No: 9/91 **Ref: EW/C91/4/2** **Category: 1a**

Aircraft Type and Registration:	Boeing 757-23A, G-OOOH
No & Type of Engines:	2 Rolls-Royce RB 211-535E4 turbofan engines
Year of Manufacture:	1989
Date & Time (UTC):	15 April 1991 at 1718 hrs
Location:	London Gatwick Airport
Type of Flight:	Public Transport
Persons on Board:	Crew - N/K Passengers - N/K Total 227
Injuries:	Crew - None Passengers - None
Nature of Damage:	Left nose wheel broken-up and nose wheel axle damaged
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	42 years
Commander's Flying Experience:	6,900 hours (of which 155 hours were on type)
Information Source:	AAIB Field Investigation

The aircraft landed on runway 08 and was taxied towards its stand. After a 270 degree left turn, followed by a 100 degree right turn, a problem was experienced with the nose landing gear. The aircraft was brought to a halt. ATC was informed and a visual inspection carried out by the airport fire service indicated that the left nosewheel had failed on the axle and was precariously balanced. The engines were then shut down and the passengers informed of the situation. The passengers remained onboard until the landing gear locks and the nosewheel jack were in position.

Subsequent examination of the wheel and its associated bearings, which had completed 305 landings since they were last serviced, revealed that the outer bearing, part number 29685-29620, had failed in such a manner as to allow the wheel to slide outboard on its axle and to pivot upwards. This upwards pivoting action overloaded the inboard bearing and caused the inboard bearing cup and wheel housing to fail. The wheel retaining nut had remained on the axle and its locking system had remained intact to the extent that it could be seen that the nut had not "backed-off".

Detailed examination of the remains of both the inboard and outboard bearings was carried out by a representative of the bearing manufacturer, in the presence of an AAIB Inspector and a metallurgist from the Materials Department of the Royal Aerospace Establishment (RAE), Farnborough.

The outboard bearing had suffered severe frictional heat deformation at the cone thrust rib, cage failure and subsequent hub failure. Due to the severe damage it was difficult to obtain conclusive evidence as to the cause. However a small section of the cone thrust rib was visible and showed considerable 'wear-back' prior to the final bearing collapse. This wear-back was a good indication that there had been insufficient quantity/quality of lubricant between the roller end face and the rib face which had allowed metal-to-metal contact with the resultant extreme wear. The bearing section is shown in the accompanying diagrams.

The inboard bearing was intact apart from two fractures in the cup. However, on the side of the track adjacent to the cup front face there were a few heavy, angled, indentations and 'chips' which appeared to have been caused by the rollers slewing out of position. Slight discolouration was evident on the roller, cup and cone surfaces and, on the cone, each roller position was marked by two parallel lines. This effect was also present on the cup, but not in every roller position. A detailed examination of the discolouration and parallel lines on the scanning electron microscope revealed that this damage had been caused by corrosion and it was apparent that the pattern of parallel lines which marked the roller positions on the cup and cone had resulted from attack where fluid capillaries had formed either side of the roller contact region, indicating that the corrosive attack must have occurred during static conditions.

The grease from these bearings, together with an unused sample of the same type of grease, was analysed by the Analytical and General Chemistry Section of RAE Farnborough with the following results:

Testing by the Karl Fischer coulometry method showed 0.1% water in the unused sample and 0.4% water in the grease from the bearings. Aqueous extracts were subjected to ion chromatography which showed formate and acetate in the grease from the bearings, but not in the unused sample. Formate and acetate are known to form in greases by oxidation processes and their formation is thought to be catalysed by some metals. Experiments have shown that greases refluxed with water over a period of days gradually produce formate and that the presence of copper accelerates the process.

It is thus considered that the damage evident on the remains of the outboard bearing had occurred as a result of water contamination, with possible formate and acetate formation, which had degraded the grease. This water contamination had probably caused pitting of the bearing surfaces which could have resulted in 'rough-running' and vibration, inducing wear at the outboard cone rib/roller end, which would have produced excessive clearance and culminated in the rollers and cage "rolling-out" from between the tracks.

