



REPUBLIC OF NAMIBIA

MINISTRY OF WORKS AND TRANSPORT

DIRECTORATE OF AIRCRAFT ACCIDENT INVESTIGATION

**CIVIL AIRCRAFT ACCIDENT REPORT
ACCID/032420/01-01**

OPERATION : PRIVATE

AIRCRAFT : V5-HOZ

LOCATION : TSUMEB AIRFIELD

DATE : 24 MARCH 2020



REPUBLIC OF NAMIBIA

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Our Ref: 3/48

Date: 26 April 2021

To : Minister of Works and Transport
Deputy Minister of Works and Transport
ED: Ministry of Works and Transport

From : Director: Aircraft Incident and Incident Investigation

RE: CIVIL AIRCRAFT ACCIDENT REPORT

Please find attached the final report on the above subject accident. In accordance with the International Civil Aviation Organization Annex 13 – Aircraft Accident and Incident Investigation – Standard 6.13, final reports shall be published as soon as possible in the interest of accident prevention.

It is recommended that copies of these final reports be made available to the public and other interested parties upon request. Your approval is therefore sought to release the said reports.

NOTE: This report took long to be finalized because the investigator was waiting for component test result from the manufacture in the USA. The pandemic of COVID-19 delayed the whole process.

Magnus Abraham

DIRECTOR: AIRCRAFT ACCIDENT AND INCIDENT INVESTIGATION



"Effective and Efficient Delivery of Service"

All official correspondence must be addressed to the Permanent Secretary

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FOREWORD

This report presents the factual information, data analysis, conclusions, and safety recommendations reached during the investigation. The purpose of the investigation was to establish the circumstances surrounding this accident.

In accordance with the provisions of Annex 13 to the convention on International Civil Aviation Organization, and Civil Aviation Act, (act No 6 of 2016) , the accident's analysis, conclusions, and safety recommendations contained therein are intended neither to apportion blame nor to single out any individual or group of individuals. The main objective was to identify the systematic deficiencies and draw lessons, from the occurrence, which might help to prevent accidents and incidents in the future. To this end, many a time, the reader may be interested in whether or not an issue was a direct cause of the accident (that has already taken place), whereas the investigator is mainly concerned with the prevention of future accidents/incidents.

As a result, usage of this report for any purpose other than (the latter and spirit of Annex 13 and Civil Aviation Act (Act No. 6 of 2016 or other relevant statutes) prevention of similar occurrences in the future might lead to erroneous interpretations and applications.

ABBREVIATIONS

AMO	-	Approved Maintenance Organization
AMSL	-	Above Mean Sea Level
NCAA	-	Namibian Civil Aviation Authority
°C	-	Degrees Celsius
C. of .A	-	Certificate of Airworthiness
C. of .R	-	Certificate of Registration
CVR	-	Cockpit Voice Recorder
DAAI	-	Directorate of Aircraft Accident Investigation
FDR	-	Flight Data Recorder
ICAO	-	International Civil Aviation Organization
VFR	-	Visual Flight Rules
UTC	-	Universal Time Coordinated
AOC	-	Air Operator Certificate
MPI	-	Mandatory Periodic Inspection

DIRECTORATE OF AIRCRAFT ACCIDENT AND INCIDENT INVESTIGATIONS
ACCIDENT REPORT – EXECUTIVE SUMMARY

Aircraft Registration	V5-HOZ		Date of Accident	24 March 2020	Time of Accident	08:15 UTC
Type of Aircraft	BELL 205 UH-1H HELICOPTER		Type of Operation	Agricultural work		
Pilot-In-Command License Type		Commercial Pilot License-Helicopter	Age	50	License Valid	Yes
Pilot-in-command flying experience		Total Flying Hours	931.4 hours	Hours on Type	99.8 hours	
Last point of departure		Tsumeb Airfield (FYTM)				
Next point of intended landing		Tsumeb Airfield (FYTM)				
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)						
Tsumeb Airfield GPS Position: 19°15'43"S 017°43'57"E						
Meteorological Information	Wind: East, Wind speed 7 knots: Visibility: >10km, Temperature: 20°C Cloud cover: 40%, Cloud base: 2000ft, Dew point: Not known					
Number of people on board	1	No. of people injured	0	No. of fatalities	0	
Synopsis						

On the 24th March 2020 at 08:15 UTC, a Helicopter Bell 205UH-1H type with Registration V5-HOZ, crashed during the landing phase after returning from Farm Kraalkop portion 1 where it was used for shrubs spraying. There was one pilot on board. The flight was planned under Visual Flight Rules (VFR) conditions that were prevailing at the time. There was no injuries sustained by the pilot, but the Helicopter was substantially damaged. While on the hover for landing the pilot experience a collective bounce and there after a serious vertical oscillation of the helicopter (vibration).

