

## ACCIDENT

<b>Aircraft Type and Registration:</b>	British Aerospace Jetstream 41, G-MAJD
<b>No &amp; Type of Engines:</b>	2 Garrett Airesearch TPE 331-14GR-807H turboprop engines
<b>Year of Manufacture:</b>	1992
<b>Date &amp; Time (UTC):</b>	4 February 2011 at 1921 hrs
<b>Location:</b>	Leeds/Bradford Airport
<b>Type of Flight:</b>	Commercial Air Transport (passenger)
<b>Persons on Board:</b>	Crew - 3                      Passengers - 5
<b>Injuries:</b>	Crew - None                      Passengers - None
<b>Nature of Damage:</b>	Left main landing gear outboard trunnion pin fractured
<b>Commander's Licence:</b>	Airline Transport Pilot's Licence
<b>Commander's Age:</b>	48 years
<b>Commander's Flying Experience:</b>	5,237 hours (of which 3,530 were on type) Last 90 days - 121 hours Last 28 days - 46 hours
<b>Information Source:</b>	AAIB Field Investigation

## Synopsis

After landing in strong and gusty wind conditions, damage was found to the aircraft's left Main Landing Gear. It was determined that the gear outboard trunnion pin had failed in overload due to upward loading on the outboard wheel.

## History of the flight

The aircraft was operating a scheduled service from Teeside to Southampton, with a transit stop at Leeds/Bradford. On board was a flight crew of two, one cabin attendant and five passengers. The crew had commenced duty at 1615 hrs, and the flight was the first of their duty period.

As the aircraft neared Leeds/Bradford, the crew received ATIS code 'G' (valid from 1829 hrs) which reported a surface wind from 250° at 29 kt gusting 46 kt. Lowest cloud was FEW at 1,200 ft agl and visibility was 20 km. Runway 32 was in use and was reported damp in all sectors. The aircraft's maximum demonstrated crosswind value was 35 kt. After a period of holding, the crew elected to make an approach whilst monitoring reported wind; the commander was the handling pilot.

Because of the strong wind and gusts, a flap 15 landing was planned (normal flap setting for landing was 25). The approach was reported to be quite steady until the latter stages when it became destabilised

and the aircraft descended below the glideslope. The commander initiated a go-around, during which the aircraft's main gear briefly made light contact with the runway surface.

The crew decided to make a second approach. As the wind had appeared steady during the first approach, they decided to use flap 25. In the latter stages of the approach the Tower controller passed a wind report of 250° at 45 kt. The crew continued the approach and received a further report of 270° at 33 kt on short finals, at which point the decision to land was made.

The commander recalled that the touchdown was not heavy but, as the aircraft slowed, he experienced directional control difficulties. The aircraft first yawed right, which he corrected. However, the aircraft nose then swung further left than intended before regaining the runway track. The commander thought that reducing rudder authority and a sudden response to nosewheel steering input may have contributed to the handling difficulties in the strong crosswind.

The aircraft vacated the runway as normal, but once on stand damage to the left main landing gear was discovered.

### **Recorded data**

#### *Radio Telephony (R/T)*

Recorded R/T data for Leeds/Bradford Approach frequency (125.575 MHz) and Tower frequency (120.300 MHz) was examined.

At 1837 hrs, when the aircraft was routing towards the 'LBA' hold, the Approach controller passed the crew an average wind for the past ten minutes of 240° at 30 kt, maximum 42 kt. The crew informed ATC that they would remain holding and that the maximum

permissible wind strength for landing would be 37 kt, providing the direction remained steady from 250°. The controller replied that the instantaneous wind was 240° at 25 kt. The crew announced that they could start an approach but would require instantaneous wind readouts throughout.

The aircraft contacted the Tower controller at 5.5 nm from touchdown. The controller passed instantaneous wind reports during the approach, which varied between 26 kt and 32 kt, the lower figure being reported with the aircraft on short finals. At 1903:45 hrs the crew transmitted "GOING AROUND". Less than a minute later, the Approach controller passed an instantaneous wind report to another aircraft of 250° at 36 kt, noting that the maximum in the last 10 minutes was 42 kt.

When the aircraft transferred back to Tower controller for its second approach at 1916 hrs, the crew were given a reported wind with their landing clearance of 240° at 28 kt gusting 42 kt. Again, the Tower controller passed instantaneous wind reports during the aircraft's approach.

