بسم الله الرحمن الرحيم

Republic of Maldives

SAFETY INVESTIGATION REPORT 2023/03

# FINAL REPORT

## INVESTIGATION OF THE OCCURRENCE INVOLVING MANTA AIR OPERATED DHC-6-200, 8Q-RAL FLOATPLANE WHILST LANDING AT VELANA INTERNATIONAL AIRPORT ON 6 October 2023

# INTRODUCTION

Maldives is a signatory to the Convention on International Civil Aviation (Chicago, 1944) which established the principles and arrangements for the safe and orderly development of international air transport. Article 26 of the Convention obligates Signatories to investigate accidents and serious incidents to civil aircraft occurring in their State.

This report is based upon the investigation carried out by the Accident Investigation Coordinating Committee (AICC) in accordance with Annex 13 to the Convention, the Civil Aviation Act 2/2001 and the Civil Aviation Regulations. The sole objective of this investigation is to prevent accidents and incidents. It is not the purpose of this investigation to apportion blame or liability.

In investigating this accident, AICC was assisted by Manta Aviation Pvt Ltd.

All times in this report are local time unless otherwise stated. Time difference between local and UTC is +5 hrs.

The report is released on 17 September 2025.

Mr. Abdul Razzak Idris
**Chairperson**
**Accident Investigation Coordinating Committee**

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# LIST OF ABBREVIATIONS

| | |
|---|---|
| AICC | Accident Investigation Coordinating Committee |
| AMP | Approved Maintenance Programme |
| ATL | Aircraft Technical Log |
| CAMO | Continuous Airworthiness Management Organization |
| CG | Centre of Gravity |
| CSU | Constant Speed Unit |
| DHC-6-200 | Viking Air DHC-6, series 200 aircraft |
| EMMA | Equalized Maintenance for Maximum availability |
| FDR | Flight Data Recorder |
| FO | First Officer |
| lbs. | Pounds |
| LT | Local Time |
| LH, RH | Left Hand, Right Hand |
| MCAA | Maldives Civil Aviation Authority |
| MCAR | Maldives Civil Aviation Regulations |
| MLE | IATA designated three letter code for Velana International Airport |
| MMS | Maldives Meteorological Service |
| MSN | Manufacturer Serial Number |
| MTOM | Maximum Take-Off Mass |
| OEM | Original Equipment Manufacturer |
| PF | Pilot Flying |
| PIC | Pilot-in-command |
| PM | Pilot Monitoring |
| PWC | Pratt & Whitney, Canada |
| TBO | Time Between Overhaul |

| | |
|---|---|
| VFR | Visual Flight Rules |
| UTC | Coordinated Universal Time |
| VOM | Operator designated 3 letter code for Vommuli water aerodrome |
| WNW | West of Northwest |

## SYNOPSIS

On 6 October 2023, at about 1645 hours local time (LT), a Viking Air DHC-6-200 (Registration Markings 8Q-RAL) on approach to land at Velana International Airport water aerodrome (MLE), suffered loss of engine power on the RH engine while descending through, approximately 350 feet. The crew temporarily lost control of the aircraft but managed to land on water with a bounce and did a 360-degree right turn, before coming to rest. No damage was observed on the aircraft. There were no reports of any injuries to any passengers or crew.

The occurrence was reported to the AICC at 1715 hours, and an investigation was initiated on the same day.

# 1. FACTUAL INFORMATION

| | |
|---|---|
| Aircraft Legal Owner: | MG Adriatic Leasing Limited |
| Registered owner: | Manta Aviation Pvt Ltd. |
| Aircraft Type: | Viking Air DHC-6-200 (Floatplane) |
| Operator: | Manta Air (Air Operator Certificate No.014) |
| Registration: | 8Q-RAL |
| Number and type of engines: | 2 engines / PT6A-27 (PWC) |
| Engine hours / cycles since new: | LH engine: 30,409.55 hours<br>RH engine: 2,061.11 hours |
| Location of Occurrence: | MLE water aerodrome<br>(North-Right Takeoff / South-West landing)<br>(04° 11' 50.76"N/73° 32' 22.47"E) |
| Date and Time: | 6 October 2023 at 16:43 hours LT |
| Persons on board: | 08 |

## 1.1 History of Flight

### 1.1.1 Background

On 06 October 2023, about 1643 hrs, a DHC-6-200 Twin Otter floatplane (registration markings 8Q-RAL), operated by Manta Air departed Soneva Jani water aerodrome (Medhufaru, Noonu Atoll) on a charter service (NR2205) destined to MLE. There were 5 passengers, 2 flight crew and 1 cabin crew onboard. The PIC was the Pilot Flying (PF) and the FO was the Pilot Monitoring (PM).

The aircraft was released for flight from the Operator's base at Velana International Airport (MLE), at 1800 hours on the previous day with all relevant inspections completed. On the day of the occurrence, prior to the occurrence flight, the aircraft had operated on sectors MLE-FSE (Soneva Fushi, Baa Atoll)–MLE and MLE-FSE–JSE.

