so far as they caused the aircraft to spend considerable time on the ground prior to the accident flight and that they may also have influenced the initial climb performance.

Examination of the fuel system showed water to be present but, whereas some could be attributed to post-crash fire fighting activities and rain, that which was found in the accelerator pump chamber and fuel pressure gauge line could not. It was not possible to determine whether a water drain check had been carried out but, even if it had, it is unlikely that the water would have been drained off, because of the tail-down attitude of the parked aircraft. It is noteworthy that the EP9 had been designed and certificated with sumps and water drain cocks which are only at the lowest point in their respective tanks when the aircraft is approximately in level flight. However, the drain cocks can be operated only when the aircraft is stationary on the ground, and in this condition fuel or water from the lowest point in the tank cannot be drawn off via the appropriate cock.

Why the intermittent loss of power occurred, at the time which it did, must be the subject of conjecture, but there are two possibilities which seem, on the balance of evidence available, to be the most likely:

(i) When this aircraft is resting on its undercarriage, it maintains a tail-down angle of about 11 degrees. This angle would have been sufficient to allow any water present in the fuel tank to have gravitated to a point behind and below the engine fuel feed outlet and the water drain cock. As the aircraft took off and increased speed, the angle would have decreased, thereby allowing any water to pass to the engine. Because the take-off weight of G–AOZO was at or near the maximum permissible value, this change of attitude would have occurred more gradually than on a less heavily loaded flight.

(ii) The engineer, who had conducted the ground run, had no reason to be familiar with the pilot's handbook, which states that the starboard fuel tank must be used first, when that tank is full. For the purposes of the engine run, it is quite probable that he selected the first 'fuel on' position at the fuel cock, which would supply fuel from the port tank. Because the engine had just been running, it is also possible that the pilot abbreviated his pre-flight checks and that the cock remained in this position until he did the 'after take-off' checks when, in attempting to conform with the instruction in the pilot's handbook, he may well have selected the starboard tank. As it was the starboard tank which, having been partially empty, was most susceptible to water contamination, it would have been at this point that the engine started to run intermittently.

Either of these processes would account for both the timing and the character of the intermittent power loss. In the absence of any other relevant evidence, it must therefore be concluded that water contamination of the fuel was the most likely cause of the engine cuts which occurred.

2.3 The flight

It is possible that the apparently unstable initial climb after take-off could have been the result of flying at a speed very close to the stall. This lack of speed may have been occasioned by reduced power, caused by the generally poor condition of the engine, and compounded by the maximum permissible weight at which the aircraft took off.

Alternatively, it is possible that, when the engine began to cut, the pilot released his upper torso restraint in order to reach the floor-mounted fuel cock and the 'wobble pump', thereby causing less precise flight control and allowing the aircraft to become somewhat erratic in the rolling plane. During the subsequent examination however, it was not possible to establish whether the upper torso restraint harness had been released.

The reason why, when confronted with symptoms of partial engine failure, the pilot decided to continue with his normal circuit pattern, rather than make an immediate forced landing on the airfield, remains unestablished but, during his ownership of G–AOZO, he probably would have experienced the cutting and restarting of the engine when changing fuel tanks. It is therefore a reasonable conjecture that on again experiencing these symptoms, he continued his flight, rather than immediately turning towards the field for a crosswind emergency landing, because he believed that a little more pumping would cure the fuel starvation. In the event however, the engine continued to run intermittently, and the aircraft gradually lost height.

From the witness evidence of the aircraft's final manoeuvres, and the absence of any indication of structural failure or malfunction of the flying controls, it is reasonable to assume that the dive into the ground occurred as a result of a stall. This stall occurred either in approximately level flight and was characterised by a left wing drop, or whilst the aircraft was in a left turn towards the aerodrome.

It is significant that the aircraft was required to be fitted with a stall warning device, suggesting that there was inadequate natural pre-stall warning. If this device had not been removed from the aircraft, at a time which could not be determined and in contravention of the terms of the aircraft's C of A, it is quite probable that the pilot would have received sufficient warning to avoid the onset of the stall.

