



EXAMINATION REPORT & COMPANY INTERVIEWS

WPR17LA180

Pocatello, Idaho

August 5, 2017

2000 MDT

Lockheed P2V-5; N410NA

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HISTORY OF FLIGHT

On August 5, 2017, about 2000 mountain daylight time, a Lockheed P2V-5F, N410NA, was substantially damaged shortly after a departure from Pocatello Regional Airport (PIH), Pocatello, Idaho. The airline transport pilot, commercial pilot and passenger were not injured. The airplane was registered to and operated by Neptune Aviation Services, Inc. under contract with the United States Forest Service to provide aerial firefighting services as a public use aircraft under the operational control of the Bureau of Indian Affairs. Visual meteorological conditions prevailed and a flight plan was not filed for the local flight.

According to the pilot-in-command (PIC), the flight departed on its third mission to disperse fire retardant over a nearby wildfire. During the airplane's climb, the PIC observed an uncommanded aft movement of the control yoke with a simultaneous increase in the airplane's pitch attitude. He instructed the first officer (FO) to retract the flaps while he re-trimmed the elevator, but they were not able to regain pitch control. The airplane's varicam indicator showed a few degrees of nose down trim and did not change for the remainder of the flight. The FO attempted to adjust his trim wheel and then re-trim the airplane using the emergency varicam, but the airplane continued to maintain a pitch up attitude. He then deployed 5° of flaps at the PIC's instruction, which reduced the elevator backpressure. The PIC subsequently jettisoned the load of fire retardant over vacant farm land and then asked the FO to declare an emergency with the tower controller while the PIC entered a shallow left turn to intercept the downwind leg for Runway 21. As he made his control inputs he determined that the elevator was bound as he received little response from the elevator control.

The PIC had previously demonstrated approaches to land without making any adjustments to power or pitch, so he configured the airplane for an approach without trim or elevator control. They flew a wide traffic pattern and made small adjustments to compensate for altitude. During the final approach leg, the PIC used a combination of wing flaps and engine power for pitch up adjustments, crew coordinated application of elevator for trimmed pitch, and turns to make their pitch down adjustments. As the airplane reached about 500 feet above ground level, the crew

deployed the airplane's remaining 5° of flaps to increase the pitch attitude. Both the PIC and FO pulled hard on the yoke while the FO gently retarded the throttles and the PIC trimmed the emergency varicam.

Postaccident examination of the airplane revealed damage to the varicam. As this secondary control surface is directly connected to the elevators and provides a primary structural load path for all elevator loads, the damage was classified as substantial. Further examination of the varicam by the airplane owner/operator showed that one of the varicam actuator's drive coupling bolts had backed out of the drive coupling and drive stop. They further reported that the bolt head had not been safety wired.

AIRCRAFT INFORMATION

According to Federal Aviation Administration (FAA) records, the airplane was manufactured in 1954 and registered to Neptune Aviation Services on December 16, 2010. The airplane was powered by two outboard Westinghouse J34-WE-36A, axial flow, turbojet, 2,750 shaft hp engines and two inboard Curtis Wright R-3350-32WA, twin-row, supercharged, air-cooled, radial, 3,250 shaft hp engines. The airplane owner reported that its most recent 100 hour airframe and engine inspections were completed on July 10, 2017 at an accumulated flight time of 8,420.2 total flight hours. It's previous annual inspection was completed in October 2016. At the time of the accident the airplane had accrued a total of 8,486.7 total flight hours at the time of the accident.

The company's website states that Neptune Aviation operates a fleet of 14 firefighting airtankers, including 9 BAe 146 airplanes equipped with REV 3 tanks, and 7 Lockheed P2V airplanes. Neptune's firefighting airplanes are serviced in-house by the company's two certified repair stations located in Missoula, Montana and Alamogordo, New Mexico. Neptune Aviation has been operating under exclusive use contracts with the United States Forest Service for about 24 years. The company additionally owns and operates a Falcon 50, Falcon 100, and Kingair B100 for charter operations out of Missoula, Montana.

The airplane is equipped with a variable camber (varicam) horizontal stabilizer in place of an elevator trim tab. When an adjustment is made in the cockpit, the varicam drive shaft rotates to move the varicam actuators and the secondary control surface's down or up deflection. The varicam actuators are secured to the drive shaft through universal joints located at the outboard ends, comprised of two bolts that are threaded and safety wired to the drive stop and two bolts with castellated nuts and cotter pins to secure the yoke to the drive coupling (Photo 1).

AIRFRAME

Variable Camber Examination

An examination of the varicam's LH outboard drive stop and yoke showed the presence of one bolt that had been secured to the drive coupling. The drive coupling is normally secured to the drive stop with two bolts that are safety wired together; however, the second bolt was missing

from its bolt hole (photo 2). According to the Director of Maintenance, the missing drive coupling bolt was found inside the varicam without any safety wire in the bolt head. Further examination of the varicam did not reveal the presence of safety wire throughout the cavity of the secondary control surface.

