

Aircraft Type and Registration:	Boeing 747-436, G-BNLG	
No & Type of Engines:	4 Rolls-Royce RB211-524G2-19 turbofan engines	
Year of Manufacture:	1989	
Date & Time (UTC):	21 April 2004 at 1002 hrs	
Location:	Stand 127L, London Heathrow Airport	
Type of Flight:	Public Transport (Passenger)	
Persons on Board:	Crew - 18	Passengers - 326
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Puncture to leading edge of port wing above No 2 Engine. No 2 engine damaged by debris ingestion	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	52 years	
Commander's Flying Experience:	16,000 hours (of which 2,500 were on type) Last 90 days - 200 hours Last 28 days - 80 hours	
Information Source:	AAIB Field Investigation	

Synopsis

Whilst attempting to park on its allocated stand, the aircraft struck the airbridge, which had been parked in the wrong position, with its left wing. Recent work altering the stand's alignment resulted in a choice of parking positions for different aircraft types and corresponding parking positions for the airbridge. The investigation revealed the airbridge had been parked in a position marked for aircraft parking on a different part of the stand.

History of flight (aircraft perspective)

The aircraft had just completed a flight from San Francisco to London Heathrow and, after vacating Runway 27R, was given clearance to taxi to Stand 127, its allocated parking stand. The commander was at this point the handling pilot and also on the flight deck were the co-pilot, occupying the right hand seat, and a third pilot occupying one of the jump seats.

On approaching the stand the commander and co-pilot positively identified the correct centreline markings for Stand 127 and confirmed that there was no equipment infringing the parking area. Finally, they checked that the airbridge was parked within a marked parking box. With the stand appearing safe to enter the commander turned onto the stand, using the illuminated AGNIS (Azimuth Guidance For Nose In Stands) guidance system to maintain the correct centreline. As the aircraft neared its stopping position the commander then switched his attention to the PAPA (Parallax Aircraft Parking Aid) board to the right of the aircraft in order to judge the correct stopping position. Shortly after doing so the aircraft appeared to rock slightly and the commander had to increase power in order to continue moving forward. It was at about this time that the pilot sat on the jump seat noticed a member of the ground staff standing in one of the terminal windows with his arms crossed, indicating the marshalling signal for the aircraft to stop. The pilot immediately called for the commander to stop the aircraft, which he did. The engines were shut down and other members of staff could be seen in the terminal window looking alarmed and pointing towards the left wing. Shortly afterwards the fire services arrived at the aircraft and advised the crew over the radio that the aircraft had struck the passenger airbridge. As there were no abnormal indications on the flight deck nor signs of fire the commander decided not to order an emergency evacuation and the passengers were instead disembarked by steps at Door 1L.

History of flight (ground perspective)

The dispatcher reported for duty at 0530 hrs (local) on the day of the accident and, at about 1045 hrs, (local) went to prepare Stand 127 for the arrival of the flight from San Francisco. On inspecting the stand he discovered an aircraft power unit was infringing the parking area and arranged to have it removed. Once the area was clear he identified the correct AGNIS unit and PAPA board for Stand 127 and turned them on. He then went up the passenger stairs from the apron onto the airbridge and later stated he would normally have used a set of engineers' stairs which are fixed at the aircraft end of each airbridge. However, the hinges on the door on this particular airbridge were broken and whilst awaiting repairs the door had been locked to prevent its use.

Once on the airbridge the dispatcher checked that it operated correctly and raised it to what he considered an appropriate height for the Boeing 747-400 aircraft he was expecting. Shortly afterwards, the aircraft arrived and the dispatcher watched as it taxied past the end of the airbridge where he was standing. From experience the dispatcher was expecting the aircraft to slow down once the second passenger door had passed the end of the airbridge. When it failed to do so the dispatcher began to think something was wrong and, looking out of a window, realised the aircraft wing was about to collide with the airbridge. There was no means of alerting the aircraft from his current position and so the dispatcher turned and ran as fast as he could back up the airbridge, just before it was struck by the aircraft. Once off the airbridge the dispatcher was able to signal to the

aircraft through a large window in the terminal building by crossing his arms in front of him, at which point the aircraft came to a halt. The dispatcher then immediately contacted the airport emergency services.

