AIRCRAFT ACCIDENT REPORT 2/81

DEPARTMENT OF TRADE

Report on the accident to Cessna 414 G-BAOZ near Leeds/Bradford Airport, on 23 March 1980

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Department of Trade
Accidents Investigation Branch
Kingsgate House
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20 May 1981

The Rt Honourable John Biffen 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 Cessna 414 G–BAOZ which occurred two and a half kilometres north-east of Leeds/Bradford Airport, on 23 March 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 2/81
(EW/C695)

Registered Owner and Operator:	Northair Aviation Limited
Aircraft: Type:	Cessna
Model:	414
Nationality:	British
Registration:	G–BAOZ
Place of Accident:	Two and a half kilometres north-east of Leeds/Bradford Airport Latitude 53° 53′ N Longitude 001° 41′ 20′ W
Date and Time:	23 March 1980 at 1101 hrs All times in this report are in GMT

Synopsis

The accident was notified to the Accidents Investigation Branch by Leeds/Bradford Air Traffic Control (ATC) at 1130 hrs on 23 March 1980 and the investigation was commenced the same day.

The accident happened whilst the aircraft was turning on to its final approach to runway 15 at Leeds/Bradford airport. Immediately prior to the accident, the aircraft had been observed to be flying more slowly than usual and at a low height. The turn on to final approach developed into a spin to the left, and after two or three rotations, the aircraft crashed into a wood and caught fire. Both occupants were killed.

It is concluded that the aircraft entered the spin from an accelerated stall, possibly as the result of the pilot attempting to regain the approach centre line by a higher rate of turn than normal. The relatively slow speed of the aircraft, the gusty conditions and the handling characteristics associated with the aircraft's modified flap system are considered to have been contributory factors.

1. Factual Information

1.1 History of the flight

The purpose of the flight was to check the aircraft prior to its departure within a few days to Pakistan, where it was to operate on charter to the United Nations. The sole occupants were the pilot and a passenger, both of whom were to operate the aircraft in Pakistan. Following the renewal of the aircraft's Certificate of Airworthiness (C of A) on 17 March 1980, it was decided by the managing director (who was also to accompany the aircraft to Pakistan) to have fitted to the aircraft a ferry fuel system and also High Frequency (HF) radio equipment. Prior to the installation of the ferry fuel system the company's inspector advised the managing director that it would not be possible to sign for the installation and issue a Certificate of Compliance, since it was not a CAA approved item. He reiterated the point to the company's engineering manager on the evening of Friday 21 March when the installation work was almost complete, at which time he left Northair for the weekend. Initially the managing director was unsure that this advice was wholly valid since he understood that the equipment did have FAA approval. However, he finally agreed that CAA approval should be sought as early as possible during the following week though it was not determined whose responsibility that should be. It is understood that both the pilot and the passenger were present when the question of the Certificate of Compliance was discussed.

Work continued on the aircraft on Saturday 22 March and this included the removal of the tail plane to rectify a fault in the de-icing system. Towards the evening of that day the pilot taxied the aircraft to the fuel pumps where 350 litres of fuel were uplifted into the main, auxiliary and locker tanks. No fuel was put into either of the two ferry tanks, both of which were installed in the aircraft's cabin. These are believed to have contained some fuel, though the exact amount could not be determined.

Whilst the aircraft was being re-fuelled the pilot remarked to the re-fueller that he expected to leave for Pakistan the following Monday or Tuesday (ie 24 or 25 March). The preparation of the aircraft was finally completed late on the evening of Saturday 22 March at which time the pilot announced his intention to fly the aircraft the next day at 0900 hrs. He had earlier been seen to have been in conversation with the managing director who had intended also to fly the aircraft the next day at 1200 hrs.

