AAIB Bulletin No: 4/2005 **Ref: EW/C2004/03/03** **Category: 1.2**

Aircraft Type and Registration:	Cessna T310R, G-OGTX
No & Type of Engines:	2 Continental TSIO-520-B piston engines
Year of Manufacture:	1977
Date & Time (UTC):	13 March 2004 at 1155 hrs
Location:	Hotham, South Cave, Humberside
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - 2 (Fatal) Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licences:	UK Basic Commercial Pilot's Licence with Instructor rating and multi-engine examiner authorisation and FAA Airline Transport Pilot Licence with Flight Instructor Certificate
Commander's Age:	63 years
Commander's Flying Experience:	20,283 hours (of which 893 were on type) Last 90 days - 79 hours Last 28 days - 31 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft departed from Humberside Airport on an instructional flight and was being flown in clear air at medium level when radar contact was lost. Shortly afterwards it impacted the ground in a steep nose-down attitude at high speed which killed both pilots on board.

Background

The pilot under instruction was employed to fly this particular aircraft by the company that owned it. He had a total of 710 hours flying time with approximately 400 hours flying this specific aircraft. He held a current Joint Aviation Authorities (JAA) Commercial Pilot's Licence and Instrument Rating (CPL/IR) but the company was also planning to operate a United States registered Beech 200 Kingair. In order to fly this aircraft commercially within Europe without placing it on the UK register, it was necessary for the pilot to obtain a Federal Aviation Authority (FAA) CPL/IR. Part of

this licensing procedure involved a flying test with a FAA licensed examiner. Due to his experience, the pilot was required to undertake the minimum period of six hours mandatory instruction with an FAA licensed instructor prior to taking this test. It was during this period of instruction that the accident occurred.

History of flight

Three days before the accident, the company pilot flew the aircraft to Humberside Airport to undertake the instructional course. Over the next two days, he completed four flights with the FAA licensed instructor.

Immediately before the accident flight, the two pilots briefed together and 'booked out' with ATC by telephone. The instructor, who was also the commander, told the air traffic assistant that they intended *'to fly to the northwest for a while before returning to fly a couple of approaches'*. The aircraft had been refuelled the previous evening with 120 US gallons, which is almost full capacity.

They took off at 1139 hrs after requesting permission to practise an engine failure after takeoff. Although when airborne no radio call was made confirming the practise engine failure, the duty Air Traffic Control Officer noticed a reduction in the climb rate when the aircraft was at approximately 300 feet agl before the normal rate was restored about two miles later. At 1141 hrs, radio contact was established with Humberside Radar and the instructor stated that their intention was to fly to the northwest, climbing to 3,000 feet. Seven minutes later the instructor transmitted 'CLIMBING TO OPERATE BETWEEN THREE AND FIVE THOUSAND FEET'. Nothing further was heard from the aircraft and at 1157 hrs, the radar controller, having lost primary and secondary radar contact, attempted to make radio contact without success. At about the same time, eyewitnesses reported an aircraft crashing in the same area as radar contact was lost.

Radar recordings

Radar heads situated at Claxby and Great Dun Fell recorded much of the aircraft's flightpath. The recorded radar returns show the aircraft flying west from Humberside Airport for 7 nm before turning northwards to the Humber estuary. An orbit was carried out at approximately 3,000 feet altitude before the northerly track was resumed and the aircraft climbed to approximately 4,000 feet. The wind at altitude was westerly at 25 kt. Allowance for the wind was applied to the radar data to derive the equivalent 'still air' flight path, thus removing wind effect from the manoeuvres depicted by the radar plot. The entire 'still air' flight path is depicted at Figure 1 and the final three minutes of the flightpath is shown, together with associated altitudes and approximate airspeeds, at Figure 2.

The final leg began with the aircraft at an airspeed of approximately 100 kt TAS and its speed accelerated throughout the remainder of the leg to about 150 kt TAS when radar contact was lost. The last recorded altitude of the aircraft was 3,200 feet.

