

Accidents Investigation Branch

Department of Transport

**Report on the mid-air collision between
Cessna F150M G-BFEL and a
United States Air Force A-10A near
Hardwick, Norfolk
on 29 February 1984**

LONDON

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5/85	Mid-air collision between Cessna F150M G-BFEL and a United States Air Force A-10A near Hardwick, Norfolk on 29 February 1984	

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Department of Transport
Accidents Investigation Branch
Royal Aircraft Establishment
Farnborough
Hants GU14 6TD

13 January 1986

The Rt Honourable Nicholas Ridley
Secretary of State for Transport

Sir,

I have the honour to submit the report by Mr M M Charles, an Inspector of Accidents, on the circumstances of the mid-air collision between a Cessna F150M G-BFEL and a United States Air Force A-10A, which occurred near Hardwick, Norfolk on 29 February 1984.

I have the honour to be
Sir
Your obedient Servant

G C WILKINSON
Chief Inspector of Accidents

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Accidents Investigation Branch

**Aircraft Accident Report No. 5/85
(EW/E23)**

Aircraft: (1)

Registered owner: Albert Louis Strongman
Operator: Anglian Flight Training Ltd
Type: Reims Cessna
Model: F 150 M
Registration: G-BFEL

Aircraft: (2)

Owner and operator: United States Air Force
Type: Fairchild Republic
Model: A-10A Thunderbolt
Registration: A-10A-80-0180
Place of accident: Near Hardwick, Norfolk
Latitude: 52° 28' N
Longitude: 001° 15' E
Date: 29 February 1984
Time (GMT): 1528 hrs

Synopsis

The accident was notified to the Accidents Investigation Branch on the afternoon of the accident and the investigation was commenced the same day.

The Cessna 150, flown by a student pilot, was on a triangular cross-country training flight from Norwich. The A-10, operated by the United States Air Force, was flying from RAF Woodbridge in Suffolk to the weapons ranges off the east coast. The collision occurred almost head on approximately 10 miles south of Norwich at an altitude of 1000 to 1200 feet above sea level in uncontrolled airspace. The aircraft were flying in visual meteorological conditions, operating on different radio frequencies and neither aircraft was under positive air traffic control. Following the collision the Cessna fell nearly vertically to the ground, killing the pilot, and the A-10 was able to return to RAF Woodbridge and make a safe landing.

It is concluded that the collision was caused by the failure of the A-10 pilot to see and avoid the Cessna 150 and, equally by the failure of the student pilot of the Cessna to see the A-10 in sufficient time to take effective avoiding action.

1. Factual Information

1.1 History of the flight

The pilot of the Cessna 150 was a student pilot from a flying training school based at Norwich Airport who was carrying out a triangular cross-country flight from Norwich to Diss, Southwold and return to Norwich. He had flown over the route with his instructors on two previous occasions but this was to be his first solo cross-country flight.

The weather forecast for the area of the route was of generally hazy conditions with a surface visibility of 4 to 8 km, 7 oktas of strato-cumulus cloud at a base of 1800 ft and a westerly wind of 15 knots at 2000 ft. The magnetic track of the first leg of the route to Diss was 205°. Prior to take-off, the pilot had made a navigational plan to allow for the effect of the wind over the route but had overcompensated for the wind on this leg and had calculated a heading to steer of 219° whereas a heading of 214° would have been more appropriate.

The pilot took-off from Norwich at 1515 hrs and at 1518 hrs advised the Norwich Approach controller that he was flying at 1500 ft. At 1523 hrs, the controller advised him to call Honington which he did at 1524 hrs reporting that he was "Just south of Hethel, heading 150 at 1500 ft, VFR, Norwich to Diss". The Honington Zone controller cleared him to continue VFR at 1500 ft on the Zone QFE of 1009 and to advise when turning at Diss. The pilot replied "..... roger continue VFR at 1500 feet. Zone QFE 009" after which no further radio calls were received from the aircraft.

