

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



DCA23FA339

MAINTENANCE

Group Chair's Factual Report

October 29, 2024

A. ACCIDENT

Location: Charlotte, NC
Date: June 28, 2023
Time: 08:58 EDT
Aircraft: Boeing B717-200, Registration N955AT (AC9514), Serial Number 55017

B. MAINTENANCE RECORDS

Group Chairman	Gregory Borsari/Pocholo Cruz NTSB Washington, DC
Group Member	James Hawkins Delta Airlines Atlanta, GA
Group Member	James Sayre FAA Miramar, FL
Group Member	Daniel Marcotte Boeing Seattle, WA

C. DETAILS OF THE INVESTIGATION

1.0 Air Carrier Certificates

The Federal Aviation Administration (FAA) Southern Region issued an Air Carrier Certificate (Certificate Number DALA026A, dated September 30, 1988) to Delta Air Lines Inc., Hartsfield-Jackson Atlanta International Airport, Atlanta, GA 30354.

The Federal Aviation Administration (FAA) Southern Region, Certificate Management Office issued an approved Repair Station Certificate (Certificate Number DALR026A, dated December 23, 1983) to Delta Air Lines, Inc., d/b/a Delta TechOps and/or DTO whose business address is 1775 M. H. Jackson Service Road Hartsfield-Jackson International Airport, Atlanta, GA 30354 with the following ratings: Airframe, Powerplant, Radio, Instrument, Accessory, Limited Non-Destructive Inspection, Testing and Processing (July 21, 2003) and Limited-Emergency Equipment (April 20, 2000).

The Federal Aviation Administration (FAA) Southern Region, Certificate Management Office issued an approved Satellite Repair Station Certificate (Certificate Number DAL2026A, dated January 2, 2011) to Delta Air Lines, Inc., d/b/a Delta

TechOps and/or DTO whose business address is 7500 Airline Drive, Minneapolis, MN 55450 with the following ratings: Limited Airframe, Limited Engine, Limited Instrument, Limited Radio, Limited Non-Destructive Test, and Limited Accessory, Limited - Emergency Equipment (December 24, 2014).

2.0 Operations Specifications (OpSpecs)¹

Delta Air Lines has a Part 121 Air Carrier Certificate, which includes the standards, terms, conditions, and limitations contained in the FAA approved Operations Specifications (Parts D and E).

- A. Air carrier was authorized as a 14 CFR Part 121 operation.
- B. Per section D072 of the OpSpecs, the Continuous Airworthiness Maintenance Program (CAMP) authorized Delta Air Lines to use the Technical Operations Policies and Procedures (TOPP) Manual 20-20-01 to maintain the airplanes.
- C. Per section D074 of the OpSpecs, Delta Air Lines was authorized to use a maintenance reliability program for its fleet of aircraft per the TOPP 20-40-05 Reliability Document D074 dated 3/10/2023. The Time Limitations for the overhaul, inspections and checks of the aircraft related systems including appliances and components controlled by the program are contained in Delta's TOPP 20-20-27 (B717) Manual.
- D. Per section D085 of the OpSpecs that contains the aircraft listing including N955AT.
- E. Per section D090 of the OpSpecs, Delta Air Lines was authorized to utilize C.A.S.E.² as a means of qualifying a vendor for services, parts, and materials to satisfy the requirements of 14 CFR Section 121.373.
- F. Per Section D095 of the OpSpecs, Delta Air Lines was authorized to use an approved Minimum Equipment List (MEL).
- G. Per Section D097 of the OpSpecs, the FAA has approved sections of Delta Air Lines maintenance program for the compliance of Repairs Assessment for Pressurized Fuselages (121.1107), Supplemental Inspections (121.1109), Fuel Tank Systems Maintenance Program (121.1113), Flammability Reduction

¹ Operations Specifications contains the authorizations, limitations, and certain procedures under which each kind of operation, if applicable, is to be conducted by the certificate holder.

