



Tail strike – Brisbane Airport, Qld

23 October 2008

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Abstract

On 23 October 2008 at 2357 Eastern Standard Time, a British Aerospace BAe 146-300 aircraft, registered VH-NJM, operating a freighter flight, had a tail strike on landing at Brisbane Airport, Qld.

The aircraft and crew had commenced duty earlier that evening at Adelaide, SA and had flown via Sydney, NSW to Brisbane. The aircraft and crew then did the reverse sectors back to Adelaide. It was only after landing at Adelaide that the crew became aware of the tail strike.

Damage to the aircraft consisted of abrasion to the tail strike indicator through to the fuselage skin and abrasion to the fuselage skin. There was also damage to the aircraft's structural frame under the tail strike indicator.

The aircraft manufacturer had identified an increase in the number of BAe 146-300 tail strikes and has recommended a number of procedural changes for flight crew. The aircraft operator has implemented those changes and issued notices to flight crew highlighting the risks and conditions for tail strike.

FACTUAL INFORMATION

History of the flight

On 23 October 2008 at 2357 Eastern Standard Time¹, a British Aerospace BAe 146-

300 aircraft, registered VH-NJM, operating a freighter flight, had a tail strike on landing at Brisbane Airport, Qld.

The flight crew and aircraft had commenced operations at Adelaide, SA earlier that evening. The pilot in command (PIC) had completed a thorough pre-flight inspection and external inspection (walk-around) of the aircraft and accepted it for that night's operation. That night's duty consisted of four sectors, Adelaide-Sydney-Brisbane-Sydney-Adelaide.

The PIC reported that a standard practice he had adopted for determining who was to be the flying pilot on what sectors was as follows:

- if one of the flight crew had been on duty the previous night, then that person would act as pilot flying² for the first two sectors
- the pilot who had not flown the previous night would act as pilot flying on the last two sectors.

The copilot had been on duty the previous night and consequently flew the first two sectors.

At interview the crew stated that the night's operations had been uneventful and that they were unaware that the aircraft had sustained a tail strike until they were notified by the Adelaide aerodrome controller, on their return.

1 The 24-hour clock is used in this report to describe the local time of day, Eastern Standard Time (EST), as particular events occurred. Eastern Standard Time was Coordinated Universal Time (UTC) + 10 hours.

2 Pilot flying (PF) and pilot monitoring (PM) refer to the different roles that the pilots play when occupying an aircraft control seat. The pilot in command will at all times have ultimate responsibility for the safe operation of the aircraft but allows the copilot to physically fly the aircraft.

The crew reported that the weather was good for the arrival at Brisbane. The PIC stated that the approach was well flown by the copilot and that during the landing sequence the thrust levers may have been closed too quickly, and that the touchdown was firm. The PIC also stated that at no time was he concerned with the aircraft's nose-up attitude or the landing.

The copilot stated that in the landing phase, he initially thought that the aircraft was closer to the ground than it was and that he subsequently flared³ earlier than required. Consequently, with the thrust levers closed, the speed slowed and the aircraft settled on the runway from a height higher than normal. That resulted in a firmer touchdown than desired and with a high nose-up attitude.

The crew had critiqued the landing while taxiing to the parking bay in Brisbane. At no time did either pilot think that the aircraft had sustained a tail strike during the landing. The PIC carried out a walk-around at Brisbane, but did not detect the damage to the tail strike wear strip.

The aircraft was flown to Sydney, where the PIC completed another walk-around and did not detect the damage.

On arrival at Adelaide, the aerodrome controller asked the PIC to contact the safety officer at Brisbane Airport. The safety officer advised that an inspection of the runways at Brisbane had found several pieces of metal, which were believed to have come from his aircraft.

The PIC conducted a post-flight inspection of the aircraft and found damage to the tail strike wear section of the empennage (Figure 1). The aircraft was removed from service and repaired.

The qualifications and experience of the PIC and copilot are listed at Table 1.

The aircraft data is listed at Table 2.

