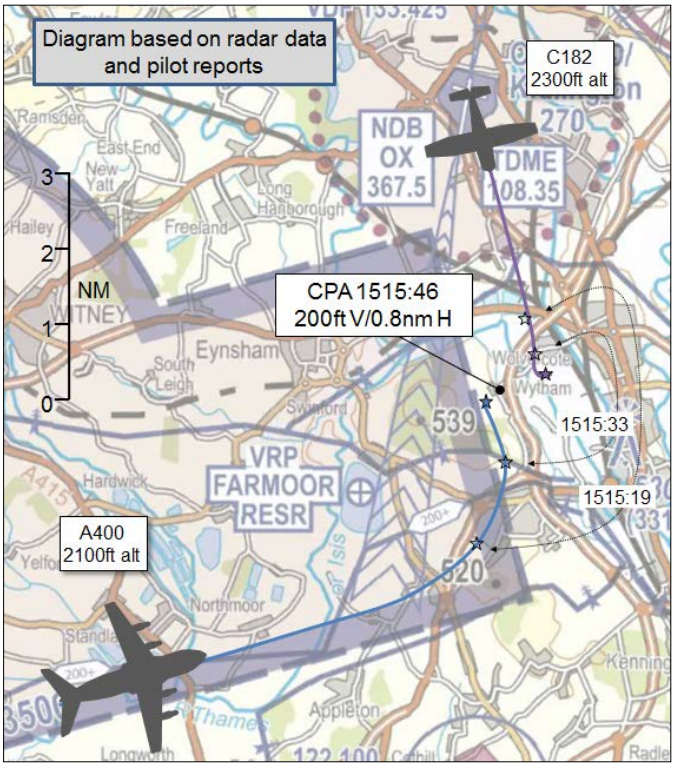
AIRPROX REPORT No 2016165

Date: 08 Aug 2016 Time: 1515Z Position: 5145N 00118W Location: 10nm East Brize

PART A: SUMMARY OF INFORMATION REPORTED TO UKAB

Recorded	Aircraft 1	Aircraft 2
Aircraft	A400	C182
Operator	HQ Air (Ops)	Civ Trg
Airspace	Lon FIR	Lon FIR
Class	G	G
Rules	IFR	IFR
Service	Traffic	Basic
Provider	Brize	Oxford
Altitude/FL	2100ft	2300ft
Transponder	A, C, S	A, C, S
Reported		
Colours	Grey	White, blue
Lighting	Nav, Strobes, Wing and Landing	NK
Conditions	VMC	VMC
Visibility		10km
Altitude/FL	2300ft	2400ft
Altimeter	QNH (1022hPa)	QNH
Heading	340°	168°
Speed	NK	90kt
ACAS/TAS	TCAS I	Not fitted
Alert	RA	N/A
Separation		
Reported	NK	200ft V/1nm H
Recorded	200ft V/0.8nm H	



THE A400 PILOT reports that he was on an instructor-training flight and, at the request of ATC, agreed to fly a vectored PAR for controller training. Brize Director commenced vectors and informed them that it would be a single frequency approach, they were then transferred to the talkdown controller. At 2300ft on the QNH during a left-hand level turn onto the final approach track for RW25, the controller called traffic to the north, 100ft below. Within 10 seconds they received a TCAS TA and then an RA, giving a 'fly-down' command. The RA was followed and the turn continued against the opposing traffic, which they were now visual with, a low-wing yellow light aircraft. Once clear the 200ft height loss was regained and the RA was reported to ATC.

He assessed the risk of collision as 'Medium'.

THE C182 PILOT reports that he was conducting a Standard Missed Approach (SMA) from the OX beacon, and receiving a Traffic Service (he recalled) as is standard for this type of procedure. At approximately 1nm from the beacon, he saw a large aircraft, low-level, possibly taking-off from Brize. He watched it intently, but presumed it would remain within the Brize controlled airspace and not go through the Oxford SMA path. It left the Brize zone and passed in front of the C182 on a track that would have passed well in front at 090°, this wasn't a problem; however, just outside the Brize zone it turned directly towards them, pointing at them with a much higher speed and rate of climb. The C182 pilot turned away to the left, (away from Brize without any prompting from ATC and the other aircraft passed safely behind. Once established in the turn, Oxford ATC gave an instruction of 'turn left immediately'. The pilot noted that had he been IMC, this would have been very close, and opined that he needed better Traffic Information and for Brize to be aware of the Oxford Instrument procedure.

He assessed the risk of collision as 'None'.

THE BRIZE DIRECTOR reports vectoring the A400 for a PAR. At the end of the downwind leg he gave the pilot a turn onto a heading of 340° for base leg, the rate of turn was slower than he had anticipated, meaning that the aircraft approached the edge of the Brize zone. He gave Traffic Information on an aircraft wearing an Oxford squawk and operating 1.5nm east of the Brize zone. He instructed the A400 to continue the turn onto an inbound heading to turn away from the traffic. At this point, the pilot called visual with the other aircraft and reported that he had received an RA against it. The controller believed that although further east than he intended, the A400 had remained within the Brize CTR (albeit right on the edge). As such, the pilot was receiving a Radar Control Service and thus deemed separated from aircraft outside the CTR. With hindsight, he thought he should have anticipated the slow rate of turn and instructed a turn onto base leg sooner to keep a greater distance from the traffic outside the zone.

He perceived the severity of the incident as 'Medium'.

THE BRIZE SUPERVISOR reports that he was observing the director when the A400 was turned onto base leg. He reminded the controller that slightly early turns were required for A400 due to their known slow rate of turn, and asked the controller to call the traffic just departing Oxford RW19. The controller did this, and shortly afterwards the A400 called visual with the traffic and reported a TCAS RA but did not state if descending or climbing. There was no mention of an Airprox on the frequency.

