

# Investigation Report

1X002-06  
November 2011

## Identification

Type of Occurrence:	Accident
Date:	15 May 2006
Location:	Frankfurt / Main
Aircraft:	Transport aircraft
Manufacturer / Model:	Boeing / B747-400
Injuries to Persons:	No injuries
Damage:	Aircraft severely damaged
Other Damage:	None
Information Source:	Investigation by BFU

retraction of the nose landing gear. The nose landing gear immediately retracted and the airplane's bow came to rest on the tow truck standing beneath the airplane.

A loadmaster standing close to the nose landing gear saw how the forward landing gear doors hit the bar of the ground lock pin hard during the first test run. As the landing gear doors were moved the second time, bar and pin fell out of the nose wheel well.

The tow truck driver standing with his tow truck beneath the nose noticed the opening of the nose landing gear doors and the sudden plunge of a red pole. He had not observed the first test run.

The airplane suffered severe damage to the lower fuselage area.

The 238 passengers, 18 crew already aboard and the members of the ground crew working on the airplane did not suffer any injuries.

### Personnel Information

The following mechanics participated in the work carried out on the aircraft:

- Licensed Aircraft Mechanic with B2 qualification, age 47, working for the company since 1985
- Licensed Aircraft Mechanic with B1 qualification, age 45, working for the company since 1989
- Licensed Aircraft Electrician with B2 qualification, age 47, working for the company since 1996

## Factual Information

### History of the Flight

On 15 May 2006 a B747-400 was prepared at gate A23 at Frankfurt/Main Airport for the scheduled flight to New Delhi leaving at 1350 hrs<sup>1</sup>. The pre-flight inspection showed a hydraulic leakage in the wheel well of the left body gear. The hydraulic line had to be replaced. This repair made a functions and hydrostatic test necessary as defined in the Aircraft Maintenance Manual (AMM) task 32-33-06-024-001.

The test was to be carried out twice. The first test run showed no malfunctions. As the landing gear lever was moved a second time to the position "landing gear up", the Ground Lock Pin (GLP) including bar fell out of the nose wheel well once the nose landing gear doors were opened. The ground lock pin prevents the

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<sup>1</sup> All times local, unless otherwise stated

#### Aircraft Information

The aircraft was a B747-400 with the MSN 29871, manufactured in 2001 by Boeing, Seattle. On 25 January 2002 the Luftfahrt Bundesamt (LBA) (German civil aviation authority) issued a certificate of registration. Since then the aircraft has accumulated about 23,748 flight hours.

#### Flight Recorders

Cockpit voice recorder and flight data recorder data were not available.

#### Wreckage and Impact Information

The airplane was at gate A23 at Frankfurt Airport. The nose was on top of a tow truck. The fuselage's structure was severely damaged on a length of about 2.50 m. The tow truck's superstructure had penetrated the airplane's outer skin and thereby destroyed beams and stringers in this area. The tow truck suffered minor damage.

The nose landing gear had retracted completely and seemed to be undamaged.



Accident site

Photo: BFU

Ground lock pin including the 2-meter-long bar was found at right angles to the fuselage beneath the nose.

The operating lever at the lower part of the bar was slightly bent.

The bar was covered with a red heat-shrinking hose which showed heavy wear marks.

In order to take the aircraft to a hangar a substitute ground lock pin was used. Upon a subsequent attempt to insert the original ground lock pin in the drag brace hole the pin jammed and could only be inserted into the hole by about half its length.

During a function test of the GLP with bar used during hydraulic checks it was determined that the lever at the end of the bar which controls the safety pin was jammed in the pulled back position.

Ground lock pin including bar and drag brace were subject to further investigations.



Ground lock pin including bar

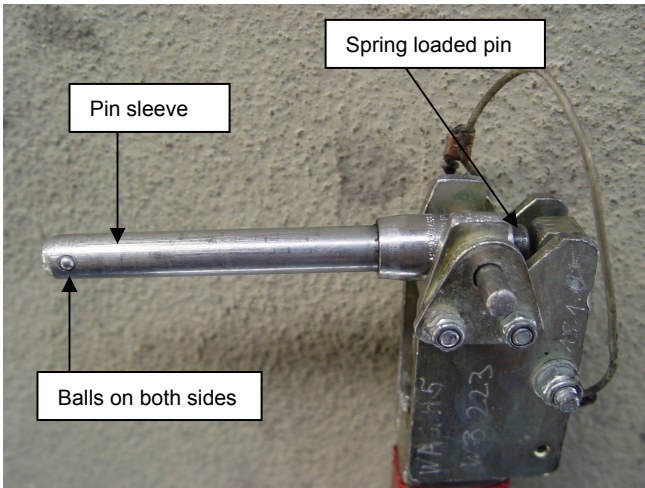
Foto: BFU

#### Additional Information

During the functions and hydrostatic test the hydraulic system No 1 is pressurised and then the landing-gear control handle moved into the "gear up" position. Thus the landing gear's hydraulic system is pressurised and the forward nose landing gear doors open and close as they would during a regular retraction of the nose landing gear. The ground lock pin's task is to prevent the gear from retracting while on the ground. Leakage tightness is being checked during the hydraulic system's pressurisation.