² The Air Carriers section of the Nonprofit Coordinating Agency for Supplier Evaluations (C.A.S.E.) was organized as a means of sharing non-prejudicial supplier quality approval data among the membership Air Lines. This increases surveillance coverage of suppliers and thereby upgrades their quality programs. It also has an economic impact on each C.A.S.E. member by decreasing the cost of supplier surveillance and making their surveillance programs more effective

Means (121.1117) and Electrical Wiring Interconnection Systems (EWIS) Maintenance Program (121.1111).

- H. Per section E096 of the OpSpecs, Delta Air Lines was authorized for a Weight and Balance Program (TOPP 20-10-25). Delta Air Lines was authorized under 14 CFR Part 121 subpart 121.153(b) to use fleet aircraft weights outlined in their Weight and Balance Program. The Weight Sampling Program was every 36 months.

3.0 Type Certificate Data Sheet

The Type Certificate Data Sheet (A6WE) prescribes conditions and limitations under which the product for which the Type Certificate (TC) was issued meets the airworthiness requirements of the Federal Aviation Regulations. According to the document, The Boeing Company is the holder of the TC.

4.0 Aircraft Information

The Boeing Company manufactured the accident aircraft on October 2, 2000. A standard airworthiness certificate was issued November 15, 2000. The aircraft was operated and registered with other airlines prior to Delta acquiring and operating the aircraft. The aircraft was leased by Delta Air Lines and owned by Wells Fargo Trust Company on August 19, 2013, with 39,582 total hours and 26,641 total cycles. The aircraft was placed on the Delta OpSpecs on March 24, 2014. The aircraft had 60,831.87 total hours with 43,224 total cycles at the time of the accident.

The aircraft was equipped with two Rolls Royce engines and a Hamilton Sundstrand auxiliary power unit (APU). The engines and APU had accumulated the following operating times at the time of the accident:

Table 1 - Engine and APU Information

	No.1 Engine	No.2 Engine	APU
Manufacturer	BMW Rolls Royce	BMW Rolls Royce	Hamilton Sundstrand
Part Number	BR700-715C1-30	BR700-715C1-30	APS2100
Manufacture Date	9/21/2000	10/07/1999	8/3/2000
Date Installed	9/26/2018	12/28/2019	7/7/2020
Serial Number	13208	13145	SPE0010049
Time Since Overhaul (Engine /APU hours) at installation	21,355.0	17,497.31	6,157.34
Total Cycles Since Overhaul (Engine/APU cycles) at installation	16,925	13,956	5,418
Engine Total Time Hours	52,020	52,103	51,673.21
Engine Total Cycles	37,606	37,376	43,972

5.0 Maintenance and Inspection Program

The maintenance program was developed using the Maintenance Steering Group (MSG-3) analysis logic. All Maintenance Planning Documents (MPD) were incorporated into the Delta Air Lines Maintenance Program. Airworthiness Directives and Manufacturer Service Bulletin compliance were written into the program as applicable. Additionally, all Zonal and Structural tasks were written into the Delta Air Lines maintenance program.

Table 2 - Maintenance Check Intervals

Check	Time Limit
Transit Check (Oil/Hydraulics/Oxygen)	4 Day
Service Check	9 Day
1A-Check	720 Flight Hour
2A-Check	1,440 Flight Hour
B-Check	365 Days or 1,800 Flight Hour
C-Check	730 Day or 6,600 Flight Hour
C2-Check	1460 Day or 13,200 Flight Hour
H-Check	2,556 Day (7 year)

The following is a listing of the previous inspections accomplished on airplane N955AT.