A test flight was flown over the same area in order to establish the base of the radar cover. This figure will vary from day to day depending on the atmospheric pressure setting and the aircraft's aspect to the radar head. However, 700 feet altitude was established as an approximate base. Although the precise elapsed time from the last radar contact to ground impact is not known, the aircraft was not detected by the next radar sweep, which was eight seconds later. If the aircraft had already descended below the base of the radar cover, it would have averaged a rate of descent during that time of over 18,000 feet per minute.

Witness information

Several people witnessed this accident at relatively close range. Due to a low cloud base, the engine noise was generally heard first and described as 'normal' with little variation in power setting. A subsequent increase in the noise level prompted several witnesses to look up and the aircraft was seen exiting the cloud base in an approximately 45° nose-down attitude, wings-level and travelling "extremely quickly". Approximately 5 seconds elapsed until the impact and during this period, only one witness reported any sign of attempted recovery from the dive. Nothing was seen to fall from the aircraft and no pre-impact smoke or fire was observed.

During the evening before the accident, the company pilot held a telephone conversation with his partner during which he discussed that day's training flights. He told her that "*he was learning a lot more about the aircraft and enjoying the whole experience"* and that his instructor had said he would have *"no problem in passing his flying tests"*. He also described how the instructor had demonstrated a stall that was *"almost nose up"* during which they entered cloud. Generally she described his manner as cheerful and enthusiastic.

Meteorology

An aftercast from the Meteorological Office showed a light to moderate, rather moist westerly airflow covering eastern England. The reported weather at Humberside Airport for 1150 hrs was a wind of 220°/10 kt, a visibility of 3,000 metres in light rain and a broken cloud base at 1,000 feet. An airborne message from another aircraft stated that the cloud tops were at 2,400 feet. The commander also called his company operations to advise them that the cloud tops were at 2,000 feet.

Pathology

Although it was not physically possible to determine the presence of any pre-existing disease, it was established that there was no evidence of any toxicological factors in either pilot that may have contributed to the cause of this accident.

FAA CPL/IR training

The instructor operated a flying school that trained students for Joint Aviation Regulations (JAR) Private Pilot Licences and FAA Commercial Pilot's Licences and Instrument Ratings. The instructor last renewed his JAR examiner authorisation, which included a flight test, on 14 January 2004.

The school was registered with the JAA for the purpose of private pilot licence training. However, because it did not offer JAR commercial pilot training it neither required nor held Flying Training Organisation (FTO) status. This meant that an annual physical inspection from a JAR inspector was not required. Moreover, under Federal Aviation Regulations (FARs), FAA commercial licence training can be conducted in the UK without requiring the school to be approved provided that the instructor has a current FAA Flight Instructor Certificate and the school operates under FAR Part 61. FAR 61.197 entitled 'Renewal of Flight Instructor Certificates', states that a person who holds a flight instructor certificate may renew it without taking a practical test by presenting the following to an authorised FAA Flight Standards Inspector:

(i) 'a record of training students showing that, during the preceding 24 calendar months, the flight instructor has endorsed at least five students for a practical test for a certificate or rating and at least 80% of those students passed that test on the first attempt;

(ii) a record showing that, within the preceding 24 calendar months, the flight instructor has served as a company check pilot, chief flight instructor, company check airman or flight instructor in a Part 121 or Part 135 operation or in a position involving the regular evaluation of pilots; or

(iii) a graduation certificate showing that, within the preceding 3 calendar months, the person has successfully completed an approved flight instructor refresher course consisting of ground training or flight training or a combination of both.'

The instructor involved in this accident renewed his Flight Instructor Certificate on the previous two occasions by completing a ground-based Flight Instructor Refresher Course in the USA. Once issued, a certificate remains valid for 24 months.

The FAA published Advisory Circular No. 61-67C on 25 September 2000 which stated in para 200:

> *'Stall demonstrations and practice, including manoeuvres during slow flight and other manoeuvres with distractions that can lead to inadvertent stalls should be conducted at sufficient altitude to enable recovery by 3,000 feet agl in multi-engine aircraft'.*

Aircraft description

G-OGTX was a Cessna T310 with two turbocharged, fuel injected, direct drive, air cooled, horizontally opposed, six cylinder engines each with a hydraulically actuated three-bladed constant speed, fully feathering propeller. Fuel was stored in wing tip tanks and bag tanks fitted in the wings. The aircraft had six seats with the main cabin door located on the right hand side above the wing adjacent to the co-pilot's seat. The pilot's side window, which included an integrally mounted foul weather window (sometimes called a Direct Vision or DV window) was designed such that it could be removed in an emergency. Operation of a red emergency 'pull ring' retracted retainers located around the top of the window frame and allowed the complete window to be pushed out.