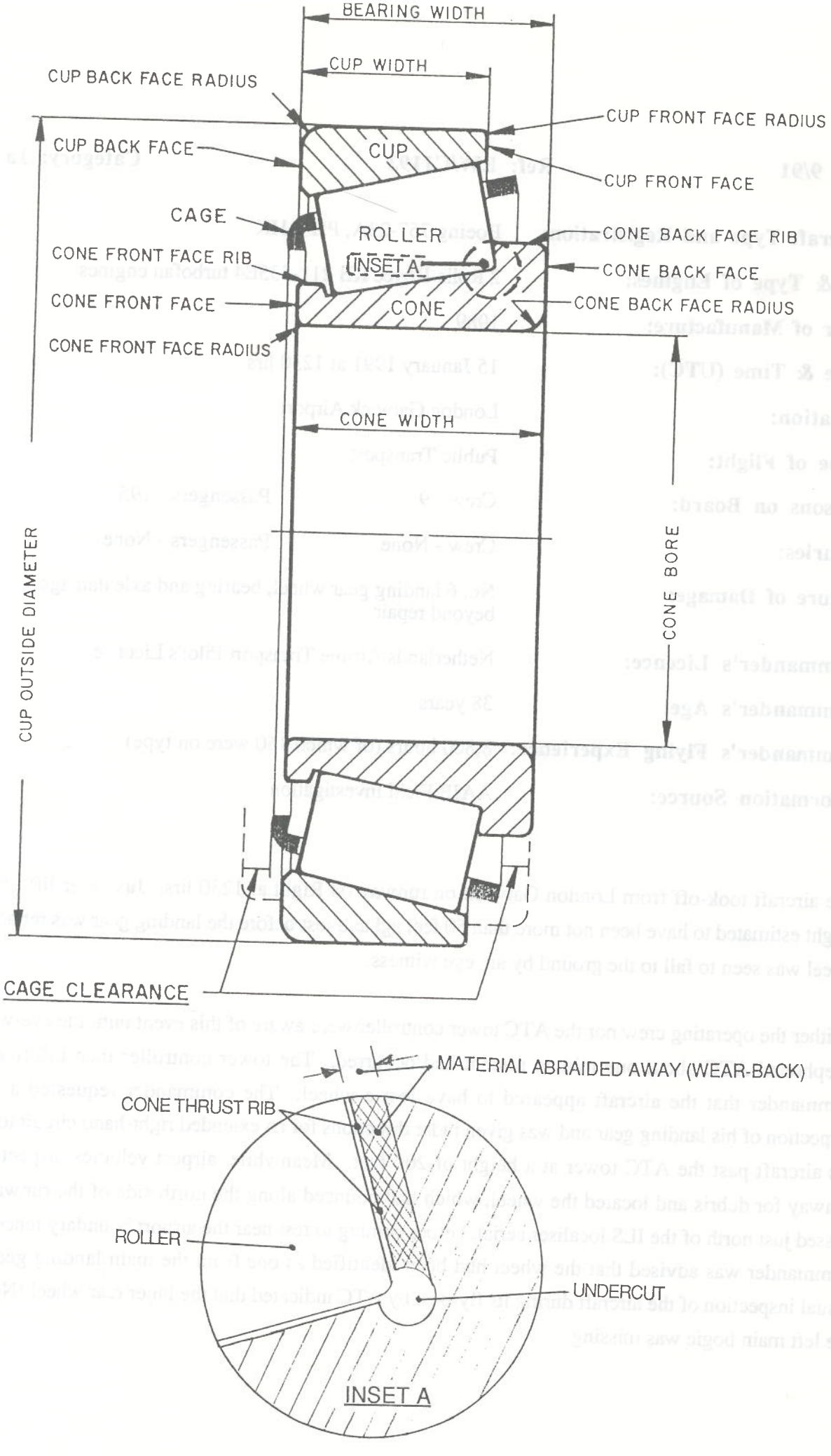
During the course of this investigation a number of wheel overhaul facilities were visited and it was noted that it was not uncommon to find bearings removed from an in-service wheel to be in a severely damaged state and very close to the point of failure. In every case the wheel had been removed from an aircraft for a tyre change.

In view of these findings, the following Safety Recommendations have been made to the Civil Aviation Authority:

1. The CAA take action to ensure that the life assessment, maintenance and inspection procedures applicable to public transport aircraft wheel bearings in service are satisfactory, particularly astyre lives are extended, and draw the attention of operators and maintenance organisations to the problems associated with water ingress into wheel bearings or associated greases.

2. The CAA introduce a requirement to check landing gear wheel retaining nut torque during the installed life of Boeing 757 wheels in order to detect cases of excessive bearing wear before wheel detachment occurs.

3. The CAA require that research be conducted into the formation of formate and acetate in bearing greases and associated effects on bearing life.



ILLUSTRATED ROLLER BEARING