Boeing 767-200, Air New Zealand ZK-NBF, Los Angeles International Airport, September 6, 1993

Micro-summary: The right main landing gear collapsed after the airplane was loaded and was ready for taxi.

Event Date: 1993-09-06 at 2135 PDT

Investigative Body: Transport Accident Investigation Commission (TAIC), New Zealand

Investigative Body's Web Site: http://www.taic.org.nz/

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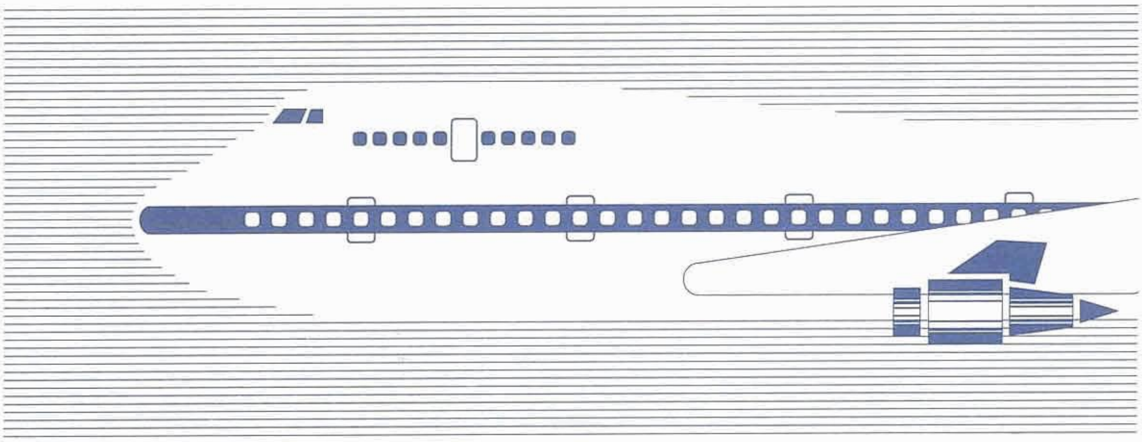


AVIATION OCCURRENCE REPORT

NO. 93-011

BOEING 767-200

ZK-NBF

LOS ANGELES INTERNATIONAL AIRPORT

6 SEPTEMBER 1993

TRANSPORT ACCIDENT INVESTIGATION COMMISSION

WELLINGTON • NEW ZEALAND

The Transport Accident Investigation Commission is an independent Crown agency established under its own Act of Parliament. The Commission conducts transport accident and incident investigations with the principal purpose of determining their causes and contributing factors with a view to avoiding similar occurrences in the future. The Commission seeks to identify safety deficiencies in the course of its investigations and make recommendations designed to eliminate or reduce such safety deficiencies.

No 93-011

Boeing 767-200

ZK-NBF

Los Angeles International Airport

6 September 1993

ABSTRACT

This report relates to the failure of the right rear main undercarriage of Boeing 767-200 aircraft, registration ZK-NBF, at Los Angeles Airport on 6 September 1993. The safety issues discussed are the effectiveness of post-runway excursion inspections of the undercarriage, the inspection of main undercarriage assemblies which had already been involved in runway excursion incidents and the marking for identification of main undercarriage axles.

TRANSPORT ACCIDENT INVESTIGATION COMMISSION

AIRCRAFT ACCIDENT REPORT NO. 93-011

Aircraft Type, Serial Number and Registration:	Boeing 767-200, 22681, ZK-NBF
Number and Type of Engines:	Two Pratt and Whitney JT9D-7R4D
Year of Manufacture:	1982
Date and Time:	2135 hours, 6 September 1993*
Location:	Gate 104, Los Angeles Airport Latitude: 33°56.4' N Longitude: 118°24.5' W
Type of Flight:	Scheduled Air Transport
Persons on Board:	Crew: 9 Passengers: 195
Injuries:	Crew: Nil Passengers: Nil
Nature of Damage:	Substantial
Pilot in Command's Licence:	Air Transport Pilot Licence (Aeroplane)
Pilot in Command's Age:	45
Pilot in Command's Total Flying Experience:	9500 hours 1000 on type
Information Sources:	Operator's engineering report, manufacturer's metallurgy report and IIC's examination of components
Investigator in Charge:	Mr R Chippindale

*All times in this report are Pacific Daylight Time (UTC-19 hours)

1. NARRATIVE

1.1 The aircraft ZK-NBF was scheduled to depart, as Air New Zealand Flight NZ 55 from Los Angeles to Honolulu, at 2130 hours on 6 September 1993.