An absence of the one of the drive coupling bolts would hinder the torque capabilities of drive shaft; thereby allowing one side of the varicam to move and the other side to remain stationary or turn incrementally.

A review of the service facility's task summary card 163379-244, dated July 27, 2016, stated "L/H side varicam. Universal joints for outboard drive shaft are worn on both inboard and outboard side (see Appendix B). Also lock assembly universal joints are worn on both sides." In the notes section of the entry, a mechanic recorded "26Jul2016. Removed and Replaced three sets of universal joints on L/H varicam, inboard, and outboard sides I.A.W. NAVAIR 01-75EDA-2-3. No defects noted." The entry was stamped "M77," a designation assigned to one of the mechanics who left the company a few days after he completed this service for unrelated reasons. Task card 10-3, line "j" of the annual inspection requires the installation of the drive shafts, u-joints and drive shaft stop assembly, secured with lockwire (see Appendix B). The entry was verified as completed with the notation of the stamp, "M77." Task card 163379-17 indicated that task card 10-3 was completed on July 28, 2016 (See Appendix B).

INTERVIEWS, NEPTUNE AVIATION

A series of interviews were conducted by representatives of the Department of Interior, Federal Aviation Administration, and the NTSB Investigator-in-Charge at Neptune Aviation's Missoula, Montana offices. The following representatives of Neptune Aviation were interviewed:

- Director of Maintenance
- Director of Operations
- Shop Manager
- Quality Assurance

Service Facility History

The Director of Maintenance (DOM) stated that the accident airplane was serviced at their facility in Alamogordo, New Mexico, a service facility that had been dormant until 2014 when they reactivated the repair station. At the time of the annual inspection that took place in July 2016, they had a total of 12 full time employees at Neptune's Alamogordo, New Mexico location: one shop manager, a lead mechanic, a quality assurance mechanic, and 6 line mechanics, each of whom held an airframe and powerplant certificate. The facility additionally employed 3 people whose function was parts purchasing. Neptune's New Mexico facility employs only one daytime shift of mechanics who work from 0700 to 1730, 4 days per week. The facility does not employ any contractors and crews only work on one aircraft at a time.

After the facility re-opened full time in 2014 at the time the Director of Maintenance, Assistant Director of Maintenance, and Chief Inspector cross-trained the employees separately in one

week rotations. The employee who was responsible for the safety wire work in July 2016 was hired in October 2015 and his lead had been with the company since September 2014.

Workflow and Workday

Neptune's service staff is comprised of the shop manager who oversees the lead mechanic's activities and the facility. The lead mechanic is responsible for organizational planning and normally sits at a desk located atop a podium on the shop floor, accessible to any employees who need assistance from the lead during their shift. At his side is the quality assurance (QA) mechanic who is responsible for overseeing the inspections, but reports to the Chief Inspector. The QA's main responsibility is to complete any required inspection items (RII) that are notated on a task card. To prevent any lapse in work continuity, the company trained other mechanics at its Alamogordo, New Mexico location in the company's RII procedures in the event the QA is ill or unable to complete an inspection. Part of the QA's responsibility is to also inspect areas that have not been designated as RII as part of his follow-up work.

During a normal workday, the lead mechanic will generate and assign parent and child task cards to the line mechanics that cover different areas of the aircraft. For example, parent task card 163379-17 furnished specific instructions under its "Task Description" to "Comply with Card 10-3 of Annual Inspection per Neptune Aviation Services AIP." Additionally, parent task card 163379-16 included instructions to comply with card "10-2 of Annual Inspection..." In this case, the mechanic notated that the work had been completed with his stamp designation, in this case "M77," which was assigned to the mechanic that completed the work. The mechanic was further issued a child task card, 163379-244, which pertained to parent card 163379-16. In this entry, he notated that three sets of universal joints on the inboard and outboard sides of the L/H varicam were removed and replaced in response to the child card task description, which stated that the universal joints for the outboard drive shaft were worn. Once the mechanic has completed the work, he gives the parent and associated task cards to the lead mechanic who then sends the records to the QA. In this case, the QA stamped child task card 163379-244 with his designated stamp, Q03" to indicate that the task had been processed by QA. He additionally processed annual inspection card 10-4, which includes tasks to verify installation and safety for the varicam universal joints and mechanically stop assembly. Entry no. 2, part "a" was stamped as approved by QA for proper installation of the varicam universal joints.