A fellow student from the flying school and with a similar amount of flying experience had flown the same route about 20 minutes earlier. He flew from Norwich to Diss at 1800 ft, just below the cloud base and had found no difficulty in following the route although he reduced his height on the later legs to 1500 ft where he found the visibility was improved.

Two single seat A-10 aircraft of the United States Air Force took-off from RAF Woodbridge in Suffolk at 1522 hrs for a training exercise involving weapon delivery on the east coast firing ranges. The pilots' intentions were to operate as a flight of two aircraft and to cross East Anglia flying at 270 knots at 1000 ft above ground level (agl). Their intended route was from Woodbridge to Debach, to the disused airfield at Thorpe Abbots and then between the airfields of Tibenham and Hardwick before turning to the west near the prominent radio mast at Tacolneston and proceeding towards Marham. The intended routes of both the Cessna 150 and the A-10 aircraft are shown at Appendix 1.

The normal tactical role for the A-10 aircraft is to operate in pairs, the leading aircraft having the primary role of navigation while the second aircraft, flying a mile behind and to the side of the leader, is mainly responsible for lookout in all directions. On this occasion, as the pilot of the leading aircraft approached Thorpe Abbots airfield, he checked the position of his wingman, checked the airspace ahead and to the left and then looked down to change the radio to the Marham Approach frequency. During this frequency change he heard and felt a loud thud on the right hand side of the aircraft and thought that he had hit a large bird. He noted that there was some visible damage to the leading edge slat on the right wing.

The wingman had been checking for other aircraft approaching them from the rear and had looked forward to see his leader hit a light aircraft and that aircraft then fall vertically into farmland. The wingman closed-up to the leader to inspect the leader's aircraft for damage while they circled the accident site. After then transmitting a distress call which was acknowledged by London Air Traffic Control Centre, the two A-10 aircraft returned to RAF Woodbridge where the damaged aircraft landed safely. When the aircraft was examined it was found that 4 out of the 6 practice 25 lb bombs that the aircraft had been carrying on under wing racks were missing.

1.2 Injuries to persons

(a) Cessna 150 G-BFEL

Injuries	Crew	Passengers	Others
Fatal	1	—	—
Serious	—	—	—
Minor/None	—	—	—

(b) A-10A-80-0180

Injuries	Crew	Passengers	Others
Fatal	—	—	—
Serious	—	—	—
Minor/None	1	—	—

1.3 Damage to aircraft

(a) Cessna 150 : Destroyed

(b) A-10 : Substantially damaged

1.4 Other damage

Nil

1.5 Personnel information

1.5.1 Cessna 150

Pilot:

Male, aged 33

Licence:

No licence. He was permitted to fly as Pilot-in-Command for the purpose of gaining experience for the award of a Private Pilot's Licence by holding a valid Medical Certificate

Medical Certificate: A Class 3 Medical Certificate with no limitations was issued on 15 August 1983 and was valid for 24 months.

Total pilot hours: 29.40

Total hours on type: 29.40

Total solo experience: 3.15

1.5.2 A-10

Pilot: Male, aged 28. Pilot of the United States Air Force

Medical examination: 10 March 1983

Instrument flight check: 19 December 1983

Competency check: 19 December 1983

Total pilot hours: 1,086

Total hours on type: 585

Total hours last 28 days: 3

1.6 **Aircraft Information**

1.6.1 Type: Cessna Reims F 150M

Constructor's Number: 1375

Date of Manufacture: October 1977

Certificate of Registration: Registered in the name of Albert Louis Strongman

Certificate of Airworthiness: Transport Category (Passenger)
Valid until 25 November 1985

Certificate of Maintenance: Issued on 6 February 1984 at 4700 aircraft hours and valid until 4750 hours.

