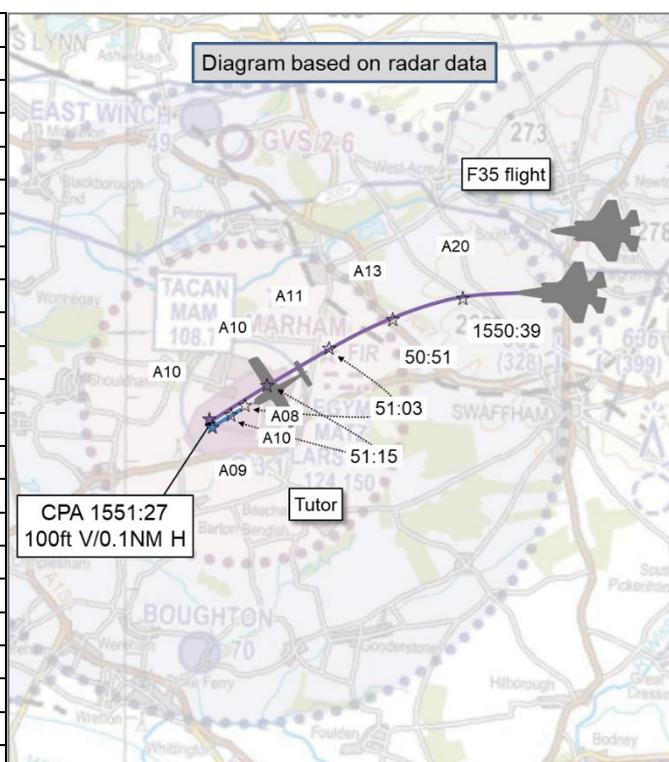


AIRPROX REPORT No 2020154

Date: 26 Oct 2020 Time: 1551Z Position: 5239N 00032E Location: RAF Marham

PART A: SUMMARY OF INFORMATION REPORTED TO UKAB

Recorded	Aircraft 1	Aircraft 2
Aircraft	Tutor	F35 x 2
Operator	HQ Air (Trg)	Foreign Mil
Airspace	Marham ATZ	Marham ATZ
Class	G	G
Rules	VFR	VFR
Service	Traffic	None ¹
Provider	Marham Approach	(Marham Tower)
Altitude/FL	FL014	FL015
Transponder	A, C, S	A, C, S
Reported		
Colours	White, blue	Grey
Lighting	Nav, landing, HISL	NK
Conditions	VMC	VMC
Visibility	40km	>10km
Altitude/FL	500ft	1000ft
Altimeter	QFE (992hPa)	Rad Alt
Heading	240°	236°
Speed	80kt	350kt
ACAS/TAS	TAS	NK
Alert	TA	NK
Separation		
Reported	300ft V/0m H	700ft V/100ft H
Recorded	100ft V/0.1NM H	



THE TUTOR INSTRUCTOR reports that the student pilot had just completed an ILS and was executing the go-around. The forward visibility while flying along the Final Approach Track was very poor due to it being directly into a low sun, however, visibility in all other directions was excellent. Once the student had completed the after take-off checks the Instructor took control, at approximately 500ft, and called Marham Approach iaw the briefed departure instructions. A Traffic Service was requested and then the TAS give a Traffic warning. The Instructor looked down to see a TAS contact at about 1 mile to the rear, indicating 300ft above then 200ft above as they were in the climb at about 1000ft/min. The instructor looked over their shoulder and saw 2 F35s joining the circuit, slightly above and closing very rapidly. The instructor bunted the aircraft to try and increase vertical separation and the F35s passed directly overhead, breaking onto the downwind leg as they did so with the TAS now showing a separation of 300ft. The instructor was not sure of the maximum height reached in the circuit prior to bunting. The Approach Controller was informed that the Tutor Instructor wished to file an Airprox. The Tutor Instructor noted that the F35 pilots would have had little chance of seeing the Tutor because from their perspective it would have been almost directly into the low sun.

