

AIRCRAFT INCIDENT REPORT

**Report by the Danish Accident Investigation Board into the
incident to Boeing 757, TF-FIJ at Kastrup Airport, Denmark on 28
June 2001**

M-04001/AIG-09



The aim of aircraft accident investigation is solely to identify mistakes and/or deficiencies capable of undermining flight safety, whether contributing factors or not to the accident in question, and to prevent further occurrences of similar cause(s). It is not up to the investigation authority to determine or divide blame or responsibility. This report shall not be used for purposes other than preventive ones.

FINAL REPORT

HCL 40/01	Accident	
Aircraft type:	Boeing 757-208	Aircraft registration: TF-FIJ
Engines:	2 Rolls Royce RB211-535E4	Type of flight: Scheduled, IFR
Crew:	8 – no injuries	Passengers: 182 – no injuries
Place of occurrence:	Copenhagen Airport, Kastrup (EKCH)	Dato og tidspunkt: 28.06.2001 at 2001 hrs UTC

All times in this report are UTC.

Synopsis

The CPH Operation Centre (OC) in Copenhagen Airport notified the Danish Aircraft Accident Investigation Board (AAIB DK) on June 28th 2001 at 2130 hrs.

The Danish Civil Aviation Administration (SLV), the International Civil Aviation Organization (ICAO), the National Transportation Safety Board (NTSB), and the Icelandic Aircraft Accident Investigation Board (AAIB Iceland) were notified about the accident on June 29th 2001.

The aircraft was parked at a gate in EKCH when the accident occurred.

The boarding of the aircraft was almost completed when the right hand main landing gear's truck beam failed. As the right hand truck beam failed, the aircraft's right side rested on the shock strut instead of on the wheels. The photo below shows the failed truck beam and the aircraft resting on the shock strut.



Conclusion

After the accident, Boeing issued SB 757-32A0135 revision 2, which summarized events with failed truck beams. The SB revision 2 provided for inspection of previously overhauled gears, so it was established from the records that truck beams had been correctly overhauled.

Danish regulations state that maintenance programs must be based on the manufacturers recommendations or on Danish AD, which ensures that Danish operators are obliged to follow the SB issued by Boeing.

Therefore, the Danish AAIB considers the above actions adequate for addressing this or similar occurrences related to the SRP concerning truck beams for the B757.

1. Factual information

History of flight

The aircraft arrived at Copenhagen Airport, Kastrup (EKCH) on June 28th at 1905 hrs from Reykjavik, Iceland. The landing and the taxiing to the gate, where the aircraft was parked, were normal and without any remarks.

The next flight was scheduled to depart EKCH at 2120 hrs with Reykjavik as destination.

The cockpit and cabin crew boarded the aircraft in order to prepare the flight.

Fuel and cargo had already been loaded on board the aircraft and the boarding of the passengers had begun.

When the boarding of the aircraft was almost completed, the right hand main landing gear's truck beam failed. As the right hand truck beam failed, the aircraft's right side rested on the shock strut instead of on the wheels.

The passengers were disembarked and the flight was cancelled.

Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	0	0	0
Serious	0	0	0
Minor/None	8	182	

Damage to aircraft

The failure of the truck beam is considered as being substantially damage to the aircraft.

Other damage

The pavement was damaged where the right hand main gear's shock strut had been in contact with the ground.

Aircraft information

General data

Manufacturer:	The Boeing Company
Aircraft type/model:	B757-208
Registration:	TF-FIJ
Line number:	368
Airframe total flight hours:	46.781
Airframe total cycles:	12.774

The aircraft held a valid certificate of airworthiness and registration at the time of the accident.

Mass and balance

The mass and centre of gravity of the aircraft were within the limits at the time of the accident.

Defects, errors, and deficiencies

Except from the failed truck beam, the Danish AAIB did not find any defects, errors or deficiencies.

Flight recorders

The aircraft was equipped with a **D**igital **F**light **D**ata **R**ecorder (DFDR) and a **C**ockpit **V**oice **R**ecorder (CVR).

It was decided not to make readout of the CVR.

Readout of the DFDR was made with assistance of the UK AAIB.

The readout was of a good quality and the result was used in order to verify, if any records of forces exceeded the limitations of the aircraft.

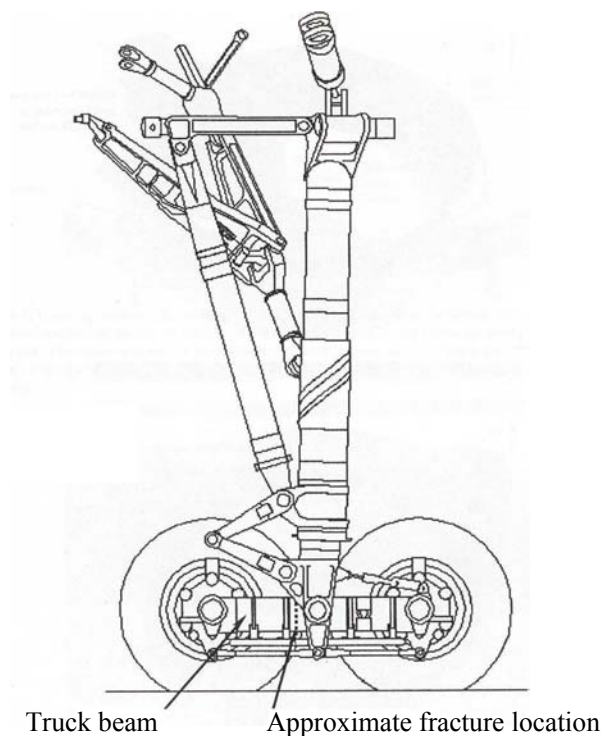
The readout did not reveal any exceeding of limitations or records of forces in the DFDR memory, which would have contributed to the accident.