At the start of the flight there were no recorded defects that would affect the airworthiness of the aircraft

Total airframe hours: 4742 hours

Maximum total weight authorised: 1600 lb

Estimated weight at time of accident: 1438 lb

Estimated Centre of Gravity (CG) at time of accident:	34.14 inches aft of datum
CG range applicable:	32.7 to 37.5 inches aft of datum
Fuel:	Prior to the flight, the aircraft had been refuelled to full tanks with 100 LL aviation gasoline. A sample of fuel from the tanker was analysed and shown to conform to the correct specification
1.6.2 Type:	Fairchild Republic A-10A Thunderbolt
Identifying Number:	80-0180
Date of Manufacture:	August 1981
Total airframe hours:	1122
Last maintenance:	972 hours
Next maintenance due:	1172 hours
Aircraft defects:	Twelve "Delayed Discrepancies" were on record for the aircraft at the time of the accident flight and four parts were awaiting replacement under a 'Time Compliances Technical Order'. All of these were minor items and not relevant to aircraft operation or pilot activity at the time of the accident
Maximum take-off weight:	50,000 lb
Weight at the time of the accident:	37,046 lb
Centre of Gravity at the time of the accident:	Within the approved limits

1.7 Meteorological information

1.7.1 Forecast

The forecast issued at Norwich Airport at 1130 hrs on the 29 February covering the local area within 20 miles radius and valid between 1300 hrs and 2200 hrs GMT included the following:

Wind/Temperature :	Surface	230°/07 kt	
	1000'	260°/12 kt	+ 2°
	2000'	270°/15 kt	0°

Cloud : 7/8 Stratocumulus cloud, base 1800 ft top 3500 ft with 5/8 stratus forming during the evening, base 800 ft, top 1500 ft

Visibility : 4000 m to 8km

Weather : Hazy

1.7.2 *Norwich Airport weather observations*

The following weather observations were made at Norwich Airport for the period 1250 to 1550 GMT on 29 February 1984:

Time (hrs)	Wind	Visibility	Cloud cover	QNH
1250	240°/10 kt	6000 metres, haze	7/8 at 2000 ft	1016 mb
1350	240°/10 kt	6000 metres, haze	7/8 at 2000 ft	1016 mb
1450	220°/8 kt	6000 metres, haze	6/8 at 2000 ft	1015 mb
1550	220°/10 kt	6000 metres, haze	7/8 at 1600 ft	1015 mb

1.7.3 *Aftercast*

The following aftercast was prepared by the Meteorological Office for the area of the accident site between 1500–1600 hrs on 29 February 1984.

Situation : A light, stable southwesterly flow covered the area

Wind/Temperature :
Surface 220°/5–10 kt
1000 ft 240°/10 kt + 2°C
2000 ft 250°/12 kt – 1°C

Cloud : 7/8 – 8/8 strato-cumulus layers,
base 1700–2200 ft
tops 3500–4500 ft

Visibility : 4000 to 8 km

Weather : Cloudy and hazy

1.7.4 *In flight estimation of visibility*

At the time of the collision the pilot of the A–10 estimated the visibility to be 7 km.

1.8 Aids to navigation

1.8.1 Cessna 150

The pilot of the Cessna was not using any radio or electronic navigational aids. The navigational exercise required that he used visual reference combined with map reading to follow the route. A student pilot with a similar experience had flown the same route approximately 20 minutes earlier and had reported no difficulty in identifying landmarks in the prevailing conditions.

1.8.2 A-10

The pilot of the USAF A-10 was also flying by visual reference to the ground along what was a familiar route. He had tuned the Coltishall Tactical Air Navigation Equipment (TACAN) and, later, reported the position of the collision to London Air Traffic Control Centre (LATCC) by means of a bearing and distance from this TACAN.

1.9 Communications

1.9.1 Cessna 150

The communications between the pilot of the Cessna G-BFEL and the various Air Traffic Control (ATC) units were recorded and transcripts were made from those recordings. They show that after a routine departure from Norwich Airport, the pilot changed frequency to 'Norwich Approach' at 1518 hrs and passed the information that he was flying at 1500 ft. At 1524 hrs he was changed to the Honington Military Control Zone frequency as his proposed route passed close to the zone boundary. He informed the zone controller that "G-BFEL is a Cessna 150, just south of Hethel, heading 150° at 1500 ft, VFR Norwich to Diss, over". The zone controller cleared him to continue VFR at 1500 ft on the zone QFE of 1009 mb and to advise when turning over Diss. The pilot replied "..... roger continue VFR at 1500 ft Zone QFE 009" after which no further radio calls were received from the aircraft.

