Aviation Investigation Final Report

Location:	Santa Monica, California	**Accident Number:**	WPR14LA253
Date & Time:	April 18, 2014, 13:40 Local	**Registration:**	N522GS
Aircraft:	McDonnell Douglas Helicopter 500N	**Aircraft Damage:**	Substantial
Defining Event:	Landing gear collapse	**Injuries:**	4 None
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The private pilot/owner of the helicopter was conducting a local personal flight. The pilot reported that, upon landing, he slowly sat the helicopter down on a landing pad and then felt it "drastically" slip to the right. He then lifted the helicopter off the pad, at which time a passenger verified that the right aft landing gear strut was broken. A passenger reported that, upon touchdown, he heard a "loud pop."

The Federal Aviation Administration (FAA) had previously issued an airworthiness directive (AD) applicable to the accident helicopter make and model to detect cracks that could result in the failure of the strut and subsequent loss of helicopter control during landing. The AD required modifications to the landing gear strut rivet holes and fairings and subsequent initial dye penetrant inspections followed by continuing 10x magnified visual inspections at intervals not to exceed every 100 hours time in service or during each annual inspection. According to the FAA, the AD was complied with at an airframe total time of 2,248.3 hours. At the time of the accident, the total airframe time was 2,274 hours.

Examination of the right aft landing gear strut revealed that it had fractured due to undetected fatigue cracking in an inboard rivet hole. The fatigue cracks were very small, and given their size, they likely would not have been detectible by the existing required visual inspections. The cracks initiated after the rivet hole diameter was increased; therefore, they initiated after the initial penetrant inspection.

Although it is possible that the fatigue cracks were the result of a degradation in material properties or, more likely, due to greater loads from a previous hard landing or normal landing on primarily the right skid, the investigation was not able to determine the origin of the fatigue cracks based on the available information.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

The fracture of the right aft landing gear strut due to undetected fatigue cracking in an inboard rivet hole.

Findings

Aircraft	Main gear strut/axle/truck - Fatigue/wear/corrosion
Aircraft	Main gear strut/axle/truck - Failure

Factual Information

History of Flight

Landing	Landing gear collapse (Defining event)

HISTORY OF FLIGHT

On April 18, 2014, about 1340 Pacific daylight time (PDT), a McDonnell Douglas Helicopter (MDHI) 500N, N522GS, right rear landing gear strut failed during landing, and while attempting to set the helicopter on the ground, the front strut also collapsed at Santa Monica Airport (SMO), Santa Monica, California. The owner/pilot was operating the helicopter under the provisions of 14 Code of Federal Regulations (CFR) Part 91. The private pilot and three passengers were not injured; the helicopter sustained substantial damage to the front landing gear structure. The local personal flight departed Camarillo, California, about 1315, with a planned destination of Santa Monica. Visual meteorological conditions prevailed, and no flight plan had been filed.

The pilot reported that on landing he slowly sat the helicopter down on a landing pad and felt the helicopter "drastically" slip to the right. He then lifted the helicopter off the pad at which time a passenger on board verified the right strut was broken. A passenger reported that on touchdown he heard a "loud pop."

AIRCRAFT AND AIRWORTHINESS DIRECTIVE

The 1993 McDonnell Douglas 500N helicopter was subject to Airworthiness Directive (AD) 2007-12-23, requiring modifications to the strut and fairings and continuing inspections. The AD references MD Helicopter Service Bulletin SB500N-022 that describes the modifications. The increased size of the rivet hole and the polished surface around the hole suggest that the modifications had been performed. The AD required an initial dye penetrant inspection followed by continuing 10x magnified visual inspections at intervals not to exceed every 100 hours time in service or during each annual inspection. According to the Federal Aviation Administration (FAA), AD 2007-12-23 was complied with at a airframe total time of 2,248.3; at the time of the accident the a total airframe time of 2,274 was reported. The FAA notes that there were no dates on the record for the AD compliance and it was assumed that the AD was complied with during the aircraft 100/annual inspection, which was performed in December 2013, according to maintenance records.

TESTS AND RESEARCH

Magnified visual examinations of the fracture surfaces by a National Transportation Safety Board materials specialist uncovered faceted features and arrest marks consistent with fatigue cracking on both sides of the inboard holes. The remaining fracture area was matte gray and highly textured consistent with overstress separation. The fatigue appeared to initiate at multiple origins on opposite sides of the hole bore. The fatigue cracks propagated circumferentially short distances into the strut wall with

slightly greater penetrations adjacent to the outer diameter of the strut. Visually, the fatigue measured about 0.043 inch (aft) and 0.054 inch (forward) at the outer surface of the strut

About 1.5 inches above the fracture, the outer diameter of the strut measured approximately 2.368 to 2.374 inches with an inner diameter measuring 1.998 to 1.999 inches. The inner and outer diameters were not concentric consistent with the engineering drawing. The wall thickness measured about 0.167 inches thick at the inboard location above the fracture.

Engineering representatives of the manufacturer stated that the material was specified as aluminum alloy AA1 7075 in the T73 temper condition per AMS-A-227712. X-ray fluorescent spectroscopy 3 confirmed the composition as consistent with aluminum alloy 7075. For further information see the NTSB Material Lab Factual Report in the docket for this accident.

Pilot Information

Certificate:	Private	**Age:**	64,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	4-point
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 3 With waivers/limitations	**Last FAA Medical Exam:**	May 9, 2014
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	May 8, 2012
Flight Time:	2110 hours (Total, all aircraft), 368.5 hours (Total, this make and model), 32 hours (Last 90 days, all aircraft), 22 hours (Last 30 days, all aircraft), 0 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	McDonnell Douglas Helicopter	**Registration:**	N522GS
Model/Series:	500N	**Aircraft Category:**	Helicopter
Year of Manufacture:	1993	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	LN056
Landing Gear Type:	High skid	**Seats:**	5
Date/Type of Last Inspection:	December 16, 2013 100 hour	**Certified Max Gross Wt.:**	3350 lbs
Time Since Last Inspection:		**Engines:**	1 Turbo shaft
Airframe Total Time:	2274 Hrs at time of accident	**Engine Manufacturer:**	ROLLS ROYCE
ELT:	Installed, not activated	**Engine Model/Series:**	250C20RZ
Registered Owner:	V & A AVIATION LLC	**Rated Power:**	450
Operator:	V & A AVIATION LLC	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KSMO,175 ft msl	**Distance from Accident Site:**	0 Nautical Miles
Observation Time:	20:51 Local	**Direction from Accident Site:**	109°
Lowest Cloud Condition:	Few / 3500 ft AGL	**Visibility**	10 miles
Lowest Ceiling:		**Visibility (RVR):**	
Wind Speed/Gusts:	8 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	240°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.92 inches Hg	**Temperature/Dew Point:**	20°C / 12°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	CAMARILLO, CA (CMA)	**Type of Flight Plan Filed:**	None
Destination:	Santa Monica, CA (SMO)	**Type of Clearance:**	None
Departure Time:	12:50 Local	**Type of Airspace:**	Class D

Airport Information

Airport:	SANTA MONICA MUNI SMO	**Runway Surface Type:**	Metal/wood
Airport Elevation:	177 ft msl	**Runway Surface Condition:**	Dry
Runway Used:		**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	Traffic pattern

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	3 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	4 None	**Latitude, Longitude:**	34.016109,-118.451385

Administrative Information

Investigator In Charge (IIC):	Jones, Patrick
Additional Participating Persons:	Steve Sonneson; Federal Aviation Administration; Los Angeles, CA
Original Publish Date:	September 14, 2016
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=89491