2.4 The pilot

The pilot had considerable experience of private flying and, in particular, as a pilot of the EP9. It is therefore improbable that the irregularities, discussed below, would have been contributory to the accident. Nevertheless, his pilot's licence was approximately one year out of date, and although his certificate of experience was current, the fact that his medical certificate had not been renewed for over three years had rendered his licence invalid since March 1977. That this apparent breach of the regulations had continued undetected for a considerable period raises the question as to whether sufficient regulatory control over private pilots' licences is exercised by the appropriate Authority. The number of similar licence irregularities revealed in recent accident investigations suggests that there may be many other cases which remain undetected and that the relevant regulations are being disregarded to a significant degree. To remedy this situation, it is recommended that the CAA consider the introduction of random checks upon non-professional pilots' licences.

Although the pilot lacked a current medical certificate, there is no evidence that any medical factor contributed to the accident. It is considered that the 13.8% carboxyhaemoglobin saturation, found in the pilot, was partly the result of the airflow around the aircraft allowing some exhaust gases containing carbon monoxide to enter the cockpit, and partly due to the fact that he was a cigarette smoker. This level of saturation, however, was not sufficient to have caused problems to the pilot in the short duration of the flight.

There is insufficient evidence to state definitely why the pilot allowed the airspeed to fall to the point of stall, but this could well have been due to the loss of power occasioned by the series of engine cuts, and possibly also because his attention to the airspeed was diverted by his attempts to cure the engine problem. Although power was regained at the last moment, there was insufficient height remaining for recovery from the stall to take effect.

2.5 Other matters arising from the investigation

2.5.1 Air tests

Remarkably, although a valve had been replaced on the engine of the EP9 just before the accident flight, there is no requirement for a subsequent air test to be carried out prior to the carriage of passengers. It might, however, have been considered a prudent precaution, especially in view of the time lapse since the aircraft had last flown, and would also have provided the engineer with a legal right to be on the first flight. In the event, the engineer's presence in the aircraft, flown on this occasion for the purpose of a parachute drop, would appear to invalidate the exemption from the ANO, granted to parachuting clubs, whereby they may carry out parachuting from civil aircraft. It is notable that had an air test been carried out without any passengers on board, it is possible that the reduced weight of the aircraft would have allowed a safe landing to be accomplished.

2.5.2 Fuel handling

It has not been possible to establish whether G–AOZO was actually refuelled from jerrycans, but as the weather during the weeks preceding the accident had been very wet, it is quite possible that condensation had formed either in these cans or in the starboard tank, which is believed to have been partially empty during this period of non-usage.

The use of jerrycans for refuelling one aircraft from another cannot, in general, be conducive to flight safety and it is recommended that pilots read the information contained in the CAA General Aviation Safety Information Leaflets Nos 12/80 and 1/81, concerning the dangers of fuel contamination.

3. Conclusions

(a) *Findings*

(i) The aircraft's documentation had not been kept up to date. However, other documentation indicated that the aircraft had been maintained in accordance with an approved maintenance schedule. Nevertheless, the condition of the engine included a number of defects.

(ii) The stall warning stick-shaker had been removed from the aircraft prior to the accident flight in contravention of the terms of the C of A.

(iii) The pilot was sufficiently experienced for the flight, but was not in possession of a valid pilot's licence or a valid medical certificate.

(iv) Although the pilot had not undergone a medical examination within the prescribed period, there was no evidence to suggest that any medical factor contributed to the accident.

(v) The presence of the engineer on the flight appears to have invalidated the exemption issued by the CAA under Article 88 of the ANO, which allows parachuting clubs to operate.

(vi) The intermittent loss of engine power was most probably caused by contamination of the fuel by water.

(vii) The position of the water drain cocks is such as to allow some residual water to be retained in the tanks, despite their use prior to flight.

(viii) The aircraft stalled either in straight flight or in the course of a turn made towards the airfield.

(b) *Cause*

The accident was caused by the aircraft stalling at a height from which recovery was impossible. Water contamination of the fuel and the absence of the mandatory stall warning system were probable contributory factors.

4. Safety Recommendations

It is recommended that:

4.1 The CAA consider the introduction within the United Kingdom of random checks upon non-professional pilots' licences.

4.2 Where major rectification has been carried out upon the powerplant of a single engined aircraft, consideration should be given to introducing a requirement that an air test be performed before passengers are carried.

4.3 The attention of owners and operators be drawn to the General Aviation Safety Information Leaflets Nos 12/80 and 1/81 which emphasise the danger of fuel contamination.

C C Allen
Inspector of Accidents

Accidents Investigation Branch
Department of Trade

July 1981