1.9.2 A-10

After departing from RAF Woodbridge the pilot of the A-10, as leader of the flight of two aircraft, had changed to a military Ultra-High Frequency (UHF) channel for communication between the two aircraft and with other military aircraft in the vicinity. This was essentially an air-to-air channel and no recordings were made on this frequency. At the time that the collision occurred, the pilot of the leading A-10 was in the process of changing radio frequency to that of RAF Marham Approach. This frequency was recorded and the first communication occurred at 1528 hrs when the leader referred to a "crashed aircraft". At 1529 hrs, the leader made a distress call on the Guard Frequency, 243 MHz, reporting the collision to the London Air Traffic Control Centre.

1.10 Aerodrome and ground facilities

An analysis was made of the film recording of the radar display at Eastern Radar. The quality of the primary radar returns was such that the aircraft tracks and particularly speeds could not be assessed with accuracy at any one point but only by averaging a series of returns. The analysis showed that,

for the 17 miles before the collision, the A-10 had remained within a mile of its planned track and the speed was consistent with the airspeed of 270 knots reported by the pilot. The Cessna had maintained a track of 147° (M) from just south of Hethel at a speed comparable with the planned cruising airspeed of 85 knots. However, for the final minute before the collision the radar returns indicated that the Cessna had turned right approximately 25° and that this had been accompanied by a significant increase in airspeed.

1.11 Flight recorders

Neither aircraft was required to be fitted with any recorder and none was fitted.

1.12 Wreckage and Impact Information

1.12.1 *Crash Site*

The Cessna 150 aircraft, G-BFEL, had descended almost vertically on to open farmland and had been in an inverted nose-down attitude at impact. The complete empennage was missing and the right wing had suffered damage evidently not related to the ground impact. The propeller showed evidence of having been under power at impact.

Further scattered wreckage from the Cessna was found in an area north-east of the main wreckage to a distance of 400 metres. This area also contained two items which were identified as coming from the A-10 aircraft; a piece of leading edge skin from the right tailplane and a nose fairing from a Triple Ejector Rack (TER) positioned under the A-10's right wing.

Four 25 pound practice bombs (smoke cartridge type) were reported missing from the underwing racks on the A-10 and three of these were found, closely grouped, in an area about 1150 metres from the crash site in a direction of approximately 015° (M).

1.12.2 *Examination of Wreckage*

The wreckage of G-BFEL was laid out in front of the A-10 aircraft and the points of contact identified and cross-related. It was found that, when the scattered pieces of the Cessna were assembled, virtually all of the aircraft could be accounted for.

The collision had occurred between the top surfaces and empennage of the Cessna and the lower surfaces of the A-10 including the right main landing gear fairing and the underwing weapons and equipment pylons.

In the collision the Cessna had lost its tail surfaces, together with the supporting fuselage tail structure, and its right wingtip with a section of aileron. The right wing had also suffered a deep gash aft of the main spar which had penetrated downwards through to the underside and severed the flap. Black rubber marks were found which began on the cabin top surface as a light smear with virtually no associated mechanical damage but which were also evident in areas of gross damage on the rear fuselage and the left tailplane. These marks were identified with the half-exposed tyre of the A-10's right main gear. The gash in the Cessna's right wing was identified as being caused

by the A-10's right inner pylon and TER from which three practice bombs were missing. The damage to the Cessna's right wingtip was related to collision with the A-10's left inner pylon and one practice bomb was found missing from the TER at that position. The A-10's right wing leading edge just inboard of the undercarriage pod showed evidence of collision with the fin of the Cessna.

If it assumed that the A-10 was in level flight at the time of impact, then the deep gash in the aft structure and flap of the Cessna's right wing and the contact marks on the cabin roof leading into the catastrophic damage the aircraft's rear fuselage and tail indicate that the Cessna was pitched nose down by 15°-20° relative to the flight path of the A-10.

