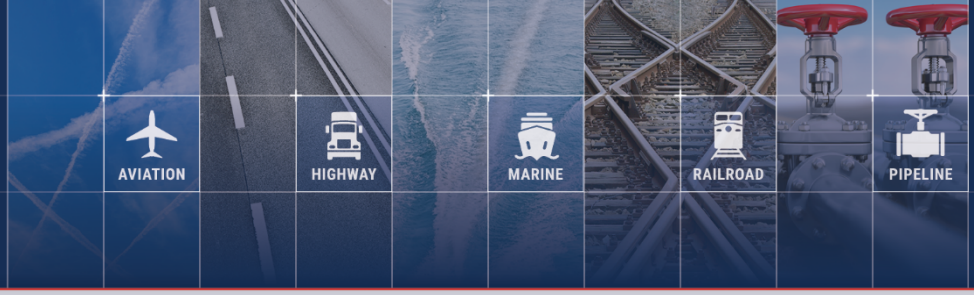


Aviation Investigation Factual Report

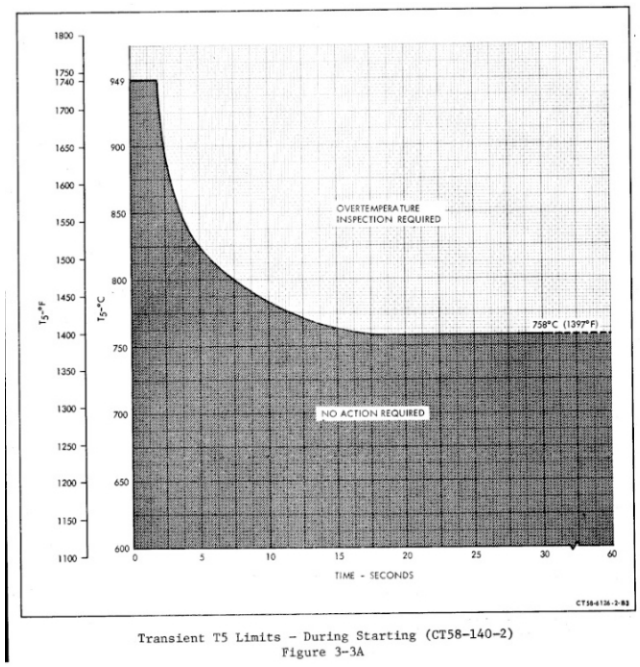
Location:	Shady Cove, Oregon	**Accident Number:**	WPR22LA330
Date & Time:	September 1, 2022, 07:35 Local	**Registration:**	N617CK
Aircraft:	Sikorsky S-61N	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (total)	**Injuries:**	2 Minor
Flight Conducted Under:	Part 133: Rotorcraft ext. load		

Factual Information

On September 01, 2022, about 0735 Pacific daylight time, a Sikorsky S-61N helicopter, N617CK, sustained substantial damage when it was involved in an accident near White City, Oregon. The two pilots and a ground support team member sustained minor injuries. The helicopter was operated as a Title 14 *Code of Federal Regulations* Part 133 rotorcraft external load flight.

Two days before the accident, according to the maintenance personnel and the second in command (SIC), the morning of August 30, 2022, the SIC and PIC entered the cockpit with the intent of conducting timber logging operations. The No.1 engine start was completed by the SIC. During the No. 2 engine start sequence, the SIC reported that the Ng took longer to rise, but increased before he moved the speed select lever to the idle detent. The SIC reported that the fuel pressure increased, and ignition occurred. The No. 2 engine Ng reached 45 percent, and the T5 temperature fluctuated between 630° C to 670° C, before he released the starter. The temperature subsequently increased to 720° C and the SIC alerted the PIC. The PIC told the SIC to “Hold” and the SIC watched the temperature gauge increase, and the digital T5 gauge indicated 001° C.

The PIC stated that he did not report the hot start event to the operator’s director of maintenance because he understood a hot start to entail a T5 temperature of 950° C sustained over 2 seconds. Guidance from the engine manufacturer indicated that hot start criteria are based on a combination of temperature over time, and that hot starts may occur at temperatures of approximately 750° C within about 15 seconds (see figure 1).



