AIRCRAFT INCIDENT SHORT REPORT

CA18/3/2/1287: During touch-and-go, the nose landing gear wheel assembly and fork separated from the landing gear strut.

Date and time	:	17 October 2019 at 1145Z
Location	:	On Runway 07 at Lanseria Aerodrome (FALA)
Aircraft registration	:	ZS-SJY
Aircraft manufacturer and model	:	Diamond Aircraft Industries, DA 20-C1
Last point of departure	:	Lanseria Aerodrome (FALA)
Next point of intended landing	:	Lanseria Aerodrome (FALA)
Location of incident site with reference to easily defined geographical points (GPS readings if possible)	:	S25°56'15.99" E27°55'35.02" Elevation 4521 feet
Meteorological information	:	Wind: Variable at 5 knots, Temperature: 31°C, Dew point 8°C, Visibility: CAVOK
Type of operation	:	Training (Part 141)
Persons on-board	:	1+1
Injuries	:	None
Damage to aircraft	:	Substantial

All times given in this report are Co-ordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.

Purpose of the Investigation:

In terms of Regulation 12.03.1 of the Civil Aviation Regulations (2011), this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and ***not to apportion blame or liability.***

Disclaimer:

1. SYNOPSIS

1.1 On 17 October 2019 at approximately 1145Z, a flight instructor and a student pilot were conducting circuit training at Lanseria Aerodrome (FALA) under the provisions of Part 141 of the Civil Aviation Regulations (CAR) 2011 as amended. The instructor reported that the student pilot completed three circuits with three successful touch-and-go landings. While the student pilot was conducting the fourth circuit during touch-and-go on Runway 07, the nose landing gear wheel and fork assembly separated from the landing gear strut and the aircraft's propeller struck the runway's surface.

1.2 The aircraft was substantially damaged during the incident sequence, and both occupants did not sustain any injuries.

1.3 The investigation revealed that it was likely that during the replacement of the cracked nose landing gear fork, the engineer fitted the incorrect cotter pin when reassembling and refitting the new nose landing gear fork to the nose gear strut.

2. FACTUAL INFORMATION

2.1. On 17 October 2019 at approximately 1145Z, a flight instructor and a student pilot were conducting circuit training at Lanseria Aerodrome (FALA) under the provisions of Part 141 of the Civil Aviation Regulations (CAR) 2011 as amended.

2.2. The instructor reported that the student pilot completed four take-offs and four circuits, with three successful touch-and-go landings. The instructor and the student pilot did not notice any signs of defects, nose wheel shimmy or other abnormalities during the first three touch-and-go landings. However, during the fourth circuit touch-and-go, the instructor noticed that after they had touched down, there was a slight jolt on the main wheels as the aircraft's nose lowered. The nose dropped lower than normal, and at that point, the instructor took control of the aircraft. The instructor then applied full back pressure on the control column and closed the mixture control. As the aircraft slowed down, the nose lowered followed by a loud grinding sound that could be heard in the cockpit. The instructor stated that the propeller scraped the runway's surface just before the aircraft came to a full stop on the centreline of Runway 07.

2.3. The instructor further reported that the air traffic control (ATC) contacted them to find out if they had a problem, to which they responded that they had an incident. The instructor inquired to ATC if they could shut the power off and evacuate the aircraft as they were in the middle of the runway. The ATC also dispatched the fire department crew to assist the instructor and the student pilot. Once the instructor and the student pilot had exited the aircraft, they noticed that the nose landing gear fork and the wheel assembly had separated from the nose landing gear strut. The fire department crew recovered the nose landing gear fork and wheel assembly approximately 150m behind the point from where the aircraft had come to a stop on Runway 07.


Figures 1 and 2: The damaged propeller (left) and the aircraft as it came to rest (right).

2.4. Investigation

2.4.1 Description and Operation (Source: AMM Chapter 32)

The DA20-C1 aircraft has a fixed nose landing gear with a castoring wheel. The nose gear strut is a welded tubular-steel component. The aft upper end has a transverse tube which holds the main attachment journal bearings. These journal bearings allow the strut to move only up and down.

Forward and below the attachment bearings is a welded bracket which holds the bottom of the shock absorber assembly. The upper end of the shock absorber assembly attaches to the engine mount.

The forward bottom end of the nose gear strut has a near-vertical pivot for the nose-fork. This lets the nose wheel caster. Stops limit the caster movement to ±64 degrees.

When the airplane is on the ground, the shock absorber assembly pushes up against the engine mount. The journal-bearing pulls down against the front fuselage. When the aircraft is flying, the shock absorber assembly pulls down against the front fuselage. When the aircraft is flying, the shock absorber assembly pulls down against the engine mount and the journal-bearing pushes up against the front fuselage.

