

Department of Trade

ACCIDENTS INVESTIGATION BRANCH

**Boeing 707-436 G-APFH
Report on the accident at Heraklion Airport,
Crete, on 6 June 1974**

LONDON
HER MAJESTY'S STATIONERY OFFICE
1975

List of Aircraft Accident Reports issued by AIB in 1975

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Department of Trade
Accidents Investigation Branch
Shell Mex House
Strand
London WC2R ODP

8 April 1975

The Rt Honourable Peter Shore MP
Secretary of State for Trade

Sir,

I have the honour to submit the report by Mr P J Bardon, an Inspector of Accidents, on the circumstances of the accident to Boeing 707-436 G-APFH which occurred at Heraklion Airport, Crete on 6 June 1974.

I have the honour to be
Sir
Your obedient Servant

W H Tench
Chief Inspector of Accidents

ADDENDUM

Since the completion of this report, British Airways have reported that early in March 1975 during removal of the left main gear of G-APFH for fitting to another aircraft, it was found that the trunnion collar shear bolt (part number 66-3932) had been bent. Further investigation revealed that the top spigot attachment of the piston tube (part number 65-1271-1) contained within the leg had fractured. It was considered that this damage was consistent with a hard landing having been made at some time.

The incident at Heraklion on 6 June 1974 and which is the subject of this report was the last reported occasion of a hard landing. Assuming that there have been no unreported hard landings since that time, it is conceivable that this damage to the left main gear occurred as a result of the incident and remained undetected during subsequent checks.

The Boeing 707 Hard Landing Check schedule current at the time of the Heraklion incident required an inspection of the forward trunnion collar and attachment bolts for evidence of hole elongation and bolt distortion (such as collar displacement). It also required examination of the piston rod retaining nut (i.e. top spigot attachment) for signs of looseness or movement. The nature of the failures was such that neither of these checks could have revealed them. As a result the Hard Landing Check covering these points has been amended.

Accidents Investigation Branch
Aircraft Accident Report No.4/75
(EW/A245)

Aircraft: Boeing 707-436 G-APFH

Engines: 4 Rolls-Royce Conway 508 Turbo-jet

Registered Owner and Operator: British Airtours Limited

Crew: Commander – Uninjured
Co-pilot – Uninjured
Third Crew Member – Uninjured

Cabin Staff: 5 – Uninjured

Passengers: 156 (KT943) – Uninjured

Place of Accident: Heraklion Airport, Crete

Date: 6 June 1974

All times in this report are GMT

Summary

After a non-scheduled charter flight from London (Gatwick) the aircraft touched down heavily at its destination, Heraklion. Following a preliminary inspection of the aircraft, the crew telexed their base giving a summary of the damage and asking whether it was permissible to operate the aircraft back to Gatwick in this condition. The company's Engineering Superintendent, after consulting the British Airways Boeing 707 Project Office, replied that, subject to no leaks being found after an engine run, the aircraft could be considered fit for return to base. Although the local Olympic Airways Station Engineer protested that the aircraft was not airworthy, the commander ran the engines and, finding no fuel leaks, operated the return flight to Gatwick with passengers.

On arrival at Gatwick the No. 2 pylon fitting over wing shear bolt was found to be sheared.

NOTE:

Throughout this report the phrase 'hard landing' is used to denote a landing in which an excessive rate of sink is involved. Although this type of landing is commonly known in the United Kingdom as a 'heavy' landing, in the United States and in the company's documentation the word 'hard' is used instead of 'heavy' to distinguish the landing from one that is made overweight.