Table 2 - Maintenance Checks

Check	Last Check Date	Location	Total Time	Total Cycles
Transit Check	6/28/2023	ATL	60,831.52	43,224
Service Check	6/24/2023	ATL	60,821.05	43,215
1A-Check	4/3/2023	ATL	60,274.19	42,735
2A-Check	2/23/2023	MSP	60,019.26	42,512
B-Check	12/2/2022	ATL	59,493.33	42,053
C-Check	3/19/2022	QRO	57,886.17	40,566
C2-Check	3/19/2022	QRO	57,886.17	40,566
H-Check	3/22/2018	QRO	49,248.43	33,958

6.0 Continuing Analysis and Surveillance System (CASS)³ and Reliability Program

The CASS program was in place to provide surveillance and analysis of the Delta Air Lines CAMP for its performance and effectiveness. Delta Air Lines conducted monthly CASS meetings, which according to Delta representatives; the FAA representatives were invited to attend.

Reliability programs provide a method for relating operating experience to established maintenance controls. The program described in the document presents the philosophy and operation of Delta Air Lines' Reliability Program. The reliability program is intended to fulfill the long-term mechanical performance monitoring and the emergency mechanical response functions as part of Delta's Continuing Analysis and Surveillance System TOPP 20-40-40. The audit function interfaces with mechanical performance monitoring and emergency mechanical response via Delta's Reliability Program. Quality Assurance (see TOPP 20-60-05) periodically reviews the Reliability Program either in whole or parts. The purpose of the Quality Assurance audit and internal evaluation reviews are to ensure linkage and compliance with written procedures and highlight areas for improvement.

Additionally, Delta Air Lines has an FAA approved Reliability Program. The program monitors the operations to ensure established reliability levels are achieved. The program was intended to fulfill the long-term mechanical performance monitoring functions of CASS (121.373). The Reliability Program defines the time limitations or standards for determining intervals between restoration, inspections,

³ As established by 14 CFR Part 121.373, each certificate holder shall establish and maintain a system for the continuing analysis and surveillance of the performance and effectiveness of its inspection program and the program covering other maintenance, preventative maintenance, and alterations and for the correction of any deficiency in those programs, regardless of whether those programs are carried out by the certificate holder or by another person.

and checks of airframes, powerplants, appliances and emergency equipment and serves to satisfy the requirements of 14 CFR Part 119.49(a)(8), 119.5, and 121.135. The Reliability Program has implemented adequate controls such as the systems used to collect the data, methods used to analyze the data, and their application to maintenance controls, development and maintenance of performance standards, implementation of corrective actions, etc. (TOPP 20-40-05).

CASS and Reliability Reports were generated from each program monthly. The reports typically contain Airline Operational Performance metrics, Organizational metrics, Fleet Engine and Component dispatch reliability metrics, Delay and Cancellations, Airline project status and Quality Assurance Audits.

7.0 Minimum Equipment List (MEL)⁴

Delta Air Lines was authorized to use an approved MEL on its airplanes, per its OpSpecs. At the time of the accident, there was one open MEL item in the airplane logbook and electronic records for the forward right fuel boost pump.

8.0 Supplemental Type Certificates (STC)⁵

Supplemental Type Certificates (STCs), supplied by air carrier, were reviewed. There were no STCs that affected the nose landing gear.

9.0 Airworthiness Directives (AD)⁶ and Service Bulletins (SB)

Delta Air Lines provided an AD summary for review. The AD summary contained the applicable service bulletins. A review of Airworthiness Directive status lists for the airplane, powerplants and appliances were conducted. All ADs applicable to this airplane were either implemented or being tracked for compliance. No discrepancies were found during the review.

AD 2007-11-13 superseded by AD 2017-01-03 – AD 2007-11-13 required revising the Airworthiness Limitations Section (ALS) of the Instructions for Continued Airworthiness to incorporate new removal limits for certain components of the flap system and to reduce the inspection intervals for fatigue cracking of principal structural elements (PSE). This new AD (2017-01-03) requires revising the maintenance or inspection program, as applicable, to incorporate reduced intervals for the inspections for three PSEs and add nondestructive inspections (NDIs). The Nose Landing Gear (NLG) upper lock link is included in Principal Structure Element. This AD did not specifically look for surface

⁴ The FAA approved Minimum Equipment List contains a list of equipment and instruments that may be inoperative on a specific aircraft for continuing flight beyond a terminal point.

