National Transportation Safety Board
Aviation Accident Final Report

Location:	Lohn, TX	**Accident Number:**	CEN12LA120
Date & Time:	01/01/2012, 1400 CST	**Registration:**	N9021R
Aircraft:	CONTINENTAL COPTERS INC. 47G2	**Aircraft Damage:**	Substantial
Defining Event:	Flight control sys malf/fail	**Injuries:**	2 Serious
Flight Conducted Under:	Part 91: General Aviation - Aerial Observation		

Analysis

The pilot performed a preflight inspection of the helicopter to include checking the tail rotor oil level through its sight glass. He had flown the helicopter for more than an hour when the tail yawed to the left, slowly at first then rapidly. The pilot "cut" the throttle, flew the helicopter "to the ground as fast as possible,"and impacted terrain. A postaccident examination of the wreckage revealed that the tail rotor gearbox did not operate when it was rotated. A teardown revealed that the interior surfaces of the gearbox were covered with a black oily substance consistent with residual lubricating oil contaminated with liberated metal particles. The oil level sight glass exhibited no discoloration or other hindrance to normal oil level detection in service.

Examination of the ring and pinion gears revealed that the teeth on the pinion gear were deformed and worn almost down to the tooth root in some locations. Wear was observed on the top land and drive faces of the ring gear. Wear patterns were noted on the coast faces of the ring and pinion gear teeth. The observation of wear on the coast faces of the gear teeth is most probably an indication that the spacing between the gears was too tight as a result of improper alignment during installation, causing accelerated wear. A logbook entry showed that the helicopter's last annual inspection was completed about 6 months before the accident during which the tail rotor gearbox was overhauled and installed.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The improper installation of the tail rotor gearbox by maintenance personnel, which led to accelerated wear of the ring and pinion gears, resulting in the loss of tail rotor effectiveness and subsequent forced landing.

Findings

Aircraft	Tail rotor gearbox - Fatigue/wear/corrosion (Cause) Tail rotor gearbox - Incorrect service/maintenance (Cause)
Personnel issues	Repair - Maintenance personnel (Cause)

Factual Information

On January 1, 2012, about 1400 central standard time, a Continental Copters Inc. 47G2 helicopter, N9021R, impacted terrain during a forced landing following a loss of tail rotor effectiveness near Lohn, Texas. The commercial pilot and passenger sustained serious injuries. The helicopter's tailboom was substantially damaged during the forced landing. The helicopter was registered to and operated by Sky Horse Helicopters Inc. under the provisions of 14 Code of Federal Regulations Part 91 as an aerial observation flight. Day visual flight rules (VFR) conditions prevailed for the flight, which did not operate on a VFR flight plan. The helicopter departed on the local flight about 1300.

The pilot stated in his accident report that he performed a preflight inspection of the helicopter to include checking the tail rotor oil level through its sight glass. He flew the helicopter for "over" an hour when the tail yawed to the left. The yaw was slow at first and then the helicopter yawed rapidly. The pilot "cut" the throttle and flew the helicopter "to the ground as fast as possible."

A logbook endorsement showed that the helicopter's last annual inspection was completed on July 13, 2011, and that the helicopter had accumulated 8,989 hours of total flight time. The pilot reported that the helicopter had accumulated 9,057 hours of total flight time at the time of the accident and that he did not have any records in reference to the tail rotor gearbox.

A Federal Aviation Administration (FAA) inspector examined the wreckage on-scene. The tail rotor gearbox did not operate when it was rotated. The FAA inspector measured the gearboxes' shim and he reported its thickness measurement as 0.015 inches, plus or minus 0.001 inches.