The pilot assessed the risk of collision as 'Medium'.

THE F35 PILOT reports that both formation members were aware of and visual with the Tutor in the circuit. The F35s were given Traffic Information by Marham approach, then switched to Marham Tower. Marham Tower also passed Traffic Information. The Tutor was visually acquired and on radar at 300ft agl. In order to keep separation from the Tutor, the F35 flight broke into the RAF Marham landing circuit above and then behind the Tutor. The F35s were offset just north of the runway to laterally deconflict and at the circuit altitude of 1000ft agl. The F35 pilot noted that they were unsure why the Tutor would

¹ The F35 formation had been instructed to contact Marham Tower but RTF communication was not established until after the Airprox had occurred.

climb into an occupied military traffic pattern or unsure why Approach climb-out instructions would climb the Tutor through the occupied military circuit.

The pilot assessed the risk of collision as 'None'.

THE MARHAM APPROACH/DIRECTOR CONTROLLER reports that the Approach/Director positions were bandboxed. When they took over the position the Tutor was established on Talkdown, a pair of F35s In the TACAN hold, a pair recovering for an ILS from the northwest and the Airprox F35s requesting a visual recovery from the east. Reports of storms in the area were causing all aircraft to request alternative vectors to those given, increasing the workload. The Airprox F35 flight called visual with the aerodrome at about 10 miles. Traffic Information was passed on the traffic recovering from the northwest before sending the Airprox F35 flight to the Tower frequency at about 7-8 miles. The Marham controller then turned their attention to other aircraft under their control. The Tutor had carried out its approach and the pilot re-contacted approach for the departure. After identification, the Tutor pilot said there were 2 fast jets behind and asked what they were doing. They were informed that the F35 flight were joining the visual circuit and the Tutor pilot replied that they were close enough to file an Airprox.

THE MARHAM SUPERVISOR reports that the controller had just taken a handover in the position during a busy period. The controller workload was high and the situation made even more difficult with thunderstorms and lightning causing aircraft to be unable to take the instructed vectors. The Airprox F35 flight were instructed to contact Marham Tower at about 7 miles to the east to join for initials. The Supervisor then switched their attention to the rest of the radar traffic. Tower then called via landline to say that two F35s were joining via initials and that they had not made radio contact. The Supervisor informed the controller that it was [the Airprox F35 flight] and to make a blind call on the Tower frequency. The Airprox was then called by the Tutor pilot. The Supervisor noted that the F35 flight did not contact Tower until they had broken into the circuit and were downwind. The Supervisor noted that there were several contributing factors to the Airprox; the warning inbound call had been missed in the handover and due to the high workload had not been picked up by the new controller or the Supervisor; there was pressure in the radar room for a trainee controller to carry out an SRA for endorsement (which was why a change of controller took place); the original controller was a multi-tourist in their first live session when it became busy; Marham has had very little mixed type traffic in the visual circuit.

Factual Background

The weather at Marham was recorded as follows:

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METAR EGYM 261550Z 24012KT 9999 VCSH FEW014CB FEW015CB 11/08 Q0995 BLU TEMPO 3000 +SHRA
BKN015TCU RMK BLU TEMPO YL01=
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Analysis and Investigation

Military ATM

An Airprox occurred on 26 Oct 20 at approximately 1551UTC, in the vicinity of RAF Marham Visual Circuit between a pair of F35s and a Tutor.

The pair of F35s had been receiving a Traffic Service from Marham Approach for a radar vectored run-in overhead, this is historically a standard visual join. Initially delayed in their recovery due to the Tutor which was at 6nm on the ILS they were eventually cleared visual recovery when the Tutor was 1nm final. The F35s reported visual with the aerodrome and were passed further Traffic Information on another pair of F35s before being instructed to continue with Marham Tower. They reported that Marham Tower provided a "traffic callout" and they visually acquired the Tutor as well as having them on radar. Separation was reported as 700ft vertical and 100ft horizontal and they did not believe there was a safety excursion.