The flight from JSE to MLE was uneventful until about 350 feet altitude on approach to MLE. The PIC called for full flaps, max propeller rpm and landing checks. Immediately after flaps were fully extended and the propeller levers were selected to fully FWD position, for max rpm, the aircraft reacted violently and yawed to the right, with a right bank. The crew reported that they did lose control of the aircraft initially and felt as if it was entering into a spin.

Flight radar recordings and the ATC Communication recordings indicate the aircraft was at about 350 feet altitude on final course to water runway South Left and the speed was 80 knots at 16:43:43 hours. Just 4 seconds later the aircraft had turned right by about 30 degrees and descended to 300 feet giving a descend rate of 750 per minute with a speed of 66 knots. Even though the aircraft continued to turn right the aircraft descend rate changed to 500 per minute over the next 9 seconds. But by this time the speed had bled to 52 knots. After the initial veering to the right of the approach path, the aircraft was seen making a slow left turn before impacting the water.

The PIC stated that he was unable to even glance at the flight instruments or engine instruments since the aircraft was at a critically low altitude. When the crew regained control of the aircraft, the aircraft had veered to almost 60° to the right, and an imminent crash was feared. The PIC stated that an attempt was made to add power on the LH engine but was unable to move the lever as it was stuck and added that he felt both the power levers were stuck.


Figure 1a

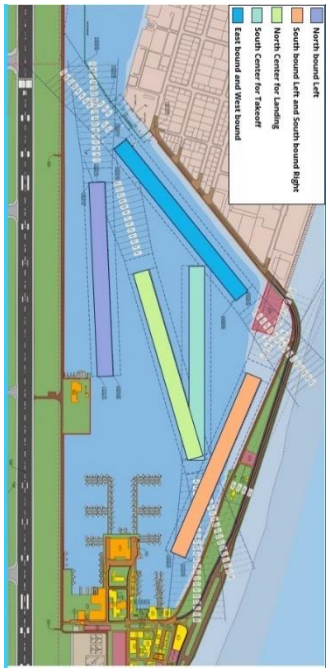



Figure 1b

The PIC realized that the aircraft was heading towards the red and white painted tanks located on the south end of HulhuMale' island. At the time the stall warning horn was heard the PIC was attempting to pitch down the aircraft more in a desperate attempt to gain airspeed to avoid the aircraft stalling. At this point the PIC advised the FO to declare MAYDAY. PIC stated that the idea was to gain maximum air speed and flare up so that the touchdown would be on the water instead of land in front.

The PIC was concerned that the float could become detached on impact, hence attempted to land on both floats thus sharing the impact load equally. The aircraft had a very hard landing on water and bounced; the aircraft remained upright on both the floats. When the aircraft stabilised on water, the crew found the LH power lever had come free and was able to gain partial control of the aircraft.

The crew then shut down the RH engine by retarding the fuel lever thus shutting off the fuel to the RH engine. The aircraft taxied with the assistance of the rescue boat and docked on the fixed platform and the left engine was shut down. The passengers then disembarked through the main airstair door.

## 1.2 Injuries to Persons

| Injuries | Flight Crew | Cabin Crew | Passengers | Total on board | Others |
|---|---|---|---|---|---|
| Fatal | 0 | 0 | 0 | 0 | 0 |
| Serious | 0 | 0 | 0 | 0 | 0 |
| Minor | 0 | 0 | 0 | 0 | 0 |
| Nil | 2 | 1 | 5 | 8 | 0 |
| Total | 2 | 1 | 5 | 8 | 0 |

## 1.3 Damage to aircraft

No damage was reported.

## 1.4 Other Damage

None

## 1.5 Personnel Information

### 1.5.1 Pilot-In-Command

| | |
|---|---|
| Age: | 31 years |
| Nationality: | Indian |
| Gender: | ATPL |
| License issued on: | 13 Sep 2022 |
| License expires on: | 12 Sep 2027 |
| Type of medical: | Class One (1) medical certificate |
| Medical issued on: | 23 Sep 2023 |
| Medical expires on: | 23 Sep 2024 |
| Types flown: | DHC-6 |
| Hrs. on type: | 4860.30 hours |
| Ratings: | DHC6 / IR |

| | |
|---|---|
| Last Proficiency check: | 14 Jul 2023 |
| Total hours as PIC: | 634.3 hours |
| Total flight time: | 5287.30 |
| Last 90 days: | 169.42 hours |
| Last 28 days: | 75.25 hours |
| Last 24 hours: | 5 hours 25 minutes |
| Previous rest period: | 12 hours 45 minutes |