Factual Background

The weather at Brize was recorded as follows:

```
METAR EGVN 081450Z 28008KT CAVOK 20/05 Q1022 BLU NOSIG=
```

Portions of the tape transcripts between the A400 and Brize Director are below:

From	To	Speech Transcription	Time
DIR	A400	[A400 c/s] turn left heading three four zero degrees.	15:14:29
A400	DIR	Left three four zero degrees [A400 c/s].	15:14:32
DIR	A400	[A400 c/s] traffic north three miles tracking south east indicating one hundred feet below.	15:14:59
A400	DIR	[A400 c/s]	15:15:06
DIR	A400	[A400 c/s] turn left heading two eight zero degrees.	15:15:16
A400	DIR	Left two eight zero degrees [A400 c/s].	15:15:20
DIR	A400	Two eight zero degrees.	15:15:24
A400	DIR	Two eight zero degrees [A400 c/s], we are visual with that traffic.	15:15:25
DIR	A400	[A400 c/s] roger.	15:15:27
A400	DIR	[A400 c/s] for the record that was an RA.	15:15:37
DIR	A400	[A400 c/s] roger report ready for further turns.	15:15:41
A400	DIR	Wilco.	15:15:44

Analysis and Investigation

CAA ATSI

The A400 was being vectored by Brize Norton for a Precision Approach Radar (PAR) at Brize Norton. The C182 was in the climb-out from Oxford Airport, on its own navigation to the OX NDB hold for a procedural ILS to RW19 with Oxford Radar and receiving a Basic Service.

At 1515:23 the C182 was instructed to climb to altitude 3500ft for the hold (Figure 1).

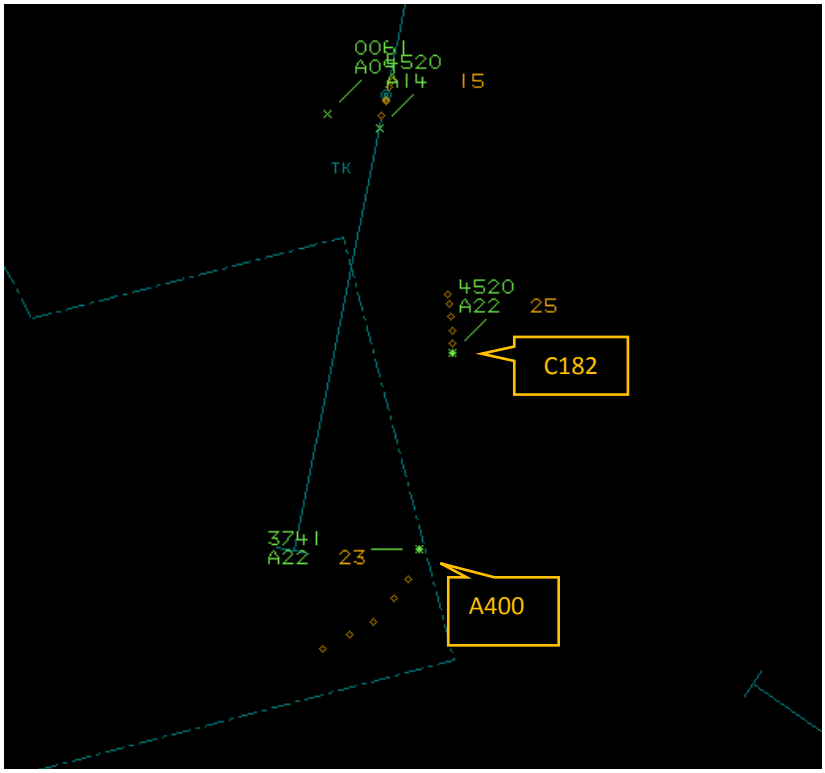


Figure 1 – 1515:23

At 1515:33, the Oxford radar controller instructed the C182 to make an immediate left turn but with no advice on a heading to fly, Traffic Information was then passed, advising the C182 pilot that there was traffic opposite direction to, and at the same level as themselves. The pilot of the C182 immediately reported visual with that traffic (Figure 2).

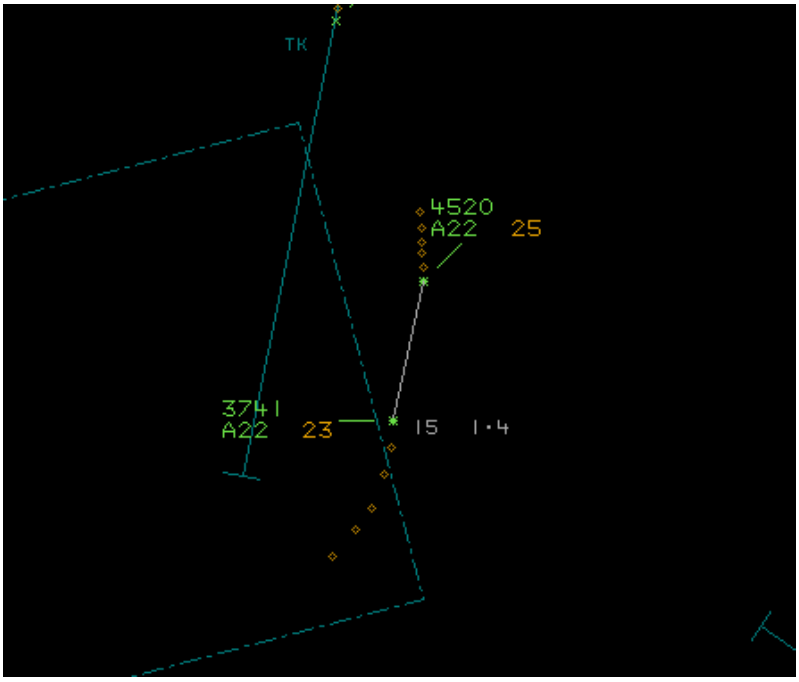


Figure 2 – 1515:33

CPA took place at 1515:42, with the aircraft separated by 0.8nm laterally and 200ft vertically.

