NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety

February 15, 2012

MAINTENANCE GROUP CHAIRMAN'S FACTUAL
DCA12MA020

A. ACCIDENT

Operator:	Sundance Helicopters, Inc.
Location:	Henderson, NV
Date:	December 7, 2011
Time:	1630 Pacific standard time
Aircraft:	N37SH, Eurocopter AS-350B2

B. MAINTENANCE GROUP

Chairman:	Kristi Dunks National Transportation Safety Board
Member:	Maryam Allahyar National Transportation Safety Board
Member:	Gary Campbell Federal Aviation Administration
Member:	Kyle Reynolds Sundance Helicopters, Inc.
Member:	Jack Weese Sundance Helicopters, Inc.
Member:	Seth Buttner American Eurocopter

C. SUMMARY

On December 7, 2011 at 1630 Pacific Standard Time, a Eurocopter AS350-B2, registration N37SH, operated by Sundance Helicopters, Inc., as flight Landmark 57, crashed in mountainous terrain approximately 14 miles east of Las Vegas, Nevada. The 14 CFR Part 135 flight was a tourist sightseeing flight, which departed from Las Vegas McCarren International Airport (LAS), Las Vegas, NV, intending to fly to the Hoover Dam area and return to LAS, operating under visual flight rules. The helicopter impacted in a ravine in mountainous terrain between the city of Henderson and Lake Mead. The pilot and four passengers were fatally injured, and the helicopter was substantially damaged by impact forces and fire. Access to the accident site was moderately difficult and the investigators were assisted by the National Park Service. There were no installed on-board recording devices. Weather was reported as clear with good visibility and dusk light conditions.

Radar data obtained from the FAA show that the helicopter departed LAS and followed a normal route of flight easterly out of the LAS airport traffic area, then turned to the southeast toward Hoover Dam. Tour routings are standardized for all the area tour operators. The helicopter was level at 3,500 feet at approximately 120 knots. About one minute prior to the accident the radar indicated the helicopter climbed to 4,100 feet and turned about 90 degrees to the left. The left turn and climb are not part of the normal route. Radar then indicated the helicopter descended to 3,300 feet and tracked a northeasterly course for about 20 seconds, until entering a left turn then a descent of at least 2,500 feet per minute. The last radar target received was about 1/8 miles from the accident site.

D. DETAILS OF THE INVESTIGATION

The maintenance group convened on December 9, 2011. The first meeting occurred at the facilities of Sundance Helicopters, where a review of the records commenced. On December 10, interviews with the five mechanics who performed maintenance on the helicopter, and the check pilot that signed off the operational check flight, were conducted. Additional records were reviewed on December 11. The onsite portion of the investigation concluded on December 13.

Additional visits to the operator's facility commenced on January 11, 2012, and included a review of the maintenance practices and further discussions with maintenance personnel. Investigators also visited Malmrose Heli Services, Inc., on January 25, 2012.

E. FACTUAL INFORMATION

1. Overview of Sundance Helicopters
   1.1. Overview of Sundance Helicopters' Maintenance

Sundance Helicopters maintenance department consists of the Director of Maintenance, Training Manager, Production Manager, and multiple maintenance personnel. They also have a Quality Assurance department and a Logistics department. An organizational chart is noted in figure 1.

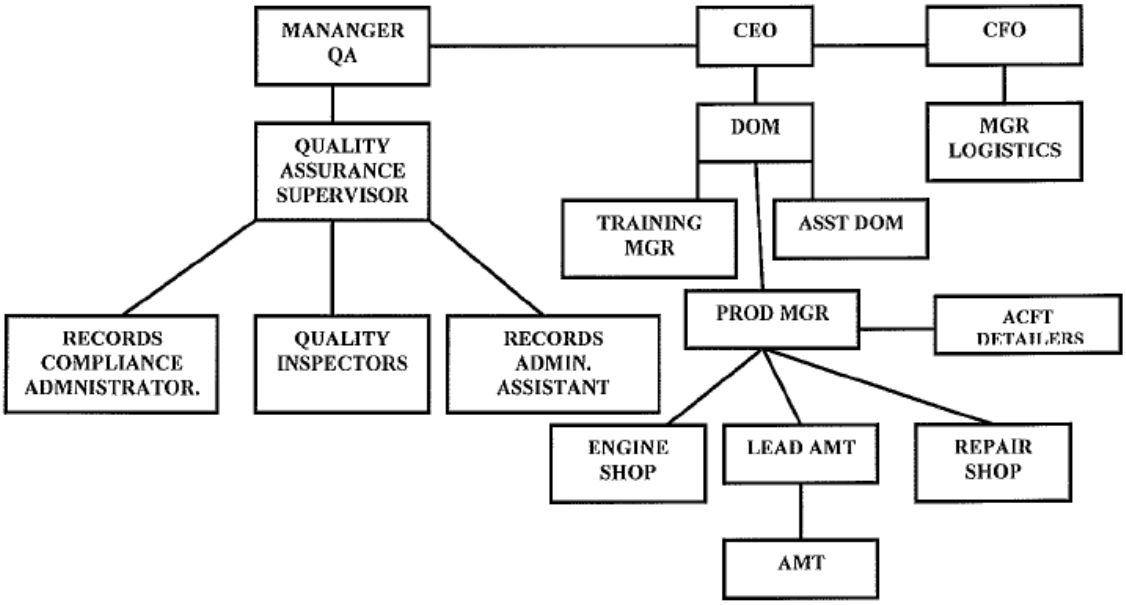

Figure 1. Maintenance Organizational Chart

The maintenance department has 19 technicians, with one Production Manager and one Director of Maintenance (DOM). The company has an assistant DOM position, but the position has not been filled for two years. The current DOM indicated that the staffing is adequate to perform his job functions, but they have maintained the position in the event that the company decides to fill the position in the future. The company also has one employee in each of its allied shops.[1] The component repair shop does not currently have an employee assigned. There are five employees in the materials department, four employees in the quality department, and four detailers. The company currently operates 21 helicopters: 4 EC 130 B4s, 16 AS350B2s, and 1 AS350BA from their Las Vegas base.

In recent years, the maintenance department management team was restructured. In addition, a day crew, additional mechanics, and a General Maintenance Manual (GMM)[2] were implemented into the program. The size of the maintenance department has increased as the company has gained new aircraft.

1.2. Maintenance Program and History

1.2.1. Maintenance Program

All maintenance is performed per the manufacturers' specifications. Sundance Helicopters does not operate using an approved aircraft inspection program (AAIP) or progressive inspections. All maintenance is conducted in-house except for component overhauls. Sundance Helicopters employs two mechanics certified to perform Level 3 maintenance for the Turbomeca engine.

[1] Sundance described their Allied shops as engine, component repair, and upholstery.
[2] The GMM is not required by current Federal Aviation Administration regulations. However, Sundance has incorporated the procedures and policies into their operations.

According to the General Operations Manual (GOM), Chapter 7:

> Inspections and maintenance of the aircraft, engines, rotor systems accessories and appliances will be performed by certificated or non-certificated company technicians. All company non-certificated technicians will be supervised at all times, while performing maintenance, by a certificated company mechanic. Inspection and maintenance may also be performed by an FAA approved repair stations that meet the requirements of an approved vendor. Inspection and maintenance of the aircraft, engines, rotor systems accessories, and appliances when the aircraft are located at the home base will be conducted through the Director of Maintenance. Inspection and maintenance will be done in accordance with the applicable aircraft maintenance manual and other approved data.
>
> 7.1.3 All maintenance, preventive maintenance, Instructions for Continued Airworthiness (ICAs) as well as applicable operating regulatory inspection requirements and alteration to the aircraft, engines, rotor systems and appliances will be performed in accordance with current FAA regulations, manufacturer's service manuals recommendations and specifications, manufacturer's Mandatory Service Publications, Airworthiness Directives, ICAs, and good Maintenance practices. Following any maintenance, appropriate entries will be made in aircraft and engine log books, flight log books, and other company required maintenance records prior to the next flight.
>
> 7.1.4 A maintenance operational check flight will be made following any maintenance operation that could change the flight characteristics of the aircraft. The Director of Maintenance will ensure that all Special Inspections and Airworthiness Directive notes are complied with as required.

Sundance Helicopters informational distribution methods primarily use the quality alert notice (QAN). Information is also shared through employee meetings. According to Sundance Helicopters GMM, "The QAN is a Sundance Helicopters internal publication. It is used to alert maintenance technicians of particular technical issues that involve maintenance procedures, repetitive discovered discrepancies, or any technical information that the Director of Maintenance requires to be distributed to all maintenance technicians. The QAN will identify the finding; convey any immediate action required and supply supporting data to the technicians at the maintenance facility. QAN(s) are issued by the Quality Assurance Department and posted within the maintenance facility. When the information contained in the QAN is integrated into company or manufacturer’s written guidance, the QAN can then be posted as “cancelled” in the master list of QAN(s)."

