ACCIDENT

Aircraft Type and Registration:	DHC-2 Mk.III Turbo-Beaver, OY-JRR
No & Type of Engines:	1 Pratt & Whitney PT6A-34 turboprop engine
Year of Manufacture:	1966
Date & Time (UTC):	11 March 2007 at 1615 hrs
Location:	Headcorn Airfield, Kent
Type of Flight:	Aerial work
Persons on Board:	Crew - 1 Passengers - 8
Injuries:	Crew - 1 (Fatal) Passengers - 1 (Minor)
Nature of Damage:	Substantial damage to the aircraft
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	36 years
Commander's Flying Experience:	932 hours (of which 27 were on type) Last 90 days - 36 hours Last 28 days - 22 hours
Information Source:	AAIB Field Investigation

Synopsis

The pilot commenced a takeoff on Runway 21 at Headcorn Airfield with eight parachutists on board. The flaps were not selected and the aircraft failed to get airborne in the available distance. The pilot aborted the takeoff but was unable to prevent a collision with a parked aircraft. The pilot received fatal injuries as a result of the collision.

History of the flight

The pilot was conducting flights for the purpose of parachute operations; these flights are known colloquially as 'lifts'. On the previous day, he had conducted 13 lifts, of which eleven were to an altitude of 12,000 ft and two to an altitude of 5,500 ft or less.

On the day of the accident the pilot recorded that he took off for the first lift at 0927 hrs. The aircraft, with nine parachutists aboard, climbed to 12,000 ft and landed at 0946 hrs. There followed three flights of an average 18 minute duration, between each of which the aircraft was on the ground for no more than 7 minutes. The last of these flights landed at 1100 hrs, after which the aircraft uplifted 230 ltr of Jet A1 fuel. The aircraft utilised the main runway, Runway 29, for each of these flights.

The surface wind had freshened from the south and the pilot requested the use of the shorter Runway 21. The air/ground radio operator refused this request because he believed that the pilot had not been checked out to use this runway, as required by the Headcorn Aerodrome Manual. Accordingly, the pilot approached a nominated

check pilot who agreed to observe his next flight. The check pilot briefed the pilot of OY-JRR on the procedures for using the short runway, emphasising the need to make an early decision to abort the takeoff if necessary. The check pilot stated that the pilot of OY-JRR performed a thorough pre-takeoff check using the full checklist available in the cockpit and that the subsequent flight was entirely satisfactory.

Following the check flight the aircraft took off again at 1148 hrs and flew a further five flights, each separated by periods that ranged between 7 and 36 minutes. The check pilot observed several of these flights, all of which were from Runway 21, and most appeared to proceed normally. He and another witness noticed that on one occasion the climb gradient after takeoff appeared shallower than normal, but they believed that the wind speed had decreased at this time. The pilot recorded that the aircraft was refuelled again after landing at 1443 hrs, this time uplifting 266 ltr of fuel. The next takeoff was at 1447 hrs and having climbed to 12,000 ft again the aircraft landed at 1521 hrs.

The accident occurred on the pilot's eleventh flight of the day. Prior to the flight the aircraft was refuelled with a further 100 ltr at 1555 hrs. Shortly before 1605 hrs the aircraft taxied to Runway 21. It appeared to accelerate normally but at no time was the tail seen to rise in its usual manner prior to becoming airborne. Onboard, the experienced jump-master noticed that the aircraft was passing the aerodrome refuelling installation and several aircraft parked close to the runway, beyond the intersection of Runway 21 with Runway 29. He was aware that the aircraft had now passed the point where it would normally become airborne. Almost simultaneously, he heard the pilot shout "Abort". One of the parachutists shouted to the other occupants "Brace - Brace, everyone on the floor". The aircraft stopped abruptly when its left wing and cockpit collided with a camouflaged F100 fighter aircraft which was parked as a museum exhibit to the left of the southern edge of Runway 21.

The occupants of the cabin were able to vacate the aircraft with mutual assistance. Members of the aerodrome fire service extinguished a small fire, which had started in the area of the engine, and other witnesses helped the occupants to move away from the aircraft. The pilot, however, remained unconscious in the cockpit. He was attended subsequently by paramedics and taken to hospital, where he succumbed to his injuries.

Medical and pathological information

Post-mortem examination conducted by an aviation pathologist revealed that the pilot died of multiple injuries, consistent with those sustained at the time of the impact with the parked aircraft. The post-mortem showed no evidence of natural disease which could have caused or contributed to the accident and toxicology was negative.

The aviation pathologist considered that this was potentially a survivable accident, as evidenced by the very few injuries sustained by the eight parachutists on board. Impact of the cockpit with the nose of the parked aircraft had caused the fatal injuries sustained by the pilot and no alternative or additional safety equipment would have altered the fatal outcome.