Procedures and Training

Additionally, Neptune's Standard Operating Procedure (SOP) guide includes criteria to designate certain task cards as RIIs. The lead mechanic is responsible for annotating "RII required" on the corresponding task cards at the time the cards are generated and assigned. From this notation, the QA is required to inspect the mechanic's work. Under Table 8.1 of this guidance, ATA 27 item no. 10 states "Varicam System Components – Install/Rig/Adjust (P2V)." In the right hand column of the same table, item no. 1 states to "Check proper installation, required torque values, security, and safety." An "RII required" notation was not placed on child task card 163379-244 or 163379-243. Although the varicam qualifies as an RII under the company SOP, the oversight never registered with either the mechanic or lead mechanic.

At the request of the NTSB, FAA and DOI, the company subsequently completed an audit of the aircraft's annual inspection package and discovered seven task cards that did not record a mandatory RII.

Turnover Procedures

According to the Director of Maintenance, Neptune Aviation uses a form entitled "Shift Change" in Chapter 6 of its repair station manual, dated Jul 1, 2014 for its employees to ensure continuity and communication of any incomplete work between shift changes. Additionally, number 22 section D of the company's maintenance standard operating procedure is used to record the working status of each task and states that the procedure "shall be complied with to ensure each task is completed correctly." Specifically, item 3 notes that "As each step of the work is completed it will be documented by the mechanic performing the work for references, part numbers and serial numbers." Although there is a step to remove the drive coupling bolts in the company's annual inspection task card 10-2, task summary 163379-244 did not include any notation of the drive coupling bolts.

Training

The DOM further reported that training for incoming and current staff mechanics for the P2V airplane consists of a one-time course that includes both hands-on and classroom training. Additionally, they send their mechanics through recurrent training when necessary. Although the company does maintain a two-year recurrent requirement on RII training, it does not currently offer recurrent training on its internal procedures for quality assurance, lead mechanics and line mechanics.

Mechanic, Lead Mechanic, and Quality Assurance

The mechanic who was responsible for safety wiring the drive coupling bolts departed the company on August 2, 2016, a few days after he serviced the varicam. At the time of the inspection he had already submitted his 2 week notice due to family troubles.

The Director of Operations reported that the lead mechanic's employment had been terminated for poor attitude and falsifying completed work as he had inscribed a mechanic's name on task card on a day that he was not present for work. Additionally, the lead mechanic had created a stressful work environment by pressuring the mechanics to expedite their work efforts through verbal means. The shop manager at Neptune's New Mexico location and the lead mechanic's manager before his termination reported that the lead mechanic worked well in his position and with others until his second year, 2016 when he attempted to create a barrier between the New Mexico facility and the company's Missoula headquarters. During this time, the shop manager received complaints from several employees that the lead mechanic was not involved in the day to day work of the company. Further information revealed that he preferred to remain at his desk instead of conversing with the line mechanics and performing spot inspections. The lead mechanic had part of his foot amputated several years prior, but never complained about it.

Additionally, at the beginning of 2016, the lead mechanic's father passed away, which seemed to affect him.

According to the QA mechanic, he had been with Neptune Aviation as a mechanic since 2010 and had been doing QA work since November 2015. He reported that the lead mechanic was too preoccupied with paperwork and spent most of his time sitting at the podium instead of completing inspections. The QA mechanic remarked that the lead mechanic was "not very productive." When asked about the RII inspection process, the QA mechanic stated that if an RII requirement is not documented on the task card paperwork, then the paperwork will go to the lead and then the QA who will review the paperwork and stamp the work as approved. The QA then returns the paperwork to the mechanic who closes the corresponding aircraft section.

Safety Suggestions

1. Implement recurrent training that covers the company's internal procedures, specifically those that comprise the position of the mechanic, lead mechanic, and quality assurance. Additionally, the training should address the company's expectations for RII inspections and non-RII inspections. These trainings should be used as a platform to communicate errors, omissions and safety concerns at all levels.
2. Hold technical and internal procedure training in-person instead of remotely.
3. Designate RII items through software so they appear automatically when work order is generated instead of requiring lead mechanic to manually enter them.
4. Develop a turnover log and procedure for line mechanics to ensure continuity of work between shifts and in the event of a distraction.