1. Investigation

1.1 History of the incident

The aircraft was operating British Airtours flight KT 942 from London (Gatwick) to Heraklion, Crete and was due to operate the return service (KT 943) the same day. It left Gatwick at 1000 hrs on 6 June with 134 passengers on board. The commander was the handling pilot for this sector. On arrival at Heraklion, the aircraft made its approach at a slightly higher speed than normal. As it approached the threshold, the commander was seen to push the control column forward, resulting in what seemed to the other two crew members to be a steep nose down attitude. The co-pilot shouted 'Pull up' and at the same time pulled back on the control column himself. The aircraft touched down very hard in a fairly level attitude with power on. Following a slight bounce, the second touch down was level and after power was reduced, reverse thrust and speed brakes were applied. At this stage the control tower called the aircraft to ask if 'everything was alright?'. The commander replied that it was. Shortly afterwards the chief steward came on to the flight deck to report that there was 'a state of near panic' among the passengers. In order to reassure them, the third crew member made an announcement over the passenger address system. The aircraft was then taxied to the apron and the passengers disembarked. It was found that about a dozen emergency oxygen masks had fallen from the passenger service units in the rear of the cabin.

At this stage the co-pilot suggested that a full hard landing check would be required. The commander replied to the effect that he would make a preliminary inspection before coming to a decision. He entered in the Defect Symptom Column of the aircraft's Technical Report: 'NIL NEW'.

Olympic Airways provide engineering services for British Airtours at Heraklion and when their Senior Station Engineer came on board to check for possible defects and to ascertain the fuel requirements for the return flight to London, he noted the commander's entry in the report. During the subsequent inspection of the aircraft by the crew and the Station Engineer, the following damage was noticed and reported to the commander:

- (a) Buckled panels above Nos 1, 2 & 4 engine thrust reversers.
- (b) ½" gap at the forward end of No. 2 wing/pylon gap cover.
- (c) Torn out Dzus fasteners around the forward end of the No. 2 pylon gap cover.

The No. 2 engine cowlings and panels were also opened up, but at a later stage, and the engine mountings examined. No damage was found and the commander was notified of this.

After completing the refuelling, the Station Engineer carried on with a more detailed inspection of the aircraft. Whilst he was removing the No. 2 pylon gap cover to check for further damage, he noticed that the passengers were starting to board the aircraft for the return flight. He immediately protested to the commander that because the aircraft showed signs of damage he could not sign the Technical Report, and that a hard landing check should be carried out. The commander replied to the effect that although the aircraft had experienced a firm landing, he did not think it serious. However, he agreed that the passengers should be disembarked whilst a further investigation was made. The co-pilot then drafted, and the commander signed, a telex to the Airtours Station Engineer at their base, London (Gatwick), with a copy to British Airways (Athens), as follows:

'Due to heavy landing on arrival No. 2 engine pylon buckled above wing leading edge. Also skin buckled above No. 2 and 1 engine silencer. No heavy landing check form on aircraft. Please advise if damage acceptable to operate return flight soonest possible thanks' .

The telex was despatched at 1500 hrs. At about the same time, the Station Engineer telephoned the Olympic Airways Superintendent of Line Maintenance at Athens to report the hard landing. The Line Maintenance Superintendent in turn alerted the Olympic Airways Maintenance Manager and the British Airways staff in Athens. He then telephoned back to his Station Engineer at Heraklion with instructions to commence a hard landing check, and added a warning that he should not sign the Technical Report 'until full engineering approval standards were met'. At this juncture the aircraft commander was asked if he wished to speak to the Maintenance Superintendent and he took over the telephone from the Station Engineer to express the view that the damage did not appear to be serious. The Maintenance Superintendent replied that he was concerned about possible damage to the forward engine mountings, and that his Station Engineer's competence and judgement could be relied on. If the commander nevertheless considered the damage was not serious, he would have to take the aircraft on his own responsibility. However he advised him to wait for specialist engineers to assess the damage.

Following this conversation, the Station Engineer and his assistant returned to the aircraft to carry on with their inspection. At this stage, the third crew member handed them the HARD LANDING/OVERWEIGHT LANDING check sheets which he had eventually found on the aircraft. Meanwhile the British Airways Operations Supervisor at Athens telephoned the commander to tell him that the Corporation's Athens staff were not qualified to help him on engineering matters. He asked if the aircraft had suffered burst tyres or oleo bottoming. The commander replied that he did not think so, but that the Olympic engineers were inspecting the aircraft. The Operations Supervisor cautioned him that the damage might be more serious than it seemed and that the commander would have to make his own decision concerning the aircraft's fitness for flight.