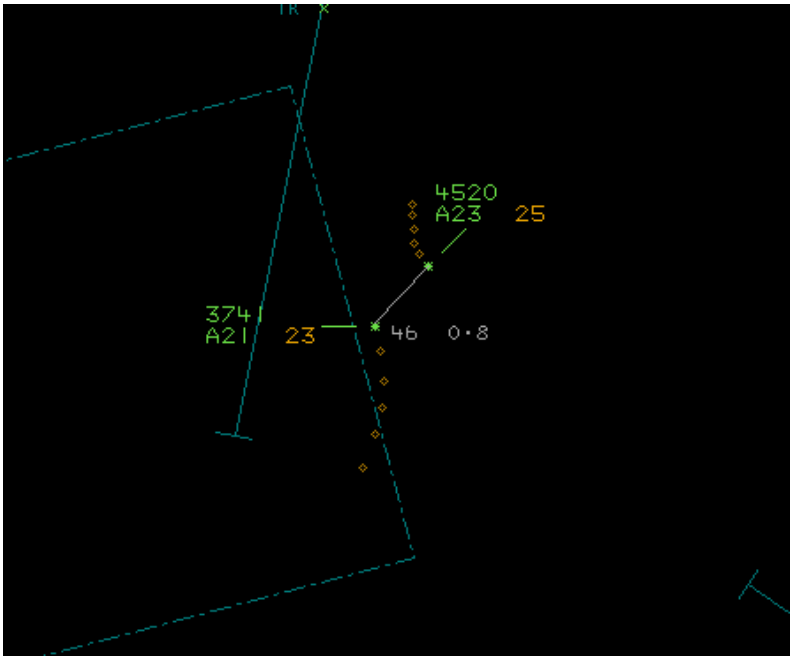


Figure 3 – 1515:42

The Oxford controller stated that they had been fully aware of the presence of the A400, but had expected it to remain inside the Brize Norton CTA. In accordance with the Letter of Agreement between Oxford and Brize Norton ATC:

> *Traffic Information (TI) will not routinely be passed between the units if their aircraft are squawking Mode A and C; if Mode A or Mode C is not available controllers will endeavour to pass timely TI.*

The Oxford controller took action as they believed that a definite risk of collision existed.

CAP774 states that under a Basic Service:

> *If a controller/ FISO considers that a definite risk of collision exists, a warning shall be issued to the pilot (SERA.9005(b)(2) and GM1 SERA.9005(b)(2)).*
> *Whether traffic information has been provided or not, the pilot remains responsible for collision avoidance without assistance from the controller.*

and;

> *Deconfliction is not provided under a Basic Service. If a pilot requires deconfliction advice outside controlled airspace, Deconfliction Service shall be requested. A controller shall make all reasonable endeavours to accommodate this request as soon as practicable*

Military ATM

At 1514:41 (Figure 4), the A400 was downwind in the radar training circuit at 2300ft on the Brize QNH and had just been given (1514:29) a base leg turn by the controller onto a heading of 340°. Note that the replay indicates the A400 had not yet initiated the turn. The C182 is tracking south-southeast simulating a missed approach.

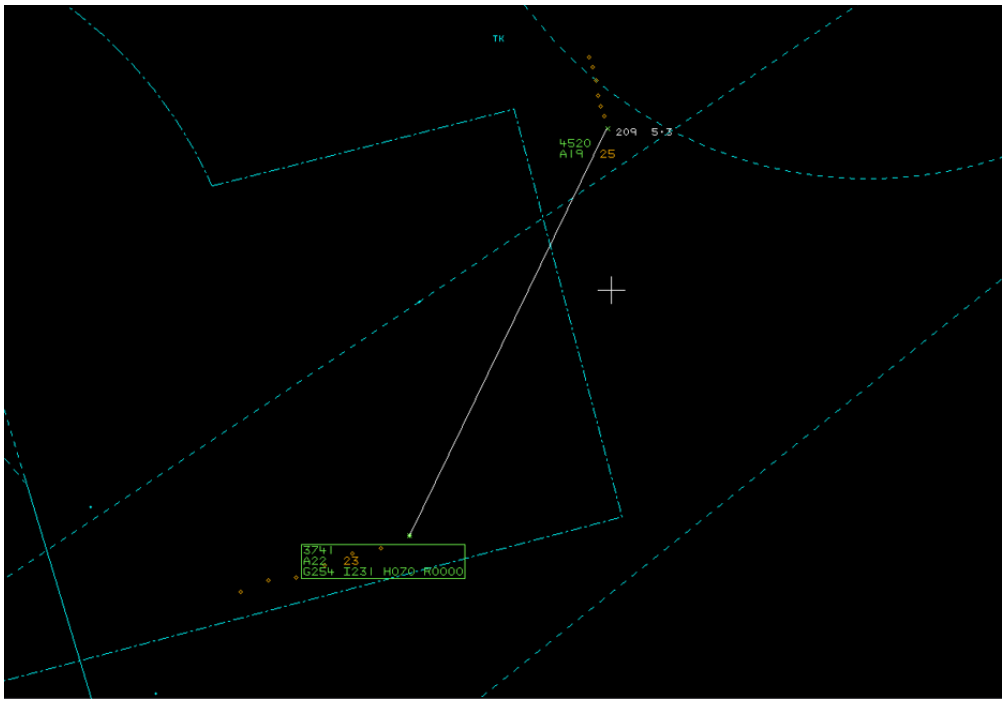


Figure 4: Geometry at 1514:41 (A400 squawking 3741; C182 squawking 4520).

At 1515:01 (Figure 5), the A400 is in the left turn and the controller passes Traffic Information on the C182 *'traffic north three miles tracking south east indicating one hundred feet below'.* The A400 is still within the Brize Norton CTR.

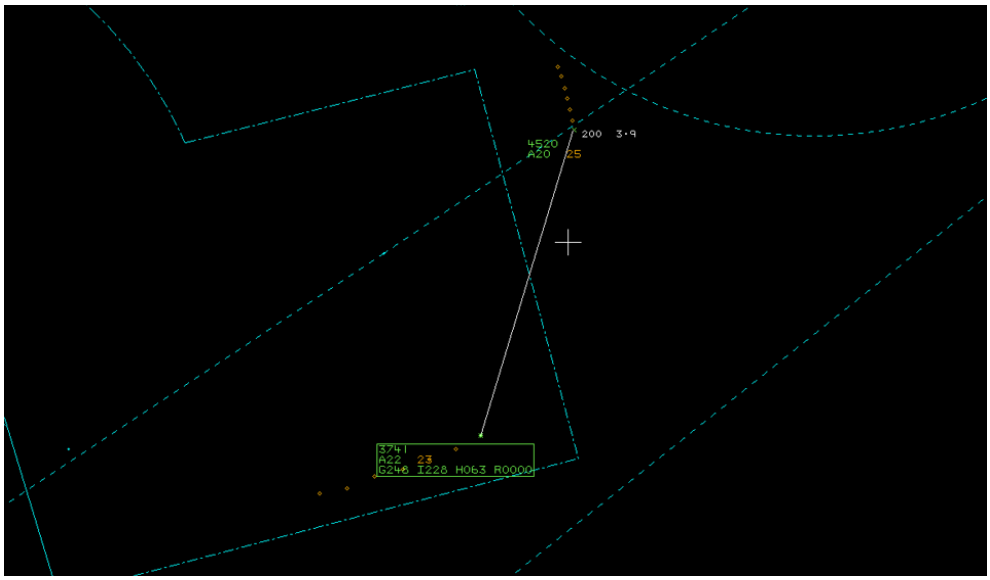


Figure 5: Geometry at 1515:01 (A400 squawking 3741; C182 squawking 4520).

