National Transportation Safety Board
Aviation Incident Final Report

Location:	Salinas, California	**Incident Number:**	LAX08IA241
Date & Time:	July 21, 2008, 12:07 Local	**Registration:**	N902CS
Aircraft:	MD Helicopters Inc MD 902	**Aircraft Damage:**	Minor
Defining Event:	Flight control sys malf/fail	**Injuries:**	3 None
Flight Conducted Under:	Part 91: General aviation - Positioning		

Analysis

During the approach to land, the pilot reported that he brought the helicopter to an 8- to 10-foot hover when the nose broke to the right and the helicopter started an uncommanded right spin. The pilot's attempt to correct with full left pedal failed to stop the spin. The pilot then initiated a hovering autorotation, which resulted in a hard landing and minor damage to the landing skids. The postaccident airframe inspection revealed that the threaded portion of the rear of the forward directional control cable of the no tail rotor (NOTAR) had separated. The forward directional control cable and the rotating cone control rod of the NOTAR, as well as associated hardware, were sent to an NTSB specialist for a detailed examination. The examination of the cable and associated hardware revealed that the cable had failed in fatigue due to the misplacement of the lock washer that was located between the cable's telescopic part and the rotating cone control rod.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this incident to be: The pilot's inability to maintain directional control due to the fatigue failure of the threaded portion of the forward directional control cable as a result of the improper installation a lock washer.

Findings

Aircraft	Tail rotor control system - Failure
Aircraft	Fasteners - Incorrect service/maintenance
Aircraft	Directional control - Attain/maintain not possible
Personnel issues	Installation - Not specified

Factual Information

HISTORY OF FLIGHT

On July 21, 2008, at 1207 Pacific daylight time, an MD Helicopters, Inc., MD 902, N902CS, made a hard landing following a loss of anti-torque control at the Salinas Municipal Airport (SNS), Salinas, California. California Shock Trauma Air Rescue, d.b.a. CALSTAR, operated the helicopter under the provisions of Title 14 Code of Federal Regulations (CFR) Part 91 as a positioning flight when the accident occurred. The pilot and two flight nurses were not injured; there was no patient on board. The helicopter sustained minor damage to the skids. The flight departed from the San Jose Regional Medical Center (RMC) helipad with a planned destination of SNS. A company visual flight rules (VFR) flight plan had been filed.

According to the pilot, the helicopter was on a 1-mile final when he noted that he was using more left pedal than he thought was necessary for the flight profile. He requested and received permission from SNS tower personnel to perform a right 360-degree turn, and then continue on to the CALSTAR ramp. Once the turn was completed, he continued on with his intended landing spot, as everything appeared normal. The pilot brought the helicopter to an 8- to 10-foot hover, the nose broke to the right, and the helicopter started an uncommanded right spin. He reported that full left pedal had no affect on stopping the spin. He then performed a hovering autorotation per the rotorcraft flight manual (RFM) while simultaneously rotating both twist grips to idle power. The helicopter landed hard, bounced, and came to rest about 45 degrees to the right of the first touch down point.

WITNESS STATEMENTS

According to the flight nurses, as the helicopter approached the airport, the pilot radioed the tower and requested a 360-degree turn before heading to the ramp. The 360-degree turn was normal. The pilot then proceeded to the CALSTAR ramp, and the pilot performed a right turn. They noted that the helicopter slowed, and started a flat right turn. The pilot reported that he had a stuck pedal and to hold on. The nurses reported several rotations before the helicopter landed hard, bounced back into the air, and then came to rest without further incident.

AIRCRAFT INFORMATION

The 2007 MD Helicopters, Inc., MD902 Explorer, serial number 900-00123, was powered by twin engine turboshaft Pratt and Whitney (P&W Canada) PW207E engines. According to CALSTAR, the helicopter had a total airframe time of 55 hours at the time of the accident. Engine number 1, serial number PCE-BG-0073, had a total of 85 hours. Engine number 2, serial number PCE-BG-0072, had a total of 84 hours. An annual inspection had been performed on June 11, 2008.

A Federal Aviation Administration (FAA) airworthiness inspector responded to SNS to examine the helicopter. He, along with CALSTAR maintenance personnel, found that the aft end of the rotating control cable (forward directional control cable, part number 900C3010045-105) had failed where the threaded section of the control cable threads into the

rotating cone (control rod part number 900C2010582-103). The part and associated hardware were shipped to the National Transportation Safety Board's (NTSB) Materials Laboratory, Washington, D.C., for further examination.

NOTAR Anti-Torque System

The helicopter is equipped with the NOTAR system for anti-torque and directional control (the NOTAR [no tail rotor] system is exclusive to MD helicopters). A variable pitch fan driven by the engines inducts ambient air and pressurizes the tail boom with low pressure, high volume air. Operation of the control pedals rotates a cone located at the rear of the tail boom and also varies the pitch of the fan. When the helicopter is in a hover, some of the air in the tail boom is expelled through longitudinal slots on the right side to produce sufficient lift to provide a majority of the anti-torque required. The remaining air is utilized for directional control and is expelled sideways through a thruster located at the rear of the tail boom. The rotating cone is located over the thruster and governs the amount of air expelled. In forward-flight, vertical fins located at each end of a horizontal stabilizer, forward of the rotating cone, provide a majority of the anti-torque and the thruster still provides the directional control. The components received are part of the control system for the rotating cone.