The journal bearing keeps the nose gear strut aligned fore and aft. A side load on the nose wheel causes it to caster. The stiffness (steering friction) of the nose-wheel fork pivot can be adjusted with the nose wheel fork mounting-screw. This prevents nose-wheel shimmy.

2.4.2 During the last Mandatory Periodic Inspection (MPI) of the aircraft which was completed on 16 October 2019 at 3991.8 airframe hours, the nose landing gear fork

assembly was changed because of cracks that were found on the nose gear fork (see Figure 3). The nose landing gear fork with part number 20-3220-08-00 was removed and replaced with a new nose landing gear fork with part number 20-3220-08-00_1 which was in accordance with Diamond Service Information Letter No. SIL20C1-005 (Appendix A) and Service Bulletin DAC1-32-03 (Appendix B). According to the aircraft maintenance manual (AMM), the nose landing gear fork should be inspected every 100 hours. This led to the installation of an improved nose landing gear fork assembly with part number 20-3220-08-00_1.

2.4.3 The last step of the AMM requires the installation of the cotter pin to secure the castellated nut in position. During the interview with the aircraft maintenance organisation (AMO), they had indicated that all installation steps were followed and that the nut was secured using a cotter pin. The material list that was supplied by the AMO to the investigator indicated that part number MS24665-360 cotter pin was used to secure the nut. According to the Service Bulletin for installation of the improved nose landing gear fork assembly, the part number required to be used is MS524665-285 cotter pin. The AMO did not install the required (cotter pin) part number as stipulated by the manufacturer in the AMM.

2.4.4 The aircraft maintenance engineer (AME) (0272004896) was issued an AME licence on 3 November 2017 with an expiry date of 2 November 2019. The AME is a holder of CAT A, CAT B, CAT C and CAT X ratings and the aircraft type was endorsed on his licence.

2.4.5 Suspected unapproved parts

CAR Part 43.02.22 *(1) (a) Any Class I, Class II or Class III part, component or product, whether new or previously used, for which no historical records are available or traceable, or for which the available records do not confirm that they have been approved by an appropriate authority, shall be considered to be unserviceable.*

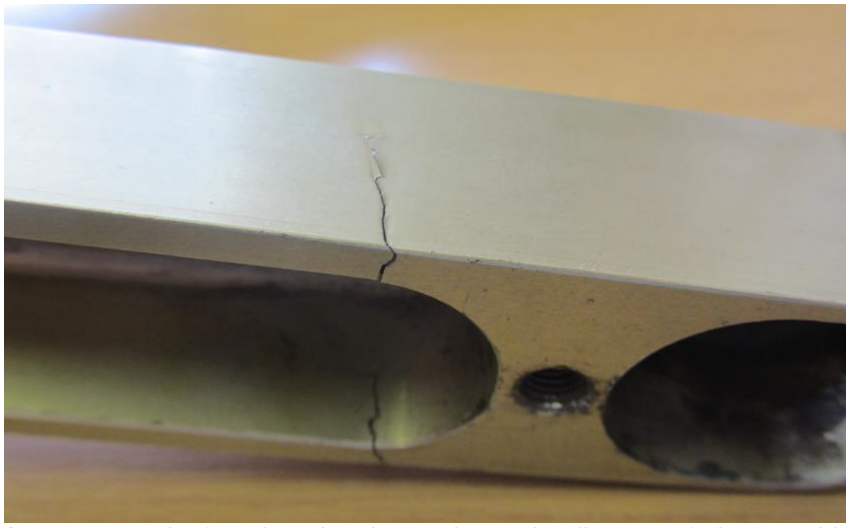

Figure 3: Cracks found on the changed nose landing gear fork assembly.

2.4.6 The aircraft had accrued 2.2 hours and accomplished five successful landings after its last MPI (before the nose landing gear fork and wheel assembly separated from the nose landing gear strut at the pivot point). The nose landing gear fork and wheel assembly separated from the landing gear strut during the fourth touch-and-go on an asphalt runway.