On-site wreckage examination

The aircraft had impacted the ground at high speed, in a nose-down attitude of approximately 45º, on a heading of around 110°M. The impact crater contained pieces from the left and right wing tip-tanks and further debris from the structure of both wings. There was a strong smell of fuel around the crater, and some liquid with the visual appearance of fuel was evident at the bottom of the crater, although the wreckage had not burnt. The aircraft had broken up on impact, with items of wreckage thrown forward, creating a large debris field. The furthest items, including some of the cockpit instruments, were some 130 metres from the impact crater.

Some sections from the main cabin door were identified, including the latch mechanism which was closed and locked. Pieces of transparency material from the emergency exit window were found to the left of the wreckage trail, between 40 and 190 metres from the initial impact crater. From their positions relative to the main wreckage it was apparent that these pieces, including the foul weather window, had detached prior to impact. The window surround, including the pins, which were still extended, was found in the main debris field. It is considered probable that the airflow entering via the periphery of the foul weather window during the final high-speed descent, had caused the foul weather window together with the transparency material from the remainder of the side window to blow out; however the structure of the window frame had been retained. Representative amounts of material from each of the other aircraft transparencies were also identified. There was no evidence of a bird strike.

Two propeller blades from each engine were found buried in the impact crater to a depth of around one metre; the remaining blade from each engine had been thrown forward at impact and they were found separately in the main debris field. The blade pitch mechanisms had broken and so no assessment could be made of propeller pitch angle. All the blades showed evidence of rotational scoring associated with high power and damage to the left and right sets of blades was symmetrical. The landing gear and flaps were retracted.

Detailed wreckage examination

The wreckage was recovered to the AAIB's facility at Farnborough for a detailed examination in conjunction with the aircraft manufacturer's representative. There was no evidence of any mechanical failure within the engines.

The aircraft was fitted with two vacuum driven instruments: one artificial horizon and one directional gyro, both fitted in the pilot's instrument panel. The aircraft type's vacuum system includes two engine driven vacuum pumps, one fitted to each engine and each providing vacuum to a common manifold; should either pump fail, a check valve will isolate the inoperative vacuum pump from the system. The gauge also provides failure indicators for the left and right vacuum pumps, these small red buttons are spring loaded to the extended (failed) position. When a normal vacuum is applied to the system from both pumps the failure buttons are pulled below flush with the gauge face. Should insufficient vacuum pressure be sensed at either pump the relevant button will extend. The suction gauge from G-OGTX was recovered; it had been crushed in the impact with the needle indicating a normal five inches vacuum pressure. The red failure buttons had been destroyed.

Neither of the vacuum driven instruments were recovered; however some internal components were identified. These included a gyro, which showed evidence of rotation at impact, consistent with a serviceable vacuum system.

Continuity of the elevator and rudder control systems was confirmed and there was no evidence of any pre-impact disconnection. It was not possible to check the aileron system due to the extensive breakup of the airframe, which also precluded an assessment of the possibility of a flying control restriction due, for example, to a loose article.

Aircraft history

G-OGTX was constructed in 1977 since when it had accumulated around 5,280 hours; it had been placed on the UK register in December 2001. The last maintenance activity was a 50 hour inspection which had been completed on 9 March 2004. There were no outstanding maintenance issues and the pilot had not reported any recent problems with the aircraft.