APPENDIX A

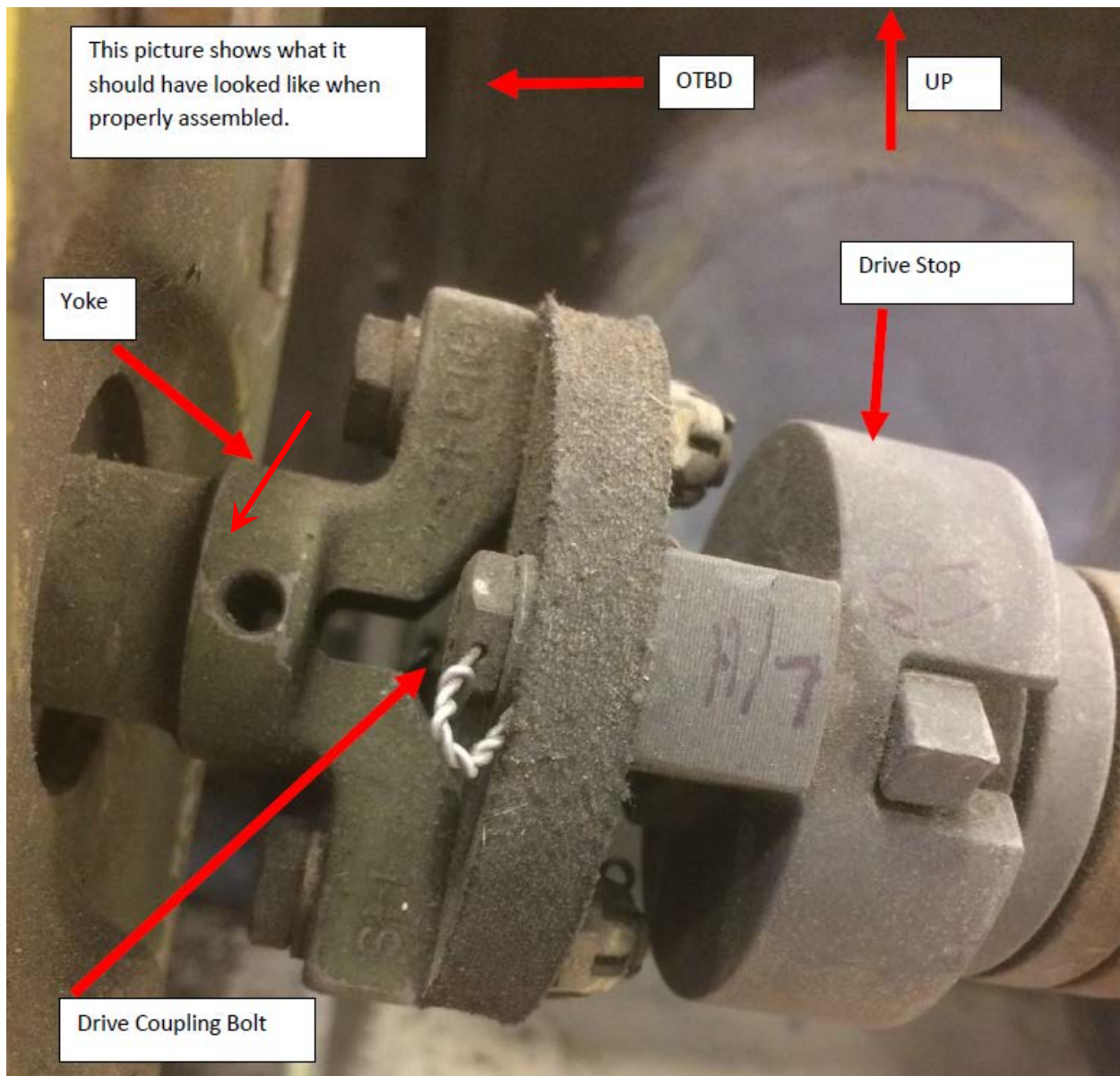


Figure 1 – Outboard Varicam Drive Shaft with Safety Wire

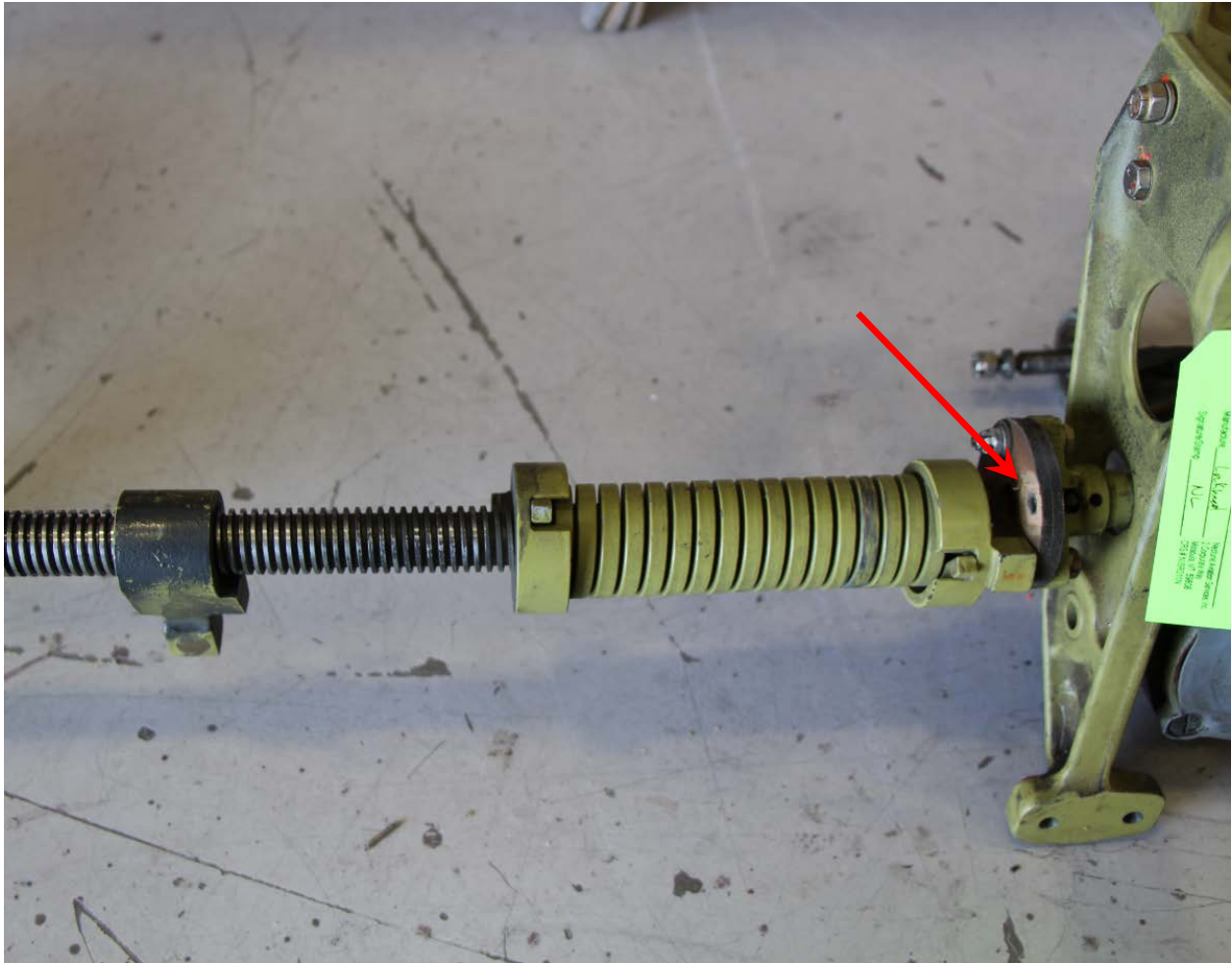


Figure 2 – Outboard Varicam Drive Stop Mechanism at the Mount Assembly with Missing Drive Coupling Bolt

APPENDIX B



Neptune Aviation Services, Inc.

Task Card: **163379-16**

Aircraft:	N410NA	S/N:	131482	Template:	BP2V	Customer:	NEPT - NEPTUNE AVIATION
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Task ID:	ANNUAL INSP CARD 10-2			OEM Ref.:	T14 ANNUAL		
Description:	ANNUAL INSP CARD 10-2 VARICAM						
ATA:	05-00-00 TIME LIMITS/MAINT CHECKS			Pos. Path:	000: Airframe		
P/N:	...	S/N:	...	Descr:	...		
Documents:	...	Check:	Annual Check				
Triggered by:	...						

Skill Req.:	MECHANICAL	Shop Est.:	0.00 H	Created:	2016-06-09
Base:	ALM	Due At:	...	DUE:	

Task Description:

Comply with Card 10-2 of Annual inspection per Neptune Aviation Services AIP

Corrective Action:

Complied with Card 10-2 of Annual inspection I.A.W. Neptune Aviation Services AIP. Noted defects on child task # 243, and # 244

	Part Number	Serial Number	Description	Batch #
OFF				
ON				
OFF				
ON				

Log:	1 / 85	HRS	CYC	LHJET	RHJET		
Date:	2016-07-26	8,317.8	1,886	302.70	278.00		

☐

Work complete

Signature: _____

Name: BRIAN THOMPSON

License: _____ Date: _____

☐

Required Inspection Item completed as per applicable maintenance standards.

Signature: _____

License: _____ Date: _____

☐

This task card has been completed.