The following morning the pilot booked out with Leeds/Bradford ATC for a test flight in the local area, during which he had arranged for the aircraft to be photographed in flight by a colleague flying in another aircraft. Also at about this time the company's deputy chief engineer satisfied himself that the aircraft's centre of gravity had not been affected by the installation of the ferry fuel system and that it was still within limits. The aircraft took off at 0941 hrs with the pilot observed to be occupying the left-hand front seat and the passenger in the right. After reporting clear of the zone at 0946 hrs the aircraft rendezvoused with the other aircraft and photographs were taken of G–BAOZ. Following this the aircraft climbed to FL110, and various avionics checks were carried out. It is also understood that it was the pilot's intention to check the ferry fuel system at the same time.

At 1053 hrs the aircraft returned to the airfield and joined a left-hand circuit for a landing on runway 15, close behind a Cessna 152. The pilot of OZ stated in his downwind call that he was then holding 2,000 feet, though it is unclear if this altitude was with reference to QNH or QFE, both of which he had been given. Shortly before OZ turned on to base leg, the pilot of the Cessna 152 stated that he would be carrying out a glide approach from 1,000 feet a g l. When the pilot of OZ called that he was turning onto base leg, he also stated that he had the other aircraft in sight. At about this time OZ was seen by ATC to be approximately 1,000 feet a g l and 3½ miles from the airfield. The aircraft appeared to the ATC assistant to be flying more slowly than he would have expected for an aircraft of that class. Other witnesses on the ground also commented upon the aircraft's apparent slow speed and also its low height. Both landing gear and flaps were seen to be extended a short while later.

At a point approximately 2250 metres from the runway threshold and some 250 metres to the right of the extended centre line the aircraft was seen to turn sharply to the left. The bank angle was seen to increase steadily and the nose to drop coincident with the rapid and substantial application of engine power which was heard by more than one witness. The aircraft was then seen to make two or three complete turns before it entered a wooded area and struck the ground in a steep nose-down attitude. The wreckage caught fire shortly after impact and the aircraft was totally destroyed. Both occupants were killed.

The accident occurred at 1101 hrs and the airport fire service together with other units arrived at the scene at 1108 hrs and brought the fire under control.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	1	1	–
Serious	–	–	–
Minor/none	–	–	

1.3 Damage to aircraft

The aircraft was destroyed by the impact and post crash fire.

1.4 Other damage

A number of trees were severely damaged by the aircraft impact and some surface scarring was caused by the emergency and recovery operations.

1.5 Personnel information

(a) Pilot: Male

Age: 23 years

	Licence:	Commercial Pilot's Licence valid until 21 March 1987 with an Instrument Rating renewed on 30 July 1979
	Medical:	Class I certificate, date of last examination 31 January 1980
	Total flying experience:	Estimated 1440 hours
	Total hours on type:	Estimated 900 hours on Cessna 400 series aircraft including at least 5 hours on G–BAOZ. The pilot's log-book and licence were destroyed in the accident
	Total hours recorded during preceding 28 days:	26 hours
(b)	Passenger:	Male
	Age:	22 years
	Licence:	Private Pilot's Licence – Permanent
	Medical:	Class III certificate valid until 31 May 1981
	Total flying experience as pilot:	660 hours in light single engined aircraft

The passenger was also to accompany the aircraft to Pakistan and had been involved in some of the preparation including the refuelling of the aircraft after it had been weighed on 17 March 1980.

1.6 **Aircraft information**

(a)	Type:	Cessna 414
	Serial No:	0381
	Date of Manufacture:	1973
	Total airframe hours:	1931 hrs 23 mins
	Engine type:	Teledyne Continental TS10-520-J
	Engine Serial Nos:	Port 218541 Stb'd 208302
	Date of manufacture:	Port 1973 Stb'd 1972
	Hours since overhaul:	Port 593 hrs 17 mins Stb'd 189 hrs 07 min
	Propeller type:	McCauley 3AF 32C23
	Propeller serial Nos:	Port 789661 Stb'd 791689

Hours since new:	Port 2 hrs 40 mins Stb'd 2 hrs 40 mins
Certificate of Airworthiness:	Certificated in the Private Category, the Certificate having been renewed for one year from 17 March 1980
Certificate of Registration:	Registered to Northair Aviation Ltd on 26 February 1980

