

ACCIDENT

Aircraft Type and Registration:	1) North American P-51D, Mustang, G-SHWN 2) North American P-51D-20 (Modified), Mustang, G-BIXL
No & Type of Engines:	1) 1 Rolls-Royce V-1650-7 piston engine 2) 1 Packard Motor Car Co Merlin V-1650-7 piston engine
Year of Manufacture:	1) 1944 (Serial no: 122-40417) 2) 1944 (Serial no: 38675)
Date & Time (UTC):	23 September 2017 at 1530 hrs
Location:	Near Duxford Airfield, Cambridgeshire
Type of Flight:	1) Private 2) Private
Persons on Board:	1) Crew - 1 Passengers - None 2) Crew - 1 Passengers - None
Injuries:	1) Crew - None Passengers - N/A 2) Crew - None Passengers - N/A
Nature of Damage:	1) Propeller 2) Horizontal stabiliser
Commander's Licence:	1) Airline Transport Pilot Licence 2) Airline Transport Pilot Licence
Commander's Age:	1) 52 years 2) 53 years
Commander's Flying Experience:	1) 18,000 hours (of which 600 were on type) Last 90 days - 9 hours Last 28 days - 5 hours 2) 19,000 hours (of which 87 were on type) Last 90 days - 119 hours Last 28 days - 37 hours
Information Source:	AAIB Field Investigation

Synopsis

Two P-51 Mustangs were taking part in a display sequence at the *Battle of Britain Air Show* at Duxford, Cambridgeshire. The accident occurred as they were joining formation with a Boeing B-17G in preparation for the next part of the display. The pilots had briefed and agreed that the lead P-51 would join on the B-17's right side and the other on its left side. However, during the display both pilots tried to join on the B-17's right, resulting in the two P-51s colliding. They landed without further incident.

A number of human factors were contributory to the accident. Most significantly, although the P-51 pilots had performed a 'walk through' of their display, they did not include the

part involving the B-17. The CAA has added some additional guidance to Edition 15 of CAP 403, *Flying Displays and Special Events: Safety and Administrative Requirements and Guidance*, with regards to performing walk throughs of displays prior to flight.

History of the flight

Introduction

The two P-51s were part of a formation flypast that included a B-17. The B-17 had already completed a flypast with a Douglas DC3 and a Douglas C47 and the next part of the sequence involved the P-51s joining the B-17 once the DC-3 and C-47 had departed. After the formation flypast with the B-17, the P-51s planned to separate from the B-17 and perform formation aerobatics. G-SHWN was the lead P-51, with G-BIXL following.

Background

The P-51 pilots had arrived at Duxford the day before the airshow. That evening they discussed the formation aerobatics they planned to fly. This was to be the same sequence they had flown together at Prestwick Airshow, three weeks earlier, where the pilot of G-SHWN had led the display.

The pilots attended the main pilots' mass airshow briefing by the Flying Display Director at Duxford the following morning. Afterwards, the pilots of the DC-3, C-47, B17 and P-51s were given an additional formation briefing by the leader of their part of the display; the DC-3 pilot. In addition to the verbal briefing, the DC-3 pilot/formation leader gave the pilots a written brief which he had produced.

The pilot of G-BIXL read this handout during the verbal brief, then drew a pictorial representation of the display with aircraft symbols, as he preferred to use this form of aide memoire (Figure 1). When discussing how the P-51s would join the B-17, the lead P-51 (G-SHWN) pilot stated that, after taking off separately from the B-17, DC-3 and C47, the P51s would initially practice some formation aerobatics away from the airfield, with G-BIXL positioned on the right. After the DC-3 and C-47 had completed their flypast with the B-17, the P-51s would join the B-17 for their flypast. He said G-SHWN would join on the B17's right with G-BIXL joining on its left; G-BIXL's pilot agreed with this. They then discussed what they would do during the formation aerobatics. At this time, G-BIXL's pilot's focus was on the formation aerobatics, as the flypast with the B-17 was "bread and butter flying"; he having flown many of these before, albeit in and with various types of aircraft.