1.2 Approximately 10 minutes prior to departure, just after the Air Traffic Control clearance for the flight had been obtained and the loading of passengers had been completed, the aircraft lurched and a bang was heard by the occupants.

1.3 An investigation revealed that the rear axle (part number 161T1138-4, serial number CPTO166AT) of the right main undercarriage assembly (part number 161T0000-14, serial number 8154) had fractured adjacent to the rear outboard (number eight) wheel. The axle was encased in a sleeve in that area. (See Figure 1).

1.4 Although the axle was vibro-etched with the part and serial number there was no visible evidence of this

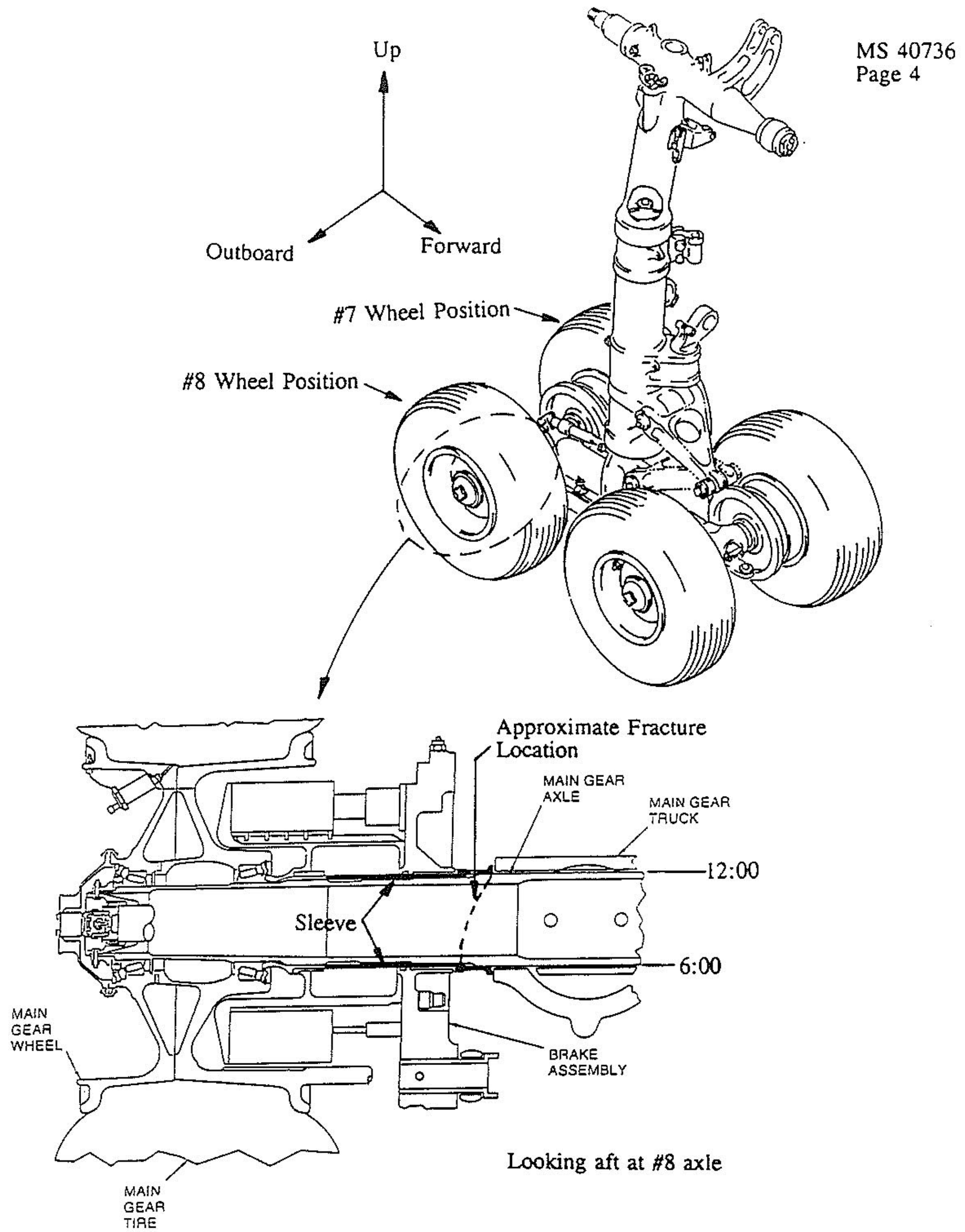
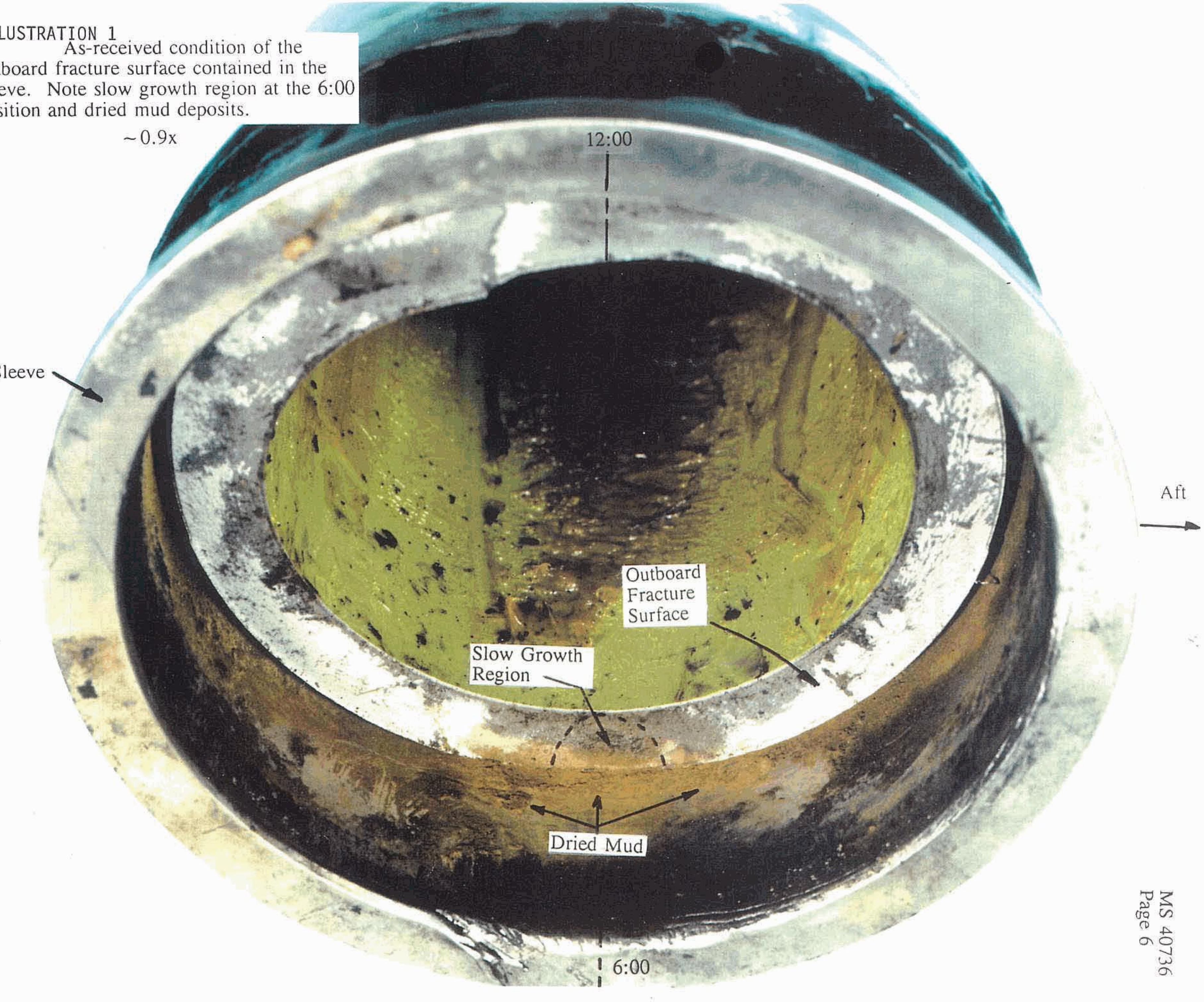


Figure 1: Illustrations depicting the location of the fracture through the #8 axle on the right hand main landing gear assembly of the model 767 airplane.

