

ACCIDENT

Aircraft Type and Registration:	1) Boeing 777-240(LR), AP-BGY 2) DHC-8-402 Dash 8, G-JEDR
No & Type of Engines:	1) 2 General Electric GE90-110B turbofan engines 2) 2 Pratt & Whitney Canada PW150A turboprop engines
Year of Manufacture:	1) 2005 2) 2003
Date & Time (UTC):	15 February 2007 at 1220 hrs
Location:	Manchester Airport
Type of Flight:	1) Commercial Air Transport (Passenger) 2) Commercial Air Transport (Passenger)
Persons on Board:	1) Crew - 12 Passengers - 144 2) Crew - 6 Passengers - 37
Injuries:	1) Crew - None Passengers - None 2) Crew - None Passengers -None
Nature of Damage:	1) Minor scratches on right wingtip 2) Damage to the rudder
Commander's Licence:	1) Airline Transport Pilot's Licence 2) Airline Transport Pilot's Licence
Commander's Age:	1) N/K 2) 46 years
Commander's Flying Experience:	1) 14,000 hours (of which 180 were on type) Last 90 days - N/K Last 28 days - N/K 2) 9,873 hours (of which 2,000 were on type) Last 90 days - 150 hours Last 28 days - 50 hours
Information Source:	AAIB Field Investigation

Synopsis

A DHC-8-400 had stopped short of the runway, at intersection Holding Position JA1, prior to taking off. A following Boeing 777 was cleared to Holding Position J1, at the beginning of the runway, which involved taxiing beyond JA1. The crew of the B777 were cautioned about the presence of the DHC-8 as

they continued towards J1. As the B777 passed behind the DHC-8, its right wingtip struck the DHC-8's rudder. The B777 suffered minor scratching to its wingtip. The DHC-8's rudder was damaged and required replacement.

History of the flight

The Boeing 777, AP-BGY, and the DHC-8, G-JEDR, were both due to depart from Manchester Airport on scheduled public transport (passenger) flights. The two aircraft pushed back from their respective parking stands, in different parts of the airport, within 10 minutes of each other and taxied towards Runway 24R¹, which was in use for departures and arrivals. The weather was benign, with good visibility and a light southerly wind.

Complying with an instruction from the Ground Movement Control (GMC) controller, the commander of G-JEDR taxied his aircraft to Holding Position JA1 (see Figure 1) and stopped the aircraft “on the line” at about 1216 hrs. The flight crew prepared for an immediate departure and waited for clearance to enter the runway. They were aware that the Boeing 777, AP-BGY, was taxiing along Taxiway Juliet and would pass behind them.



Figure 1

Footnote

¹ Changes in magnetic variation since this event mean that the runways at Manchester Airport have been re-designated 23L and 23R.

The GMC controller cleared AP-BGY to taxi along Taxiway Juliet to Holding Position J1, and the co-pilot read back this clearance. The commander was the handling pilot.

At 1218 hrs, the GMC controller transmitted to AP-BGY “[CALLSIGN] JUST CAUTION THE TAIL OF THE [NAME OF DHC-8 OPERATING COMPANY] DASH EIGHT UP AHEAD OF YOU [BRIEF PAUSE] HOLD AT JULIET ONE CONTACT TOWER ONE ONE EIGHT DECIMAL SIX TWO FIVE”. The co-pilot read back “ROGER JULIET ONE AND ONE EIGHT SIX TWO FIVE [CALLSIGN]”. He then contacted the Tower controller, who replied “[CALLSIGN] HOLD AT JULIET ONE WHEN YOU’RE ABLE TO”. The co-pilot replied “ROGER JULIET ONE [CALLSIGN]”.

Approaching the point at which their aircraft would pass behind the DHC-8, the commander and co-pilot of AP-BGY discussed the position of G-JEDR. The commander stated that he believed that, in view of the ATC clearance and provided he taxied on the taxiway centreline, adequate space should exist between his aircraft and G-JEDR, otherwise the controller would have instructed him to stop. Nonetheless, the commander elected to deviate one or two metres to the left of the taxiway centreline, to increase the separation between the two aircraft.