(b) Weight and Centre of Gravity

(i) The weight and balance of the aircraft at the time of the accident could not be determined with certainty and a number of assumptions have had to be made, based on the following information:

G–BAOZ was dispatched on C of A air test on 16 March 1980 with full fuel tanks, the flight time being 1 hr 25 mins. The remaining fuel was drained from the aircraft and on the following day it was weighed and a new centre of gravity calculated. Subsequent to this two ferry fuel tanks were installed in the cabin and the aircraft was refuelled under the supervision of the mechanic who flew as passenger on the accident flight. The ferry tanks are thought to have been half filled and it is assumed that all the fuel remaining from the air test was returned to the aircraft. However, there is no record of the amount or distribution. Allowance has been made for a number of engine runs and the taxying of the aircraft to the refuelling point to uplift a total of 350 litres of fuel. It is known that the locker tank and auxiliaries were filled at this time, and 50 litres requested for each main tank but again no record can be discovered of the total amount of fuel on board or its distribution. The aircraft was not weighed subsequent to the installation of the ferry fuel system or the HF set. The weight of these two items is reported to have been 87 lbs total.

(ii)	Maximum authorised weight:	6350 lbs
	Maximum authorised landing weight:	6200 lbs
	Estimated accident weight:	6020 lbs
	Centre of Gravity limitations at the accident weight (gear extended):	Between 150 ins aft of datum (a.o.d.) and 160.1 ins a.o.d.
	Estimated Centre of Gravity:	
	(i) assuming ferry, locker and auxiliary tanks full and main tanks partially full:	159.3 ins a.o.d.
	(ii) assuming main, locker and auxiliary tanks full and ferry tanks partially full:	158.1 ins a.o.d.

(c) Fuel

Type:	Avgas 100 LL – a sample from the refuelling point conformed to the required specifications
Fuel on board – prior to departure	Estimated to be approximately 181 Imp gal – 1302 lbs

(d) Ferry Fuel System

A ferry fuel system was installed in the aircraft by the owners between the time of the C of A renewal survey on 17 March 1980 and the accident on 23 March 1980. At the time of the accident no Certificate of Compliance had been issued in respect of the installation as required by the ANO. The modification included two additional fuel tanks removed from another aircraft which had been ferried from the United States. The American ferry company, following an approach from Northair, supplied a triple fuel selector assembly together with a sketch indicating how to connect the two tanks and selector assembly to the existing aircraft system.

The tanks were mounted in place of the two seats immediately aft of the cabin/cockpit divider and secured to the seat rails. The left tank was rectangular and of galvanised mild steel construction of approximately 50 US gallons capacity; the right was a 30 US gallon steel drum. The fuel selectors were mounted on the cabin floor on a section of Dexion angle about 8" aft of the main aircraft fuel selectors. The tanks were piped to the aircraft crossfeed lines just beneath the cabin floor via the ferry selector manifold using fuel resistant plastic hoses. A screw type filler cap was mounted on the top of each tank with a vent pipe being tapped from the centre of each one and terminating within the rear cabin adjacent to the pressurisation outflow valve.

In order to supply the engines from the ferry tanks the main aircraft fuel selectors had first to be set to the crossfeed positions, then by manipulating the ferry fuel selectors, both or either one of the engines could be supplied from either of the ferry fuel tanks.

(e) H F Radio

A Brelonix ferry HF radio transmitter/receiver was installed in the cabin forward of the right hand ferry fuel tank between the tank and the cockpit/cabin divider at the same time as the ferry fuel installation. The radio pack was complete with antenna tuning unit, Mic/Tel sockets and speaker, so the only connection with the aircraft was a positive electrical supply via a circuit breaker. The aerial was connected through the centre of the cockpit roof and ran from there to the tip of the fin and then out to the starboard wing tip.