About 30 minutes before takeoff, the P-51 pilots met at their aircraft and discussed the display again. The focus was on the formation aerobatics, which they walked through together. This was something they had done before all their previous displays together. While the pilot of G-BIXL waited in the cockpit to start, he went through the formation aerobatics in his head with his eyes closed; he did not go through the join with the B-17.

Accident flight

The P-51s' start up, takeoff from Runway 24R and departure from Duxford were uneventful. At the time, the weather was clear and the wind was from the south-south-west at 6 to 7 kt.

Having completed the practice formation aerobatics with G-BIXL on the right of G-SHWN, the pilot of G-SHWN became visual with the B-17. It was flying about 500 ft agl, tracking south-west away from Duxford. The P-51s then flew towards it to commence the join.

After the B-17 commenced a right turn back towards the airfield, the P-51s passed below and through its 6 o'clock in a left turn, before reversing the turn. Once in the right turn, G-BIXL's pilot flew through the B-17's 6 o'clock to join on its right. As he did, he looked at G-SHWN, which he was moving away from and believed it was going to join on the B-17's left. Thinking that both P-51s were now on their nominated sides of the B-17, he looked inside the cockpit to check the instruments. At this point he believed that the airspace to the B-17's right was only for his aircraft and he thus had "carte blanche" to fly into position for their flypast. He briefly looked in his 9 o'clock and saw nothing, but was not concerned that he could not see G-SHWN, as they were both at low level and it may not have been easily visible against the ground due to its camouflaged paint scheme (Figure 2). He also believed the pilot would have been doing the same as him, flying low and fast before climbing into position with the B-17.

G-BIXL's pilot's next recollection was that the aircraft nosed down slightly and started to shake moderately. He checked the engine instruments, which were indicating normally, and believed something had detached from the aircraft. As the shaking increased, he turned towards Duxford. He transmitted a MAYDAY declaring he would land on Runway 06L (grass), as the wind was relatively light from the south-west. The landing was uneventful.

The pilot of G-SHWN stated that as the B-17 was in its right turn, the P-51s passed through its 6 o'clock in a left turn and below it, before reversing the turn. Just before the right turn reversal he looked over his right shoulder and saw G-BIXL. This did not concern him as they had briefed to do a "loose formation join". G-BIXL next appeared descending from above right and its tailplane passed through his propeller disk as he was about to move up and into position on the B-17. He did not see G-BIXL prior to this as he was predominately concentrating on the B-17 that was in his 11 o'clock. He felt a very slight knock which made him realise they had collided. G-BIXL initially disappeared under his aircraft's nose and then re-appeared out to its left, whereupon he observed the damage to its left tailplane.

Having heard the pilot of G-BIXL transmit a MAYDAY, the pilot of G-SHWN initially followed the B-17. Once G-BIXL had landed, he separated from the B-17 and landed on Runway 24 (asphalt) without event.

G-BIXL's pilot's comments

G-BIXL's pilot stated that when he draws a diagram of a formation display he usually annotates an aircraft symbol with 'ME' to indicate which aircraft is his in the formation. On this occasion he annotated 'P51' against both symbols representing the P-51s (Figure 1). He is "fairly sure" that had he differentiated between the two symbols, he would not have joined the B-17 on the right. He stated that he would ensure that he always does so in future.