The pilot lost rudder control of helicopter due to severe vibration resulting in the helicopter to yaw to the right and lost height in a rolling motion to the left.

The Directorate of Aircraft Accident and incident Investigation carried out the investigation and was informed telephonically about the accident on the 24th of March 2020 by the Aircraft Maintenance Organization (AMO). The Minister of Works and Transport was responsible for the release of the official final accident report.

The weather was fine with good visibility.

The pilot was a holder of a valid commercial Pilot Helicopter License with rating pertaining to the agricultural work. NAMCAR 61.01.7(b) and 61.01.7(4) stated that helicopters type ratings are by names for each helicopter which means that for a rating to be endorse in the pilot license the pilot has to had done a skill test with a DE to revalidate the rating. In this case the pilot only had a skill test done on a Bell 206 but he was issued the rating of Bell 204/205 R22, R44 and H 269. The pilot had a valid medical certificate with restrictions to wear suitable corrective lenses. The Air operator Certificate (AOC) number NCAA/AOC/022/2014 issued on the 19 March 2020 with expiry date 18 March 2021 to the operator indicated that the aircraft was operated within the AOC approval operation scopes.

The helicopter was in possession of a valid Certificate of Airworthiness and Certificate of Registration. The last Mandatory Periodic Inspection (MPI) prior to the accident flight was carried out on the 23rd of January 2020 at 8363.1 airframe hours. The regulatory authority audited the AMO that certified the last MPI inspection on the aircraft prior to the accident, it granted the AMO an approval issued on 07 February 2020 with expiry date 06 May 2020. It was in possession of a valid Aircraft Maintenance Organization, Approval No #66. At the time of the accident a further 01.1 hours was flown with the helicopter since the last MPI inspection.

Contributing factors

Loss of directional control.

Probable cause

Loss of Control



AIRCRAFT ACCIDENT REPORT

Name of Owner/Operator:	Expedite Aviation CC
Manufacturer:	Bell Helicopter Company
Type:	Bell 205 UH-1H
Model:	1983
Nationality:	Namibian
Registration Markings:	V5-HOZ
Place:	Tsumeb airfield
Date:	24 March 2020
Time:	08:15 UTC

All times given in this report is Co-ordinated Universal Time (UTC).

Disclaimer:

This report is given without prejudice to the rights of the Directorate of Aircraft Accident Investigations, which are reserved.

Purpose of the Investigation:

*In terms of the Civil Aviation Act (act No.6 of 2016) and ICAO ANNEX 13, this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and **not to apportion blame or establish legal liability**.*

This report contains fact relating to aircraft accidents or incidents which have been determined at the time of issue. The report may therefore be revised should new and substantive facts be made available to the investigator(s).

1. FACTUAL INFORMATION

1.1 History of Flight

- 1.1.1 On the 24th March 2020, at 08:15 UTC, a Bell 205UH-1H helicopter with Registration V5-HOZ, crashed during landing at Tsumeb airfield. The helicopter was returning back from Kraalkop portion 01 farm after shrubs spraying operation. Kraalkop portion 01 farm is located 3km east of Tsumeb airfield. There was one pilot on board.
- 1.1.2 The flight was conducted under visual flight rules (VFR), and there was no flight plan filed, nor was it a requirement.
- 1.1.3 During the landing phase the pilot turned the aircraft in the direction 080° into wind as a normal procedure during landing. When the aircraft was few feet above the landing spot in a hover for landing,

the pilot started experiencing collective bounce.

