



# Aviation Investigation Final Report

<b>Location:</b>	TOULON, Illinois	<b>Accident Number:</b>	CHI94LA175
<b>Date &amp; Time:</b>	May 25, 1994, 18:30 Local	<b>Registration:</b>	N9375S
<b>Aircraft:</b>	HUGHES 269B	<b>Aircraft Damage:</b>	Destroyed
<b>Defining Event:</b>		<b>Injuries:</b>	2 Minor
<b>Flight Conducted Under:</b>	Part 91: General aviation		

## Analysis

THE HELICOPTER HAD BEEN REASSEMBLED AFTER AN ANNUAL INSPECTION, WITH INSTALLATION OF 3 OVERHAULED MAIN ROTOR BLADES. THE MAIN ROTOR BLADE DAMPERS HAD BEEN DISASSEMBLED, INSPECTED AND REASSEMBLED. DURING REASSEMBLY, THE INTERNAL SEQUENCE OF FRICTION DISCS WAS INCORRECT, RESULTING IN IMPROPER AND NON- UNIFORM DAMPING ACTION BETWEEN THE BLADES. THE SHOCK STRUT OLEOS WERE NOT SERVICED. POST ACCIDENT INSPECTION REVEALED LOW PRESSURE IN THE 3 REMAINING INTACT STRUTS. DURING THE FIRST TAKEOFF AFTER REASSEMBLY TO TRACK THE MAIN ROTOR BLADES IN A HOVER, THE HELICOPTER ENCOUNTERED GROUND RESONANCE AND WAS DESTROYED.

## Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: the improper reassembly of the main rotor blade dampers and the underservicing of the landing gear skid hydraulic struts which resulted in ground resonance of the helicopter when the first takeoff after reassembly was attempted.

## Findings

Occurrence #1: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION  
Phase of Operation: TAKEOFF

Findings

1. (F) ROTOR SYSTEM,MAIN ROTOR HUB LEAD-LAG STOP/DAMPER - IMPROPER
2. (C) MAINTENANCE,OVERHAUL - IMPROPER - OTHER MAINTENANCE PERSONNEL
3. (F) LANDING GEAR,MAIN GEAR SHOCK ABSORBING STRUT - PRESSURE TOO LOW

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Occurrence #2: LOSS OF CONTROL - ON GROUND/WATER

Phase of Operation: TAKEOFF

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Occurrence #3: ON GROUND/WATER ENCOUNTER WITH TERRAIN/WATER

Phase of Operation: TAKEOFF

## Factual Information

On May 25, 1994, at 1830 central daylight time, a Hughes 269B helicopter, N9375F, owned and piloted by Dwain Webster of Toulon, Illinois, was destroyed while performing main rotor blade tracking. The private pilot in command and mechanic passenger received minor injuries. Visual meteorological conditions existed at the time of the accident and winds were reported as 10 knots. The flight was operated under 14 CFR Part 91 as a maintenance flight, no flight plan was filed and there was no intent to depart from a hover.

The pilot reported that upon completing the fourth rotor engagement to track the newly installed main rotor blades, he began to increase collective pitch to check blade track in a hover. With approximately 2 inches of up collective, the helicopter began violent vertical vibrations. The pilot reduced collective and secured the throttle. The tail boom separated from the helicopter, the cockpit and skids were destroyed, and all three main rotor blade dampers separated from the main rotor blade trailing edges.

A post-crash inspection of the helicopter revealed that all the landing gear oleo attaching lugs separated from their attaching points. Flight control continuity was established to the rotor head, and all controls still moved freely. All three main rotor blade spindles rotated smoothly. The red and white main rotor blade flap restrainers were intact. The blue main rotor blade flap restrainer was broken in an upward direction. The main transmission rotated freely. All 3 main rotor blade dampers were able to be moved through their ranges, exhibiting some resistance, which was not measured due to a lack of a calibrated torque wrench.