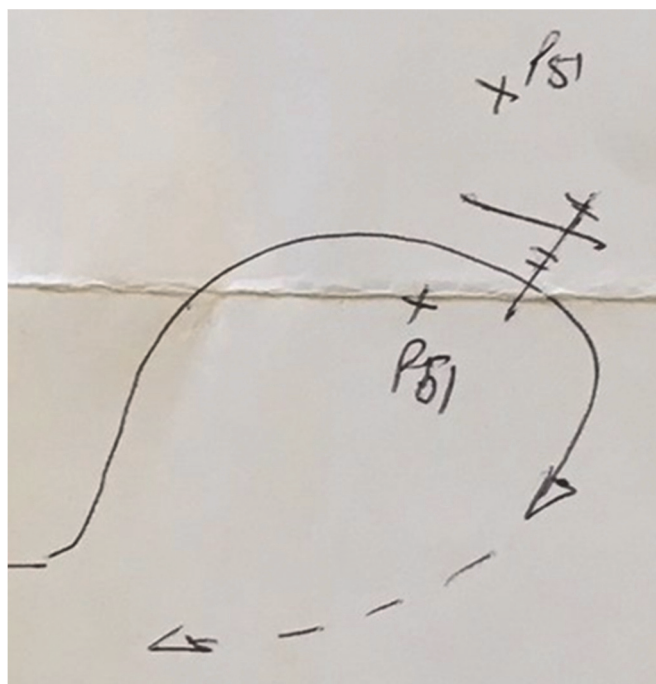


Figure 1

Part of G-BIXL's pilot's annotated diagram

Also, had all the pilots walked through the display on the ground, as is generally the norm, and had he flown the whole display through in his mind during his pre-flight preparation, he stated he was almost certain his misunderstanding would have been noticed and corrected before takeoff. He added that they only walked through the formation aerobatics as the join and flypast with the B-17 was considered a "standard piece of flying" that they had flown recently at Prestwick, albeit with a different lead aircraft. He believed he was likely to have suffered from "risky shift"¹ as a result of having done similar joins "hundreds of times".

He stated that in future he would keep the lead aircraft visual until it is established in formation with the flypast's lead aircraft before moving to his briefed side. Had he believed G-SHWN was on the incorrect side he would have sought clarity over the radio.

Footnote

¹ Risky shift is a tendency for individuals to make more daring decisions when they are in groups, than when they are alone.

CAP 403 - *Flying Displays and Special Events: Safety and Administrative Requirements and Guidance*

Edition 14 of the CAA's CAP 403 was extant at the time of the accident. Whilst evidence from the pilot interviews suggested it was generally the norm for display pilots to do walk throughs as part of their preparation prior for a display, there was no mention of this in CAP 403.

Aircraft information

The North American P-51D Mustang is a single-pilot World War Two era long range fighter aircraft. It has an all metal airframe construction, with a hydraulically retractable main landing gear and tailwheel arrangement. The fuselage is 32 ft long, it has a wingspan of 37 ft and a horizontal stabiliser span of 13 ft. The single V-1650 engine drives a Hamilton Standard four blade propeller, which has a diameter of 11 ft 2 in. The accident aircraft are depicted in Figure 2.



Figure 2

P-51D Mustang aircraft involved in the accident.
(G-BIXL on the left and G-SHWN on the right)

Aircraft examination

Damage was present on both aircraft from contact between the propeller blades of G-SHWN with the left horizontal stabiliser of G-BIXL (Figures 3 and 4). The blade strike on the horizontal stabiliser was within a few centimetres of the control cables for the elevator trim system, but resulted in structural damage only. The propeller blades all exhibited scuffing to the paint, but no visible structural damage.