At 1220 hrs, the right wing tip of AP-BGY struck the rudder of G-JEDR. The crew of AP-BGY were unaware of the collision, although they felt a very slight motion which the commander thought was a gust of wind. The flight crew of G-JEDR felt “a bump” through the rudder pedals and airframe. They discussed whether a collision had occurred or if they had been affected by a gust of wind. They dismissed this latter possibility as the aircraft was stationary, facing almost exactly into the wind. The commander concluded that a collision

had occurred and informed ATC. The cabin crew had also felt the aircraft move but did not recognise that a collision had taken place.

The Tower controller informed the flight crew of AP-BGY of the collision. The commander of the B777 stopped the aircraft and asked the co-pilot to go into the passenger cabin to inspect the wingtip. There did not appear to be any significant damage. Meanwhile, ATC dispatched an Airfield Operations vehicle and the Airport Fire and Rescue Service (AFRS) to the accident.

Both aircraft were inspected by airport operations staff and damage to the DHC-8’s rudder was discovered. The aircraft were then taxied back to parking stands at the terminal. After the collision neither aircraft’s position was noted for the purposes of investigation.

GMC controller’s recollection

The GMC controller recalled observing G-JEDR stationary at Holding Position JA1 and clearing AP-BGY to taxi to Holding Position J1. He had expected AP-BGY to wait until G-JEDR had moved forward from its position before continuing along Taxiway J to J1. However, he also stated that he had previously seen a B777 successfully taxi behind a DH8-Q400 which was holding at JA1, although the manoeuvre was “close” and “tight”. Which variant of B777 was involved on that occasion is not known.

Tower controller’s recollection

The Tower controller recalled that the GMC controller was directing some outbound aircraft to JA1, and others to J1, to provide flexibility in the outbound sequence. He recalled the flight crew of AP-BGY contacting him when G-JEDR was already holding at JA1 and instructing them to “[CALLSIGN] HOLD AT JULIET ONE WHEN YOU’RE ABLE TO”, adding “WHEN YOU’RE ABLE

TO” to reflect his expectation that AP-BGY would hold before passing behind G-JEDR.

Aircraft information

The wingtips of the Boeing 777 are not visible from the flight deck. The flight deck is fitted with opening ‘direct vision’ windows at the sides, but the commander of AP-BGY reported that it would be most unusual for the windows to be opened during taxiing.

Engineering examination

Both aircraft had been moved after the collision so it was not possible to determine, from physical examination, precisely where they were at the time of

the impact. However, the clearances between the two aircraft were simulated using a computer generated map, based on accurate survey data, on which scale representations of various aircraft types could be displayed (see Figure 2). This indicated that there would be a clearance of 2.0 m between the rudder of a DHC-8-400 (parked with its nose precisely at the stop line at holding point JA1 and on the taxiway centreline) and the right wingtip of a Boeing 777-200LR taxiing behind it along the centreline of Taxiway J. The gap between the wingtip of the B777 and the higher trailing edge of the DHC-8’s left elevator would be less, at 1.4 m.