1.2.2. General Maintenance Manual

Sundance Helicopters maintenance operates using a GMM, in conjunction with their FAA company operations specifications and General Operations Manual (GOM). Although the GMM is not required, they have implemented it to standardize processes and procedures. They have been working with the FAA since 2010 on getting the GMM accepted into their program.

1.3. Maintenance Flight Check

Maintenance flight checks are conducted in accordance with the flight manual chapter 8, flight portion conducted under 91.407B. According to Eurocopter, when an engine is removed and reinstalled on the same airframe, the checks specified in the "Engine Removal/Installation" column are required. When a new engine is installed, whether or not it came directly from another airframe, the checks specified in the "Engine Replacement" column are required. Once the flight is completed, all record checks are included in the maintenance paperwork kept in the helicopter throughout the day. The sign off is included on the maintenance log page and is kept in the helicopter.

LIST OF TEST SHEETS

No 0 FLIGHT REPORT

No 1 CHECKS AFTER ENGINE OR MODULE REPLACEMENT

No 2 CHECKS AFTER MRH OR FREQUENCY ADAPTER OR MAIN ROTOR BLADE REPLACEMENT

No 3 CHECKS AFTER MGB REPLACEMENT

No 4 CHECKS AFTER TRH OR TAIL ROTOR BLADE REPLACEMENT

No 4A CHECKS AFTER TAIL ROTOR DRIVE SHAFT REPLACEMENT

No 5 CHECKS AFTER OPERATIONS ON FLYING CONTROLS

No 6 CHECKS AFTER GENERATOR OR ELECTRICAL MASTER BOX REPLACEMENT

No 7 SYSTEM CHECKS

OPERATIONS ON ENGINE OR MODULE

- TESTS TO BE CONDUCTED ACCORDING TO THE COMPONENT REPLACED

TEST	Engine Removal/ Installation	Engine replacement	Hydro-mechanical governor replacement	Module Replacement		
				No 1-5	No 2-3	No 4
Starting Ground Run	●	●	●	●	●	●
Hover Flight		●	●			
Acceleration		●	●		●	
Bleed Valve		●			●	
Engine Condition Power Check		●		●	●	●
Ng at Max. T/O PWR or Static droop check		●	●			
Engine coast-down		●		●	●	●

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Figure 2. Post Maintenance Required Checks

According to the GMM, Section 6.15, "Maintenance Check Flights/Non-Routine Flight Operations",

"A Maintenance Check Flight is defined as a flight of the aircraft to determine the validity of a discrepancy or the accomplishment of a maintenance function as required in the appropriate maintenance manual or company maintenance procedures.

Before any maintenance check flight is conducted the pilot must review the intention and requirements of the flight. All maintenance entries will be reviewed.
1. When the necessity of a Maintenance Check Flight is determined, a discrepancy will be entered by the AMT into the “DISCREPANCY” column of the Aircraft Maintenance Log, Form SDM-001 stating, “A Maintenance Check Flight(s) is/are requested to check the <insert system> system.”
2. Upon successful completion of the maintenance check flight, the PIC will enter into the “CORRECTIVE ACTION” column of the “Aircraft Maintenance Log, Form SDM-001”, the following statement: “Complied with maintenance check flight requirement for <insert system>.”

6.15.3 Performing Flights.
A maintenance check flight will be performed after any of the following maintenance procedures has been accomplished:
1. Maintenance functions on adjustable flight controls.
2. Replacement of engine(s).
3. Maintenance of engine control systems.
4. Replacement of any flight control surface (e.g.; Main Rotor Blade, Tail Rotor Blade etc.).
5. Navigational instrument changes (as needed).
6. Major airframe or component repairs or alterations.
7. Anytime Maintenance or Operations determines that an operational check flight is required."

1.4. Minimum Equipment List

Sundance Helicopters has an approved minimum equipment list (MEL). According to the Quality Assurance Manager, there were no open MEL items on the accident helicopter at time of accident.

1.5. Required inspection items (RII)

Sundance Helicopters does not have required inspection items (RII), nor are they required to under current FAA regulations.

1.6. Quality Control Inspectors

Sundance Helicopters requires specific inspections by independent personnel on required items. The inspections are completed by designated inspectors within the company. Nine maintenance personnel are certified to perform company required inspection items.

The qualifications for the inspector position include the following (GMM Section 4.9.2):

1. Must hold a mechanic certificate with airframe and powerplant ratings.
2. Have 3 years' experience within the past 6 years maintaining aircraft as a certified mechanic, including, at the time of appointment, as QC inspector, experience in maintaining the same category and class of aircraft as the certificate holder uses.
3. Have 3 years' experience within the past 6 years repairing aircraft, including 1 year in the capacity of approving aircraft for return to service.
4. Must be knowledgeable of all company auditing, evaluation, and reporting procedures.
5. Must be knowledgeable of the Aircraft Manufacturer's Maintenance Manual, inspection and maintenance specifications, applicable Federal Aviation Regulations.
6. Complete required company training.

The GMM states the following:

1. The following maintenance procedures require a company assigned inspector to sign, initial or stamp to approve for return to service;
a. All maintenance functions requiring a safety. (safety wire, cotter pin etc.)[3]
b. Prior to installation of cowlings or panels that would cover a safety or work procedure.
c. Any maintenance procedure involving a flight control or drive train assembly.
d. Reassembly of a component.
e. Installation of engines, main gearbox or tail rotor gearbox.
f. Installation of all fuel lines, hydraulic lines and oil lines. (Rigid or Flexible)
2. The assigned QC inspector will review all work packages for completeness to include insuring there are no open blocks. After review the inspector will sign, initial or stamp the cover sheet as indicated.
3. The assigned QC inspector will review all serviceability tags to ensure correct information and will sign, initial or stamp the component serial number verification block.

1.7. Maintenance Manuals and Guidance

Sundance has a subscription service with Eurocopter and Turbomeca for their manuals and guidance. The revisions are applied to manuals as received. Every 30 days the manuals receive a

[3] During the inspector training, inspectors are instructed to mark all safeties and line installations with paint marker. Each inspector has a designated color.

currency check. The Quality Assurance department checks the manufacturer's website for current revisions and physically verifies the manuals are up to date.

The majority of the mechanics currently use paper manuals. Sundance Helicopters is in the process of setting up electronic kiosks for mechanics. The DOM and QA have electronic manuals, and the mechanics on the floor have paper manuals. Some mechanics use their personal laptops equipped with the electronic manual software. The electronic manuals are kept current through the quality assurance department and mechanics that use their personal laptops have access to the updated manuals.

1.8. Training

Upon initial employment, mechanics have a general indoctrination into the company system through a training program set up by Sundance's quality assurance department. Mechanics usually undergo factory training within the first year of employment. Indoctrination training can take 2-3 days and is dependent upon the mechanic's background. After indoctrination they go to the maintenance floor and go through an on the job training program. All training is documented and kept in the mechanic’s training file. Within 6 months to a year, after it is decided that the mechanic will remain on staff, they are sent to specific product training.

Sundance Helicopters currently brings in one Eurocopter or Turbomeca class to their facility each year. Mechanics are considered for training based on their work history, background, previous training, and length of employment. The company also conducts recurrent training for all mechanics to review procedures and issues that arose throughout the previous year. Specific training, such as balancing, component repair, etc., is occasionally offered.

There is one employee in the QA department with an inspection authorization (IA). The primary duty of the IA is to approve 337 Major Repair and Alterations.

At the time of the accident, Sundance employed 18 aviation maintenance technicians. Of those, two were uncertificated mechanics, one mechanic with an airframe rating only, and the remainder had both airframe and powerplant ratings. Of the technicians, the company has nine designated inspectors that undergo training, and conduct inspections on certain items in maintenance that require specific inspections. Eurocopter experience is not required to be hired, but it is preferred.

1.9. Mechanic Schedule

The mechanics work in shifts. The night shift mechanic shifts consist of a rotation of 3 days on, 4 days off, and then 4 days on, and 3 days off. The lead for each shift is a designated inspector by the company, and another individual assigned to the shift is also a designated inspector. Night shift mechanics work 12- or 11-hour shifts over a three to four day period. The typical night shift runs from noon- midnight or noon – 2300. Day shift mechanics work from 0600 to 1400, with 5 days on and 2 days off. The dayshift maintenance team consists of two certificated mechanics and one uncertificated mechanic. Typical staffing for the afternoon includes a combination of the

dayshift and night shift mechanics, including a maintenance team of six mechanics, with two company designated inspectors, and one of those inspectors a lead.

The Production Manager approves whether or not work would continue past midnight. He works dayshift and is available to mechanics for consultation throughout the night via telephone.

According to section 7.8 of the GOM, Maintenance Technician Duty Time:

> The Maintenance Technician duty day is normally limited to 14 hours per day, but may be extended as directed by the DOM to meet maintenance requirements.

2. Helicopter History and Maintenance

2.1. Helicopter Information

The helicopter's production certificate was issued in 1988. The aircraft was originally an AS 350B. It was converted to an AS350BA on December 18, 1995, in accordance with Eurocopter SB 01.35R2, with a total time at conversion of 3, 597.6 hours. It was converted to an AS350B2 on April 10, 2008, in accordance with Eurocopter SB 01.00.50, revision 3, dated October 22, 2007, with a total time at conversion of 19,122.6 hours.

