

Boeing 747-4H6, 9M-MPH

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**Aircraft Type and
Registration:**

Boeing 747-4H6, 9M-MPH

No & Type of Engines:

4 Pratt & Whitney PW-40-56 turbofan engines

Year of Manufacture:

1994

Date & Time (UTC):

15 January 2001 at 0538 hrs

Location:

London Heathrow Airport

Type of Flight:

Public Transport

Persons on Board:

Crew - 22 Passengers - 367

Injuries:

Crew - None Passengers - None

Nature of Damage:

No.4 engine nacelle wedged against three trolleys

Commander's Licence:

Airline Transport Pilots Licence

Commander's Age:

53 years

**Commander's Flying
Experience:**

14,771 hours (of which 1615 were on type)

Last 90 days - 160 hours

Last 28 days - 30 hours

Information Source:

Aircraft Accident Report Form submitted by the pilot and further enquiries with Heathrow Airport Ltd

History of the flight

A Boeing 747-400 was scheduled to land at London Heathrow airport (LHR) from a long haul flight at 0530 hrs, and had been allocated parking Stand J2 at Terminal 3.

Prior to the flight's arrival, a driver from the airline's handling agent positioned three tugs and a number of baggage dollies side by side to the right (looking from a parked aircraft's cockpit) of Stand J2 at right angles to the stand centreline. The driver used two white lines painted on the ramp parallel to the stand centreline to judge a safe distance from the centreline at which to park the

equipment. After positioning the tugs and dollies, the driver adjourned to his supervisor's van, which was parked elsewhere on the stand, to await the arrival of the aircraft.

The ramp supervisor responsible for parking the aircraft arrived at the stand prior to the aircraft's arrival and carried out a safety check. He noted the tugs and dollies to the right of the stand and a 'high loader' vehicle to the left rear of the stand within the stand boundary. None of the vehicles was manned. Although he could see no stand markings by which to assess safe clearance, the supervisor judged the tugs and dollies to be far enough to the right of the stand centreline to be clear of the aircraft, but he was concerned at the proximity of the 'high loader'. He requested that the 'high loader' be moved, and switched on the Automatic Positioning and Information System (APIS).

The 'high loader' had not been moved by the time the aircraft arrived at the stand and the supervisor therefore positioned himself to the left of the stand to monitor the clearance between the aircraft and the vehicle. As the aircraft turned into the stand, the supervisor satisfied himself that the left wing tip would clear the 'high loader' and started walking toward the jetty. As he walked he noticed an engineer run to the APIS controls at the front of the stand and operate the emergency stop button.

On arrival at the entrance to the stand the aircraft commander noticed that the APIS was lit and that there was a number of tugs with attached baggage dollies parked on the right of the stand. The commander judged that there was sufficient clearance between the parked ground equipment and the aircraft and continued to follow the APIS guidance.

During the approach to the final parking position the commander felt a 'bump' and immediately brought the aircraft to a halt. The number four engine had collided with one of the tugs and had pushed it into the other tugs causing the first tug to tip on its side and wedge between the ground and the bottom of the engine nacelle. Damage was caused to the number four engine nose cowl, fan cowl, and right reverser sleeve.

A ground engineer had been present on the stand during the incident. The engineer was responsible for chocking the aircraft and connecting ground power once the aircraft had come to a halt. He was standing adjacent to the stand centreline as the aircraft turned on to the stand. As the aircraft straightened from the turn he became aware of the proximity of the tugs to the number four engine and ran to the front of the stand to activate the emergency stop button. Unfortunately he was too late to prevent the collision with the tugs.

Stand information

Stand J2 is part of a Multiple Choice Apron on Pier 6 at LHR Terminal 3. To the left of the stand looking from the cockpit is a terminal building connecting Piers 5 and 6 with Pier 7, and to the right are parking Stands J4 to J10. With the exception of Stand J6A, all the stands are at right angles to the terminal building. The parking stands immediately adjacent to the right are Stands J4 and J6. Stands J2 and J6 are parallel and each can accommodate a single Boeing 747-2/300 sized aircraft. If either J2 or J6 is being used for 747 parking J4 may not be used; however, if neither J2 nor J6 is being used for 747 parking J2, J4 and J6 may be used to park smaller aircraft.

Stand markings

General information on surface markings for aircraft parking stands is provided in CAP 637, Visual Aids Handbook. Markings intended for pilot use are coloured yellow while other colours are used for markings intended for service vehicle drivers. CAP 637 Section 2 Figure 11a shows markings for a typical stand. The figure shows that an inter-stand clearway is normally marked in white between each stand indicating an area that should be beyond the maximum wing span of a parked aircraft.