⁵ The FAA issues Supplement Type Certificates, which authorize a major change or alteration to an aircraft, engine or component that has been built under an approved Type Certificate.

⁶ Airworthiness Directive (AD) is a regulatory notice sent out by the FAA informing the operator of an action that must be taken for the aircraft to maintain its airworthiness status.

roughness in the upper lock link. According to the FAA 8130 Form, the AD was complied with on August 8, 2013, by Israel Aerospace Industries, LTD and met the requirement of 2017-01-03.

SB 717-32-0002 NLG Upper lock link assembly. Inspect lock link for tool marks and/or rough surface finish across the parting plane that can cause stress concentration and cracks along the forged parting plane of the upper lock link. Part number 3914464-509⁷, serial number 0007 delivered 2/1/2001. A "V" was later added after the part number per service bulletin instructions to indicate the SB was complied with. According to Delta Records, upon Delta's purchase of the airplane from Southwest Airlines (August 19, 2013), Southwest Airlines did not list SB 717-32-002 on the service bulletin status in the delivery documents.

10.0 Aircraft Flight Logs

Electronic Aircraft Flight Logs were reviewed from April 1, 2023, to June 28, 2023. The review focused on the hydraulic and nose landing gear system. The following are noted:

May 11, 2023 - Both nose landing gear tires worn. Replaced both tires.

April 12, 2023 - Nose gear very creaky during taxi. Maintenance lubed the NLG actuators and collar per AMM 12-21. Ops checked normal.

February 19, 2023 - A/C pulls to the left during taxi. Tiller pressure required to keep nosewheel centered. Found left nose tire pressure low, serviced.

11.0 Weight and Balance Summary

Per the Delta Air Lines OpSpecs, the airplanes were to be weighed every thirty-six (36) calendar months using a fleet sampling program. The last actual weight and balance on the airplane was accomplished on March 15, 2022. The aircraft was maintained in compliance with the Fleet Average Weight program defined in the

⁷ The link was originally manufactured as a -505. Prior to original delivers, it had McDonnell Douglas Engineering Order (EO) 3914464 Rev. Z, dated December 2001, incorporated. Per the EO instructions, it was identified as 3914464-509. P/N 3914464-509, S/N 0007 was delivered on Fuselage No. 5051 (A/C S/N 55020) in February 2001.

In June/July 2009, the link was removed from the originally installed airplane to have Service Bulletin 717-32-002, dated December 2001, incorporated. According to records, the gear including the link was sent to Israel Aerospace Industries (IAI) for overhaul. The IAI AD and SB listing shows SB 717-32-0002 as accomplished with a link P/N 3914464-509V. The link had been in service for 17,313 flight cycles at Service Bulletin accomplishment.

P/N 3914464-509V, S/N 0007 was then installed on A/C S/N 55076. The link remained in service for an additional 7,365 flight cycles, when it was removed with the landing gear for landing gear overhaul.

After overhaul, the link was installed on the event airplane, N955AT (A/C S/N 66017) in March 2014 and remained on the airplane until the event.

Weight and Balance Manuals. The figures for the last weight and balance are shown below:

Basic Operating Weight: 68,323 pounds
Arm: 771.20 inches
Moment: 526,907.72 lb-inches

Based on fleet calculations on May 16, 2022, the weight and balance calculations were adjusted to the following:

Basic Operating Weight: 68,257 pounds
Arm: 772.08 inches
Moment: 527,001.56 lb-inches

12.0 Service Difficulty Reports (SDR)⁸ and Mechanical Interruption Summary Report (MISR)⁹

The Maintenance Records Group analyzed the SDR for the accident aircraft starting from 2003. The review focused on the landing gear and hydraulic system. There were two SDRs that affected the landing gear.

June 28, 2023 - Flight crew declared an emergency, unable to extinguish the NLG unsafe light. Quick Reference Handbook (QRH) complied with, unable to extinguish the unsafe light. Crew made a successful nose gear up landing and maintained runway centerline.