Table 1: Pilot qualifications and experience

	Captain	First Officer
Date instrument rating valid to	31/01/2009	31/8/2009
Date Medical valid to	5/12/2008	02/07/2009
Date Last simulator check	12/8/2008	13/8/2008
Total flying hours	12,304 hrs	6,680 hrs
Total hours BAe 146 to 24/10/2008	4,955 hrs	184 hrs
Total hours BAe 146 last 90 days	153.7 hrs	184 hrs

Table 2 Aircraft data

Aircraft Model	BAE 146-300
Serial number	E3194
Date of manufacture	1991
Certificate of registration	29 Nov 1995
Total airframe hrs	15,753.03 hrs
Cycles	12,902 cycles

Aircraft damage

The tail strike indicator, aircraft skin and one of the structural frames were damaged in the incident. The structural frame was repaired and a new skin section and a new tail strike indicator fitted. The damaged section is within the pressurised zone of the aircraft.⁴

³ The flare refers to the final control input by the handling pilot to pitch the nose of the landing aircraft up so as to reduce the rate of descent to approximately zero at touchdown.

⁴ The aircraft was pressurised between the front and rear pressure bulkheads.

Figure 1: Damaged tail strike indicator and skin



Weather

The conditions for arrival at Brisbane at the time of the incident were clear skies and a south-easterly breeze of 8 km/h.

Weight and balance

The aircraft was loaded in accordance with the operator's approved load and trim system. The load was distributed between containers on the main cargo deck, and bulk loaded cargo in two compartments below the main cargo deck.

The most limiting weight for the aircraft was its maximum landing weight at Brisbane. The aircraft was loaded to arrive in Brisbane within 60 kg of that weight.

The investigation did not determine the actual weight and distribution of the cargo. The aircraft balance information indicated that the load distribution was such that it was in the middle of the permitted range.

Aircraft inspection procedures

The operator had set out guidelines for pre-flight inspections to be carried out by the flight crew. Those inspections were to be carried out prior to every flight and included the inspection of the 'tail bumper', which was fitted to the

BAe-146-100/200 series aircraft. This bumper was not fitted to the BAe 146-300 series aircraft. It was, however, fitted with a tail strike skid, which was fitted in a similar position to the tail bumper.

Tail strike guidance for pilots

The operator had provided guidance and training for pilots in respect to tail strikes. This training was included in the initial endorsement training and in subsequent recurrent simulator training. However, that training emphasised tail strike on takeoff rather than on landing.

Flight recorder examination

At the time of the occurrence, VH-NJM was fitted with both a cockpit voice recorder (CVR) and a flight data recorder (FDR). The CVR was not examined, since this information was overwritten in the subsequent flights following the incident. The information recorded on the FDR during the incident flight was examined to assist in the analysis of events surrounding this occurrence (see Figures 2, 3 and 4).

Figure 2 shows that at about 300 ft, the aircraft was at the nominated approach speed of approximately 124 KIAS⁵ and at touchdown the aircraft's speed was approximately 107 KIAS.

Figure 3 shows that from the same altitude the pitch attitude rose from approximately 7° to 12° at touchdown.

Figure 4 shows a comparison between the pitch angles on this flight compared to previous flights

⁵ Knots indicated airspeed.