ILLUSTRATION 1
As-received condition of the outboard fracture surface contained in the sleeve. Note slow growth region at the 6:00 position and dried mud deposits.

~0.9x



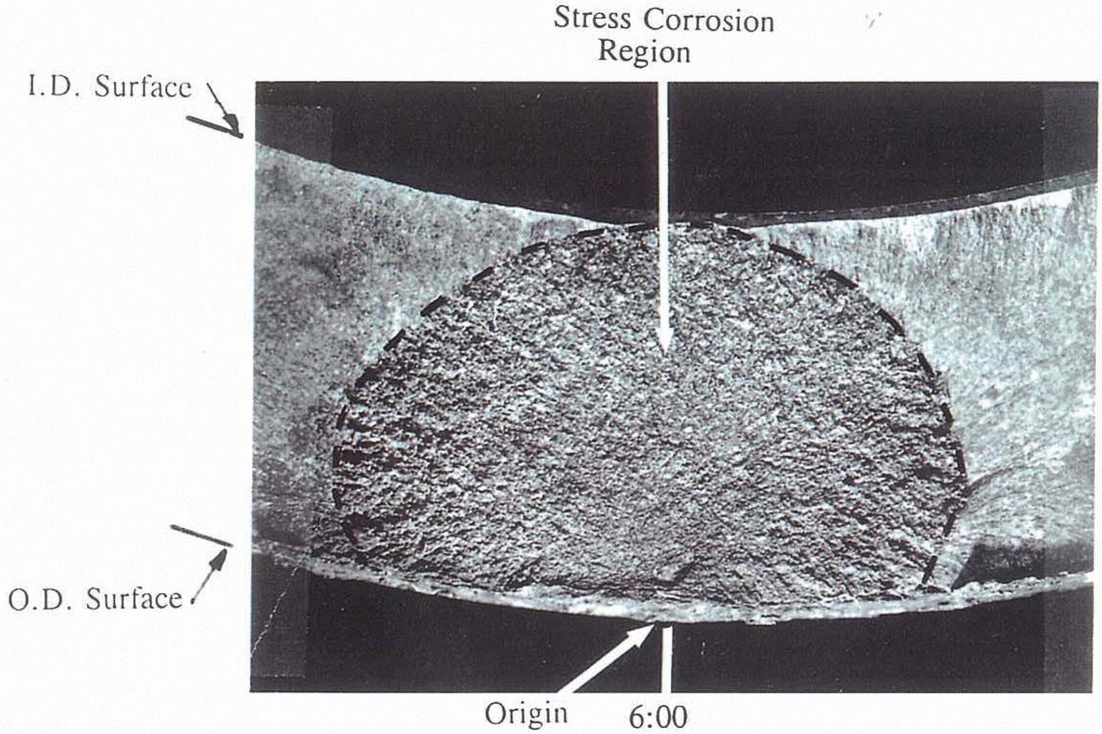


ILLUSTRATION 2 ~4x

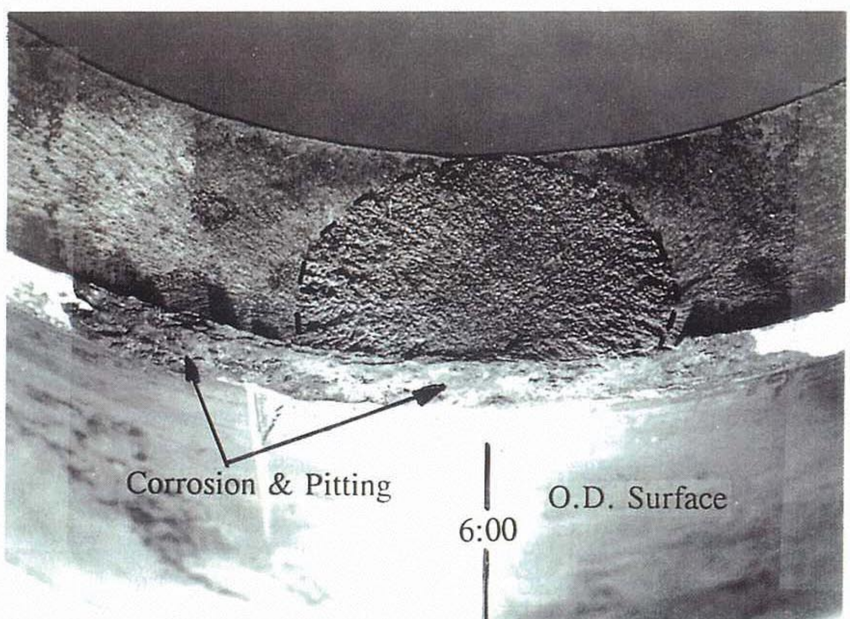


ILLUSTRATION 3 ~1.3x

Photographs of the outboard side fracture surface showing the stress corrosion cracking region at the 6:00 position, and the corrosion/pitting on the O.D. surface of the axle.

or any other identification marks on the axle which failed as the numbers had been covered, subsequently by the protective coatings applied to the component.

1.5 The aircraft was returned to service after the following components were replaced:

Right main undercarriage truck assembly,
Compensating torque rods,
Brake torque link pin,
Numbers 7 and 8 main undercarriage axle assemblies, and
Number 8 wheel brake assembly.

1.6 The portion of the right main undercarriage rear axle which had remained in the truck was removed in Auckland and this together with the separated portion was shipped to the manufacturer's laboratory for a metallurgical report.

1.7 A visual inspection of the fracture area while the assembly was in Auckland revealed that a quantity of mud had become trapped outside the axle near the point of origin of the failure and there was no apparent evidence of the protective grease which was intended to be applied to the axle in that area during the assembly of the components. (See Illustration 1).

1.8 The failure initiated from a pit in an area of corrosion on the outer face of the axle on its lower surface beneath the sleeve which surrounded it at this point.

1.9 The maintenance records showed that the main undercarriage, serial number 8154, had not been overhauled. It had completed 29,123 hours in service and 9297 cycles in that time. It had been involved in a runway excursion accident on 9 March 1991 while fitted to another B767-200 aircraft, ZK-NBC. In the course of that mishap it had become buried in mud.