The status sheet current the morning of December 7, showed that the Hobbs time was 1,755.2. The aircraft total time was 25,216.5 hours and the engine total time was 7,400 hours, Np cycles 7,845 hours and Ng cycles 9,667.2 hours. The total number of airframe flights was 61,405. The component nearest due was the hydraulic hose replacement due in 117 hours.

During the initial wreckage examination at the accident site, the Airworthiness Group identified that the fore/aft servo input rod was not connected to the fore/aft servo (See Photo 1 and Figure 3). The input rod is normally secured using a bolt, washer, and lock nut. The assembly is then safetied using a cotter pin. During the on scene portion of the investigation, the hardware that secures the input rod to the fore/aft servo was not found. Additional information regarding the full wreckage examination can be found in the Airworthiness Group Chairman's Factual Report.

Photo 1. Fore/Aft Servo and Input Rod

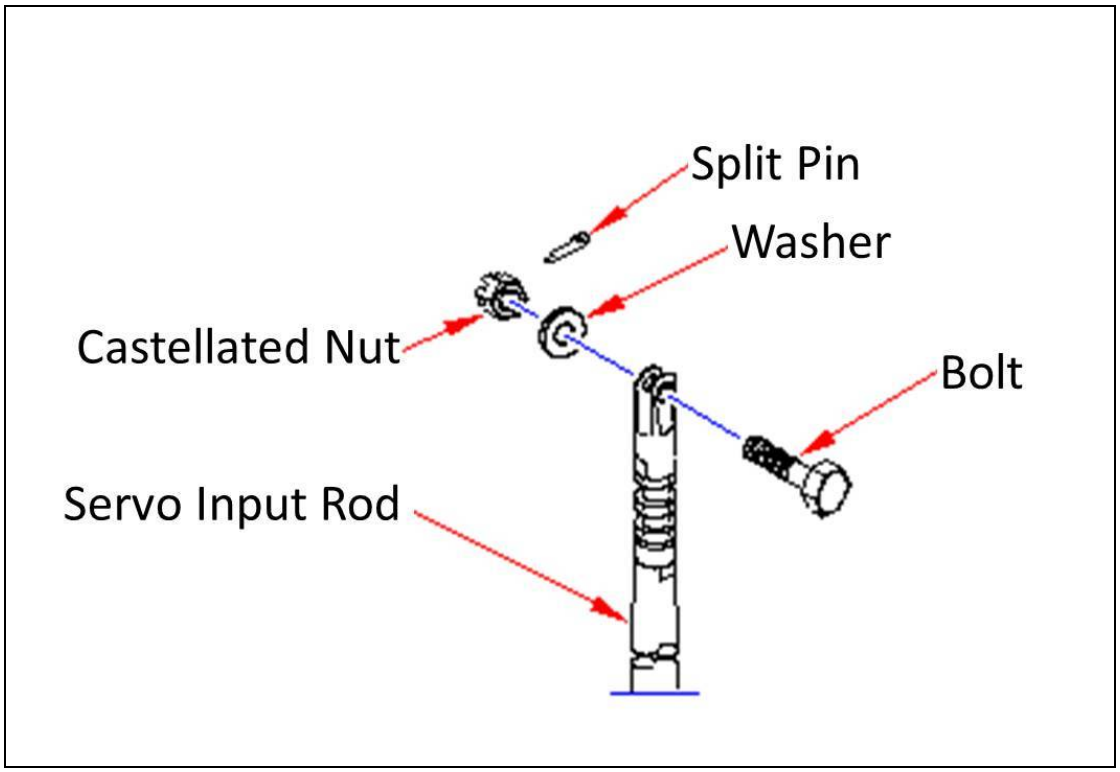


Figure 3. Bolt, washer, nut, and cotter pin

2.2. Aircraft Records Review

2.2.1. Previous Accident Data

Review of accident data for the helicopter indicated that the helicopter had not been involved in any previous accidents.

2.2.2. Post Accident Actions

Following the accident, all fifteen AS 350 helicopters[4] operated by Sundance were inspected to ensure that the fore/aft servo hardware was connected and safetied properly. All fore/aft servos were found secure. Additionally, the hardware for the input rod to each of the servos[5] was removed and examined for company helicopters at 5,000 hours of flight time or more. Out of 13 helicopters that had been inspected as of January 11, 2012, approximately half of the nuts were determined to have no locking capability. Of the bolts examined, 19 were determined to be unairworthy.

Of the unairworthy hardware identified, two bolts and nuts were retained by the NTSB Airworthiness Group. These were from the fore/aft servos on helicopters N351WM and N340SH. Both of the bolts contained wear markings on the shank that rendered them unairworthy. The nut for N340SH had no locking capability, and the nut for N351WM was serviceable. According to Sundance Helicopters, a new bolt for N351WM was installed at an aircraft total time of 12,210.9 hours in November of 2008. At the time of removal, the total hours on N351WM were 16,415 hours, indicating that the bolt had been installed for 4,204.1 hours. There were no records of replacement for the hardware on N340SH. At the time of removal, the total hours on N340SH were 7,308 hours. In 2009, Sundance implemented a record policy to require recording when the bolt and nut are replaced. However, this is not a standard industry requirement. There is no requirement by the manufacturer to replace the nut when the bolt is replaced.[6] [7]

[4] Sundance also operates four EC-130 helicopters.
[5] Each helicopter has three main rotor servos. These include one fore/aft servo and two lateral servos.
[6] Following the accident, Sundance required that all lock nuts be replaced following removal.
[7] Bell Helicopter notes in the reuse of hardware on their light helicopters, "If measured tare torque value is less than the minimum listed, the lock nut must be replaced." Additionally, if a component requires a onetime use of a lock nut, this information is called out by Bell in an Alert Service Bulletin. Sikorsky Helicopter provides similar guidance regarding torque values and replacements on reused lock nuts. Eurocopter provides guidance and replacement of the hardware in the Eurocopter Standard Practices Manual.

Photo 2. Old and New Bolts

Review of the Sundance's Logistics records on the purchase and issuance of the bolt (PN 22731BC060020M) and nut (PN ASNA0045-060BCL) showed the following[8]:

Table 1. Bolt and Nut Purchase and Issuance

Bolt	**Purchased**	**Issued**
2009	0	0
2010	0	0
2011	10 (April)	4
12/7/11-12/31/11	80 (December)	16
Nut	**Purchased**	**Issued**
2009	0	2
2010	1	32
2011	0	7
12/7/11-12/31/11	80	21

2.2.3. Inspections

The most recent maintenance on the helicopter was a 100-hour inspection completed on December 6, 2011. In addition to the 100-hour inspection requirements, during the inspection,

[8] This does not take into account bolts and nuts in stock.

the engine was changed, the fore/aft servo was changed, and the tail rotor servo was changed.[9] A 400-hour inspection was also completed on the engine. The engine had originally been installed on May 26, 2011, in helicopter AS-350B2, S/N 2009, N53SH. The engine was removed from N53SH on November 20, 2011, and installed in the accident helicopter on December 6, 2011. The engine installed was a rental engine from Vector Aerospace. According to the DOM, when an asset is needing overhaul, they will acquire a rental engine from the company until overhaul is completed.

The fore/aft main servo that was removed was P/N AC67246, S/N RX187, and it had a time since overhaul (TSO) of 1959.5 hours. The installed fore/aft main servo was S/N BX264, and it had 0 hours TSO. It was recently overhauled at Malmrose Heli-Services, Inc. The tail rotor control servo that was removed was P/N AC76032, S/N FE212, and it had a TSO of 1959.5 hours. The installed tail rotor servo was S/N DK287, and it had 0 hours TSO. It was also overhauled at Malmrose Heli-Services.