The Marham Approach Controller had taken over from a UT Approach Controller just prior to the F35s being allowed to change frequency to Marham Tower. They were providing an ATS to at least 4 speaking units and were bandboxed with the Director control position. The work rate of the

Approach Controller was high due to a number of thunderstorms in the vicinity which increased the number of control instructions and traffic information calls. Traffic Information was passed to the F35s twice regarding the Tutor which also included its intention to depart climbing to 4000ft prior to allowing them to change frequency. The warning inbound call from Approach to the ADC had not been conducted for the F35s and it is unknown whether Traffic Information was passed to the Talkdown Controller. The Tutor called the Approach Controller on departure and was provided with the requested Traffic Service. No information on the F35s was passed to the Tutor until after they reported that they had two fast jets approaching from behind. The ADC Controller saw the joining F35s approximately 2NM away which allowed them to ask the Supervisor for information on the joining pair. Once a callsign was ascertained the ADC Controller was able to pass the details required for the Visual Circuit join and provide Traffic Information on the Tutor. As the Tutor was conducting a radar approach and departing, they were not on the ADC frequency at any point in the approach.

Figures 1-5 show the positions of the F35s and the Tutor at relevant times in the lead up to and during the Airprox. The screen shots are taken from a replay using the NATS Radars, which are not utilised by Marham and therefore may not be entirely representative of the picture available to the Marham Controllers. The F35s, under a Traffic Service, were conducting a visual recovery to the airfield and had been provided with Traffic Information on the Tutor which was conducting an ILS approach. The F35s were advised that the Tutor would be departing after their approach climbing to 4000ft. After the F35s reported visual with the aerodrome (Figure 1) they were provided with further Traffic Information on another formation before being directed to switch to the Tower frequency 12sec later. The separation between the Tutor and the F35s when they were directed to switch frequency was estimated to be 5.8NM and 1600ft (Figure 2).

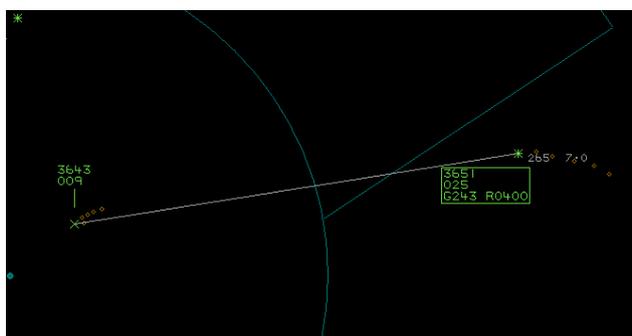


Figure 1:
F35s report visual with the Aerodrome.

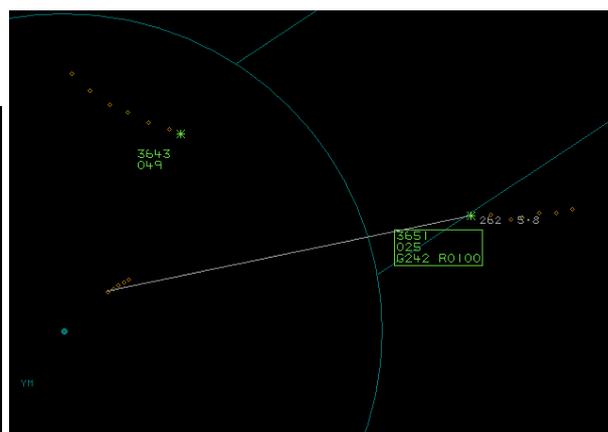


Figure 2:
F35s instructed to change frequency.

The Tutor reported on frequency with Marham Approach after completing their ILS approach and requested a Traffic Service. Eleven seconds later a Traffic Service was agreed (Figure 3). Separation decreased to 2nm and 200ft.