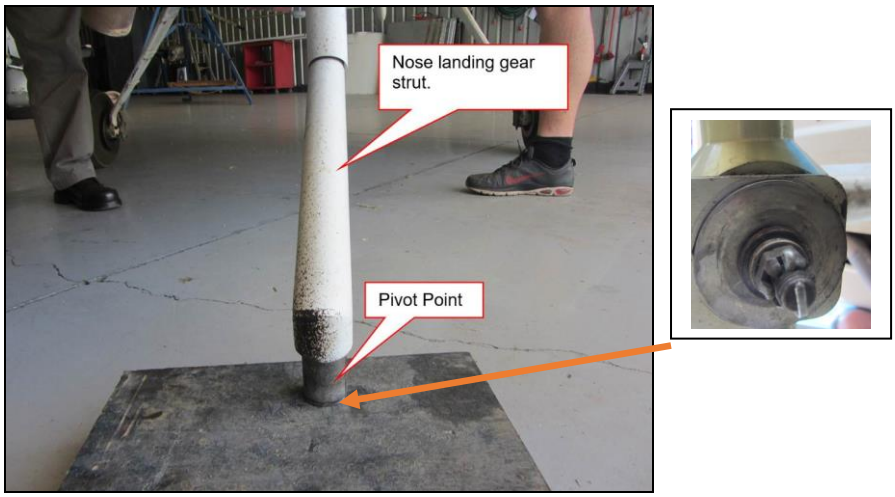

Figure 4: The nose landing gear strut and pivot point.

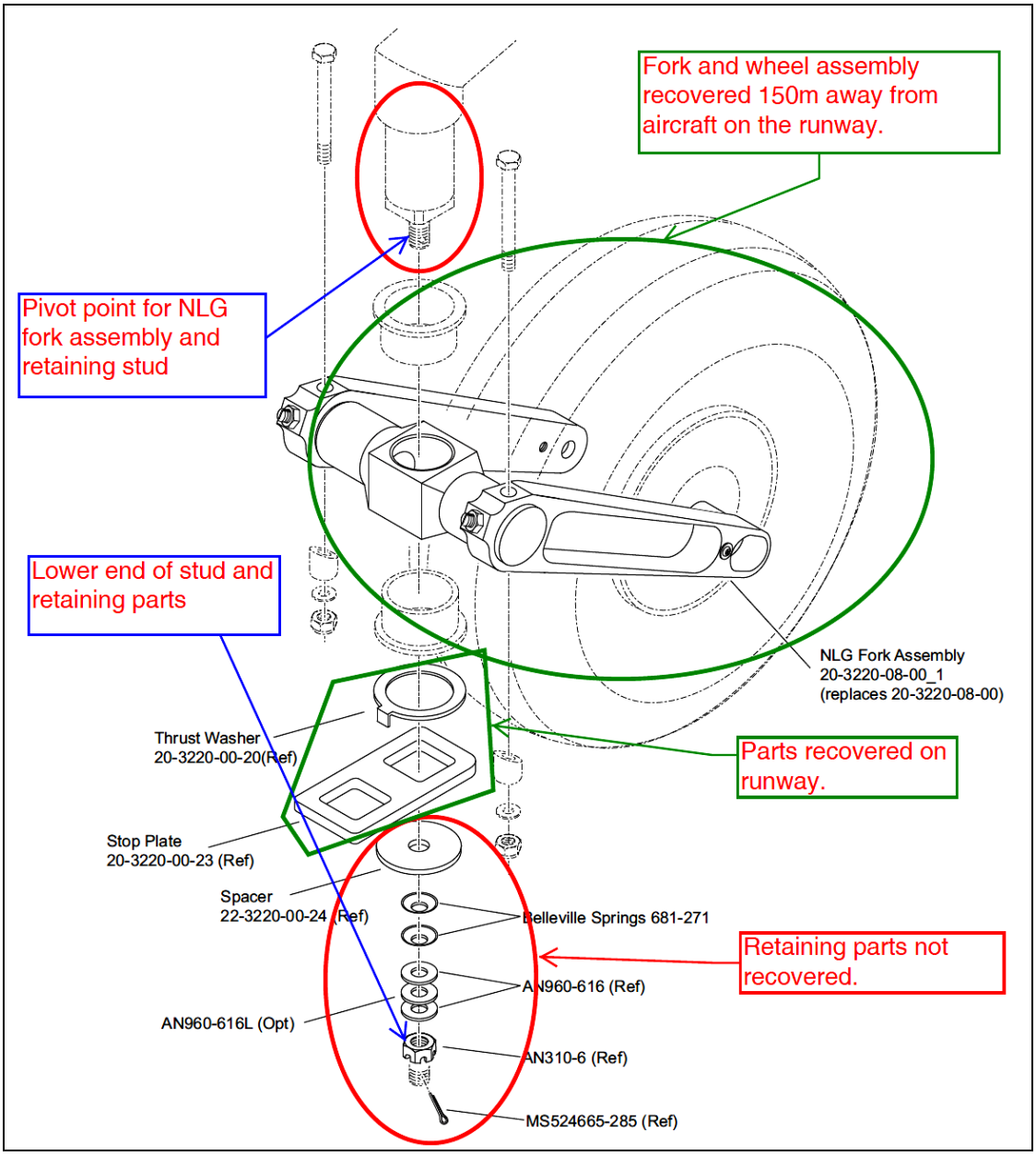

Figure 5: Diagram of the nose landing gear fork assembly. (Source: Diamond SB DAC1-32-03)

2.4.7 During the aircraft's last MPI, the AMO completed Task no. 22 of the Diamond Scheduled Maintenance Checks 05-20-00 (page 213) for a 100-hour interval inspection - *"Inspect the pivot stud threads of the lower end of the strut for cracks/damage".* No findings were recorded.