(f) Modified Flap System

The aircraft was fitted with a Robertson Aircraft Corporation Short Take-Off and Landing (STOL) Modification in accordance with Federal Aviation Administration

(FAA) Supplemental Type Certificate (STC) SA48NW at the time of manufacture. This modification consisted of the installation of Fowler Flaps, Flap Actuated Droop Ailerons, Flap Actuated Elevator Trim and an Anti-Servo Rudder Trim Tab. The flaps could be selected to 10° and 30° with 8° of aileron droop being achieved with 10° or more of flap set.

A supplement to the aircraft's Flight Manual was issued by the United States FAA in June 1973 and was validated by the CAA. The supplement stated that it was applicable to aircraft fitted with the Robertson STOL modification and that the information provided superseded the basic Flight Manual only where stated. Otherwise, Limitations, Procedures and Performance were unchanged from the basic manual. The changes listed were concerned principally with those associated with the different flap settings and operating speeds.

It was noted in particular that the minimum approach speed had been revised to 99 mph CAS (Calibrated Airspeed), which the manual notes is equal to 104 mph IAS (Indicated Airspeed). This in contrast to the minimum approach speed quoted in the basic Flight Manual of 107 mph IAS in the case on an unmodified aircraft.

Of particular significance however are figures pencilled in the basic Manual in the Section entitled Normal Procedures. The origin of these pencilled figures is not known, but against Minimum Approach Speed is the figure 100 and this is associated with a heading, also in pencil, of 'R/TOL'. A similar note had been made against the Climb Out (V_2) speed where the figure pencilled in is 93. The Supplement states that this speed (with the Robertson STOL modification) is 93 mph CAS which is equal to 98 mph IAS. Though the revised speeds in the Supplement were quite clearly labelled CAS, the IAS equivalent was not stated alongside but on the opposite page.

(g) Previous Accident

The aircraft had been involved in an accident on 22 March 1979 when the landing gear collapsed towards the end of the landing run. The damage was confined to the landing gear and the propellers.

1.7 Meteorological information

The weather recorded at Leeds/Bradford Airport at 1045 and 1145 hours on 23 March was:

Wind 110°/20 knots, visibility 9000 metres, cloud 6 oktas alto cumulus at 10,000 feet, temperature +3° Centrigrade.

An aftercast obtained from the Meteorological Office agrees with these observations and further comments – 'the surface wind of 20 knots and gradient of 30-35 knots could be expected to give some roughness to the low level flow. However, wind structure and stability criteria would not lead one to expect either mountain or rotor streaming and none was reported'.

The trace produced by an anemograph sited on the airfield indicates a gust reaching 30 knots at approximately 1102 hrs, and participants in a clay pigeon shoot some 500 metres from the accident site also commented on the erratic behaviour of the clays due to the effect of the wind. Windshear on the approach to runway 15 was experienced by a public transport aircraft at 1240 hrs on the same day.

The accident occurred in daylight.

1.8 Aids to Navigation

Not applicable.

1.9 Communications

During the flight, the pilot was in contact with Leeds Approach on 123.75 MHz, Border radar on 132.9 MHz, and Manchester on 126.65 MHz. All transmissions received from the aircraft, including those made immediately prior to the accident, were normal and routine.

1.10 Aerodrome information

The airfield elevation is 681 feet amsl. Runway 15, which was the one in use at the time of the accident, is 1646 metres in length. A number of obstructions under the approach to this runway are listed in the UK Air Pilot, but none of them are considered to have been significant in the context of this accident. At the time of the aircraft's approach, the left hand Visual Approach Slope Indicator (VASI) was unserviceable and the right hand VASI was at 30% intensity.

1.11 Flight recorders

None fitted nor required to be fitted.

1.12 Examination of wreckage

1.12.1 *On site examination*

The aircraft was found to have descended in a left spin into a dense copse of 60 ft tall trees located 1¾ miles from the airfield to the right of the extended centre line of runway 15. The tailplane, fin and rudder were removed in upper branches of the trees, the remainder of the aircraft falling to the ground the correct way up in a nose-down attitude. The nose of the aircraft came to rest in a small stream with the rear fuselage leaning against a tree.