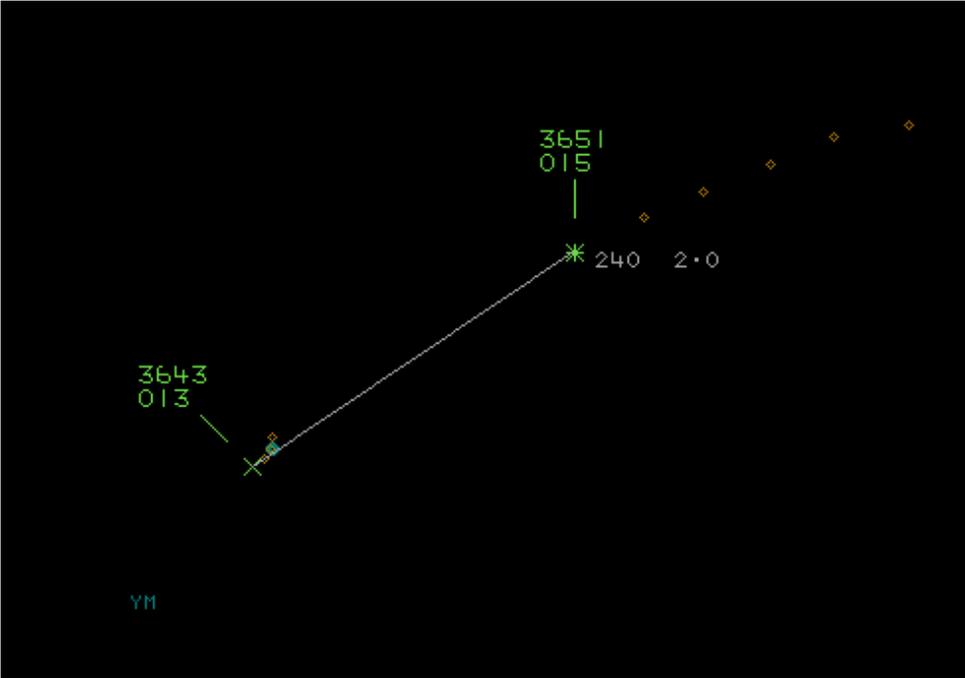


Figure 3: Traffic Service agreed between the Tutor and Marham Approach.

Eleven seconds later the Tutor reports that they had two fast jets approaching from the rear (Figure 4). Separation between the Tutor and the F35s decreased to 1.1nm and 100ft.

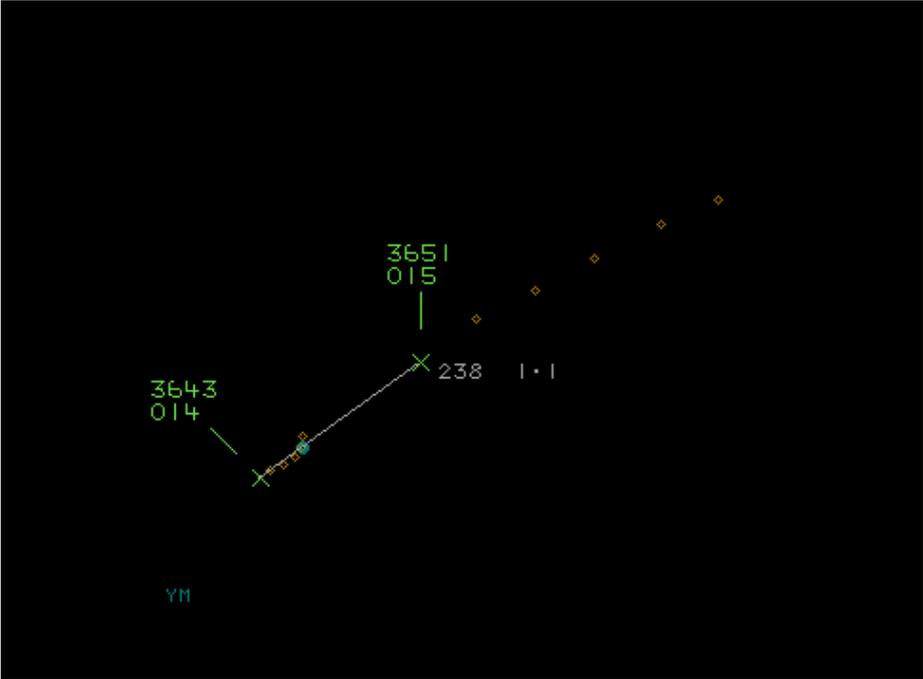


Figure 4: Tutor advised Marham Approach of the approach F35s.