At 1515:15 (Figure 6), the controller gave the A400 a further left turn onto a heading of 280° for positioning for the PAR.

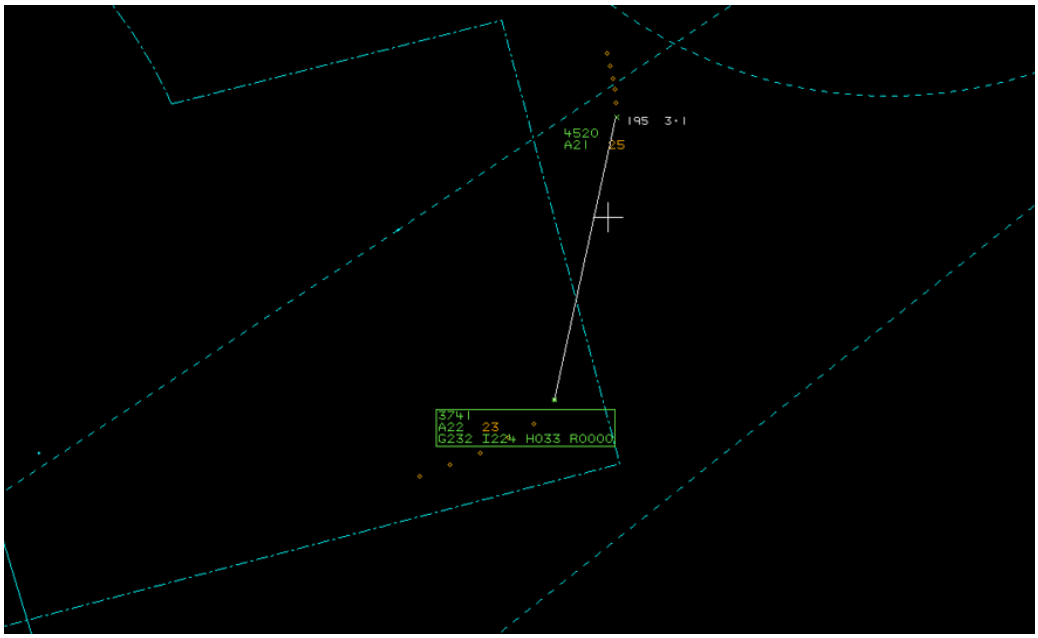


Figure 6: Geometry at 1515:15 (A400 squawking 3741; C182 squawking 4520).

At 1515:29 (Figure 7), A400 pilot calls visual with the C182. The radar replay shows that 1.8nm lateral separation exists with the aircraft at co-altitude. The A400 is still in the left hand turn and is outside the Brize Norton CTR.

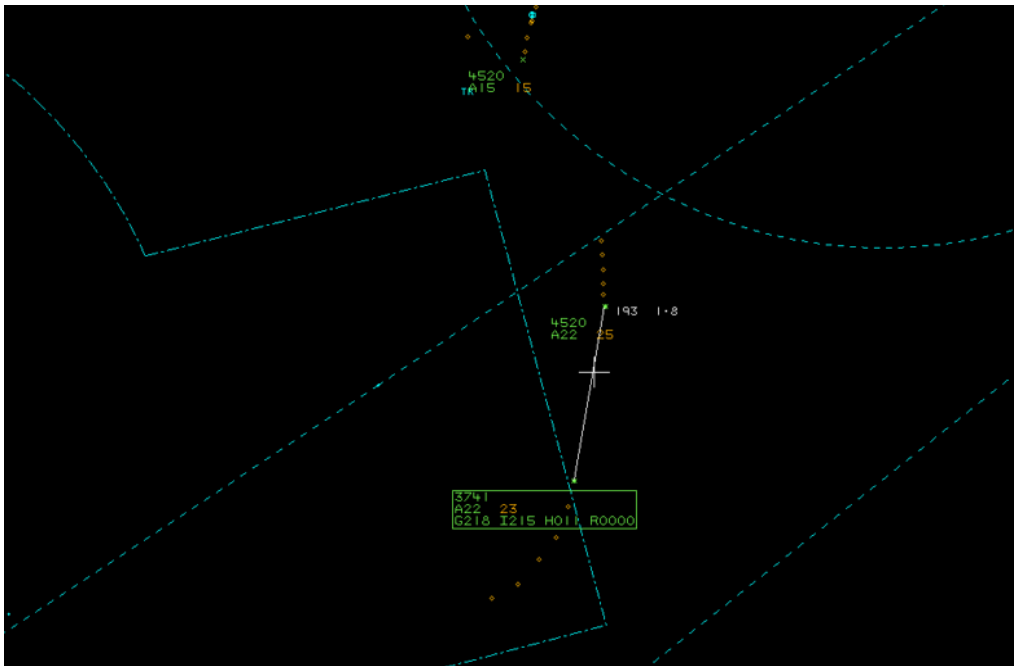


Figure 7: Geometry at 1515:29 (A400 squawking 3741; C182 squawking 4520).

At 1515:44 (Figure 8), the aircraft are at CPA of 0.8nm lateral separation and 200ft vertical separation. The A400 pilot responded to a TCAS RA descent and continued his left turn, whilst the C182 turned left, away from the A400.