Figure 2: Selected parameters from 600 ft radio altitude

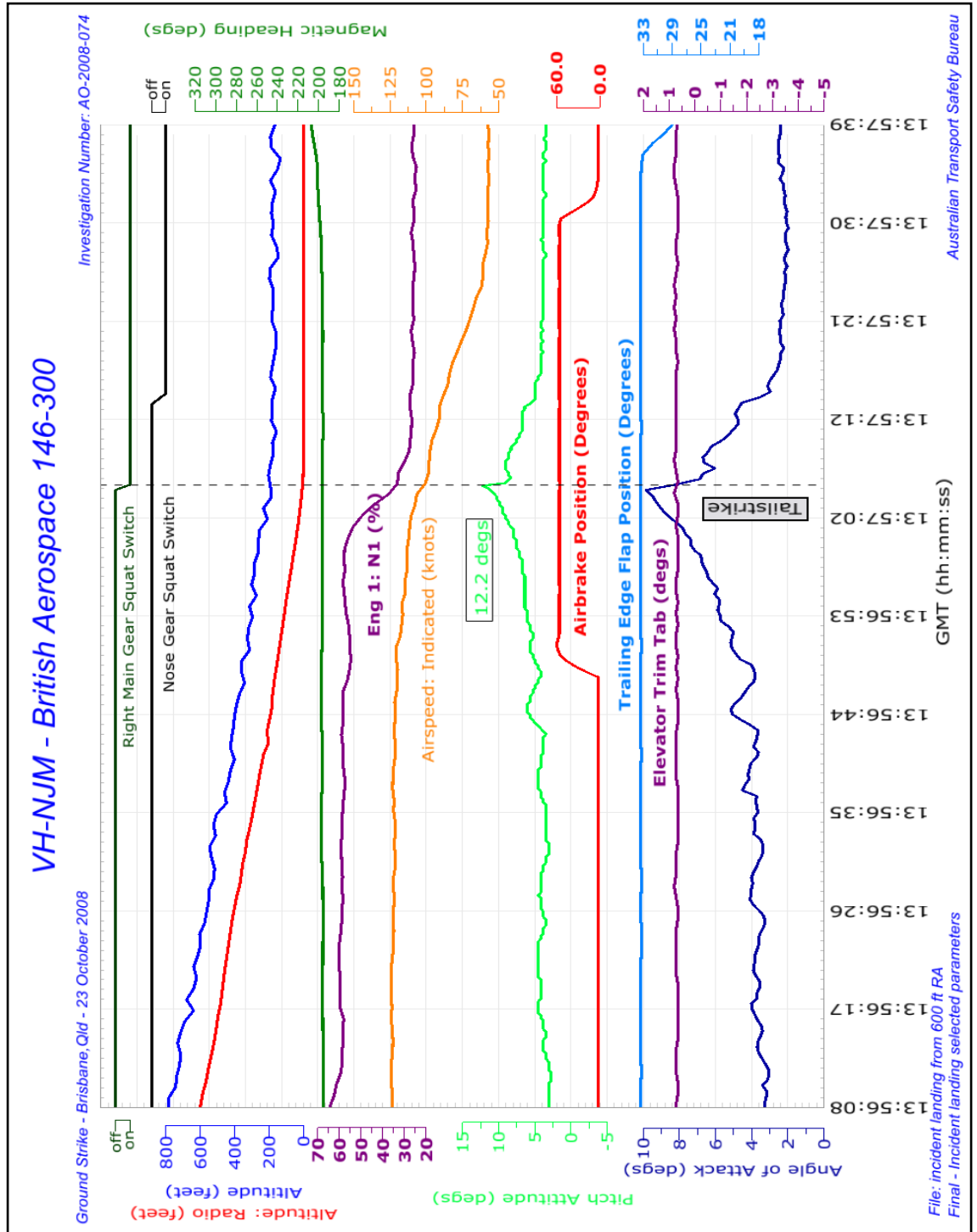


Figure 3: Vertical