

The Dutch Safety Board

Occurrence #: 2005135 **Classification:** Serious incident

FACTUAL INFORMATION

Date of the occurrence:	14-09-2005	Flight crew:	2
Place of the occurrence:	Amsterdam (EHAM)	Cabin crew:	0
Aircraft registration:	JA01KZ		
Aircraft model:	Boeing 747-400F	Passengers:	0
Aircraft type:	Freighter aircraft		
Type of flight:	Scheduled flight	Injuries:	None
Phase of operation:	Takeoff		
Damage to aircraft:	Substantial	Lighting conditions:	Daylight

The flight and the incident

The flight was a scheduled freight flight from Amsterdam Airport Schiphol (EHAM) to Milan Malpensa (LIMC). When the flight crew selected gear up after takeoff the EICAS¹ generated the message "GEAR TILT" followed by "GEAR DISAGREE". The left-hand body gear door was not closed which was confirmed by the gear synoptic on the upper EICAS display. The flight crew requested Air Traffic Control (ATC) to abort the climb which was approved.

The flight crew performed the items on the non-normal checklist for "GEAR TILT" and "GEAR DISAGREE" but the situation did not change. An attempt to lower the gear and raise it again was not successful, the EICAS messages did not disappear. The flight crew decided to return to Amsterdam where an uneventful landing was made. At the platform broken seals were visible on the left-hand body gear, with damage to the landing gear doors and linkage corresponding to the gear/structure interface point. The shock strut was found fully compressed (inflation pressure was zero) and the tires did not contact the ground.

The airplane had been delivered to the operator in June 2005 and was about three months old.



Fully compressed shock strut with tires off the ground

¹ EICAS – Engine Indication and Crew Alerting System.

Investigation & Analysis

Boeing launched a repair team and a service engineer to support the operator with troubleshooting of the landing gear. The Boeing team reported that the damage was caused by over-extension of the left-hand body landing gear. During gear retraction, the tires of the over-extended left main body gear contacted and damaged the structure. During the incident landing the shock strut was fully compressed and the strut remained in the fully compressed situation.

Disassembly of the shock strut revealed that the following internal components were fractured/cracked:

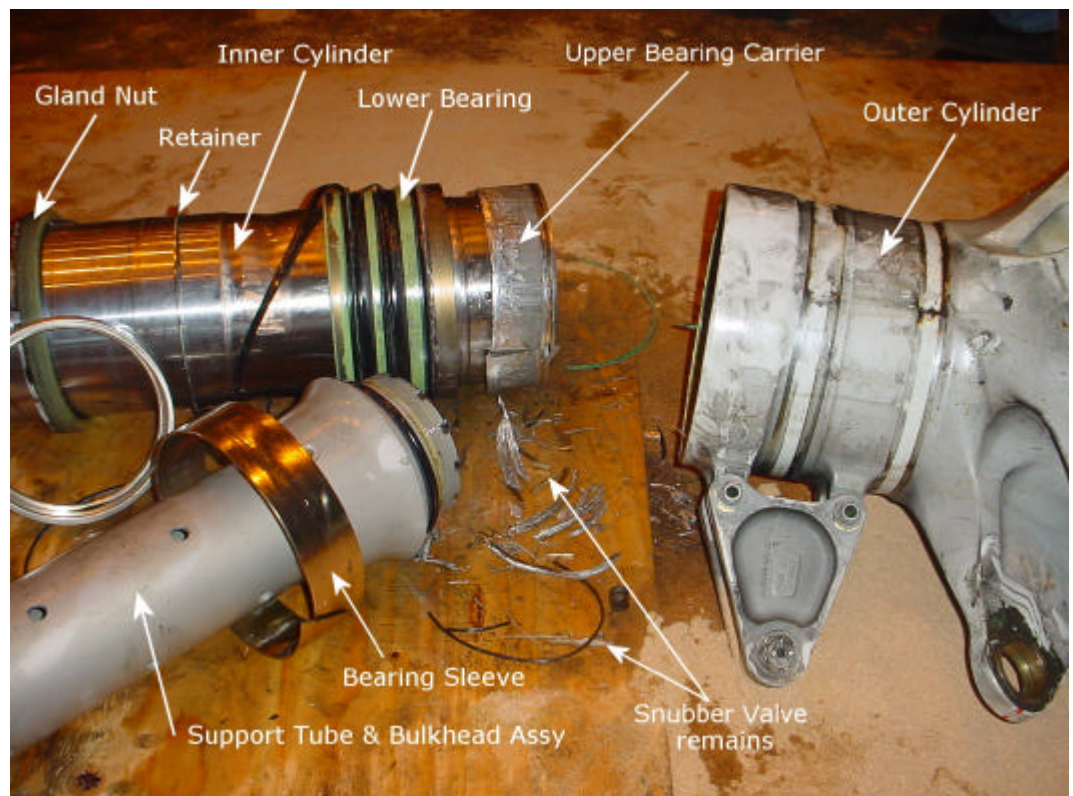
- Upper Bearing Carrier;
- Snubber Valve;
- Follower Tube.



Damaged structure

The upper bearing carrier, upper bearing sleeve, and snubber valve were found loose in the outer cylinder. The snubber valve was completely fractured in at least eight locations with the horizontal flange completely severed; the upper bearing carrier halves both were fractured near the lower relief; the follower tube had multiple cracks.

In addition, the inner cylinder was bent, and the upper bearing sleeve was damaged at multiple locations. The deformation to the inner cylinder was a result of the over-extension and was caused by short coupling of the cylinder upper barrel by the lower bearing during the incident landing.