Personnel information

The pilot possessed a Commercial Pilot's Licence, issued by the CAA, which included a DHC-2 Turbo-Beaver rating issued on 7 February 2007 and valid until 6 February 2009. He also possessed a valid Flight Instructor rating and an Instrument Rating valid for single and multi-engine single pilot aircraft. His unrestricted Class One Medical certificate was valid until

28 March 2007. He also possessed a Commercial Pilot's Licence issued by the United States Federal Aviation Administration, valid for single and multi-engine aircraft, which included a Flight Instructor rating.

Members of the parachute school who saw him on the day of the accident commented that he seemed happy, excited and keen to go flying.

Pilot fatigue

Guidance produced by the British Parachuting Association (BPA) in relation to pilot fatigue stated that a pilot who is engaged on parachuting operations should not fly more than four hours without a thirty minute break away from the aircraft and should not fly more than eight hours in any one day. The pilot's record of flights indicates that he had operated in accordance with this guidance.

Meteorological information

Several pilots who witnessed the accident reported a surface wind of approximately 10 kt from the south. Witnesses described the runway surface as slightly wet but not unduly soft or boggy. The temperature at the time of the accident was approximately 13ºC.

Aerodrome information

Headcorn Airfield is a grass aerodrome with two landing strips. Runway 11/29 is licensed with a declared takeoff distance of 840 m. Runway 21/03 is unlicensed, which means that it does not necessarily comply with the provisions of CAP 168 – *'Licensing of Aerodromes'*, a document that describes the minimum standards necessary to meet licensing requirements, including the provision of runway markings and freedom from obstacles. The Headcorn Aerodrome Manual stated that the length of Runway 21/03 was 312 m, being the distance between the marked northern threshold of Runway 21 and its intersection with Runway 29/11. The distance from this threshold to the position of the parked F100 fighter aircraft was approximately 570 m.

The UK Aeronautical Information Package (AIP) contains information about individual licensed aerodromes. The edition of the AIP current at the time of the accident concurred with the declared length of Runway 11/29 but did not report the length of the unlicensed Runway 21/03 (see Figure 1). One of the commercially available aerodrome guides noted that Runway 21/03 was unlicensed but had a length of 312 m. Another such guide, whilst also referring to this runway as unlicensed, gave its length as 549 m. The publishers of both guides commented that in respect of unlicensed runways they rely on information provided by the aerodrome operator except where graphical representation of the aerodrome shows an obvious geometric error.

A diagram on the Headcorn Aerodrome website depicted the runway layout. It showed Runway 21/03 extending south beyond the location shown in the Headcorn Aerodrome Manual so that it resembled the depiction in the aerodrome guide which quoted its length as 549 m.

The aerodrome operator commented that historically Runway 21/03 was considered to be 549 m long. More recently, whilst applying to license this runway, the aerodrome operator reduced its nominal length to 312 m in order to comply with the provisions of CAP 168 in relation to obstacles. The operator considered, however, that the provision of threshold markings, in accordance with CAP 168, would have been confusing visually. Consequently, these markings were not provided and the runway remained unlicensed, albeit at the reduced published length of 312 m.