April 2021 - Flight crew declared an emergency while on approach due to proximity switch electronic unit fail illuminating. Crew complied with the QRH and reset the ground proximity circuit breaker. Uneventful landing at normal speed, but then the auto ground spoiler fail spoiler fault and cabin pressure main failure all illuminate. Maintenance ran a build-in test equipment check and it faulted the weight on wheels sensor. Right weight on wheels sensor was replaced and adjusted.

⁸ As required under 14 CFR 121.703, each scheduled operator is to report the occurrence or detection of each failure, malfunction or defect concerning (a) fires during flight, (b) false fire warning during flight, (c) engine exhaust system that causes damage during flight, (e) an aircraft component that causes accumulation or circulation of smoke, vapor, or toxic or noxious fumes during flight, (f) engine shutdown during flight, (g) a propeller feathering, (h) aircraft structure requiring major repairs, (i) cracks, corrosion, (j) other safety critical issues as stated in the FAR part. These occurrences must be reported within 72 hours of the event.

⁹ Each scheduled operator is required under 14 CFR Part 121.705 to submit a summary of any (a) interruption to flight, (b) unscheduled change of aircraft enroute, or unscheduled stop or diversion from a route caused by known or suspected mechanical difficulties or malfunctions that are not required to be reported as service difficulty reports.

13.0 Major Repairs and Major Alterations

Major repairs and major alterations for the aircraft, engines, and APU were documented and reviewed. No major repairs or major alterations for the NLG and supporting structure were accomplished on the airplane.

14.0 Time Limit Components

Time Limit component status for the airplane, the landing gear, the two installed powerplants and the APU were reviewed. The review focused on the NLG that was installed on N955AT.

Table 4 - Time Limit Components

NLG Component	Part Number and Serial Number	Flight Cycle Limit	Cycles Remaining	Total Hours	Total Cycles	Overhaul / Replacement Date	Total Hours since Overhaul	Total Cycles since Overhaul
Housing Assembly	PN 32-0500-005, SN 76	39,887	5,527	48,500.87	34,360	3/5/2014	21,249.87	16,583
Lower Lock Link	PN 3913968-513, SN CPI177	59,333	22,860	52,309.57	36,473	11/27/2017	11,583.17	9,266
Upper Lock Link	PN 3914464-509V, SN 7	46,500	5,243	57,482.00	41,257	3/5/2014	21,249.87	16,583
Outer Cylinder	PN 5920602-511, SN 7	300,000	265,859	46,426.87	34,141	3/5/2014	21,249.87	16,583
Metering Pin	PN 5963256-1, SN 74	300,000	264,978	47,719.87	35,022	3/5/2014	21,249.87	16,583

15.0 Nose Landing Gear

The Maintenance Group reviewed the records associated with the nose landing gear. The historical history for the NLG and lock link were reviewed and the following are noted.

Table 5 - NLG Maintenance Program

Delta ID	Task	Description	Frequency	Accomplished
75805	Lubricate	NLG Shock Strut, Cylinder, Housing, Steering Lever, Piston, and Axle Fittings*	1,200 cycles	3/5/2023
75806	Restore	NLG Shock Strut, Cylinder, Housing, Steering Lever, Piston, and Axle Fittings (Upper and Lower Lock Links) **	20,000 Cycles 3,652 Days	8/8/2013
76247	Service	Service Nose and Main Landing Gear Struts	1,800 flight hours	3/4/2023
76249	Lubricate	Lubricate NLG Torque Arms	720 flight hours	5/11/2023
76250	Functional Check	Check NG torque arms	1C	3/19/2022

78784	Detect	NLG Tune Up*** (Inspect NLG components for corrosion and wear)	2,191 Days	3/1/2018
79277	Operational Check	Landing Gear Integrity Check**** (Inspect NLG Structure and wiring)	1C	3/19/2022
79428	General Visual Inspection	NLG Bungee Springs	1C	3/19/2022
84265	General Visual Inspection	NLG Bungee Over Center Linkage*****	1C	3/19/2022
90226	Restore	Nose Bungee Cylinder	H	2/21/2020

NOTE: The surface roughness condition observed in the failed lock link would not have been inspected for in the routine maintenance schedule.