### 1.5.2 Co-pilot

| | |
|---|---|
| Age: | 34 years |
| Nationality: | Indian |
| Gender: | Male |
| Type of License: | Commercial Pilot License (CPL-A) |
| License issued on: | 13 Jan 2022 |
| License expires on: | 12 Jan 2025 |
| Type of medical: | Class One (1) medical certificate |
| Medical issued on: | 15 Nov 2022 |
| Medical expires on: | 14 Nov 2023 |
| Types flown: | DHC-6 |
| Hrs. on type: | 1419.40 hours |
| Ratings: | DHC6 |
| Last Proficiency check: | 13 Jan 2023 |
| Total flight time: | 2106.04 |
| Last 90 days: | 136.42 hours |
| Last 28 days: | 19.16 hours |
| Last 24 hours: | 05 hours 25 minutes |
| Previous rest period: | 12 hours 45 minutes |

### 1.5.3 Cabin Crew

| | |
|---|---|
| Age: | 27 years |
| Nationality: | Maldivian |
| Gender: | Male |
| Type of License: | Cabin Crew License |
| License issued on: | 28 Feb 2022 |
| License expires on: | 27 Feb 2027 |
| Type of medical: | Class Three (3) Medical Certificate |
| Medical issued on: | 01 Feb 2023 |
| Medical expires on: | 01 Feb 2025 |
| Previous rest period: | 12 hours 45 minutes |

## 1.6 Aircraft Information

DHC-6-200 aircraft bearing MSN 045 was built in 1967 by de Havilland Inc. The aircraft was registered for the first time in the Maldives on 13 December 2018, under registration markings 8Q-TAI and was in operation with TMA until 24 November 2021. The aircraft was re-registered with Manta Aviation Pvt Ltd., in November 2021, and since then the aircraft has been in operation with Manta Air.

### 1.6.1 Airframe

The DHC-6-200 "Twin Otter" is an unpressurised, all-metal, high wing aircraft powered by two Pratt & Whitney PT6A-27 engines driving four-bladed, reversible-pitch, full feathering propellers. The aircraft is designed for seating two pilots, side by side with dual controls, standard and optional flight instrumentation.

| | |
|---|---|
| Manufacturer | de Havilland Inc. |
| Model: | DHC-6-200 series |
| Manufacturer's serial number: | 045 |
| Year of Manufacture: | 1967 |
| Nationality: | 8Q (Republic of Maldives) |

| | | |
|---|---|---|
| Registration Markings: | 8Q-RAL | |
| Certificate of Registration: | Initial Issued on 31 Dec 2018 | |
| Owner: | Manata Aviation Pvt Ltd | |
| Operator: | Manta Air | |
| Validity of Certificate of Airworthiness: | Valid since initial issue on 12 Dec 2021 | |
| | (Normal category) | |
| Airworthiness Review Certificate: | ARC Reference MV.MI.0123 Issue 3 | |
| | Last issue: | 07 June 2023 |
| | Date of Expiry: | 15 February 2024 |
| Total Flying Hours since manufacture: | | 44,254:39 hours |
| Total Landings since manufacture: | | 78,306 landings |
| Last periodic inspection: | EMMA 37 | |
| Last inspection carried out at TAT/TAC: | 44,201:09 hours / 78,221 cycles | |
| Total Flying Hours since last periodic inspection: | 54:30 hours | |

### 1.6.2 Engines and Propellers

| **Right Engine (Gas Generator)** | |
|---|---|
| Right engine manufacturer | PWC |
| Year of manufacture | 1985 |
| Model | PT6A-27 |
| Serial number | PCE-42433 |
| Total Hrs. since new | 2,061.11 hours |
| Last overhaul date | 05 Oct 2021 |
| Hrs. since overhaul | 938.02 hours |
| Last check carried out | EMMA No 37 on 22 Sep 2023 |
| Hrs. since last check | 47.18 hours |
| | |
| **Right Engine (Power section)** | |
| Right engine manufacturer | PWC |
| Year of manufacture | 1985 |
| Model | PT6A-27 |

| | |
|---|---|
| Serial number | 42433-100 |
| Last overhaul date` | 05 Oct 2021 |
| Hrs. since overhaul: | 938.02 hours |
| Last check carried out: | EMMA No 37 on 22 Sep 2023 |
| Hrs. since last check: | 47.18 hours |
| | |
| **Left Engine (Gas Generator)** | |
| Left engine manufacturer: | PWC |
| Year of manufacture: | 1985 |
| Model: | PT6A-27 |
| Serial number: | PCE-42432 |
| Total hrs. since new: | 30,409.55 hrs |
| Last overhaul date: | 11 October 2021 |
| Hrs. since overhaul: | 453:07 hours |
| Last check carried out: | EMMA No 37 on 22 Sep 2023 |
| Hrs. since last check: | 47.18 hours |
| | |
| **Left Engine (Power section)** | |
| Left engine manufacturer: | PWC |
| Year of manufacture: | 1985 |
| Model: | PT6A-27 |
| Serial number: | 42432-100 |
| Last overhaul date: | 11 October 2021 |
| Hrs. since overhaul: | 453:07 hours |
| Last check carried out: | EMMA No 37 on 22 Sep 2023 |
| Hrs. since last check: | 47.18 hours |
| | |
| **Right Propeller** | |
| Manufacturer: | Hartzell |
| Year of manufacture: | Unknown |
| Model: | HC-B3TN-3DY |
| Serial number: | BUA19757 |
| Last overhaul date: | 10 May 2019 |
| Hrs. since last overhaul: | 2873:37 hours |

