

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



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AIRWORTHINESS

Group Chair's Factual Report

December 9, 2024

A ACCIDENT

Location: Balch Camp, California
Date: September 9, 2023
Time: 1345 Pacific daylight time
Helicopter: Bell 212, registration N873HL

B AIRWORTHINESS GROUP

Group Chair	Chihoon Shin National Transportation Safety Board Washington, District of Columbia
Group Member	Lea Weinkauff United States Forest Service Fort Collins, Colorado
Group Member	Matt McLuckie Bell Fort Worth, Texas
Group Member	Merryn Spielman Pratt and Whitney Canada Longueuil, Quebec, Canada
Group Member	Helen Tsai Transportation Safety Board of Canada Ottawa, Ontario, Canada

C SUMMARY

On September 9, 2023, about 1345 Pacific daylight time, a Bell 212 helicopter, N873HL, was destroyed when it was involved in an accident near Balch Camp, California (CA). The pilot was seriously injured. The helicopter was operated as a Title 14 *Code of Federal Regulations* Part 133 firefighting flight.

On December 5-6, 2023, representatives from the National Transportation Safety Board (NTSB), Bell, Pratt and Whitney Canada, and the United States Forest Service (USFS) examined the recovered wreckage at Plain Parts in Pleasant Grove, CA. From March 5-7, 2024, the engines were examined at Pratt and Whitney Canada facilities in Longueuil, Quebec, Canada.¹

¹

D DETAILS OF THE INVESTIGATION

1.0 Helicopter Information

1.1 Helicopter Description (Figure 1)

The Bell 212 has a two-bladed, semirigid (teetering) main rotor system that provides helicopter lift and thrust. A two-bladed, semirigid tail rotor, provides lateral thrust for directional control. The helicopter is equipped with a skid-type landing gear. The Bell 212 is equipped with either Pratt and Whitney Canada PT6T-3 or PT6T-3B "Twin-Pac" turboshaft engines mounted behind the main transmission.² The Bell 212 is type certificated under Federal Aviation Administration (FAA) type certificate data sheet (TCDS) No. H4SW.

