CIVIL AVIATION SAFETY AUTHORITY OF PAPUA NEW GUINEA

SAFETY ALERT BULLETIN (SAB)

SAB NO: 01/2023

DATE: 09 February 2023

A SAB is issued under section 12(k) of the Civil Aviation Act 2000(as amended). It contains important safety information and may include recommended action. SAB content should be especially valuable to air operators in meeting their statutory duty to provide service with the highest degree of safety in the public interest. Besides specific action(s) recommended in a SAB, an alternative action may be as effective in addressing the safety issue in the SAB.

TITLE: HIGH RISK OF SEPARATION OF MAINWHEELS FROM AIRCRAFT DUE FAILURE OF MAINWHEEL ASSEMBLY BEARINGS

OBJECTIVE: This SAB provides safety guidance information for:

- Operators of DHC8-series aircraft.
- Part 145 Aircraft Maintenance Organisations.

APPLICABILITY: This SAB is applicable to personnel who are engaged in aircraft maintenance, maintenance control and continuing airworthiness, airline operations and others undertaking an aviation activity and service including:

A. Air Operators
B. Part 145 Aircraft Maintenance Organisations.
C. Aircraft Maintenance Engineers

BACKGROUND:

On 03 March 2011, a DHC8-402 aircraft (UK registration G-JEDR), lost its right inboard main gear wheel during the take-off roll at Exeter airport, United Kingdom and fell to the ground within the airport boundary. Investigations found that it's outer cone bearing had seized, most likely a result of bearing cage and cup coming into contact due to the excessive movement of the bearing cage, probably due to wear. This caused the bearing to fail catastrophically. Consequential damage had allowed the wheel to detach from the axle and fall off the aircraft as the landing gear was retracted.

On 04 January 2020, a Jazz Aviation DHC8-300 aircraft (Canadian registration C-FSOU), lost its left inboard main gear wheel during the take-off roll at Montreal airport and fell to the ground within the airport boundary. Investigation revealed that it had suffered a main gear wheel bearing failure.

Inspection of the detached wheel and bearing debri in both the above cases, found that the wheel nut was still in position on the axle with its locking devices correctly installed.

On 29 January 2023, the right outboard main gear wheel (#4) detached from an Air Niugini DHC8-300 aircraft (P2-ANO; MSN 252) on landing at Port Moresby International airport.

Inspection by CASA PNG of the detached wheel and bearing debri, found that the wheel nut was still in position on the axle with its locking devices correctly installed (see figure 1)

Air Niugini grounded the DHC8-fleet and carried out inspections of the main wheel assembly and took necessary maintenance action(s) as recommended in this SAB, before releasing the aircraft back into service.

Figure 1- RH outboard Mainwheel detaches from P2-ANO aircraft on landing roll.

The DHC8 main wheel assembly bearings not only bear the friction loads from the wheel rotating on the axle but it also holds the wheel to the axle. Catastrophic failure of the main wheel assembly bearing may cause the main wheel to detach from the aircraft. Currently, these bearings are maintained 'on-condition'.

The similarities between the above incidents has prompted CASA PNG to release this SAB to inform all PNG air operators of DHC8-series aircraft to take note of the contents of this SAB and take preventative action(s) as recommended to avoid a repeat of such incidents on your aircraft.

General Arrangement of Main Wheel Assembly Bearings:

Each main wheel is fitted with a pair of taper roller bearings arranged with their smaller rolling diameter towards the center of the wheel (see Figure 2). Figure 3 shows the general arrangement of the DHC8-400 mainwheel, brake unit and bearings for the inboard (#3) RH mainwheel assembly. Figure 4 show the general arrangement of the DHC8-300 mainwheel and bearings for the outboard (#4) RH mainwheel. Each wheel bearing consists of a cup located in the wheel and an inner cone, roller and cage assembly which locates on the axle. The bore of the outer bearing cone is of a slightly smaller diameter than the inner bearing to prevent mis-assembly. The rollers and cups are common to both bearings. The bearings are lubricated on installation with high quality grease. The correct wheel installation process involves tightening the wheel nut to a specific torque loading (eg. 32 ft-lb) to seat the bearings initially before backing off the nut and then tightening it to a lower in-service torque loading (eg. 16 ft-lb). The wheel must be rotated by hand throughout the process to ensure the correct pre-loading of the bearing is achieved.

