AIRCRAFT ACCIDENT REPORT 5/75

Department of Trade

ACCIDENTS INVESTIGATION BRANCH

Rollason Druine D31 'Turbulent' G-APLZ Report on the accident at Grange Farm, Latchingdon, Maldon, Essex on 23 April 1974

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Department of Trade
Accidents Investigation Branch
Shell Mex House
Strand
London WC2R ODP

9 April 1975

The Rt Honourable Peter Shore MP
Secretary of State for Trade

Sir,

I have the honour to submit the report by Mr P J Bardon, an Inspector of Accidents, on the circumstances of the accident to Rollason Druine D31 'Turbulent' G-APLZ which occurred at Grange Farm, Latchingdon, Maldon, Essex on 23 April 1974.

I have the honour to be
Sir
Your obedient Servant

W H Tench
Chief Inspector of Accidents

Accidents Investigation Branch
Aircraft Accident Report No. 5/75
(EW/C484)

Aircraft:	Rollason Druine D31 'Turbulent' G-APLZ
Engine:	One Ardem 4C 02 Mk 1B
Registered Owners:	Mr R Chatfield Mr T Fox Mr R D Tapp Mr D E Marshall
Pilot:	One – Seriously injured
Passengers:	None
Place of Accident:	Grange Farm, Latchingdon, Maldon, Essex Position – 51° 39'N 0°44'E
Date and Time:	23 April 1974 at 1113 hrs All times in this report are GMT

Summary

Shortly after take-off from Southend en route to Felthorpe, near Norwich, the pilot noticed that the engine was running roughly. Whilst attempting to carry out a precautionary landing the aircraft crashed, and was destroyed. The pilot was seriously injured. There was no fire.

The report concludes that the aircraft was allowed to stall whilst being manoeuvred for a precautionary landing as a result of an engine malfunction. The cause of the malfunction was unskilled maintenance.

1. Investigation

1.1 History of the flight

The pilot intended to fly from Felthorpe to Southend and return the same day. Before departure from Felthorpe he carried out a normal pre-flight inspection and checked that he had sufficient fuel for the round trip. The flight to Southend was uneventful and the aircraft remained there for two hours.

Before take-off for the return leg, an engine run up check was carried out satisfactorily. The aircraft took off normally at 1100 hrs, and climbed out on track. Shortly after take-off, when the aircraft was near the River Crouch, about 4 miles north of Southend Airport, the engine began to run roughly and the pilot found that he was unable to continue climbing. He decided that as he might not be able to return safely to Southend, he would carry out a precautionary landing nearby. The pilot selected a large field north of the river and flew round it. He is unable to recollect any further details of the flight subsequent to this.

However an observer on the ground saw the aircraft approach the field from the south-east and circle the field twice in a clockwise direction at a low altitude. At the end of the second circuit, when the aircraft was over the southern end of the field, it was seen to reverse the direction of its circuit and turn to the left through 180°. During the course of this third circuit, when the aircraft was travelling approximately south-west, it was seen to pitch up and then dive into the ground about 90 feet short of the western boundary of the field. The pilot was seriously injured and the aircraft destroyed. There was no fire.

1.2 Injuries to persons

Injuries	*Crew*	*Passengers*	*Others*
Fatal	–	–	–
Non-fatal	1	–	–
None	–	–	

1.3 Damage to aircraft

The aircraft was destroyed.

1.4 Other damage

Slight surface damage to bean field.

1.5 Crew information

Pilot:	Aged 21.
Licence:	Private Pilot's Licence, valid until 6 December 1978.
Aircraft Rating:	Group A.
Certificate of Test:	14 October 1973.
Medical Certificate:	Class 3, valid until 20 May 1975.
Night Rating:	
RFT Licence:	Restricted VHF only.
Flying Experience:	
Total hours:	98 hours (Pilot in command 48).
Hours on type:	5 hours 30 minutes.

The pilot was a paid up prospective member of the Flying Group that owned the aircraft. The only experience he had of the type prior to the accident flight was about 4½ hours of familiarisation flying at Felthorpe.

1.6 Aircraft information – Druine D31 'Turbulent' G-APLZ

1.6.1	Airframe Manufacturer:	Rollason Aircraft and Engines Ltd.
	Manufacturer's No:	PFA 480.
	Date of manufacture:	6 November 1958.
	Certificate of Airworthiness: (C of A)	Special category, valid until 30 September 1974.
	Certificate of Maintenance:	Not required.
	Total hours since new:	986 hours 15 minutes.
	Hours since C of A renewal:	10 hours 10 minutes.
	Engine type:	Ardem 4C02 Mk 1B (modified Volkswagen engine).
	Engine total hours:	981 hours.
	Engine hours since last overhaul:	454 hours 40 minutes.