The initial contact between the two aircraft was between the right elevator tip (mass balance horn) of the Cessna and the nose underside of the A-10; the bulk of G-BFEL being under the A-10 but not yet in contact with its under wing projections. The mass balance horn had scuff damage matching the A-10 contact but the tailplane tip fairing immediately in front of the horn was untouched. This indicated that the horn had been projecting upward and that the elevators had been depressed to a marked degree. This control position was consistent, therefore, with a steep nose down aircraft attitude.

In the horizontal plane the damage on the Cessna showed that the almost head-on approach of the A-10 had been from 15° to the right. Similarly, damage on the leading edge of the A-10's right wing, indicated a relative approach of the Cessna from 5° to the left. A diagram showing the relative position of the aircraft at the moment of the collision is at Appendix 2.

Further examination of the Cessna wreckage revealed no defect or failure which could have been a factor in the accident. No pre-existing failure in the controls could be identified. The altimeter subscale setting was 1016 millibars. The filaments of both the landing and taxi lights in the aircraft's nose had broken while cold, thus indicating that neither had been illuminated. The red anti-collision beacon had been destroyed and no evidence was obtained of its pre-accident condition. The magneto switch was found in the "Both" position. None of the other switch or control positions were considered to be reliable indications of their pre-crash condition.

The A-10 did not suffer any damage which affected its flying behaviour. The starboard engine ingested some small debris but continued to operate.

Height estimates for the point of collision, were made using bomb trajectory data together with the relative positions of the three practice bombs which were found and the rest of the wreckage. The calculated heights ranged from approximately 1,000 feet above ground level to 1,200 feet, giving about 1,200 feet and 1,400 feet above mean sea level respectively. A witness on the ground saw the aircraft immediately before the collision and the collision itself. The view of the witness was restricted to between 2° and 18° above the horizontal and the witness' estimation of the elevation of the collision was measured as being 7.5° above the horizontal. Calculations based on these measurements gave the estimated height of the collision as being 740 feet amsl and a maximum altitude of 1500 feet was established by the 18° vertical limitation.

1.13 Medical and pathological information

A full autopsy and toxicological examination was carried out on the pilot of the Cessna 150. No evidence was found of medical factors which might have caused or contributed to the accident.

1.14 Fire

There was no fire although both Cessna wing fuel tanks were ruptured and almost all the fuel soaked into the ground. Units of the Norfolk Fire Service were in attendance 18 minutes after the accident occurred.

1.15 Survival Aspects

The decelerative forces experienced by the pilot of the Cessna 150 were well beyond human tolerance. The seat belt and diagonal torso strap remained intact although there was gross distortion of the cabin area.

1.16 Tests and research

None

1.17 Additional information

1.17.1 Relevant legislation

1.17.1(a) The Rules of the Air and Air Traffic Control Regulations 1981

Rule 23:

The Visual Flight Rules shall be as follows:-

a) Outside controlled airspace

ii) An aircraft other than a helicopter flying outside controlled airspace at or below 3000 feet above mean sea level shall remain at least 1 nautical mile horizontally and 1000 feet vertically away from cloud and in a flight visibility of at least 3 nautical miles: Provided that this sub paragraph shall be deemed to be complied with if the aircraft is flown at a speed which according to its airspeed indicator is 140 knots or less and remains clear of cloud, in sight of the surface and in a flight visibility of at least 1 nautical mile.

1.17.1(b) The USAF Flying Orders concerning weather limitations for visual flight state that aircraft flying at an indicated speed in excess of 140 knots are to maintain a minimum flight visibility of 5.5 kilometres (3 nautical miles) and at least 1 nautical mile horizontal and 500 feet vertical separation from cloud.

1.17.1(c) The Rules of the Air and Air Traffic Control Regulations 1981

Rules for avoiding aerial collisions

Rule 17(3) Approaching head-on

When two aircraft are approaching head-on or approximately so in the air and there is danger of collision, each shall alter its course to the right.