| | |
|---|---|
| Last check carried out: | EMMA No 37 on 22 Sep 2023 |
| | |
| **Left Propeller** | |
| Manufacturer: | Hartzell |
| Year of manufacture: | Unknown |
| Model: | HC-B3TN-3DY |
| Serial number: | BUA35198 |
| Last overhaul date: | 15 April 2023 |
| Hrs. since last overhaul: | 191:09 hours |
| Last check carried out: | EMMA No 37 on 22 Sep 2023 |

*Engine / Propellor details including hours are stated as provided by the Operator and has not been independently verified.

### 1.6.3 Flight Controls

The flight controls consist of conventional, manually actuated primary flight controls operated through cables, pulleys, and mechanical linkages. Rudder and elevator trim are manually controlled and mechanically actuated; aileron trim is electrically actuated. Secondary flight controls consist of hydraulically actuated wing flaps.

### 1.6.4 Fuel

Jet A-1 fuel was used on the aircraft engines. The aircraft was last refueled at the main base at MLE. The mass of fuel as per records on the ATL are detailed below:

Departure from MLE: 1400 lbs.
Arrival at JSE: 890 lbs.
Arrival at MLE: 400 lbs.

### 1.6.5 Recent maintenance

The most recent maintenance inspections carried out include Equalized Maintenance for Maximum Availability (EMMA) check number 37, complied with on 22 Sep 2023, at 44,201:09 TAT and 78,221 TAC. The next maintenance inspection would fall due at 44,326:09 hours TAT.

As per Aircraft Technical Log (ATL) sheet number 11131, the latest daily inspection was carried out at 1800 hrs on 05 Oct 2023.

Past records show that a defect relating to the same system was reported on 4 October 2023. It stated: “After landing right prop went to almost feather NP 20-30%, could not get

reverse." Troubleshooting carried out, post pilot report, revealed that the RH Engine Reversing Lever Carbon Block was damaged, and as such it was replaced in accordance with PSM 163-2 CH 61-00-00 Rev 21 with satisfactory results. The carbon block is a component attached to the beta valve of the CSU.

### 1.6.6 Defects

There was no record of open deferred defects, and the crew did not report any defects prior to the incident.

### 1.6.7 Aircraft Load

The aircraft departed JSE with a take-off mass of 11,066 lbs. The estimated landing mass at arrival in MLE was 10,616 lbs.

The crew were provided with a printed load sheet which was accepted and signed by the PIC. Based on the load sheet, both takeoff and landing masses were well within the limitations set by the Operator.

The Mass & Balance Report prepared for the flight by the PIC using the aircraft Tablet, recorded the Take-Off CG at 29.5% MAC, and the landing CG also at 30.1 % MAC.

## 1.7 Meteorological information

The maximum wind speed recorded between 1600 to 1700 hours on 06 Oct 2023 was 12 knots from WSW direction.

## 1.8 Aids to Navigation

The aircraft was operating under VFR. No navigational aids were available at the water aerodrome.

## 1.9 Communications

There were no communication issues or defects recorded. Both VHF Communication systems were operating normally.

## 1.10 Aerodrome information

Arrival Aerodrome: MLE water aerodrome

(North-Right Takeoff / South-West landing) water runway

Water runway coordinates: 04.1974 N (04° 11' 50.76"E)
73.5396 E (73° 32' 22.47"E)

## 1.11 Flight Recorders

No flight data recorder (FDR) or Cockpit Voice Recorder (CVR) was installed on the aircraft, and they are not required under MCARs.

## 1.12 Wreckage and impact information

### 1.12.1 Wreckage Condition

No damage was reported.

### 1.12.2 Salvage operations

Upon landing, the aircraft taxied to the nearest dock, using left engine power. A powered dinghy from ARFF Marine rescue, tied to the right float provided assistance to taxi the aircraft.

## 1.13 Medical and pathological information

All three crew members were subjected to drug tests and the results were reported negative for all crew.

## 1.14 Fire

There were no fires or fire alarms.

## 1.15 Survival Aspect

The airports ARFF Marine rescue attended to the aircraft soon after the aircraft landed and assisted the aircraft to taxi to the dock while the passengers and crew were on board. The passengers and crew disembarked onto the dock safely using the airstair door.