The accident gearbox, marked with part no. 47-640-044-39 and serial no. A13-3661, was retained and was shipped to Scott's – Bell 47 Inc. for detailed examination under FAA supervision. The examination, in part, revealed that the interior surfaces of the gearbox were covered with a black oily substance consistent with residual lubricating oil contaminated with liberated metal particles. The oil level sight glass exhibited no discoloration or other hindrance to normal oil level detection in service. Damage was noted on the upper aft portion of the main case assembly where the aft casting accommodated the tail rotor guard. This area of displaced or previously removed material was filled with a media consistent with an epoxy mix. The gearbox assembly was dismantled in accordance with procedures listed in its service instruction and no significant difficulties or abnormal conditions were encountered. Scott's – Bell 47 Inc. report is appended to the docket material associated with this case.

Parts, to include the ring and pinion gear, were removed and shipped to the National Transportation Safety Board (NTSB) Materials Laboratory. A NTSB Senior Materials Engineer examined the parts and produced Materials Laboratory Factual Report No. 13-028. The examination revealed that the teeth on the pinion gear were deformed and worn almost down to the tooth root in some locations. Wear was observed on the top land and drive faces of the ring gear. Wear patterns were noted on the coast faces of the ring and pinion gear teeth. Hardness testing revealed that both gears exhibited a trend of increasing hardness with decreasing distance from the bottom land surface. The NTSB Materials Laboratory report is appended to the docket material associated with this case.

History of Flight

Prior to flight	Aircraft maintenance event
Maneuvering-low-alt flying	Flight control sys malf/fail (Defining event)
Emergency descent	Loss of tail rotor effectiveness
Uncontrolled descent	Collision with terr/obj (non-CFIT)

Pilot Information

Certificate:	Commercial	**Age:**	54, Male
Airplane Rating(s):	Single-engine Land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	Seatbelt
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 Without Waivers/Limitations	**Last Medical Exam:**	04/04/2011
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	05/03/2011
Flight Time:	14000 hours (Total, all aircraft), 14000 hours (Pilot In Command, all aircraft), 35 hours (Last 90 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Manufacturer:	CONTINENTAL COPTERS INC.	**Registration:**	N9021R
Model/Series:	47G2	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Normal	**Serial Number:**	CCI-165
Landing Gear Type:	Skid	**Seats:**	2
Date/Type of Last Inspection:	07/13/2011, Annual	**Certified Max Gross Wt.:**	2350 lbs
Time Since Last Inspection:	68 Hours	**Engines:**	1 Reciprocating
Airframe Total Time:	9057 Hours	**Engine Manufacturer:**	LYCOMING
ELT:	Not installed	**Engine Model/Series:**	VO-435-A1D
Registered Owner:	SKY HORSE HELICOPTERS INC	**Rated Power:**	250 hp
Operator:	SKY HORSE HELICOPTERS INC	**Air Carrier Operating Certificate:**	None

Meteorological Information and Flight Plan

Observation Facility, Elevation:	BBD, 1827 ft msl	**Observation Time:**	1535 CST
Distance from Accident Site:	12 Nautical Miles	**Condition of Light:**	Day
Direction from Accident Site:	162°	**Conditions at Accident Site:**	Visual Conditions
Lowest Cloud Condition:	Clear	**Temperature/Dew Point:**	13°C / -6°C
Lowest Ceiling:	None	**Visibility**	10 Miles
Wind Speed/Gusts, Direction:	12 knots, 340°	**Visibility (RVR):**	
Altimeter Setting:	30.52 inches Hg	**Visibility (RVV):**	
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Lohn, TX	**Type of Flight Plan Filed:**	None
Destination:	Lohn, TX	**Type of Clearance:**	None
Departure Time:	1300 CST	**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	1 Serious	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 Serious	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Serious		

Administrative Information

Investigator In Charge (IIC):	Edward F Malinowski	**Adopted Date:**	09/05/2013
Additional Participating Persons:	Michael P Garvin; Federal Aviation Administration; San Antonio, TX Don Maguire; Scott's - Bell 47, Inc.; Le Sueur, MN		
Publish Date:	09/05/2013		
Investigation Docket:	http://dms.ntsb.gov/pubdms/search/dockList.cfm?mKey=82607		

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