2.4.8 Service Information Letter No. SIL20C1-005 warns owners about the following: *Cracks have been found on some NLG Fork assembly, P/N 20-3220-08-00 during routine inspections. Cracking usually occurs on higher time aircraft but could occur sooner with rough field operations or hard landings*.

2.4.9 The investigation revealed that there was one recorded case (CA18/3/2/1157) where the nose wheel and fork assembly separated from the landing gear strut on a similar aircraft. The investigation concluded that the stud on the landing gear strut cracked and broke off, causing the separation of the wheel assembly and fork.

2.4.10 The Transport Safety Board (TSB) Canada had recorded 10 similar occurrences, which happened during landing, take-off and touch-and-go events, dating back to 2010. The TSB Canada and type certificated holder, Diamond Industries Inc., continue to actively monitor the DA20 nose landing gear failures.

2.4.11 The damaged landing gear strut was sent to the TSB laboratory for a detailed inspection. The inspection revealed that there was no information that could be analysed on the landing gear strut because the lower end of the strut was damaged when it came into contact with the runway's surface during the touch-and-go exercise.

2.4.12 The following were identified as the possible causes of the incident:

- Cracking due to hard landings – which was ruled out because there were no reports/records to support hard landing incidents.
- Stud failure – which was ruled out because the aircraft had undergone its MPI and accumulated 2.2 hours after the inspection.
- Omission by the engineer to secure the nut with the cotter pin after the installation of the nose landing gear fork assembly – based on the material list provided by the AMO, the engineer did use a cotter pin.
- Incorrect cotter pin part number used to secure the castellated nut to a stud, which secures the nose landing gear fork to the nose gear strut – this cause was further analysed and is discussed below.

2.4.13 The investigation revealed that it was likely that during the replacement of the cracked nose landing gear fork, the engineer fitted the incorrect cotter pin when reassembling and refitting the new nose landing gear fork to the nose gear strut.

3. PROBABLE CAUSE/CONTRIBUTING FACTOR

3.1. The separation of the nose landing gear fork and wheel assembly from the nose gear strut was likely caused by the installation of the incorrect cotter pin following replacement of the cracked nose landing gear fork during the aircraft's last MPI.

4. REFERENCES USED ON THE REPORT

4.1 Diamond Service Information Letter No. SIL20C1-005

4.2 Diamond Service Bulletin No.: DAC1-32-03

4.3 Diamond DA20-C1 Aircraft Maintenance Manual (AMM)

4.4 Diamond DA20-C1 List of Applicable Publications

4.5 ZS-SNM Diamond DA20-C1 Incident Report CA18/3/2/1157

5. SAFETY RECOMMENDATION

5.1 Whether or not the AIID identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. Below is the safety action taken by the AMO:

5.1.1 Following this occurrence, the AMO proactively implemented a 50-hour Non-Destructive Testing (NDT) inspection in the retaining stud area.

5.2 It is recommended to the Director of Civil Aviation to consider issuing maintenance notice to all operators and maintenance organisation operating and maintaining this aircraft type to adhere to the manufacturer's maintenance instruction and the use of the correct parts during maintenance. Such incidents could result in serious injuries if they remain undetected and not corrected. A total of 10 incidents have been reported in TSB Canada.

6. ORGANISATION

6.1. None.

7. SAFETY MESSAGE

7.1 In the interest of safety, it is recommended that the AMO uses recommended approved parts as required by the manufacturer during the performance of aircraft maintenance.

Appendix A: SIL20C1-005

SERVICE INFORMATION LETTER

Diamond AIRCRAFT

SERVICE INFORMATION LETTER NO. SIL20C1-005

NOTE: Service Information Letters are used only:

1. To distribute information from Diamond Aircraft Industries (DAI) to our customers.
2. To distribute applicable information/documents from our suppliers to our customers with additional information.

NOTE: Typically there is no revision service for Service Information Letter (SIL). Each new information or change will be sent along with a new SIL.

1. TECHNICAL DETAILS

1.1 Aircraft Affected

DA20-C1 aircraft from S/N C0001 to C0571.