## 1.16 Tests and research

The defective CSU Part number 8210-304, Serial number 11393795 was sent to the OEM, Woodward Inc. Loves Park, Illinois, United States of America for investigation. The investigation was carried out under the direct oversight of the NTSB.

Woodward's investigation report is attached as Appendix 4.3.

## 1.17 Organizational and Management Information

Manta Air (MA) is a MCAA approved Air Operator Certificate holder who commenced their operation in 2019. MA provides domestic air services using 3 ATR 72 and 16 DHC-6 floatplanes. DHC-6 floatplane aircraft is authorized to conduct day VFR Operations only. The company also holds Aircraft Maintenance Organization Approval (MV.145.077) and CAMO Approval reference MV. CAMO.007. While its operating base is located at VIA, Manta carries out majority of the scheduled and unscheduled maintenance at their maintenance based in Dhaalu Airport, located in the south of the country – Maldives.

## 1.18 Additional Information

None

# 2. ANALYSIS

The PIC and FO were medically fit and held valid licenses. They had operated within the FDTL limits, prior to the flights on the day of the occurrence. Crew training records suggest that both crew members had undergone necessary trainings and were qualified to operate the flight.

The aircraft experienced engine power loss (RH position) at about 350 feet on approach to landing. Troubleshooting actions carried out immediately after the occurrence found LH engine and the power lever was functioning normally while the RH engine power lever was stuck with the RH propeller locked in feather position. RH engine and its power lever worked well after replacement of the corresponding CSU. Thus, the power loss on the RH engine was attributed to failure of the CSU.

When the CSU was examined, the Beta valve clevis was found to be loose. The CSU was sent to Woodward Inc., for further investigation. The task was carried out by Woodward under the direct oversight of the NTSB.

Testing and research carried out by Woodward found that the beta valve plunger assembly, a constituent part of the CSU, was detached at the brazed joint: clevis piece separated completely from the plunger.

Prior to power loss on RH engine, the propeller was operating in Beta Range with the propeller lever brought forward to the maximum RPM (96% NP) position, which is the standard configuration for landing Twin Otter aircraft.

In Beta Range the propeller blade angle is controlled by the beta reverse valve, the plunger moving within the through-hole, exerting an axial load on the plunger. The axial load on the Beta Valve separated the clevis from the plunger of the Beta valve assembly. According to the Woodward report, this separation was due to a shear overload of the copper braze material.

Past records show that a defect relating to the same system was reported on 4 October 2023. It stated: “After landing right prop went to almost feather NP 20-30%, could not get reverse.” Troubleshooting carried out, post pilot report, revealed that the RH Engine Reversing Lever Carbon Block was damaged, and it was replaced in accordance with PSM 163-2 CH 61-00-00 Rev 21 with satisfactory results. The carbon block is a component

attached to the beta valve of the CSU. This may have been the indication of an impending failure of the CSU that occurred on this flight.

# 3. CONCLUSIONS

## 3.1 Findings

AICC determines that:

1. Medical fitness and FTDL of the crew were not factors.
2. The LH engine was operating normally
3. Propeller latches were engaged on RH engine following failure of the CSU.
4. Beta Valve clevis piece and plunger of the CSU were separated completely from each other at the brazed joint.

## 3.2 Causes / Contributing Factors

The AICC determines that the cause of the serious incident is related to the CSU failure due to the separation of clevis from the plunger of the Beta valve assembly.

## 3.3 Safety Recommendations

Nil

# 4. APPENDICES

## 4.1 Load sheet – Soneva Jani – MLE sector

MantaAir

8QRAL

FCGO-029 ISS01REV02 161221
ALL WEIGHTS IN POUNDS (LB)

**LOADSHEET**

| | | | | | | |
|---|---|---|---|---|---|---|
| Flight number | NR2205 | Date | 6 Oct 2023 | Crew | 2 | 1 |
| A/c Registration | 8QRAL | A/c Type | DHC-6 on Floats | From | JSE | |
| Seating version | 09 Y | Time | 15:07:52 | To | MLE | |

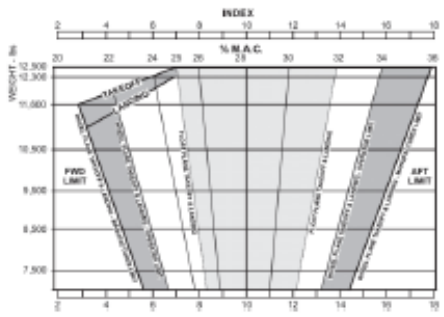
| Passengers | Standard PW | | | Actual PW | | | Weight | Index | Total Passengers | |
|---|---|---|---|---|---|---|---|---|---|---|
| Seat | A | D | | A | D | | | | | |
| Row 1 | | | E | | | | 0 | 0.0 | Male | 2 |
| Row 2 | M | M | E | | | | 378 | -1.1 | Female | 2 |
| Row 3 | F | F | | | | | 300 | 0.2 | Child | 1 |
| Row 4 | C | | | | | | 77 | 0.4 | Infant | 0 |
| Row 5 | | | | | | | 0 | 0.0 | | |
| | | | | Total | | | 755 | -0.554 | Total (incl. inf) | 5 |