The Tutor was advised that the F35s were joining the Visual Circuit and CPA occurred six seconds later (Figure 5). Separation was measured at 0.1NM and 100ft.

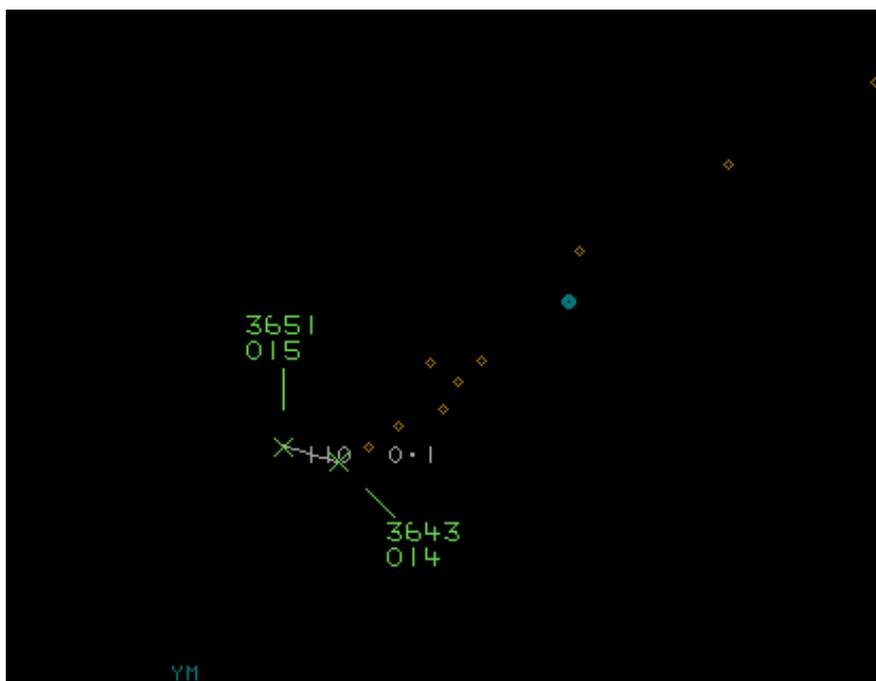


Figure 5: CPA

Poor weather in the local area, particularly the proximity of thunderstorms, increased the workload in an already complex situation for the Approach Controller. This was further exacerbated by bandboxing with the Director console and a controller change-over which resulted in the warning inbound call to the ADC being missed by both the Approach Controller and the Supervisor. The Controller change was required to allow the examination of a controller in another discipline to take place which potentially could have been better managed by the Supervisor. However, the Approach Controller did provide Traffic Information including the expected climb out details of the Tutor twice to the F35s prior to their frequency change. Traffic Information could have been passed to the Tutor by the Approach Controller on initial climb-out, because it was likely that separation would be reduced due to the relative speeds, however, it would have been expected that the F35s would follow the Visual Circuit procedures, to be visual with and maintain separation from the Tutor.

It was unfortunate that the warning inbound call was missed by the Controllers, however, the F35s did not follow the standard joining procedure and did not contact the ADC until they were already inside the Visual Circuit. Positive lookout by the ADC allowed them to obtain information from the Supervisor to interrogate the joining pair. Additionally, it was unclear whether the F35s followed the expected ground track for an initials join which should be 0.5NM deadside at initials rather than over the runway; this would have provided further lateral separation from the Tutor.