- 1.1.4 According to the pilot a collective bounce was experienced followed by a serious vertical oscillation of the helicopter (vibration). Due to the severe vibration the pilot was not able to keep his feet on the rudder pedal which resulted in loss of directional control of the aircraft.
- 1.1.5 While the pilot was still fighting the loss of directional control, the aircraft became uncontrollable and started to yaw to the right while losing height in a rolling motion to the left and crashed with the main rotor blade striking the ground first. The aircraft came to rest lying on its port side facing 180° from the flight path.
- 1.1.6 The accident occurred during daylight conditions at a geographical position that was determined to be 19°15'43"South 017°43'57" East at an elevation of 4353 feet above mean sea level (AMSL).

1.2 Injuries to Persons

Injuries	Pilot	Crew	Pass.	Other
Fatal	0	0	0	0
Serious	0	0	0	0
Minor	1	0	0	0
None	0	0	0	0

1.3 Damage to Aircraft

- 1.3.1 The helicopter was substantially damaged.



FIGURE 1: Photo showing the helicopter was substantial damage especially the transmission support platform.



FIGURE 2: Photo showing the helicopter lying on its port side after the crash.



FIGURE 3: Photo showing the damage of the rotor blades, the broken transmission support platform and broken pitch change links.

1.4 Other Damage

1.4.1 There was no other damage to property, vegetation or surrounding environment.

1.5 Personnel Information

Nationality		Namibian			
Licence No	CA/R0696	Gender	Male	Age	50
Licence valid		Yes	Type Endorsed	Yes	
Ratings		Game/livestock cull, Agricultural operations, under sling/ winching			
Medical Expiry Date		31 August 2020 (class1)			
Restrictions		Suitable corrective lenses			
Previous Accidents		Not known			

Flying Experience:

Total Hours	931.4 hours
Total Past 90 Days	02.2 hours
Total on Type Past 90 Days	1.6 hours
Total on Type	99.8 hours

1.6 Aircraft Information

Airframe:

Type	Bell 205 UH-1H	
Manufacturer	Bell company	
Aircraft Serial Number	8472	
Year of Manufacture	1983	
Total Airframe Hours (At the time of the accident)	8363.1Hrs.	
MPI Inspection (Date & Hours)	23 January 2020	8363.1 Hrs.
Hours since Last Import inspection	01.1Hrs.	
C of A (Issue Date)	18 July 2017	
C of A Expiry Date)		
C of R (Issue Date) (Present owner)	28 February 2017	
Operating Categories	Restricted	

Engine:

Type	Honey Well
Engine Serial Number	7237
Hours since New	1725.6
Hours since Overhaul	488.5hrs

WEIGHT AND BALANCE.

The weight and balance of the helicopter on the day of the accident was within the limit and it is not considered as a factor to the accident.

Weight & Balance

<u>Aircraft</u>	<u>Registration</u>	<u>SG of Fuel</u>	<u>Full Tanks (Liter)</u>	<u>Main Tanks (Liter)</u>	<u>Aux Tanks (Liter)</u>
Bell BH05 Huey	V5 HOZ	0.8	789.3	789.3	0
<u>Empty Weight (Kg)</u>	<u>ARM</u>	<u>Moment</u>	<u>M.T.O.W. (Kg)</u>	<u>Useful Load (Kg)</u>	<u>Seats</u>
2439	0	0	4100	1148.6	1 + 14

Aircraft Type	V5 HOZ				
Empty Weight (Kg)	2439				
ARM	0				
Moment	0				
M.T.O.W. (Kg)	4100				
	Quantity	Unit Weight	Total Weight	ARM	Moment
Emp. Weight (Kg)	1	2439	2439		
Fuel (Liter)	0.8	300	240		
Pilot	1	90	90		
Pax	0	90	0		
Load	1	1000	1000		
Take-off Weight (Kg)			3769		
M.T.O.W. / Load (Kg)		4100	1090		
Space left to go for M.T.O.W. (Kg)			331		

Pilot in Command:

FRANK B. HENNING
J.H.S.

Date:

2020.03.24

1.7 Meteorological Information

1.7.1 The following weather information was obtained from the pilot questionnaire.

Wind direction	North-East	Wind Speed	±7 knots	Visibility	>10 KM
Temperature	20°C	Cloud cover	high	Cloud base	Above 2000 ft.
Dew point	Not known				

1.8 Aids to Navigation

1.8.1 The helicopter was equipped with standard Navigation Aids applicable for the type and no difficulties with navigation aids were reported.

