

SD3-30 Variant 100, G-SSWT, 13 February 1999

AAIB Bulletin No:	4/2000	Ref:	EW/C99/2/7	Category:	1.1
Aircraft Type and Registration:	SD3-30 Variant 100, G-SSWT				
No & Type of Engines:	2 Pratt & Whitney PT6A-45R turboprop engines				
Year of Manufacture:	1983				
Date & Time (UTC):	13 February 1999 at 0425 hrs				
Location:	London-Luton Airport, Bedfordshire				
Type of Flight:	Private (training)				
Persons on Board:	Crew - 2 - Passengers - None				
Injuries:	Crew - None - Passengers - N/A				
Nature of Damage:	Minor to right main landing gear sponson				
Commander's Licence:	Airline Transport Pilot's Licence				
Commander's Age:	53 years				
Commander's Flying Experience:	8,240 hours (of which 482 were on type)				
	Last 90 days - 131 hours				
	Last 28 days - 45 hours				
Information Source:	AAIB Field Investigation				

History of flight

The crew reported to ATC that they had an unsafe indication for the right landing gear during approach to Runway 08. Following unsuccessful efforts to obtain a safe 'down-and-locked' indication, the aircraft conducted a low pass over the airport. However, although the right landing gear appeared to be extended during this fly past, ATC could not confirm to the crew that it was locked down. Following a subsequent uneventful touchdown, the right landing gear collapsed at the end of the landing roll.

Engineering examination

The aircraft was lifted and the right landing gear lowered and locked down prior to the aircraft being recovered from the runway. Following inspection and temporary repair to the right landing gear sponson, the aircraft was released to service with the landing gear locked in the down position. A concession was granted by the operator's CAA Flight Operations Inspector to allow the aircraft to return to service for a limited period.

An investigation of the right landing gear was carried out by a third party maintenance organisation three weeks after the incident. This revealed that the rear outer bearing bush (as illustrated in Figure 1, which shows a diagram of the left landing gear) which was an aluminium alloy bush containing a fibrous bearing liner, part number SD3-1 1-0752, had corroded (Photograph 1) to the extent that the aluminium corrosion products had 'jacked' the liner causing it to 'bind' on the rear pintle. (The corrosion products of aluminium are approximately 50% greater in volume than the uncorroded material). This had caused the pintle to seize within the bearing during the final part of the right landing gear extension cycle. It was noted that it was not possible to inspect the condition of this bush without removing the pintle, which in turn required the removal of part of the landing gear from the aircraft. However, in the case of this particular bearing bush the corrosion was readily visible without having to remove the bush from the landing gear beam or remove the fibrous bearing material, both of which would have rendered the bush a scrap item. There are a number of other similarly constructed bearing bushes within the landing gear system, but they differ in that it is almost impossible to inspect them for corrosion without first removing the fibrous bearing material. (Some forty years previously the properties of a similar fibrous bearing material were researched by a prominent British aircraft manufacturer and it was discovered that it absorbed moisture which could possibly account for the initiation of corrosion).

During the course of this investigation, two other aircraft of the same type that were being maintained by the same third party maintenance organisation had their main landing gears removed as part of a Service Bulletin requirement. In both cases the bearing bushes were found heavily corroded and the fibrous bearing material had become detached from the aluminium alloy bush (Photograph 2). It was noted that the inner bearing bushes showed no evidence of corrosion externally.

Some of the main landing gear bearings used on the Shorts 3-60 series aircraft are very similar in construction to those fitted to this 3-30 series aircraft.

Maintenance history

This aircraft had a recent history of problems with the right landing gear. On 2 January 1999 it was reported that the '*starboard gear illumination fails to indicate correctly*'. The landing gear was therefore locked in the down-and-locked position and the aircraft released back to service. On 5 January an examination by the third party maintenance organisation traced the fault to the uplock switch. This was replaced, retraction checks carried out in accordance with (iaw) Chapter 32 of the Maintenance Manual (MM) and the system found to function satisfactorily. On 13 January it was reported: '*right main undercarriage green light unserviceable*'. An examination by the same maintenance organisation traced the fault to the right downlock switch. The switch was replaced, retraction checks carried out iaw Chapter 32 of the MM and the system functioned satisfactorily. Following the next two flights on 13 January it was reported: '*right main gear indicator showing red intermittently*' and '*right main gear red light showing intermittently with gear selected*'. The landing gear was locked in the down-and-locked position and the aircraft released back to service. On 15 January the maintenance organisation could not find any defect in the landing gear system, but as a precaution replaced the right hydraulic retraction actuator. Several normal and emergency landing gear extension and retraction checks were carried out in accordance with Chapter 32 of the MM and no defects were found. This incident occurred on 13 February.