Engineering examination

The aircraft was manufactured in 1989 and carried the manufacturer's serial number 24049. It was delivered new to BA and first registered on 23 Feb 1990.

Initial examination of the aircraft on the stand showed that it was correctly aligned with the centreline markings, but had stopped a few feet short of the B747 stop mark. At this position, the self-levelling mechanism of the airbridge had penetrated the wing leading edge by about one or two feet, just inboard of the No 2 engine. The airbridge itself had rotated and moved backwards one or two feet, its wheels leaving skid marks, indicating that with the aircraft correctly positioned on the stop marker, there would have been an overall zone of contact between aircraft and airbridge of perhaps 10 feet or so. The airbridge had been parked in one of two painted 'boxes' on the stand, one which was rectangular and which was the correct box for a B747 operation, the other, in which the airbridge was positioned, was circular and intended for use with smaller aircraft.

The wing was penetrated through its leading edge skin and there was also damage to the composite skin behind the leading edge, resulting in a hole some one by one and a half feet in size. There was no apparent damage to any wing systems or primary structure.

As a consequence of the impact and release of debris, the No 2 engine had sustained significant impact damage to the fan blades and also to the acoustic liner. Several pieces of torn and bent grey painted aluminium alloy were found in the engine intake and bypass duct. The fan blades were subsequently all changed, however the core of the engine was found to be undamaged. The impact had forcibly rotated the head of the airbridge, failing its rotation mechanism, releasing debris and allowing the drive chain to fall across the engine intake. Initially, it was thought that the debris in the engine was from the wing but closer examination showed that the material and protective treatments were not those of the damaged part of the wing, and it was concluded that they were from the damaged airbridge mechanism.

Stand description

Changes had recently been made to the layout of Stand 127 to accommodate different aircraft types, in response to a change in airline schedules using the central terminal area of the airport. At the time of the accident the stand was divided into three different parking positions: Stand 127, Stand 127L and Stand 127R. The intention was that the stand could accommodate either one large aircraft, up to

and including the Boeing 747-400 and Airbus A340-600 on Stand 127, or two smaller aircraft, up to and including the Airbus A321, simultaneously on Stands 127R and 127L.

Two airbridges were provided on the stand, one for aircraft on Stand 127L and one for aircraft on Stands 127 and 127R. Ground markings were provided to denote the correct parking positions for both airbridges so that they were in a safe position when aircraft taxied onto stand. In the case of the airbridge intended for Stands 127 and 127R two different parking areas were denoted. One, a yellow square, denoted the correct parking position when Stand 127 was in use and the other, a yellow circle, when Stand 127R was in use. There were also various lines delineating the airbridge manoeuvring areas.

Lateral parking guidance to aircraft on all three stands was provided by AGNIS units and the correct stopping points by use of PAPA boards. Each stand also had a sign positioned in line with its centreline which could be illuminated with the word STOP in case of emergency. These lights could only be operated by a switch at ground level in a centrally located position between all three stands.

Details of the new stand layout and operating procedures for the airbridges were contained in the airport operator's Operational Safety Instruction (OSI) 07/04, the contents of which are reproduced in Figure 1.

Analysis

When interviewed, the aircraft dispatcher stated that he had read OSI 07/04 relating to the new layout and operating procedure for Stand 127. This had been issued on 6 April 2004 by his company in the form of an Aircraft Dispatch Notice (ADN), little more than two weeks prior to the accident. Whilst a copy of this ADN was retained in the company's dispatch office the dispatcher himself did not carry a copy, nor was there one posted for reference in the airbridge for Stand 127.

OSI 07/04 refers both to a parking box and a parking circle. Parking positions for the wheels of airbridges had historically been marked on the ground by a rectangular box. The airport operator was however finding unnecessary wear being put on the airbridge tyres and the ground markings as a result of the wheels being slewed round whilst parked in order to align them with the markings. Some stands had therefore had the traditional rectangular box replaced by a circle. This eliminated the need to slew the wheels round as they could remain within the correctly marked position when parked, regardless of orientation. Relevant documents however continued to refer to these circles as boxes.