Figure 3

Damage to horizontal stabiliser of G-BIXL

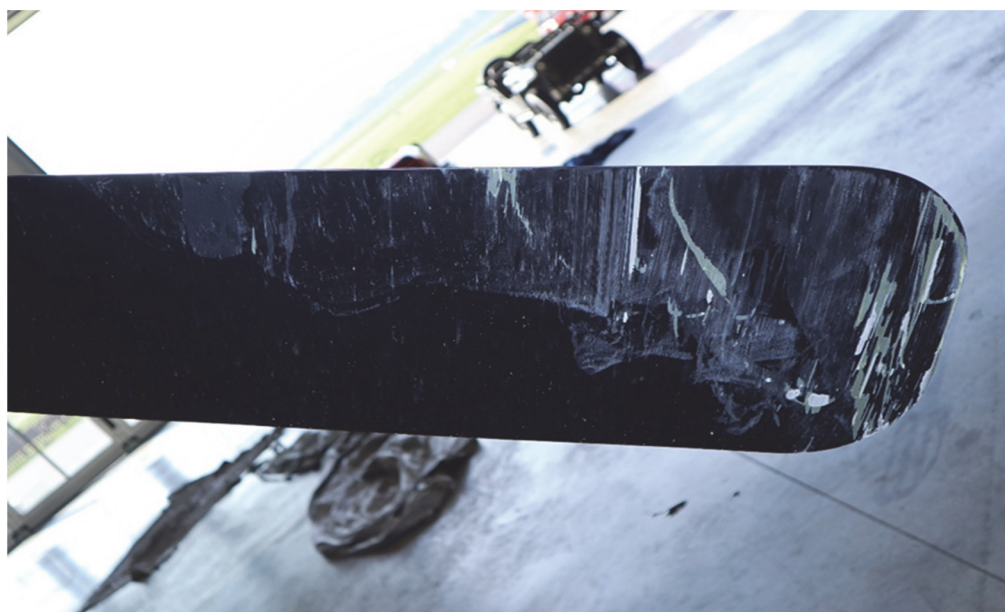


Figure 4

Damage to rear face of G-SHWN propeller blade

Recorded data

The collision between the aircraft was recorded by two cameras; one being operated by a witness on the ground and another fixed to the B-17, looking rearward from one of the observation windows and recording autonomously. A still from the latter is shown in Figure 5.



Figure 5

Video still showing the collision

Analysis

The P-51 pilots had flown many formation flypasts together before, in different types of aircraft. They had also practised the formation aerobatics part of the display three weeks prior to the accident.

At the briefing, the pilots of the DC-3, C-47, B-17 and P-51s were given a written description of the flypast by the leader. During the briefing, G-BIXL's pilot drew a diagram of the flypast with aircraft symbols. While he would normally annotate such a diagram with 'ME' against the symbol depicting his aircraft, in this case he annotated 'P51' for both the symbols that represented the P51s. Having done this, he was not subsequently able to identify from the sketch which side he was briefed to join the B-17. However, he added that had he been in any doubt, he would have sought clarity over the radio.

The pilot of G-BIXL agreed and acknowledged at the briefing that his P-51 would formate on the left side of the B-17. However, having planned and practised the formation aerobatics in echelon right he may have had some confirmation bias to support his belief that being on the right of the B-17 for the flypast was correct.

The P-51 pilots' concentration was predominantly focused on the formation aerobatics during the briefing and walk through, rather than the whole display. This resulted in G-BIXL's pilot incorrectly recalling the brief and attempting to join on the B-17's right, as opposed to the left. Had they widened their attention to the whole display, the pilot of G-BIXL believed the accident may have been avoided.

As the pilot of G-BIXL closed into position on the B-17's right he briefly looked in the aircraft's 9 o'clock and did not see G-SHWN. Had he remained visual with G-SHWN and monitored its position while it joined on the B-17's right, this may have caused him to either remember that he was briefed to formate on the B-17's left, or to make an appropriate radio call to confirm the intentions of G-SHWN's pilot.

Conclusion

The two P-51s collided due to a combination of human factors. The pilot of G-BIXL did not annotate his diagram of the display sequence to show which was his aircraft. This removed one of the possible means of confirming which side he had been briefed to join the B-17. There appears to have been omissions, possibly resulting from a degree of complacency, during the briefings and subsequent walk through, where the join and flypast with the B-17 were not considered. Best practice would have been for the pilot of G-BIXL to have remained visual with G-SHWN until it was in the final formation position.

It was only providence that prevented this accident from resulting in a catastrophic outcome.

Safety action

Given that most display pilots conduct walk throughs and G-BIXL's pilot commented that he believed the accident would have been avoided had they done a walk through of the whole display, the CAA has made the following addition to Appendix C of Edition 15 of CAP 403, *Flying Displays and Special Events: Safety and Administrative Requirements and Guidance*, that was published in March 2018:

'Useful guidance for display pilots

...

Briefings and walk throughs

C3 It is essential that in addition to the FDD's written and verbal briefings that all display items consisting of formations are thoroughly briefed. It is vital that every member of the formation has a clear picture of the objectives of the formation as a whole and of their individual positioning and responsibilities within it. Walk throughs are an integral part of this briefing process and it is strongly recommended that they are adopted as a standard part of all formation briefings [AAIB bold].

C4 Walk throughs are not exclusive to formation briefs and can also be of benefit to the solo display pilot.'