TESTS AND RESEARCH

A Safety Board specialist examined the forward directional control cable and the rotating cone control rod of the NOTAR assembly. Documents reviewed were the MD Helicopters maintenance manual CSP-900-RMM-2 section 67-20-00; the illustrated parts list CSP-900IPL-4, section 67-20-00; the National Aerospace Standard (NAS) 1193, locking device, positive index; McDonnell Douglas Helicopter Company drawing 900C3010045-105, cable assembly, forward directional controls; and the Aerocontrolex drawing 2601624, end rod.

The forward directional control cable is connected to the rotating cone control rod, and makes up the directional control rod assembly. A two-part locking device, identified in the illustrated parts list as a locking device positive index part number NAS1193K4CP, was located between the components on the threaded portion near the aft end of the control cable. One part has an internal tang intended to be engaged in a groove in the threaded section of the aft end of the control cable and radial serrations on the face that engages with the second part. The second part has a serrated face to mate with the first part and castellations on the other face that engage with slots in the forward end of the rotating cone control rod. The second part also has an external tang, with a wire locking hole. Proper engagement of the castellations and serrations is required when the telescopic part of the control cable is rotated toward the rotating cone control rod during assembly. The assembly is then torque loaded and the telescoping end is wire locked to the external tang of the locking device. The grooves in the aft threaded portions of the control cable were found offset by approximately 45 degrees.

The Safety Board specialist examined the aft threaded end of the control cable that was protruding from the telescope part and noted that it had been mechanically damaged and was too short to engage with the rotating cone control rod. The remaining portion of the thread was found still located in the end of the rotating cone control rod with a relatively undamaged fracture face. The forward face of the rotating cone control rod also displayed a radially

oriented shallow groove consistent with the castellations on the locking device being positioned on the face during assembly and not in the grooves provided for that purpose. Circumferential marks extended from the outer tips of the shallow groove consistent with the locking device rotating. Examination of the undamaged fracture face revealed features consistent with fatigue. The specialist reported that it is considered probable that the offset between the grooves in the threaded portion of the control cable are indicative of a torsional force being imparted during assembly. The torsion rotated the locking device during aircraft operation producing a loose connection which developed the fatigue. (The full Materials Laboratory report is attached to the public docket).

As a result of this accident, on August 13, 2008, MD Helicopters issued a mandatory service bulletin (SB) SB900-108R1, which required a non-destructive inspection of the cable threads by florescent magnetic particle, trimming the aft end of the control cable conduit, disposal of the locking device (which would prevent a repeat of the initial assembly error), drilling of a wire locking hole in the control tube, increasing the assembly torque, and wire locking of the control cable directly to the control rod. On August 14, 2008, the FAA issued an emergency airworthiness directive 2008-17-51, which repeated the requirements of SB900-108R1.

History of Flight

Landing	Flight control sys malf/fail (Defining event)
Autorotation	Hard landing

Pilot Information

Certificate:	Commercial	**Age:**	45,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	Airplane; Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 Without waivers/limitations	**Last FAA Medical Exam:**	November 12, 2007
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	June 5, 2008
Flight Time:	5200 hours (Total, all aircraft), 20 hours (Total, this make and model), 4900 hours (Pilot In Command, all aircraft), 50 hours (Last 90 days, all aircraft), 20 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	MD Helicopters Inc	**Registration:**	N902CS
Model/Series:	MD 902	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Normal	**Serial Number:**	900-00123
Landing Gear Type:	Skid	**Seats:**	5
Date/Type of Last Inspection:	June 11, 2008 Annual	**Certified Max Gross Wt.:**	6500 lbs
Time Since Last Inspection:	38 Hrs	**Engines:**	2 Turbo shaft
Airframe Total Time:	55 Hrs at time of accident	**Engine Manufacturer:**	Pratt and Whitney - Canada
ELT:	Installed, not activated	**Engine Model/Series:**	PW207E
Registered Owner:		**Rated Power:**	646 Horsepower
Operator:		**Operating Certificate(s) Held:**	On-demand air taxi (135)
Operator Does Business As:	CalStar	**Operator Designator Code:**	

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	SNS,85 ft msl	**Distance from Accident Site:**	0 Nautical Miles
Observation Time:	11:53 Local	**Direction from Accident Site:**	0°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	Overcast / 1100 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	9 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	300°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.04 inches Hg	**Temperature/Dew Point:**	15°C / 11°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	San Jose, CA (RMC)	**Type of Flight Plan Filed:**	Company VFR
Destination:	Salinas, CA (SNS)	**Type of Clearance:**	VFR
Departure Time:	11:40 Local	**Type of Airspace:**	

Airport Information

Airport:	Salinas Municipal Airport SNS	**Runway Surface Type:**	
Airport Elevation:	85 ft msl	**Runway Surface Condition:**	
Runway Used:		**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	Traffic pattern

Wreckage and Impact Information

Crew Injuries:	3 None	**Aircraft Damage:**	Minor
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	3 None	**Latitude, Longitude:**	36.662776,-121.606109(est)

Administrative Information

Investigator In Charge (IIC):	Cornejo, Tealeye	**Report Date:**	
Additional Participating Persons:	Wilbert J Robinson; Federal Aviation Administration; San Jose, CA John Hobby; MD Helicopters Inc.; Mesa, AZ		
Publish Date:			
Note:			
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=68511		

The National Transportation Safety Board (NTSB), established in 1967, is an independent federal agency mandated by Congress through the Independent Safety Board Act of 1974 to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The NTSB makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

The Independent Safety Board Act, as codified at 49 U.S.C. Section 1154(b), precludes the admission into evidence or use of any part of an NTSB report related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report. A factual report that may be admissible under 49 U.S.C. § 1154(b) is available here.