Recorded flight data was synchronised with R/T data using aircraft transmission keying. This indicated that the penultimate wind report of 250° at 45 kt (the highest value reported on the approach) had been made by the controller when the aircraft was passing about 1,216 ft altitude (554 ft ARTE), or about 1.6 nm from the runway<sup>1</sup>. The final wind report of 270° at 33 kt was passed when the aircraft was about 1.1 nm from the runway at about 1,073 ft altitude.

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#### **Footnote**

<sup>1</sup> The calculations assume that the aircraft was on or close to the published 3° glideslope. Runway Threshold Elevation was 662 ft amsl.

### Meteorological data

An anemometer recording was provided by Leeds/Bradford Airport. The device recorded maximum and minimum values for wind speed and direction over successive 30 second periods.

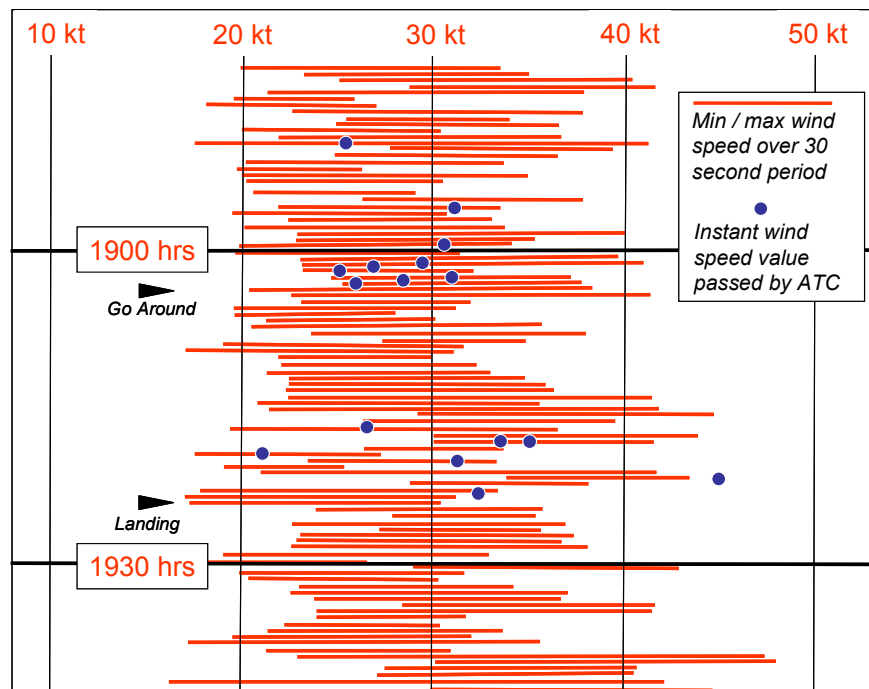
In the time period covering the two approaches, the wind direction averaged between 240° and 250° with occasional greater variations between 210° and 270°. The variations became more frequent during the second approach, with a single variation up to 277° recorded at about the time of landing.

Recorded wind speeds for the period are shown graphically at Figure 1. The figure also shows the time and values of instantaneous winds passed to the crew by ATC.

### Flight Data

The aircraft was fitted with a CVR and an FDR. The CVR records the last 30 minutes of operation. The time taken to recognise the problem and preserve the recording was inadequate for the given duration of CVR and so the relevant recording was overwritten. The 25 hour FDR recording covered the period of interest.

The recordings showed erratic normal and lateral accelerations associated with windy conditions. Two approaches were flown with the autopilot coupled to the ILS for the majority of the descent. High on the first approach the aircraft had more than 20° of drift; this reduced further down the approach but was still varying about an average drift angle of approximately 15° before reaching the runway. The radio altimeter



