NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington, D.C. 20594

June 2, 2020

Maintenance Records – Factual

NTSB No: ERA20MA001

A. ACCIDENT

Location:	Windsor Locks, CT
Date:	October 2, 2019
Operator:	Collings Foundation
Time:	09:53 Eastern Daylight Time
Aircraft:	Boeing B-17G, Registration N93012

B. MAINTENANCE RECORDS

Gregory Borsari
National Transportation Safety Board
Washington, D.C.

C. SUMMARY

On October 2, 2019, at 0953 eastern daylight time, a Boeing B-17G, N93012, owned and operated by the Collings Foundation, was destroyed during a precautionary landing and subsequent runway excursion at Bradley International Airport (BDL), Windsor Locks, Connecticut. The commercial pilot, airline transport pilot, and five passengers were fatally injured. The flight mechanic/loadmaster and four passengers were seriously injured, while one passenger and one person on the ground incurred minor injuries. The local commercial sightseeing flight was conducted under the provisions of Title 14 *Code of Federal Regulations* Part 91, in accordance with a Living History Flight Experience exemption granted by the Federal Aviation Administration (FAA). Visual meteorological conditions prevailed in the area and no flight plan was filed for the flight, which departed BDL at 0947.

TABLE OF CONTENTS

LIST OF ACRONYMS

AC	ADVISORY CIRCULAR
AD	AIRWORTHINESS DIRECTIVE
CAR	CIVIL AVIATION REGULATION
CFR	CODE OF FEDERAL REGUALTIONS
COMM	COMMUNICATION
ELT	EMERGENCY LOCATOR TRANSMITTER
FAA	FEDERAL AVIATION ADMINISTRATION
FSDO	FLIGHT STANDARDS DISTRICT OFFICE
GPS	GLOBAL POSITIONING SYSTEM
GS	GLIDE SLOPE
IAW	IN ACCORDANCE WITH
LH	LEFT HAND
LLC	LIMITED LIAIBILITY COMPANY
LTC	LIMITTED TYPE CERTIFICATE
NAV	NAVIGATION
No.	NUMBER
RH	RIGHT HAND
SDR	SERVICE DIFFICULTY REPORT
STC	SUPPLEMENTAL TYPE CERTIFICATE
T.O.	TECHNICAL ORDER

D. DETAILS OF INVESTIGATION

1.0 Aircraft Information

Aircraft registration number N93012, serial number 32264 was a Boeing B-17G. The FAA Flight Standards District Office (ASO-FSDO-15) issued a special airworthiness certificate, limited category aircraft (not for hire) on December 10, 2002. According to the registration issued March 22, 2007, CCT of 1979 B-17 Series, LLC[1] is the registered owner. The airplane had 11,388.0 total

[1] February 2, 2006 the registration application amended the name from Collins Children Trust to The CCT of 1979 B-17 Series LLC B-17 Series.

flight hours on September 23, 2019, the most recent recoverable onboard[2] airworthiness release form that included flight hour data.

The airplane was equipped with four Wright Cyclone 9, model R-1820-97 engines and four Hamilton Standard 23E50 Propellers. The engines and propellers had accumulated the following times as of September 23, 2019, see Table 1.

Table 1 - Engine and Propeller Information

	No.1 Engine	**No.2 Engine**	**No.3 Engine**	**No.4 Engine**
Manufacturer	Wright Aeronautical Company	The Studebaker Corporation	The Studebaker Corporation	Unknown[3]
Model Number	R-1820-97	R-1820-97	R-1820-97	R-1820-97
Serial Number	46465	130945	SW-041978	156819
Date of Overhaul	January 8, 2019	December 10, 2018	January 15, 2018	May 13, 2015
Date Installed	February 21, 2019	January 16, 2019	September 15, 2018	January 15, 2016
Time Since Overhaul (hours)	250.0	267.4	290.7	1,105.6
	No.1 Propeller	**No.2 Propeller**	**No.3 Propeller**	**No.3 Propeller**
Manufacturer	Hamilton Standard	Hamilton Standard	Hamilton Standard	Hamilton Standard
Part Number	23E50-473	23E50-473	23E50-473	23E50/6477A-0
Serial Number	NKR1643	FA3962	146287	P44285
Date of Overhaul	January 10, 2007	January 10, 2007	January 10, 2007	January 5, 2009
Time Since Overhaul (hours)	3567.3	2595.9	3567.3	2880.7