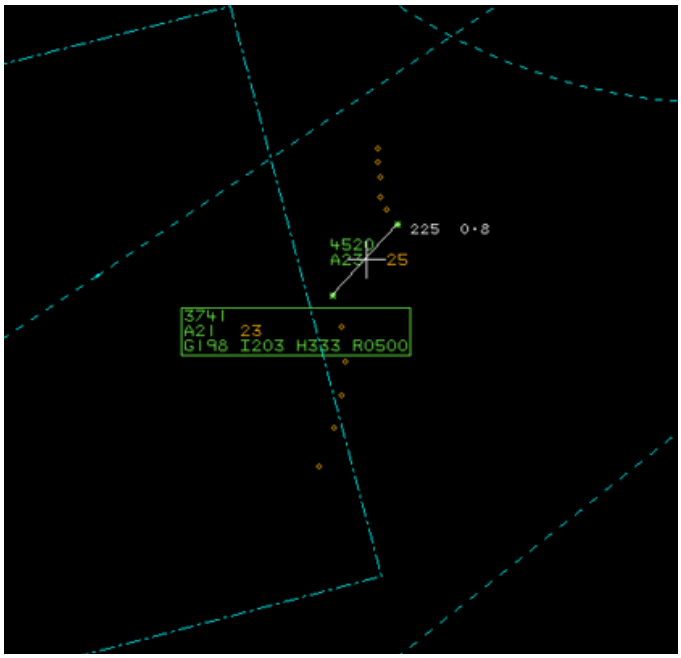


Figure 8: Geometry at 1515:44 (A400 squawking 3741; C182 squawking 4520).

The C182 pilot reported conducting an SMA at Oxford, he reported receiving a Traffic Service from Oxford. The pilot had sighted a large aircraft, low-level, possibly taking off from Brize when they were about 1 mile from the (Oxford) beacon. The pilot reported watching this aircraft intently and assuming that it would not go through the Oxford SMA (radar replays show the A400 did not go through the SMA track, but was in close proximity). The pilot reported the aircraft turning towards them and so they turned away to the left. A subsequent operating authority investigation, using RT recordings, identified the C182 was actually receiving a Basic Service. It also indicated the pilot was instructing with a student 'under the hood'. The instructor assessed that there was no risk of collision.

The A400 pilot reported accepting to fly a PAR for controller training. The Brize Director commenced vectors following a Bravo departure from the field. At 2300ft (Brize QNH 1022), and during a left-hand turn onto final approach track for RW25, the controller passed Traffic Information on traffic to the north, 100ft below. Within approximately 10 seconds a TA, then RA was triggered giving a fly-down command. The RA was followed and the pilot continued the turn against the opposing traffic. The pilot reported the perceived severity as medium.

The Brize Norton controller reported vectoring for a PAR. At the end of the downwind leg they turned the aircraft onto a heading of 340° to initiate a base leg. The controller reported the rate of turn was slower than they had anticipated, meaning the aircraft approached the edge of the Brize CTR. The controller called traffic (wearing an Oxford squawk) to the A400 pilot and then continued the aircraft's turn onto an inbound heading to continue to take it away from the traffic. The controller reported the perceived severity as medium.

Inside the CTR, the A400 was under Radar Control, outside of the CTR the aircraft was receiving a Traffic Service [UKAB Note: although the fact that the A400 was effectively under a Traffic Service was not formally agreed with the pilot, Brize Norton procedures are such that this is the default assumption if an aircraft exits the CTR]. CAP 774 states:

> *'When providing headings/levels for the purpose of positioning and/or sequencing or as navigational assistance, the controller should take into account traffic in the immediate vicinity based on the aircraft's relative speeds and closure rates,* ***so that a risk of collision is not knowingly introduced by the instructions passed. However, the controller is not required to achieve defined deconfliction minima and pilots remain responsible for collision avoidance even when being provided with headings/levels by ATC'****.*

In this instance, the controller was turning the aircraft inbound for a PAR; the allocated turns were not directed towards the C182 and were not going to introduce a risk of collision. The controller turned the aircraft onto a baseleg heading and there was a delay between the instruction and the aircraft turning, this led to the A400 extending slightly further than expected. A further left turn was issued to continue the aircraft onto its final approach heading and away from the C182; at no stage would collision have been likely.

Brize Norton is situated within the Oxford Area of Intense Aerial Activity (AIAA), a busy piece of airspace for GA where aircraft routinely fly in and around the Brize Norton CTR, often close to the edges. The Brize Norton CTR is established to protect military aircraft in the final stages of flight; however the shape and size of the CTR is not necessarily sufficient to encompass all stages of vectoring in the radar training circuit (RTC). With large military aircraft, rates of turn can vary significantly, especially between different types, of which Brize Norton operates many. It would be unviable for a controller to keep all aircraft types within the CTR at all times during vectoring in the RTC, and, given that the airspace outside is Class G, this offers the freedom to manoeuvre. CPA was calculated as 0.8nm; if the A400 had remained inside the CTR this would have been 1nm, not significantly further lateral separation to that which existed at CPA.

The Brize Norton and London Oxford Airport LOA details departures and the missed approach procedure for RW19:

> **Departures**
>
> Twin-piston and single-engine aircraft. The performance characteristics of single- and twin-engine aircraft, together with Oxford based single-engine turbo-prop aircraft allow the aircraft to depart and remain outside the BZN CTR.
>
> **Missed App RW19**
>
> j. The Standard Missed Approach Procedure (SMAP) for RW19 involves a climb out straight ahead until passing 1000ft and then a turn to track 169 deg. The SMAP is utilised for aircraft procedurally climbing out for further approaches as well as for aircraft electing to go around due unstable approach or other phenomenon. **If a turbo-prop or jet aircraft goes around it is highly likely to enter the BZN CTR uncoordinated and could conflict with RW25 inbounds. In the unlikely event of a go-around the Oxford controller is to notify BZN App ASAP and issue any conflict resolution instructions that may be necessary**. Initial instructions should aim to achieve the maximum separation possible in either or both the vertical and lateral plane.

The C182 is a single engine aircraft and so the Oxford controller, under the LOA, would not have spoken to Brize to notify them. That, coupled with the C182 believing they were under a Traffic Service when in fact they were receiving a Basic Service, led to the C182 pilot receiving no Traffic Information on the A400.