1.9 Communications.

1.9.1 There was no communication problem reported. The pilot was broadcasting on unmanned VHF frequency 124.8 MHz

1.10 Aerodrome Information

The airfield where the accident occurred was flat ground and had a tar runway. The Air field is at elevation (AMSL) of 4353ft with one runway. The runways direction and Measurement is as follow: Runway direction 12/30 measuring 1470 meter



Figure 4: Tsumeb airport, 19°15'43"S 017°43'57"E, there was no navigation aids nor emergency services at the airfield.

1.11 Flight Recorders

- 1.11.1 The helicopter was not equipped with Flight Data Recorders (FDR) or Cockpit Voice Recorder (CVR). Neither recorder was required by the relevant regulation.

1.12 Wreckage and Impact Information

- 1.12.1 The helicopter impacted the ground with the main rotor blades first, and finally rested on the port side. Small pieces that detached from the wreckage were found distributed within 8 meters radius from the main wreckage. The helicopter was in landing configuration. There was no engine or mechanical defect prior to the accident. The impact with the ground damaged the aircraft main rotor blades, landing skids, the transmission support platform, windscreen and other structural damage could be observed on the aircraft structure. The main gear box has been broken off completely from its attachment and tilted 90° toward the nose of the aircraft. All the pitch change links have been broken off from their attachments.

1.13 Medical and Pathological Information

- 1.13.1 The pilot had a valid medical certificate with restrictions to wear suitable corrective lenses. The Medical Certificate (class 1) was valid at the time of accident with an expiry date of 31 August 2020.
- 1.13.2 There was no evidence that physiological factors or incapacitation may have affected the performance of the pilot.

1.14 Fire

- 1.14.1 There was no pre or post impact fire.

1.15 Survival Aspects

- 1.15.1 There was no Search and Rescue carried out, but there was a cell phone coverage at the accident site which the AMO official at the accident site used to call DAAI'
- 1.15.2 This was a survivable accident, the pilot was properly restrained and the impact forces were not beyond human body tolerance and no compression of the cabin compartment.

1.16 Tests and Research.

- 1.16.1 The Helicopter hydraulic servo actuator PN 204-076-052-101 SN 55519 was send to Woodward, Inc. Santa Clarita CA, USA. For functional test. The test was done on the 03-04 March 2021 according to Woodward ATIP 41000870, Rev. AF, and Section 605 through 60.9 and the Irreversible valve Assembly was removed and tested according to ATIP 42550-006, Rev.D, and Section 40.

Summary of the test result

The Servo –actuator was tested according to the requirements of the assembly, test and inspection procedure. Although the unit failed leakage tests 60.5 and 60.7.2, it was found functional and performed as intended.

To further investigate the leakage, the unit was disassembled and the seals were inspected. The visual examination found the seals in good condition with no problems noted. However, an examination of the piston found a polished finish with no evidence of cross-hatching, which is a typical of a Woodward piston. It is suspected that the piston may have been replaced at some point by a third-party repair facility. An overly polished piston is most likely the cause of the leaking noted during test.

Conclusion of the test result

Regardless of the leaking issue and possible piston replacement, the unit performed according to the design requirements. That means the unit was not the contributing factor to the collective bounce phenomenal that was said to have been experience by the pilot prior to the helicopter crashed.

The procedure, requirement and the result of the test are attached to the report as **appendix 1**

1.17 Organizational and Management Information

- 1.17.1 The aircraft was operating under Expedite Aviation CC Air Operator's Certificate.
The aircraft was used for Aerial work the day of the accident and was within the company AOC approval scope.

The type of operation authorised in the Air Operator's Certificates issued to Expedite Aviation CC on the 19 March 2020 with the expiry date of 18 March 2021. The type of authorised operations were: Commercial air operations, Cargo and Other Aerial work.

The regulation NAMCAR 127.03.6 (1) (e), states that "each flight crewmember undergoes operator proficiency check, (OPC) every six calendar months as part of a normal flight crew complement". There is no evidence provided to the investigator by Expedite Aviation indicating that OPC was carried out neither an approval from the Executive Director of NCAA grating the Company an exemption from the above regulations.