The bar used for the insertion of the ground lock pin was developed by the maintenance organisation during the 70s and has been in use ever since. There were neither overhaul or maintenance procedures nor working orders for the use of this tool.

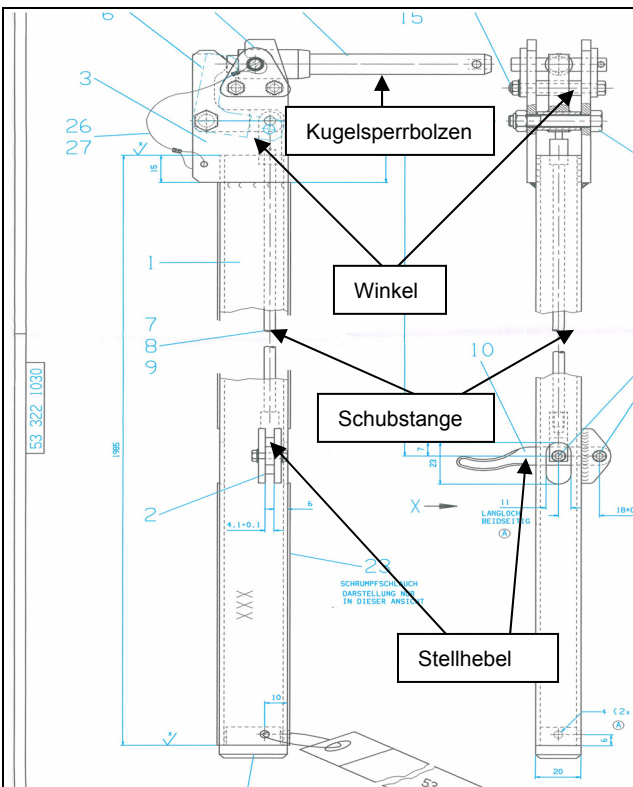
The ground lock pin from Boeing is a ground lock pin intended for this aircraft type to prevent the nose landing gear from retraction while on the ground.



Ground Lock Pin

Foto: BFU

The ground lock pin was attached to an approximately 2 m long rectangular tube (20 mm x 30 mm) from 2 mm thick galvanized steel.



Detail drawing of the ground lock pin including bar  
Source: Maintenance Organisation

To insert the pin the operating lever at the end of the bar is pulled back so that the two balls are pulled inside and the pin can be inserted in the drag brace hole. Once the pin is fully inserted in the drag brace hole, the operating lever is released. The spring loaded pin pushes the two balls at the pin sleeve end

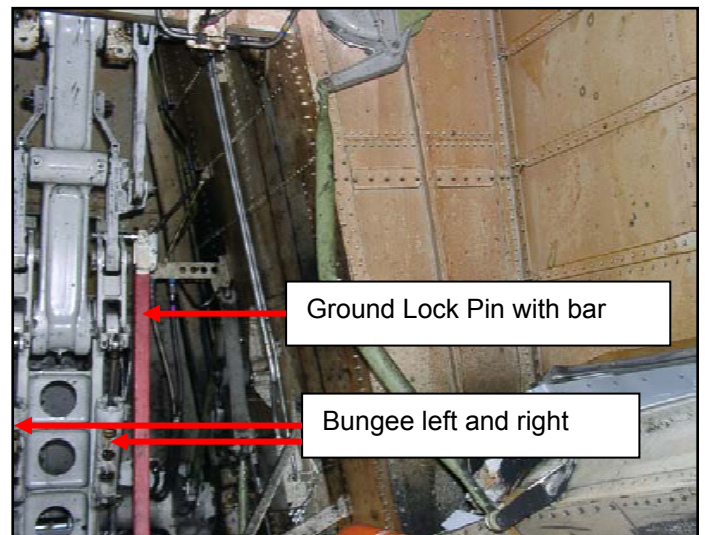
outward and therefore retains the pin in the drag brace hole.