The dispatcher made the point that where OSI 07/04 stated:

'When stand 127 is used the jetty will be parked in the standard parking box',

to him this could have meant either a circle or a rectangle. Indeed it is only under the paragraph referring to Stand 127R that any distinction is made between the '*standard parking box*' and a circle. The dispatcher further stated that he was used to seeing the airbridge parked in the position delineated by the circle, as this had been the airbridge's normal parking position prior to the realignments of the stands.

OSI 07/04 requires that the airbridge is parked in the rectangular box once an aircraft has been pushed back from either Stand 127 or 127R. This had not been done and, on further investigation, it was revealed that on dispatching aircraft from Stand 127R the airbridge is frequently not returned to the proper parking position. It is quicker for the dispatcher to leave it parked in the parking circle intended for Stand 127R. A dispatcher from a different company questioned on this point explained that they were regularly pressed for time and that to wait for an aircraft to depart and then move the airbridge would make them late in trying to meet their next flight.

The commander of the aircraft stated that he had checked the airbridge was parked within a parking box prior to turning onto the stand. The airbridge had indeed been parked within a box and there was nothing to indicate to the crew that the airbridge was in anything other than its correct parking position.

When it became clear to the dispatcher that the aircraft was about to collide with the airbridge he was faced with great difficulty in trying to stop it. In the absence of a switch to operate the STOP light from the airbridge, and unable to use the engineers' steps to get quickly to the switch positioned at ground level, he had little choice other than to run clear of the airbridge in order to save himself from injury. He did however have the presence of mind to signal to the aircraft through the terminal window in a successful attempt to catch the pilots' attention. There is no doubt his actions at this point prevented the damage to both aircraft and airbridge being considerably worse.

Parts of the following analysis are shared with the investigation into another stand collision on 4 March 2004 at the same airport, involving a Boeing 737 (Report Number EW/C2004/03/02), which is also published in this bulletin.

Operational Safety Instructions (OSI)

Operational Safety Instructions are the means by which Heathrow Airport Limited (HAL) distributes safety related information to those operating airside ground services. These can incorporate operating instructions for equipment such as airbridges (as in OSI 07/04). Operational Safety Instructions are frequently referred to in the airport operator's Aerodrome Manual and as such form an integral part in the proper operation, by all parties, of the airport services.

In the course of this investigation it became apparent that not all operators were in possession of the Aerodrome Manual, including one major airline based at London Heathrow Airport. This airline stated that the Aerodrome Manual is a document produced and maintained by the airfield operator for the purposes of licensing under CAP168. They considered that it was not directly aimed at airlines and that any relevant information for an operation (eg fire cover, declared distances etc) was supplied in the relevant Aeronautical Information Publication (AIP). As a result they did not hold the Aerodrome Manual, using instead, the relevant AIP.

Thus it might be considered that the airport operator relies upon its Aerodrome Manual as its chief operating document and the airline the AIP, with both using OSIs as an additional source of information. As these are easily published they form the main basis of disseminating information on changes to the day-to-day operation of the airport.

Once an OSI is published it is the responsibility of each organisation operating at the airport to distribute its contents internally. This is normally done by placing a copy of the OSI, or a company version of it, in a file checked by staff prior to each shift.

In reality, this results in important operating information being retained within a large collection of separate OSIs, many of which have been in effect for a considerable period of time. They are not divided into different categories, appearing in the order in which they were published. This means the user has to search through the entire collection to find required documents, assuming that they know of their existence. Individual staff members are expected to know the information contained within the OSIs but are not normally given their own individual copies. They instead have to refer to the centrally held collection retained by their company, which is often in an office some way from the point where they are working.

Airport safety system

The HAL safety system relies on categorisation of accidents and serious incidents into four categories. The most serious accidents and incidents fall into category one with a sliding scale of severity down to category three. Category four is reserved for events which fall directly outside the control of HAL. The three main criteria used to ascertain which category an event falls into, are the health and safety implications, financial cost and damage to HAL's reputation. The assessment is undertaken by the safety adviser for the area in which the accident or incident occurred.