1.2 Subject

The improvement in the design of the Nose Landing Gear (NLG) Fork assembly. The old P/N 20-3220-08-00 has been replaced with the new NLG Fork assembly, P/N 20-3220-08-00_1.

1.3 Reason

Cracks have been found on some NLG Fork assembly, P/N 20-3220-08-00 during routine inspections. Cracking usually occurs on higher time aircraft but could occur sooner with rough field operations or hard landings. Figure 1 shows where the cracking has normally occurred. Also, the machine screw, pan head, P/N MS35207-282 (see Figure 1) should be installed with Loctite 242 when the wheel fairings are not used to avoid any potential cracking that may occur at that location.

1.4 Information

Refer to DA20-C1 Aircraft Maintenance Manual (AMM) Document No. DA201-C1, Revision 17 dated 01 November 2010 or later revisions for new inspection requirements for the NLG and the Illustrated Parts Catalogue (IPC), Document No. DA203-C1, Revision 8 dated 15 November 2010 or later approved revisions.

2. OTHERS

Contact DAI or your local authorized Diamond Service Center.

SERVICE INFORMATION LETTER

Diamond AIRCRAFT

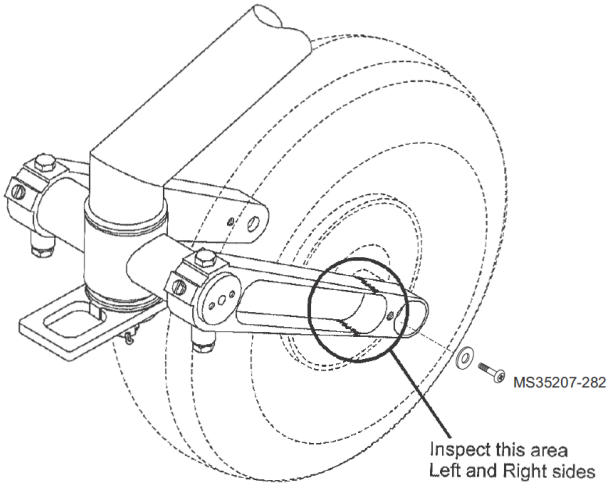

Figure 1

To obtain satisfactory results, procedures specified in this service information letter must be accomplished in accordance with accepted methods and current government regulations. Diamond Aircraft Industries Inc. cannot be responsible for the quality of work performed in accomplishing the requirements of this service information letter. Diamond Aircraft reserves the right to void continued warranty coverage in the area affected by this service information letter if it is not incorporated. If you no longer own the aircraft to which this service information letter applies, please forward it to the current owner and send the name of the current owner to Diamond Aircraft Industries Inc. at the address below.

Diamond Aircraft Industries Inc. 1560 Crumlin Sideroad, London, Ontario, Canada N5V 1S2
Phone: (519) 457-4030 Ext. 3173 E-mail: techpubs@diamondair.com

SERVICE BULLETIN

Diamond AIRCRAFT

Service Bulletin No.: DAC1-32-03 Rev 0 **Date Issued:** 15 July 2011

Title: NLG Wheel and Fork Installation Improvements

1. ATA Code: 3220

2. Effectivity: DA20-C1 aircraft - Serial Number C0001 to C0581.

3. General: This service bulletin provides information regarding updated NLG gear fork and wheel assembly installations to reduce wear and maintain steering friction. It has been noted during service that there has been issues with frequent adjustment of the steering friction and nose wheel shimmy. Incorporation of this service bulletin will assist with these issues.

4. Compliance: This service bulletin is highly Recommended and should be completed at the next 200 hour or annual inspection.

5. Approval: Engineering data referenced or contained in this service bulletin is approved as part of the type design.

6. Labour: Approximate time required to complete the Service Bulletin - 1 hour.

This estimate is for direct labour performed by a technician and it does not include setup, planning, familiarization, cure time, part fabrication or tool acquisition.

7. Material:

Part Number	Description	Qty
New Parts		
681-271	Belleville Spring	2
AN960-616L	Flat Washer - Steel	1
22-3220-00-25	0.010" Shim	2
22-3220-00-26	0.020" Shim	2
Original Parts (use if necessary to replace damaged or worn parts)		
20-3220-00-20	Thrust Washer	1
20-3220-00-23	Stop Plate	1
22-3220-00-24	Spacer	1
AN960-616	Washer	2
AN310-6	Castellated Nut	1
MS24665-285	Cotter Pin	1
CRC SP-400	Corrosion Inhibitor	AR

8. Special Tools: N/A

9. References: DA20-C1 Aircraft Maintenance Manual, Document Number DA201-C1.
DA20-C1 Illustrate Parts Catalogue, Document Number DA203-C1

10. Accomplishment Instructions:

10.1 Either jack the aircraft in accordance with DA20-C1 AMM Chapter 07-10-00 or raise the front of the aircraft in accordance with Chapter 32-40-00 3.B. (page 203).