Signature: _____

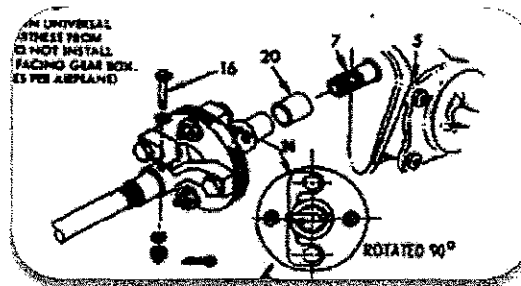
Name: FELTON ELZY

License: _____ Date: _____

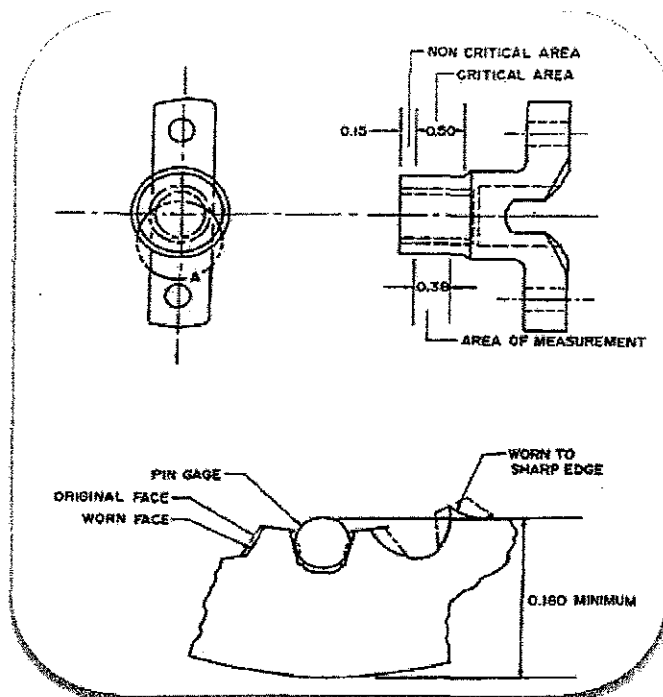
ANNUAL INSPECTION CARD 10-2 VARICAM

- e. Remove two drive coupling bolts from both ends of drive shaft stop assembly and remove assemblies (for access to u-joints, splines on either end).
- f. Remove locating bolts in drive shaft slide off u-joint at each jackscrew.

Note: For removal and installation instructions see NAVAIR 01-75EDA-2-3 paragraph 3-150.



- g. Slide u-joints onto drive shaft and remove (12 u-joints, 5 drive shafts and stop assembly)
- h. U-joint spines for wear.
 - 1) Serviceable u-joints lubricate with molybdenum disulfide(Dry Moly).
 - 2) Unserviceable u-joints replace with new part and lubricate.





Neptune Aviation Services, Inc.

Task Summary: 163379-243

Aircraft:	N410NA	S/N:	131482	Template:	BP2V	Customer:	NEPT - NEPTUNE AVIATION
Origin:	Maint - Scheduled	Pos. Path:	...	T14 ANNUAL			
ATA:	05-00-00 TIME LIMITS/MAINT CHECKS	Parent Task:	163379-16 Comply with Card 10-2 of Annual inspection per Nep				
Skill Req.:	...	Shop Est.:	...	Created:	2016-07-27		
Base:	ALM			DUE:			

Task Description:

L/H Outboard elevator drive shaft for varicam, splines are worn to limits.

Notes:

26 Jul 2016 Removed and Replaced L/H OUTBOARD VARICAM drive shaft
with serviceable I.A.W. NAVAIR 01-75 EDA-2-3. No defects noted. 

PN OFF 440213-4
S/N OFF NA
PN ON 440213-4
S/N ON NA



Neptune Aviation Services, Inc.

Task Card: 163379-243

Aircraft: N410NA	S/N: 131482	Template: BP2V	Customer: NEPT - NEPTUNE AVIATION
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Origin: Maint - Scheduled	Pos. Path: ...	T14 ANNUAL
ATA: 05-00-00 TIME LIMITS/MAINT CHECKS	Parent Task: 163379-16 Comply with Card 10-2 of Annual inspection per Nep	

Skill Req.: MECHANICAL	Shop Est.: 0.00 H	Created: 2016-07-27
Base: ALM		DUE: [REDACTED]

Task Description:

L/H Outboard elevator drive shaft for varicam, splines are worn to limits.

Corrective Action:

Removed and replaced L/H outboard varicam drive shaft with serviceable I.A.W. NAVAIR 01-75EDA-2-3.

No defects noted.

PN off 440213-4 SN off N/A

PN on 440213-4 SN on N/A

	Part Number	Serial Number	Description	Batch #
OFF				
ON				
OFF				
ON				

Log: 1 / 85	HRS	CYC	LHJET	RHJET		
Date: 2016-07-27	8,317.8	1,886	302.70	278.00		



Work complete

Signature: _____

Name: BRIAN THOMPSON

License: _____ Date: _____



Required Inspection Item completed as per applicable maintenance standards.

Signature: _____

License: _____ Date: _____



This task card has been completed.

Signature: _____

Name: FELTON ELZY

License: _____ Date: _____



Neptune Aviation Services, Inc.