The system is designed to cover all types of events, not only those affecting aircraft operations, and the majority of accidents and serious incidents are reported using a standard form (F3001). This is lodged on the Performance Measurement System (PMS), a computerised database managed by the HAL Safety Services Department. Investigations are carried out at a local level when the accident or

incident is classed as category three or four. However, where it is classed as a category one or two event the investigation is carried out by a senior manager from a different department to that in which the event took place.

The investigation of category one and two events is monitored at board level whilst an overall review of HAL's accidents and incidents is carried out on a monthly basis at HAL's health, safety, security and environment performance meeting.

The situation is complicated where the accident or incident involves an aircraft, as additional investigations may be carried out by the Civil Aviation Authority or the Air Accidents Investigation Branch (AAIB). Events which occur airside rely on the Airside Operations Team for assessment.

In the case of this accident, and the accident referred to in report number EW/C2004/03/02, the Airside Operations Team attended the scene of each accident and made preliminary enquiries. It has subsequently been difficult to identify the individual at HAL responsible for any internal investigation and remedial actions. It is believed through conversation that, as there were no injuries or fatalities, HAL was content to await the outcome of the investigations being undertaken by the airline and the AAIB, using these in place of their own investigation and implementing any recommendations made where they were deemed suitable. HAL did however take the unilateral step of fixing an amended set of operating instructions above the control panel on the airbridge for Stand 127/127R, Figure 2.

Emergency Stop Sign

Both Stands 127 and 214 (report EW/C2004/03/02) were fitted with a prominent sign placed at cockpit level at the end of the stand. This illuminates red with the word STOP and can be switched on by the ground crew at any time the guidance system is active, to indicate that the aircraft should immediately come to a halt. Originally these signs could only be operated from ground level but a program is in place to install additional switches to allow operation from the control panel of the airbridge. Due to budgetary constraints, this program has been on-going for several years and is not likely to be completed in the very near future.

At the time of the accident, such a switch had not been fitted to the airbridge on Stand 127/127R. This left the dispatcher powerless to act although it was still possible for the switch at ground level to have been activated by a member of the ground crew present at the time on the stand. Whilst the airline involved instructs that anyone may activate the stop sign in the interests of safety, no one is actually allocated the task of standing next to the button whilst the aircraft manoeuvres onto the stand. Not only does this make suitably swift action unlikely it also removes the specific

responsibility from those on the ground to actively monitor the safe progress of the aircraft. No attempt was made on this occasion to operate the ground button.

This situation is in direct contrast to the accident on Stand 214 (report EW/C2004/03/02) where the handling agents involved specifically allocate a member of the ground crew team meeting each aircraft to man the stop switch at ground level. This stand had also had a stop switch fitted to the airbridge some time before the day of the accident and both this and the switch at ground level were operated by the relevant members of the ground handling team. It is of note, however, that despite the STOP sign being illuminated it was not seen by either pilot on the flight deck. This was due to the Commander concentrating on the STOP point guidance (a mirror to the left of the stand) whilst the co-pilot was looking out of his side window to the right at the ground crew.

In a subsequent visit by the AAIB to Stand 127, on 23 August 2004, a STOP button had been fitted to the airbridge as part of the on-going program. This had however been placed in close proximity to another stop button intended to stop the airbridge moving in case of emergency and markings did not make it clear which of the stop buttons was for which purpose. Indeed, one label was found simply propped up on one of the switches, Figure 2.

Conclusions

Stand 127 had recently been realigned to allow increased utilisation, with operating instructions for the new configuration published in OSI 07/04. Both the aircraft commander and the dispatcher believed that the airbridge was parked in the correct position for Stand 127 and that it was safe for the aircraft to enter the stand and park. The airbridge was actually parked in the correct position for a different stand, Stand 127R, which resulted in the aircraft's left wing subsequently striking the airbridge whilst attempting to park. The aircraft was brought to a halt only when the flight crew noticed the dispatcher signalling to them through a terminal window, but not before considerable damage had been caused.