1.17.2 *Visibility limitations*

At the time of the flight, Anglian Flight Training the operator of the Cessna 150, stipulated the following weather limitations for student pilots in their General Flying Orders:

“2 Weather Minima for Student Pilots

	Cloudbase	Visibility	Max Wind Gusts
Local flying	1500 ft	8 km	25 kt
Crosscountry	2000 ft	10 km	25 kt

Students will also observe a cross-wind limitation of 15 kt.”

The operators have stated that “local flying” in this context included any flying carried out within 25 nm radius of Norwich Airport which did not involve a landing away from Norwich. An amendment was later made to the General Flying Orders to include this definition.

1.17.3 *Military low flying*

The 81st Tactical Fighter Wing of the United States Air Force operating from RAF Woodbridge, Suffolk stipulated a minimum height of 1000 feet for the A-10 aircraft when flying from Woodbridge to the east coast firing ranges. The purpose of the height restriction was to reduce the noise nuisance to the civil population in the area. Since this accident, the minimum height has been reduced to 500 feet with the intention of reducing the risk of collision with civil air traffic.

1.17.4 *UHF radio – A-10 aircraft*

The controller for the aircraft’s UHF radio was situated on the left hand cockpit console, level with the pilot’s left thigh. The controller contained a channel change facility between six preset frequencies to enable rapid reselection by means of a single knob. Other frequencies had to be selected by means of five rotary switches, each selecting one digit of the required frequency. The primary indicators were mounted immediately above each rotary switch but there was also a remote frequency indicator on the left side of the pilot’s main instrument panel.

A recent research project was carried out by the United States Air Force to study the time taken by pilots to perform secondary tasks in the cockpit and to evaluate the degradation of flying accuracy while they did so.

This study had been carried out on the A-10 flight simulator equipped with video cameras incorporating a time reference and using instructor pilots who were well experienced on the aircraft type. One of the tasks given to the pilots had been to change the UHF radio frequency while simultaneously trying to fly at a constant height. The time taken for this task varied from a minimum of 5 seconds to a maximum of 16 seconds with the average time of 9.6 seconds. The height variations from the target height averaged 37 feet with a maximum variation of 100 feet.

1.17.5 Cockpit visibility

Cockpit visibility diagrams were constructed for both aircraft and are shown at Appendix 3.

1.18 New Investigation Techniques

None

2. Analysis

2.1 Introduction

The collision occurred when both aircraft were in cruising flight in uncontrolled airspace with neither aircraft operating under positive Air Traffic Control. The aircraft were working different frequencies with the pilot of the Cessna 150 in communication with the Honington Zone controller and the A-10 aircraft attempting to contact Marham Approach.

There were no recorded defects on either aircraft prior to take-off that would have affected their safe operation. The examination of the Cessna found that the engine was rotating at the time of impact with the ground, and there was no evidence that the aircraft had not been under power and under control when the collision occurred. The pilot was competent in the use of the radio, yet no communications were received that would suggest that he was experiencing any difficulty. In the absence of any medical factor or significant aircraft technical defect, other factors affecting the operation of the two aircraft were considered.

2.2 Collision altitude

The evidence of the one witness to see both of the aircraft immediately before the collision and the collision itself, suggests that the aircraft could have been as low as 740 feet. It was reliably established from this witness' line of sight that the aircraft could not have been higher than 1500 feet.

The Cessna 150 pilot had been given the Norwich QNH of 1015 mb and he had told Norwich ATC that he was flying at 1500 feet. At 1525½ hrs, 2½ minutes before the collision, he had been requested by the Honington Zone controller to fly at 1500 feet on the QFE of 1009 mb. The pilot replied “. . . Roger continue VFR at 1500 feet. Zone QFE 009 . . .”. In the wreckage of the aircraft the altimeter was found to be set to 1016 mb which suggests that, although the pilot had acknowledged the QFE, he did not appreciate that he was expected to fly at 1500 feet on this setting.

Analysis of the radar recording showed an increase in the ground speed of the Cessna during the final minute before the collision. Assuming that a student pilot on a cross-country would be likely to maintain a constant power setting, the increase in speed could be explained by a descent from the cruising altitude of 1500 feet amsl.