UKAB Secretariat

The Tutor and F35 pilots shared an equal responsibility for collision avoidance and not to operate in such proximity to other aircraft as to create a collision hazard.² An aircraft operated on or in the vicinity of an aerodrome shall conform with or avoid the pattern of traffic formed by other aircraft in operation.³

Marham Occurrence Investigation

The investigator reviewed RAF Marham approach procedures, ATC transcripts, the Tutor DASOR and interviewed the F35 pilots and ATC personnel by video conference. The assessment of the Closest Point of Approach (CPA) has been hampered by lack of independent access to the F35 Sensor Tape Review due to Security Restrictions, and in the absence of radar data which has been

² MAA RA 2307 paragraphs 1 and 2.

³ MAA RA 2307 paragraph 15.

sent to the Airprox Board. Consequently, the provided assessment of CPA is an estimate from data supplied on this DASOR, from the linked [Tutor] DASOR, ATC voice tape transcript and interviews with ATC and the F35 pilots. This assessment is likely to be less accurate than the Airprox Board determination, obtained from their enhanced data gathering and debrief procedures.

It should be noted that the F35 flight are a [foreign military] detachment of a deployment that have been operating at RAF Marham and HMS QNLZ for the 8-week period running up to this event. [F35 flight] have stated that the Tutor was in sight during the join and break, which is supported by the ATC transcript, and they maintain that they broke in to the Visual Pattern without any Safety concerns regarding vertical separation minima with [the Tutor] but who initiated an instinctive defensive bunt to increase vertical spacing. [The F35 flight] did not perceive a loss of safe separation during their break whereas [the Tutor pilot] did and was already aware of the approaching and expected parallel offset traffic, but not with [the F35 flight] positioning overhead [the Tutor's] outbound climbing flightpath. From the information logged, it is likely that the CPA is in the region of 200-700ft vertically and approximately in the overhead of [the Tutor]. This CPA boundary is defined by the 200ft from the Tutor reported TAS information and the 700ft from the visual estimate from [the F35 flight] as they entered into the visual pattern prior to breaking.

This was a normal overshoot from a routine IFR approach with a pair joining for the overhead break into the RAF Marham visual VFR closed pattern. Both [F35s] were visiting aircraft, with a slow speed propeller aircraft overshooting from a second approach. The joining aircraft confirmed they had the traffic in sight and broke into the circuit with assessed sufficient separation. [The Tutor] was tracking the approach of [the F35 flight] on their cockpit TAS, initiated a last-ditch bunt on a TAS read-out of '200' and then sighted the F-35's as they broke in the near overhead to join downwind. All aircraft were receiving information and direction from Marham ATC but [the F35 flight] did not respond to TWR calls until after the break and as they positioned into the downwind leg.

The investigation recommended that, 'ATC to conduct a review of approach and circuit procedures to ensure that the system of deconflicting joining visual traffic from that on approach or overshoot from the IFR pattern maintain safe separation both laterally and vertically'.

Comments

HQ Air Command

This Airprox was subject to a Local Investigation and made one recommendation: 'ATC to conduct a review of approach and circuit procedures to ensure that the system of deconflicting joining visual traffic from that on approach or overshoot from the IFR pattern maintain safe separation both laterally and vertically'. After a thorough review, it was agreed that the visual circuit joining procedures are appropriate and sufficiently safe when adhered to. However, after consultation with the Aircrew, the Flying Order Book will be updated to reflect more accurate 'break-point' locations. Also, visiting Aircrew will be given a more detailed and comprehensive procedure briefing on arrival which will be refreshed if necessary.

Several barriers were degraded in this occurrence; poor into-sun visibility, high controller workload and joining procedures not followed by the F35 flight. With a warning from the Tutor's TAS, the pilot was able to acquire the F35s visually and manoeuvre their aircraft to prevent the situation from worsening. It is apparent from the radar recording that the recorded CPA is closer than that reported by the Tutor or the F35 flight, which is concerning. When joining a visual circuit, it is imperative that crews have full SA on all aircraft before going through initials. Good airmanship would also dictate giving aircraft a wide berth when breaking into the circuit. This is particularly important when considering the effect of wake turbulence or jet efflux on a light trainer. The F35s were being operated by a foreign military detachment; better documentation and a more detailed station procedure brief will mitigate the risk of re-occurrence.