The main rotor blade dampers and the four shock strut oleos were removed for testing at Schweizer Helicopters. The test and disassembly was attended by FAA representatives from the Rochester, NY FSDO. These tests revealed that all the dampers were set 70 to 100 inch-pounds below the value specified in the maintenance manual. The red damper internal discs were assembled in an incorrect order.

Blade damper torque values were measured as:	1st stage lead	1st stage lag	2nd
stage BLUE	140 in-lb	150 in-lb	220 in-lb
WHITE	150 in-lb	150 in-lb	250 in-lb
RED	130 in-lb	120 in-lb	200 in-lb
normal	200-230 in-lb	200-230 in-lb	-----

The 3 intact oleos were compression tested as follows:	initial	maximum	LFWD
70 lbs	600 lbs	RFWD	75 lbs
500 lbs	RREAR	50 lbs	250 lbs
150 lbs	3300 lbs	normal	

The Airframe and Powerplant mechanic who was performing the annual inspection stated he did not remember servicing the oleo struts. He stated the struts looked ok, and were hand checked by lifting up the tail to check for reaction. They were not checked with any pressure

gauge.

The same mechanic stated that every other year during the annual inspection the dampers were disassembled, the plates cleaned using emery cloth, and reassembled with new fluid. The same parts that were removed were reinstalled into each damper, the torque was set using a dial calibration type torque wrench calibrated in inch-pounds, and the tension was checked using a scale and pulley. Lead to lag should be set from 6.5 to 7.0 inch pounds according to the maintenance manual.

The Pilot Operating Handbook for the Hughes 300 Model 269B contains an OPERATIONAL CHECK - OLEO DAMPERS section, which includes the following: "CAUTION"

"Ground resonance can result if aircraft is operated when oleo damper extension, fluid type, and/or fluid-to-air proportions are incorrect."

The 269 Series - HMI states:

"5.3.f(7) Cycle overhauled dampers and readjust locknut as many times as necessary to stabilize torque reading at 230 inch-pounds."

"NOTE: ...if torque readings from lead-to-lag and lag-to-lead positions for first stages of all dampers are not equal, back off cover assembly on individual dampers as necessary...Damper torque may vary from 200 to 230 inch-pounds in actual service."

"WARNING"

"INCORRECT PHASING AND/OR TORQUE ADJUSTMENTS CAN LEAD TO CONDITIONS THAT MAY RESULT IN GROUND RESONANCE AND DESTRUCTION OF THE HELICOPTER..."

Chapter 15 of Helicopter Aerodynamics, by Raymond Prouty, an aeronautical engineer specializing in rotorcraft, discusses the phenomena of ground resonance. The phenomena is associated with fully articulated rotor heads, and results when a resonant frequency is obtained between the ground, a shock strut system, and the rotor system. This resonance is initiated when the blades move on their respective lead-lag hinges, placing their combined center of gravity outside the center of rotation of the rotor disc. Damping to prevent this resonance is required in both the landing gear system and the lead-lag plane of a fully articulated rotor head.

## Pilot Information

<b>Certificate:</b>	Private	<b>Age:</b>	47, Male
<b>Airplane Rating(s):</b>	None	<b>Seat Occupied:</b>	Left
<b>Other Aircraft Rating(s):</b>	Helicopter	<b>Restraint Used:</b>	
<b>Instrument Rating(s):</b>	None	<b>Second Pilot Present:</b>	
<b>Instructor Rating(s):</b>	None	<b>Toxicology Performed:</b>	No
<b>Medical Certification:</b>	None Expired	<b>Last FAA Medical Exam:</b>	July 31, 1984
<b>Occupational Pilot:</b>	No	<b>Last Flight Review or Equivalent:</b>	
<b>Flight Time:</b>	1306 hours (Total, all aircraft), 1295 hours (Total, this make and model), 1250 hours (Pilot In Command, all aircraft)		