2.0 Limited Type Certificate Data Sheet

The Limited Type Certificate Data Sheet (L-1-3) prescribes conditions and limitations under which the product for which the Limited Type Certificate (LTC) was issued meets the airworthiness requirements of the Federal Aviation Regulations. According to the document dated December 2, 1946, the LTC holder is Transcontinental and Western Air, Inc.

[2] The onboard daily status sheets (logs) and daily release forms that were recovered from the wreckage were fire damaged and fuel soaked. The top set of sheets presumed to be from September 24 to the date of the accident were not recoverable.

[3] Engine data plate partially unreadable. Engine logbooks that were reviewed did not contain manufacturer details.

3.0 Special Airworthiness Certificate

On December 10, 2002 the FAA Orlando, FL. Flight Standards District Office issued a Special Airworthiness Certificate, Limited Category. Designated LTC (AL-1-3) for Boeing B-17G, N93012, serial number 32264 for the purpose of operation of limited category aircraft (Not for Hire). See Attachment one.

4.0 Limited Category Operating Limitations

Limited Category Operating Limitations (AL-1-3) issued by the FAA Orlando, FL. Flight Standards District Office on December 10, 2002 for Boeing B-17G, registration N93012, serial number 32264 contains the following limitations.

A. No person may operate this aircraft unless the FAA Form 8130.7, Special Airworthiness Certificate is displayed at the cockpit entrance so that it is visible to passengers or crew.
B. This aircraft shall be operated in accordance with applicable air traffic and general operating rules of Part 91, and all additional limitations herein prescribed under the provisions of Section 91.315. These operating limitations are part of the FAA Form 8130.7 and are to be carried aboard the aircraft at all times for availability to the pilot in command of the aircraft.
C. Any persons carried in flight aboard this aircraft other than the pilot or co-pilot shall be considered passengers.
D. Any persons carried in flight aboard this aircraft other than the pilot and co-pilot shall be seated in an approved seat with a seat belt fastened during ground movement and take-off and landing operations.
E. In addition to the pilot and co-pilot seats, an approved seat shall be those seats which meet the structural requirements of CAR 4b and are installed using data provided in Aerodesign Report Number 1194-1 and subsequent revisions. There are 10 such seats in this aircraft.
F. This airplane must be operated at all times within the limitations set forth in TO AN01-EG-1 for B-17G except in cases of maximum loadings and airspeed limits in which cases the values given in Aircraft Specification no. AL-1 must be observed. A copy of the TO and the aircraft specification must be carried in the aircraft during flight.
G. The following placard shall be prominently displayed in the passenger compartment. “This is a military type aircraft and under the civil air regulations shall not be used for the carriage of passengers or cargo for compensation or hire.”

5.0 Boeing B17-G Maintenance Inspection Program

The B17 continuous airworthiness inspection program for the B-17G consists of four inspections conducted at a 25-hour interval. Inspections one through four performed sequentially each 25 flight hours and then repeated. The number one inspection is performed 25 flight hours after the number four inspection. The number two inspection is performed within 50 flight hours of flight time. The number three inspection is performed within 75 flight hours of flight time. The number four inspection is performed within 100 hours of flight time. There is also a periodic inspection that is performed whenever the aircraft has not been flown in the last 30 days.