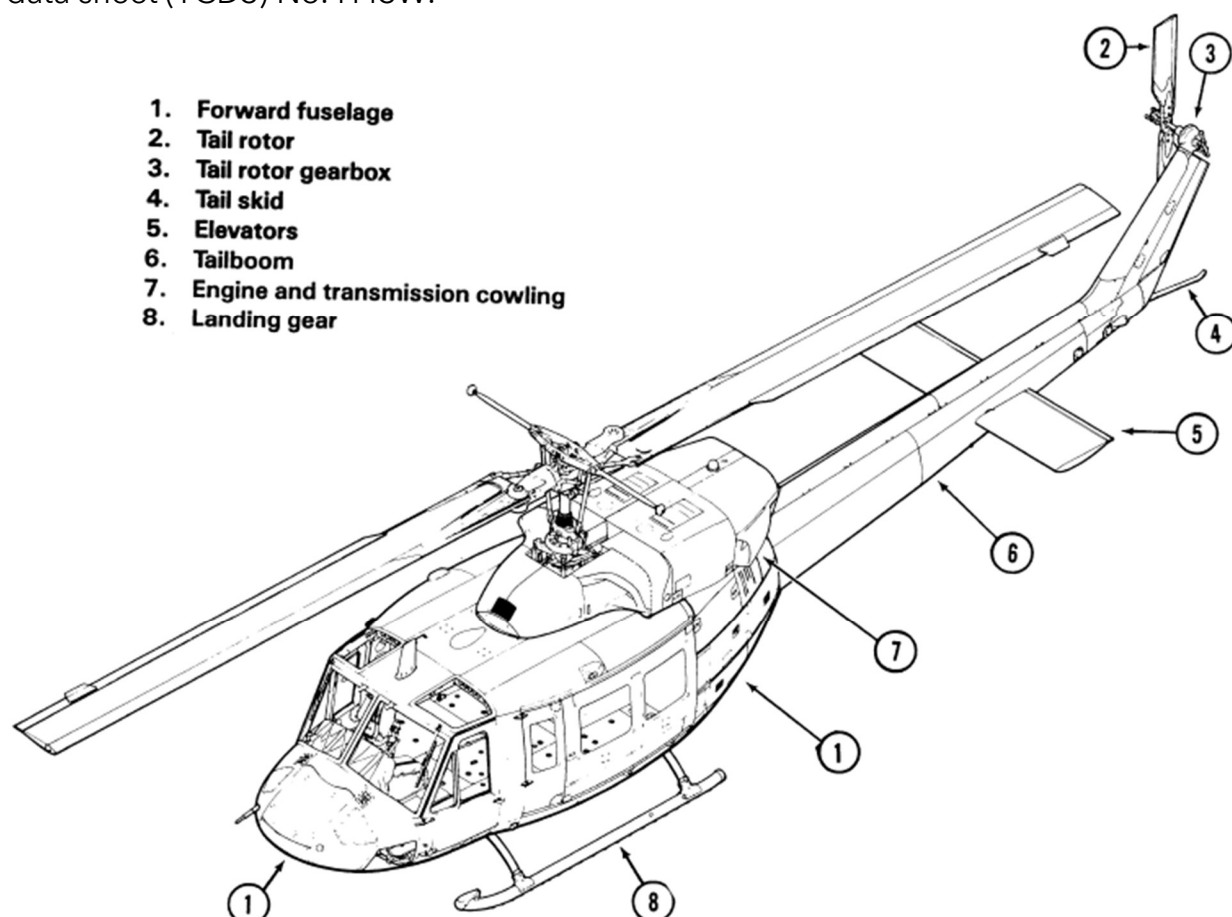


Figure 1. A diagram of the Bell 212 helicopter. (Image courtesy of Bell)

² The Twin-Pac is composed of two turboshaft engines powering a single combining gearbox. N873HL was equipped with PT6T-3B engines.

1.2 Accident Helicopter History

The accident helicopter, serial number (S/N) 30873, was manufactured in 1978. The engines installed on the accident helicopter were S/N CP-PS 60529 (left engine) and S/N CP-PS 72332 (right engine). According to maintenance records, on September 4, 2023, the helicopter had an aircraft total time (ATT) of 13,429.1 hours, a Hobbs time of 3,207.0 hours, and 15,740 airframe cycles. Additionally, the left engine had an engine total time (ETT) of 21,071.2 hours and 20,978 total cycles and the right engine had an ETT of 5,587.9 hours and 6,872 total cycles.

According to the accident helicopter's airworthiness records, equipment from multiple supplemental type certificates (STC) were installed. One of these STCs was the Dart Aerospace Left Hand (LH) Pilot in Command (PIC) system, installed under the provisions of STC No. SR02233SE on April 26, 2023. The LH PIC system allows the helicopter to be operated with a PIC in either seat position by modifying the left-handed pilot position to be at the same operational level as the right-hand pilot position. Additionally, the Simplex Aerospace Model 304 Fire Attack aerial firefighting system was installed under the provisions of STC No. SR09181RC on July 15, 2021. The Simplex Model 304 is composed of a belly-mounted tank, a hover refill pump, and cockpit controls for dispensing of the tank contents. The BLR Aerospace FastFin System was also installed on February 1, 2018 under the provisions of STC Nos. SR01865SE and SR00798SE. The FastFin System incorporates changes to the vertical fin and adds tail boom strakes to improve aerodynamic efficiency during hover.

2.0 On-Scene Summary

The NTSB did not travel to the accident site. Based on a ground witness video provided to the NTSB by the USFS, the accident helicopter did not experience an inflight breakup prior to contacting trees.³ Photographs of the accident site provided by the USFS showed the helicopter experienced a postcrash fire that consumed large portions of the wreckage (**Figure 2**). Red-colored fire retardant was visible on portions of the wreckage, which was applied on the wreckage due to the postcrash fire. According to the USFS, the left (No. 1) engine twist grip was found out of its fly/governing position (**Figure 3**). The left engine twist grip was estimated to be about a 90° turn toward the throttle close position. The right (No. 2) engine twist grip was found at its fly/governing position. The wreckage was recovered and transported to Plain Parts facilities in Pleasant Grove, CA.

³ Sound spectrum analysis of the ground witness video was conducted by the NTSB. See the Video Study in the docket for this investigation for additional details of the sound spectrum analysis.