Transient T5 Limits – During Starting (CT58-140-2)
Figure 3-3A

Figure 1: Engine manufacturer Hot Start guidance

Additionally, the SIC reported that when the digital gauge indicated 001° C, the maintenance technician located outside the helicopter transmitted over the intercom, “It’s hot” and the No. 2 engine start was aborted. The maintenance technician located inside the helicopter reported that the No. 1 engine start occurred without issue, but during the No. 2 engine start, the engine “temped out” and “it maxed the T5 to 999, then the gauge had 3 dashes (---) across [the] gauge and then the number 001.” According to the T5 gauge manufacturer, 001° C is the maximum value the gauge will report, even if the T5 temperature continues to increase above 999°C. The No.1 engine was secured, the No. 2 engine was allowed to cool and the No. 2 engine digital T5 gauge indicated that the engine temperature was decreasing, but the analog gauge needle did not show the temperature dropping back to normal operating temperature range. About five minutes after aborting the start sequence, the No. 2 engine was started by the PIC without anomaly, along with the No. 1 engine. That day the flight crew flew multiple sorties and shut down both engines during a crew break. Both engines were restarted after the break without anomaly; the crew finished their eight-hour flight day, and the helicopter remained in service. No entries were annotated on the maintenance log regarding the hot start.

On September 01, 2022, the PIC who experienced the hot start two days before was assigned to N617CK with a different SIC for a day of timber logging flights. During climb out, a pedal turn to the right was accomplished while departing the log landing site. Shortly after the right turn, the crew heard a loud “bang” sound. They assessed the instrument panel and confirmed that all systems were within normal operating limits. The flight and engine instruments did not indicate that an anomaly existed; the PIC elected to continue the logging operation. Two

additional sorties were accomplished, and the “bang” sound occurred again. A precautionary landing was made to troubleshoot the abnormal sound with the assistance of maintenance personnel while the engines continued to run.

A definitive source of the “bang” sound was not identified by the maintenance personnel, and a decision was made by the PIC to continue the operation. While departing the log landing site, a right pedal turn was accomplished, and a subsequent “bang” ensued. However, this iteration presented several immediate and successive “bangs” followed by a grinding noise and a degradation of the No. 2 engine torque value to zero. The Master Caution warning light illuminated, and the helicopter descended to the ground, landing hard on the main landing gear. The helicopter rolled to the right and came to rest on the right-side fuselage.

The helicopter came to rest on a flat surface used for timber storage, and the accident site was surrounded by trees over 50 ft tall. Each of the five main rotor blades had separated from the fully articulated main rotor hub, which remained attached to the upper fuselage. Examination of the airframe revealed substantial damage to the right overhead and chin bubble as well as the wind screen. The lower fuselage revealed substantial damage to the tailwheel landing gear attachment points. The tail rotor remained attached to the driveshaft, but the horizontal stabilizer sustained substantial damage.

After making the precautionary landing, the flight crew did not complete an out-of-ground-effect hover power check to ensure that the helicopter had single-engine capability within the current environmental parameters, while operating in a confined area. According to Chapter 11 of the Federal Aviation Administration Helicopter Flying Handbook, “When one engine has failed, the helicopter can often maintain altitude and airspeed until a suitable landing site can be selected. Whether or not this is possible becomes a function of such combined variables as aircraft weight, density altitude, height above ground, airspeed, phase of flight, and single-engine capability.”

A review of the engine logbooks indicated that the No. 2 engine, serial number 285036RC was installed in the accident helicopter on July 14, 2022. At the time of the accident, the No. 2 engine had about 18,646 hours time since new, about 311 hours since installation and about 479 hours since light overhaul. Additionally, the No. 2 engine was operated about 17 hours between the aborted hot start and the accident.

Postaccident examination of the engine T5 temperature gauges on both engines indicated that they were operational. The fuel flow divider was removed from the helicopter for testing and revealed that the component did not meet operational standards. The testing facility identified the abnormalities as common occurrences amongst flow dividers that come in for overhaul or repair; however, no observable discrepancies had been noted by the customer.

Postaccident examination of the spindle bearings to determine the source of the “bang” sound experienced by the flight crew was inconclusive. The spindles were disassembled by the

operator before their arrival at Sikorsky, so the intended test for bearing stick could not be performed.