| Deadload | Area D | | Rear cpt | | Aft Shelf | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Pcs | Weight | Pcs | Weight | Pcs | Weight | Pcs | Weight |
| Cabin Baggage | | | 3 | 39 | | | 3 | 39 |
| Checked Baggage | 5 | 187 | | | | | 5 | 187 |
| Cargo | | | | | | | 0 | 0 |
| Others | | | | 4 | | | 0 | 4 |
| Total | 5 | 187 | 3 | 43 | 0 | 0 | 8 | 230 |

| Fuel | Weight | Index |
|---|---|---|
| FWD Tank | 437.5 | -1.5 |
| AFT Tank | 437.5 | 0.6 |
| Trip Fuel | 450 | -0.4 |

Notes

| | Weight | Index | MAC % |
|---|---|---|---|
| Dry Operating Weight | 9206 | 10.3 | |
| Total Traffic Load | 985 | 2.0 | |
| Actual Zero Fuel Weight | 10191 | 12.3 | |
| Take Off Fuel | 875 | -0.9 | |
| Actual Take Off Weight | 11066 | 11.4 | 29.5 |
| Trip Fuel | 450 | -0.4 | |
| Actual Landing Weight | 10616 | 11.8 | 30.1 |
| Underload | 1434 | | |




| | |
|---|---|
| Total Passengers | 5 |
| Total Onboard | 8 |

| Prepared by | |
|---|---|
| Name | |
| Signature | |

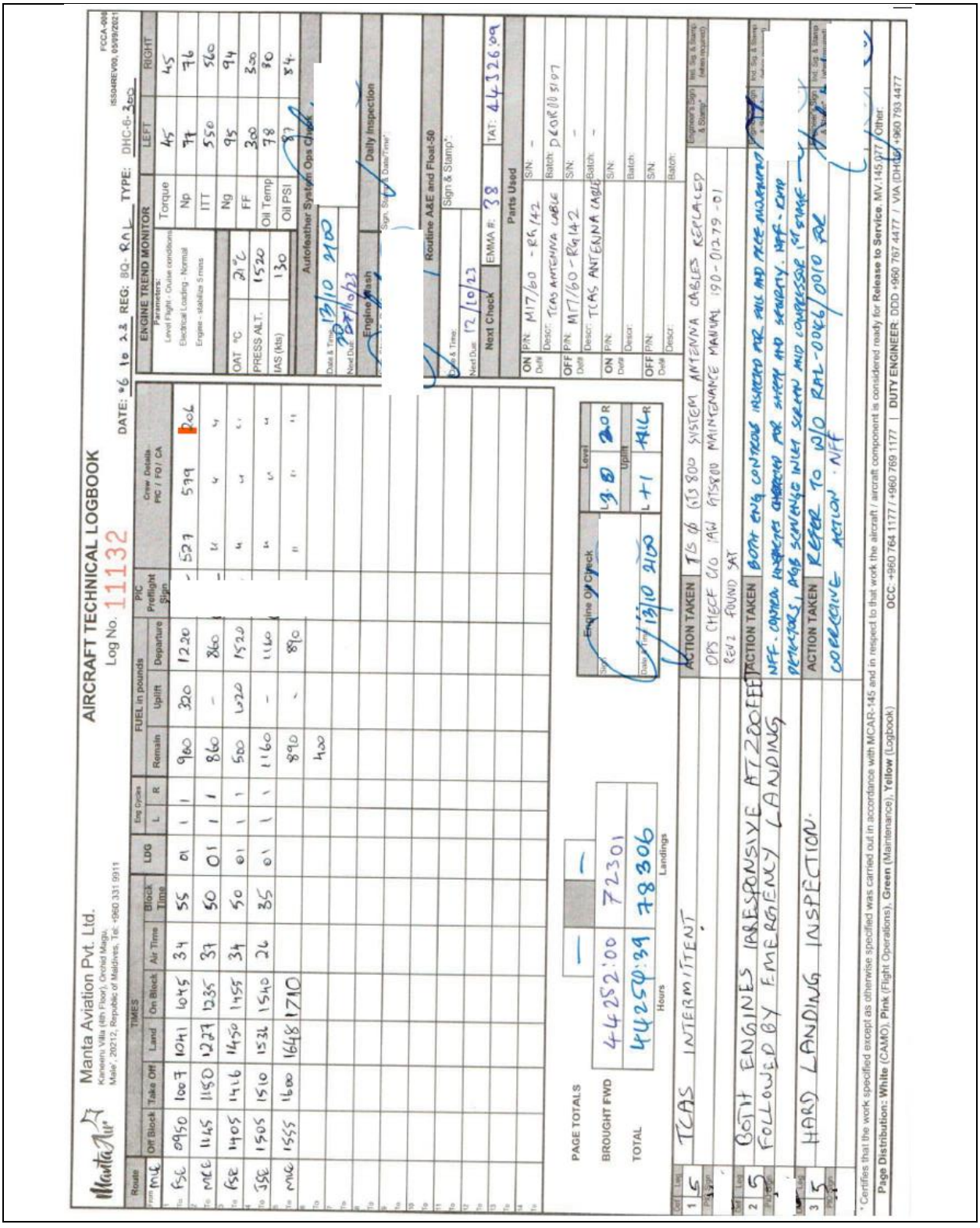
| Approved by | |
|---|---|
| Name | |
| Signature | |