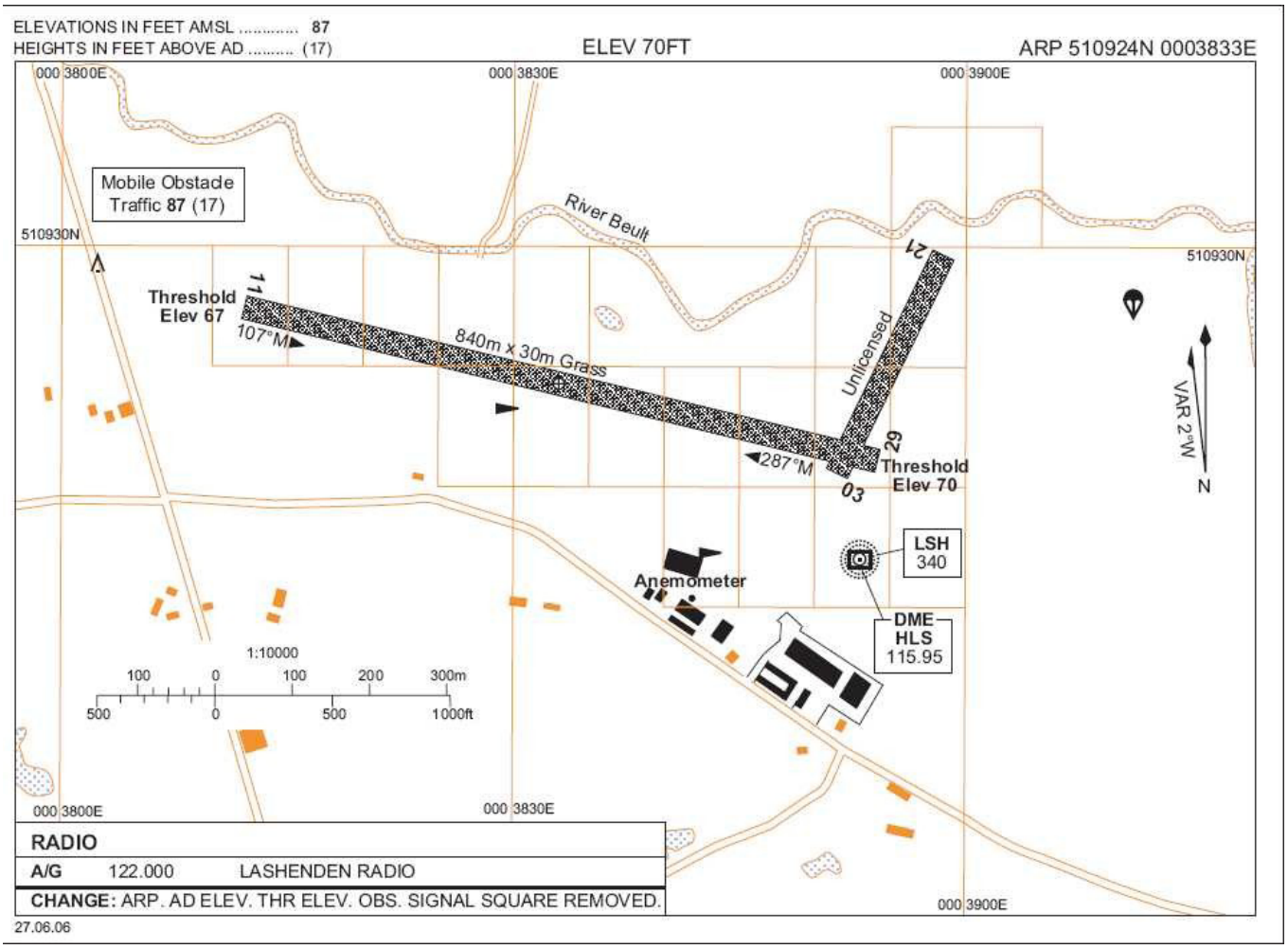

Figure 1

Aerodrome chart, UK AIP

The Operational Procedures section of the Headcorn Aerodrome Manual, current at the time of the accident, contained information about operation of Runway 21/03. It stated that this runway could only be used by pilots who were based at the aerodrome and had been checked by an instructor or nominated check pilot. The nature of this check was not specified but was understood to involve the candidate pilot being observed to operate safely in the context of that runway's characteristics. In addition, the air/ground radio operator had the right to refuse the use of the short runway.

A museum, occupying an area adjacent to the south-eastern boundary of the aerodrome, included as exhibits several non-airworthy parked aircraft, one of which was the F100 aircraft. This 1960s jet fighter aircraft wore faded green and brown camouflage paintwork that was difficult to distinguish from the skyline beyond it when viewed from the start of Runway 21.

Impact sequence

The left side of the Beaver struck the nose of the F100 static display aircraft, tearing open the left side of the forward fuselage and cockpit, until its left wing contacted the right side of the F100's fuselage. Thereafter, the Beaver's momentum drove the front end of the F100 sideways a distance of some 3.5 m (measured at the nose

wheel), pivoting it about its main wheels, before finally coming to rest. The disruption of the Beaver cockpit's left side and windscreen pillar weakened the forward fuselage to extent that the surviving structure could no longer support the weight of engine and propeller, and the whole of the aircraft's nose section collapsed downwards, bending about the lower fuselage skins and the remnants of cockpit floor structure just aft of the instrument panel, until the propeller rested on the ground.

The speed at impact could not be determined with any degree of precision from the evidence available at the scene, but the damage was consistent with a speed of at least 30 kt.

Wreckage examination

Flaps

System description

The wing flaps on the Beaver family of aircraft are linked to the aileron control circuit, so as to provide aileron droop when the flaps are deployed. A single hydraulic actuating cylinder, located in the wing centre section, drives the system by operating a torque tube which extends laterally to each wing root. The rotational movement of the torque tube is transferred to the individual flap via lever arms on the ends of the torque tube and short push rods connected directly to the flap surfaces. Hydraulic fluid is directed to the appropriate side of the actuating cylinder by means of a flap selector valve controlled by a lever located just to the right of the pilot's seat. The system is pressurised by means of a hand pump operated by a lever, also positioned to the right side of the pilot's seat.