Summary

An Airprox was reported when a Tutor and a pair of F35s flew into proximity in the visual circuit at RAF Marham at 1551Z on Monday 26th October 2020. Both pilots were operating under VFR in VMC, the Tutor pilot in receipt of a Traffic Service from Marham Approach and the F35 pilots not in receipt of an ATS.

PART B: SUMMARY OF THE BOARD'S DISCUSSIONS

Information available consisted of reports from both pilots, radar photographs/video recordings, reports from the air traffic controllers involved and reports from the appropriate operating authorities. Relevant contributory factors mentioned during the Board's discussions are highlighted within the text in bold, with the numbers referring to the Contributory Factors table displayed in Part C.

Due to the exceptional circumstances presented by the coronavirus pandemic, this incident was assessed as part of a 'virtual' UK Airprox Board meeting where members provided a combination of written contributions and dial-in/VTC comments.

Members first discussed ATM aspects of the Airprox. Radar controller workload and complexity were high, due to the changeable weather conditions, with heavy shower cells in the vicinity and consequent re-vectoring of aircraft and formations. In this context, the ATM team at Marham had decided to make a controller change in order to allow a trainee controller carry out an SRA for endorsement purposes. The Board agreed that normally this would be an entirely normal state of affairs but felt that controller workload and complexity levels on the day were such that the conduct of the trainee controller endorsement adversely affected ATM (**CF2**). Having conducted a controller changeover, the warning inbound call to the Tower was then missed (**CF1, CF4, CF5**) by both the replacement controller and the Supervisor (**CF3**), the Board thought perhaps due in part to the timing of the controller changeover. However, Traffic Information on the Tutor and its climb-out intentions was passed twice to the F35s by the Approach controller who was also able to confirm to the Tutor pilot that the F35s were inbound to the circuit when queried. Controller members noted the importance of matching the flying task to the available ATM resource, acknowledging that this was well understood by all concerned, and commented that it may perhaps also have been better to decline or break off the Tutor practice approach, given the degree of ATM complexity on the day.

Turning to the pilots' actions, the Board first discussed the F35 formation's circuit joining procedure and agree that this had not been iaw the standard Marham procedure (**CF6**). The formation had not joined through the initial point and importantly had not made timely radio contact with Marham Tower after being directed to do so (**CF10**). A military pilot member commented that a joining aircraft or formation is required to call at the initial point in order to declare their intentions and to receive safety critical information on traffic in and around the airfield circuit pattern, but that the F35 formation had not made contact with Marham Tower until after the Airprox (**CF9**). Nevertheless, the F35 pilots achieved a high degree of SA on the departing Tutor, from their radars and from Traffic Information calls from the Approach controller, and positioned to break in to the visual circuit. The situation developed such that the Tutor's flight path took it towards that planned by the joining F35 formation but the F35 formation did not adapt their plan in order to maintain separation from the Tutor by an appropriate margin (**CF7**). Members noted the F35 narrative comment that, '... they were unsure why the Tutor would climb into an occupied military traffic pattern or unsure why Approach climb-out instructions would climb the Tutor through the occupied military circuit.' and wondered whether the foreign military F35 pilots were habituated to a greater degree of air traffic control in the visual circuit, rather than the UK military requirement for pilots to visually judge the break position whilst maintaining clear of, or integrating with, other traffic (**CF6, CF8**). The Tutor pilot became aware of the closing F35 formation when the TAS alerted (**CF12**) and was able to take avoiding action by taking control and bunting the aircraft. Although the F35 pilots had seen the Tutor and perceived that there was no conflict (**CF14**) the Board felt that the Tutor instructor's report of TAS separation of 300ft and the radar derived separation at CPA were such that there had been a conflict. Given that the F35 pilots had a high level of SA of the Tutor's position and its pilot's intentions, the Board felt that the F35 formation's lack of plan adaption had

resulted in them flying into conflict with the Tutor (**CF15**). The Board also felt that the closing speed and degree of separation at CPA indicated that safety had been much reduced (**CF13**).