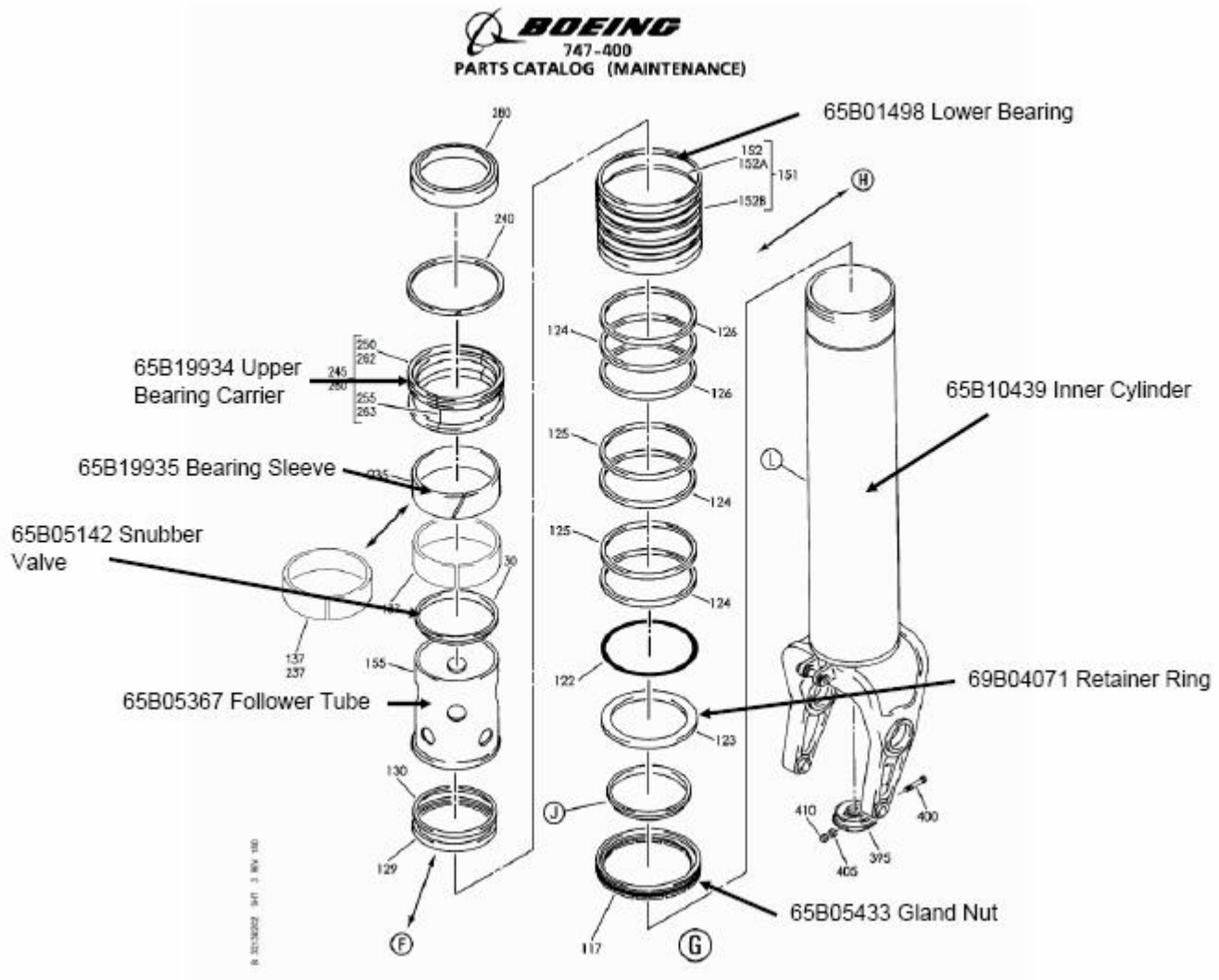
Damaged Parts

Over-extension of the shock strut occurred when the upper (bearing) carrier dislodged from the inner cylinder. Evidence of contact between the steering yoke assy and the outer cylinder indicates that the

shock strut extension was limited by the steering mechanism assy. Limited only by the steering mechanism assy the shock strut extended approximately 12 inches beyond maximum design extension.

Disassembly and investigation of the shock strut revealed that failure of the upper bearing carrier initiated the failure sequence of the shock strut internal component damage and subsequent over-extension.

Subsequent to the disassembly of the shock strut Boeing received a Notice Of Escapement (NOE) from the landing gear manufacturer advising that their supplier disclosed that a number of upper bearing carriers had not been properly heat treated and were delivered in the annealed condition. An electrical conductivity inspection was performed by Boeing on the two upper bearing carriers removed from aircraft JA01KZ. The inspection confirmed that both upper bearing carriers were annealed 2024 aluminum which agrees with the NOE from the part supplier. All upper bearing carriers with improper heat treatment were traced and the affected operators were informed by Boeing and were offered support to replace the parts.



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Note 1: In the weeks prior to the occurrence a total of sixteen gear-related messages appeared on EICAS: "GEAR MONITOR". Further information from the Central Maintenance Computer (CMC) revealed that the messages were related to a problem with the proximity switch of the left-hand body gear truck. The switch consists of a sensor and a target. According to Boeing the root cause of the messages was either an incorrect sensor/target gap or a problem with the target itself and has no relation with the occurrence in Amsterdam.

Note 2: This report has been published in English and Dutch language. If there are differences in interpretation the Dutch text prevails. The investigations in the USA were monitored by the National Transportation Safety Board (NTSB) on behalf of the Dutch Safety Board.