Meanwhile the commander's telex had been received by the Engineering Superintendent at Gatwick, who in due course consulted one of the staff of the British Airways Boeing 707 Projects Office at Heathrow. They discussed the symptoms of damage reported in the telex and the fact that pylon wrinkles, which were not unusual on this type of aircraft, did not necessarily indicate serious damage. Mention was made of the lack of an engineer approved by British Airways to carry out the heavy landing check at Heraklion. The Projects Engineer gave his opinion that, from past experience of Boeing 707 hard landings and the fact that the main items of concern listed in the hard landing check were not specified in the telex, the aircraft could be flown to base for the check provided the crew made a visual inspection and physically rocked the No. 2 engine to check for signs of sideways movement.

At 1605 hrs, following this conversation, the Engineering Superintendent caused the following telex message to be sent to the commander:

'Ensure no leakage on engine run considered satisfactory for return to base' .

Shortly after this, the Olympic Airways Maintenance Manager, Athens, telephoned the British Airtours Engineering Superintendent at Gatwick to suggest that a suitably qualified inspector be sent to Heraklion from Athens. To his surprise he learnt that the Engineering Superintendent had provisionally released the aircraft. He expressed his objections that the aircraft should be allowed to fly without inspection of the pylon support fittings and engine mountings, or completion of the hard landing check. The Engineering Superintendent appeared to agree, promised to re-examine the matter and to communicate with him again. However, he did not in fact do so.

The Olympic Airways Maintenance Manager then telephoned his Station Engineer at Heraklion to tell him of his conversation with the British Air Tours Engineering Superintendent and to warn him not to release the aircraft until the hard landing check had been satisfactorily completed.

However the commander, on receiving the telex from his base, told the Station Engineer to cease his inspection of the aircraft because he intended to run the engines with a view to operating the return flight.

The Station Engineer attempted to protest that in his opinion the aircraft was not air-worthy. However, perhaps because of the language difficulty, the protest did not register with the commander who in due course ran Nos. 1 and 2 engines, and, finding no fuel leaks, ordered the re-embarkation of the passengers. The Station Engineer had difficulty in refitting the No. 2 pylon gap cover and did so to the best of his ability. He then taped over the gap at its forward end where the fasteners had been torn out. He subsequently boarded the aircraft to ask the commander to sign his Work Order. The commander did so and then, according to the Station Engineer, asked him to 'sign off' the entry in the Technical Report which the commander had amended from 'NIL NEW' to 'AFTER VERY FIRM LANDING SLIGHT BUCKLING FOUND ON FWD PANEL ABOVE NO. 2 ENGINE'. The Station Engineer says that he refused to do so on the grounds that after a hard landing the associated check must be carried out and also because, in his opinion, the aircraft had sustained damage. The commander maintains that, possibly owing to the Station Engineer's inability to express himself clearly in English, at no time did he receive the impression that the Station Engineer was unhappy about the aircraft's fitness for flight and that his refusal to sign the Technical Report was solely because he was not authorised to do so. The commander states that he simply exercised his Captain's prerogative to sign the Technical Report himself, writing in the column headed 'Action Taken'; 'OLYMPIC ENGINEER INSPECTED PANEL TAPED'. He also signed the Pre-Departure Check (PDC), and the Captain's Acceptance. He omitted to sign the Flight Clearance and the Fuel and Oil Statement although the respective quantities had been properly entered.

At 1708 hrs the aircraft departed on the return flight, KT 943, to London (Gatwick) with 156 passengers on board. At 1723 hrs the Station Engineer at Heraklion sent the following telex to his Line Maintenance Superintendent at Athens:

'Report A/C BEA Air Tours KT 943 GAPFH departed repeat departed for Gatwick with remained defect symptom STP. The aircraft technical report signed by CPT not by me STP (Signed) ST Engineer'.