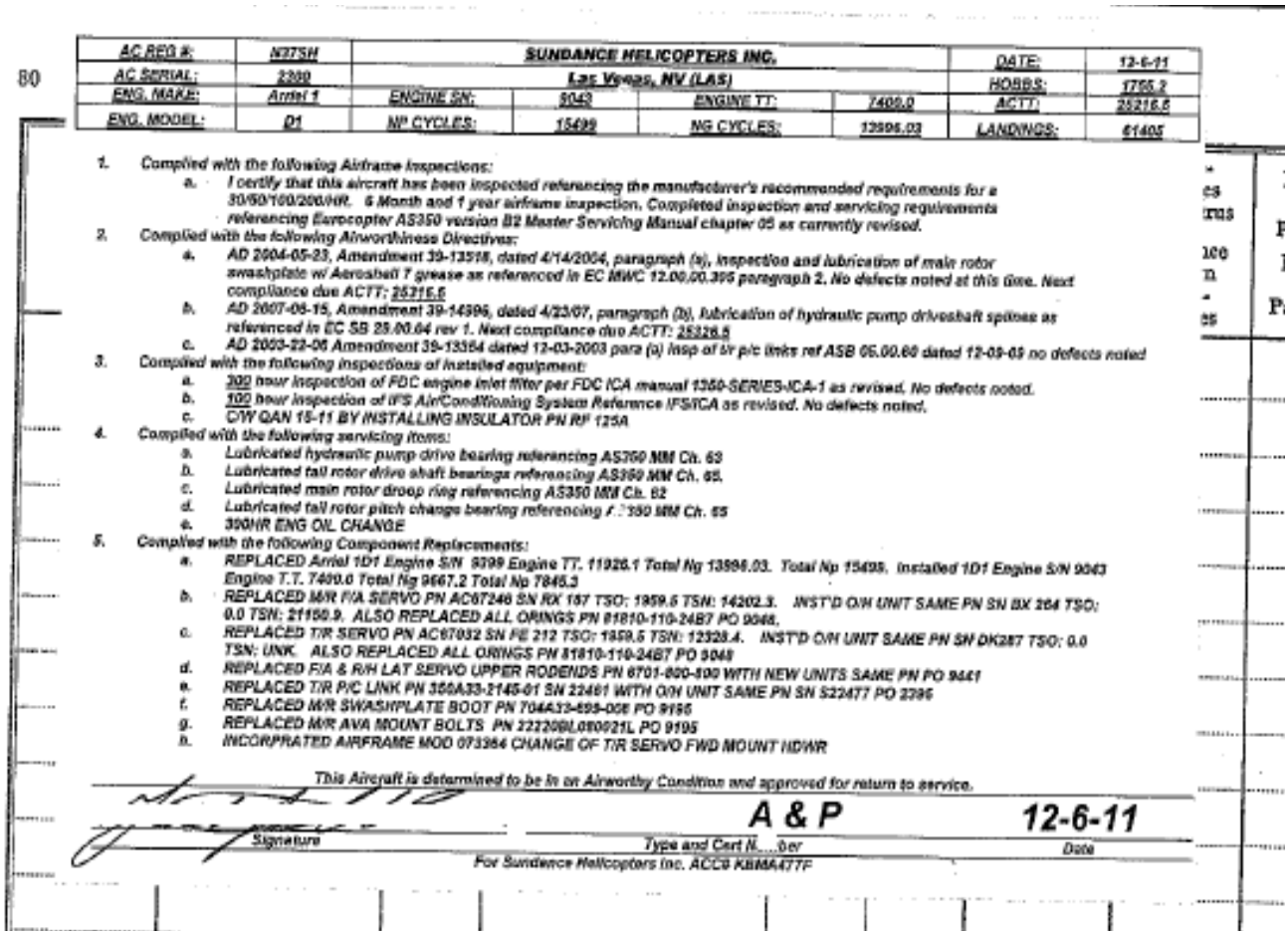
Four mechanics worked on the helicopter on December 6. Throughout the remainder of the report, they will be designated as noted in the following table.

Table 2. Mechanics and Check Pilot

Title	Position
Mechanic 1	Main Rotor Area
Mechanic 2	Tail Rotor Area
Mechanic 3	Engine Area
Inspector/Mechanic	Inspections
Day Mechanic	Worked Day of Accident
Check Pilot	Completed Check Flight

Mechanic 1 completed work in the main rotor area, including the fore/aft servo installation. Mechanic 2 completed the tail rotor area inspections, including the tail rotor servo installations. Mechanic 3 completed the installation of the engine. The Inspector/Mechanic, a company inspector and mechanic, completed required inspections and signed off the ground checks for the work. The logbook entry from the airframe logbook is shown in Figure 2.

[9] The overhaul requirement of the servos is 1,800 hours, with an allowable 180-flight hour or 180-day exceedance.



AC REG #:	N27SH	SUNDANCE HELICOPTERS INC.				DATE:	12-6-11
AC SERIAL:	2309	Las Vegas, NV (LAS)				HOBBS:	1755.2
ENG. MAKE:	Arriel 1	ENGINE SN:	9043	ENGINE TT:	7409.0	ACTT:	25216.6
ENG. MODEL:	D1	NP CYCLES:	15499	NG CYCLES:	13996.03	LANDINGS:	61405

1. Complied with the following Airframe Inspections:
   a. I certify that this aircraft has been inspected referencing the manufacturer's recommended requirements for a 50/50/100/200/HR. 6 Month and 1 year airframe inspection. Completed inspection and servicing requirements referencing Eurocopter AS350 version B2 Master Servicing Manual chapter 05 as currently revised.
2. Complied with the following Airworthiness Directives:
   a. AD 2004-05-23, Amendment 39-13518, dated 4/14/2004, paragraph (a), inspection and lubrication of main rotor swashplate w/ Aeroshell 7 grease as referenced in EC MWC 12.00.00.395 paragraph 2. No defects noted at this time. Next compliance due ACTT: 25716.6
   b. AD 2007-06-15, Amendment 39-14996, dated 4/23/07, paragraph (b), lubrication of hydraulic pump driveshaft splines as referenced in EC SB 25.00.64 rev 1. Next compliance due ACTT: 25326.6
   c. AD 2003-22-06 Amendment 39-13364 dated 12-03-2003 para (a) insp of t/r p/c links ref ASB 05.00.60 dated 12-03-03 no defects noted
3. Complied with the following inspections of installed equipment:
   a. 300 hour inspection of FDC engine inlet filter per FDC ICA manual 1350-SERIES-ICA-1 as revised. No defects noted.
   b. 100 hour inspection of IFS AirConditioning System Reference IFS/ICA as revised. No defects noted.
   c. C/W QAN 15-11 BY INSTALLING INSULATOR PN RF 125A
4. Complied with the following servicing items:
   a. Lubricated hydraulic pump drive bearing referencing AS350 MM Ch. 63
   b. Lubricated tail rotor drive shaft bearings referencing AS350 MM Ch. 65.
   c. Lubricated main rotor droop ring referencing AS350 MM Ch. 62
   d. Lubricated tail rotor pitch change bearing referencing AS350 MM Ch. 65
   e. 350HR ENG OIL CHANGE
5. Complied with the following Component Replacements:
   a. REPLACED Arriel 1D1 Engine S/N 9099 Engine TT. 11926.1 Total Ng 13996.03. Total Np 15499. Installed 1D1 Engine S/N 9043 Engine T.T. 7409.0 Total Ng 9667.2 Total Np 7845.3
   b. REPLACED M/R F/A SERVO PN AC67246 SN RX 157 TSO: 1959.5 TSN: 14202.3. INST'D O/H UNIT SAME PN SN BX 264 TSO: 0.0 TSN: 21150.9. ALSO REPLACED ALL ORINGS PN 81810-110-24B7 PO 9048.
   c. REPLACED T/R SERVO PN AC67032 SN FE 212 TSO: 1959.5 TSN: 12328.4. INST'D O/H UNIT SAME PN SN DK287 TSO: 0.0 TSN: UNK. ALSO REPLACED ALL ORINGS PN 81810-110-24B7 PO 9048
   d. REPLACED F/A & R/H LAT SERVO UPPER RODENDS PN 6701-600-500 WITH NEW UNITS SAME PN PO 9441
   e. REPLACED T/R P/C LINK PN 350A33-2145-01 SN 22461 WITH O/H UNIT SAME PN SN S22477 PO 2396
   f. REPLACED M/R SWASHPLATE BOOT PN 704A33-695-008 PO 9155
   g. REPLACED M/R AVA MOUNT BOLTS PN 222209L080021L PO 9195
   h. INCORPRATED AIRFRAME MOD 073364 CHANGE OF T/R SERVO FWD MOUNT HDWR

This Aircraft is determined to be in an Airworthy Condition and approved for return to service.

Signature — A & P (Type and Cert N...ber) — 12-6-11 (Date)

For Sundance Helicopters Inc. ACC# K8MA477F

Figure 4. 100-Hour Inspection Airframe Logbook

Eurocopter maintenance manual procedures for installing the fore/aft servo specify the following, in part:

5 INSTALLATION (Figure 1)

- If necessary, build up the servocontrol as per W.C. 67.30.15.401.
- Apply the grease G.382 on the smooth part of the bolts (4) and (15).
- Put the servocontrol in position with the actuator down.
- Install the bolt (4), the washers (2) and the nut (1) on the non-rotating swashplate (3).
- Install the bolt (15), the washer (16) and the nut (17) on the flared housing side (19).
- Torque the nuts (1) and (17).
- Savety the nuts (1) and (17) with the split pins (5) and (18).
- Attach the input rod (13) with the bolt (9), the washer (10) and the nut (11).
- Torque the nut (11).
- Savety the nut (11) with the split pin (12).
- Connect the connector (14) of the servolcontrol.
- Remove the blanking caps from the hydraulic lines and from the servocontrol.
- Install and tighten the hydraulic lines on the servocontrol.
- Install and attach the fairing (6) with the washers (7) and the screws (8).
- Savety the screws (8) with the lockwire.