The number one, 25-hour inspection is for the number one engine and leftwing area. The inspection covers the open up and inspection of engine related items such as cowls, fuel system, oil system, engine cylinders, engine exhaust and intakes, generator, cowl flaps, air-oil separator, carburetor, fuel pump, vacuum pump, tach generator, fluid lines, ignition harness, magnetos, oil tank, push rod housing, baffles, engine compression and engine controls. The number one, 25-hour inspection includes the number one propeller. There are items for checking the hub, inspecting the blades, propeller track, inspect the governor for leaks, and inspecting the feathering pump. In addition, the number one 25-hour inspects the left-hand wing for such items as inspecting the left wing for general condition, cracks, loose screws or corrosion. Inspect wing joint terminals, attachment plates and flanges for security, cracks and elongated holes. Check aileron control surface lock system operation. Check ailerons for internal damage, corrosion, deterioration and torn fabric or skin wrinkles, missing rivets, excessive play, attaching brackets and bracket supports for cracks, loose or missing bolts, pins and safetying. Check aileron mechanism, including bearings, screws, torque tubes, connecting rods, chains and actuating cylinders, pulleys, bell cranks, guides, turnbuckles, hinges and hinge fittings. The left and right wing flaps are inspected for condition of skin, corrosion, security of attaching hardware. With the flaps lowered the flap cables, pulleys, bell cranks and carriages are inspected. Flap operational check for freedom of operation, flap asymmetry and proper travel. The leftwing nacelles structure is inspected for dents, cracks, loose rivets, corrosion, buckling, and the nacelle junction box for security. The left wing fuel system aft of the firewall inspection incudes inspecting the fuel lines for cracks, leakage, connections, sharp bends and hose clamps for general condition. Fuel strainers and drain cocks are checked. Fuel shut off valves for leaks and proper operation. Fuel filler cap gaskets for condition and cap security is checked. Fuel cells mounting supports are checked for security and all fuel quantity transmitter mounting flanges are checked for leaks.

The number two 25-hour inspection is for the number two engine, number two propeller and the right wing and covers the same items as described for the number one 25-hour inspection but are for the number two engine and right wing.

The number three 25-hour inspection is for the number three engine, number three propeller, the empennage, instrument inspection and fuselage inspection. The number three engine and propeller inspection items are the same as described previously for the number one engine and propeller inspection items.

All instruments are inspected for broken glass, looseness and cleanliness as well as for security of mounting, proper range markings, condition and legibility. The instrument panel shock mounts are inspected. Fuel and oil pressure transmitters are bled, checked for leaks, security and condition. Manifold pressure gauges are checked including the lines. All engine instrument lines are checked. Vacuum oil separator is removed and cleaned. Vacuum relief valve screens are cleaned. Pitot static lines are checked. Pitot static tubes are checked. Clock is checked for proper operation. Magnetic compass is inspected for liquid discoloration, leakage, and air bubbles, as well as the correction card. Directional gyros and artificial horizon are checked for proper caging. All placards are checked for security and legibility. The number three 25-hour inspection checks the fuselage exterior for general condition of the skin, corrosion or evidence of structural defects. Cabin and cockpit windows are inspected for crazing, cracks, security and general cleanliness. The interior is checked for security of all equipment, portable fire extinguishers are inspected. The hydraulic

pump and motor are checked for proper operation and the accumulator is checked. Cockpit seats and seatbelts are checked. Cockpit interior lighting is checked. Flight controls and trim tabs are checked for proper operation. Control column torque tubes, arm assemblies and connecting rods are checked for proper operation, lubricated and proper function. Cables are inspected for frayed wires and proper tension. Turnbuckles, pulleys, guides, fairleads, links, brackets and fittings are checked for proper attachment and safetying. Rudder pedals are checked are inspected for condition, proper function and lubrication. Mixture control lever is stop wire is checked for stretching or breakage. Fuel transfer valves are checked for proper operation, security and leakage. The number three 25-hour inspection also inspects the hydraulic system. Items such as hydraulic lines, valves, units are checked for leakage and proper condition. Flexible lines are checked for deterioration. Hydraulic valves are checked for proper operation as well as the hand pump. The hydraulic accumulator is checked for proper charge, leakage and operation. Electric pump is checked for condition, proper operation and security. Cowl flap cylinder assemblies are checked for proper operation.

The number four 25-hour inspection is for the number four engine, number four propeller, the landing gear inspection and an equipment inspection. The number four engine and propeller inspection items are the same as described previously for the number one engine and propeller inspections.