Flight KT 943 encountered little or no turbulence en route and landed at Gatwick at 2106 hrs. The entry for this flight in the Technical Report said: 'PLEASE CHECK A/C FOR HEAVY LANDING DAMAGE SPR*. (PYLONS ABOVE NO. 4, 2, 1 SILENCERS) + NO. 2 PYLON AT WING ROOT L/EDGE TEMPORARY REPAIR'.

On arrival the commander filed an Air Safety Report as follows:

'Heavy landing at HERAKLION caused some damage to panel above No. 2 engine. Engineering advice requested from ATHENS and LGW. Olympic engineers inspected No. 2 engine bearings, and made temporary repairs to panel. Service operated HER/LGW'.

During the subsequent full hard landing check at Gatwick the aircraft was found to have sustained damage which substantially reduced its structural strength in the area of the No. 2 engine pylon.

* SPR is an abbreviation for 'See Previous Report'.

1.2 Injuries to persons

None.

1.3 Damage to aircraft

Although the damage was not extensive, it was nevertheless significant.

1.4 Other damage

None.

1.5 Crew information

- (a) Commander: Aged 49.
- Licence: Airline Transport Pilot's Licence, valid until 28 February 1978.
- Aircraft ratings: Boeing 707 Comet 1VB, BAC 1-11 AW 650, Viscount, Dakota C-47.
- Instrument rating: Valid until 20 February 1975.
- Medical certificate: Valid until 31 August 1974.
- Last competency check: 21 January 1974
- Last route check: 16 October 1973.

Flying experience

- Total pilot hours: 12,144.
- Total flying hours in command of Boeing 707 aircraft: 429.
- Total flying hours in last 28 days: 48.

Rest period: two days prior to commencing duty on the date of the accident.

The Commander had operated into Heraklion Airport on two previous occasions.

- (b) Co-pilot: Aged 29.
- (1) Airline Transport Pilot's Licence: Valid until 10 January 1978.
- Aircraft ratings: Boeing 707/720, Trident, Comet, Vanguard, PA 23.
- Instrument rating: Valid until 28 December 1974.
- Medical certificate: Valid until 30 November 1974.
- Last competency check: 29 November 1973.

- (2) Flight Engineer's Licence: Valid until 21 January 1979.
 Aircraft rating: Boeing 707.
 Last competency check: 28 November 1973.

Flying experience

- Total pilot hours: 5,100.
 Total flying hours as co-pilot of Boeing 707 aircraft: 564.
 Total flying hours in last 28 days: 41.

Rest period: Three rest days prior to commencing duty on the day of the accident.

The co-pilot had operated into Heraklion Airport on six previous occasions.

- (c) Third crew member: Aged 29.

- (1) Airline Transport Pilot's Licence: Valid until 22 November 1978.
 Aircraft ratings: Boeing 707, Comet, Vanguard, PA 23.
 Instrument rating: Valid until 28 December 1974.
 Medical certificate: Valid until 31 August 1974.
 (2) Flight Engineer's Licence: Valid until 28 February 1979.
 Aircraft rating: Boeing 707.
 Last competency check: 5 June 1974.

Flying experience:

- Total pilot hours: 4,921.
 Total flying hours as co-pilot of Boeing 707 aircraft: 1,234.
 Total flying hours in last 28 days: 60.

Rest period: 17 hours 40 minutes rest prior to commencing duty on the date of the accident.

This crew member had operated into Heraklion Airport on 14 previous occasions.

- (d) In accordance with normal British Airtours procedures, the third crew member, who was also a qualified co-pilot, carried out the duties of flight engineer. As the second and third crew members were qualified both as co-pilots and flight engineers, they exchanged duties for the return flight to Gatwick.

- (e) Although the second and third crew members had the experience and qualifications required by the Civil Aviation Authority to hold a Flight Engineer's licence, they had no experience of aircraft maintenance engineering.