10.2 Remove the wheel in accordance with AMM Chapter 32-40-00

10.3 Remove NLG fork (A new fork assembly is availble see SIL20C1-005) .

10.4 Inspect all parts for condition checking for cracks, corrosion and wear. New hardware should be used where necessary (For the fork assembly please review SIL20C1-005).

10.5 Apply CRC Corrosion Shell to the stud. Do not contaminate the tire or fiberglass.

10.6 Lubricate the axle in accordance with AMM Chapter 12-20-00.

10.7 Re install the fork using the new Belleville springs with the rest of the parts listed in figure 1. Be sure that both springs are installed with the open side facing up as per figure 1.

Note: The AN960-616L steel washer should be used if it is not possible to install the cotter pin correctly when adjusting the friction force.

10.8 Re install the wheel and use the shims to eliminate the gap between the axle spacer (20-3220-00-19) and the fork. Use a maximum of two shims and divide the shim installation evenly from side to side. Maximum difference between sides is 0.010". See figure 2.

10.9 Carry out friction adjustment as per AMM Chapter 32-20-00. Use the AN960-616L washer as noted above if required to properly install the fork and obtain the proper friction.

10.10 Make a log book entry that this Service Bulletin has been incorporated.

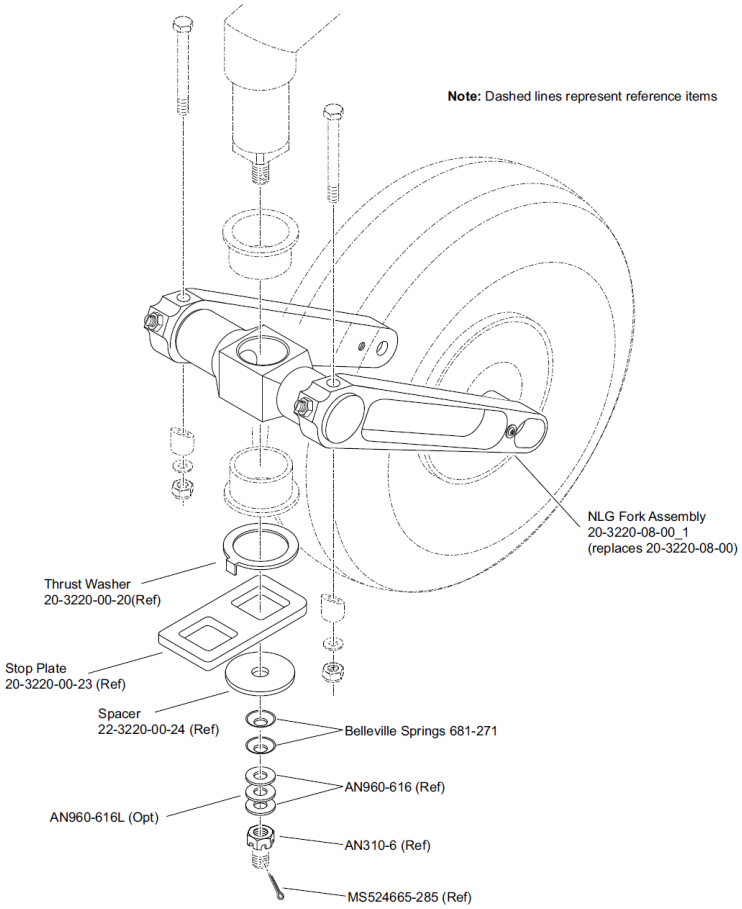

Figure 1 - NLG Fork Assembly Installation

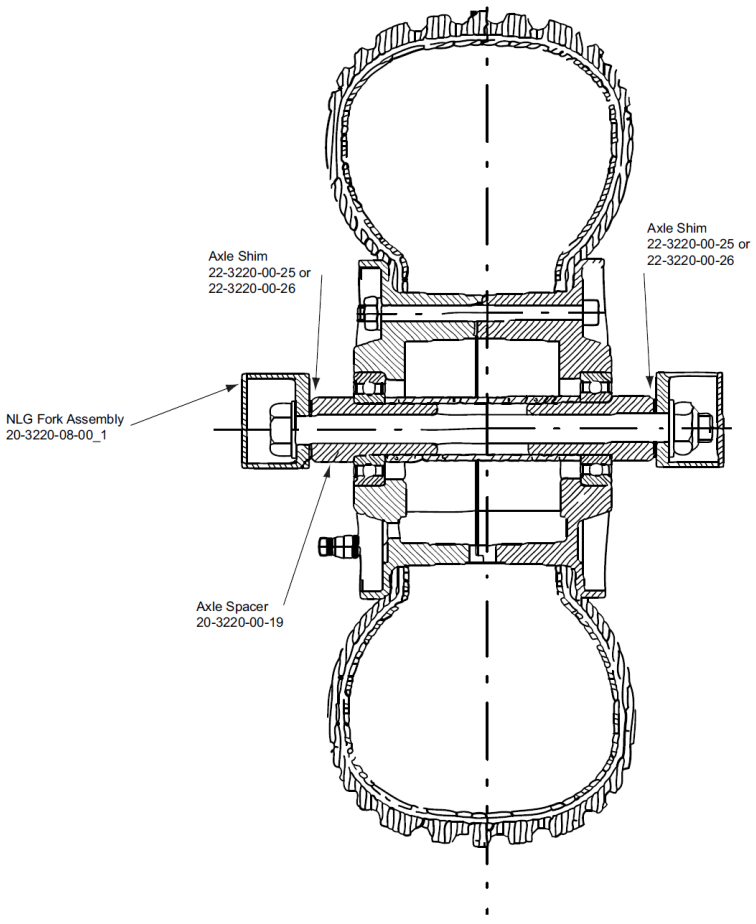

Figure 2 - NLG Wheel Installation with Shims

11. Weight and Balance: Weight and Balance is not affected by the installation of this Service Bulletin

12. Availability: Contact Diamond Aircraft.

13. Credit: Aircraft that are still covered by the warranty period will be credited for parts and 1 hour labour.

To obtain satisfactory results, procedures specified in this service bulletin must be accomplished in accordance with accepted methods and current government regulations. Diamond Aircraft Industries Inc. cannot be responsible for the quality of work performed in accomplishing the requirements of this service bulletin. Diamond Aircraft reserves the right to void continued warranty coverage in the area affected by this service bulletin if it is not incorporated.