Figure 5. Fore/Aft Servo Install

According to the DOM, Sundance marketing sells their seats in advance, based on the projected availability of the company helicopters by the maintenance department. Due to the tours booked on the day of the accident, the helicopter was needed in order to satisfy the seat demand. The DOM indicated that if the helicopter would have been delayed on the 100-hour, the flights would have been canceled until a helicopter became available. He reported that calling in mechanics during their scheduled time off is not an uncommon occurrence.

Interviews with the four mechanics indicated that three of them were contacted on Monday afternoon (December 5), their normal scheduled day off, requesting their availability to report to work on Tuesday, their other scheduled day off.[10] They were called in to complete a 100-hour inspection on the accident helicopter, because the normally scheduled maintenance crew had other work to accomplish. The shift would begin at 0530 AM.

Mechanic 3, who works as an engine mechanic, was scheduled to work his normal day shift on Tuesday, from 730-1600. The following clock in times were recorded for December 6:

Mechanic 1- In: 550, Out: 1846
Mechanic 2- In: 537, Out: 1658
Mechanic 3- In: 708, Out: 1704
Inspector/Mechanic- In: 531, Out: 1855

They completed the 100-hour inspection, the replacement of the servos, and the engine installation with no anomalies noted. The Inspector/Mechanic inspected the work. The work was completed by approximately 1700 on Tuesday, December 6, and the Inspector/Mechanic and Mechanic 1 stayed until about 1830 to complete the ground run checks on the helicopter. The Inspector/Mechanic completed the paperwork which readied the helicopter for the maintenance operational check flight the following morning.

After the inspection, the Check Pilot completed the maintenance operational check flight the following morning, December 7. He arrived to work at 0545. During his initial walk around, he noted that the hydraulic belt was loose. The Dayshift Mechanic was called over to readjust the belt. The Check Pilot also noted that the batteries for the flashlight were low, and the window cleaner fluid was almost empty. The hydraulic belt was readjusted, the other items were corrected, and the pilot then conducted his check flight from 0715-0730. Following the maintenance check flight, the Check Pilot flew the helicopter for a tour flight. The helicopter was then flown on a tour by the accident pilot, followed by the accident flight.[11]

2.2.3.1. Reuse of Hardware

Review of the maintenance records revealed no record of the fore/aft servo hardware having been replaced.[12] Approximately 3 years prior to the accident, Sundance changed their record

[10] At the time of the maintenance, the mechanics were in a 4-day off cycle.
[11] Each of the tour flights consist of two segments. The accident flight was one segment.
[12] The maintenance records were checked dating back to July 9, 2001, at an aircraft total time of 9,773.8 hours.

procedures to require written requests for controlled hardware[13] such as the bolt and nut. Prior to that time, there was no company requirement that this be documented (nor was or is this a requirement under current FAA regulations). There was no record of the bolt being replaced in the three years prior to the accident.

According to the Eurocopter Standard Practices Manual, "Prior to reusing the nuts:

- Make sure nylon lock is not excessively damaged
- Fit the nut by hand:
  - If nut can easily be tightened, it is to be discarded
  - If nut is hard and cannot be tightened by hand, it may be reused

  (In a workshop, the minimum locking torque value can be read using a torque wrench)."

The following chart is then provided:

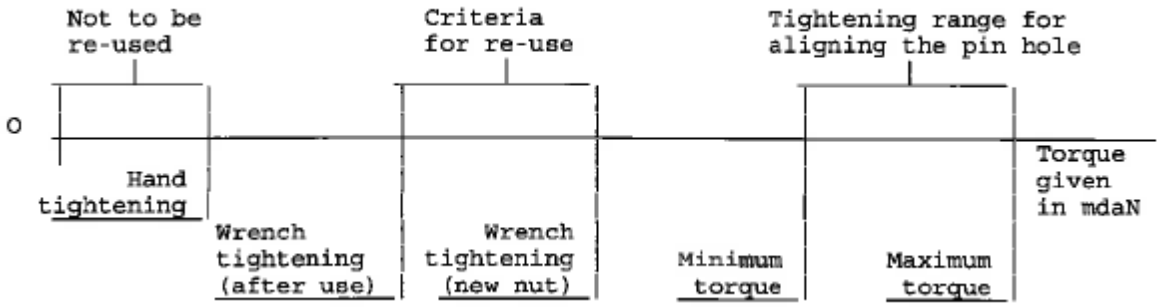


Figure 6. Nut Reuse Guidance (Eurocopter Standard Practices Guidance MTC.20.02.05.404, 2009.11.2)

2.2.3.2. Cotter Pin Determination

Sundance stocks 11 different cotter pins as consumable items. These cotter pins are located in bins on the shop floor labeled with the specific part number. Maintenance personnel determine which cotter pin they will need and then access the cotter pins directly. They do not require that a parts request form be completed by the mechanic.

2.2.3.3. Estimated Flight Time Since Maintenance

The aircraft completed five flight segments following the replacement of the servo and prior to the accident. The spider Spider Tracks[14] data, a flight tracking system, showed approximately 180 minutes of flight time. The system records in 8-minute increments so may not reflect the entire flight time. Additionally, the tracking data did not record the post maintenance ground run.

[13] According to Sundance, controlled hardware is hardware that is specific to the maintenance being performed and is inventoried by the Logistics department. Hardware that is not controlled would not require a written request and be readily available to maintenance personnel.

[14] Spider Tracks provides satellite flight tracking data for aircraft.

- Maintenance Operational Check flight- 14 minutes
- Canyon Tour (two segments)- 79 minutes
- Canyon Tour (two segments)- 82 minutes
- Twilight Tour- 14 minutes

Based on typical operating times and cycles for the Sundance tour flights, it is estimated that the helicopter accrued approximately 3.5 hours of flight time following the maintenance, with 6 engine cycles.

2.2.3.4. Mechanic Interview Summaries

2.2.3.4.1. Inspector/Mechanic

The Inspector/Mechanic was initially interviewed on December 10, 2011.

After obtaining employment with Sundance Helicopters, the Inspector/Mechanic went through indoctrination training and line training for two weeks. While employed with another operator at an earlier time, he received factory training on the Eurocopter AS 350 and EC 130 helicopters, and the Turbomeca 1D1 and 2B1 engines. Approximately 6 months prior to the date of the accident, the Inspector/Mechanic was designated as an inspector for Sundance. During the designation process, he underwent company training that included a review of the FARs, required items that need inspection, the building of packets, and what has to be accomplished and signed off. When the inspector/mechanic was asked what specific items need to be inspected he reported, "Anything that requires a safety or a cotter pin, all pipes and lines. Basically anything that, whoever the mechanic is, deems he wants someone to look at again." He was unable to think of any other inspection items during the interview.

The Inspector/Mechanic indicated that he works with the same group of mechanics for each of his shifts and that this arrangement works well. They work either 11-hour or 12-hour shifts and overtime is occasionally available, but he did not consider it overwhelming. The Inspector/mechanic's last scheduled shift prior to the accident was Saturday, December 3. He was off on Sunday and Monday. On early Monday afternoon, he was contacted about coming in on his day off, Tuesday, to conduct a 100-hour inspection on N37SH (the accident helicopter). Upon reporting for work Tuesday morning at 0530, the Inspector/Mechanic printed off a status run to determine what items were due in addition to the 100-hour inspection. He then put together the inspection packet. The Inspector/Mechanic noted that in addition to the 100-hour inspection, two servos needed to be replaced for overhaul and the engine needed replacement due to an internal life-limited component.

The Inspector/Mechanic reported that Mechanic 3 conducted the engine removal and installation, Mechanic 1 completed the fore/aft servo installation, and Mechanic 2 completed the tail rotor servo installation. The Inspector/Mechanic indicated that Mechanic 1 also replaced a rod end during the fore/aft servo installation. The hydraulic accumulators were not replaced. When the work was complete, the Inspector/Mechanic inspected it and signed off on it. When asked what he looks at for the fore/aft servo installation, he reported, "I look for the two safeties on both the rod ends, the two cotter pins on the mount hardware, and the safety holding the two bolts that

hold the accumulator assembly to the servo." The Inspector/Mechanic did not find any problems during the inspections.

At the completion of the work, the helicopter was signed off and ground run by the Inspector/Mechanic about 1800. Mechanic 1 assisted him in performing the ground run. In addition to the normal 100-hour verifications, they completed engine checklist items. The tail rotor and short shaft balance were checked and anything that was replaced was leak checked. Once the ground run was completed, the Inspector/Mechanic moved the cyclic around to verify movement of the servos and to check for leaks. The Inspector/Mechanic estimated it took about 40-45 minutes to complete the ground run. At that point, the inspection packet was completed, he ensured everything was signed and stamped off, and the discrepancy sheets were completed. He also verified that the aircraft logbooks were completed. Paperwork was left in the helicopter for the morning crew to verify before the check flight.

The Inspector/Mechanic was asked about the hydraulic belt removal and reinstallation and indicated that Mechanic 1 completed that work. The belt was disassembled, greased, inspected, put back together, and reinstalled. The Inspector/Mechanic then inspected the belt and tested the tension by pressing on the belt. He also indicated that during the ground runs it checked satisfactory. The following morning, it was found loose by the check pilot.