Landing gear

The aircraft is fitted with a tricycle retractable landing gear consisting of a nose gear and two main gears.

The affected gear was the right hand main landing gear.

On the drawing below, a main landing gear assembly of a B-757 is shown.



The part of the main landing gear assembly that failed was the truck beam assembly.

The main landing gear assembly is life limited to 103.000 cycles. Within the 103.000 cycles in the maintenance program, intervals between inspections and overhaul of different parts of the main landing gear assembly are specified.

The operator's maintenance program

The operator used an approved maintenance program for the aircraft.

Until May 2001, the operator chose to set the time between overhauls for the complete main landing gear assembly, including the truck beam assembly, at 7.500 cycles or approximately 5 years and 7 months.

After May 2001, the operator implemented an altered maintenance program for main landing gear assembly, so the time between overhauls was extended to 8 years with an overhaul of the truck beam assembly at every fourth year. By doing this, the operator followed a time limitation between overhauls used by the majority of operators of the B757.

The main landing gear assembly was latest overhauled 09.09.1997. At the overhaul, the failed truck beam assembly was installed on the aircraft. From the time installed on the aircraft and until the accident took place, no remarks were made concerning the truck beam assembly at inspections or exceeding of limitations at landings.

The next overhaul of the truck beam assembly was scheduled for September 2001, according to the new maintenance program.

Danish regulations for Civil Aviation (BL)

In the Danish Regulation for Civil Aviation, BL 1-1 covering airworthiness and the continuous airworthiness, the following is stated:

“ 4.2.2.2 A maintenance program that has been designed for a type of aircraft not previously operated by that operator, must be based either on the “Maintenance Review Board” report or recommendations made by the manufacturer based on the report, e.g. Maintenance Planning Documents. The program must at any time be based on the manufacturer's recommendations). “

Airworthiness Directives or Service Bulletins

Boeing issued a Service Bulletin SB 757-32A0135R1, 30 November 2000, and SB 757-32A0135R2, 16 May 2002 concerning the truck beam, which referred to the Federal Aviation Administration Airworthiness Directive AD 2001-09-01.

SB 757-32A0135R1 was effective at the time of the accident, and specified a drainage and internal protective finish inspection for the airplane TF-FIJ. The inspection is recurring at every six months. This inspection was performed on the failed truck beam at 18.01.2001 without remarks, although the truck beam was overhauled on 09.09.1997, which was terminating action for SB 757-32A0135R1. Following this event, SB 757-32A0135R2 was released on 16 May 2002 to make sure that records for overhauled

truck beams showed that the overhaul was done correctly.

The SB 757-32-A0135R2 and AD inspections are terminated when the truck beams are overhauled to 757 Component Maintenance Manual (CMM) sections 32-11-56 and 32-00-05.

General data for the truck beam

Truck beam assembly:

Part number:	161N1611-5
Serial number:	342MH51
Material:	4340M Steel Forging
Cycles since new:	10.930
Cycles since last overhaul:	4.982

Examination of the failed truck beam

When disassembling the landing gear in order to get hold of the truck beam for further examination, it was noticed that the cosmoline (a corrosion inhibiting compound) was flaking off the inner diameter of the beam. At some areas, the primer was missing and the presence of corrosion pitting could be identified.



A thoroughly examination of the fracture of the failed truck beam was conducted at an external institute.

The following are extracts of the institute's report.

The examination of the truck beam was done visually and in electron microscope and some samples were cut out for metallographic examination and for tensile testing.

The conclusion made by the institute was as follows:

“ *The fracture in the truck beam was a fast fracture initiated by a 39 mm long crack located at the beam bottom.*

The pre-existing crack in the beam is caused by hydrogen induced stress corrosion, starting from the beam's inside. It is the corrosion processes inside the truck beam that give rise to a hydrogen generation and some of this hydrogen (atomic) will diffuse into the steel ”

It was decided by the Danish AAIB to postpone a more detailed examination of the corrosion or the corrosion protection inside the truck beam until further information about the truck beam and its production was collected.

Boeing's examination of the fractured truck beam

One part of the fractured truck beam was shipped to Boeing. Boeing conducted a thorough examination of the received fracture. The examination at Boeing also included an examination of the protective finish.