* NLG lubrication task, Card number 1221-6001. Airplane Total time 60,085.52 and total cycles 42,568.

** The link assembly was overhauled in accordance with original equipment manufacturer manual ATA No. 32-21-2- Rev 49 by Israel Aerospace Industries, LTD. The assembly included the upper lock link PN 3914464-509V SN 0007. At that time the Lock Link Cycles Since New (CSN) was 24,678. At the time of the accident, the upper lock link had 41,257 total CSN. The upper lock link flight cycle limit is 46,500 with 5,243 cycles remaining.

*** Inspect nose landing gear components for corrosion and wear. Card number 3230-5002. Lock link total time 45,898.9, total cycles 31,991.

**** Inspect the NLG structure and wiring for integrity, card number 3262-2001. Airplane Total time 57,886.17 and Total cycles 40,566.

***** Nose gear bungee visual inspection of the bungee actuator for damaged mounting hardware, hydraulic fluid leakage, visible signs of dirt and debris in the cylinder. Inspect springs for proper alignment and fit, corrosion, damaged or bent spring attachment pulley and attachment lugs. Check for proper pulley arm orientation (55 degree) with Upper Lock Link Assembly. card number 3260-2003. Lock link total time 54,536.65, total cycles 38,599.

16.0 Method of Record Keeping

Delta Air Lines uses several different maintenance electronic systems (i.e. System Computerized for Economic Performance, Tracking, Recording and Evaluation (SCEPTRE)) to manage the various aspects of the maintenance program and configuration of their aircraft. Data for components installed, MEL/carry over/deferred item records, engineering authorizations, logbooks, engine records, etc. were entered into the aircraft computer records on a daily basis. A computer file history was maintained so that all inspections and checks were monitored for time limitations. The computer files were backed up daily to prevent total loss of history files. All hard copy documents are verified, scanned, audited and imaged and the hard copies are then shredded by Delta Air Lines. At this time, Delta Air Lines retains all maintenance historical files in the TechOps approved imaging system as outlined in Delta Air Lines TOPP 50-40-05.

17.0 Manuals

Delta Air Lines used the following manuals to maintain the airworthiness of its fleet and management of the airline.

Technical Operations Policy and Procedures (TOPP) - Manual outlines Delta TechOps policies and procedures used to comply with 14 CFR Part 121 regulatory

requirements and to provide information, policies, and procedures for the overall safety, administration, and operation of Delta's TechOps.

Minimum Equipment List (MEL) - List of equipment and instruments that may be inoperative on a specific aircraft.

Weight and Balance Manual - Weight and balance procedures to be followed by maintenance and flight operations personnel on all aircraft operated by Delta Air Lines.

Manufacturer Supplied and Delta Air Lines customized manuals - Aircraft/Engine Maintenance Manuals, Structural Repair Manuals, Overhaul Manuals, Wiring Manuals, Fault Isolation Manuals, Illustrated Parts Catalog, Corrosion Program Manual, NDT Manual, and Service Bulletins.

18.0 Flight Recorder Parameter Verification

The flight recorder parameter verification was a bi-annual task on the B717 fleet. The review process verifies that each parameter was being recorded correctly and if not, corrective action was taken. The parameter verification reviews the FAA mandatory parameters and select parameters that Delta Air Lines tracks. In addition, while accomplishing the parameter verification if an issue was observed with a non-required parameter corrective action is taken. The maintenance group reviewed the flight recorder parameter verification checklist for N955AT. The last check was completed March 24, 2022. The flight recorder was removed and sent to Delta for the parameter verification. All parameters passed the verification check.

Submitted by: Pocholo Cruz
Aerospace Engineer