## Aircraft and Owner/Operator Information

<b>Aircraft Make:</b>	HUGHES	<b>Registration:</b>	N9375S
<b>Model/Series:</b>	269B 269B	<b>Aircraft Category:</b>	Helicopter
<b>Year of Manufacture:</b>		<b>Amateur Built:</b>	
<b>Airworthiness Certificate:</b>	Normal	<b>Serial Number:</b>	54-0091
<b>Landing Gear Type:</b>	Skid	<b>Seats:</b>	2
<b>Date/Type of Last Inspection:</b>	May 19, 1994 Annual	<b>Certified Max Gross Wt.:</b>	1670 lbs
<b>Time Since Last Inspection:</b>	0 Hrs	<b>Engines:</b>	1 Reciprocating
<b>Airframe Total Time:</b>	3669 Hrs	<b>Engine Manufacturer:</b>	LYCOMING
<b>ELT:</b>		<b>Engine Model/Series:</b>	HIO-360-A1A
<b>Registered Owner:</b>	DWAIN WEBSTER	<b>Rated Power:</b>	180 Horsepower
<b>Operator:</b>	DWAIN WEBSTER	<b>Operating Certificate(s) Held:</b>	None
<b>Operator Does Business As:</b>		<b>Operator Designator Code:</b>	

## Meteorological Information and Flight Plan

<b>Conditions at Accident Site:</b>	Visual (VMC)	<b>Condition of Light:</b>	Day
<b>Observation Facility, Elevation:</b>	,800 ft msl	<b>Distance from Accident Site:</b>	
<b>Observation Time:</b>	18:30 Local	<b>Direction from Accident Site:</b>	
<b>Lowest Cloud Condition:</b>	Unknown	<b>Visibility</b>	5 miles
<b>Lowest Ceiling:</b>	Overcast / 1000 ft AGL	<b>Visibility (RVR):</b>	
<b>Wind Speed/Gusts:</b>	8 knots / 12 knots	<b>Turbulence Type Forecast/Actual:</b>	/
<b>Wind Direction:</b>	330°	<b>Turbulence Severity Forecast/Actual:</b>	/
<b>Altimeter Setting:</b>		<b>Temperature/Dew Point:</b>	22°C
<b>Precipitation and Obscuration:</b>	No Obscuration; No Precipitation		
<b>Departure Point:</b>		<b>Type of Flight Plan Filed:</b>	None
<b>Destination:</b>		<b>Type of Clearance:</b>	None
<b>Departure Time:</b>	18:15 Local	<b>Type of Airspace:</b>	Class G

## Airport Information

<b>Airport:</b>	DWAIN WEBSTER FARM	<b>Runway Surface Type:</b>	Concrete
<b>Airport Elevation:</b>	800 ft msl	<b>Runway Surface Condition:</b>	Dry
<b>Runway Used:</b>	0	<b>IFR Approach:</b>	None
<b>Runway Length/Width:</b>		<b>VFR Approach/Landing:</b>	None

## Wreckage and Impact Information

<b>Crew Injuries:</b>	2 Minor	<b>Aircraft Damage:</b>	Destroyed
<b>Passenger Injuries:</b>		<b>Aircraft Fire:</b>	None
<b>Ground Injuries:</b>	N/A	<b>Aircraft Explosion:</b>	None
<b>Total Injuries:</b>	2 Minor	<b>Latitude, Longitude:</b>	41.089462,-89.860443(est)

## Administrative Information

<b>Investigator In Charge (IIC):</b>	Thomas, Matthew
<b>Additional Participating Persons:</b>	DONALD F MILLER; ROCHESTER , NY STEVE GLEASON; ELMIRA , NY ROBERT SCOTT; SPRINGFIELD , IL
<b>Original Publish Date:</b>	February 14, 1995
<b>Last Revision Date:</b>	
<b>Investigation Class:</b>	<a href="#">Class</a>
<b>Note:</b>	
<b>Investigation Docket:</b>	<a href="https://data.nts.gov/Docket?ProjectID=9543">https://data.nts.gov/Docket?ProjectID=9543</a>

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The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, “accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties ... and are not conducted for the purpose of determining the rights or liabilities of any person” (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB’s statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)). A factual report that may be admissible under 49 *United States Code* section 1154(b) is available [here](#).