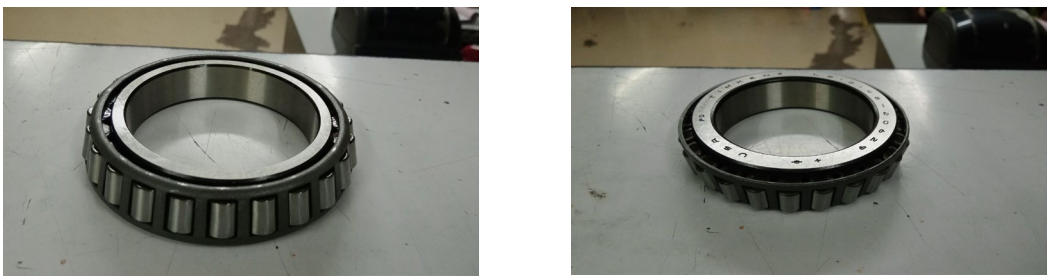

Figure 2- New main wheel bearing cone assembly showing rollers located in the cage

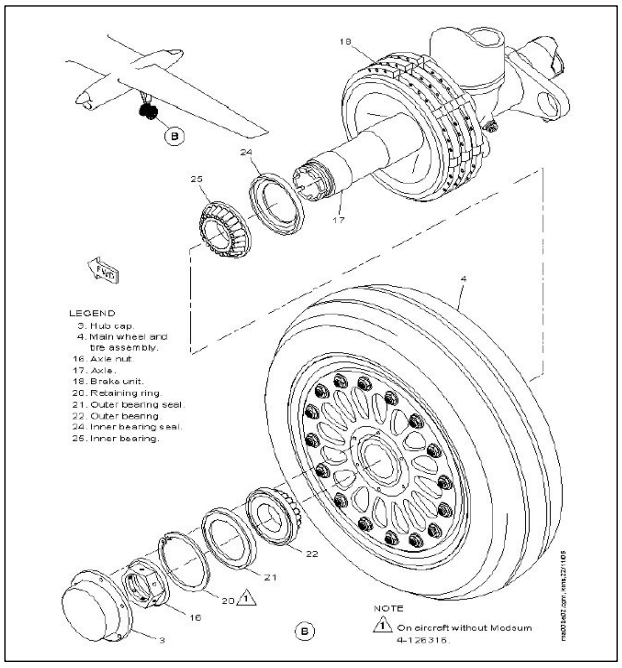

Figure 3- General arrangement of mainwheel and bearings on DHC8-402 aircraft

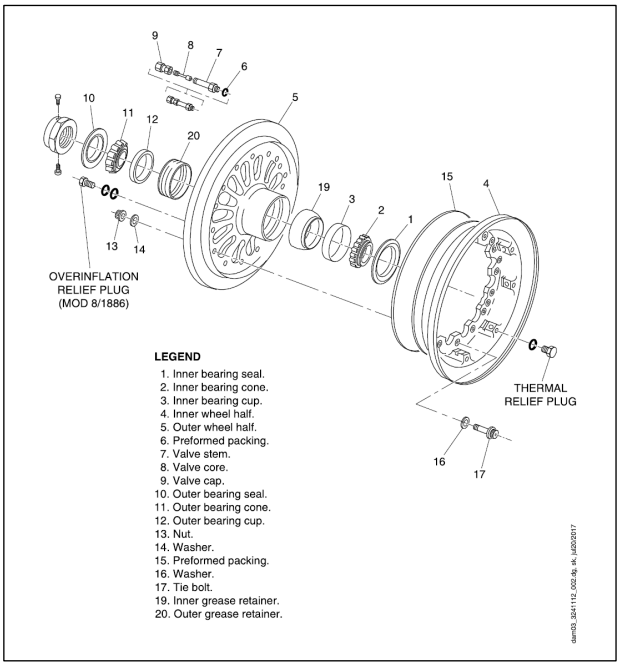

Figure 4- General arrangement of mainwheel and bearings on DHC8-200/300 aircraft

Potential Causes of Main Wheel Assembly Bearing failure:

De Havilland advised that potential causes of main wheel bearing failure are:

1. Loose or worn cage bearing returned to service
2. Heavy/Hard landings inducing radial shock loads and bearing cage wear
3. Grease contamination – loss of bearing grease causing cage wear
4. Poor wheel installation procedures
5. Excessive wheel shimmy due to worn linkages
6. Brake judder or vibration causing cage wear

Figure 5 shows the damaged mainwheel bearings and its cup recovered from taxiway 32F Port Moresby.

Figure 5 – damaged mainwheel bearings and its cup

Literature Review of similar past incidents by CASA PNG

A review of UK AAIB Bulletin No.11/2011 that was released following the DHC8-402 incident at Exeter Airport, UK, notes that the same part number bearings have been used extensively in other aircraft types over a long period of time without any significant issues. The AAIB report further notes that there have been a limited number of other bearing failures on the DHC8-series aircraft, but these have been attributed to either incorrect installation procedures or use of inappropriate grease. Furthermore, the AAIB report noted that the mainwheel manufacturer, Goodrich Corporation had made recommendation to the aircraft manufacturer following the Exeter, UK incident that the mainwheel bearing and cage assembly be replaced at each tyre change. The report indicates that the aircraft manufacturer has considered the wheel manufacturer's recommendation and notes that some operators already replace their bearings on this basis.

However, CASA is concerned that the aircraft manufacturer, De Havilland Canada has not issued any Service Bulletins or Service Letter to date, making recommendations for air operators to introduce a fixed operating life for these bearings rather than the "ON-CONDITION" basis used at present. This SAB recommends that air operators in PNG propose a fixed operating life for these bearings to CASA for approval.

Cost-Benefit Analysis - CASA has also reviewed the cost of these bearings and found that a batch containing 20 bearings costs less than USD$2000. The cost of replacing a pair of these bearings costs less than USD$200. The cost of replacing these bearings would be negligible when compared to the costs of grounding an aircraft, safety and reputational risk incurred by the operator arising from adverse social and other media events.

AIRCRAFT MAINTENANCE PROGRAM (AMP) ACTIONS: Currently these non-serialized FAA-PMA bearings are maintained as "On-Condition" items. For DHC8-200/300: Inner Bearing P/N: *L713049-20629*; Outer bearing P/N: *L812148-20629*. For other DHC8 fleet: r*efer to Goodrich Corporation CMM IPC for specific P/N details.*

RECOMMENDED SAFETY ACTIONS: Maintenance Controllers are strongly encouraged to:

(I) Scrap/Replace main wheel bearings at every tyre change or propose other fixed operating life based on air operators component reliability data, acceptable to the Director; and

(II) Submit the necessary aircraft maintenance program (AMP) amendment applications to CASA for review and approval of change from 'on-condition' to a fixed 'operating/scrap life' for all main wheel bearings.

Failure to take the above recommended actions may result in catastrophic bearing failure that may cause the separation of the mainwheel from the aircraft resulting in high safety and reputational risk to the company.

RELATED REFERENCE MATERIALS:

1.UK AAIB Bulletin 11/2011 – Right Main Landing Gear inboard wheel detached *G-JEDR EW/C2011/03/01 (Exeter Airport, UK. 03 March 2011)*.

2. De Havilland Aircraft Canada website – *Wheel installation and wheel bearing maintenance training videos (DHAC. 2021)*.

ENQUIRIES:

For any further enquiries regarding the contents of this Safety Alert Bulletin (SAB), you may contact the CASA PNG Manager Airworthiness Branch:

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