1.6.2 At the time of the accident the certificate of registration did not show the true ownership of the aircraft. However an internal Civil Aviation Authority (CAA) notice from Airworthiness Division to the Central Registry indicated a change in composition of the group from that on the certificate. The group was still in the process of changing when the aircraft was destroyed.

The aircraft was maintained by members of the group using the General Purpose Maintenance Schedule Fixed Wing Aircraft (ARB/GPMS/FW/1971). All work done on the aircraft, except the most recent work on the fuel system, was fully described and entered in the Aircraft Log Book. The signature of a licensed engineer had been obtained only for the certificate of airworthiness renewal checks.

In November 1972, low compression in one cylinder was observed. Two group members partially dismantled the engine and performed a top overhaul on one side of the engine in accordance with the 1961 Volkswagen engine manual. After grinding in the valves, the inlet and exhaust valves were inadvertently transposed on reassembly. In spite of this the valves were still functioning properly at the time of the accident and were sealing the ports completely.

In the period immediately before the accident the engine had run erratically on ground test, and the member of the group who had experienced this had sought advice on the possible causes and remedies for this from the CFI and engineer of a local club. Acting on this advice he had undertaken a thorough strip and inspection of the fuel system, and after several attempts had succeeded in obtaining smooth full power running of the engine.

After this work had been completed the aircraft flew for about 10 hours without any further problems with the engine.

1.6.3 The following information is contained in the aircraft's Operating Instructions under handling notes and is relevant to this accident:

1.	'Stalling':	(a)	The stall is gentle but there is no warning.
		(b)	Great caution is necessary in steep and max. rate turns as speed drops off very quickly and induces a stall without warning.
2.	'Gliding':	T	The speed which produces the lowest rate of descent is 35 knots but to allow a margin for manoeuvring, 45 knots is the recommended gliding speed.
3.	'Approach and 'Landing':		Approach at 45 to 50 knots. Keep speed in hand because this can be quickly lost if the nose is raised.

1.7 Meteorological information

An aftercast for the area of the accident was prepared by the Meteorological Office as follows:

General situation:	A north easterly airstream prevailed over the area.
Surface wind:	A north to north-east 11 to 14 knots.
Visibility:	More than 10 kilometres.
Cloud:	3/8 to 5/8 base 2,000-3,500 feet. Estimated tops 4,000-5,000 feet.

Temperature: 10° to 12°C.

Dew point: 2° to 5°C.

The weather conditions were conducive to carburettor icing, but this was not thought to be a factor in the accident.

1.8 Aids to navigation

Not applicable.

1.9 Communications

No radio fitted.

1.10 Aerodrome and ground facilities

Not applicable.

1.11 Flight recorder

Neither required nor fitted.

1.12 Wreckage

1.12.1 *Accident site*

The aircraft crashed near the western boundary of a large field which was surrounded on all sides by trees between 30 and 50 feet tall. The field was rectangular, approximately 400 metres by 200 metres, the long axis orientated north/south. The ground sloped up, with gradually increasing gradient towards the northern end. The surface was hard, dry, rolled earth, and the field was planted with beans which had just broken through the surface.

1.12.2 *Airframe*

The aircraft struck the ground whilst heading in a south westerly direction, descending fairly steeply with some left bank. The speed at impact was fairly low, and the length of the wreckage trail was only 40 feet. The aircraft disintegrated on impact, only the rear fuselage and empennage being relatively undamaged. No evidence of pre-impact defects existing in the airframe or flying control system was found.

1.12.3 *Engine*

The engine, propeller and front bulkhead became detached as a unit. The propeller showed little evidence of power being applied at impact. A strip examination of the engine at the manufacturer's works was carried out but no evidence of mechanical failure was found. The combustion chambers of all four cylinders showed evidence of weak mixture running. It was also found that the inlet and exhaust valves of the No.1 cylinder had been transposed (see Fig 1). Examination of the ignition system showed that all parts were functioning at impact, and the magneto correctly timed.

1.12.4 *Engine controls*

The throttle and mixture controls were both operated by Bowden type cables. These both detached with the engine and bulkhead, and neither outer cable was stretched during impact and break up.