The actuating cylinder incorporates a mechanism which prevents it from being back-driven when the system is not being actively pressurised via the hand pump, and holds the actuator at the position to which it was last moved. Therefore, the position of the flap selector valve lever does not provide a reliable indication of the last flap selection made by the pilot. For example, the flaps could be pumped DOWN, and the flap selector valve then returned to the UP position in readiness for a subsequent retraction; the flaps would then remain in the DOWN position until such time as the hand pump is operated.

Post-accident state

The flap selector valve in the cockpit was positioned to port fluid to the flaps up side of the actuator. However, it was not possible to determine whether the lever had been disturbed during the post-impact rescue activities.

The flap actuating system of OY-JRR comprising the actuator, torque tube and push rods, was in the fully retracted position. Both flap surfaces were fully UP, and neither aileron was drooped. The left wing root trailing edge was driven into engagement with the fuselage side when the left wing struck the side of the F100's fuselage; the flap surface was in the fully UP position at that time.

Engine and propeller

The engine and propeller controls in the cockpit were largely undamaged, but their associated operating cables had been stretched when the nose section dropped to the ground. Consequently it was not possible to determine their pre-impact settings.

The engine casing exhibited no deformation indicative of a sudden stoppage under power, and there was no compelling evidence on the propeller blades indicative of a high power setting at the instant of contact with the F100 aircraft. A section was broken out from the leading edge of one propeller blade near its tip, as a result of it striking the F100's nose intake structure, but there were no deep or clearly delineated circumferential scores on the faces of this, or any other blade. Numerous nicks

and small, localised areas of breakout, also caused by contact with the F100's nose structure, were present on the other two blades. These were possibly indicative of their having been in reverse pitch at the time of the collision but this could not be confirmed. The mechanical interlock between the power lever and propeller pitch mechanisms was functional and would have prevented the power from being increased in the event of the blades failing to achieve reverse pitch.

Taken overall, the evidence at the scene suggested that the engine was not under high power at the time OY-JRR struck the F100 aircraft.

Cabin integrity

Except for the penetration of the cockpit by the F100's nose structure, and the associated collapse of the nose section, the fuselage of the Beaver suffered relatively minor damage and the passenger cabin had remained intact.

Two elements of the thin-wall tubular steel space-frame supporting the forward-facing bench seat at the rear of the cabin had failed. The remaining framework had twisted as a result of inertial forces transferred to it via the seat belts, which were anchored directly to the seat. However, the seat itself had not become detached. One of the tube failures, close to the top of the tube forming the front right seat leg, was a pre-existing fracture at a welded joint. This was indicated by corrosion and bruising of the fracture faces, which in some regions exhibited features indicative of fatigue crack propagation. The design of the seat support frame was asymmetric due to a requirement for it to provide clearance for the curtain-type cabin door to slide around in its tracks, following a curved path behind the right rear corner of the seat. The distribution of the anchorage points securing the seat to the cabin floor structure was also asymmetric, for similar reasons. The attachment points were biased towards the left side and with just a foot resting on the cabin floor, with no attachment to the structure supporting the rear right corner of the seat. The remaining seats in the cabin were intact.

The sliding curtain-style cabin door was found in the fully open position, occupying the section of door track which curved around behind the rear cabin seat. Despite the deformation and partial separation of this seat from its mountings, and its close proximity to the door tracks, it had obstructed neither the tracks nor the door itself.

Survival aspects

It is unlikely that an impact of the sort encountered on contact with the F100 was envisaged during the original design of the DHC-2. Consequently, no specific provision would have been made for protection of the pilot in these circumstances.

Although the forward-facing passenger seat was provided with lap restraints the seated occupants had, immediately prior to impact, decided to lie on the floor. All of the parachutists were essentially unrestrained. The jump master commented that the issue of restraint had been discussed throughout the parachuting community. Additionally, this issue was the subject of three Safety Recommendations arising out of the investigation into the fatal accident to G-BGED. In its response to these recommendations the BPA stated that it considered the dangers arising from becoming entangled in restraining devices during a jump outweighed the theoretical benefits of being restrained in the event of an occurrence on the ground.

GPS data

Track log data covering both the accident takeoff and the previous takeoffs flown by the same pilot earlier in

the day, was downloaded from a GPS unit recovered from the aircraft. The frequency with which these data were logged by the unit was dynamically controlled by algorithms in the unit's controlling software, based on rates of change of height, track, and ground speed. From the data obtained, it was possible to make estimates of the average speed of the aircraft during four consecutive segments of the final take off. This data suggested that during the failed takeoff, the aircraft's average speed during the first 85 m segment had been approximately 5 kt; 17 kt during the following 105 m segment; 51 kt over next 170 m segment; and 50 kt over the final 185 m segment.