Postaccident examination of the No. 2 engine revealed overtemperature distress on most of the gas generator turbine parts. All the stage 1 turbine blades sustained severe overtemperature distress, most notably visible at the leading edge tips and trailing edge tips. Four of the stage 1 turbine blades had separated at their mid-span. Additionally, multiple stage 1 turbine blades had cracks initiated at their trailing edge and mid-span. All stage 1 turbine blades also exhibited profile “cupping” to varying degrees compared to an exemplar stage 1 turbine wheel. Most of the stage 2 turbine blades had minor overtemperature distress at the leading edge tips. The metallurgical examination of 11 stage 1 turbine blades (2 destructively) revealed evidence of bulk deformation, coating cracking/melting, and creep voiding/surface cracking consistent with overtemperature exposure. The turbine coupling shaft was unusually difficult to remove. The turbine forward shaft exhibited a dark blue color. All gas generator turbine (GGT) seals were confirmed to be in place. General material debris was found throughout the GGT assembly.

According to Chapter 15 of the Federal Aviation AdministrationAirplane Flying Handbook, “An engine tendency to exceed maximum starting temperature limits is termed a hot start. The temperature rise may be preceded by unusually high initial fuel flow, which may be the first indication the pilot has that the engine start is not proceeding normally. Serious engine damage occurs if the hot start is allowed to continue.”

Pilot Information

Certificate:	Commercial	**Age:**	65,Male
Airplane Rating(s):	None	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	Lap only
Instrument Rating(s):	None	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	September 15, 2021
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	March 27, 2022
Flight Time:	(Estimated) 28041 hours (Total, all aircraft), 17341 hours (Total, this make and model), 28041 hours (Pilot In Command, all aircraft), 247 hours (Last 90 days, all aircraft), 122 hours (Last 30 days, all aircraft), 8 hours (Last 24 hours, all aircraft)		

Co-pilot Information

Certificate:	Commercial; Flight instructor	**Age:**	55,Male
Airplane Rating(s):	None	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	Lap only
Instrument Rating(s):	Helicopter	**Second Pilot Present:**	Yes
Instructor Rating(s):	Helicopter	**Toxicology Performed:**	
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	July 1, 2022
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	August 29, 2022
Flight Time:	(Estimated) 568 hours (Total, all aircraft), 308 hours (Total, this make and model), 131 hours (Pilot In Command, all aircraft), 232 hours (Last 90 days, all aircraft), 25 hours (Last 30 days, all aircraft), 8 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Sikorsky	**Registration:**	N617CK
Model/Series:	S-61N	**Aircraft Category:**	Helicopter
Year of Manufacture:	1962	**Amateur Built:**	
Airworthiness Certificate:	Transport	**Serial Number:**	61164
Landing Gear Type:	Tailwheel	**Seats:**	28
Date/Type of Last Inspection:	August 30, 2022 AAIP	**Certified Max Gross Wt.:**	22000 lbs
Time Since Last Inspection:	8.1 Hrs	**Engines:**	2 Turbo shaft
Airframe Total Time:	27942.2 Hrs as of last inspection	**Engine Manufacturer:**	GE
ELT:	C126 installed, not activated	**Engine Model/Series:**	CT58-140-2
Registered Owner:	Croman Corporation	**Rated Power:**	1500 Horsepower
Operator:	Croman Corporation	**Operating Certificate(s) Held:**	Rotorcraft external load (133), On-demand air taxi (135), Agricultural aircraft (137)

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KMFR,1313 ft msl	**Distance from Accident Site:**	20 Nautical Miles
Observation Time:	07:29 Local	**Direction from Accident Site:**	163°
Lowest Cloud Condition:		**Visibility**	3 miles
Lowest Ceiling:	Broken / 3800 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	/	**Turbulence Type Forecast/Actual:**	/
Wind Direction:		**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.02 inches Hg	**Temperature/Dew Point:**	17°C / 9°C
Precipitation and Obscuration:	Moderate - None - Haze		
Departure Point:	Shady Cove, OR	**Type of Flight Plan Filed:**	None
Destination:	Shady Cove, OR	**Type of Clearance:**	None
Departure Time:		**Type of Airspace:**	Class G

Wreckage and Impact Information

Crew Injuries:	2 Minor	**Aircraft Damage:**	Substantial
Passenger Injuries:	N/A	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Minor	**Latitude, Longitude:**	42.696,-123.006(est)

Administrative Information

Investigator In Charge (IIC):	Hicks, Michael
Additional Participating Persons:	Jason Lawver; FAA; Portland, OR
Report Date:	
Last Revision Date:	
Investigation Class:	Class 3
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=105847