1.12.5 *Fuel system*

The fuel tank broke free at impact; the fuel feed line breaking at the front bulkhead. The tank had been split and crushed, and no fuel remained in it. The contents indicator, a floated rod projecting through the filler cap, had been bent in a position which indicated that the tank was about half full at impact. Fuelling records showed that the tank had been filled to capacity the previous day with 100 L Avgas. The fuel tap, which was a simple slide type, was found in the nearly closed position. However, mud adhering to the 'Push Off' side of the slider indicated that it had most probably been driven there during the crash.

The carburettor was a Solex automative pattern with an auxiliary starting carburettor type choke. When first examined the throttle was about ¼ open and the choke in the intermediate position. Detailed examination of these positions and the control cables indicated that these were probably the selected positions at impact. The carburettor was stripped and found free from contamination, and all jets were clear. There was evidence of previous corrosion in the float chamber bowl. The fuel inlet strainer was clear.

The fuel pump was functionally tested and found satisfactory. The pump strainer was clear.

The bowl of the main fuel filter was found to be extremely loose. When the filter was tested by drawing fuel through it by operating the engine fuel pump, it was found that a large quantity of air was drawn past the seal at the top of the bowl, thus supplying a fuel foam to the pump and carburettor.

Further examination of the filter assembly revealed that one of the two lugs which held the clamping thumbscrew to the retaining stirrup had broken, (see Figs 2, 3 and 4). This fracture was not caused by impact. Also the safety wire was wound round the stirrup to retain the thumbscrew. The safety wire was also attached to the thumbscrew itself in an anti-locking sense.

On disassembly it was found that the bowl was so loose that it was possible to swing the stirrup from under the bowl without slackening the thumbscrew. It was also found that two cork sealing washers were fitted rather than one, and that both these washers were old and damaged. No contamination was found in the fuel filter.

1.13 **Medical and pathological information**

No medical evidence was found to account for the accident. The pilot sustained severe injury to the head, spine and legs.

1.14 **Fire**

There was no fire.

1.15 Survival aspects

The pilot was wearing the full harness which was fitted. On impact, the inertial forces on the pilot's body caused partial failure of the shoulder harness attachment to the rear fuselage. A combination of these inertial forces and the general break up of the centre section also rendered the lap strap attachments ineffective. However the light wooden structure would have absorbed energy quite effectively during the break up and this coupled with the low forward speed at impact combined to make this accident survivable. The pilot was not wearing a protective helmet.

1.16 Tests and research

None.

1.17 Other information

1.17.1 *Maintenance requirements*

From a study of the Air Navigation Order (ANO) it was concluded that the only statutory requirements which relate to the maintenance of Special Category aircraft are those contained in Articles 7, 8 and 11. These are summarised as follows:

Article 7 states that 'an aircraft shall not fly unless there is in force ..... a certificate of airworthiness .....'

Article 8 describes the conditions under which certificates of airworthiness are issued or renewed. Paragraph (7) of this Article states that 'a certificate of airworthiness shall cease to be in force if the aircraft ..... is overhauled, repaired or modified ..... otherwise than in a manner and with material of a type approved by the Authority .....'

Article 11(1)(a) exempts Special Category aircraft from needing a certificate of compliance –

It is also relevant to note that Regulation 16 of the Air Navigation (General) Regulations (1972) contains details of certain repairs or replacements which may be carried out by a pilot under the terms of Article 11(2) of the Air Navigation Order. However, this Article appears to be applicable to aircraft in the General Purpose Category only.

An explanatory leaflet entitled 'Certification and Maintenance of Aircraft not exceeding 6,000 lb' was issued by the then Air Registration Board in 1971. This leaflet is for guidance only and has no legal status. The only explanatory matter relevant to the maintenance of Special Category aircraft is a list of items of maintenance similar to that contained in Regulation 16 'which may be carried out by a pilot who is the owner or operator of an aircraft not exceeding 6,000 lb. maximum total weight authorised and not being flown for the purpose of public transport', and a note that a record of any pilot maintenance performed must be made in the appropriate log book.

1.17.2 *Maintenance under the auspices of the Popular Flying Association (PFA).*

The group owning the aircraft was affiliated to the PFA through its membership. The PFA is a Civil Aviation Authority approved inspection organisation. It is also permitted to recommend the issue and renewal of certificates of airworthiness for Special Category aircraft.