Numerous factors contributed to the accident.

- The commander had no means available to him to determine that, although the airbridge was parked in a box, it was the wrong one.
- The dispatcher had read OSI 07/04 but this had been some days before the accident and he had no copy available to refer to at the stand.
- The information in OSI 07/04 was open to misinterpretation.

- The airbridge had been left in the wrong parking position, contrary to the instructions in OSI 07/04.
- Ground markings were confusing.
- The dispatcher was used to seeing the airbridge parked in that position from operations prior to the stand realignment.
- The dispatcher was unable to stop the aircraft quickly as there was no means of operating the STOP light from the airbridge.
- Despite there being a switch for the STOP light at ground level it was not operated by anyone on the stand.

A review of previous ground collisions at Heathrow, specifically AAIB report EW/G2001/01/12, raises a number of issues. The report highlighted the number of aircraft being damaged at the airport and, whilst it is accepted that ground damage to aircraft is a universal problem, not one solely restricted to Heathrow, a study of recent figures for the airport indicates that there has been little improvement since report EW/G2001/01/12 was published in 2001. HAL have, however, recently introduced certain initiatives, most recently an inspection team whose function is to monitor stand operations during aircraft turn rounds. Whilst this is a positive move, there continue to be failings in other important areas of the ground operation, two specifically being revealed by this investigation.

There appeared to be little overall strategy for the guidance of aircraft onto stands. Discussions revealed improvement to parking guidance provided by the introduction of Combined Laser and Radar Aircraft Systems (APIS), driven by a request from British Airways, the airport's biggest customer, as a result of research undertaken by that airline. It was not, as might be expected, as a result of an initiative by HAL. The same discussions similarly revealed that funds were not specifically allocated to research guidance options for Terminal Five, a major addition to the airport infrastructure currently under construction. Funds were only provided at the request of operational staff. During the course of this investigation, no one individual could be identified within the HAL staff who had specific responsibility for stand guidance at the airport.

Of equal concern was the level of investigation carried out by HAL into both this accident and the previous similar accident, the subject of report EW/C2004/03/02. As a consequence, despite HAL operational staff pointing to deficiencies noted on the day of each accident, no remedial action was taken and the deficiencies were still present on a visit by the AAIB some months later.

AAIB report EW/G2001/01/12 relates to an accident occurring in January 2001. It raised concerns over the level of ramp safety at HAL and the effectiveness of their safety system. This led to a recommendation (Safety Recommendation 2001-66) that the CAA and Health and Safety Executive (HSE) should conduct a joint audit of the airside safety system at Heathrow to determine its adequacy. HSE's response to this recommendation was that they considered hazards to aircraft the responsibility of the CAA and would therefore not be in a position to undertake such an audit. The CAA did accept the recommendation, however, it is understood that only a superficial inspection of the safety system was undertaken with no written report ever being made. This response from both the CAA and HSE is of concern and in part must contribute to the inadequate response to these accidents by HAL.

London Heathrow Airport operates within a site of restricted size. It is apparent that the airport is working to capacity and that the operation is constantly being driven to increase this capacity still further, resulting in initiatives such as the realignment of Stand 127. In this constantly changing environment it is all the more important that adequate resources are provided to support the airside operations at HAL, together with the protection afforded by a robust and proactive airside safety culture.

Safety Recommendations

In view of the continuing problem at London Heathrow Airport of aircraft colliding with airbridges, the following safety recommendations are made:

Safety Recommendation 2005-014

It is recommended that Heathrow Airport Limited should expedite the program to install duplicate emergency stop buttons at all of its airbridge control stations and ensure that all such buttons are clearly and unambiguously marked.

Safety Recommendation 2005-015

It is recommended that Heathrow Airport Limited should identify a management post responsible for the maintenance, development and safety of aircraft stand parking guidance systems.