Data for the previous, successful, takeoff suggested the average speeds over broadly comparable segments of the take off were: 5 kt, 10 kt, 46 kt (with the aircraft airborne, at around 30 ft agl), and 57 kt (when the aircraft was climbing away).

Runway marks

A number of tyre tracks were visible in the grass at the threshold end of the runway, consistent with a Beaver's main wheel track and tail wheel tyre profile, evidently made by OY-JRR as it was manoeuvred onto the runway and lined-up prior to takeoff. However, it was not possible to identify which of these sets of marks was made during its final takeoff.

Sets of both main and tail wheel tracks from OY-JRR were also visible on the grass runway, but during the early stages of the takeoff roll the marks from the final takeoff could not be differentiated from those made during previous takeoffs by the aircraft that day. Further up the runway, however, one set of tyre tracks began to display differing characteristics from all the others. These distinctions became increasingly apparent as the takeoff progressed, and it was possible to follow these marks right up to where OY-JRR had come to rest. Working forward from the start of the takeoff to the impact with the F100 aircraft, the marks displayed the following changes of character, as the attempted takeoff progressed. (Distances are quoted to the nearest 5 m from the Runway 21 numbers.)

- At 135 m, the tail wheel track started to become more clearly defined; the main wheel tracks remained substantially unchanged.
- Beyond 140 m, the tail wheel track became progressively more pronounced and by 200 m had developed into a deep and clearly defined depression reflecting the characteristic profile of the Beaver's edge-ribbed tyre. The main wheel tracks remained substantially unchanged initially during the period, but then started to lighten perceptibly as the tail wheel track deepened.
- At 205 m, the main wheel tracks became intermittent, and had disappeared completely by 255 m; the tail wheel track remained consistently deep throughout.
- Between 255 m and 380 m no main wheel tracks were present except for a brief contact at 320 m, made by the left main wheel tyre with brake applied. The tail wheel track remained consistently deep throughout.
- At 380 m, the tail wheel track disappeared abruptly, and was replaced by a series of intermittent marks from by both main wheel tyres, made with the brakes applied. These intermittent braked main wheel marks continued to 400 m, with no tail wheel track visible.

- From 400 m onwards, the intermittent (braked) main wheel tracks became continuous, with evidence of wheel-locking at 430 m; they remained locked thereafter until impact with the F100, which occurred approximately 550 m from the start of the takeoff roll. No tail wheel mark was present at any stage during this period except at the point of impact with the F100 aircraft, when it dropped back into contact with the ground.

- Until very shortly before impact with the F100, OY-JRR followed a substantially straight track directly towards the centre of the F100. Some 40 m before impact the tracks start to deviate to the right and thereafter continued in a tightening curve to the right, up to the point of impact.

- At the point of initial contact with the F100 aircraft, there was a clearly defined imprint, and a subsequent skid laterally to the right, made by the tail wheel as it dropped to the ground and was dragged sideways during the impact sequence. The geometry of these marks showed that when it collided with the F100, OY-JRR had been yawed some 10º to right of its track over the ground track, sideslipping 10º left.

Photographic evidence

Photographs taken by a witness who saw the aircraft during the initial stage of its takeoff roll showed the aircraft's flaps in the retracted position.

Aircraft operation

The Airplane Flight Manual (AFM) for OY-JRR contained normal and abnormal operating procedures. The *'Normal Operating Procedures'* section contained a statement that, before takeoff, the flaps should be set to the TAKE-OFF position. It did not contain any information regarding takeoff performance with any other flap setting. The *'Performance Information'* section of the AFM contained a chart showing the takeoff performance of the aircraft according to weight and environmental factors which noted, as an 'associated condition', that the flaps should be set at TAKE-OFF (35°). The distance required to stop the aircraft following an aborted takeoff was not shown.

A checklist found in the cockpit, entitled *'OY-JRR DHC-Mk3 Turbo Beaver Check list'*, contained abbreviated normal and emergency procedures. The section entitled *'Taxi'*, which would have been the last such check accomplished prior to a normal takeoff, contained the item:

'Flap……Set for T/O'

indicating that the flaps should be set to the TAKE-OFF position prior to commencing the takeoff run.

Some aircraft are fitted with a system which, independently of the flap position indicator, will provide a warning that the aircraft is not in the correct configuration for takeoff. The warning is usual aural and may be accompanied by a warning light. No such system is fitted to the Turbo-Beaver.

The organisation holding design authority for this type was unable to provide information regarding performance during takeoff with the flaps in the UP position, commenting that this configuration was "outside the normal flight envelope", and that it was not considered for the development of performance charts or normal procedures for insertion in the Flight Manual.