1.6 Aircraft information

- 1.6.1 Type: Boeing 707-436.
- Manufacturer: The Boeing Company, Seattle, USA.
- Year of manufacture: 1960.
- History of ownership: Delivered to British Overseas Airways Corporation 15 July 1960.
- Re-registered in the name of British Airtours 14 January 1972.
- Certificate of Airworthiness (C of A): Renewed 13 July 1973 and current at the time of the accident.
- Certificate of maintenance: Current at the time of the accident.
- Total Airframe hours: 47,808.
- Hours since C of A renewal: 1,388.
- Maximum authorised landing weight: 93,894 kg.
- Actual landing weight at Heraklion: 91,267 kg.
- Centre of Gravity: within the limits as shown on the Company's loadsheet.
- Total number of landings: 18,026.
- 1.6.2 The minimum operating crew specified in the aircraft's Flight Manual is two pilots and a flight engineer. British Airtours operate the aircraft with a commander and two other pilots, one of whom must hold a Flight Engineer's licence.

1.6.3 *The wing pylon attachment.*

Each pylon is attached to the wing at four points. The uppermost of these, known as the overwing fitting, is at the wing/pylon junction. It consists of a fork end fitting, forward of the wing front spar, which is attached by a shear bolt to a lug on the front spar of the pylon at the closure rib. The two main pylon attachments consist of fork fittings which attach to the underside of the wing forward of the main spar. The fourth, or aft, attachment is by means of a diagonal brace between the pylon and the wing bottom surface at a rib.

The two main attachment points are designed to accept the thrust and side loads applied to the pylon. The overwing fitting and the diagonal brace are designed to accept vertical and nodding loads. Hence failure of the overwing fitting results in compressive loading of the diagonal brace with the possibility of its crippling. The design is fail safe in that failure of any one of the four attachments, while reducing the overall attachment strength below the design value, does not reduce it below that required to withstand the maximum

loads which are normally expected in flight. However it is the opinion of both the CAA Airworthiness Division and the Boeing Aircraft Company that, because failure of one of these components nullifies the fail-safe feature of the design and also reduces its capability to meet unexpected loads, an aircraft should not be operated intentionally in this condition.

Owing to their location close to the pylon closure rib, the overwing fitting fork end and its associated shear bolt are not readily visible or accessible.

1.7 Meteorological information

The weather at the time of the landing at Heraklion was fine, with a surface wind velocity of 320°/15 knots. Thus the crosswind component was 8 knots.

The weather on the return flight from Heraklion to London was good, and little or no turbulence was encountered.

1.8 Aids to navigation

Not relevant.

1.9 Communications

Not relevant.

1.10 Aerodrome and ground facilities

1.10.1 Olympic Airways staff at Heraklion provided traffic handling and certain engineering facilities for British Airtours flights. The approval for engineering assistance accorded to Olympic Airways by British Airways Overseas Division (acting for British Airtours) covered Pre-Departure Checks, refuelling and wheel and filament changes, but excluded rectification and certification of defects.

1.10.2 The Olympic Airways Senior Station Engineer at Heraklion held a Green maintenance engineer's licence valid for Boeing 707-320 aircraft but not for the type 707-436's of British Airtours which, although similar, have a different type of engine and a slightly different pylon design. His approval to work on British Airtours aircraft was limited to those items mentioned in paragraph 1.10.1 above. Thus although competent to make a preliminary inspection of the 707-436 type aircraft for signs of damage, he was not authorised to certify in the aircraft's Technical Report that he had completed a hard landing check.

1.11 Flight recorder

A graphical plot of the EFDAS digital flight data recorder readout showed that 2.9g (ie an increment of 1.9g) was recorded on touchdown at Heraklion. This is approximately equivalent to a vertical rate of descent of 12 feet per second. The aircraft is designed to withstand a rate of descent of 10 feet per second without permanent deformation of the structure.