A fierce ground fire ensued consuming the majority of the fuselage and wings together with much of the aircraft systems, indicative of a significant amount of fuel remaining at impact.

The aircraft configuration at impact was established as undercarriage down and flaps fully extended.

Damage to the propellers and 'cuts' in a tree trunk were indicative of both engines developing power at impact.

Two fuel tanks were recovered from amongst the wreckage, one rectangular the other drum shaped (along with a triple fuel valve assembly) which were not standard aircraft items.

1.12.2 *Subsequent detailed examination*

The detailed examination of the aircraft was limited by the nature of the wreckage following the severe ground fire. However examination of the flying controls did not reveal any evidence of pre-impact disconnection but it was not possible to comment on whether any restrictions had occurred.

All trim actuators were found at other than positions of extreme travel but the actual positions were unreliable as indications of the pre-impact trim setting.

A detailed strip examination of the port engine did not reveal any evidence of pre-crash mechanical failure.

A detailed examination of the aircraft fuel selector valves led to the conclusion that 'main' tanks had been selected at impact. This would preclude the use of the ferry fuel fit at that time. It was confirmed that the impact configuration was undercarriage extended, flaps fully down with ailerons drooped.

1.13 Medical and pathological information

There is no pathological evidence as to a causative or contributory medical factor to account for the accident. The possibility of pilot incapacitation by petrol fumes from the ferry fuel system was considered. Such contamination would not produce sudden incapacitation, but, if in sufficient concentration, would lead to irritation of the air passages and general discomfort. Pilot incapacitation is therefore considered to have been a remote possibility and is unsupported by any other evidence.

1.14 Fire

The airport fire service was called out at 1103 hrs, together with units from the West Yorkshire Fire Service. Four vehicles from the airport attended, one of which was a rescue tender. Only the latter vehicle was able to reach the site due to the soft ground. The other three vehicles, which were foam tenders, remained on the road nearest to the site and ran out a line consisting of eight lengths of hose. Thirty gallons of FP/70 foam, 15 lbs of carbon dioxide, 300 lbs of dry powder and 1 Monex powder extinguisher were used to knock down the fire. The airport was without fire service cover from 1103 hrs to 1205 hrs, during which time operations were suspended.

1.15 Survival aspects

The accident is considered to have been non-survivable.

1.16 Tests and research

Nil

1.17 Additional information – flight test of the Robertson STOL modification

A Cessna 414 fitted with the Robertson STOL modification was flown by the CAA in August 1974. It was noted that the aircraft only just complied with the requirements of BCAR K2-10d 2.2.3 with respect to stability in the landing configuration. Spinning tests were not appropriate to this class of aircraft, but stalls in turning flight were carried out in the landing configuration.

These did not exhibit any adverse characteristics, although poor longitudinal stability was again noted. The lateral characteristics were considered to be good with no significant wing drop tendency.

The Cessna Aircraft Company itself states that it has had no direct experience of the characteristics of the Robertson STOL system. Their knowledge is limited to that which they have learnt mainly from informal conversations from which they form the impression that the STOL performance is achieved at some expense to handling margins.

2. Analysis

2.1 Certificate of Airworthiness validity

Under Article 8(7) of the Air Navigation Order 1976 a Certificate of Airworthiness ceases to be in force if the aircraft or such of its equipment as is necessary for the airworthiness of the aircraft is modified otherwise than in a manner and with the material of a type approved by the Civil Aviation Authority unless a Certificate of Compliance has been issued in accordance with Article 11. In the case of G–BAOZ the Authority has no record of the ferry fuel system fitted to the aircraft being an approved item. The company's inspector was therefore acting quite properly in not signing for the work done or issuing a Certificate of Compliance. The point was well taken by his managing director and the engineering manager and it was recognised by both that CAA approval for the fit would have to be sought. It is understood also that the pilot and his passenger, who was also a mechanic, were aware of these matters. The point that did not seem to be appreciated by any of those concerned (except perhaps by the company's inspector though he did not give expression to it) is that without a Certificate of Compliance the C of A itself was invalid and that the aircraft should not have been flown until the provisions of Article 11 of the Air Navigation Order (ANO) 1976 had been complied with. There is no evidence nor is it believed that there was any wilful intent to fly the aircraft with an invalid C of A in deliberate contravention of the Article. It seems more likely that the matter was simply overlooked by all those concerned who were at the time undoubtedly under pressure to complete the preparations for the aircraft's imminent departure to Pakistan.