Throughout the day, there were no other aircraft that the mechanics were working on.

The Inspector/Mechanic reported using a combination of paper and electronic manuals to complete the work.

In a later interview with the Inspector/Mechanic conducted on January 11, 2012, he provided additional information regarding the maintenance performed on the fore/aft servo and general maintenance practices. The Inspector/Mechanic reported that after Mechanic 1 installed the fore/aft servo completed the build-up, he inspected the work. The ice shield[15] was on the servo at this time. The Inspector/Mechanic said that he knew the ice shield was on because of the purple torque stripes used by the overhaul facility that were apparent. If Mechanic 1 had removed the shield, the purple torque stripes would have been broken. The Inspector/Mechanic indicated that Mechanic 1 left the ice shield installed during the installation. After it was installed on the helicopter, he inspected the servo again. The Inspector/Mechanic indicated that when he inspects items he physically touches things and visually looks everything over. Dependent on what it is, he'll put a wrench on items and check them to make sure they are tight. Once the fore/aft servo was installed, the Inspector/Mechanic inspected the upper and lower attachment bolts and cotter pins, torque striped them, and then inspected the input rod, hardware, and cotter pin, and torque striped that too. He also inspected the hydraulic lines that connect to the manifold. At the time he was using white torque striping, but he now uses yellow because the white would fade over time.

[15] The ice shield is a protective composite cover that is attached to the top of the servo and contains a cutout where the bolt and nut securing the input rod is secured. There is no requirement to remove the ice shield during installation of the fore/aft servo. If the fore/aft servo is installed with the ice shield installed, due to clearance around the shield cutout, inserting the cotter pin is more difficult than if the ice shield is removed prior to the insertion of the cotter pin.

He reported that the items to be inspected are easy to access and are not blocked by other components.

When asked when or if hardware could be reused, the Inspector/Mechanic reported that the Standard Practices Manual gives you a breakdown on bolts, nuts, and wear limits, and whether or not they can be reused. He indicated the in Chapter 20, it specifically states what type of nut and how many reuses is it authorized for, if it could be reused. He was uncertain how he would determine how many times the nut had been reused. Specifically regarding the fore/aft input rod nut, the inspector/mechanic reported that from his personal experience, if the nut can be threaded all the way on by hand, it cannot be reused because it has lost its entire locking feature. The inspector/mechanic reported that the hardware is replaced on the servo approximately 60-70 percent of the time.

The Inspector/Mechanic reported that when he did installations of fore/aft servos, he would normally leave the ice shield installed. He said the only reason it would be removed is to make the reinstallation access easier. With the ice shield installed, access to put the cotter pin in is more difficult.

2.2.3.4.2. Mechanic 1

Mechanic 1 holds an airframe and powerplant mechanic certificate and he had been employed with Sundance for approximately 6 months. All of his mechanic experience prior to coming to Sundance was fixed-wing. When he began with Sundance he went through a few initial training programs in the Quality Control department. In this training he learned about keeping proper records, maintenance procedures, and how to read the Eurocopter manuals. Mechanic 1 said as far as his line training, it was not formalized but when he had a question of the other mechanics he would ask it.

Mechanic 1 indicated that overtime was available if he wanted to take it. The Saturday prior to the accident, he worked a short shift, and then went to the company Christmas party that evening. He was contacted Monday afternoon about coming in on Tuesday to complete the 100-hour inspection on N37SH.

During the 100-hour inspection, Mechanic 1was responsible for the fore/aft servo replacement. When he arrived, the Inspector/Mechanic, had the replacement servo and the new O-rings ready for him. Mechanic 1's job was to take the servo off of the aircraft, disassemble it, clean it, inspect it, and change out the old servo for the new servo. He also replaced the upper rod end. He also put the new O-rings in the accumulator attachment, reassembled it, torqued and safetied everything, and reinstalled it on the aircraft. He then connected the hydraulic lines and retorqued all of the rod ends back to the flight controls. The mechanic said that he had performed this process six times since June. He did not encounter any difficulties during the installation. Once it was reassembled and installed, the mechanic called the Inspector/Mechanic over to verify the work.

During the 100-hour inspection, Mechanic 1 also removed the hydraulic belt and then reinstalled it. He did not have any difficulty setting the tension which is accomplished through two bolts:

one at the bottom and one at the top. Mechanic 1 also believed that the inspector was required to sign this item off.

Mechanic 1 was involved in the post maintenance ground run checks. He ensured that there were no leaks, verified the tail rotor was in balance, the short shaft was in balance, and verified the levels of all fluids. He also checked the servos to ensure they were not binding. No problems were identified.

In a later interview with Mechanic 1 conducted on January 11, 2012, he provided additional information regarding the maintenance performed on the fore/aft servo. The mechanic reported that when removing the fore/aft servo, he removes the cotter pins, and then removes the input rod bolt and the upper and lower attachment bolts. He loosens the hydraulic lines, removes them, then caps or bags them to prevent contamination. He then removes the magnet and secures it. At this point, he disconnects the input rod and is able to remove the servo from the helicopter.

After the fore/aft servo is removed, Mechanic 1 removed the accumulator from the servo, cleaned it, and made sure that it is serviceable. He also measured the ball ends on each side and compared them to the measurements in the maintenance manual. In the case of the accident helicopter, he determined that the top ball end was not within limits and replaced it. He then installed the new O-rings and secured them. He also torqued the ball ends downs, safetied them, and had all of the work inspected.

Mechanic 1 then reinstalled the fore/aft servo on the helicopter. He secured both the upper and lower rod ends. He reconnected the hydraulic lines and torqued them. He then reconnected the input rod, assembled the bolt and nut together, torqued it, and installed the cotter pin. He then ensured that the upper and lower rod ends were torqued and cotter pinned. He used an analog torque wrench.

Mechanic 1 indicated that when he is determining whether or not hardware can be reused, he removes it, cleans it, and then inspects it for any cracks, damage, or discoloration. He determines reuse of the nut by threading it on and seeing if it threads all the way down. If either piece of hardware is unairworthy, he requests new hardware. In the case of the accident helicopter, the hardware was deemed airworthy. The mechanic indicated that if he is able to turn the nut down to where the shank is visible, he replaces the nut.

To determine which cotter pin to use, Mechanic 1 uses a chart. In this case, he used the 151 size that is common on the helicopter. This allows the bolt and nut to be secured, without having to trim the cotter pin. When reinstalling the servo, Mechanic 1 was asked whether or not he removes the ice shield. He said that he normally removes it so that he has easier access for the input rod bolt and nut, and the installation of the cotter pin is easier. He could not recall whether or not he removed it during the fore/aft servo installation. Mechanic 1 stated that after the inspector/mechanic verified his work, he reviewed it to ensure that nothing was missed.

1.1.1.1.1. Mechanic 2

Mechanic 2 holds an airframe and powerplant mechanic certificate, private pilot single engine airplane certificate, and a commercial certificate for instrument rotorcraft. He has been employed by Sundance for about one year and works as a line mechanic, completing 11 and 12-hour shifts. Mechanic 2 indicated that once he was hired on with Sundance Helicopters he did not receive formal training. He mainly had to get familiar with their operations and inspections. The mechanic did not have any formal training with Eurocopter.

Mechanic 2 was called in on the afternoon of his day off to complete the 100-hour inspection on N37SH. He arrived at 0530 and was assigned the tail section for the 100-hour. In addition, he had to replace the tail rotor servo. During the replacement, the forward mounting bolt was replaced. He had done this procedure approximately 20 times in his career. Mechanic 2 indicated that the inspection was not rushed, and they were able to work at a slower pace. After the work was completed and signed off by the mechanic, the Inspector/Mechanic inspected his work. He did not find any problems.

Mechanic 2 reported using paper manuals to complete the work.

1.1.1.1.2. Mechanic 3

Mechanic 3 holds an airframe and powerplant mechanic certificate. Mechanic 3 has been employed at Sundance Helicopters for two years.

The mechanic had recently been moved into the Engine Shop Supervisor position and he works a Monday through Friday schedule from 730-1630 each day. He is also a designated inspector at Sundance, and does not hold an inspection authorization. Before that, he worked as a line mechanic. As a mechanic, he primarily worked with powerplants. In his new position, he conducts level III work. His last Turbomeca training was November of 2010.

The day of the 100-hour inspection, Mechanic 3 was asked to remove the current engine and install the new engine. He worked his normal shift. It took him about 6.5 hours to complete the removal and installation. In order to complete the work, the mechanic used a combination of paper and electronic manuals. The Mechanic/Inspector then inspected the work and stamped it off.

1.1.1.1.3. Dayshift Mechanic

The Dayshift Mechanic indicated that he held an airframe and powerplant certificate. After previously being employed by Sundance, he was rehired by Sundance in January of 2011. He had formal Turbomeca training in 2003, and various fixed-wing training. He is working on obtaining an inspection authorization and works as a dayshift mechanic.