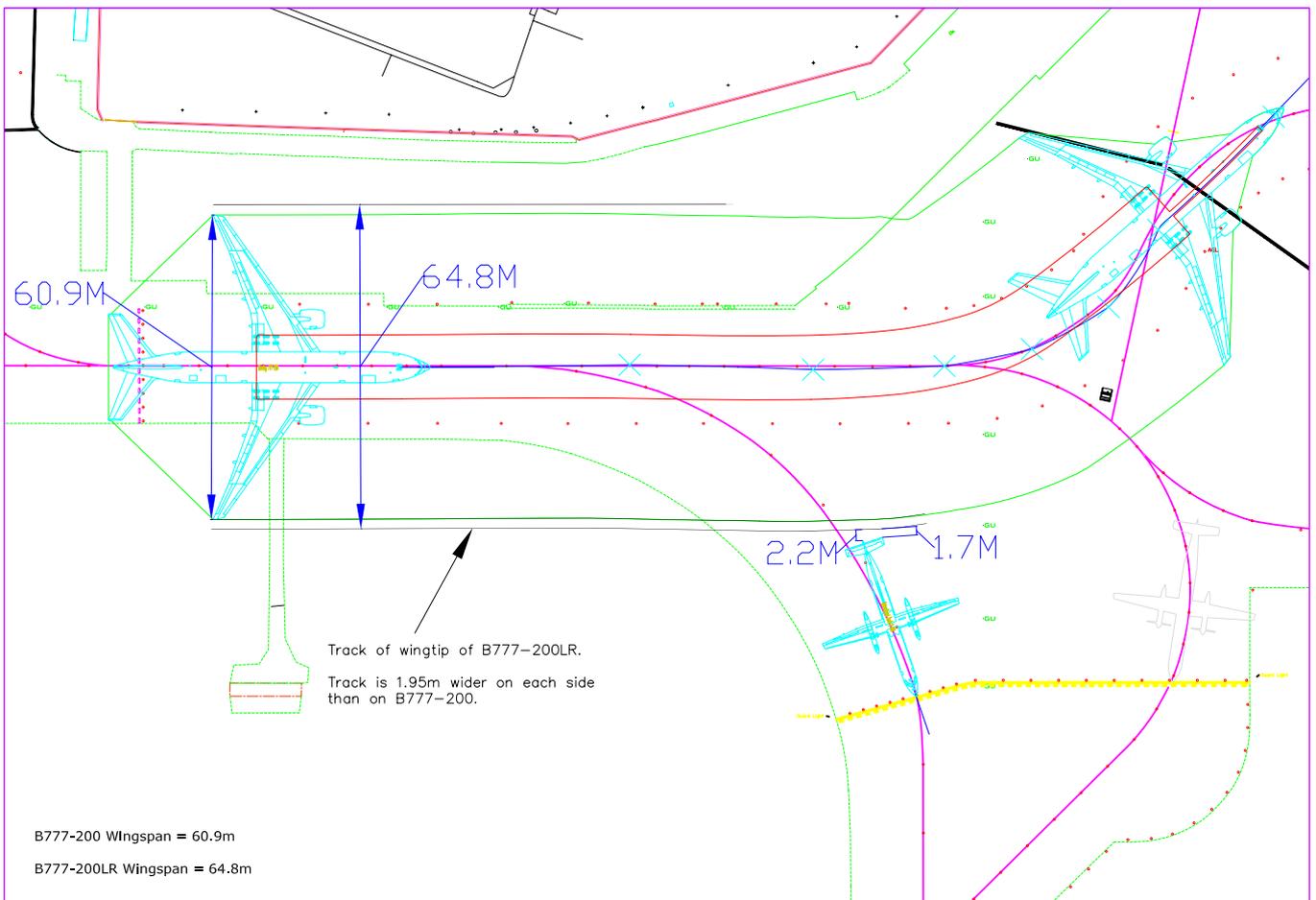


Figure 2

The trailing edge of G-JEDR's rudder had been struck just below the level of the horizontal stabiliser by AP-BGY's right wingtip. The impact had bent the trailing edge of the rudder at right angles over a length of about 80 cm. The damage was not repairable and the rudder was replaced.

There was little more than superficial scratching to the wingtip and outboard leading edge of AP-BGY's right wing which, after examination, was allowed to continue in service without requiring repairs.

Flight recorders

Introduction

Both aircraft were equipped with a Flight Data Recorder (FDR) and a Cockpit Voice Recorder (CVR), capable of recording a minimum of 25 hours of data and 120 minutes of audio respectively. Parameters recorded by AP-BGY included its heading and ground speed. A plot of the salient FDR parameters from both aircraft is provided in Figure 3.

FDR and CVR Data

The FDR and CVR were removed from both aircraft and successfully replayed.

When AP-BGY was about 100 metres from G-JEDR, it gradually decelerated (Figure 3, POINT A). There was some conversation between its flight crew about the position of G-JEDR, reflecting a concern that there would be little separation between the aircraft as they passed. As it closed to about 60 metres from G-JEDR, AP-BGY started to make a gradual turn to the left, with its ground speed reducing to about 6 kt (Figure 3, POINT B). As the turn continued, the collision occurred. There was a small oscillation of G-JEDR's rudder during the impact (Figure 3, POINT C), with associated lateral

and longitudinal accelerations being recorded. There was no associated recording of an impact on AP-BGY and its flight crew made no mention of one. The flight crew in G-JEDR briefly discussed whether they had been struck, before they contacted ATC to advise "[CALLSIGN] I THINK THE AIRCRAFT BEHIND US HAS JUST CAUGHT THE BACK OF OUR WING...OUR TAIL RATHER" (Figure 3, POINT D). ATC responded by advising that they had noticed it as well and advised AP-BGY to hold position, which it did (Figure 3, POINT E).