Figure 2. The wreckage after the postcrash fire. (Image courtesy of the USFS)

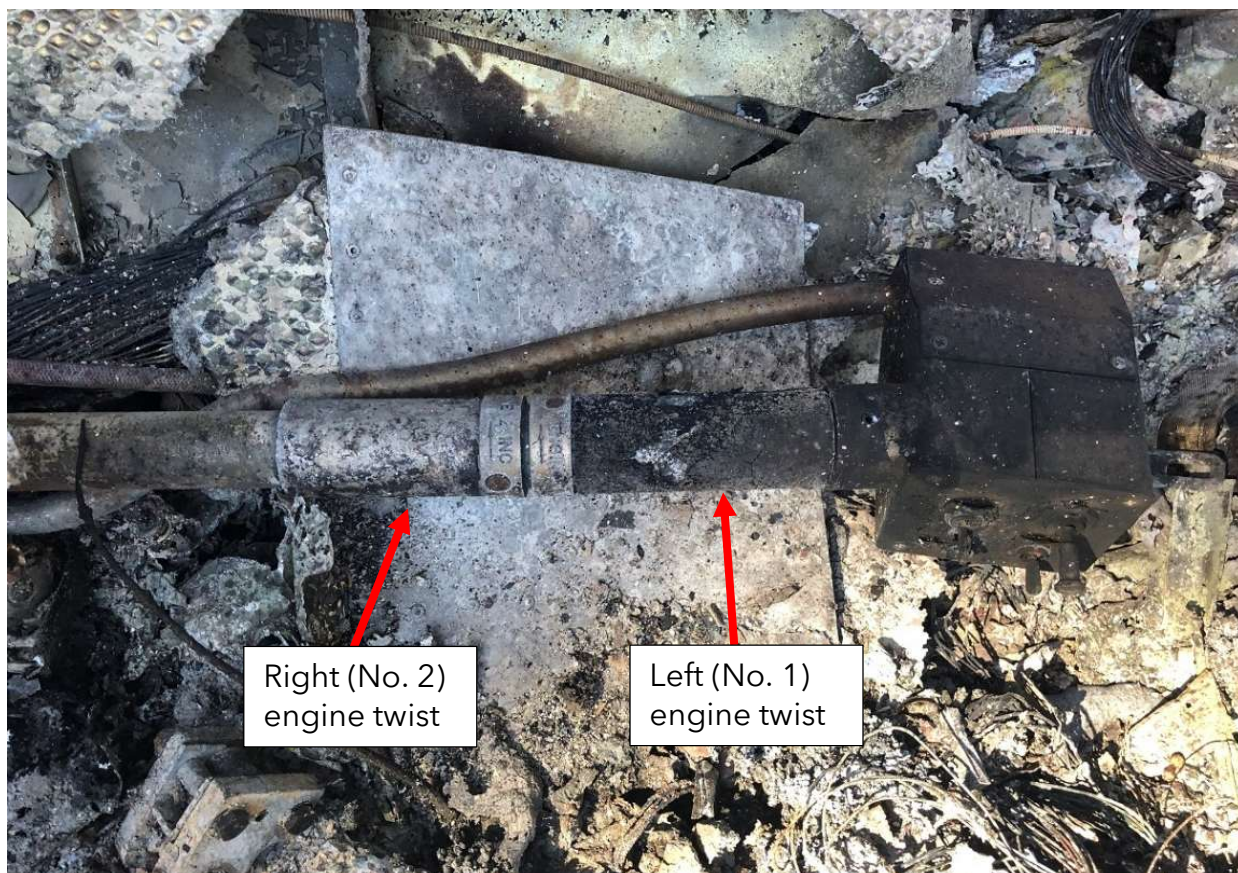


Figure 3. The collective-mounted twist grips. (Image courtesy of the USFS)

3.0 Post-Recovery Wreckage Examination

On December 5-6, 2023, representatives from the NTSB, Bell, Pratt and Whitney Canada, and the USFS examined the recovered wreckage at Plain Parts in Pleasant Grove, CA.

3.1 Airframe

The majority of the main fuselage was consumed by the postcrash fire. Fractured portions of the skid landing gear were recovered. The tail boom was present and did not exhibit significant thermal damage. The right horizontal stabilizer remained installed, but the left horizontal stabilizer was separated. The base of the vertical fin was attached to the tail boom but the upper-most portion of the vertical fin had separated. The tail rotor gearbox remained installed on the separated upper-most portion of the vertical fin.

The Simplex firefighting system was consumed by the postcrash fire. The cockpit instruments were found separated in the recovered wreckage. The annunciator panel was found but exhibited significant thermal damage.

3.2 Main Rotor System

The main transmission was separated from the airframe and was partially consumed by the postcrash fire (**Figure 4**). The main [input] drive shaft to the input quill (between the combining gearbox and the main transmission) was found in the recovered wreckage. The input drive shaft spline teeth, on both ends, did not exhibit missing teeth or anomalous and excessive wear. Circumferential scoring was observed through the input drive shaft tube adjacent to both splined ends. The tail takeoff pinion gear was found separated in the recovered wreckage; it was thermally damaged. The lower portion of the main transmission, containing the oil sump and pumps, had fractured and separated. The swashplate and collective lever assemblies remained attached to the main rotor mast and exhibited impact and thermal damage. The main rotor hub remained attached to the main rotor mast. The stabilizer bar was recovered as a single assembly but had fractured and separated from the main rotor head.