This Airprox highlights three effective barriers. The C182 pilot reported being visual with the A400 throughout the incident, the A400 pilot was passed Traffic Information on the C182 allowing them to visually acquire the C182 at 1.8nm, and TCAS was effective in providing the A400 pilot an RA against the C182. In this instance the delayed turn of the A400 as it was being turned for the PAR contributed to its close proximity with the C182.

London Oxford Airport and Brize Norton are both in the process of producing an Airspace Change Proposal (ACP) which may allow for engagement on new procedures and ways of working.

UKAB Secretariat

The A400 and C182 pilots shared an equal responsibility for collision avoidance and not to operate in such proximity to other aircraft as to create a collision hazard[1]. If the incident geometry is considered as head-on or nearly so then both pilots were required to turn to the right[2]. However, in instance a left turn meant that both pilots were able to continue with their approaches to their respective airfields.

Comments

HQ Air Command

Whilst the fact that radar replays show that Brize Norton ATC had allowed the A400 to drift fractionally outside the Brize Norton CTR, meaning that the conflict was in Class G airspace, several barriers were available to ensure separation was maintained; the look out of both pilots, Traffic Information from Brize Norton to the A400, a call from the Oxford controller (despite the Basic Service) to the C182 and the TCAS on the A400. It is difficult to ascertain whether it was the C182's avoiding action or the A400's reaction to the RA which came first; however, both actions would have the same desired effect.

The fact that the A400 had just been given instructions to turn left (away from the C182) and the C182 had already been instructed to climb to 3500' meant that the CPA was never likely to have been less than the 0.8nm recorded.

C182 Operating Authority

This was a conflict in Class G airspace between a C182 training flight, conducting an IFR missed approach procedure under an ATS from Oxford ATC, and a large transport aircraft which exited the Brize Norton CTR and turned into conflict with the Oxford instrument traffic. The C182 instructor had been watching the other aircraft, (the student was 'under the hood') and assessed from its original track that it would pass clear ahead. When the other aircraft turned towards and into conflict, the intructor took control and turned to avoid. The instructor assessed that there was no risk of collison and there was no indication on the RT at the time that an Airprox had been filed. We were alerted by the UKAB 10 days after the event and subsequently able to identify the crew involved.

We conclude from interviewing the instructor and from his subsequent report (above) that this 'open-FIR' conflict was resolved in the first instance by the visual detection and manoeuvre initiated by the C182 instructor. A subsequent instruction from the Oxford controller to 'turn immediately' acted as an additional saftety barrier. Although the C182 instructor's recollection was that he was on a Traffic Service at the time (which iaw the UKAIP is the standard service provision at Oxford during the promulgated radar hours) local discussion with Oxford ATC staff during our internal investigation, with the benefit of RT recordings, shows that a Basic Service was requested and in effect.

Had VMC not prevailed or the instructor not detected the other aircraft visually, the minimum separation distance would have been less and the risk of collision accordingly higher. Our local investigation is, therefore, continuing and would benefit from the other aircraft's intended flight profile. The standard missed approach procedure for Oxford RW19 passes close to the boundary of the Brize Norton CTR. This leaves little time for reaction if an aircraft exits the CTR without prior warning. The Board may, in its deliberation of the circumstances of this Airprox, wish to consider whether the relative positions of the respective civil and military instrument approach procedure tracks for Oxford and Brize Norton were relevant to the circumstances.

[1] SERA.3205 Proximity.
[2] SERA.3210 Right-of-way (c)(1) Approaching head-on.

Summary

An Airprox was reported when a A400 and a C182 flew into proximity at 1515 on Monday 8th August 2016. Both pilots were operating under IFR in VMC, the A400 pilot in receipt of a Radar Control Service from Brize and the C182 pilot in receipt of a Basic Service from Oxford.

PART B: SUMMARY OF THE BOARD'S DISCUSSIONS

Information available consisted of reports from the pilots of both aircraft, transcripts of the relevant RT frequencies, radar photographs/video recordings, reports from the air traffic controllers involved and reports from the appropriate ATC and operating authorities.

The Board first looked at the ATC aspects regarding the A400 in the instrument pattern nominally under a Radar Control Service. Without positive indications from either ATC or his aircraft systems that he had left the CTR, the Board noted that the A400 pilot may not have been aware that he was in Class G airspace and therefore effectively responsible for his own separation. The Board were informed that there was a local order that allowed the Brize Controllers not to have to tell the pilots every time they left controlled airspace if it was to be for a short period of time, and to automatically impose a Traffic Service. Some members thought that this was a highly undesirable procedure given that it assumed that the pilot would know that they had crossed the CTR boundary and that the collision avoidance responsibility had therefore changed to them; in aircraft that were not fitted with moving maps or appropriate navigation systems, the pilots might be completely unaware unless ATC told them. With traffic just outside the CTR, these members thought that a reminder by the controller that the A400 was leaving controlled airspace would have alerted the pilot to the fact that he was now required to take his own separation. Other members thought that this was a red herring in that the A400 was already in the turn when it crossed the line of the Brize CTR and so would never have come closer than it did at CPA anyway because, even if the pilot had been aware that he needed to take his own separation, he would probably have chosen the same turn. Military controller members also opined that, in this incident, the controller didn't think that the A400 had crossed the CTR boundary anyway, and so would not have given a warning. They commented that, contrary to the clear displays used in the analysis of the incident, Brize radar resolution and display limitations meant that the A400 track could easily have been displayed as just within the CTR boundary.

For his part, the Board noted that the A400 pilot had received a TCAS RA to 'fly-down' and, whilst following this RA, had continued on his turn to the NW. Some members questioned whether this was the correct procedure, but they were quickly informed by the airline pilot members that it is perfectly acceptable to continue with a turn as long as the TCAS manoeuvre can also be completed at the same time and the turn is not contrary to the TCAS indications. The Board also noted that, according to the radar replay, the A400 was flying at about 230kts downwind in the radar pattern, and military members confirmed that this was the usual speed for the A400. Pilot members thought this was quite fast for that stage of the pattern and some opined that this was probably one of the reasons why the radius of turn was so large. However, without knowing the detailed operating requirements of the A400, the Board thought that it was unable to make any specific judgement or recommendations regarding this aspect other than to comment that the A400 operators might wish to consider the implications of high pattern speeds and turn radius in what was clearly constricted airspace. Finally, the radar recordings appeared to show that the A400 pilot had delayed his turn after the instruction by ATC (there appeared to be a delay of nearly 30 seconds after the controller had instructed the turn onto 340° before the aircraft manoeuvred). The Board thought that this may also have contributed to the aircraft going outside the CTR.