The flight crew on both aircraft advised ATC that they would need to return to a stand to assess the damage. The commander of AP-BGY also advised ATC that "WE WERE MAINTAINING LEFT OF THE CENTRE LINE AND THEN I THINK IT CLIPPED". The commander of G-JEDR, in conversation with his co-pilot, had commented that they were "ON THE LINE". They were not sure, initially, if the aircraft had been struck, both agreeing that the rudder and aircraft movement may have been due to the jet blast from AP-BGY's engines as it passed behind them.

Manchester Airport

Manchester Airport has two parallel runways, 24L and 24R which are usually used simultaneously, with departures from one and arrivals on the other. However, only Runway 24R was in use at the time of the accident.

Air Traffic Control at Manchester

Prior to the incident, the Tower controller asked the Approach controllers to provide a mixture of gaps in arriving traffic, some of six miles and others of eight, at their convenience. He was endeavouring to achieve two departures in each eight mile gap, and one in each six mile gap. Where he planned two departures in the same gap, one would be a large aircraft using the full length of the runway, the other a smaller aircraft

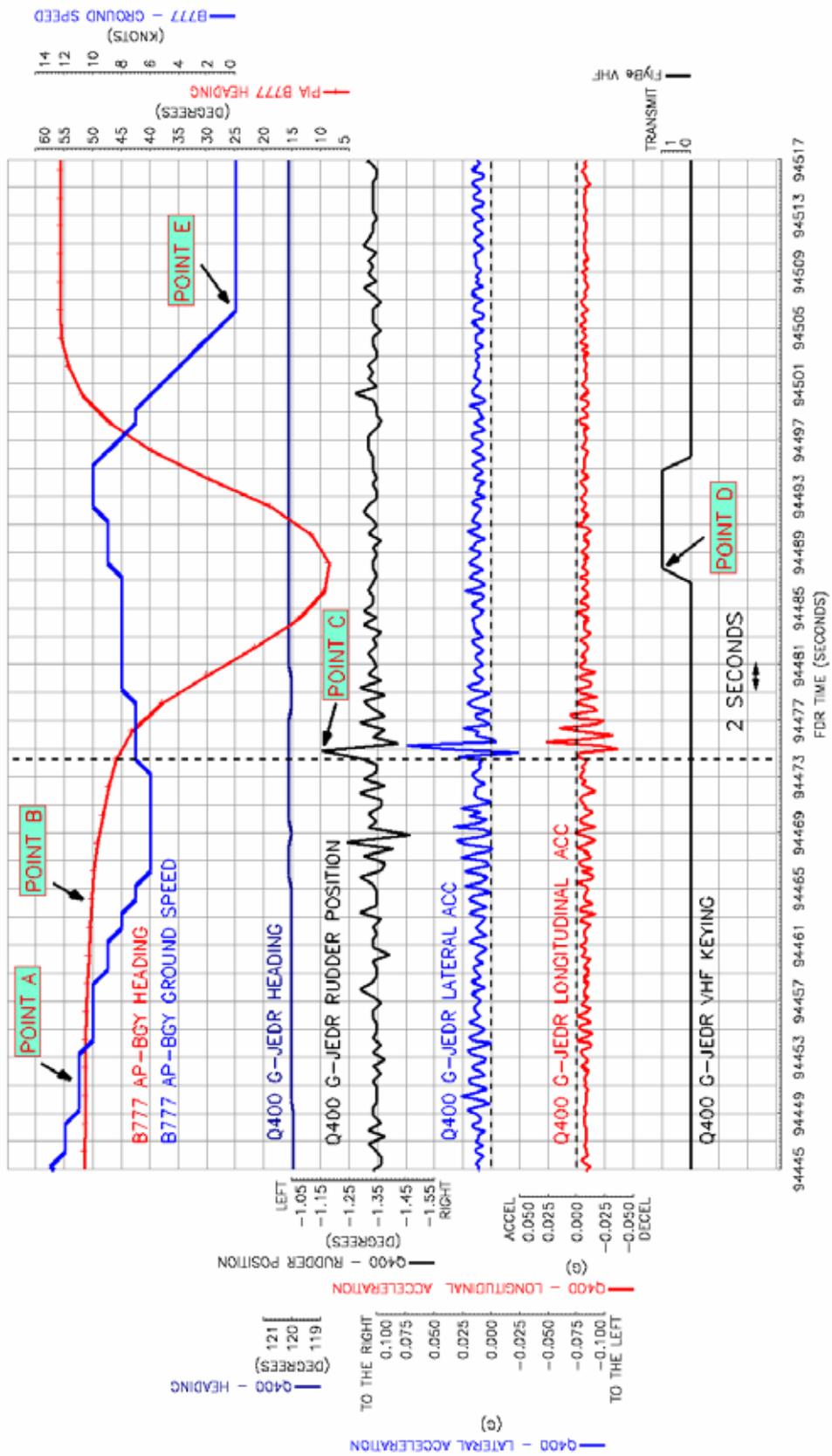


Figure 3

departing from an intersection. The smaller aircraft would depart first and fly on a different route from the larger, thus eliminating delays caused by separation considerations.

The GMC controller was aware of the technique being employed by the Tower controller and was using his own judgement to direct aircraft to Holding Positions J1 and JA1 to facilitate his colleague's plans.

The views from the GMC and Tower controllers positions in the Visual Control Room (VCR) are mainly unobstructed, but their distance and angle from Holding Position JA1 make it very difficult, if not impossible, to assess the clearance between the tail of one aircraft holding at JA1 and the wingtip of an aircraft on Taxiway J.

Air Traffic Control in the United Kingdom

Civil Aviation Publication (CAP) 493, the *Manual of Air Traffic Services (MATS) - Part 1*, gives guidance and instruction to air traffic controllers working in the United Kingdom. Under 'Aerodrome Control', it contains statements of responsibility for controllers undertaking various functions, including:

'2.1 Aerodrome control is responsible for issuing information and instructions to aircraft under its control to achieve a safe, orderly and expeditious flow of air traffic and to assist pilots in preventing collisions between:

.....

- c) aircraft moving on the apron;*
- d) aircraft and vehicles, obstructions and other aircraft on the manoeuvring area.'*

Aerodrome controllers were required to pass information to pilots as follows:

'Information to Aircraft

5.1 Aircraft under the jurisdiction of aerodrome control and in receipt of information critical to the continuing safe operation of the aircraft must be kept informed of any subsequent changes. For example:

- changes in essential aerodrome information...*

5.2 Essential Aerodrome Information

Essential aerodrome information is that concerning the state of the manoeuvring area and its associated facilities that may constitute a hazard to a particular aircraft. It shall be issued to pilots in sufficient time to ensure the safe operation of aircraft... Essential aerodrome information shall include:

- e) aircraft parked close to the runways or taxiways and aircraft engaged in ground running of engines'.*

9.3 Taxi Clearance

'The importance of issuing clear and concise instructions to taxiing aircraft cannot be over-emphasised. The visibility from an aircraft flight deck is limited and, when taxiing, the pilot is dependent to a large degree upon aerodrome control to assist him in determining the correct taxi route to be followed. Essential aerodrome information is to be passed to the pilot to assist him in preventing collisions with parked aircraft and obstructions on or near the manoeuvring area.'

Where there is a collision risk on the ground between two aircraft, controllers routinely instruct pilots to follow or give way to another aircraft, or issue conditional clearances such as ‘after the (aircraft type) crossing from right to left...’.

Published instructions to pilots

CAP 637, the *Visual Aids Handbook*, states:

‘At major aerodromes in the UK, taxiway width is determined so as to ensure a specified minimum clearance between the taxiway edge and the main undercarriage outer wheels of the largest aircraft that the taxiway is designed to accommodate. This minimum wheel clearance is assured in turns provided that the pilot keeps the ‘cockpit’ over the taxiway centreline.’