Pilot training

The pilot was trained by the owner of the aircraft. The training syllabus included familiarisation with the aircraft and its systems and consideration of normal and abnormal operating procedures. A takeoff with the flaps in the UP position was not included in the syllabus and was not demonstrated to the pilot. The owner had made several takeoffs from long hard surface runways with cruise flap set and noted that, whereas the aircraft was "extremely short field capable" with takeoff flap set, it was "very difficult to get airborne" without it.

Operation from unlicensed runways

Article 126 of the Air Navigation Order (ANO) is applicable to operation of the Turbo-Beaver and states that:

> *'aircraft flown for public transport shall takeoff and land at a licensed aerodrome'*

Article 157 of the ANO states that:

> *an aircraft shall be deemed to fly for the purposes of public transport if valuable consideration is given or promised for the carriage of passengers or cargo in the aircraft on that flight.*

Such valuable consideration was given or promised for the carriage of several of the occupants of OY-JRR, in the sense that they had paid to conduct the parachuting operations that necessarily involved their carriage in this aircraft. However, Article 163 *'Public transport and aerial work – exceptions- parachuting'* states that:

> *'A flight shall be deemed to be for the purpose of aerial work if it is a flight in respect of which valuable consideration has been given or promised for the carriage of passengers and which is for the purpose of:*
>
> *(a) the dropping of persons by parachute and which is made under and in accordance with the terms of a parachuting permission granted by the CAA under article 67.'*

There is no requirement for aerial work to be conducted from a licensed aerodrome. Consequently, operation of this flight from an unlicensed runway was in accordance with the provisions of the ANO.

CAP 428 – *'Safety standards at unlicensed aerodromes'*, published by the CAA, is a guidance document for the operation of unlicensed aerodromes. Its contents are not mandatory. It states, in relation to the following topics:

> *'Runway markings*
>
> *The usable parts of hard runways (if all of the hard area cannot be used) and of grass runways may be edged with white rectangular paint markings or marker boards, flush with the runway surface, each 3 metres long and 1 metre wide, at intervals of not more than 90 metres. Alternatively, suitable elevated frangible markers, such as traffic cones at the same spacing may be used. The ends of the usable runway may be indicated with similar paint or markers at right angles to, and adjoining the end lateral markers.*
>
> *Where operations are not confined to marked, paved or unpaved runways, the limits of the usable area may be marked in a similar way, i.e. 3 metre by 1 metre markers spaced at intervals of not more than 90 metres around the perimeter.'*
>
> *Obstacles*
>
> *'Anything that, because of its height or position, could be a hazard to an aeroplane landing or*

taking off, and which cannot be removed, should be conspicuous and marked if necessary.'

Aircraft parking

If designated parking areas are provided:

a) They should not be sited under aircraft flight paths or within the runway strip, and should have barriers and notices warning against unauthorized entry.

b) Suitable fire extinguishers should be available in areas where aircraft engines are started.

Aircraft performance

'Pilots must also check that the runway surface is suitable for use by their aircraft type, and that there is sufficient distance for the takeoff or landing and to abort the takeoff if necessary.'

Analysis

Engineering aspects

Both the wreckage and photographic evidence indicate that the takeoff was initiated with the flaps fully retracted, and that they remained so throughout. There was no evidence to suggest that there had been any malfunction or failure of the engine or the propeller. Indeed, the GPS data shows that the aircraft accelerated normally and had achieved a velocity somewhat in excess of that achieved at a comparable stage during the previous takeoff, at which stage it was climbing through about 30 ft. The changing character of the tyre marks left on the runway suggests that as the expected lift off point was approached, the pilot had been increasingly trying to pull the aircraft off the ground, and indeed that the aircraft had almost lifted off. The evidence for this is the deeply imprinted tail wheel track and ultimately, briefly, the absence of main wheel tracks.

However, when the aircraft failed to lift off cleanly the pilot apparently decided to abort the takeoff. During the abort phase, the tail was up and the wheel brakes applied heavily – sufficiently to lock the wheels for much of the time. There was no evidence available from which either the propeller pitch or engine power settings used prior to impact could be determined, but a study of the acceleration and abort profiles illustrated by the graphic at Figure 2 suggests that it would not have been possible to stop the aircraft before reaching the airfield boundary.

Figure 2 shows a range of speed profiles broadly compatible with the average acceleration segment speeds from the GPS data, giving a range of terminal speeds (at impact with the F100 aircraft). Those profiles having terminated at a high impact speed with the F100 also fit well with the average segment speeds for both acceleration and abort phases. Those profiles giving an impact speed below about 35 kt do not make for a very convincing fit with the final average speed block, suggesting that the maximum speed obtained was more likely to have been 52 - 53 kt than the 60 kt which lower impact speed profile would imply. An abort speed of 52 - 53 kt is also consistent with the tyre track evidence, which suggest that the aircraft was marginally wing-borne at that stage. (No lift off speed is given by the manufacturer for a takeoff without flap, but the flaps-up stall speed of 52 kt would equate to a ground speed, in this case, of the order of 51 kt.) It is also the case that the principal decelerative forces acting on the aircraft comprising the combination of main wheel braking and, if used, reverse thrust, would not have been capable of slowing the aircraft significantly, and certainly not below 25 kt at impact.