Whether or not it was appreciated that CAA approval of the ferry fuel installation would take some considerable time is not clear. It was unlikely, according to the CAA, that the installation could have been cleared by the local surveyor without the involvement of the Airworthiness Division. It is improbable, therefore, that in the event the aircraft would have been able to leave for Pakistan on time.

2.2 Circumstances of the accident

Since the aircraft's fuel selectors were found selected to main tanks, there is positive evidence that the ferry fuel system was not in use at the time of the accident. Furthermore there were no indications that the installation of fuel tanks in the cabin had any bearing on the accident in respect of either fuel vapour contamination of the cabin air supply, in-flight fire or the detachment of the tanks from their mountings. The routine nature of the pilot's radio transmissions immediately prior to the accident would appear to preclude not only difficulties with the ferry fuel installation but also any other mechanical or technical problem and this would seem to be confirmed by the results of the wreckage examination. Also the balance of the evidence is that the engines were operating normally up to the time of impact.

In the absence of any positive evidence of a technical failure or malfunction that may have contributed to the accident it is necessary to consider the pilot's operation of

the aircraft and in this respect two items of evidence are particularly noteworthy. The first is the apparent speed of the aircraft whilst it was on base leg, which more than one witness described as being unusually slow. This is particularly significant because at the time the aircraft had a tail wind component of approximately 10 knots, and therefore if despite that, it still appeared to be flying slowly then this would indicate that it was indeed being flown at a substantially reduced air speed. One possible explanation for this is that the pilot was attempting to maintain separation from the Cessna 152 ahead of him on the approach. This aircraft was making a glide approach and in the prevailing wind conditions its ground speed would have been about 60 mph and the pilot of OZ would therefore have to have made a conscious effort to avoid catching up with it before it reached the runway. It is also possible that the pilot's unusually early selection of full flap in relation to the aircraft's distance out from the airfield, particularly bearing in mind the strength of the wind, could have been related to the need to maintain separation. It is quite possible therefore that in these circumstances the pilot could well have been exploiting the slow speed characteristics of the aircraft conferred upon it by the modified flap system. If this in fact was the case, some significance may attach to the pencilled figures in the aircraft's flight manual. The purpose of these may simply have been to draw attention to the differences in normal operating speeds brought about by the installation of the Robertson STOL equipment. Suffice it to say that these pencilled figures were incorrect and it would appear that whoever transposed them from the Robertson supplement to the basic flight manual did not notice that they were Calibrated Airspeed values and not Indicated Airpeeds. The reason why the figure pencilled next to the minimum approach speed was 100 rather than 99, which is the CAS value, is not clear unless it was simply to round the figure up to a more convenient value. Whatever the reason, the fact remains that the transposed figure was still wrong since the revised minimum approach speed was 104 mph and not 100. If the pilot had been attempting to fly the aircraft relative to the lower value, then his safety margin over the stall would have been to that extent eroded. Though the difference appears small it could nevertheless have been significant at the lower end of the speed range and may therefore have contributed to the loss of control that occurred.

The other significant item of evidence is that provided by the actual position of the crash site which was to the right of the runway extended centre line. This indicates that the pilot had overshot his turn onto the final approach course and suggests that he may have been turning at a higher rate than normal in order to avoid being displaced further from the centre line by the prevailing cross wind. There is no doubt that in the course of this manoeuvre the aircraft stalled and entered a spin. There is good evidence that the pilot applied a substantial amount of engine power at the last moment either to assist the turn or when he recognised the onset of the spin. Notwithstanding the reason for the power application, it was too late to prevent the spin from developing.