Figure 4. The main transmission was partially consumed by the postcrash fire. The swashplate assembly also exhibited thermal damage.

The main rotor blades had been cut into multiple sections for the purpose of recovery. Portions of the main rotor blades remained attached to the hub at their inboard ends (**Figure 5**). Both main rotor blades exhibited impact damage, but did not exhibit evidence of preimpact failure. The pitch horns of both main rotor blades had separated from their respective blades, but portions of the pitch change links remained attached to the horns.



Figure 5. The inboard ends of the main rotor blades, the main rotor hub, and main rotor mast remained as an assembly.

3.3 Tail Rotor System

The tail rotor drive shaft normally installed between the intermediate and tail rotor gearbox was found separated in the recovered wreckage. A portion of the tail rotor drive train remained with the tail boom wreckage. This portion was connected to the intermediate gearbox but was fractured and thermally damaged at its forward end. Continuity of drive was confirmed through the intermediate gearbox. The remainder of the tail rotor drive system forward of the tail boom was consumed by the postcrash fire. The tail rotor gearbox remained installed on the separated upper

portion of the vertical fin and the tail rotor remained installed. Rotation of the tail rotor resulted in a corresponding rotation of the tail rotor gearbox input pinion.

The two tail rotor blades remained installed on the tail rotor hub and did not exhibit fragmentation (**Figures 6 and 7**). One of the tail rotor blades was bent chordwise about 1/4-span inboard of its tip end. The second tail rotor blade did not exhibit significant deformation. The tail rotor pitch links remained installed and intact. Both blades exhibited continuity of control through the gearbox-mounted tail rotor actuator to the tail rotor blades.



Figure 6. The inboard ends of the two tail rotor blades, the tail rotor head, and the tail rotor gearbox. The red-colored material on the surfaces of the tail rotor is fire retardant that was applied on the wreckage after the accident occurred.



Figure 7. A view of the separated tail boom, with the right horizontal stabilizer attached, and the separated upper portion of the vertical fin with the tail rotor blade spans visible behind it.

3.4 Flight Control System

Fractured parts of the flight control system were found separated within the recovered wreckage. Continuity of control could not be established due to significant fragmentation as well as the majority of the system having been consumed by the postcrash fire. The main rotor hydraulic actuators were found separated within the recovered wreckage. The actuators' housing had partially or completely consumed by the postcrash fire, revealing their pistons.

The left-seat collective control was found separated from the wreckage and was thermally damaged. The twist grips for the left and right engines remained installed on the collective control and could be manipulated by hand.

3.5 Powerplants

Both engines were PT6T-3B variants. The combining gearbox housing was consumed by the postcrash fire, but the gearsets were found in the recovered

wreckage. All of the combining gearbox gears were thermally damaged but none of the gear teeth were missing or excessively and anomalously worn. The combining gearbox gears and bearings could not be manually rotated.

The accessory gearbox housings for the Nos. 1 and 2 engines were consumed by the postcrash fire. Thermally damaged parts of the engine accessories gearbox, such as the starter/generator, oil pump gears, fuel pump drive gear, and a fuel control unit governor flyweight, were found in the recovered wreckage (**Figure 8**). One partially consumed fuel control was recovered in the wreckage. Most of the gearsets of the accessory gearboxes were found in the recovered wreckage. One fuel pump, a fuel control unit gear, and one coupling shaft were not found in the recovered wreckage. None of the recovered accessory gearsets exhibited missing gear teeth or excessive and anomalous wear.



Figure 8. Separated gears found in the recovered wreckage. (The fuel control unit governor flyweight is not shown in this image.)

3.5.1 Left (No. 1) Engine

The left engine was separated from the airframe but portions of the airframe firewalls remained attached to it. The engine's accessory gearbox was consumed by the postcrash fire and was not attached to the engine. The engine inlet was consumed by the postcrash fire, but the inlet screen was present. The exhaust ejector had separated from the engine, but the tailpipe remained attached. The tail pipe was

impact-deformed. The coupling shaft remained connected to the power turbine wheel splines. Manual rotation of the coupling shaft resulted in movement of the power turbine, but manual movement was extremely difficult. When the coupling shaft was moved axially, the power turbine exhibited significant axial movement as well. The accessory shaft remained installed at the splined connection in front of the first stage compressor.