I certify that this aircraft is loaded in accordance with the approved weight and balance schedule. LMC is not allowed on this loadsheet

☐ Non-Standard Passenger weights used

Standard weights used for Passengers and Cabin baggage, unless ticked above.
Actual weights used for checked baggage, Cargo and Other deadloads

## 4.2 ATL showing entries pre and post incident



## 4.3 Woodward report

WOODWARD

**INVESTIGATION/8D REPORT**

Class 1 Published: 12-JUL-2024 (D8)

| | | | |
|---|---|---|---|
| CUSTOMER: MANTA AVIATION PVT. LTD | | | INVESTIGATION NO: 1194855 |
| CUSTOMER ORDER: Crash Investigation | WOODWARD SALES ORDER: 3907740 | | WOODWARD WORK ORDER: C888526 |
| CUSTOMER REJECTION DOCUMENT (CAR, QN, RFA, DMR, ETC.): N/A | WARRANTY DISPOSITION: N/A | | PRODUCT STATUS: N/A |
| PROGRAM/ENGINE TYPE: P&WC PT6 CSU | | ITEM RECEIVED: 8210-304 | ENGINE MFR MODEL RECEIVED: N/A |
| PROGRAM CODE: 83053 CSU | SERIAL NUMBER: 11393795 | ITEM SHIPPED: 8210-304 | ENGINE MFR MODEL SHIPPED: 3075355-01 |
| PARENT ITEM NUMBER: 8210-304 | PARENT ITEM SERIAL NUMBER: 11393795 | FIRST SHIPPED: 21-OCT-1994 | LAST SHIPPED: 21-OCT-1994 |
| CUSTOMER SERIAL NUMBER: N/A | APPLICATION: N/A | VESSEL TYPE & VESSEL NUMBER: N/A | SITE & LOCATION GRID ID: N/A |
| TIME/CYCLES SINCE NEW, OVERHAUL, OR REPAIR: N/A | | | |
| DATE REPORT OPENED: N/A | DATE PART REMOVED: N/A | | DATE RECEIVED: 06-DEC-2023 |

**TEAM MEMBERS (D1)**

Product Engineer: Nathan Bogdonas
Customer Service Rep: Shannon L. Cote

**REASON FOR INVESTIGATION (D2)**

Reported Issue: INCIDENT DETAILS: ON OCTOBER 6, 2023, ABOUT 1643 LOCAL TIME, A TWIN OTTER, REGISTRATION 8Q-RAL OPERATED ON FLOATS WHILST ON APPROACH TO MLE SUFFERED LOSS OF ENGINE POWER ON RH ENGINE AT ABOUT 350 FEET ALTITUDE. THE AIRCRAFT MADE A SUDDEN RIGHT TURN WHICH RESULTED IN THE COCKPIT CREW BEING UNABLE TO CONTROL THE AIRCRAFT AND DECLARED EMERGENCY; BUT MANAGED TO LAND ON WATER. AT TOUCHDOWN, THE AIRCRAFT BOUNCED AND LANDED AGAIN. THE AIRCRAFT WAS CIRCLING ON WATER BEFORE IT FINALLY SETTLED ON WATER. THE CREW THEN SHUT DOWN THE RIGHT HAND ENGINE USING THE FUEL LEVER: SHUTTING OFF THE FUEL TO THE RIGHT HAND ENGINE. THE AIRCRAFT WAS THEN TAXIED WITH THE ASSISTANCE OF THE RESCUE BOAT AND FINALLY DOCKED ON THE FIXED PLATFORM AND THE LEFT ENGINE SHUTDOWN, NORMALLY. THE PASSENGERS DISEMBARKED THROUGH THE MAIN AIRSTAIR DOOR.

**INVESTIGATION SUMMARY (D4)**

Confirmation Text: NOT KNOWN IF REASON FOR INVESTIGATION/RETURN IS CAUSED BY DISCREPANCY FOUND
Discrepant Item Number: 3535-035
Discrepancy: PART IS DAMAGED
Finding: BROKEN/ CRACKED/ FRACTURED/ SEPARATED
Conclusion: An as received visual inspection was conducted on the unit. It was noted that the lockwire, lockwire seal, and torque sealant were all non-Woodward indicating the originals had been removed after leaving the Woodward facility. Additionally, the beta valve braze joint between the plunger and head had separated (see Figure 1). The beta valve head/clevis had dented material on the outside of the prongs (see Figure 2). It was determined that the unit could proceed with testing even with the damaged beta valve.