PART C: ASSESSMENT OF CONTRIBUTORY FACTORS AND RISK

Contributory Factors:

	2020154		
CF	Factor	Description	Amplification
	Ground Elements		
x	• Regulations, Processes, Procedures and Compliance		
1	Human Factors	• ATM Regulatory Deviation	Regulations and/or procedures not fully complied with
x	• Manning and Equipment		
2	Organisational	• ATM Staffing and Scheduling	Sub-Optimal establishment or scheduling of staff
3	Human Factors	• Leadership and Supervision	
x	• Situational Awareness and Action		
4	Human Factors	• Distraction - Job Related	Controller engaged in other tasks
5	Human Factors	• ATM Coordination	
	Flight Elements		
x	• Regulations, Processes, Procedures and Compliance		
6	Human Factors	• Flight Operations Documentation and Publications	Regulations and/or procedures not fully complied with
x	• Tactical Planning and Execution		
7	Human Factors	• Insufficient Decision/Plan	Inadequate plan adaption
8	Human Factors	• Monitoring of Other Aircraft	Did not avoid/conform with the pattern of traffic already formed
9	Human Factors	• Accuracy of Communication	Ineffective communication of intentions
10	Human Factors	• Communications by Flight Crew with ANS	Pilot did not communicate with appropriate ATS provider
x	• Situational Awareness of the Conflicting Aircraft and Action		
11	Human Factors	• Understanding/Comprehension	Pilot did not assimilate conflict information
x	• Electronic Warning System Operation and Compliance		
12	Contextual	• Other warning system operation	Warning from a system other than TCAS
x	• See and Avoid		
13	Contextual	• Near Airborne Collision with Aircraft, Balloon, Dirigible or Other Piloted Air Vehicle	Piloted air vehicle
14	Human Factors	• Perception of Visual Information	Pilot perceived there was no conflict
15	Human Factors	• Lack of Action	Pilot flew into conflict

Degree of Risk: B.

Recommendation: Nil.

Safety Barrier Assessment⁴

In assessing the effectiveness of the safety barriers associated with this incident, the Board concluded that the key factors had been that:

⁴ The UK Airprox Board scheme for assessing the Availability, Functionality and Effectiveness of safety barriers can be found on the [UKAB Website](#).

Ground Elements:

Regulation, Processes, Procedures and Compliance were assessed as **partially effective** because the F35 formation was not warned-in.

Manning and Equipment were assessed as **partially effective** because the controller changeover for the trainee controller validation was not appropriate for the work-load and complexity at the time.

Situational Awareness of the Confliction and Action were assessed as **partially effective** because although the warning inbound call was missed by the controllers, the Tower controller achieved early visual contact with the inbound F35 flight and passed information to the Tutor pilot.

Flight Elements:

Regulations, Processes, Procedures and Compliance were assessed as **partially effective** because the overtaking F35 flight did not integrate effectively with the departing Tutor.

Tactical Planning and Execution was assessed as **partially effective** because although the F35 flight initially had correct SA on the departing Tutor, its climb towards circuit altitude did not result in a plan adaption by the F35 flight, which broke into the circuit pattern in close proximity to the Tutor.

Situational Awareness of the Conflicting Aircraft and Action were assessed as **partially effective** because the F35 flight did not appear to assimilate the Tutor's converging flight path or take action to avoid the Tutor by a greater margin but the Tutor pilot's TAS warning enabled timely visual acquisition of the F35 flight and avoiding action.

See and Avoid were assessed as **partially effective** because although all parties saw the other aircraft the Tutor was avoided by an insufficient margin and could not increase separation further in the time available.