The first stage compressor blades were all present and did not exhibit impact deformation or missing material from their leading edges. The stators behind the first stage compressor remained intact with all stators [of that stage] present. The tail pipe was removed and the power turbine was visible through the exhaust. All power turbine blades were damaged and missing airfoil material at varying lengths (**Figure 9**). The trailing edges of most of the blades exhibited a wavy deformation. The power turbine shroud was rubbed through portions of the shroud around the shroud inner circumference. The combustor injectors remained installed on the combustor case and the fuel lines between the injectors were present.



Figure 9. Damage observed on the No. 1 engine power turbine blades viewed through the exhaust.

The left engine was retained by the NTSB for further examination at Pratt and Whitney Canada facilities in Longueuil, Quebec, Canada.⁴

3.5.2 Right (No. 2) Engine

The right engine was separated from the airframe but portions of the airframe firewalls remained attached to it. The engine's accessory gearbox was consumed by the postcrash fire and was not attached to the engine. The engine inlet was consumed by the postcrash fire, but the inlet screen was present. The exhaust ejector remained attached but exhibited impact deformation. The coupling shaft remained connected to the power turbine wheel splines. The accessory shaft was not present at the first stage compressor.

The first stage compressor blades were all present and did not exhibit impact deformation or missing material on their leading edges. The stators behind the first stage compressor remained intact and all stators were present. The exhaust ejector was removed and the power turbine was visible. All blades from the power turbine were present and were mostly intact with the exception of the tip ends of about 1/3 of the blades in an arc, which exhibited tip rub damage consistent with the tips contacting the turbine shroud (**Figure 10**). Rotational scoring was also visible on the turbine shroud. The power turbine coupling (output) shaft was present. Manual rotation of the coupling shaft resulted in movement of the power turbine, but manual movement was extremely difficult. When the coupling shaft was moved axially, the power turbine exhibited significant axial movement as well. The combustor injectors remained installed on the combustor case, but several portions of the fuel lines between the injectors were thermally damaged and consumed by the postcrash fire.

The right engine was retained by the NTSB for further examination at Pratt and Whitney Canada facilities in Longueuil, Quebec, Canada.⁴

⁴ For information about the findings from the engine examination at Pratt and Whitney Canada, see the Powerplants Group Chair's Factual Report in the docket for this investigation.



Figure 10. The No. 2 engine power turbine blades viewed through the exhaust.

4.0 Maintenance

According to maintenance records, the last recorded maintenance activity was on September 4, 2023, at an ATT of 13,429.1 hours, when the operator complied with FAA Airworthiness Directive (AD) No. 2013-15-02 with no defects found. This AD required a recurrent inspection of the tail rotor blades at a 25-hour or 30-day interval, whichever occurred first. A review of the maintenance records found no anomalous trends, no overdue inspections, and component life limit overages.

On September 2, 2023, at an ATT of 13,429.1 hours, the operator completed a daily inspection with no defects found. On September 1, 2023, at an ATT of 13,428.2 hours, the operator complied with the 25-hour inspection of the Simplex Fire Attack system with no noted defects. **Attachment 1** contains copies of aforementioned maintenance accomplished on the accident helicopter.

The helicopter was last weighed on May 25, 2023, with a resultant basic weight of 7,041.3 lbs. According to the Form A weighing record, the Simplex Fire Attack system tank ("Simplex tank") was installed and included in the basic weight, but the Simplex hover refill pump was listed as not included in the basic weight. The Form C weighing record showed the installation of a hover refill pump, manufactured by Kawak ("Kawak pump"), on May 25, 2023 and a resultant total weight of 7,140.3 lbs.

Attachment 2 contains scanned copies of the Forms A, B, and C weighing records provided to investigators.

The Form C weighing record found at the accident site showed the Simplex tank and the Kawak pump were removed on June 25, 2023, and subsequent both were reinstalled on June 26, 2023. After reinstallation of the Simplex tank and the Kawak pump, the total weight was recorded as 7,041.3 lbs, instead of the 7,140.3 lbs recorded on May 25, 2023. **Attachment 3** contains the Form C weighing record found at the accident site.

E LIST OF ATTACHMENTS

1. Maintenance records for N873HL for inspections conducted on September 1, 2023 and September 2, 2023.
2. Helicopter weighing record Forms A, B, and C
3. Helicopter weighing record Form C found at the accident site

Submitted by:

Chihoon Shin
Aerospace Engineer - Helicopters