AAIB Bulletin No: 8/94 **Ref: EW/G94/04/21** **Category: 1.1**

INCIDENT

Aircraft Type and Registration:	Concorde Type 1 Variant 102, G-BOAA	
No & Type of Engines:	4 Rolls-Royce Olympus 593/610 turbojet engines	
Year of Manufacture:	1975	
Date & Time (UTC):	29 April 1994 at 2100 hrs	
Location:	London Heathrow Airport	
Type of Flight:	Non-Revenue, post-maintenance check flight	
Persons on Board:	Crew - 9	Passengers - 55
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Three window outer panels shattered, one inner panel cracked; scores and scratches on fuselage skin	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	49 years	
Commander's Flying Experience:	10,686 hours (2,306 were on type) Last 90 days - 73 hours Last 28 days - 23 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and engineering reports from the Operator and window Manufacturer	

The aircraft was being flown on a non-revenue flight following scheduled maintenance and before being returned to public transport operation. During cruise at FL 570 and Mach 2.0 it was reported to the crew that two outer window panels had shattered in the rear cabin on the port side. This was confirmed by the Flight Engineer and aircraft speed was reduced to M 1.9 in accordance with the check list. There was no loss of cabin pressure.

On return to London Heathrow Airport it was discovered that a third outer panel had failed in a window (No 23 Left) immediately forward of the other two windows (24 and 28 Left) and which was concealed behind a wardrobe and covered by an internal panel. In '23 Left' the outer ply of the two-ply inner panel had also cracked. The single-ply outer panel of the window assembly acts as a heat shield and the two-ply inner panel is the primary load bearing element. In window '23 Left',

cabin pressure was being carried by the remaining single-ply of the inner panel but each ply in the laminate is designed to withstand more than the aircraft maximum differential pressure. The debris from the missing outer window panels had caused extensive scratching and scores on the fuselage which required permanent repairs. The wardrobe adjacent to window '23 Left' had been replaced during the maintenance but nothing was found to associate this work with the subsequent failure of the window.

The failed window assemblies were sent to the manufacturer for detailed examination. It was found that the cracked outer ply of the inner panel of window '23 Left' had failed from impact damage which it must have incurred from the rupture of the outer panel. Most of the outer panel material had been lost but it was considered, from this evidence, that the initial failure had been that of '23 Left' outer panel and that windows '24 and 28 Left' outer panels had been damaged by debris as had the aircraft's skin.

Though the inner panel is the principal load bearing element in the window assembly a small amount of pressurisation, 0.5 psi, is maintained between the panels with a through-flow of air to counter misting. Some cracks were found in the demister interconnection tubes and these would have resulted in a higher than normal differential pressure being applied to the window outer panels, reducing their tolerance to surface damage.

Scoring or crazing alone can lead to premature failure of the outer panel and such failures have occurred at the rate of about one per year across the whole Concorde fleet. This led the window manufacturer to design a two-ply outer panel which was approved in 1990 and all replacement windows are of this standard.

A number of other remedial measures have been instituted following this incident. Fleet checks were raised on all windows, including concealed ones, and a modification is to be raised to fit aluminium blanks in place of transparent windows at the six locations obscured by the wardrobes. A fleet check was also raised on the window demister interconnection tubes to examine them for cracking and a requirement for recurrent inspections is being considered. Though the Approved Maintenance Manual at present calls for an inspection of window surfaces following an Intercheck there were found to be inspection criteria presented which were difficult to implement. A scratch depth limit of 0.001 inch has been agreed with the manufacturer and cabin windows will be covered for protection during heavy maintenance.