As a dayshift mechanic, he ensures that all morning flights depart as they should. If there is a problem, they are contacted by the pilots. The day of the accident, the mechanic arrived about 6 AM with two other dayshift mechanics. At one point, the mechanic was asked to look at the hydraulic belt on N37SH. He opened up the cowling and saw that the hydraulic belt was loose.

He also verified its tension by putting his finger on it. He then looked at the bolts and noted the green torque marks indicating that the bolts had been torqued were present. He also verified that the belt was not damaged.

The Dayshift Mechanic then removed and reinstalled the belt, checking the tension both visually and with a press test. He could not determine why the belt was loose initially. As he was waiting for a torque wrench, he signed off the helicopter. Once the torque wrench arrived, he torqued the fittings. After it was reinstalled, an inspector verified the work and stamped next to his signature. The paperwork was then left in the helicopter for the pilot.

1.1.1.2. Check Pilot Interview

1.1.1.2.1. Check Pilot

The Check Pilot conducted the check flight following the maintenance performed on the helicopter. He began flying helicopters in 2003 and was also trained as a mechanic. He also holds a fixed-wing certificate. He began work with Sundance in February of 2010 as a line pilot. Although he does not work as a mechanic for Sundance, the check pilot does spend a lot of time communicating with maintenance personnel. He has conducted about 10-12 flight checks since starting his employment with Sundance.[16]

The Check Pilot arrived on December 7, the morning of the accident. He reviewed the logbook to determine what maintenance was performed. He found it was a normal 100-hour inspection, but it also showed that an engine replacement had been done and what he believed was the forward and right servo had been replaced. Because of the extra work performed, the Check Pilot felt that additional checks might have been necessary. He spoke to the Director of Safety and asked him if there were any other checks required. The Director of Safety said it was dependent on the work performed and whether a module was replaced, a new section of the engine was installed, if the engine was new, or if it was swapped from another helicopter. Maintenance advised the check pilot that the engine was swapped from another helicopter so therefore, he determined that a regular operations check was required.

He proceeded with the preflight and found that the belt for the hydraulic pump needed to be tightened. He noticed it was loose by spinning the pulley of the pump by itself. It did not turn the blades, it just spun. One of the mechanics tightened it up. Additionally he found that the batteries in the flashlight needed replacement, and the window cleaner was not installed. Everything else checked out satisfactorily. The check flight was conducted with no problems noted.

Following the check flight, he completed the paperwork, did a post flight check, and then departed on his first tour of the day in the helicopter. When he returned he noted no problems with the helicopter and that the accident pilot would be flying the next flight. He left the maintenance log on the pilot’s seat for the accident pilot to verify. The accident pilot completed one tour and the accident occurred on the following flight. The copy of the maintenance log page and associated documentation related to the flight check were destroyed in the accident.

[16] At the time of the accident, Sundance had 12 company check pilots.

1.1.2. Airworthiness Directives

The airworthiness directive (AD) sign offs were included in the maintenance logs and recurring ADs are noted on the status log. Daily AD requirements are kept within the logbook container in the aircraft.

For rental engines, during the receiving inspection the ADs are verified and checked based on the AD list in the engine logbook. Any recurring ADs are then completed by Sundance Helicopters.

The following ADs were current for servos at the time of the accident:

- AD 2010-22-08 (replacement of servo controls, not applicable to part numbers, completed November 12, 2010)
- AD 2006-19-01 (involved inspecting housing for a crack, completed March 25, 2005)
- AD 2003-22-11(involves removing specific servos from use, completed November 9, 2003)
- AD 2003-14-12 (verifying part times and not applicable due to part numbers, completed August 4, 2003)
- AD 90-23-03 (required installation of an ice shield not applicable due to part numbers, completed on October 20, 1999).

1.1.3. Service Bulletins

Compliance with service bulletins (SBs) is not required. SBs are directed to the DOM and production manager with decisions on whether or not they should be immediately required. The decision on whether or not to implement the SB is made at the DOM level. SBs pertaining to the servos were recorded as completed through the servo overhaul, or were made mandatory through ADs.

1.1.4. Audits

The last internal records audit was completed in February 2011 and takes about 60 days to complete. Sundance Helicopters also conducts daily audits through its QA office. During the audit, the records are audited for sign offs and completion, the audit is signed off, then another person in the QA office verifies that it was completed correctly.

In addition to internal audits, Sundance Helicopters received an audit by Tour Operators Program of Safety (TOPS) in July 2011 and by the Department of the Air Force[17], Civil Air Carrier Review Board (CARB) in September of 2011. During the CARB review, it was noted that Sundance did not have a way to verify the capabilities of its vendors. In October of 2011, they created a required vendor checklist that vendors were required to complete within 90 days. The files are updated every two years. The CARB audit was then approved.

In August of 2009, Sundance requested an independent audit by JDA Aviation Technology Solutions to evaluate the maintenance policies and practices at the company. The audit provided

[17] Sundance Helicopters holds a military contract and a military audit is required.

multiple recommendations to the company about developing their own inspection plans, formalizing processes and procedures into a written format, purchasing tools, establishment of a quality control position, and advancing their maintenance tracking capabilities. The majority of the recommendations[18] had been incorporated into the Sundance maintenance program at the time of the accident. The implemented recommendations included development of a quality assurance department, creation of a general maintenance manual, creation of a self audit program, and development of a HAZMAT training program.

1.1.5. Malmrose Heli Services, Inc.

Malmrose Heli Services, Inc. overhauled the fore/aft servo and the tail servo that were installed during the 100-hour inspection. Sundance personnel reported working with the company for many years. Investigators visited the Malmrose facility and spoke with the owner of the company and his employee. A FAA airworthiness inspector from the Salt Lake City FSDO also participated in the visit.

Malmrose consists of two employees (the owner and his employee) and their primary function is the overhaul of Dunlop servos. They both hold repairman certificates issued by the FAA and have no other aviation experience or certificates. The owner had been involved in servo overhaul since 1994, and Malmrose began operation in 1999. His employee had been working there since 2002.

The entire servo overhaul process takes about 15 hours to complete, with time required to send required components for non-destructive testing. They are issued updated maintenance requirements from Eurocopter via compact disc, and the information they need is printed out and placed next to their workbenches. All service bulletins and ADs are monitored by the company owner through e-mail subscriptions and referenced through service bulletin/AD manuals created by the company.

2. FAA Oversight of Sundance Helicopters, Inc.

2.1. National Flight Standards Work Program Guidelines (NPG)

The FAA's Directors, Flight Standard's Service (AFS-1) has responsibility for administering the national surveillance programs and for developing the guidelines for inspectors to use, as published in the NPG, FAA Order 1800.56J.[19] Regional flight standards offices have primary responsibility for implementation of the national surveillance programs at the local Flight Standards District Offices (FSDO).

[18] Those items that were not implemented include development of their own inspection program, disposal of life-limited parts, development of shift turnover procedure, development of maintenance personnel performance standards, development of policy and procedure for calibrated tools, development of reliability data, use of web-based maintenance tracking and scheduling software, and acquiring tooling for the EC130 helicopter.
[19] FAA Order 1800.56J, National Flight Standards Work Program Guidelines was effective on September 26, 2008.

According to NPG 1800.56, to ensure that the FAA fulfills its statutory and regulatory requirements, four major safety areas have been identified as critical to ensure an overall level of safety within the aviation system. The four identified areas, listed in order of FAA priority, are surveillance, investigation, certification, and aviation education. The NPG also indicated that, "surveillance is one of the most important functions performed by AFS field office personnel to ensure safety and regulatory compliance in the aviation system."

The AFS work program consists of required surveillance work activities, but classified the items as required (R-items) and planned (P-items). According to the NPG, the R-items "comprise the mandatory core inspection program that is based on critical oversight issues, which have been identified at a national level. The required inspection program provides an essential level of surveillance activity for certificate holders." The P-items "provide comprehensive targeted inspections that meet special surveillance requirements for each certificate holder operating within a field office's geographic district." The P-items ideally would provide "special emphasis inspection areas" that should be developed from safety trends affecting aviation safety.

2.1.1. FAA Interaction

In interviews immediately following the accident, Sundance Helicopters maintenance management and QA management personnel reported limited interactions with their principal maintenance inspector (PMI) and principal avionics inspector (PAI). The operator moved to its new maintenance facility about 60 days prior to the accident and, as of December 12, 2011, the FAA had not completed an inspection of it. The PMI had indicated to the DOM that he would be visiting the new facility. They noted that the FAA does complete ramp checks under their operational oversight requirements. They reported that additional interaction with their oversight team would be beneficial.

In the last three years, the principal operations inspector (POI) has remained the same. The PMI has changed four times and the PAI has changed three times.

2.2. FAA Inspector Interviews

The Sundance previous and current PMIs and PAI were interviewed via telephone on January 17, 2012. The Former PMI (designated as PMI 1) had served as the PMI from October 2009 until October 2010. The PAI served as the PMI from October 2010 until April 2011, when he became their PAI, of which he currently assigned. The Las Vegas FSDO manager reported that April 2011- September 2011, due to a shortage in office staffing there was no PMI assigned, but surveillance was completed by other office inspectors. Review of the surveillance records showed that three paperwork items, one fuel facility inspection, and one follow up on a company incident were completed during that timeframe. PMI 2 was the PMI from October 2011 until December 2011.[20]

2.2.1. Former PMI Interview (PMI 1)

[20] The PMI was assigned as the Acting Airworthiness Supervisor following the accident.