If you no longer own the aircraft to which this service bulletin applies, please forward it to the current owner and send the name of the current owner to Diamond Aircraft Industries Inc. at the address below.

Diamond Aircraft Industries Inc. 1560 Crumlin Sideroad, London, Ontario, Canada N5V 1S2

Customer Support: Phone: (519) 457-4041 Fax: (519) 457-4045 E-mail: custsupp@diamondair.com
Technical Publications: Phone: (519) 457-4030 Ext. 3173 E-mail: techpubs@diamondair.com

Inspection Items, Front Fuselage	Interval (Flight Hours)				
	50	100	200	1000	Initials
22. Visually examine the NLG fork pivot. - Look especially for cracks in the radius where the fork makes contact, corrosion and wear. Any corrosion needs to be assessed, treated and/or the component replaced - Inspect the pivot stud threads of the lower end of the strut for cracks/damage.		X	X	X	
23. Lubricate the NLG fork pivot as per Chapter 12-00 and install the NLG fork as per Chapter 32-00.		X	X	X	
24. Visually examine the NLG strut condition. Look especially for distortion, corrosion and condition of the paint. Ensure that there is no excessive play in the NLG strut pivot. Allowable radial play is 0.002" (0.05mm). If play is excessive remove strut and inspect condition of flanged bushings.				X	
25. Do a test for play and caster friction. (Refer to Chapter 32-20). The friction should be 6.75-11.25 lbs (3-5 N) at the axle.			X	X	
26. Lubricate the spherical bearing at the top of the shock absorber assembly. (Refer to Chapter 12-20).				X	
27. Lower the aircraft off jacks. (Refer to Chapter 07-10).		X	X	X	
28. Install the wheel fairings.		X	X	X	
29. Examine the exterior placards. Make sure that they are not damaged and that none are missing. - Replace any that are damaged or missing. (Refer to Chapter 11-20).			X	X	