Specific information on apron surface markings for LHR airport are contained in the UK Air Information Publication (AIP), Volume III and in Operational Safety Instructions (OSI) issued by the airport operator. In general the AIP is used as a source of reference by aircrew and operational staffs whilst the OSIs are mainly intended for use by LHR ground staff. The AIP provides some information on taxiway guidelines and specifically mentions the use of yellow and white alternately coloured centrelines on large aprons used for 'double parking' smaller aircraft, but information in the AIP is generally sparse.

OSI 52/97 provides details of surface markings for three different types of aircraft parking stand at LHR. Type 1 is described as a 'single centreline stand' and uses a single yellow centreline with an interstand clearway marked on either side. Type 2 is titled a 'Multi-Aircraft Ramp System (MARS)' and has a single central yellow centreline for use by large aircraft with parallel, slightly shorter centrelines either side of the main centreline which are intended for use by smaller aircraft. Interstand clearways are marked on the outboard side of each small aircraft centreline and MARS bar lines are marked on the inboard side. The MARS bar lines are intended to indicate the maximum wing span of smaller aircraft when the two MARS centrelines are being used by smaller aircraft. The MARS stand effectively allows two smaller aircraft to be parked on a single large aircraft stand. Type 3 is titled a 'multi-choice apron' and is marked with any number of centrelines which may be used by various combinations of large and small aircraft to maximise the parking capacity of the apron. Interstand clearways are marked either side of the multi-choice apron but the OSI shows no other markings on the ramp. J2 is a stand on a multi-choice apron.

A visit to LHR by an AAIB Inspector revealed that, in addition to the standard markings outlined above, there are a number of different markings on both MARS and multi-choice aprons. In particular, the multi-choice apron that includes Stand J2 has parallel white bars between some stands which appear to fulfil the same function as the MARS bars on a MARS stand. The parallel bars at Stand J2 had been marked to indicate the maximum wingspan of MD 80 series aircraft which frequently used the stand. They were not very distinctive, and between the bars NO PARKING was written on the ramp in faint white paint.

Parking procedures

OSI 23/99 outlines the procedures to be followed by airline or handling agent staff responsible for parking aircraft on stands with Stand Entry Guidance Systems (SEG). A pre-arrival safety check must be carried out which must include ensuring that the stand is unobstructed by vehicles or equipment. Once the safety check is complete the SEG should be switched on which indicates to the flight crew that the stand is unobstructed. The OSI also describes the emergency stop procedures using the emergency stop button located at ramp level and requires that marshalling assistance be summoned if there is any doubt about the safety of the stand.

Emergency Stop procedures

As a result of a previous ramp accident in the US the airport operator at LHR introduced an emergency over-ride button at ramp level collocated with the SEG ON/OFF buttons, the emergency telephone and the emergency fuel cut-off switch. Activation of the emergency stop button cuts power to the SEG parking aid and activates a sign at pilot's eye level flashing 'STOP'. A second emergency over-ride button is being fitted at air bridge control panels located on the air bridge.

OSI 23/99 outlines the responsibilities of airline and ground handling staff with regard to the operation of the emergency stop system. Staff are required to remain vigilant for any encroachment on to the stand which might affect the safe arrival of an aircraft, but there is no requirement for the staff to be within rapid response range of the ramp level emergency stop button during aircraft parking.

Vehicle control

Regulations for the operation of vehicles and equipment on the 'airside' of the airport are contained in OSI 24/00. Of particular relevance to this report are paragraphs 9.2, Parking and 10, Regulations Concerning Aircraft and Driving on Aircraft Stands. Specifically the regulations prohibited parking on empty aircraft stands and within interstand clearways and aircraft stands are to be kept clear and free from obstructions at all times.

Airport congestion

The requirement to use MARS stands and multi-choice aprons at Heathrow arises largely from a shortage of aircraft parking space and is being addressed by the proposal to build Terminal 5. The use of these types of stands helps maximise the use of the available space for aircraft parking but tends to reduce space for service vehicle parking. The latter problem has recently been exacerbated by an increase in the number of handling agents and ground handling vehicles. The handling agents at LHR are investigating ways of reducing the number of ground handling vehicles by sharing equipment.

Civil Aviation Publication (CAP 642)

CAP 642 provides guidance on safe operating practices to airport operators. CAP 642 Part 2 describes the steps required to develop a successful Airside Safety Management System, and outlines five stages to be followed. Stage 1 involves setting policy, Stage 2 describes organising staff, Stage 3 outlines the planning and setting of standards while Stage 4 describes how to measure performance and Stage 5 provides guidance on how to audit and review.

The airport operator at LHR outlines policy and sets standards by use of a comprehensive range of OSIs. Various different committees are involved in auditing performance and deciding on improvements. Policy on monitoring and management of risk is based largely on an infringement policy that concentrates on fines and penalties, with less emphasis on positive reinforcement of a sound safety culture. The airport operator was aware of this issue and recent changes to the safety system have attempted to address this area. Day to day monitoring of compliance with OSIs is carried out by Apron Safety Units which patrol the aprons in vehicles and report and take action on infringements. However, these units also have other responsibilities and are not tasked solely to monitor compliance with ramp procedures.