speed and pitch rate during approach

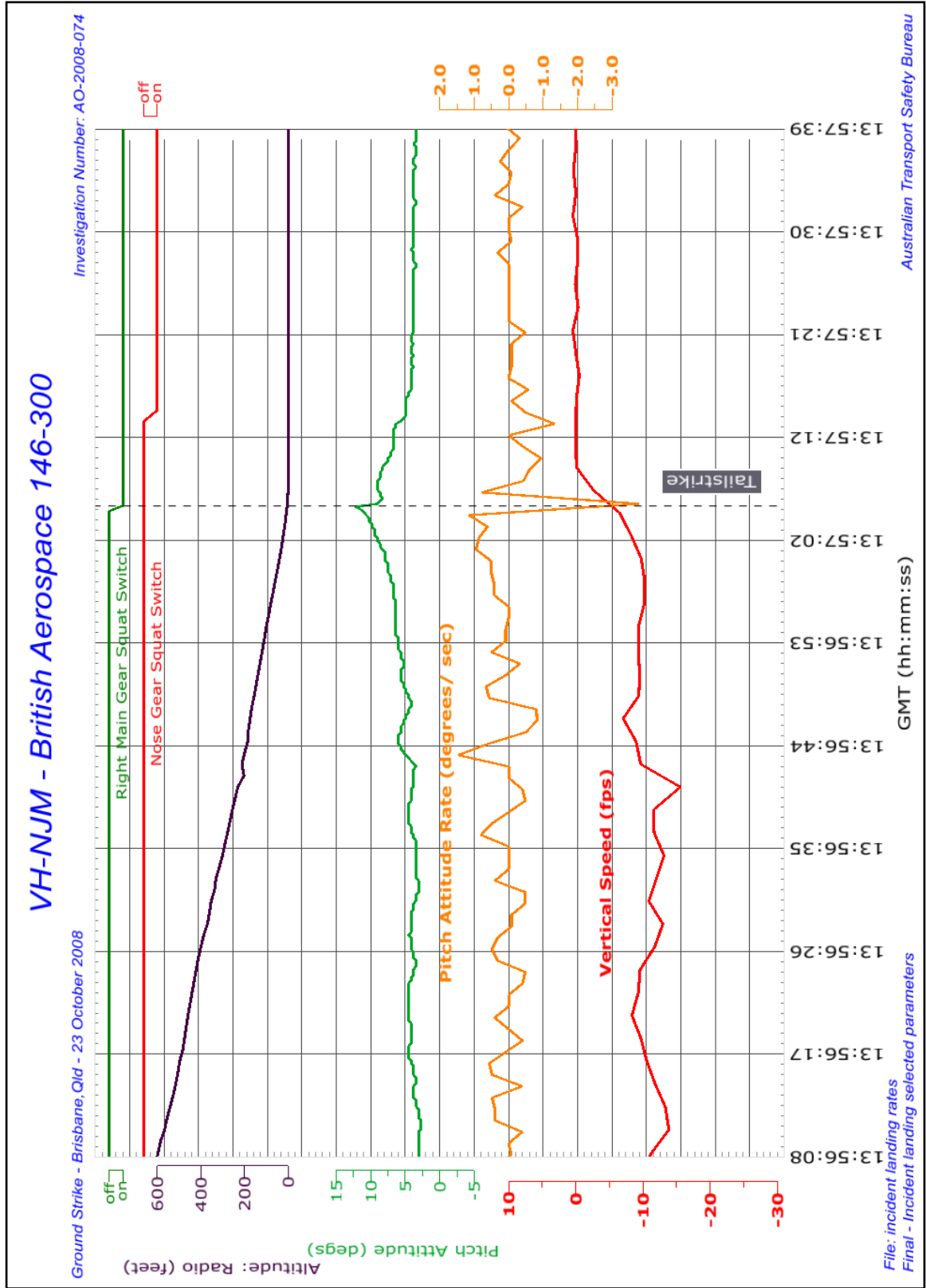
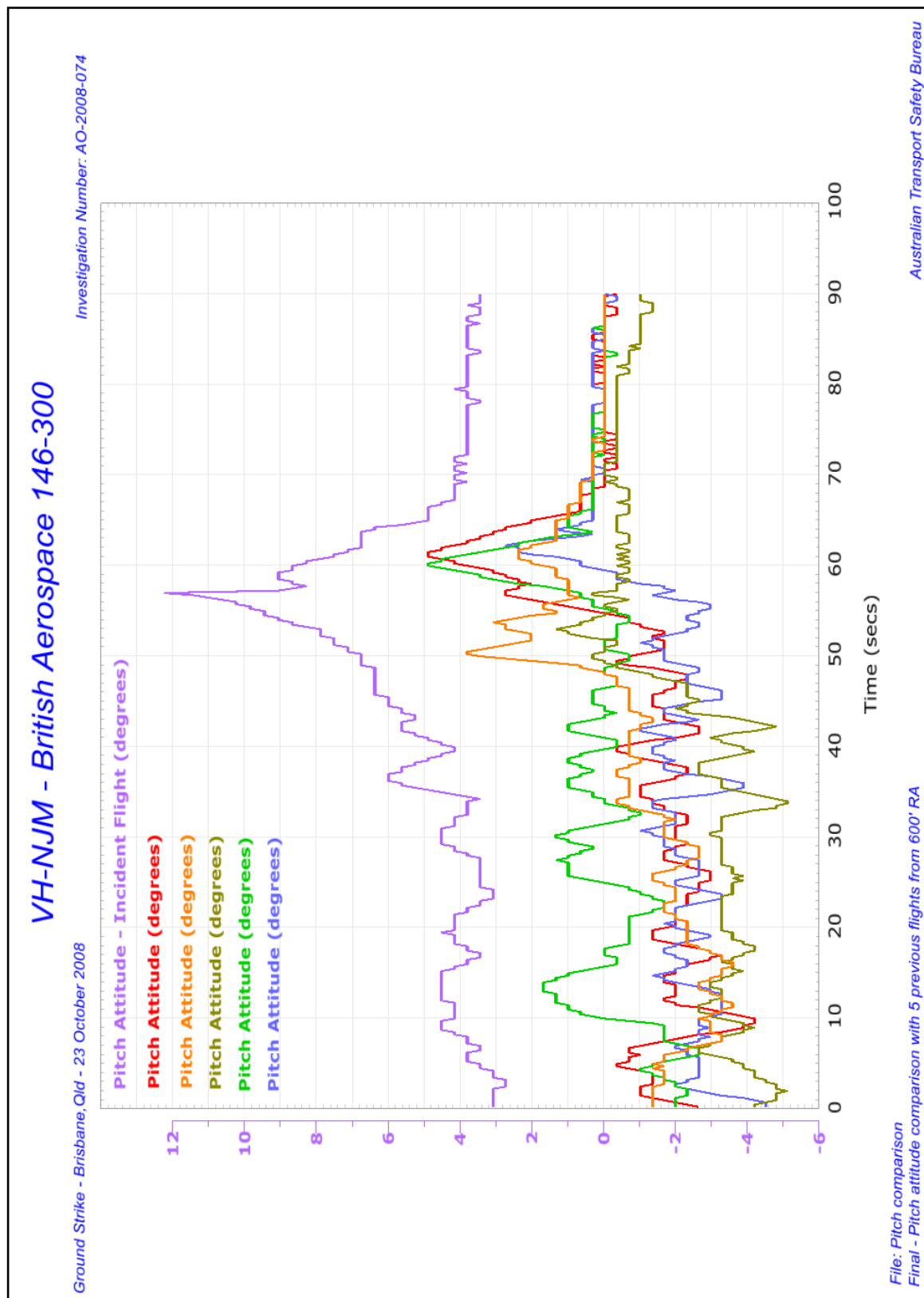