Calculation of the trajectories of the practice bombs released from the A-10 at the moment of collision gave a release height of between 1200 and 1400 feet amsl, assuming the aircraft to have been in level flight at the moment of release. Both of the A-10 pilots stated that they were maintaining an altitude of 1000 feet. Their aircraft were fitted with “Head up” display equipment so they would have been able to monitor their heights whilst still looking out of the cockpit.

It was therefore not possible to determine accurately the altitude at which the collision occurred but it is probable that it was between 1000 and 1200 feet amsl.

2.3 Weather conditions

The aftercast from the meteorological office shows that the sky was overcast with a layer of stratocumulus cloud, base 1700 to 1800 feet with the surface visibility varying between 4 and 8 kilometres over the area. The surface visibility at Norwich Airport had been reported as 6 kilometres since 1250 hrs and the local area forecast, issued at Norwich at 1130 hrs, forecast the visibility to vary between 4 and 8 kilometres. The A-10 pilot estimated the in-flight visibility to be 7 kilometres.

The USAF Flying Orders concerning weather limitations for transit flight required the pilot of the A-10 to have an in-flight visibility greater than 5.5 kilometres and at least 1 nautical mile horizontal and 500 feet vertical separation from cloud. The Cessna, flying below 3000 feet and at less than 140 knots, was required by the Rules of the Air to fly in sight of the surface and in a flight visibility of at least 1 nautical mile. There is no reason to doubt therefore, that both aircraft were being correctly operated under their respective regulations.

Minimum flying weather conditions for a student pilot are not specified in the legislation however, the Flying Orders of the flying training school stated that the minimum visibility for local student flying should be 8 kilometres. The decision of the flying school instructor to despatch the student to fly his first solo cross country exercise under the conditions obtaining on that day must be questioned. Although the instructor had himself been flying, and judged the conditions to be suitable, the visibility at Norwich had been consistently reported below the flying school's own minima and the area forecast was for the visibility at times to be only one half of the school's minimum requirement.

2.4 Navigation

The route taken by the A-10 pilot was one frequently used when the aircraft were flown to the east coast firing ranges, and was permanently marked by the pilots on their charts. The route had been chosen to minimise the noise nuisance to the civil population and for this reason the pilots were directed to fly at a minimum of 1000 feet agl when possible. The information that this was a frequently used route was not disseminated to other aviation interests and it is possible that had the flying school known this information they would have chosen different routes for their students to fly on navigational exercises.

At the time of the collision, the Cessna pilot was some 3 miles to the east of his intended track. The miscalculation of the wind drift on the first leg of his route from Norwich to Diss was such that, had he followed it, he would have erred to the west of track. When the pilot reported his position to the Honington Zone controller as "just south of Hethel" he also stated that he was "steering 150°". Since the magnetic track from Norwich to Diss was 205° this reported heading of 150° represents a major course correction. The reason for this may have been that he became aware that he was originally erring to the west of track and made the correction to regain the planned track. The effect of such a large course change and the westerly wind might account for the fact that he soon found himself to the east of track. The radar evidence shows that for the final minute before the collision the Cessna had altered course to the right by approximately 25°. Such a correction would still not even have been sufficient to maintain a track parallel to that originally planned.

It is difficult to assess the actions of a student pilot but the large alterations of heading and the loss of height suggest a possible preoccupation with the problems of navigation in the existing visibility. If such was the case he would have been less able to devote time to accurate flying and in particular to maintaining a good look-out.

2.5 Secondary tasks

The time taken by pilots to carry out tasks such as the monitoring of engine instruments or the tuning of radio equipment is probably longer than most pilots realise. It may be significant that the pilot of the A-10 thought that he had looked down for only 2 seconds prior to the collision while changing the radio frequency. In the simulator exercise conducted by the USAF it was found that 5 seconds was the minimum time taken by any of the pilots to complete this task while the average time was 9.6 seconds.