1.10 Following the accident in March 1991 the main undercarriage had undergone the post-mishap checks required in the Boeing Maintenance Manual (page 05-51-01) and had been returned to service on ZK-NBC on 26 March 1991. On 30 October 1991 it was removed from ZK-NBC and fitted to ZK-NBF on which it had remained in service. It had been removed for a corrosion inspection in accordance with the operator's service bulletin, SB 767 3211-01034 Rev-2 on 26 May 1992 and was refitted on 30 May 1992.

1.11 A sample of the soil and vegetation present in the undercarriage axle assembly was compared with a sample taken from the accident site in Fiji on 14 September 1993. The results were inconclusive but did not eliminate the possibility that the samples were related. There were no major differences between the samples in the major element compositions and the differences in the trace elements were attributable to metal corrosion producing higher values of copper, zinc, cadmium and nickel.

1.12 The axle failure resulted from a ductile fracture propagating from a pre-existing crack, which had resulted from stress corrosion, through the thickness of the axle wall at the time of final separation. The pre-existing stress corrosion crack formed a semicircular pattern with a base of 23 mm (0.9 inches). (See Illustrations 2 and 3).

1.13 The point of origin was in a corrosion pit adjacent to a quantity of soil and vegetable matter on the underside of the axle. This foreign matter was trapped in an annular void between the tubular axle and the sleeve fitted to the axle outwards from the point at which it emerged from the main undercarriage truck.

1.14 Metallographic cross sections through the origin of the stress corrosion region showed pits into the outer surface of the axle up to 0.055 inches in depth.