Chapter 32 of the MM detailed the maintenance practices for the extension and retraction of the landing gear. Paragraph 2B detailed the testing of the landing gear operation, which included gear retraction and extension times in seconds, but there was no requirement specified to record these

times. It is understood that during the above retraction and extension tests the times were not measured, but that on each occasion there was no visual discrepancy between the retraction and extension times for the three landing gears and they all appeared to function satisfactorily.

At the time of the incident the aircraft had accumulated 13,057 hours and 12,774 landings. The last 'C' maintenance check, along with the 3,600 hour, 4,800 hour and 9,600 hour structural inspections were carried out on 18 June 1998 at 12,243 hours and 12,044 landings. During this 'C' maintenance check the landing gear retraction and extension times were checked and found to be satisfactory.

Maintenance requirements

Chapter 5, section 20, of the MM specified the Maintenance Programme for the aircraft. The maintenance procedure stated in Chapter 5-25-32 of the MM for the main landing gear bearing bushes required them to be checked by timing the retraction and extension cycle at every 'C' Check and inspected whenever the landing gear was removed, and to be replaced 'on condition'. The scheduled requirement to remove the landing gears was at 13,500 hours, ie the overhaul life of the landing gears.

Chapter 5, section 22-02, of the MM specified the intervals for the 'A', 'B', 'C', 'D' and 'E' maintenance checks and the structural inspections. Paragraph 2 of this section specified the flight hours and calendar time period for the 'A' and 'B' checks and the flight hours period for the 'C', 'D' and 'E' checks. The last sentence of this paragraph stated *'In the case of very low yearly utilisation, the inspection intervals should never exceed the calendar time equivalent to a yearly utilisation of 1,200 flight hours.'* This aircraft was designated as a low utilisation aircraft. There was no definition of the calendar time, except for the 'A' and 'B' checks, within this paragraph. Paragraph 3 of this section specified the calendar time period in months for the structural inspections which is determined by taking the flight hours detailed in Chapter 5, section 26, of the MM and dividing by 200. There was no indication that this calendar time definition applied to any maintenance task other than the structural inspections.

Manufacturer's proposed actions

The aircraft manufacturer is proposing to make amendments/additions to the Maintenance Programme, section 5.25-32 in the Maintenance Manual, to require removal of the main landing gear and inspection of the condition of the bearing bushes at every D Maintenance Check (4,800 hours). The section in the MM specifying the maintenance requirement for the bearing bushes will be amplified.

Safety recommendations

As a result of these findings, the following Safety Recommendations are made:

Recommendation 2000-5

It is recommended that the amendments that Bombardier Aerospace have made to the Maintenance Programme in the Maintenance Manual for the Shorts 3-30 series aircraft concerning inspection/replacement of main landing gear bushes, due to associated corrosion and resultant gear seizure problems in service, are also incorporated in the Shorts 3-60 series aircraft Maintenance Manual.

In addition, in view of the finding that there a number of similarly constructed bearing bushes within the landing gear system, some of which are difficult to inspect for corrosion deterioration without removing the fibrous bearing material and thereby effectively scrapping the bearing bush and fibrous liner, the following Safety Recommendation is also made:

Recommendation 2000-6

In order to avoid the build up of corrosion products on the aluminium alloy bushes, fitted with fibrous bearing liners, on the main landing gears of Shorts 3-30 and 3-60 series aircraft which may not be detected by external inspection of installed bearings and could later result in gear seizure problems, it is recommended that Bombardier Aerospace, in conjunction with the CAA, consider the implementation of a calendar life for such main landing gear bearing bushes.