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Figure 1 Separated Beta Valve Assembly

Figure 2 Beta Valve Clevis Damage



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During the As Received Test all test points were found to be within limits except the following:

"Relief Valve Pressure" was out of limits low at 370 psig (Limits 385 ± 10 psig)
"Maximum Speed Setting" was out of limits low at 4057 rpm (Limits 4246 ± 5 rpm)
"Speed Setting Lever Travel" was out of limits low at 49 degrees (Limits 210 ± 2.5 degrees)
"Maximum RPM" was out of limits low at 4057 rpm (Limits 4032 ± 5 rpm)
"Pump Capacity" was out of limits low at 4.4 qts/min (Limits 5.5 qts/min Minimum)
"Internal Leakage" was out of limits high at 2.7 qts/min (Limits 2.5 qts/min Maximum)
"Beta Valve Travel" could not be run due to beta valve damage.

Testing was repeated and the max speed setting was readjusted back to test limits. The following changes were observed:

Relief Valve Pressure and Maximum Speed Setting test points returned to limits.
The speed setting lever travel was out of limits high at 78 degrees (Limits 73 ± 3 degrees)
The pump capacity increased from 4.4 to 5.4 qts/min (Limits 5.5 qts/min Minimum)
The internal leakage increased from 2.7 to 3.2 qts/min (Limits 2.5 qts/min Maximum)

Following testing the unit was disassembled. The beta valve assembly was removed, The components of the beta valve are designed to be brazed together. The braze operation is performed by Woodward during manufacturing. As a process control, the joints are 100% tested with a 500lb load. On this returned unit it was confirmed that there was separation of the braze joint between the plunger and head (see Figure 3).

Upon further inspection the joint was fully covered in copper braze indicating the braze was properly applied. Additionally, there was no sign of corrosion or other environmental factors that appeared to weaken the joint. The beta valve assembly was bagged and sent to Woodward's materials lab for analysis. The materials lab confirmed there was no signs of corrosion/pitting but found a region with silver/dark gray appearance that was consistent with porosity (see Figure 4). However, the valve allows up to 50% porosity of the internal joint and the region detected was well below the requirement. The materials lab came to the following conclusions "The fracture surface showed predominantly shear overload of the copper braze material in a direction of the long axis of the assembly. Mechanical damage was present on both halves of the assembly which would have been caused by an event which placed a shear load on the braze joint. Composition of components and braze filler metal were all consistent with the specified materials."



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**Figure 3 Beta Valve Seperated**

**Figure 4 Braze Joint Porosity**

During disassembly the governor cover was removed and the ballhead assembly, air bleed system, and pilot valve were all inspected and there were no anomalies. The baseplate was also removed exposing the pump and there were no notable findings.

Following the teardown Woodward engineering reviewed the loads the braze joint could experience during normal operation and determined that the loads are an order of magnitude lower than the 500 lb. load the braze joint is 100% inspected against when manufactured. Additionally, Woodward reviewed engineering change history and the drawing had not been revised since 1992 confirming that there were no recent changes to the beta valve.

In summary, the beta valve was found separated and the braze joint was sent to Woodward's material lab for investigation. The lab determined the cause of the separation was due to a shear overload of the copper braze material. The Woodward team reviewed the operating loads that the joint would be subject to and determined that the loads are an order of magnitude lower than the 500 lb. load the braze joint is 100% inspected against. The braze joint was inspected and no corrosion/pitting was observed that would have reduced the joints structural integrity. Due to these findings, there was no evidence to suggest that the braze joint separated under normal operation, further root cause into the overload event was not isolated during the investigation.

**ROOT CAUSE (D4)**

Origin of Cause: OTHER
General Cause: No Cause Found
Cause: Cause Not Isolated or Determined
Root Cause: The beta valve braze joint was found separated. The braze joint was sent to Woodward's material lab for investigation and the lab determined the cause of the separation was due to a shear overload of the copper braze material. The Woodward team reviewed the operating loads that the joint would be subject to and determined that the loads are an order of magnitude lower than the 500 lb. load the braze joint is 100% inspected against. The braze joint was inspected and no corrosion/pitting was observed that would have reduced the joints structural integrity. Due to these findings there was no evidence to suggest that the braze joint separated under normal operation, further root cause into the overload event was not isolated during the investigation.

**CORRECTIVE ACTION PLAN (D5)**

General Corrective Action: No Action without Additional Customer Input
Specific Corrective Action: No Direct Action, Continue to Monitor

**CORRECTIVE ACTION IMPLEMENTATION (D6)**

Corrective Action Status: NO ACTION



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