1.15 At the time of the failure the aircraft's weight was 145,065 kg, the maximum certificated take-off weight being 151,950 kg. The maximum taxiing weight approved by the manufacturer for a Boeing 767 aircraft fitted with the -4 axle was 163,719 kg.

1.16 There was evidence of dried grease in the foreign material recovered from the area in which the axle failed.

1.17 Spectrochemical analysis verified the axle material was 4340M steel and that its heat treated strength was 53.7 to 54.1 Rc.

1.18 The relevant drawing required the component to be manufactured from 4340M steel heat treated to between 275 and 300 ksi (52 to 55 Rc).

2. FINDINGS

2.1 The damage caused by the failure of the axle was confined to components of the adjacent undercarriage assembly.

2.2 The axle which failed had been involved in a runway excursion accident in which it became buried in mud.

2.3 The components of the main undercarriage had been inspected and serviced in accordance with the manufacturer's instructions prior to it being returned to service.

2.4 The inspection called for by the manufacturer did not require the axle to be removed from its parent truck or for the sleeves to be removed from the axle.

2.5 Mud had penetrated into the void between the axle and its sleeves and between the mating faces of the axle and the truck.

2.6 Surface corrosion pits had developed adjacent to the areas in which the mud had become trapped.

2.7 Stress corrosion cracking had initiated in the area of corrosion pits and one of the stress corrosion cracks had propagated through the thickness of the axle wall prior to the axle's ultimate failure.

2.8 The material from which the axle was manufactured and the processing of that material was to the manufacturer's specifications.

2.9 The extent of the post-runway excursion inspection of the main undercarriage assembly, specified by the manufacturer, was not sufficient to ensure that the results of such an excursion did not jeopardise the axles' potential to remain serviceable to the limit of their specified life.

2.10 The axle had been identified by part and serial number in the manner specified by the aircraft manufacturer.

2.11 The identification of the axle was made difficult by the serial number being subsequently covered over by protective treatment.

2.12 There was a need for other axles which may have been involved in runway excursion incidents onto unprepared surfaces to be dismantled and inspected for evidence of corrosion.

2.13 It would be prudent for the manufacturer to require any corroded areas of such axles to be checked by appropriate non-destructive tests for any evidence of cracking.

3. SAFETY RECOMMENDATIONS

3.1 As a result of this investigation it was recommended to the Boeing Commercial Airplane Company that they:

> Review the current Maintenance Manual Inspections required for Boeing 767 undercarriage components which have been involved in "hard landings or high drag/side load landing conditions" on unprepared surfaces with a view to ensure the inspections provide for the removal of any foreign matter which may have become lodged between components of the assemblies (064/93), and

> Consider the need to advise any B767 operator who has main undercarriage assemblies in service that have been involved in runway excursions onto unprepared surfaces to dismantle such assemblies and test them for evidence of corrosion and/or cracking (065/93), and

> Prepare and distribute a letter or bulletin to advise operators how to locate the part and serial number on B767 main undercarriage axles (066/93), and

> Take the appropriate steps to ensure the main undercarriage axle part and serial number remains accessi-

ble visually after all protective processes have been completed (067/93).

The Boeing Commercial Airplane Group responded:

"(064/93) Maintenance Manual Chapter 05-51-01 will be revised to read, "any component (landing gear, engine nacelle, etc) which becomes immersed or buried in a contaminant (mud, salt water, etc) should be disassembled, examined and, if necessary, cleaned."

(065/93) Boeing is reviewing the service history of all models for reports of runway excursions, and is actively considering advising operators of aircraft that have been involved in runway excursions to inspect for evidence of corrosion and/or cracking.

(066/93) Boeing is reviewing with the vendor the suitability of the present means of identification of these components.

(067/93) Boeing is currently investigating ways of improving part number visibility without sacrificing corrosion protection. The current system of plating, priming, and painting is essential for corrosion protection and has a higher priority than part number legibility."

9 February 1994

M F Dunphy
Chief Commssioner

GLOSSARY OF ABBREVIATIONS USED IN THIS REPORT

IIC	Investigator in Charge
kg	Kilograms
ksi	Thousands of pounds per square inch
mm	Millimetres
Rc	Rockwell Scale of Hardness
Rev	Revision
UTC	Universal Coordinated Time

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ISSN 0112-6962