*- Not applicable at 25 hour inspection

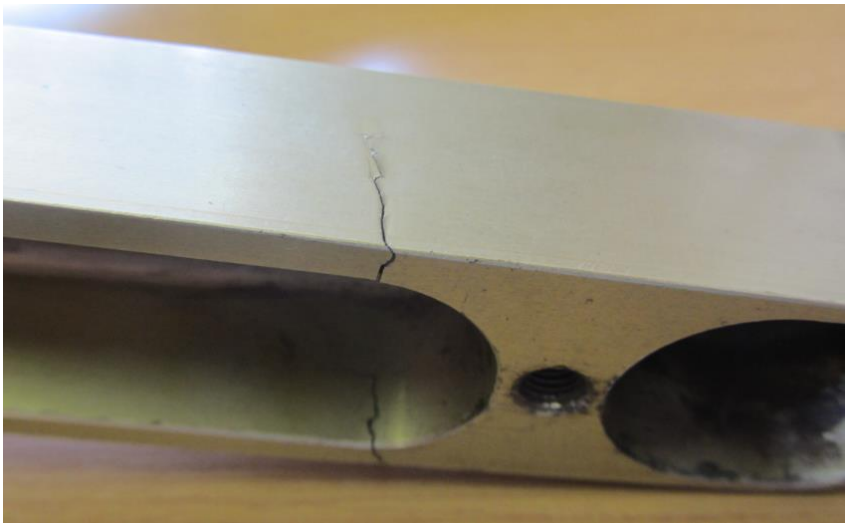

Figure 6: Cracks found on the fork assembly.

Appendix D: DA20-C1 Aircraft Maintenance Manual (AMM) 32-20 page 204 Installation of fork assembly

C. Install the NLG Fork Assembly

	Detail Steps/Work Items	Key Items/References
1.	Apply grease to the bearing surfaces of the NLG strut axle	Use MIL-C-81322 grease.
2.	Apply CRC Corrosion shell or CRC SP-400 to the non-painted area at the stud end of the NLG strut axle except the bearing surface prior to assembly.	Do not apply grease to the surfaces. Make sure that you do not contaminate the tire or the fiberglass. Refer to Chapter 12-20-00.
3.	Install the fork assembly on the NLG strut axle as follows: - Install the fork assembly onto NLG strut. - Install the thrust washer, the stop plate and the lower spacer - Install the spring disc, the washers, and the Castellated nut. - Tightened the nut to achieve break out force. - Install the cotter pin.	Refer to Figure 205. Makr sure that both spring discs are installed with open side facing up. Refer to paragraph 6.
4.	Adjust the nose wheel steering friction.	Refer to Paragraph 6.

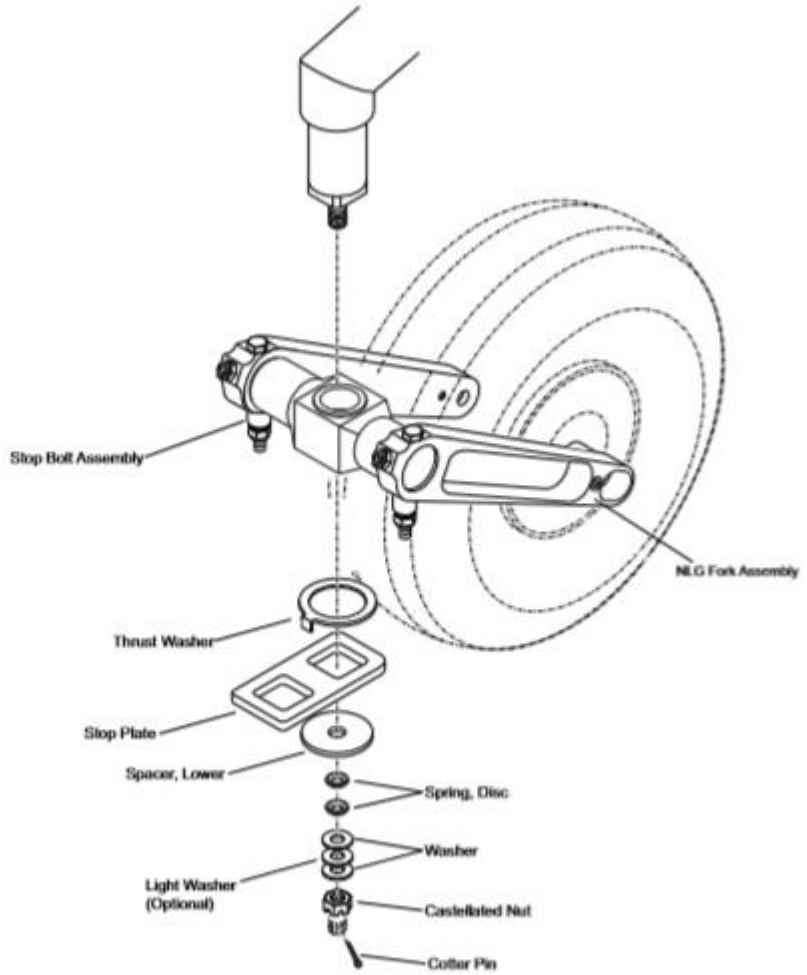

Figure 205 - NLG Fork Installation