1.17.2 Certification and Licensing authority (NCAA):

The pilot was issued ratings of Bell204/205,206, R44, R22 and H269 during his pilot license renewal. However he only did a proficiency test on the Bell 206. The other ratings were endorsed erroneously against NAMCAR 61.01.7(b) and 61.01.7(4).

- 1.17.3 On the 17 July 2020, NCAA corrective action to the safety recommendation issued by DAAII was the immediately withdrawal (revocation) of ratings erroneously endorsed in the license
- 1.17.4 Both Certificates (C of A and C of R) and the Air Operator Certificate were valid at the time of the accident.
- 1.17.5 The Air Operator Certificate number NCAA/AOC/022/2014 was issued to Expedite Aviation CC on the 19/03/2020 and has an expiring date of 29/09/2023. The agricultural spraying, seeding and dusting was approval.

1.18 Additional Information

- 1.18.1 What is collective bounce? "Collective bounce is a rotorcraft-pilot coupling phenomenon in which the collective is in resonance with the vertical motion of the helicopter, making the motion worse. It is a divergent, vertical helicopter oscillation caused by interaction between the vertical motion of the helicopter and the pilot's body, with the pilot left arm moving the collective pitch stick control. The amplitude of bouncing oscillation increases with each up-and-down movement. This motion if not immediately corrected, might cause the helicopter to crash into the ground on a down bounce, might cause the pilot to lose control of the helicopter or cause severe structural damage". The investigation could not positively establish that indeed collective bounce phenomenal said to be experience by the pilot did existed or not prior to the helicopter crashed. *The definition is from Dictionary of Aviation Copyright © 2005 by The McGraw-Hill companies, Inc.*

1.19 Useful or Effective Investigation Techniques

- 1.19.1 None

2 ANALYSIS

- 2.1.1 On the 24th March 2020, the Bell 205 UH-1H helicopter type with registration number V5-HOZ, crashed during the landing face with a pilot on board.
- 2.1.2 Although the aircraft was close to the ground when the loss of control started, the pilot could not manage to land the aircraft safely to the ground due to the fact that he lost directional control at that crucial stage of landing.
- 2.1.3 It is the view of the investigator that the pilot did everything possible to make a safe landing, but the pilot could not maintain directional control of the helicopter which contributed significantly to the loss of control those made the aircraft to yaw to the right and finally crashed.
- 2.1.4 The investigator during the investigation process found that the operator has all the necessary approval from the Regulatory Authority (NCAA) to conduct the operation that the aircraft was used for on the day of the accident. Hence the operation was within the scope of approval granted by the Regulatory Authority (NCAA).

3 CONCLUSION

3.1 Findings

- 3.1.1 The pilot was in possession of a valid Commercial pilot license, but the rating of the Bell 204/205, R44, R22 and H269 were erroneously endorsed.

- 3.1.2 On the 17 July 2020, NCAA approved the immediately cease by the pilot in exercising privilege rendered by these rating and the withdrawal (revocation) of rating erroneously endorsed in the license. However this was done without a systematic audit to determine the number of pilot currently holding such erroneously endorsed ratings. This is a safety risk when a pilot exercises a privilege of a rating without competence (skill test) done for that particular helicopter.
- 3.1.3 The pilot was in possession of a valid aviation medical certificate (class1), with expiry date of on 31 August 2020.
- 3.1.5 The aircraft's Airworthiness Certificate(C of A) and Certificate of Registration (C of R) were valid at the time of the accident.
- 3.1.6 The Air Operator Certificate number NCAA/AOC/022/2014 was issued to Expedite Aviation CC on the 19/03/2020 and has an expiry date of 18/03/2021. The agricultural spraying, seeding and dusting was also grated in the approval.
- 3.1.7 The weather was fine with good visibility at the time of the accident and was not a contributing factor to the accident.
- 3.1.8 The aircraft weight and balance was within limit and was not considered a contributing factor to the accident.
- 3.1.9 The hydraulic servo actuator test by the manufacture of the component it is concluded that the servo actuator performed as per the designed requirements.

3.1 Contributing Factors

- 3.1.2 Loss of directional control.