Tests and Research

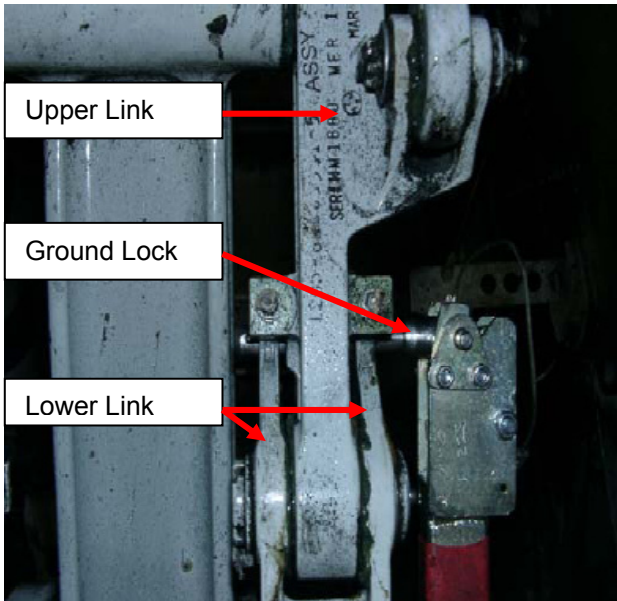
On behalf of the BFU the following components were examined at an independent laboratory of Lufthansa Technik AG: ground lock pin uncloding bar, upper link assy, P/N 65B05391-5, lower link assy, P/N 65B05396-1 and the bungee assys, left/right, P/N 65B05398-8.

The examinations were carried out using macroscopic means like magnifier, stereo microscope and camera. The components were examined for damage, unusual signs of wear and in case of the ground lock pin including bar functionality. The results were documented.

The expert opinion came to the following conclusions (excerpt of text and photos):

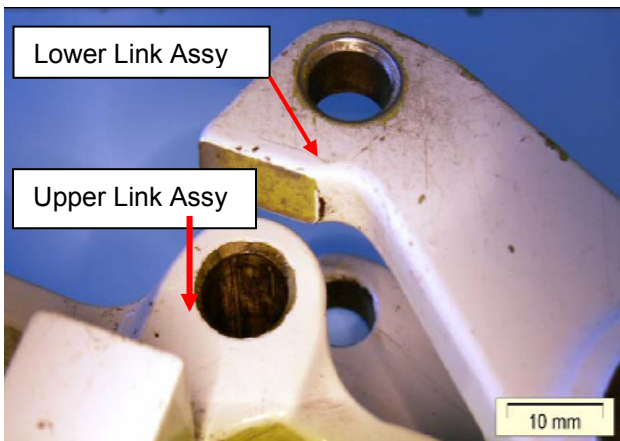


Assy area of the examined components  
Photo: Lufthansa Technik AG, Hamburg



Detail views of the component assembly

1. Upper & Lower Link Assy



Hole for the GLP on lower and upper link assy

The components do not show any damage relevant to the occurrence. The minor damages on the surface occurred during the occurrence. Positioning and unintended extraction of the ground lock pin did not cause any damage connected with the occurrence.

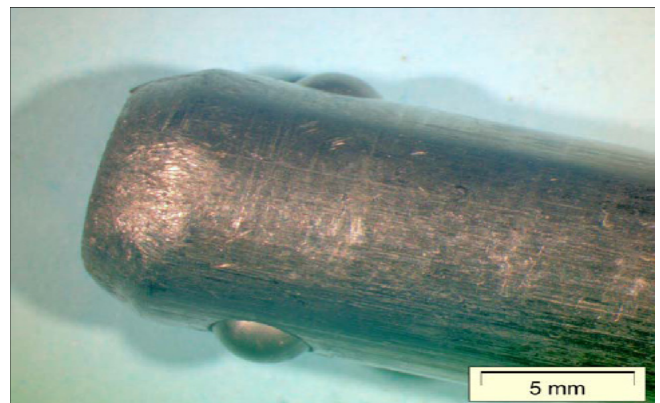
2. Bungee Assys Right and Left:



Bungee Assys Right and Left:

The components do not show any damage which could be attributed to intense contact with the bar during the occurrence.

3. Ground Lock Pin

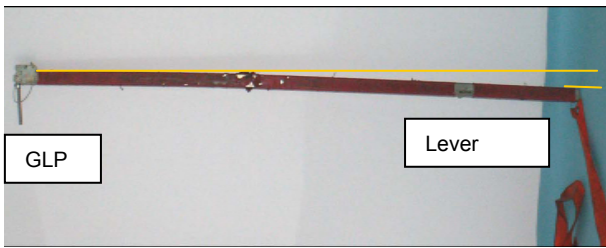


Ground Lock Pin

Photos (6): Lufthansa Technik AG, Hamburg

The GLP functions properly and showed regular signs of wear. The safety globes can be correctly locked and unlocked and do not show any damage. The ground lock pin can be properly inserted into and extracted from the disassembled upper and lower assys.