1.12 Examination of aircraft

On its return to Gatwick the aircraft was given a hard landing check by company maintenance personnel and the following damage was found:

- (i) The shear bolt attaching the No. 2 pylon to its overwing fitting was sheared in two places. (See photograph at Appendix 1).
- (ii) No. 2 pylon overwing fitting fork end was splayed outwards .050" at the bolt centreline.
- (iii) Skin buckling was apparent on all four pylon side panels.
- (iv) Numerous underwing fuel leaks had developed.

1.13 Medical and pathological information

Not applicable.

1.14 Fire

Not applicable.

1.15 Survival aspects

Not applicable.

1.16 Tests and research

No tests or research were carried out.

1.17 Other information

1.17.1 *Pre-flight action by the commander – the Air Navigation Order, Article 30.*

Article 30 of the Air Navigation Order 1972, which was applicable at the time of the occurrence, required an aircraft commander to satisfy himself on certain items concerning the aircraft's fitness for flight. A summary of the items relevant to this accident is as follows:

- (i) that the aircraft is in every way fit for the intended flight;
- (ii) that a certificate of maintenance is in force for the duration of the flight;
- (iii) that there is sufficient fuel and oil on board for the proposed flight, including a safe margin for contingencies, and that the instructions in the operations manual relating to fuel and oil have been complied with.

1.17.2 *The aircraft Technical Report*

The relevant company instructions require that, before every flight, a suitably licensed engineer or an approved person shall signify that the following items in the aircraft's Technical Report have been completed:

- | | | |
|---------------------------|---|---|
| 1. Pre-Departure Check | – | to the effect that all pre-departure checks have been satisfactorily carried out. |
| 2. Fuel and Oil Statement | – | that the disposition of the fuel is as specified in company manuals and that fuel and oil servicing has been completed. |

3. Flight Clearance — that the Technical Report has been completed up to this point, all relevant Special Technical Instructions have been complied with, and any defects have been actioned, ie cleared or carried forward as appropriate, and correctly certified.

When one of the company's aircraft is operating through a station where no suitable engineering cover is available, the commander is authorised to sign for these items.

When any defect has been entered in the left hand column of the Technical Report under 'Defect Symptom', it must be 'signed off' in the right hand, 'Action Taken' column. If the defect is of a minor nature, such that it can be carried forward, an endorsement must be made in the 'Action Taken' column to show that it will not render the aircraft unfit for flight. The endorsement must be signed by a licensed engineer, an approved person or the aircraft commander. Before every flight, when the necessary signatures have been entered in the Technical Report, and all defects have been appropriately certified, the commander is required to sign the 'Captain's Acceptance Certificate', to the effect that he accepts the aircraft and the Technical Report.

1.17.3. *The hard landing check*

The hard landing check used by British Airtours is set out in full in the Boeing 707 Maintenance Manual, Chapter 51-5-0.

The opening paragraph states: 'Whenever the airplane makes a landing at which is believed to be an excessive rate of sink, the landing will be considered as a hard landing'. There is no definition or guidance in the Company's instructions to pilots as to what constitutes a hard landing. The manual subsequently explains that the check shall be carried out in two phases, the second and more rigorous of which need only be undertaken if Phase I 'reveals evidence of damage or distress'.

The aircraft documentation includes Hard Landing Check Sheets which are provided for British Airtours by British Airways Overseas Division in their capacity as a Civil Aviation Authority Design Approved organisation. The purpose of the Check Sheets is to present the checks contained in the Maintenance Manual in a form suitable for use during an actual inspection of the aircraft. However at the time of the incident, there were a number of anomalies between the two documents, the most important of which concerned the requirement for an undercarriage retraction test (involving raising the aircraft on jacks). Whereas in the manufacturer's Maintenance Manual this item was listed in Phase II and was only required if the hard landing is combined with excessive side or drag loads, in the company's Check Sheets it is included in Phase I. It was also noted that the Maintenance Manual called for inspection of several items, (not relevant to this accident), which were omitted from the Check Sheets. The hard landing check has since been revised and there is no longer a requirement that the aircraft be raised on jacks during Phase I of the inspection.