**Figure 1**

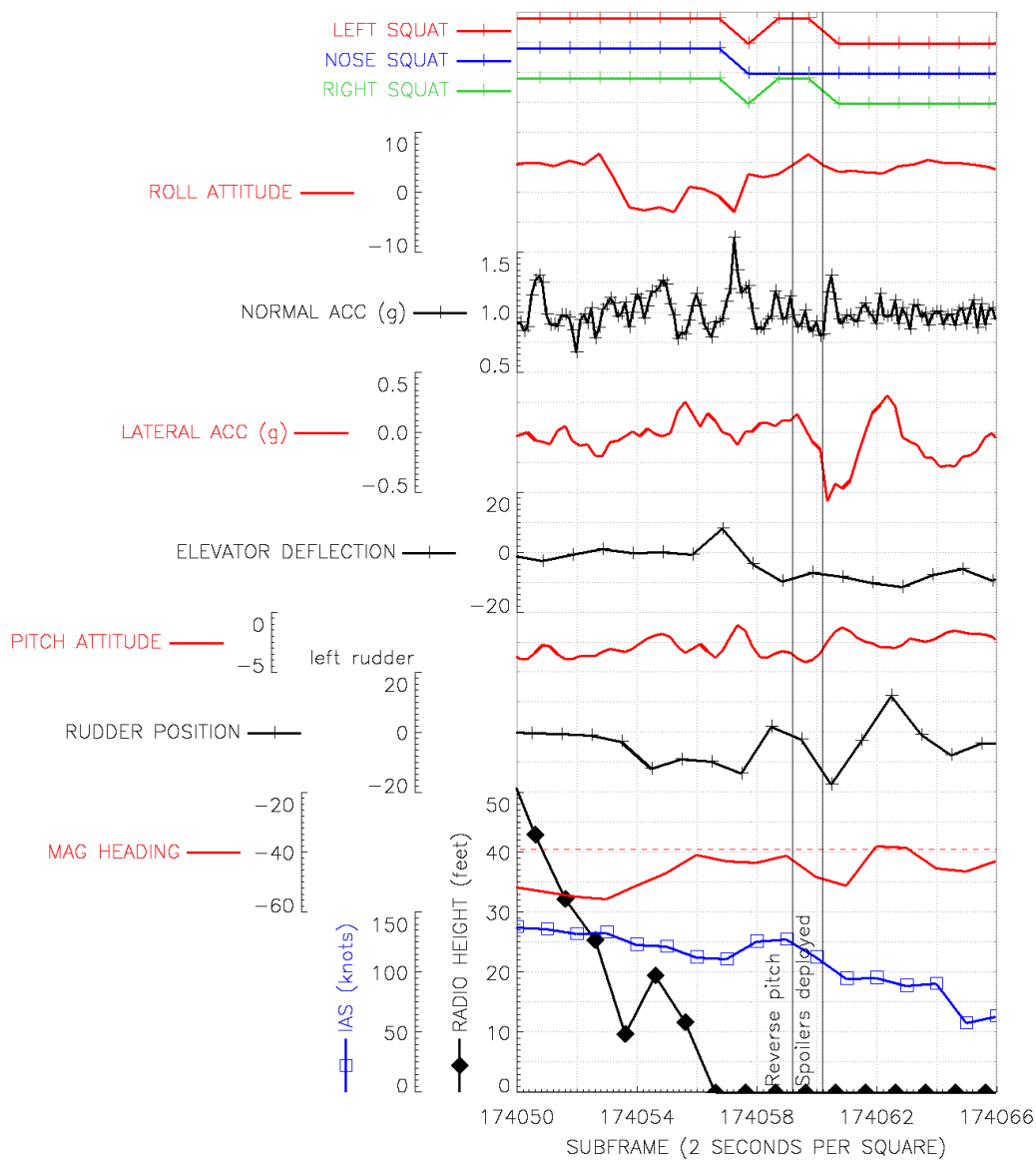
Anemometer data, with blue dots indicating time and value of ATC reported wind strength

registered zero but none of the gear or air/ground parameters were triggered. Whilst above the runway, the localizer showed the aircraft to be on the centreline and the recordings indicated a drift angle averaging approximately 10°.

On the second approach, the drift angle just prior to landing was approximately 15°. This equated to a crosswind component of approximately 34 kt. Figure 2 shows the pertinent parameters on the final landing.

The data registered a small elevator deflection with a small change in pitch attitude but no significant flare. The required recording accuracy of the pitch parameter is only ±2°, however the data showed that the pitch was generally more nose-down than any of the other 46 landings recorded.

Just prior to touch down, the drift was reduced to near zero. All three gear parameters registered as on the ground within the same one second sample period,