Turning to the C182 pilot, the Board noted that he was under a Basic Service with Oxford ATC (but thought he was in receipt of a Traffic Service). Although the instructor had seen the A400 well before CPA, with the student 'under the hood' some members thought that the crew would have been better served by specifically confirming or asking for a Traffic Service during their missed approach so that they would have then been confident that they would be given Traffic Information. As it was, the controller did give some deconfliction advice (albeit after the pilot had commenced his own avoiding action), but he was not obliged to, and the Board commended him for doing so. Understandably, the

C182 pilot had not expected the A400 to leave the Brize CTR, but the Board noted that the Brize controller was perfectly entitled to manoeuvre the aircraft outside the confines of the CTR provided it complied with normal Rules of the Air when doing so. The Board then had a discussion about the proximity of the Oxford Missed Approach Procedure and the Brize radar patterns, and noted that they were very adjacent. Noting that there were Airspace Change Proposals (ACP) in place for both Brize and Oxford, the Board thought that it was not its place to comment on these but hoped that any changes would facilitate for greater cohesion between the two units.

Finally, the Board returned to the role that ATC had played in the Airprox. Noting that the Oxford controller was not required to inform Brize about the C182 according to local agreements, the Board thought that there could have been better liaison between the two units. For his part, the Brize controller thought that the A400 had remained within the confines of the Brize CTR, albeit on the very edge, and the Board again discussed the accuracy of the Brize radar mapping/display. Some civil controllers noted that they generally recommended to their controllers that they do not vector aircraft within 2nm of the edge of controlled airspace. They acknowledged that it was unlikely that Brize would be able to do this given that the radar pattern for large aircraft was so tight against the edge of their CTR. However, they did opine that this left the controllers open to the highly undesirable situation of vectoring aircraft just within the CTR with GA aircraft perfectly at liberty to also fly right up to the other side of the CTR. Although the procedures might deem this to be acceptable on the assumption that the GA aircraft would not penetrate the CTR or that the radar traffic would not exit the CTR, this incident (and others previously) highlighted the fragility of the situation, especially when likely TCAS reactions were taken into account. Controller members also noted that, notwithstanding the comments regarding the promptness of turn of the A400 pilot, the supervisor's comments indicated that he thought that the turn was issued later than was desirable, and that in asking the controller to call the C182 to the A400 pilot, this indicated that he believed the aircraft would leave the lateral limits of the CAS.

In looking at the barriers to mid-air collision relevant to this incident, the Board assessed that the following were key contributory factors:

- **Airspace Design and Procedures** were considered ineffective because the Brize CTR did not stop the A400 from spilling out into Class G airspace, and the Brize/Oxford LOA regarding liaison in such circumstances did not apply to the single-engine C182.

- **ATC Strategic management** and **ATC conflict and detection** were effective barriers because both controllers were able to give traffic information and avoiding action. That being said, there was no **STCA** available so Ground-Based Safety Nets were not effective.

- **Flight Crew Compliance with ATC instructions** was thought to be effective.

- **Flight Crew situational awareness** was only partially effective, because the A400 pilot was not aware that he was outside CAS and that he was therefore responsible for collision avoidance rather than ATC.

- **TCAS** and **See and Avoid** were considered effective.

Finally, the Board looked at the cause and risk of the Airprox. The Board debated for some time whether the A400 pilot or the controller were responsible for the A400's late turn onto the base leg which then took the aircraft outside the CTR. In the end they could not resolve the debate and concluded that the incident was best described simply as a conflict in Class G caused by a late turn onto base leg by the A400. Turning to the risk, and recognising that both pilots had taken timely and effective avoiding action, the Board agreed that there had been no risk of collision and the Airprox was therefore assessed as risk Category C.

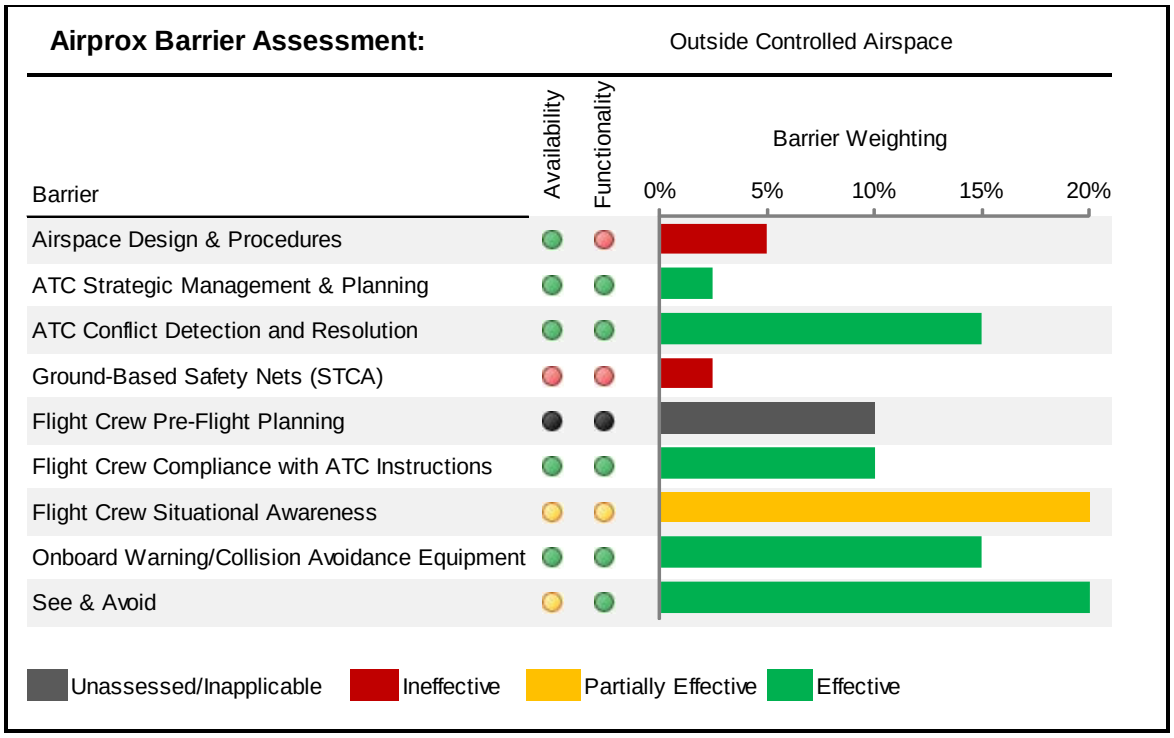
PART C: ASSESSMENT OF CAUSE AND RISK

Cause: A conflict in Class G caused by a late turn on to base leg by the A400.