Boeing made the following conclusion based on their findings:

“ *Metallurgical analyses have concluded that the fracture mode was due to Stress Corrosion Cracking (SCC). A thorough examination of the finishes on the ID showed that the Ti-Cad plating was thin or non-existent, primer adhesion on ID Surface was poor and that pivot bore rework did not receive the requisite shot peening, LHE (low hydrogen embrittlement) cadmium plating or primer prior to bushing installation. Chemical analyses did not produce any evidence to indicate that any foreign or external substances, solutions, or compounds had contributed to the deterioration of the protective finishes. Our investigation concluded that the subject truck beam fracture occurred due to improper overhaul. The truck beam did not appear to have been stripped of the original suspect Cad-Ti plating prior to refinishing per the Boeing CMM 32-11-56. Commonly, the enamel and primer layers are stripped using plastic media blasting (PMB) per SOPM 20-30- 02 (Standard Overhaul Practices Manual). Removal of organic finishes by PMB damages chemical conversion coatings and can remove plating. Boeing CMM's & SOPM's provide instructions for overhaul and there was no option for retaining original Ti-Cad plating. The result, in this case, was inadequate-to-no cadmium protection and poor primer adhesion to the substrate. Subsequent loss of these finishes led to premature and severe corrosion in service, and eventual fracture. “*

Additional information about truck beams for the B757

Service Related Problems (SRP) with truck beam used for B757

Before this occurrence took place, two other occurrences with fractured truck beams occurred. An investigation into the determination of root cause for those two fractures disclosed a service related problem with truck beams for the B757.

The disclosures lead to a thorough review and audit of the production procedures of the truck beam. The review and audit revealed that new airplane production parts delivered on airplanes prior to line position 630 did suffer from a non-uniform plating process, which resulted in Cadmium plating with unknown quality. During the early period of the production, various anomalies occurred in the plating process at different points in time. Some of the reasons were as follows; the current output at the anode was considerably lower than the plating tank rectifier at certain settings, plating thickness at the bottom of the truck was 0.0003 to 0.0004 inches thinner than at the top due to the anode design. In some cases, the plating time was insufficient, and Cadmium thickness measurements were not accurate if taken at elevated temperatures. Furthermore, only one coat of primer was being applied afterwards.

By production line position 630 and on, parts were produced with the Cadmium plating meeting drawing requirements and with the required two coats of primer.

The above was recognized as a service related problem. To address this SRP, Boeing released SB 757-32A0135, which lead to the release of AD 2001-09-01 by the Federal Aviation Administration (FAA). The intention of the Service Bulletin/Airworthiness Directive inspections was to detect any deteriorating primer or Ti-cad plating on original production parts. If finish deterioration or corrosion is found, it is specified that a complete removal and replacement of finishes per the CMM 32-11-56 at overhaul is necessary. This means that at overhaul of trucks it must be completely stripped, inspected and refinished per the CMM (Component Maintenance Manual). These actions will terminate action for the AD inspection requirement.

2. Analysis

During disassembling of the truck beam after the accident, it was observed that corrosion could have been a contributing factor to the accident. At the laboratory examination conducted on behalf of the Danish AAIB, this observation was confirmed.

During the above actions, one part of the truck beam was shipped to Boeing for use in their examination of the failed part. The conclusion made by Boeing was similar to the one made by the Danish AAIB. Corrosion had been a contributing factor to the accident. Furthermore, Boeing made an investigation into why corrosion was present. The investigation disclosed that this occurrence could be compared with two other occurrences where the truck beams had failed. Boeing identified this as a Service Related Problem (SRP) and a Service Bulletin (SB 757-32A0135) had been published to address this SRP. FAA had issued an AD-note (AD 2001-09-01), which also addressed the SRP.

In this accident another factor differed from the two other occurrences. The truck beam had been overhauled in this accident. The truck beams in the two other occurrences had not been overhauled since manufacturing. Overhauling the component eliminated the SB and AD addressing the SRP.

During the investigation made by Boeing, they conducted an audit of the service provider of overhauls. At this audit, Boeing noted some findings about the overhaul procedures. These findings showed that overhaul of the truck beams were improper and did not follow the CMM. The improper overhaul resulted

in an inadequate corrosion protection of the inner diameter of the truck beams, which lead to the occurrence. The overhaul procedures were corrected after the audit.

3. Conclusion

A Service Related Problem (SRP) concerning the manufacturing of truck beams for the use of B757 was identified. Boeing and FAA issued respectively a SB and an AD addressing this SRP. The intentions were that an overhaul of the truck beams was to correct the non-uniform plating process from the manufacturing of the truck beams. Overhauls therefore eliminate the needs for the SB and AD. An improper overhaul resulted in a continuation of the SRP leading to the accident.

By identifying this, Boeing issued a revision 2 of the SB 757-32A0135 dated 16 May 2002, which summarized the events with truck beams. The SB revision 2 provided for inspection of previously overhauled gears, so it was established from the records that truck beams had been correctly overhauled.

Danish regulations states that maintenance programs must be based on manufacturers recommendations or on Danish AD, which ensures that Danish operators are obliged to follow the SB issued by Boeing.

Therefore, the Danish AAIB considers the above actions adequate for addressing this and/or similar occurrences related to the SRP concerning truck beams for the B757.

4. Safety recommendations

None.