Additional Information

In the course of this investigation attempts were made to quantify the frequency of occurrences involving damage caused to aircraft on the ground at LHR. A variety of sources were approached including the CAA, the Metropolitan Police, Insurance companies and airlines. The CAA provided a list of 85 occurrences in the five years from 1996 to 2001. The Metropolitan police provided data for the year 2000 which showed that 70 occurrences resulting in damage to aircraft had been recorded. The airport operator had recorded some 120 occurrences in the same period. Anecdotal evidence from the airlines based on the cost of repairs to aircraft damaged by ground incidents indicated that the actual number of incidents was significantly higher than these reported figures. The statistical differences between the reporting systems arise because of different reporting criteria, but whatever their accuracy an unsatisfactory situation is evident.

Analysis

This accident was caused by a breakdown in the ground handling procedures laid down in the airport operator's OSIs and errors of judgement in assessing the tugs and dollies to be clear of the parking aircraft. Vehicles should not have been left unattended on the stand, the SEG system should not have been switched on until a satisfactory safety check had been completed and the aircraft should not have been taxied on to the stand with ground equipment located so close to the stand centreline. However, whilst this describes the primary cause of the accident, there are a number of contributory factors.

The stand markings at Stand J2 were not in accordance with the airport operator's OSI and were not described in the variations to standard ramp markings listed in the Appendix to the OSI. In addition, several different markings are used at LHR to indicate maximum wing span, and the significance of the white parallel lines on J2 is not clear and is easily mis-interpreted.

The use of such bars on multi-choice aprons is problematic since the variety of different aircraft using multi-choice aprons makes it difficult to mark the ramp clearly without the bars conflicting with other stand markings. It is therefore recommended the airport operator of Heathrow standardise wing span markings on all aircraft stands and reviews the use of such markings on multi-choice aprons. Further, the OSI providing information on stand markings should be amended to reflect accurately the markings in use.

Whilst information on stand markings is available to ground service personnel, the information in aeronautical publications used by aircrew is sparse. It is therefore recommended that Heathrow Airport Limited should amplify the current information available in the Aeronautical Information Publication to clarify the use of multi-choice aprons at the airport.

The provision of an emergency stop button at ramp level and at air bridge control panels were sensible modifications to stands with SEG. However, current procedures do not require anyone to be within range of an emergency stop button for a rapid response to any hazard arising during aircraft parking. In most cases the best view of a parking aircraft is obtained from ramp level, and it is therefore recommended that procedures are amended to require someone to be located within rapid response range of the ramp level emergency stop button during aircraft parking.

Conclusion

The non compliance with published ground handling procedures by a number of ramp personnel, possibly condoned by supervisors, gives rise to concerns about the ramp safety at LHR. Although reliable data are difficult to obtain, the available statistical evidence, supported by anecdotal evidence, suggests an unsatisfactory rate at which aircraft are being damaged on the ground at LHR. Whilst most of this damage will have been minor and may be viewed by some as an inevitable consequence of conducting operations at a busy and crowded international airport, there is a risk of serious damage remaining undetected leading to an airborne emergency with potentially catastrophic consequences.

The airport operator is aware of these concerns and is in the process of putting in place several initiatives to improve the ground safety culture at LHR, and there are early signs that some of these initiatives are leading to improvements. Nevertheless, the effectiveness of the airport operator's safety system, as outlined in CAP 642, requires some further examination. It is therefore recommended that the CAA and the Health and Safety Executive conduct a joint audit of the current airside safety system at LHR, to determine its adequacy. This will require an assessment of its implementation and supervision, and the development of a more comprehensive system for the reporting of ground damage to aircraft.

Safety recommendations

The following safety recommendations are made:

Recommendation 2001-63

Heathrow Airport Limited should standardise wing span markings at the airport and review the use of such markings on multi-choice aprons. Further, the Operational Safety Instruction providing information on stand markings should be amended to reflect accurately the markings in use.

Recommendation 2001-64

Heathrow Airport Limited should amplify the current information available in the Aeronautical Information Publication to clarify the use of multi-choice aprons at the airport.

Recommendation 2001-65

The CAA should amend the current guidance in CAP 642 [Airside Safety Management] on the use of emergency stop systems such that the system can be operated quickly in the event of an emergency while aircraft are manoeuvring onto the stand.

Recommendation 2001-66

The CAA and the Health and Safety Executive should conduct a joint audit of the current airside safety system at LHR to determine its adequacy. This will require an assessment of its implementation and supervision, and the development of a more comprehensive system for the reporting of ground damage to aircraft.