Figure 4:- Pitch attitude comparison with previous flights on FDR



ANALYSIS

Landing

The pilot in command (PIC) was experienced, not only on the aircraft type, but also with night freight operations. The copilot however, though competent, was inexperienced and was still in the process of becoming familiar with the characteristics of the different British Aerospace BAe 146 aircraft variants.

When the aircraft was flared too early and the power levers moved to idle, this resulted in a bleed off of speed earlier and at a height higher than desired. The combination of this and a further raising of the nose meant that the aircraft landed in a high nose-up attitude with a slightly higher than normal rate of descent. The tail strike commenced either within 1 second before or simultaneously with the main gear touchdown. The crew were unaware of the tail strike because the firm landing probably masked any sensory indication that one had occurred.

The aircraft pitch attitude in this event was compared to the pitch attitude during the five previous approaches from 600 ft radio altitude. The comparison of a number of flights in Figure 4 clearly shows the excessive pitch attitude in this event that resulted in the tail strike.

Pre-flight inspection

The PIC had carried out a pre-flight inspection prior to every flight, but did not detect the damage to the tail strike indicator. This indicator was in an awkward position to be observed from a standing position. Night or low light conditions would also make it difficult to detect any scrapes or damage to the tail strike indicator. As the damage extended to the aircraft skin and structural frame, the inability to readily detect any damage may have had further consequences as the damaged section was within the pressurised zone of the aircraft.