Though there were no indications in the CAA flight test report of any tendency on the part of the aircraft to stall or spin off a turn with full flap and landing gear selected down, it would seem that the improved short take-off and landing qualities provided by the modified flap system was achieved at some expense to the aircraft's handling margins. This is a view which is supported by the aircraft manufacturer. At the time of the accident the aircraft's centre of gravity was towards the aft limit where the longitudinal stability would be the least positive. In fact the CAA has stated that at the aft

limit the aircraft only just complied with the requirements of the BCAR for stability in the landing configuration. Therefore the possibility has to be considered that the characteristics of the aircraft in this configuration may have contributed to the stall and spin, notwithstanding the findings of the CAA. Though it is not stated in the CAA report, there is a clear inference that the stick force per G in a turn with the flaps down was of a low value. If this was so, then it would not be unexpected if the pilot, whose attention may have been engaged elsewhere, inadvertently applied up-elevator too quickly due to some lack of feel and achieved a relatively high rate of change of angle of attack. The consequent rapid increase in drag could then have caused a fairly sudden loss of airspeed, with the result that the aircraft stalled almost immediately.

It is assumed that the slow speed capabilities of the aircraft conferred upon it by the modified flap system have to some extent been achieved by causing the airflow over the top of the wings to remain attached to a higher angle of attack than is the case with an unmodified aircraft. It follows therefore that the flow break-away, when it did occur, is likely to have been more abrupt and over a greater span width than would normally be the case, particularly with respect to the wing on the inside of the turn. The consequences of this in turn could well have been a rapid wing drop, sufficient to initiate a high rate of yaw and entry into a spin. The tendency of the wing to drop would have been aggravated if at the same time the pilot had tried to prevent it from doing so by applying opposite aileron, which would have been a natural response in the circumstances. The situation could also have been compounded by the prevailing turbulence, and the stall could therefore have been precipitated by the aircraft encountering a gust or wind shear coincident with the inside wing reaching an angle of attack close to the stalling angle.

Though no firm conclusions can be reached the possibility must exist that the pilot was unaware of the aircraft's characteristics in this particular corner of the flight envelope. Though he is believed to have flown some 900 hours on this series of aircraft his experience of the Robertson STOL equipped aircraft amounted to only 5 hours. Therefore when he made his delayed and somewhat abrupt turn on to the final approach heading, the response to his control inputs may have been significantly different from that which he had been accustomed to on the unmodified aircraft.

In conclusion, it is considered that the accident would in all probability have been averted had the pilot taken greater account of the turbulent conditions and the wind shear and allowed a greater margin of both height and speed over and above the values to which he appears to have been operating.

3. Conclusions

(a) *Findings*

(i) The aircraft had been maintained in accordance with an approved schedule, though its Certificate of Airworthiness had been rendered invalid by the installation of the ferry fuel system which was an unapproved item and for which a Certificate of Compliance could not be issued.

(ii) The aircraft's weight and centre of gravity were within the prescribed limits.

(iii) The pilot was properly licensed and well experienced on the Cessna 400 series of aircraft. However, he may not have been fully alert to the differences in control response between an unmodified Cessna 414 and one equipped with the Robertson STOL modification.

(iv) The pilot did not allow sufficient operating margins with respect to height and airspeed to compensate for the effects of turbulence and windshear.

(v) The pilot inadvertently allowed the aircraft to enter a spin whilst making an abrupt turn at a slow speed. A recovery was virtually impossible at the height at which the aircraft was being flown and unlikely at normal circuit height.

(vi) The ferry fuel system with which the aircraft was fitted, though an unapproved item, was not in use at the time of the accident, nor was it a causal factor in the accident.

(b) *Cause*

The accident was caused by the aircraft entering a spin whilst turning at low altitude in the landing configuration. The relatively slow speed of the aircraft, the presence of turbulence and windshear, the differences in control response associated with the modified flap system were possible contributory factors.

4. Safety Recommendations

Nil.

P J BARDON
Inspector of Accidents

Accidents Investigation Branch
Department of Trade
May 1981

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