3.2 Probable Causes

- 3.2.1 Loss of Control

4. SAFETY RECOMMENDATIONS

NOTE: The safety recommendation below was already issued to NCAA. The recommendation was accepted and corrective action were done already in this regard. An internal workshop was conducted for all the PEL staff to address the historic understanding and application of NAMCAR 61.01.7(4) and 61.16.11 and AIC (B08/2020), dated 8 may 2020 was issued to the industry, to notify and emphasise the correct understanding and application of the regulations pertaining to the renewal of helicopter ratings.

4.1 Regulatory Authority (NCAA): 003/09/2020

It is recommended that the Regulatory Authority (NCAA) should carry out as a matter of urgency a comprehensive Audit on the pilot's files to determine the number of pilot erroneously issued with rating in their license against the regulations NAMCAR 61.01.7(b) and 61.01.7(4), and come up with a corrective action plan to make sure that those pilots do not exercise such privileges associated with those ratings. As well to ensure no further ratings will be issued without meeting the requirements as per the CARS.

Compiled by:

T.H.Herman
Investigator-in-Charge

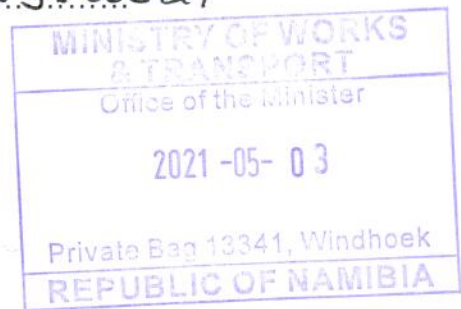
Date: 26/04/2021

Released by:

John Mutorwa, MP

Date: 3.5.2021

MINISTER: MINISTRY OF WORKS AND TRANSPORT




FLIGHT SAFETY PART

PART NUMBER

41000870

Rev. M

PARA	REQUIREMENTS	S/N: _____	RESULTS	STAMP
50.0	ASSEMBLY			
50.1	Final assembly of servo head; bend tabs.	Check	N/R	
60.0	TEST			
60.1.1	Install servo head.	Check	N/R	
60.1.2	Torque the #45 Jam Nut 400 to 500 in-lbs	Check	N/R	
		QA Verify	N/R	
60.4	<u>Proof Pressure</u>			
60.4.2	2250 psi, 3 minutes, extend.	Check	N/R	
60.4.3	2250 psi, 3 minutes, retract.	Check	N/R	
	<u>Requirement</u>			
	No permanent deformation or external leakage.			
60.5	<u>External Leakage during Cycling</u>		70 — 90	
	300 cycles, 1500 psi, zero (0) drops or 1500 psi, 125 additional cycles, four drops maximum each packing.	Check	FAILED 6 DROPS 125 CYCLES	
60.6	<u>Input Force</u>			
60.6.2	1500 psi, 12 oz maximum.	Check	✓(11/8)	

FROZEN PLANNING
WHRT PLANNING REVIEW
BOARD MUST APPROVE
ALL CHANGES


FLIGHT SAFETY PART

PART NUMBER

41000870

Rev. M

PARA	REQUIREMENTS	S/N: _____	RESULTS	STAMP
60.7	<u>Internal Leakage</u>			
60.7.2	<u>Neutral Position</u>			
	1500 psi, 30 cc/min maximum.	cc/min	<u>44</u>	
	500 psi, 15 cc/min maximum.	cc/min	<u>26</u>	
	50 psi, 10 cc/min maximum.	cc/min	<u>3.1</u>	
60.7.3	<u>Extend Position</u>			
	1500 psi, 30 cc/min maximum.	cc/min	<u>11</u>	
	500 psi, 15 cc/min maximum.	cc/min	<u>4</u>	
	50 psi, 10 cc/min maximum.	cc/min	<u>0.4</u>	
60.7.4	<u>Retract Position</u>			
	1500 psi, 30 cc/min maximum.	cc/min	<u>7</u>	
	500 psi, 15 cc/min maximum.	cc/min	<u>3</u>	
	50 psi, 10 cc/min maximum.	cc/min	<u>0.3</u>	
60.8	<u>Low Pressure Function</u>			
60.8.2	25 psi maximum.	Check	<u>✓(15)</u>	
60.9	<u>Low Pressure Leakage</u>			
60.9.1	Combined – one drop maximum/20 min.	Check	<u>✓(0)</u>	
70.0	ASSEMBLY, FINAL			
	Paragraphs 70.1 through 70.1.4	Check	_____	_____