Degree of Risk: C.

Barrier assessment:

Modern safety management processes employ the concept of safety barriers that prevent contributory factors or human errors from developing into accidents. Based on work by EASA, CAA, MAA and UKAB, the following table depicts the barriers associated with preventing mid-air-collisions. The length of each bar represents the barrier's weighting or importance (out of a total of 100%) for the type of airspace in which the Airprox occurred (i.e. Controlled Airspace or Uncontrolled Airspace).[3] The colour of each bar represents the Board's assessment of the effectiveness of the associated barrier in this incident (either Fully Effective, Partially Effective, Ineffective, or Unassessed/Inapplicable). The chart thus illustrates which barriers were effective and how important they were in contributing to collision avoidance in this incident.



Barrier Effectiveness		Consequence		
		Non-functional	Partially Functional	Functional
Availability		**1**	**2**	**3**
Completely Unavailable	**1**	1	2	3
Partially Available	**2**	2	4	6
Available	**3**	3	6	9

Key:

Effective

Partially Effective (If the system was partially available but fully functional score availability as 2.5)

Ineffective

Unassessed/Inapplicable

[3] Barrier weighting is subjective and is based on the judgement of a subject matter expert panel of aviators and air traffic controllers who conducted a workshop for the UKAB and CAA on barrier weighting in each designation of airspace.

Barrier	Availability			Functionality			Unassessed / Inapplicable
	Fully (3)	**Partially (2)**	**Not Available (1)**	**Fully (3)**	**Partially (2)**	**Non Functional (1)**	
Airspace Design and Procedures	Appropriate airspace design and/or procedures were available	Airspace design and/or procedures were lacking in some respects	Airspace design and/or procedures were not appropriate	Airspace design and procedures functioned as intended	Airspace design and/or procedures did not function as intended in some respects	Airspace design and/or procedures did not function as intended	The Board either did not have sufficient information to assess the barrier or the barrier did not apply; e.g. ATC Service not utilised. Note: The Board may comment on the benefits of this barrier if it had been available
ATC Strategic Management and Planning	ATM were able to man and forward plan to fully anticipate the specific scenario	ATM were only able to man or forward plan on a generic basis	ATM were not realistically able to man for or anticipate the scenario	ATM planning and manning functioned as intended	ATM planning and manning resulted in a reduction in overall capacity (e.g. bandboxed sectors during peak times)	ATM planning and manning were not effective	
ATC Conflict Detection and Resolution	ATS had fully serviceable equipment to provide full capability	ATS had a reduction in serviceable equipment that resulted in a minor loss of capability	ATS had a reduction in serviceable equipment that resulted in a major loss of capability	The controller recognised and dealt with the confliction in a timely and effective manner	The controller recognised the conflict but only partially resolved the situation	The controller was not aware of the conflict or his actions did not resolve the situation	
Ground-Based Safety Nets (STCA)	Appropriate electronic warning systems were available	Electronic warning systems is not optimally configured (e.g. too few/many alerts)	No electronic warning systems were available	Electronic warning systems functioned as intended, including outside alerting parameters, and actions were appropriate	Electronic warning systems functioned as intended but actions were not optimal	Electronic warning systems did not function as intended or information was not acted upon	
Flight Crew Pre-Flight Planning	Appropriate pre-flight operational management and planning facilities were deemed available	Limited or rudimentary pre-flight operational management and planning facilities were deemed available	Pre-flight operational management and planning facilities were not deemed available	Pre-flight preparation and planning were deemed comprehensive and appropriate	Pre-flight preparation and/or planning were deemed lacking in some respects	Pre-flight preparation and/or planning were deemed either absent or inadequate	
Flight Crew Compliance with Instructions	Specific instructions and/or procedures pertinent to the scenario were fully available	Instructions and/or procedures pertinent to the scenario were only partially available or were generic only	Instructions and/or procedures pertinent to the scenario were not available	Flight crew complied fully with ATC instructions and procedures in a timely and effective manner	Flight crew complied later than desirable or partially with ATC instructions and/or procedures	Flight crew did not comply with ATC instructions and/or procedures	
Flight Crew Situational Awareness	Specific situational awareness from either external or onboard systems was available	Only generic situational awareness was available to the Flight Crew	No systems were present to provide the Flight Crew with situational awareness relevant to the scenario	Flight Crew had appropriate awareness of specific aircraft and/or airspace in their vicinity	Flight Crew had awareness of general aircraft and/or airspace in their vicinity	Flight Crew were unaware of aircraft and/or airspace in their vicinity	
Onboard Warning/Collision Avoidance Equipment	Both aircraft were equipped with ACAS/TAS systems that were selected and serviceable	One aircraft was equipped with ACAS/TAS that was selected and serviceable and able to detect the other aircraft	Neither aircraft were fitted with ACAS/TAS or their systems were not selected on or unserviceable or systems incompatible	Equipment functioned correctly and at least one Flight Crew acted appropriately in a timely and effective manner	ACAS/TAS alerted late/ambiguously or Flight Crew delayed acting until closer than desirable	ACAS/TAS did not alert as expected, or Flight Crew did not act appropriately or at all	
See and Avoid	Both pilots were able to see the other aircraft (e.g. both clear of cloud)	One pilots visibility was uninhibited, one pilots visibility was impaired (e.g. one in cloud one clear of cloud)	Both aircraft were unable to see the other aircraft (e.g. both in cloud)	At least one pilot takes timely action/inaction	Both pilots or one pilot sees the other late and one or both are only able to take emergency avoiding action	Neither pilot sees each other in time to take action that materially affects the outcome (i.e. the non-sighting scenario)	