The landing gear check includes inspecting the drag links, retract mechanism, shock struts, shock strut inflation, an inspection of the entire gear installation and retract system for cracks, bends, security and elongated bolt holes. Inspected for loose or missing hardware. Lubricate entire landing gear system. Check of the retract screw for wear and general condition. With aircraft on jacks the landing gear retraction and extension system is checked both electrically and manually for proper operation. The tail gear shear bolt is checked for condition. Tail gear retract mechanism is checked. Tail gear retracting screw is lubricated. Anti-shimmy brake is checked for proper torque. Wheels are inspected for distorted rim flanges, security of retaining bolts and nuts, cotter pins and general cleanliness. Wheel bearings are removed, cleaned, inspected, lubricated and re-installed. Brakes are checked for leaks, wear and proper operation. Shock struts are serviced with hydraulic oil and inflated to the proper level. The landing gear extension and retraction system is checked. With the landing gear retracted the tire clearance with the nacelles are checked. The tire snubbers are checked for proper contact with the gear retracted.

Cockpit seats are checked for proper functioning and lubrication. Safety belts are inspected. Shoulder harnesses and inertia reels are checked. Windshield defroster tubes are checked. Wiper blades are inspected. Engine fire extinguisher is checked. Heating and ventilation outlets are checked. First aid kit is checked. Flashlights, spare bulbs, and batteries are checked for proper storage. Certificates are checked as well as the ELT battery date and check for the presence of the Pilot's Operating Instruction Manual, Operation Limitation Manual and Logbooks.

Aircraft maintained under the Boeing B-17-G approved inspection program do not require an annual inspection but still require certain items, which are done within a twelve-calendar month period and are contained in the periodic section of this program. Items such as the emergency locator beacon, ATC transponders, Air Data System, Avionics equipment check, and other calendar time items are found within the periodic section number 8.

Table 2 – 25-Hour Inspection

Inspection	Date of most recent Inspection	Total Time
No.1	July 28, 2019	11,314.6
No.2	August 17, 2019	11,338.6
No.3	September 7, 2019	11,364.4
No.4	September 23, 2019	11,388.0
Annual Inspection	January 16, 2019	11,120.6

6.0 Airworthiness Directives (AD)[4]

An airframe, engine and propeller logbook review for AD compliance was conducted. The review concentrated on the engines, propellers, fuel, and ignition systems. No discrepancies found. The following AD's are noted, see Table 3

Table 3 – Airworthiness Directives

AD Number	Description
51-12-01	Non carburized piston pins.
73-20-02	Cracking in the front spar lower cap center section.
77-17-11	Cracking in the rear spar lower cap center section.
81-13-06R2	Prevent propeller blade failure due to corrosion.
2001-22-06	Detect cracking and corrosion wing spar chords, bolts, bolt holes and wing terminals.

7.0 Aircraft Logbook Review

Aircraft, engine and propeller logbooks were kept at American Aero Services where the aircraft was maintained during the off season. While on tour, daily flight status sheets were utilized to track aircraft, engine and propeller times, as well as discrepancies and corrective actions taken. The NTSB recovered the majority of the daily flight status sheets from the wreckage and reviewed from March 15, 2019 thru September 23, 2019 (most recent recoverable entry). Aircraft, engine, and propeller logbooks were also reviewed. The review focused on routine tasks as well as any special inspections and/or operational discrepancies on the airplane. The following items are noted as written in the status sheets and logbooks.

- August 17, 2019 – Engine No.2, stuck valve on cylinder No.7. Staked valve, performed compression test.
- August 11, 2019 – Engine No.3 left magneto removed and replaced. Part number SF9LU2, serial number DD-8052 installed.

[4] 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.