The items relating to the accident, examination of which was required by both Maintenance Manual and Check Sheets, were as follows:

- (i) Inboard nacelle strut side skin panels for buckling, cracks and pulled or missing fasteners.
- (ii) Wing leading edge - nacelle gap covers for gap displacement, fastener hole elongation or tear-out, skin cracks, pulled or missing fasteners.

No provision was made in either document for a special check on the shear bolts attaching the pylons to their overwing fittings, nor was there any requirement for the running of the engines. However, both documents specified, as part of the phase II check, an inspection for signs of fuel and other fluid leaks in the region of the undercarriage.

2. Analysis and Conclusions

2.1 Analysis

The seriousness of this accident lay not in the fact that the aircraft was damaged by a hard landing but that the damage remained undetected, with the result that the aircraft subsequently flew with 156 passengers on board when its designed margin of structural strength was seriously eroded. It became clear at an early stage in the investigation that the occurrence could have been prevented if the commander had exercised a greater sense of responsibility and the British Airtours engineering staff at Gatwick had been more realistic in their approach to the matter. The sequence of events which culminated in the aircraft being flown back to London in an unairworthy condition undoubtedly stemmed from the commander's initial difficulty in accepting that he had in fact made a hard landing. Though it is difficult at times to differentiate qualitatively between a firm and a hard landing, there would seem to have been scant reason for doubt on this occasion. Not only did one of the flight crew make his views known to the commander that the landing was hard but there were further indications in the form of the chief steward's report of 'near panic' amongst the passengers, and the query from the control tower. Furthermore the visible damage to the aircraft should have resolved any doubt in the commander's mind whether or not there had been a hard landing.

What followed can only be described as a failure in communications between the persons concerned. The Olympic Station Engineer was in no doubt that the aircraft merited a proper hard landing check, but for reasons which may have been partly due to language difficulties, it would seem that this message did not get across to the commander even after he had spoken on the telephone to Olympic Airways engineering staff in Athens. However he did agree to the inclusion of the words 'heavy landing' in the telex message which the co-pilot sent to Gatwick. Shortly after this message had been despatched, the third crew member discovered the hard landing Check Sheets, and these specifically mention in Phase I 'pulled fasteners' and 'wing leading edge gap displacement' amongst the symptoms of damage requiring further investigation. Thus the base engineering staff at Gatwick were never alerted to these warning symptoms, and apparently they did not consider it prudent to signal back for further information before deciding that the damage was only superficial.

Taping over the gap on the top surface of the pylon can hardly be considered a repair in the strictest sense, such as would require the issue of a fresh certificate of compliance under the terms of Article 11 of the Air Navigation Order 1972. Therefore the C of A was not rendered invalid by this action though the possibility that it might have been, would not appear to have been considered at the time.

The commander states that he did not ask the Station Engineer to complete the aircraft's Technical Report, but elected to do so himself. The company's Flying Staff Instructions authorise the commander to sign the Pre-Departure Check, Fuel and Oil Statement and Flight Clearance when no suitable engineering cover is available. By implication he should not do so when there is suitable cover. In this instance the Station Engineer was authorised to sign the first two of these items but neither he nor the commander could sign the Flight Clearance if there were any entries in the 'Defects' column, such as a hard landing, which would require a repair, or an inspection beyond their authority. However, because the commander had only entered the landing as VERY FIRM, he avoided by a technicality the requirement for a full hard landing inspection. He subsequently endorsed the defect as though it were one which did not render the aircraft unfit for flight, and then exercised what he considered to be his prerogative to operate the flight without the signatures of approval of the local Station Engineer. Although he had received the company's authority to proceed, his decision was, under the circumstances, hardly that to be expected of an experienced captain.