The former PMI began his aviation career in the military as a mechanic. After several years doing contract work, he obtained his airframe and powerplant certificate in 2000, and inspection authorization (IA) in 2003. After several civilian maintenance jobs, he obtained employment with the FAA in 2008. Prior to coming to the FAA, the inspector obtained Eurocopter and Turbomeca training through one of the operators that he worked for.

From 2008-2009, he completed his initial FAA training. He began work with smaller operators and then was assigned oversight of Sundance. His initial assignment was October 2009-October 2010 when he served as their PMI. He described his workload as manageable during this time, with a moderate workload. He received a briefing from the previous PMI to familiarize himself with the operator. He also reviewed the fleet and Program Tracking and Reporting Subsystem (PTRS) entries, in addition to reviewing the work program for the year.

The PMI indicated that there is an initial process when taking on a new operator of getting to know them and understand how they work. Overall, his assessment of Sundance was good. He did indicate that following inspections he would brief the former Director of Maintenance (DOM) at the time of the findings, good or bad. Sometimes, the items required follow-up and occasionally were not completed. These included placards and failure to appropriately tag parts.

The PMI categorized Sundance as a typical 135 operator. When the aircraft are on the ground, they are not making money. There was an overall priority on maintenance and doing things correctly, but the PMI felt that the previous DOM might have been tasked with too many different jobs. During one of the PMI's inspections, he found that an aircraft added to the certificate had not complied with two ADs. This created problems between the CEO and DOM, and the DOM later left the company. The PMI issued a letter of investigation and enforcement action (Closed with Letter of Correction) on the AD issue.

The PMI reported that the previous DOM was not quick to respond, but that the current DOM is receptive to findings.

The PMI reported the following R and P items for Sundance Helicopters for FY 2010 and FY 2012, based on his work.

Table 3. R and P Items

	R-items	**P-items**	**R-items complete**	**P-items complete**
FY 2010	1[21]	24	1	24
FY 2012	3[22]	6	1	1

The former PMI was advised on January 11, 2012, that he had been reassigned as the PMI to Sundance[23]. He visited their facility on January 12 to notify the DOM of the change and also performed a planned inspection. He indicated that Sundance has done a lot to add safety to their

[21] The R-item involved a surveillance ramp check requirement.
[22] The R-items involved surveillance of their inspection program, and two items for the surveillance of the fuel facility.
[23] Following the conference call, a new inspector was assigned as the PMI for Sundance Helicopters, Inc.

operations with the addition of a QA department and the internal addition of the General Maintenance Manual (GMM). Although the GMM had not been accepted since it was not currently required under Part 135 operators with aircraft carrying 9 or less passengers, the PMI had corresponded with the operator previously on ways that portions of it could be incorporated into their General Operations Manual (GOM).

2.2.2. PMI 2 Interview

The PMI at the time of the accident was was hired by the FAA in September of 1998. After undergoing two years of training, he began work as the PMI for tour operators in the Grand Canyon and several Part 145 operators. He has not had any Eurocopter or Turbomeca specific training in his work history, or while employed by the FAA. Due to his oversight of tour operators that operate Eurocopter helicopters, he has had experience with the Turbomeca technical representative reviewing the helicopter and learning the components. He also attended the two week course on rotorcraft accident investigation.

The PMI was initially assigned as the Sundance PMI in October 2011 when the current PAI was assigned from PMI to PAI. The PMI was recently changed to Acting Airworthiness Supervisor so he no longer oversees Sundance, and a new PMI was assigned. The PMI had served as the PMI from 2007 to 2009, the former PMI became PMI from 2009 to 2010, the current PAI became PMI from 2010 to 2011, and PMI 2 was assigned PMI from October 2011- January 2012. In January of 2012, the former PMI was reassigned as the PMI, which was later changed in January 2012 to another designated PMI.

The PMI indicated that the FSDO manager does not like the inspectors to oversee the same operator for more than two years at a time. Additionally, acting supervisors are not assigned oversight responsibilities. He learned of his new assignment as acting airworthiness supervisor on January 10, 2012.

Prior to his assignment as acting Airworthiness Supervisor, the PMI's workload consisted of two Part 135 operators, two Part 145 repair stations, several Part 91 operators, Grand Canyon Airlines, work with IAs and DARs, and various on-demand duties. The PMI described his workload as manageable, although he indicated that he always has the time and resources to complete the work he is required to. He currently works four, 10-hour shifts, and occasionally is required to work more than 40 hours.

When the PMI was reassigned Sundance, he knew that the director of maintenance (DOM) had changed. He had a good working relationship with the previous DOM. He felt that Sundance was implementing changes including a QA department and new hangar facility that indicated their operations were going well. Although he had not had time to fully assess the company, he felt they were moving in the right direction. He visited the new hangar when they were first moving in and indicated that it looked like a nicer facility than the one that they had previously worked in. He also said that he visited the hangar prior to the accident and spoke to the mechanics about the new space. He has not visited the facility since the accident. He looked at one helicopter but does not recall what day.

The PMI was not aware of any enforcement actions, letters of investigation, or recent corrective actions. The LAS FSDO is planning an in-depth inspection following the accident.[24]

The PMI was asked about Sundance's General Maintenance Manual (GMM). He indicated that when he took over as PMI, he was not sure what was going on with the GMM. Since there is no guidance about GMMs for Part 135 operators with aircraft that carry 9 or less passengers, he was uncertain what to do with it. He spoke to the PAI and Mr. McKinney about it, and they suggested to the operator that some of the information be incorporated into the General Operations Manual (GOM). He is uncertain whether or not the FAA will accept the manual into Sundance's program since there is no guidance to inspectors on implementing a GMM for Part 135 operators with aircraft that carry 9 or less passengers.

2.2.3. PAI Interview

The PAI obtained his airframe and powerplant (A & P) mechanic certificate in 1989 and holds an Inspection Authorization (IA), issued in 2006. He obtained employment at the FAA in September of 2006 as a general aviation maintenance inspector. In April 2011, he was reassigned as a general aviation avionics inspector. He indicated that he has not had any helicopter-specific training since coming on board with the FAA.

The PAI served as the PMI for Sundance from October 2010- April 2011. He then became the PAI overseeing their 135, 133, and 137 certificates. He indicated that his relationship with Sundance has always been professional.

In his work as PAI, he oversees the following: 2 - Part 125 Air Operators, 3 - Part 133 and Part 137 Air Operators, 9 - Part 135 “9 or Less” Air Carriers (6 of which are Air Tour Operators), 2 - Part 135 “10 or More” Air Carriers (both are Air Tour Operators), and 9 - Part 145 Air Agencies. The PAI described his workload as busy, but he is able to perform his job requirements. He plans his work program into each month.

The PAI indicated that each year for his operators, he evaluates their risk in Safety Performance and Analysis System (SPAS). SPAS has an index that has default risk values. The PAI analyzes risk compared to SPAS and then adds the findings as he completes activities. He also reviews previous surveillance activities. The PAI described his work as identical to the PMI, except for he is more involved in avionics type of work. He also looks at the operators' inspection programs in relation to avionics installations.

For the past few two fiscal years, the PAI reported the following R and P items for Sundance Helicopters. Since they were considered a low risk operator based on the computerized assessment, he had not completed any inspections for FY 2012. The following R and P items were reported:

[24] The inspection was completed in January 2012 and no problems were identified.

Table 4. R and P Items

	R-items	P-items	R-items complete	P-items complete
FY 2011 (as PMI)	1[25]	11	1	11
FY 2012	0	6	0	3

The PAI reported that following the accident, the surveillance of Sundance has increased. On January 5, the PAI completed three off-hour ramp checks. He was not aware of any recent letters of investigation or enforcement actions. He was aware of a recent corrective action that involved a voluntary disclosure of the operator on a life-limited component (Main Rotor Servo) on the helicopter exceeding its time. The Voluntary Disclosure Reporting Program (VDRP) process was initiated on 01/12/2011 and completed on 02/24/2011 which resulted in a comprehensive fix to add a mandatory monthly audit of all hard time components. Sundance put procedures in place to correct the problem. The PAI was aware of an in depth inspection being organized by the FSDO manager that would involve four inspectors from the LAS FSDO. The PAI, FSDO manager, and representatives from Sundance did meet to discuss the FAA's increased surveillance and ideas on how things could be changed to improve safety. The PAI indicated that Sundance was very responsive when problems were identified.

The PAI stated that it was his opinion that required inspection items (RIIs) should be mandatory for 9 or less operators such as air tours that operate the number of hours that Sundance operates. He also indicated that SMS programs should be implemented. He indicated that with the number of hours the operators operate, more critical safety requirements should be required.

[25] The R-item involved a surveillance ramp check requirement.