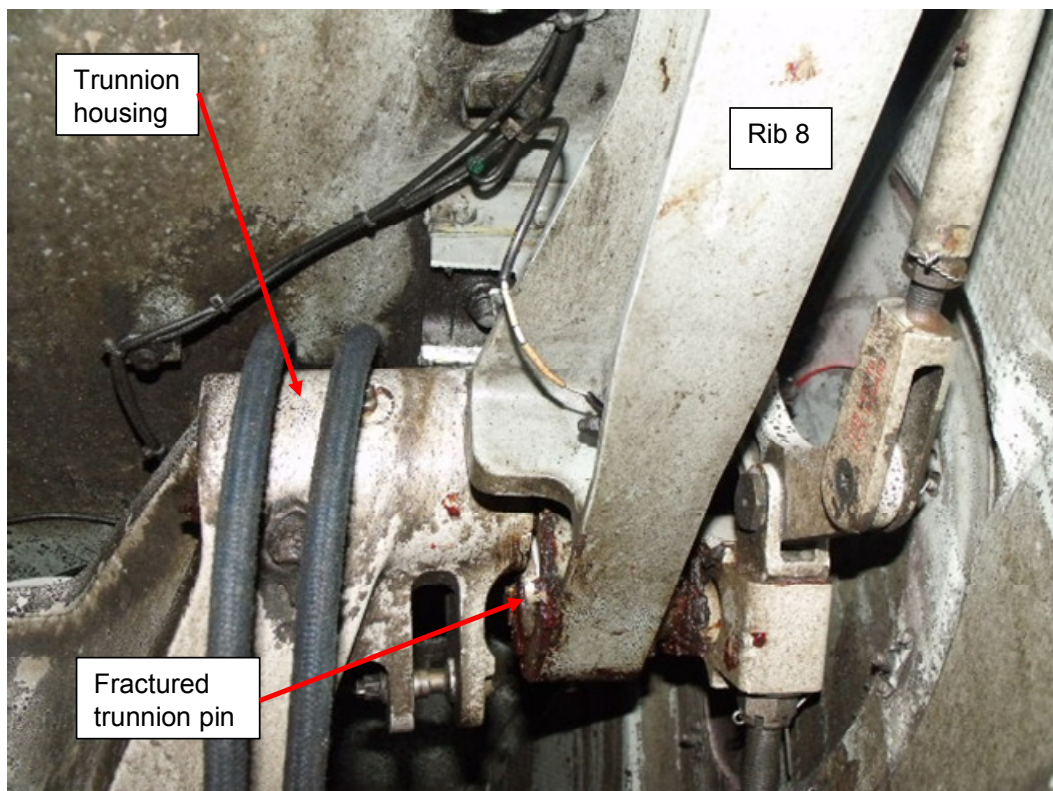
**Figure 2**  
Pertinent FDR data

associated with a peak recorded normal acceleration of 1.6 g and the aircraft slightly rolled to the left. The subsequent two samples, one second apart, showed that the main gears were no longer sufficiently compressed to register as on the ground, with the nose gear still showing on the ground. The aircraft yawed right before being brought back rapidly left in the same timeframe as the main gear recompressing. This was coincident with the peak recorded lateral acceleration of 0.6 g and a normal acceleration spike of 1.3 g.

Altitude rate was not recorded, and the quality of the altitude and height parameters did not support a robust derivation of altitude rate. Whilst the aircraft had a left roll rate at the time of the spike in normal acceleration, it was not large enough to significantly affect the overall closure rate of the gear with the ground.

### Examination of the aircraft

The AAIB examination of G-MAJD took place on the night of the accident. The aircraft was parked on the apron and was supported on jacks. It could clearly be seen that the left Main Landing Gear (MLG) was leaning outwards and, when looking into the left MLG bay, it was found that the outboard trunnion pin had broken. The trunnion pin is a fusible link and is designed to fail at a descent rate at touch down of approximately 10 ft/s. The trunnion housing was resting against the outboard rib (Rib 8), which had been damaged but was supporting the MLG leg albeit at a splayed angle (Figure 3). Also apparent was that the MLG doors were open, because the trunnion pin, which is attached to a bellcrank, is part of the door actuating mechanism; with the pin failed, the doors were able to drop down under gravity.



**Figure 3**

Photograph of left MLG showing fractured trunnion pin and trunnion housing forced up against Rib 8

The degree of movement did not allow the propeller to strike the ground and, apart from some small fuel leaks which became apparent upon detailed inspection, there was no damage outside of the MLG assembly and Rib 8 on the left side.

The fractured pin and the broken Rib 8 were removed and submitted to a metallurgical laboratory to ascertain whether there had been any material defects contributing to the failure and also for information concerning directionality of the fracture ie vertical or lateral loading being involved in the failure. The report from the laboratory showed that the pin had no pre-existing material defects and had failed primarily in overload shear. Starting at the lower surface, a crack propagated rapidly around the pin until full rupture finally occurred with the remaining material bending and fracturing in tension.

After pin failure, the whole MLG leg assembly moved upward, breaking two stiffening webs on Rib 8 before the trunnion housing became wedged against the rib, preventing further upward movement of the outboard trunnion but leaving the whole MLG leg to splay outwards.

### **Summary**

The landing had been carried out in strong and gusty crosswind conditions. There were no signs of any pre-existing material defects and that significant lateral loads contributing to the failure. Consideration of the MLG geometry and the direction of the fracture led to the conclusion that the trunnion pin had failed in overload due to purely upward loading on the outboard wheel.