FROZEN PLANNING
 WHRT PLANNING REVIEW
 BOARD MUST APPROVE
 ALL CHANGES

ASSEMBLY, TEST & INSPECTION PROCEDURE

REV. D

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PART NUMBER

42550 - 006

DWG REV. C

DATA SHEET

VALVE ASSEMBLY, HYDRAULIC PRESSURIZED-IRREVERSIBLE

Cure Date _____ Assembly Date _____ S/N _____

Traveler Number _____ Customer _____

Customer Specification 204-076-055BHT Outside Data Sheet _____ 00D03 Phy Chg 00

PARA	REQUIREMENTS		RESULTS	STAMP
20.0	CLEAN		N/R	HRT 881
20.1	Clean per HRQP 7.001	Check		MAR 04 2021
30.0	ASSEMBLY		N/R	HRT 881
30.1	Paragraphs 30.1 through 30.11.3	Check		MAR 04 2021
40.0	TEST			
40.1.2	Record Test Fluid Temperature	Record	83°	
40.4.1	Proof			
	No external leakage or deformation	Check	N/R	
40.4.2	Proof			
	No external leakage or deformation	Check	N/R	HRT 881
40.5.1	Sequence and check valve leakage			MAR 04 2021
	500 psig, 1.0 DPM	Check	1.0 DPM	
40.5.2	Sequence and check valve leakage			
	50 DPM max., 20.0 minutes	Check	4 DROPS	
40.6	Combined component leakage			
	7.0 dpm max. after 1.0 minutes	Check	4 DROPS	
	3.0 dpm max. after 10.0 minutes	Check	N/R	

ASSEMBLY, TEST & INSPECTION PROCEDURE

REV. D

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PART NUMBER

42550 - 006

DWG REV. C

PARA	REQUIREMENTS		RESULTS	STAMP
40.7	Sequence Valve Operation			  MAR 04 2021 
40.7.1.1.a.	Return land opens 525 to 575 psig	Check	<u>550</u>	
40.7.1.1.b.	Return land closes 500 to 575 psig	Check	<u>INOP</u>	
40.7.2.1	Interflow - none allowed	Check	<u>0</u>	
40.8.1	Differential Relief Valve Crack between 500 and 600 psig	Check	<u>INOP</u>	
40.8.2	Differential Relief Valve Cracks (Loaded) between 1500 and 1600 psig	Check	<u>INOP</u>	
40.9.1	Accumulator Capacity 7.4 cc	Check	<u>INOP</u>	
40.9.2	Discharge less than 40.9.1	Check	<u>INOP</u>	
40.10.1	Thermal Relief Valve Crack between 2100 and 2300 psig	Check	<u>2150 PSI</u>	
40.10.2	Thermal Relief Valve Reseats 1900 psig minimum, check 4th min.	Check	<u>1950</u>	
40.11	Check Valve Free Flow Confirmation	Check	<u>✓</u>	
40.12	Check Valve Crack and Reseat Crack, 2 to 5 psig	Check	<u>N/R</u>	
	Reseat within 1 psi of crack	Check	<u>N/R</u>	
50.0	ASSEMBLY, FINAL			
	Paragraphs 50.1 through 50.6	Check	<u> </u>	
60.0	INSPECTION			
	Paragraph 60.1	Check	<u> </u>	

Introduction:

Date: March 3 and 4, 2021

Location: Woodward, Inc. Santa Clarita CA, USA.

Oversight: Joshua Cawthra, Remote Witness

Servo Actuator PN 204-076-052-101 (Woodward PN 41000870-101), SN 55519 was functionally tested according to Woodward ATIP 41000870, Rev. AF, Sections 60.5 through 60.9. In addition, the Irreversible Valve Assembly was removed and tested according to ATIP42550-006, Rev. D, Sections 40 (see Data Sheets for details).



Actuator Assembly Tests performed

ATIP 41000870, Rev. AF, Sections 60.5 External Leakage during Cycling:

60.5.1 Open Valves V1, V2, and V4. Close Valve V3, and with the piston bottom, adjust pressure at Gage #1 until 1500 psi is indicated.