- August 2, 2019 – Removed and replace inner brake assembly. Part number H2-454-1.
- July 2, 2019 – Oil changed in all four engines with Aeroshell W120.
- June 7, 2019 – Primer wire on engine No.3 came loose in the junction box. Replaced wire ring terminal.
- May 24, 2019 – No.3 engine, No.6 cylinder right valve failed. Replaced cylinder. Part number 890555, serial number H528632 installed.
- May 20, 2019 – Engine No.1 prop governor needed adjustment. Was not making take-off power. Adjusted pulley. Engine No.2, cylinder No.6 pushrod tube leaking. Installed new seals.
- May 16, 2019 – Replaced both main tires.
- May 13, 2019 – Push rod tubes engine No.2 cylinders 4, 5 & 6 leaking. Replaced push rod seals. Voltage regulator putting out too much voltage. Replaced voltage regulator part number 1589-1-F, serial number RK55844 installed.
- May 11, 2019 – Repaired burned wires that were overheating in the left lower cockpit where the generator gauges are.
- May 10, 2019 – Engine No.4 torching, no increase in idle on shutdown. Ordering new carburetor.
- April 26, 2019 – Replaced voltage regulator part number 1589-1-C, serial number AE60080.
- March 28, 2019 – Completed inspection on number two engine. Suspect blower seal is leaking. Compression good.
- March 18, 2019 – Re-inflate tail strut. Second time since annual.
- March 15, 2019 – Generator engine No.3 failed. Removed and replaced generator part number P-1 (Delco-Remy), serial number 13272.
- January 18, 2017 – Repaired engine number four magneto "P" lead wire by replacement.

8.0 Weight and Balance

The aircraft basic empty weight and balance figures as recorded on the weight and balance clearance form dated January 18, 2000 which includes engine oil are as follows:

Basic Empty Weight:	38,735	pounds
Arm:	282.5	inches
Moment:	10,840	lb-inches

9.0 Service Difficulty Reports (SDR)[5]

A query of the FAA SDR database was conducted for N93012 from October 1, 2014 to October 1, 2019. There were no SDRs found on file for the accident aircraft. While not required for general aviation, reporting a service difficulty is recommended.

[5] A Service Difficulty Report (SDR) is a report of the occurrence or detection of each failure, malfunctions, or defects as recommended by AC 20-109A for general aviation.

10.0 Major Alterations and Major Repairs

A records review of the FAA Airworthiness file for N93012 showed there were 10 major alterations and 24 major repairs on file for the accident airplane. The following major alterations and repairs are noted.

A. Major Alterations

- March 15, 1995 – Installed eight passenger seats. All work done in accordance with Aerodesign Report 1191-4, revision 1R dated January 25, 1995. Weight and Balance change negligible.
- March 27, 2001 – Installed Aviation Development Corporation oil filter system part number 6000010-1 on No.1, No.2 No.3 and No.4 engines. Installation of the oil filter system in (No.1 and No.4) and (No.2 and No.3) are the same In all installations two Aviation Development Corporation oil filter (PN 6000010-1) were installed in parallel between the engine oil outlet and the oil tank. On engines No.1 and No.4 the filters were installed in each engine nacelle at station 2C. On engines No.2 and No.3 the filters were installed in the leading edges of each wing between stations 8 and 9.
- March 24, 2004 – Installed four engine pre-oiler pumps with associated wiring and plumbing. Work done in accordance with AC 43.13.1B (hose installation and electrical wiring), and AC 43.13.2A (pump installation).
- March 30, 2005 – Removed the following equipment: 1 each King KX155 Nav/Comm., KI208 Nav Ind., KT76A Transponder, and 1 each Northstar 660 GPS/lrn C. Installed the following equipment: 1 each Garmin GNS480 GPS/COMM/NAV/G/S Receiver. 1 each Mid-Continent MD200-306 Nav/GPS Indicator. 1 each Aero Ant 590-1104 GPS Antenna. 1 each Garmin GTX330 Transponder.