Task Summary: **163379-244**

Aircraft:	N410NA	S/N:	131482	Template:	BP2V	Customer:	NEPT - NEPTUNE AVIATION
Origin:	Maint - Scheduled	Pos. Path:	...	T14 ANNUAL			
ATA:	05-00-00 TIME LIMITS/MAINT CHECKS			Parent Task: 163379-16 Comply with Card 10-2 of Annual inspection per Nep			
Skill Req.:	...	Shop Est.:	...	Created:	2016-07-27		
Base:	ALM				DUE:		

Task Description:

L/H side varicam. Universal joints for outboard drive shaft are worn on both inboard and outboard side. Also lock assembly universal joints are worn on both sides.

Notes:

26 Jul 2016. Removed and Replaced three sets of universal joints on
L/H varicam, inboard and outboard sides I.A.W. NAVAIR 01-75EXA-2-3.
No defects noted. 



Neptune Aviation Services, Inc.

Task Card: **163379-17**

Aircraft:	N410NA	S/N: 131482	Template:	BP2V	Customer:	NEPT - NEPTUNE AVIATION
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Task ID:	ANNUAL INSP CARD 10-3	OEM Ref.:	T14 ANNUAL
Description:	ANNUAL INSP CARD 10-3 VARICAM		
ATA:	05-00-00 TIME LIMITS/MAINT CHECKS	Pos. Path:	000: Airframe
P/N:	...	S/N:	...
Documents:	...	Check:	Annual Check
Triggered by:	...		

Skill Req.:	MECHANICAL	Shop Est.:	0.00 H	Created:	2016-06-09
Base:	ALM	Due At:	...	DUE:	

Task Description:

Comply with Card 10-3 of Annual inspection per Neptune Aviation Services AIP

Corrective Action:

Complied with Card 11 of Annual inspection per Neptune Aviation Services AIP.
No defects noted.

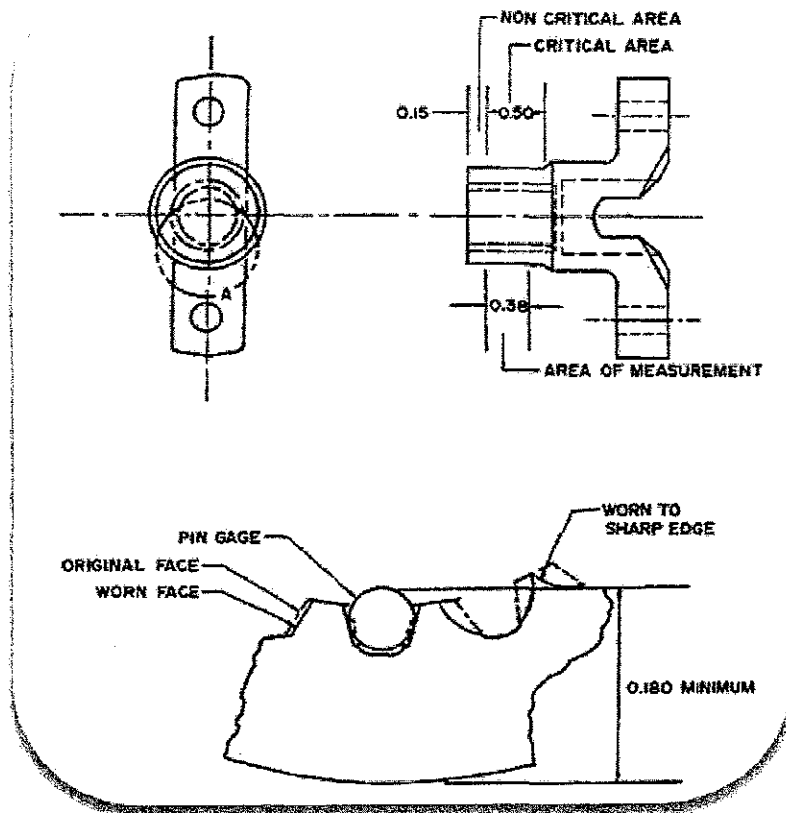
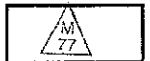
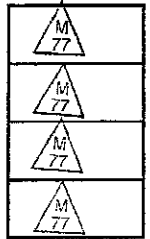
	Part Number	Serial Number	Description	Batch #
OFF				
ON				
OFF				
ON				

Log:	1 / 85	HRS	CYC	LHJET	RHJET		
Date:	2016-07-28	8,317.8	1,886	302.70	278.00		

☐ Work complete	Signature: _____ Name: <u>BRIAN THOMPSON</u> License: _____ Date: _____
☐ Required Inspection Item completed as per applicable maintenance standards.	Signature: _____ License: _____ Date: _____
☐ This task card has been completed.	Signature: _____ Name: <u>FELTON ELZY</u> License: _____ Date: _____