60.5.2 Cycle the actuator a maximum of 300 full stroke cycles or until the first drop falls from either the two piston shaft packings. If no drops fall within the 300 cycle, the piston shaft packings

are acceptable. If a drop falls prior to 300 complete cycles, continue to cycle for an additional 125 cycles and count the drops.

Requirement

If not more than four drops fall during the 125 additional completed cycles, from either of the packings, the piston shaft packings are acceptable.

Test Results

Six (6) drops measured. Unit slightly exceeded the maximum allowable of four (4) drops after the additional 125 cycle.

ATIP 41000870, Rev. AF, Sections 60.6 Input Force:

60.6.1 Open Valves V1, V2, and V4. Close Valve V3.

60.6.2 The force shall be applied at the pilot input. Adjust the pressure indicated at Gage #1 to 1500 psig with Regulator #1.

Requirement

The force required at the pilot input to control the cylinder movement shall not exceed 12 ounces.

Test Results

11 ounces max were measured. Unit met Input Force requirement.

ATIP 41000870, Rev. AF, 60.7 Internal Leakage, Neutral Position:

60.7.1 Open Valves V1, V2, and V4. Close Valve V3.

60.7.2 Adjust pressure at Gage #1 to 1500, 500, and 50 psig with Regulator #1. Shift input to locate the cylinder to near mid-stroke and not moving. Record leakage at V4.

Requirement

The neutral leakage shall not exceed:

1500 psi = 30 cc/min

500 psi = 15 cc/min

50 psi = 10 cc/min

Test Results

At 1500 psi = 44 cc/min

At 500 psi = 26 cc/min

At 50 psi = 3.1 cc/min

ATIP 41000870, Rev. AF, 60.7.3 Internal Leakage, Extend Position:

60.7.3 Place the block on the piston shaft to restrict the cylinder excursion and prevent the piston from bottoming in extend. Shift the pilot input lever until the cylinder is hard over-bearing on the preventer block. Adjust the pressure at Gage #1 to 1500, 500, and 50 psig and record the leakage at V4.

Requirement

The leakage at V4 shall not exceed:

1500 psi = 30 cc/min

500 psi = 15 cc/min

50 psi = 10 cc/min

Test Results

At 1500 psi = 11 cc/min

At 500 psi = 4 cc/min

At 50 psi = 0.4 cc/min

ATIP 41000870, Rev. AF, 60.7.4 Internal Leakage, Extend Position:

60.7.4 Repeat paragraph 60.7.3 except, the cylinder shall be at the retract hard over condition.

Requirement

The leakage at V4 shall not exceed 30 cc/min, 15 cc/min and 10 cc/min respectively.

1500 psi = 30 cc/min

500 psi = 15 cc/min

50 psi = 10 cc/min

Test Results

At 1500 psi = 7 cc/min

At 500 psi = 3 cc/min

At 50 psi = 0.3 cc/min

ATIP 41000870, Rev. AF, 60.8 Low Pressure Function:

60.8 Low Pressure Function

60.8.1 Open Valves V1, V2, and V4. Close Valve V3.

60.8.2 Slowly increase pressure on Gage #1 until the cylinder will move when the pilot input lever is shifted in the opposite direction. Record the break-out pressure.

Requirement

The pressure at which the cylinder will move shall not exceed 25 psi.

Test Results

= 15 psi

ATIP 41000870, Rev. AF, 60.9 Low Pressure Leakage:

60.9 Low Pressure Leakage

60.9.1 Apply a pressure of 500 psi to the return port of the servo valve with the pressure port blocked. Hold for 20 minutes.

Requirement

The combined leakage from the servo valve spool ends shall not exceed one drop during a 20-minute waiting period.

Test Results

= 0 drops

Summary

The Servo-Actuator was tested according to the requirements of the Assembly, Test, and Inspection Procedure. Although the unit failed leakage tests 60.5 and 60.7.2, it was functional and performed as intended.

To further investigate the leakage, the unit was disassembled, and the seals were inspected. The visual examination found the seals in good condition with no problems noted. However, an examination of the Piston found a polished finish with no evidence of cross-hatching, which is typical of a Woodward Piston. It is suspected that the Piston may have been replaced at some point by a third-party repair facility. An overly polished Piston is most likely the cause of the leaking noted during test.

Regardless of the leaking issue and possible Piston replacement, the unit performed according to the design requirements.