There are clearly some lessons to be learnt from this episode. The first is that because a hard landing check can sometimes be a lengthy procedure with consequent disruption to services, it is not surprising to find that the issue is not always squarely faced and that such euphemisms as 'very firm' can sometimes appear in the Technical Report so as not to invoke the check. It would seem that there should be a better criterion than a crew's subjective judgment for deciding when an aircraft has made a hard landing, and the need for some kind of instrumentation is demonstrated by this incident. Notwithstanding that, if a landing is hard enough so as to give rise to serious doubt afterwards, as it was on this occasion, then there can be no question but that the check should be carried out.

It is perhaps significant and an indication of the commander's true assessment of the landing at Heraklion that when the aircraft had finally returned to Gatwick, he referred to it in the Technical Report and Air Safety Report as a 'heavy landing'.

The second point relates to the base engineering staff, who should be warned against accepting at face value reports of damage from persons lacking an engineering background. They should realise that a crew consisting essentially of three pilots cannot be expected to evaluate accurately all symptoms of damage and to send a report that is guaranteed to be technically correct. They should therefore ensure, before clearing an aircraft to continue, that certain specific items have been checked by competent personnel.

It is of course impossible to determine precisely the extent to which the safety of those on board was hazarded during the return flight. However, had the aircraft encountered unusually severe turbulence or made a further hard landing, the complete engine pod could have become detached with the consequent risk of fire or loss of control.

The action of the Olympic Airways Senior Station Engineer at Heraklion and the Maintenance Staff in Athens was in every respect correct and shows the highest standards of responsibility and good engineering practice on their part.

2.2 Conclusions

(a) Findings

- (i) The crew were properly licensed.
- (ii) The aircraft had been maintained in accordance with an approved maintenance schedule, and its certificates of airworthiness and maintenance were valid.
- (iii) The weight of the aircraft and its centre of gravity were within the prescribed limits.
- (iv) A hard landing was made at Heraklion, requiring the appropriate inspection.
- (v) As a result of the landing the aircraft sustained damage which substantially reduced its structural strength in the area of No. 2 engine pylon.
- (vi) In spite of advice from the Station Engineer and other warnings the commander did not initially accept that a hard landing had been made, and formed the opinion that the damage was not such as to make the aircraft unfit for flight.
- (vii) The crew's telex report of the hard landing to their company unintentionally gave an incomplete assessment of the visible damage.
- (viii) The Company's Engineering Superintendent, as a result of this report, concluded that the damage was superficial and authorised the aircraft's return flight without completion of a hard landing check.

- (ix) The Olympic Airways Senior Station Engineer at Heraklion attempted to explain to the commander that in his opinion the aircraft was unairworthy.
- (x) The commander did not act on the advice of the Station Engineer, possibly due to a misunderstanding arising from language difficulties.
- (xi) The commander signed the Pre-Departure Check himself although suitable engineering cover was available. He did not sign, or obtain a signature for, the Fuel and Oil Statement or the Flight Clearance.
- (xii) Taping over the gap at the top of No. 2 pylon did not constitute a repair such as would require the issue of a new certificate of compliance to maintain the validity of the certificate of airworthiness.
- (xiii) The commander operated the flight to Gatwick, with passengers, in an aircraft whose structural strength was impaired.
- (xiv) The hard landing check contained in the manufacturer's Maintenance Manual and used by the operator contained no specific instruction to inspect the overwing pylon shear bolts.

(b) *Cause*

The operation of the aircraft with a reduced standard of airworthiness resulted from the failure of the commander to call for a full hard landing check when there were definite indications that the check should have been carried out. The unrealistic advice from the British Airtours Engineering Superintendent at Gatwick which was based on inadequate information, was a contributory factor.

3. Recommendations

- 3.1 It is recommended that the hard landing check for the Boeing 707 aircraft should contain a specific instruction to inspect the overwing pylon shear bolts.
- 3.2 It is recommended that consideration be given to the provision of some suitable device to assist crews of public transport aircraft of 27,000 kgs or above to determine whether a hard landing check is necessary.

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