FINDINGS

From the evidence available, the following findings are made with respect to the tail strike involving British Aerospace BAe 146-300

aircraft, registered VH-NJM, and should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing safety factors

- During the landing phase, the aircraft pitch angle exceeded the tail strike pitch angle and this was not detected by the flight crew.
- Procedures and training for tail strike prevention focused on takeoff. *[Safety issue]*

Other safety factors

- Pre-flight take-off inspection procedures were ineffective in identifying tail strike damage. *[Safety issue]*

SAFETY ACTION

The safety issues identified during this investigation are listed in the Findings and Safety Actions sections of this report. The Australian Transport Safety Bureau (ATSB) expects that all safety issues identified by the investigation should be addressed by the relevant organisation(s). In addressing those issues, the ATSB prefers to encourage relevant organisation(s) to proactively initiate safety action, rather than to issue formal safety recommendations or safety advisory notices.

All of the responsible organisations for the safety issues identified during this investigation were given a draft report and invited to provide submissions. As part of that process, each organisation was asked to communicate what safety actions, if any, they had carried out or were planning to carry out in relation to each safety issue relevant to their organisation.

Aircraft manufacturer and operator

Avoidance of tail strike

Safety Issue

Procedures and training for tail strike prevention focused on takeoff.

Action taken by the aircraft manufacturer

The aircraft manufacturer issued the following notice to all operators:-

Avoidance of tail strike

It is recommended that a procedure be established whereby the PNF [pilot not flying] calls 'attitude' if the pitch attitude on the PFD [primary flight display] exceeds 5 degrees nose-up during the later part of the approach and landing. In response, PF [pilot flying] should stop the increase in pitch attitude and consider a go around if necessary.

Action taken by the operator

The operator issued a notice to pilots in which a number of issues were identified. That notice included a number of reminders to pilots about approach and landing checks and techniques, and the introduction of new procedures, including:

- the need for a stabilised approach
- the need for accurate speed control
- the use of speed brake, thrust, weight
- the effect of ambient conditions
- new procedures to monitor the pitch attitude prior to touchdown as recommended by the aircraft manufacturer.

Aircraft operator

Pre-flight inspections did not detect damage

Safety Issue

Pre-flight take-off inspection procedures were ineffective in identifying tail strike damage.

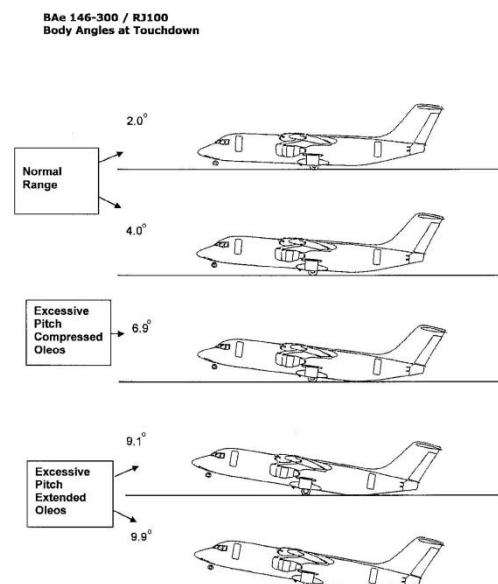
Action taken by the operator

The following 'System Improvement Request' was issued:

- that the tail strike indicator be painted in a contrasting colour to allow clear and easy identification of any scrape damage
- on every external inspection of the aircraft, a specific check of the tail strike indicator be accomplished
- a high powered torch be fitted on all freighter aircraft to assist in the external inspection at night

- a diagram showing the body angles at touchdown was also included to illustrate normal and excessive angles.

Figure 5: Body angles



SOURCES AND SUBMISSIONS

Sources of Information

The sources of information for this investigation included the aircraft operator, the aircraft manufacturer and the flight crew.

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the Transport Safety Investigation Act 2003, the Executive Director may provide a draft report, on a confidential basis, to any person whom the Executive Director considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the Executive Director about the draft report.

A draft of this report was provided to the Civil Aviation Safety Authority (CASA), the aircraft manufacturer, the aircraft operator and the flight crew.

Submissions were received from CASA and the aircraft operator. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.