ANNUAL INSPECTION CARD 10-3 VARICAM

- i. Check varicam mechanical stop PN 530172 for proper assembly by manually rotating the pawl by hand. The pawl should rotate in a clockwise direction when viewed from mid-point of assembly. Approximately 50-100 in. lbs. should be required to rotate the pawl through 20 degrees clockwise rotation. Refer to NA 01-75EEB-2-3 para 3-146B/ NA 01-75EDA-2-3 para 3-152A.
- j. Install drive shafts, u-joints and drive shaft stop assembly in reverse order and lockwire.
- k. Insure locating bolts are installed on drive shaft end of u-joints and lockwire.
- l. Insure varicam is set at "O" on elevator trim panel indicator.
- m. Insure stop lever assembly nut is properly engaged in stop nut guide and is in same position as measured at removal.
- n. Check endplay maximum 0.450" allowable. Minimum spline engagement of 0.380" is required.





Neptune Aviation Services, Inc.

Task Card: **163379-18**

Aircraft:	N410NA	S/N: 131482	Template:	BP2V	Customer:	NEPT - NEPTUNE AVIATION
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Task ID:	ANNUAL INSP CARD 10-4	OEM Ref.:	T14 ANNUAL
Description:	ANNUAL INSP CARD 10-4 VARICAM		
ATA:	05-00-00 TIME LIMITS/MAINT CHECKS	Pos. Path:	000: Airframe
P/N:	...	S/N:	...
Documents:	...	Descr:	...
Triggered by:	...	Check:	Annual Check

Skill Req.:	MECHANICAL	Shop Est.:	0.00 H	Created:	2016-06-09
Base:	ALM	Due At:	...	DUE:	

Task Description:

Comply with Card 10-4 of Annual inspection per Neptune Aviation Services AIP

Corrective Action:

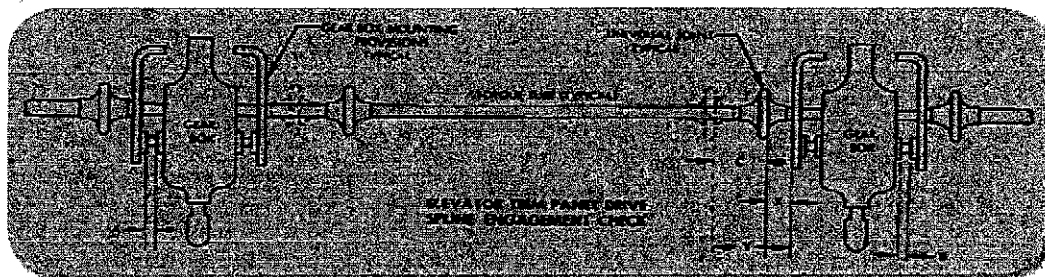
Complied with Card 11 of Annual inspection per Neptune Aviation Services AIP. Defects noted see child task 275 and 278. Panels #62 and #63 requires nutplates repairs. RII performed DR

	Part Number	Serial Number	Description	Batch #
OFF				
ON				
OFF				
ON				

Log:	1 / 85	HRS	CYC	LHJET	RHJET		
Date:	2016-07-28	8,317.8	1,886	302.70	278.00		

☐ Work complete	Signature: _____ Name: <u>BRIAN THOMPSON</u> License: _____ Date: _____
☐ Required Inspection Item completed as per applicable maintenance standards.	Signature: _____ License: _____ Date: _____
☐ This task card has been completed.	Signature: _____ Name: <u>FELTON ELZY</u> License: _____ Date: _____

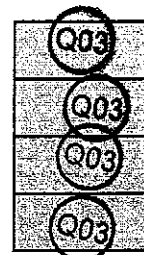
ANNUAL INSPECTION CARD 10-4 VARICAM



A AND B DIMENSION - GEAR BOX CLEARANCE TO MOUNT
X DIMENSION - UNIVERSAL BOTTOMED AGAINST
GEAR BOX SHAFT
Y DIMENSION - UNIVERSAL PUSHED MAXIMUM
DISTANCE AWAY FROM GEAR
BOX SHAFT
C DIMENSION = Y - X MAXIMUM LATERAL SHAFT
MOVEMENT
THE SUM OF DIMENSION A + B + C
MUST EQUAL 0.450 OR LESS

Note: Inspector will verify the following for proper installation and safety's.

2. Varicam U-joints and Mechanical Stop Assy. for:
 - a. Proper installation.
 - b. Evidence of excessive play.
 - c. Engagement of stop nut with guide track.
 - d. O.K. to close inspection required prior to installing panels



3. Install fairings and access panels (62, 63, and 202).
4. Panels 62, 63, and 202 for proper installation.