Safety Recommendation 2005-016

It is recommended that Heathrow Airport Limited should review the system by which Operational Safety Instructions are published to ensure that they are either incorporated into a relevant document,

such as the Aerodrome Manual or Aeronautical Information Publication, or are provided with an effective index such that the information they provide is readily identifiable

Safety Recommendation 2005-017

It is recommended that Heathrow Airport Limited should ensure that operating instructions are prominently displayed on any aircraft stand, including the airbridge, where changes in the operation have been made or where the mode of operation is non-standard.

Safety Recommendation 2005-018

It is recommended that Heathrow Airport Limited should review all ground markings related to aircraft parking stands, to ensure that their meanings are unambiguous, that markings are clearly displayed and that clear diagrams of such markings are prominently displayed on any aircraft stand.

Safety Recommendation 2005-019

It is recommended that the Civil Aviation Authority should conduct a comprehensive, documented, audit of the Heathrow Airport Limited airside safety system.

Safety Recommendation 2005-020

It is recommended that British Airways should require that a member of their ground crew assumes the responsibility of being adjacent to the ground level emergency STOP light button and of monitoring the arrival of the aircraft onto the stand, whenever ground crews are present on a stand whilst an aircraft is manoeuvring to park.

BAA Heathrow

Date: 26th March 2004

OSI/07/04

Subject: CHANGE TO STANDS 125L, 125R, 127, 127L and 127R

File:ASS/26/05

It is the responsibility of all employers to ensure that relevant OSIs are brought to the attention of their staff. However, individuals remain responsible for their own actions and those who are in any doubt should consult their Supervisor or Manager.

INTRODUCTION

- 1 In order to accommodate changes to airline schedules in the central terminal area, stands 125L, 125R, 127, 127L and 127R have been modified to accommodate different aircraft types.
- 2 This instruction details the operating procedures for the stands.
- 3 A drawing is attached for information.

OPERATING PROCEDURE FOR JETTY SERVICE ON 127 and 127R

- 4 In order to provide jetty service on stands 127 and 127R, using the same jetty, a special operating procedure is necessary. On the stand there is a jetty parking box, marked with a yellow border, in which the jetty should be parked when it is not in use.

When stand 127 is used the jetty will be parked in the standard parking box until the aircraft has parked on the stand, the jetty will then be positioned on the aircraft as normal. When the aircraft is ready to depart the jetty will be returned to the standard jetty parking box.

When stand 127R is used, the jetty must be positioned in the pre-position area marked on the stand by a circle prior to the aircraft arriving on the stand. (This is due to the fact that if the aircraft parks on the 127R centreline with the jetty in the standard parking box, there is not sufficient clearance for the jetty to swing round past the nose of the aircraft.) Once the aircraft has parked the jetty will be positioned on the aircraft. When the aircraft is ready to depart the jetty will be returned to the pre-position area. Once the aircraft has departed the jetty must be returned to the standard jetty parking box.

STAND SIZES AND INFRASTRUCTURE

- 5 Stand 127 can accommodate all aircraft up to and including Boeing 747-400 / Airbus A340-600 and is jetty served.

Stands 127L and 127R can accommodate all aircraft up to and including Airbus A321 and are jetty served subject to the special operating procedure detailed above.

Stand 125R can accommodate all aircraft up to and including Airbus A321 and is not jetty served.

Stand 125L can accommodate all aircraft up to and including Airbus A320 and is not jetty served.

Stand 125 remains unchanged.