The PFA have their own requirements related to maintenance of aircraft. One of these is, that all overhaul work, including that done by the owners of aircraft, must be signed for by an approved inspector. This requirement had not been appreciated by the group operating G-APLZ.

2. Analysis and Conclusions

2.1 Analysis

The flight was properly planned and was made in suitable conditions.

Although there was a risk of carburettor icing it is not considered that this was a factor in the accident. When the engine began to give trouble the decision to make a precautionary landing was clearly sensible, and the field selected for this was a good choice.

The aircraft's Operating Instructions contain several warnings in the Handling Notes about how rapidly the airspeed of this type can decay under certain conditions. Furthermore, it warns of the sudden nature of the stall. The pilot had only recently converted to this type, having up to the time of the accident only about 5½ hours experience. It is considered probable that whilst concentrating on the precautionary landing the pilot allowed his airspeed to decay and the aircraft stalled without warning. The aircraft was at too low an altitude for recovery to be possible. Furthermore the aircraft was flying towards a barrier of trees which it could not have cleared even if it had recovered from the stall.

The need for a precautionary landing was brought on by a partial loss of engine power. The condition of the cylinder heads showed that this power loss was caused by a weak mixture being fed to all cylinders. The position of the engine controls, as found, indicates that the pilot had probably appreciated this and was attempting to rectify the situation by applying choke and partially closing the throttle. The cause of the weak mixture was the looseness of the main fuel filter bowl, which allowed a large quantity of air to be drawn into the fuel line and resulted in the fuel level in the carburettor falling.

The looseness of the filter bowl came about as the result of unskilled maintenance. In fairness, it should be pointed out that the person who worked on the fuel system had been aware of his limitations and had sought and obtained the best available advice on how to do the work. Having completed the work however, he failed to have it inspected by a competent engineer. A trained engineer would most likely have discovered the defect and the broken part of the thumbscrew.

The transposition of inlet and exhaust valves in the No. 1 cylinder head had no bearing on the accident. It was however symptomatic of the maintenance practice applied to the aircraft. It built in a potentially insidious fault which inspection after reassembly of the engine, even by an experienced engineer, would have been unlikely to reveal.

The group maintained the aircraft themselves in the firm conviction that they were legally entitled to do so.

Article 8(7)(a) of the ANO states that a certificate of airworthiness shall cease to be in force if an aircraft is not maintained in a manner approved by the Authority. However the ANO does not say what constitutes an approved manner in the case of Special Category Aircraft though it does so for all other categories. It was not possible therefore, from an

examination of the ANO to determine whether the certificate of airworthiness was invalidated by the manner in which the aircraft had been maintained. On balance it appears most likely that it was not invalidated, but quite clearly it should have been. The Civil Aviation Authority have been aware, for some time, of the shortcomings of the ANO with respect of Special Category aircraft and have been considering possible changes.

A parallel to this accident can be found in *Civil Aircraft Accident Report 21/74 (Jodel G-AVEI).* In that case there was also evidence of unskilled maintenance and inspection. It would thus appear that there may be other owners and operators of Special Category aircraft who are unclear as to precisely what the law permits them to do with regard to the maintenance of their aircraft.

2.2 Conclusions

(a) *Findings*

(i) The aircraft's certificate of airworthiness was current and, as far as can be determined, was in force.

(ii) The aircraft was not in 'sound working order' as required by the certificate of airworthiness.

(iii) The pilot was properly licensed though inexperienced on type.

(iv) The aircraft carried adequate fuel for the intended flight.

(v) The aircraft was correctly loaded.

(vi) Whilst climbing en route, an engine malfunction caused the pilot to attempt to make a precautionary landing.

(vii) Whilst the landing was being attempted the aircraft stalled and crashed.

(viii) The engine malfunctioned because a wrongly assembled fuel filter admitted air into the fuel line. This caused the mixture to the cylinders to become excessively weak.

(ix) The inlet and exhaust valves of No. 1 cylinder had been transposed inadvertently, but this was not related to the cause of the accident.

(b) *Cause*

The accident was caused by the aircraft being allowed to stall whilst being manoevured for a precautionary landing, following a loss of engine power. The loss of power occurred because the fuel filter had been wrongly assembled due to unskilled maintenance.

3. Recommendations

It is recommended that:

The maintenance requirements for Special Category aircraft should be clarified in the Air Navigation Order as soon as possible.

P J Bardon
Inspector of Accidents

Accidents Investigation Branch
Department of Trade
April 1975

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