If the A-10 pilot on this occasion had been looking into the cockpit for the 5 seconds before the collision then, at the last possible moment for him to have seen the Cessna, the two aircraft would have been approximately 3000 feet apart. At this range, to the A-10 pilot's eye, the Cessna would have subtended an angle of 0.6° and, although it would have been visible it would not have been obvious. At a range of one nautical mile, approximately 9.6 seconds before the collision, the Cessna would have subtended an angle of 0.3° and would have been even less noticeable. Although the A-10 would have presented a slightly larger target to the Cessna pilot, similar considerations apply. With an in-flight visibility of 7 km (3.8 nautical miles) the maximum range at which either one of the pilots might have detected the opposing aircraft, had he been looking in the appropriate direction, is unlikely to be much greater than 2 nautical miles. This distance represents a time interval of 20 seconds at a closing speed of 360 knots.

2.6 Conspicuity

The chances of seeing a distant object are greatly affected by its colour contrast against the background. The A-10 aircraft are designed for a low level, ground attack role and are deliberately painted a drab olive colour to reduce their conspicuity against a land background. The evidence suggests that the Cessna pilot was initially flying higher than the A-10 which would therefore have been seen against a background of ploughed fields and trees. The Cessna aircraft was painted white and pale blue which would have provided a high colour contrast if viewed against the land, however, with the Cessna being slightly higher than the A-10 it would have been viewed against a background of cloud or haze.

There is no one ideal colour scheme that would increase the conspicuity of aircraft in all situations. Although the A-10 aircraft were using high intensity white strobe lights and the Cessna was believed to be using a red anti-collision light, in this accident, each aircraft would have been presented against its worst possible background.

2.7 Cockpit visibility

The evidence of the collision marks indicates that, prior to impact, the Cessna would have been on a relative bearing 5° to the left of the A-10's centreline and to the Cessna pilot the A-10 would have been 15° right of centreline. The

visibility from the cockpit of each aircraft is such that, had each pilot been looking in the appropriate direction, the view of the other aircraft would not have been obstructed by windscreen pillars.

The A-10 pilot did not see the Cessna and did not make any significant change to the flight path of his aircraft, which was essentially straight and level. The fact that the attitude of the Cessna was 15° – 20° nose down relative to the A-10 and also that its elevator was depressed to a marked degree, suggests that the Cessna pilot had seen the other aircraft at a late stage and taken avoiding action. His attempt to dive underneath the A-10 was not made in time to effect a substantial change in the flight path of his aircraft before the collision.

3. Conclusions

(a) Findings

- (i) Both aircraft had been properly maintained and their documentation was in order.
- (ii) There were no significant defects in either aircraft that could have had a bearing on the accident.
- (iii) The student pilot of the Cessna held a valid medical certificate and did not require a licence.
- (iv) There was no evidence of medical factors which might have caused or contributed to the accident.
- (v) The pilot of the A-10 was properly qualified to conduct the flight.
- (vi) The two aircraft collided at an altitude of between 1000 and 1200 feet amsl when approaching almost head-on.
- (vii) Under these circumstances the rules of the air require each pilot to avoid the other aircraft by altering course to the right.
- (viii) The visibility from the cockpit of each aircraft was such that each pilot would have had an unobstructed view of the other aircraft.
- (ix) The pilot of the A-10 was looking into the cockpit to make a radio frequency change at the time of the collision and he did not see the Cessna 150.
- (x) It is possible that the look-out of the Cessna 150 pilot was adversely affected by his pre-occupation with the problems of navigation in the reduced visibility.
- (xi) The Cessna 150 pilot probably saw the A-10 at a very late stage and attempted to dive underneath the other aircraft. This avoiding action was made too late to effect a substantial change in the flight path of his aircraft.

(b) Cause

The collision was caused by the failure of the A-10 pilot to see and avoid the Cessna 150 and equally, by the failure of the student pilot of the Cessna to see the A-10 in sufficient time to take effective avoiding action.

4. Safety Recommendations

Nil

M M Charles
Inspector of Accidents

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Department of Transport

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