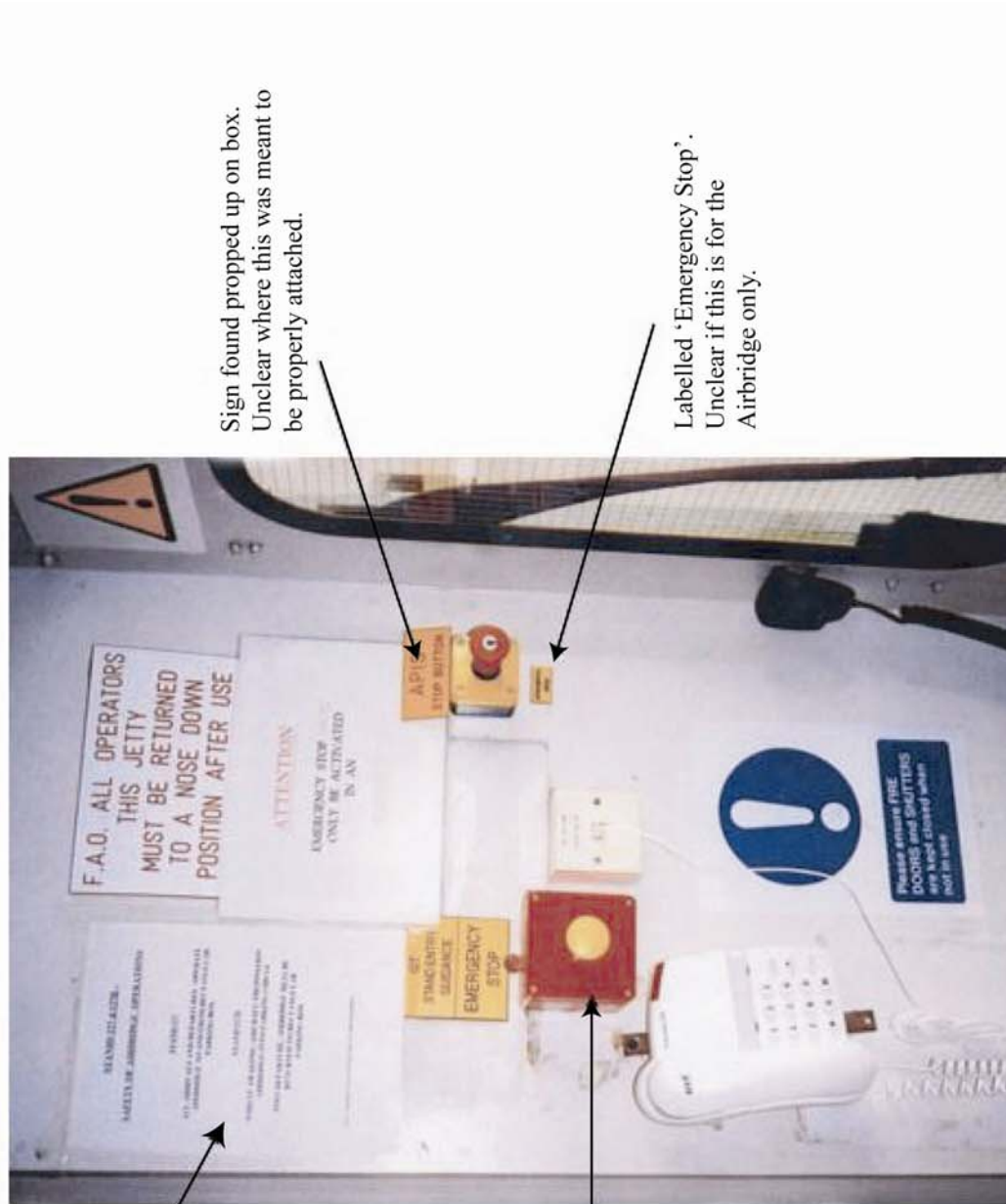
GENERAL

- 6 All other services and operating procedures for the stands remains unchanged.
- 7 Any questions regarding this instruction should be addressed to Airside Infrastructure, Airside Suite, 2nd Floor, Building 820, Heathrow Airport Limited. Tel: 020 8745 0859, Fax: 020 8745 5413

Distribution: Lists A - E

**Information reproduced from:
Operational Safety Instruction (OSI) 07/04**

Figure 2



Sign added after accident to G-BNLG

Sign found propped up on box. Unclear where this was meant to be properly attached.

Button labelled 'Emergency Stop', with '127 stand entry guidance' marked above. This is the new STOP light activation button.

Labelled 'Emergency Stop'. Unclear if this is for the Airbridge only.

Note other signs partially obscuring the top of this label, with the potential to obscure the entry guidance legend. Operator would then be faced with two buttons marked 'Emergency Stop'.

View illustrating confusing nature of displayed information/emergency stop buttons on Stand 127