Analysis

Not withstanding the extensive disruption to the aircraft, there was no evidence of any pre-existing aircraft defects. The aircraft's engines were also delivering symmetrical power at impact suggesting that neither power loss nor power asymmetry were causal factors in this accident. Moreover, the aircraft's final, wings-level dive reported by witnesses was inconsistent with a loss of roll control. Loss of pitch control was more likely but, with the exception of an elevator jam, there was adequate evidence within the wreckage to suggest that loss of elevator or pitch trim control were unlikely explanations. Had the control columns jammed, two experienced pilots should have been able to retain some degree of pitch control using the elevator trim unless the jam occurred during a dive at altitude. Therefore, whilst firm conclusions cannot be drawn, it appears likely that the primary causal factors for the accident were operational rather than technical.

Both pilots were qualified and in current practice on this aircraft type; the instructor in particular had vast experience of this type of aircraft and training operation. There was no record of the intended exercises for the forthcoming flight (and no FAA requirement for a record). Moreover, there was no annotation of their flights on the flying school's authorisation sheets, probably because they were not using a flying school aircraft and there was nothing in the briefing room to indicate the specific composition of the accident flight. Consequently, it was not possible to determine from the radar data where the actual flight profile diverged from the intended flight profile.

There appears to be nothing abnormal regarding the first phase of the accident flight with what seems to be a sensible decision to climb above the low-level cloud layer to operate in clear air. In this area, the pilot is likely to have been practising the stalls, steep turns and 'unusual attitude' elements of the FAA CPL/IR test. Analysis of the recorded radar data shows a region where the speed may have been slow enough to stall the aircraft but it is followed by speed increase in level flight suggesting full recovery from slow flight. There are periods of change of direction in level flight which may be attributable to steep turns. Unusual attitude entry and recovery generally involve significant speed change with manoeuvring in the vertical plane and it is a requirement to complete the recovery using 'limited panel' instruments, ie without reference to the artificial horizon. There does appear to be some vertical manoeuvring during the last few radar contacts that may possibly have arisen from unusual attitude entry or recovery. However it is also possible that the recorded height may be incorrect due to static pressure errors induced by an aircraft that was already out of control.

The general handling content of the FAA CPL/IR is very similar to that of the UK CPL/IR which the company pilot had recently renewed and it seems unlikely that he would have required much additional general handling training or practice. If the aircraft was being flown within the syllabus requirements there is no reason to suspect that two such experienced pilots would lose control. In

light of the conversation that the company pilot held with his long-term partner, it may be that they were manoeuvring at more extreme attitudes and either lost control or allowed such a nose-low attitude to develop that they had insufficient height to recover. In either case it is likely that the cloud layer beneath them hindered rapid recognition of the problem and/or recovery from a loss of control. The difficulty in recognising the aircraft's predicament would have been exacerbated if the artificial horizon had toppled and an extreme attitude had developed.

Recommended minimum altitude for abnormal manoeuvres

The FAA advice to complete certain manoeuvres at sufficient altitude to enable recovery by 3,000 feet agl does not take account of the additional risks encountered by inadvertently entering cloud during a manoeuvre and thereby losing potentially vital spatial orientation references during recovery. Whatever the reason for the loss of control during this flight, it would have been prudent to have conducted these exercises with a greater margin than 2,000 feet from the cloud tops. Also, from an entry altitude of 4,400 feet, the FAA's advice to **complete** manoeuvring tasks involving slow flight or distractions by 3,000 feet agl could be compromised if a nose-low attitude was allowed to develop.

The minimum suitable height for abnormal manoeuvres depends on many factors, not least the manoeuvre intended and the risks of that manoeuvre developing into an unintended and more extreme manoeuvre. Consequently, the minimum entry height for abnormal manoeuvres is best determined by 'airmanship'. Therefore, no formal safety recommendation on this aspect has been made.

Flying training in the UK for FAA licences

Although there was no connection between this accident and the conduct of flight training to FAA standards in the UK, during this investigation it was established that flying schools conducting FAA professional pilots' licence training in the UK under FAR Part 61, do not require FAA approval. This is inconsistent with the JAA requirement for all flying schools in the USA conducting training towards JAR licences to be approved.

The AAIB is concerned that any flying school may conduct training towards an FAA CPL/IR with no regulatory oversight other than issue of the individual instructor's certificate; that certificate may be renewed legally without a practical test of instructor proficiency. A pilot issued with an FAA CPL/IR may then operate USA registered aircraft commercially within UK airspace.