And

‘Upon reaching a Taxi Holding Position identifying a taxi clearance limit, the pilot should stop the aircraft as close as possible to the Taxi-Hold Position Marking, ensuring that no part of the aircraft protrudes beyond the marking.’

Conflicting demands are placed on a pilot, to stop as close as practicable to the taxiway holding position marking and yet to avoid runway incursion by ensuring that no part of the aircraft protrudes over the marking. If an aircraft has been stopped with the foremost part of its structure exactly over a hold position marking, the flight crew may find it difficult or impossible to see any stop bar co-incident with the hold position. Therefore, it is normal practice to stop short of the marking.

CAP 637 also states:

‘Taxi Holding Positions are normally located so as to ensure clearance between an aircraft holding and any aircraft passing in front of the holding aircraft, provided that the holding aircraft is properly positioned behind the holding position. Clearance to the rear of any holding aircraft cannot be guaranteed. When following a taxiway route, pilots and persons towing an aircraft are expected to keep a good lookout and are responsible for taking all possible measures to avoid collisions with other aircraft and vehicles.’

UK Aeronautical Information Publication (AIP)

In the entry *Manchester Aerodrome - Textual Data* under *LOCAL TRAFFIC REGULATIONS, Ground Manoeuvring Restrictions*, it states:

‘ATC instructions will normally specify the taxi route to be followed. This does not necessarily guarantee clearance from other aircraft, vehicles and obstructions on the manoeuvring area.’

‘Pilots are reminded of the need to exercise caution on wingtip clearances from other aircraft when manoeuvring in close proximity on the ground. Particular care should be taken in the runway holding areas and at runway crossing points.’

CAP 393, *AIR NAVIGATION: THE ORDER AND THE REGULATIONS*, Rule 37(2)², entitled ‘*Right of way on the ground*’ stated:

Footnote

² Since the event this Rule has been amended and re-numbered.

‘Notwithstanding any air traffic control clearance it shall remain the duty of the commander of an aircraft to take all possible measures to ensure that his aircraft does not collide with any other aircraft or with any vehicle’.

CAP 168, Licensing of Aerodromes

CAP 168 includes instructions on the design of taxiways and the absence of fixed obstacles near them which, broadly, cause there to be a cleared area either side of each taxiway free of obstructions at least 20% wider than the wingspan of the largest aircraft which will use that taxiway. No similar provision is made in respect of mobile obstructions such as aircraft and vehicles.

Analysis

Whilst the crew of G-JEDR reported that they had stopped “on the line” at the holding position, analysis showed that if the aircraft had been stopped with its nose precisely above the relevant marking, and that AP-BGY had been following the taxiway centreline, the two aircraft would not have collided. Therefore, it is logical to conclude that G-JEDR had stopped a few metres short of the holding position, which was consistent with allowing the crew a view of the stop bar, as is normal aviation practice.

The decision by the commander of AP-BGY to deviate slightly from the taxiway centreline, as he passed

G-JEDR, was to increase what he considered would be a small miss-distance between the two aircraft.

The method used by the GMC controller when directing departing aircraft for either full length or intersection departures, in order to present the Tower controller with opportunities to expedite the flow of traffic, was in accordance with normal ATC practice. Both controllers had expected AP-BGY to hold short of the link to JA1, until G-JEDR had moved forward. The clearances issued, for AP-BGY to taxi to J1, were correct. However, the cautions to the flight crew, which represented essential aerodrome information ‘to assist him [the pilot] in preventing collisions with parked aircraft’, as described in MATS Part 1, were not understood by them as meaning that there was a risk of a collision if they taxied past G-JEDR. The commander of AP-BGY stated that he believed that the instruction to taxi past G-JEDR would not have been issued if a collision risk had existed.

The information provided by ATC and the entry for Manchester Airport in the UK AIP, which are intended to assist pilots in their responsibility for collision avoidance, did not do so on this occasion.

Note: A report on a similar accident, involving an Airbus A320, D-AIQA, and a Boeing 737, EI-DKD, which occurred at Manchester Airport in August 2008 is also published in this Bulletin.