The initial application of brakes during the early stages of the abort in particular, and indeed subsequently,

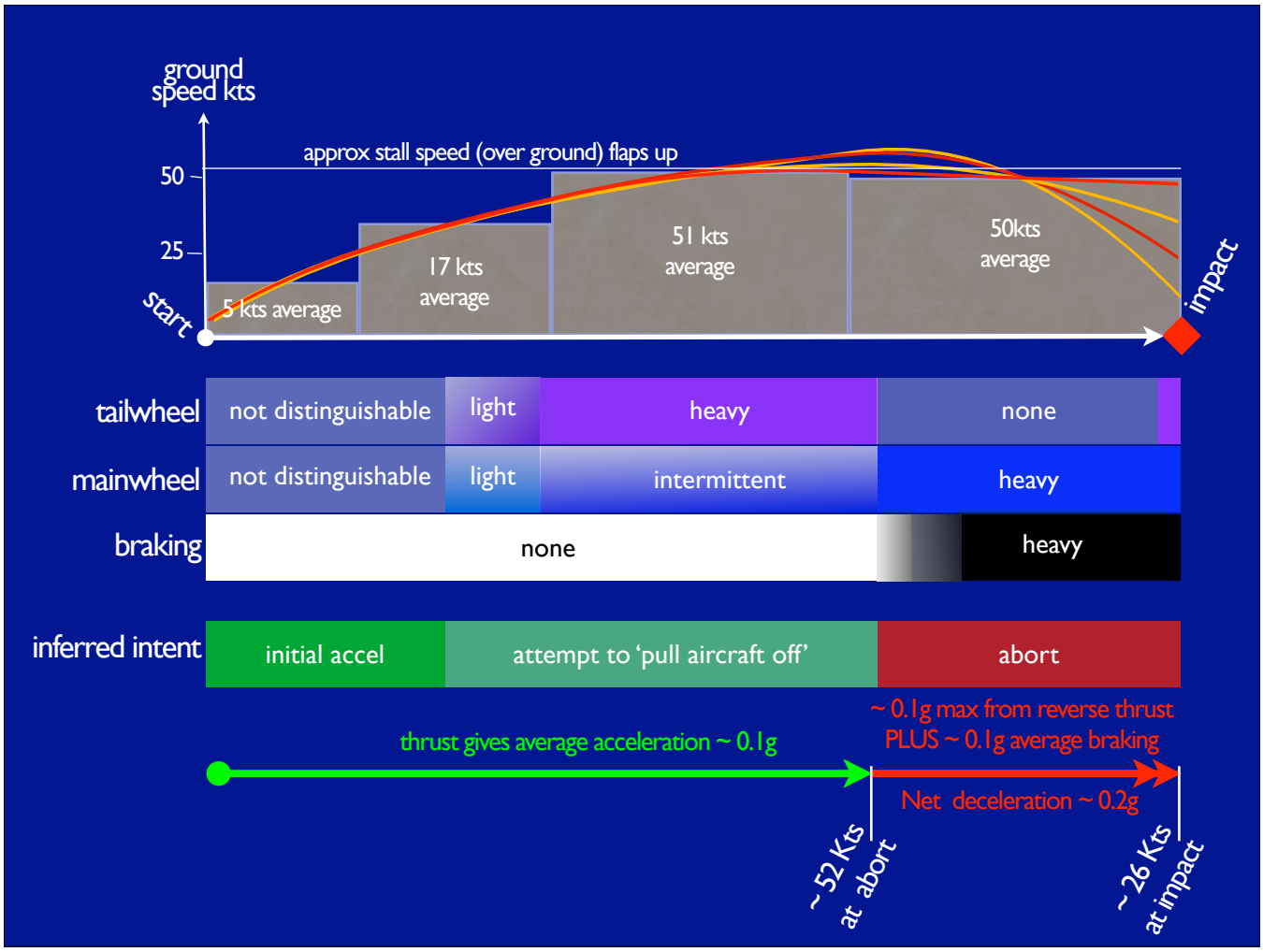

Figure 2

Possible speed profiles

would have had very little effect because with the aircraft almost wing-borne very little weight would have acted on the main wheels. The retardation force acting on the aircraft derives from the slip resistance (friction) developed between the tyre and the ground, and is directly proportional to the weight borne by that wheel. If the aircraft was 90% wing-borne, therefore, the braking force available to slow the aircraft will be only 10% of that available with no lift being developed by the wings. Even with no lift and the whole of the aircraft's weight being carried by the main wheels, the braking coefficient on grass is not likely to have exceeded 0.2 (giving approximately 0.2g deceleration).