#### 4. Safety Bar

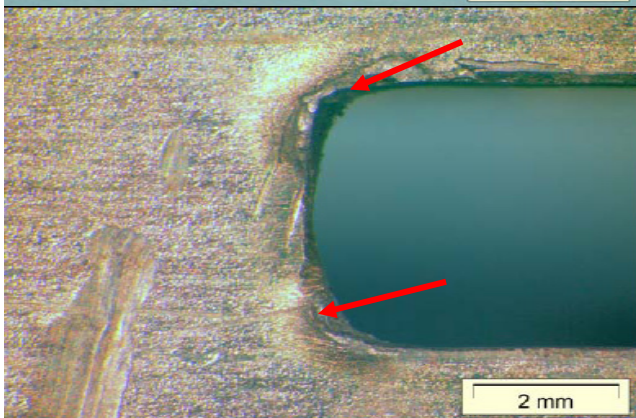
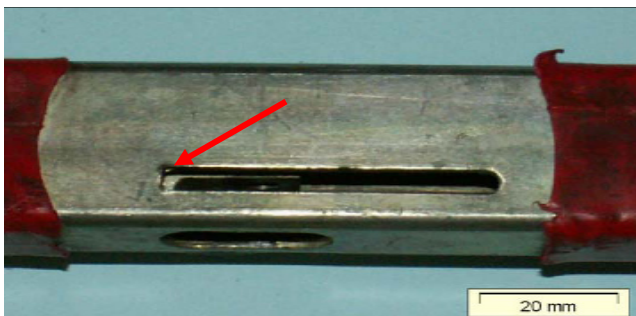


Safety bar

The safety bar is bent and shows damage on the total length of the plastic hose. The ground lock pin locking/unlocking lever is bent and jammed in the unlocking position (safety globes loose). It can only be moved by force (safety globes locked). This condition had existed for an extended period of time as indicated by wear marks on the lever and on the elongated hole in the rectangular tube.

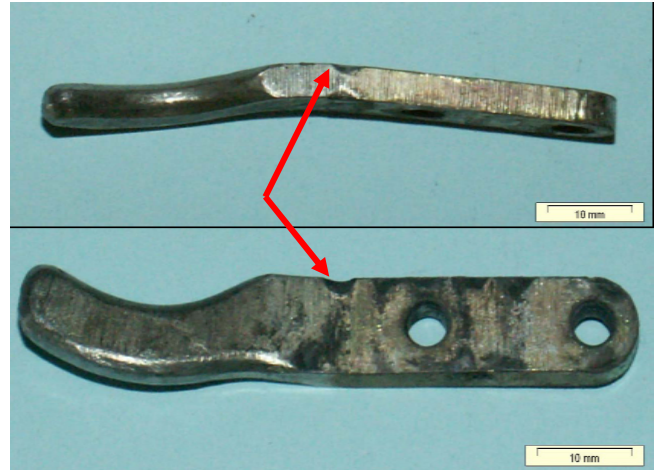


Guidance of the operating lever in the safety bar



Traces of wear

Detail views show the catch of the lever when the GLP is released and the safety balls are locked. Clearly visible are deformations which are caused during unlocking of the lever. The lever is bent.



Disassembled operating lever of the safety bar

Photos (6): Lufthansa Technik AG, Hamburg

#### Analysis

Examination of the safety bar and the GLP showed that long-time use caused abrasive wear so that a correct functionality of GLP including bar was no longer given.

Due to the missing overhaul and maintenance procedures this tool was used in defective condition.

When the landing gear doors were activated the safety bar became locked between them and bent towards the centre, the unlocked GLP could be removed from its position.

If the safety balls had been locked, removal of the ground lock pin, without leaving traces, would not have been possible. Such traces were not found on the examined components.

There were traces, however, showing that the lever which locks and unlocks the GLP had been bent long before the occurrence and had jammed in the unlocked position.

#### Conclusions

The cause for the retraction of the nose landing gear was a malfunction in the lever mechanism within the safety bar in connection with the GLP. Hence the GLP remained unlocked in the inserted position.

## Safety Recommendation

Immediately after the occurrence the BFU has issued the following safety recommendations:

Recommendation no.: 06/2006

Lufthansa Technik AG should principally only use Boeing work equipment. In case modified or self-made work equipment is used a similarly high safety level is to be ensured.

Furthermore, a work order should be established how the respective work equipment is to be used.

## Implemented Safety Measures

Implementing Safety Recommendation 02/2006, the operator involved has issued an instruction stating that the short original pin is to be used exclusively.

Additionally, the construction of a new insertion aid was commissioned which will take into account the findings of the laboratory examination of the bar.

Investigator in charge Müller