B. Major Repairs

- April 12, 1991 – Removed skins as required to access No.3 engine inboard and outboard nacelle longerons and No.2 engine outboard nacelle longeron. Repaired damage to above longerons in accordance with Aerodesign Aircraft Engineering Report No. 455-1 dated April 6, 1991. Reinstalled skins removed for access.
- April 3, 1992 – Removed skins as required to access right hand wing upper aft spar cap wing stations 2 to 4. Repaired damage to spar IAW T.O. 01-20E-3 and Boeing structural repair manual. Reinstalled skins.
- April 3, 1992 - Removed skins to access right lower aft horizontal spar cap. Removed and replaced lower aft horizontal spar cap using cap manufactured to original material, size, shape specs per T.O. 01-20-E-3. Reinstalled skins.
- February 17, 1994 – Removed wing trailing edges from stations 1 – 13 on both sides to gain access to spar cords. Removed and replaced spar cords stations 1 – 5 in accordance with B-17G T.O. No. 01-20E-3. Replaced both wing trailing edges in accordance with same T.O.
- January 20, 2001 – Removed and replaced left hand inboard and outboard aileron attach point lower cord (station 33) in accordance with B-17G Structural Repair Manual T.O. No. 01-20E-3. All parts etched, Alodine, primed and top coated before installation.

- January 1, 2002 – Recovered left and right ailerons with Poly fiber heavy duty 3.4 ounce fabric. All work done in accordance with STC SA1008WE.
- January 1, 2002 – Replaced outboard leading edge from station 158.5 to 229.3 second skin aft of leading edge between stations 28 and 168 and first two skins aft of leading edge between stations 168 and 229.3 on righthand horizontal. Installed access doors in lower skin of righthand horizontal in accordance with T.O. No. 01-20E-2, Section IV, Figure 15.
- January 13, 2003 – Removed and replaced 3 corrugation doublers in right hand wing outer wing panel at station 20. All work done in accordance with T.O. 01-20E-3.
- March 23, 2004 – Replaced upper fuselage nose skins from station 1 to station 3 and waterlines LH (K) to RH (L). Replaced upper and leading edge skins from stations 28 to station 229.3 on left and right horizontal. Replaced upper skins on right hand and left hand outer wings from station 19A to station 33. Replaced upper wing skins of main wing from rear spar to trailing edge and station 1 to station 19A. All work done in accordance with Structural Repair Instructions B-17G T.O. No. 01-20E-3 and AC43.13.
- December 30, 2016 – Recovered left and right elevator in accordance with STC SA1008WE. Manual No.1.

11.0 Method of Record Keeping

Per CFR Parts 43 and 91, maintenance records for the aircraft, engines, propellers and components with the use of aircraft, engine and propeller logbooks.

12.0 Record of Conversation

Mr. Mitchell Melton an A&P mechanic and load master was interviewed by Operational Factors and Maintenance Records on November 6, 2019. See Operational Factual report for the interview transcript.

Attachment 1

Special Airworthiness Certificate

UNITED STATES OF AMERICA

DEPARTMENT OF TRANSPORTATION – FEDERAL AVIATION ADMINISTRATION

SPECIAL AIRWORTHINESS CERTIFICATE

A	CATEGORY/DESIGNATION	LIMITED LTC (AL-1-3)	
	PURPOSE	OPERATION OF LIMITED CATEGORY AIRCRAFT (NOT FOR HIRE)	
B	MANU-FACTURER	NAME	N/A
		ADDRESS	N/A
C	FLIGHT	FROM	N/A
		TO	N/A
D	N93012		SERIAL NO. 32264
	BUILDER BOEING		MODEL B-17G
E	DATE OF ISSUANCE 12/10/2002		EXPIRY UNLIMITED
	OPERATING LIMITATIONS DATED 12/10/2002		ARE A PART OF THIS CERTIFICATE
	SIGNATURE OF AUTHORIZED REPRESENTATIVE [redacted] ALBERT		DESIGNATION OR OFFICE NO. ASO-FSD0-15

Any alteration, [illegible] of this certificate may be punishable by a fine not exceeding $1,000 or imprisonment not exceeding 3 years, or both. THIS CERTIFICATE MUST BE DISPLAYED IN THE AIRCRAFT IN ACCORDANCE WITH APPLICABLE FEDERAL AVIATION REGULATIONS.

FAA FORM 8130-7 (7-79) USE PREVIOUS EDITION

SEE REVERSE SIDE