Reverse thrust would, if used, have contributed to the aircraft's deceleration. The GPS data suggests that the net forward thrust prior to the abort gave an acceleration of approximately 0.1g, and it therefore follows that at best (had the reverse pitch propeller efficiency been comparable to that during forward thrust, which it certainly would not have been), reverse thrust could not have contributed more than 0.1g to the aircraft's overall deceleration. Following an abort at 52 kt, deceleration of 0.1g from braking and 0.1g from reverse thrust, both significantly optimistic assumptions in the circumstances, would give an impact speed of the order of 26 kt.

In summary, the evidence shows that if the flaps had been set correctly for takeoff, the aircraft could have lifted off and climbed away safely, as it had done during the previous flights that day. Because the flaps were not set correctly, the aircraft did not become airborne as expected, and this was evidently the trigger for the pilot's decision to abort. From that position on the runway, ie the abort point, there was insufficient distance, by a significant margin, to permit the aircraft to be brought to rest before over-running the airfield boundary or colliding with the static museum aircraft parked adjacent to it. In relation to these static aircraft, it was notable that, viewed from a distance on the runway, they visually merged into the background and were very difficult to pick out until at close range. This was probably the reason for the very late attempt by the pilot to take avoiding action, by jinking to the right shortly before impact.

Operational aspects

The pilot's training was probably adequate for the normal and abnormal circumstances envisaged by his instructor. However, the pilot was not familiar with the handling or performance characteristics of the aircraft during takeoff with the flaps in the UP position and consequently he may not have identified that the aircraft was in the wrong configuration for takeoff. The design authority for this type considered that this configuration was "outside the normal flight envelope" and had produced no performance charts or procedures for its use. In such circumstances, it is essential that the pilot follows the published procedures and positively ensures that the aircraft is correctly configured for takeoff.

Impact with the F100 aircraft occurred approximately 550 m from the start of the takeoff roll. This coincided roughly with the end of the runway as depicted in one of the commercially available aerodrome guides, but was beyond what the aerodrome operator considered to be the end of the runway. The use of an unlicensed runway for this operation was in accordance with the ANO in force at the time of the accident. The fact that the aircraft had operated regularly from Runway 21, without incident, indicated that it was possible to do so safely. The dimensions of an unlicensed runway are not necessarily defined. In the case of Runway 21 at Headcorn the presence of parked aircraft in what might otherwise have been an overrun area made it difficult to judge the actual distance available for each takeoff. Furthermore, the lack of markings to define the southern end of the runway made it difficult for aircraft parking or manoeuvring adjacent to the runway to ensure that they did not enter it. The presence of runway end markings such as those suggested in CAP 428 would assist in both cases. Therefore, the following Safety Recommendation was made.

Safety Recommendation 2007–098

It is recommended that Headcorn Aerodrome should install markings that indicate the southern end of Runway 21.

Aircraft involved in parachuting regularly operate from unlicensed runways and there is no evidence to suggest that to do so is inherently more dangerous than operating from licensed runways. Any requirement to conduct parachute operations from licensed runways could therefore restrict the sport without any commensurate improvement in safety. In relation to runway edge and obstacle markings, the guidance contained in CAP 428 emulates the requirements of CAP 168 in respect of licensing of runways, the physical characteristics of which afford additional protection to public transport operations. However, Headcorn Airfield would not necessarily consult CAP 428, as Headcorn is a licensed aerodrome, albeit one that also operates an unlicensed

runway. Whereas the operation undertaken by OY-JRR was defined as aerial work, and may therefore operate from unlicensed runways, it is reasonable to expect some level of protection for members of the public for whose carriage valuable consideration has been given. Moreover, it is possible that had the pilot seen the F100 aircraft earlier in the aborted takeoff he may have been able to avoid striking it with the cockpit of his aircraft. Accordingly, the following Safety Recommendation was made.

Safety Recommendation 2007–099

It is recommended that the Civil Aviation Authority should review the requirement to provide runway edge and obstacle markings for unlicensed runways from which aerial work operations are conducted.

Aircraft are often manoeuvred or taxied in the area south of what the aerodrome operator considered to be the southern end of Runway 21. The absence of such aircraft immediately in the path of the Turbo-Beaver was entirely fortuitous because their presence in that area was not expressly forbidden during operation of Runway 21. Therefore, the following Safety Recommendation was made.

Safety Recommendation 2007–100

It is recommended that Headcorn Aerodrome should amend the Operating Procedures section of the Headcorn Aerodrome Manual to prevent any aircraft entering Runway 21 or its overrun when an aircraft is taking off or landing on Runway 21.