Under new USA rules, in place as of 20 October 2004, all foreign nationals taking any flight training in the USA, on any size of aircraft, now have to submit to a security clearance procedure in advance

and pay additional fees for security clearance. These rules include foreign nationals seeking *'ab initio'* training, glider and balloon training, and even factory courses on new aircraft types as part of an aircraft purchase. Consequently, the demand for flight training and testing for FAA licences within the UK is likely to increase. Therefore, it is recommended that:

Safety Recommendation 2005-001

The Federal Aviation Administration (FAA) of the USA should require all flying training performed in the United Kingdom for the award of FAA professional pilots' licences to be conducted by flying training organisations that have been evaluated and approved by the FAA.

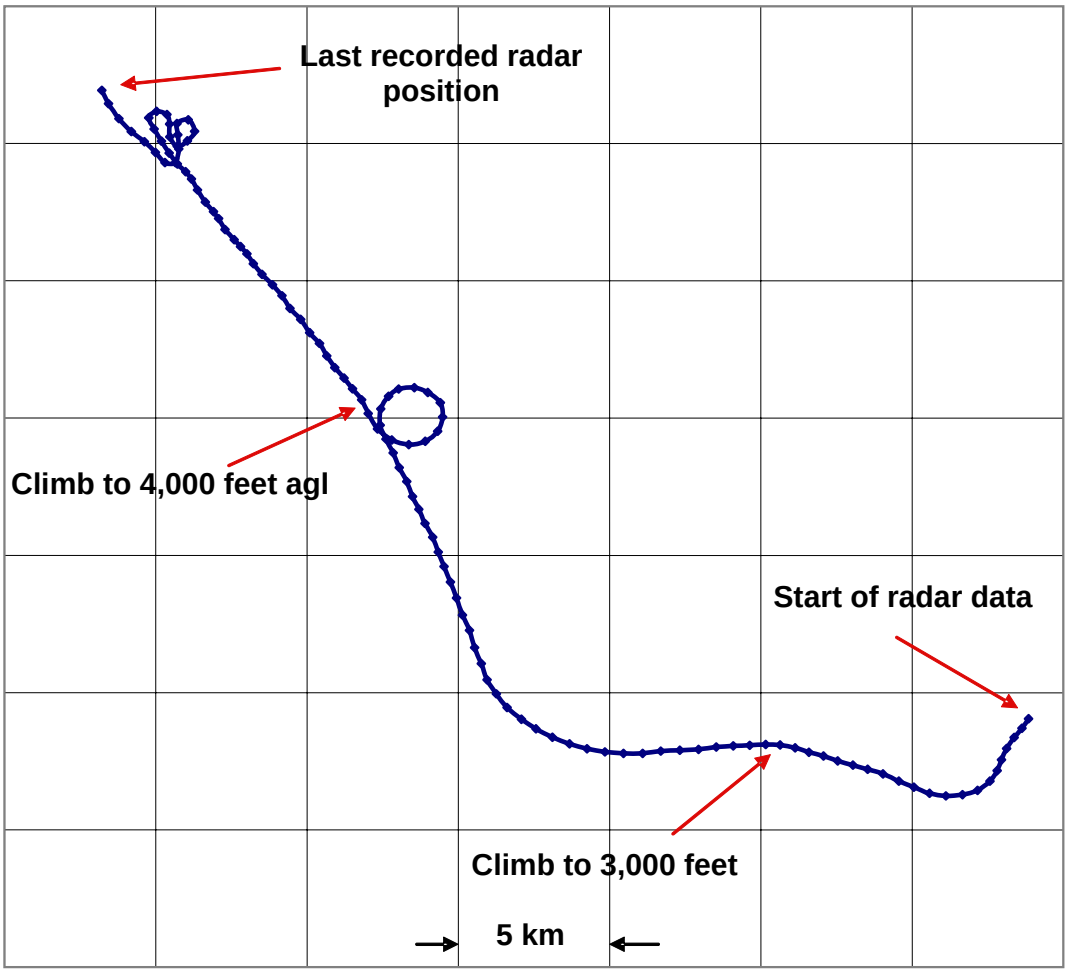

Figure 1 - Still Air Plot of Complete Flight

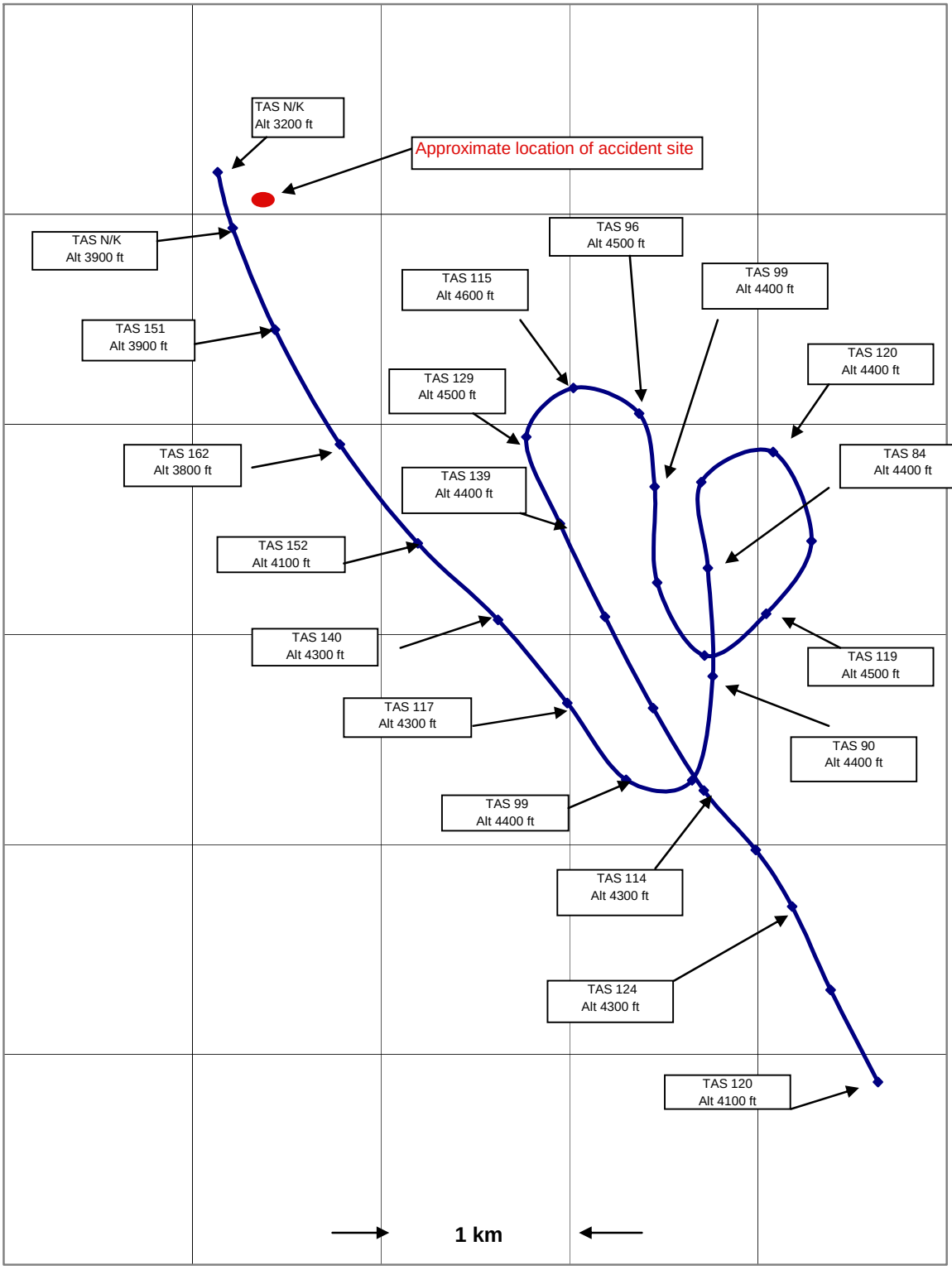

Figure 2 - Final Still Air Manoeuvring