# AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | **Reference:** | | CA18/2/3/10350 | |
| **Aircraft Registration** | **ZS-ARC** | **Date of Accident** | 11 July 2023 | | | **Time of Accident** | 0617Z |
| **Type of Aircraft** | Thrush S2R-H80 | | | **Type of Operation** | | Aerial Work - Crop Spraying (Part 137) | |
| **Pilot-in-command Licence Type** | Commercial Pilot Licence (CPL) | | | **Age** | 43 | **Licence Valid** | Yes |
| **Pilot-in-command Flying Experience** | | **Total Flying Hours** | | | 11 044 | **Hours on Type** | 9 924.6 |
| **Last Point of Departure** | Rosenburg Farm, Malmesbury, near Western Cape Province | | | | | | |
| **Next Point of Intended Landing** | Rosenburg Farm, Malmesbury, near Western Cape Province | | | | | | |
| **Damage to Aircraft** | Substantial | | | | | | |

**Location of the accident site with reference to easily defined geographical points (GPS readings if possible)**

Droeivlei Farm, approximately 10km south of Malmesbury at GPS 33°36′59.7″ South 018°42′36.8″ East, at an elevation of 357 feet (ft)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Meteorological Information** | Wind direction: 360°, wind speed: 2 knots, CAVOK, temperature: 3ºC, Dew point 2ºC, QNH 1023 | | | | | | |
| **Number of People On-board** | 1+0 | **Number of People Injured** | 1 | **Number of People Killed** | 0 | **Other (On Ground)** | 0 |

## Synopsis

On Tuesday morning, 11 July 2023 at 0550Z, a pilot on-board a Thrush S2R-H80 aircraft with registration ZS-ARC took off on a crop-spraying mission from Rosenburg Farm in Malmesbury, Western Cape province, to Droeivlei Farm which is approximately 10 kilometres (km) south of Malmesbury in the same province with the intention to return to Rosenburg Farm. The flight was conducted under visual flight rules (VFR) by day and under the provisions of Part 137 of the Civil Aviation Regulations (CAR) 2011 as amended.

The pilot reported that upon arrival at Droeivlei Farm, he commenced with the first crop-spray run on the oats crops. Approximately 27 minutes into the mission, the propeller blades advanced to feathered position without the pilot's input which resulted in the engine power loss. The aircraft could not maintain altitude and the pilot executed a forced landing on the wheat field in a neighbouring farm. Thereafter, the pilot switched off the master switch and disembarked from the aircraft. The undercarriage bumped a soft spot in the soil and collapsed, the left-wing, the propeller blades and the fuselage sustained substantial damage during the forced landing sequence. The pilot sustained minor injuries and was taken to the hospital for medical attention.

The propeller governor system failed which caused the loss of oil pressure to the propeller and thus, feathered, followed by engine power loss and an unsuccessful forced landing.

## Probable Cause/s and/or Contributory Factors

Engine power loss during the crop-spraying mission which led to the execution of an unsuccessful forced landing on a wheatland.

### Contributory Factors

The propeller governor (PG) failed which led to the loss of oil pressure in the propeller control system; this caused the propeller blades to advance to feathered position.

| | | | |
|---|---|---|---|
| SRP Date | 13 August 2024 | Publication Date | 19 August 2024 |

## Occurrence Details

| | |
|---|---|
| **Reference Number** | **:** CA18/2/3/10350 |
| **Occurrence Category** | **:** Category 1 |
| **Type of Operation** | **:** Agricultural Operations (Part 137) |
| **Name of Operator** | **:** Orsmond Aviation (PTY) Ltd |
| **Aircraft Registration** | **:** ZS-ARC |
| **Aircraft Make and Model** | **:** Thrush S2R-H80 |
| **Nationality** | **:** South African |
| **Place** | **:** Droeivlei Farm in Malmesbury, Western Cape Province |
| **Date and Time** | **:** 11 July 2023 at 0617Z |
| **Injuries** | **:** Minor |
| **Damage** | **:** Substantial |

## Purpose of the Investigation

*In terms of Regulation 12.03.1 of the Civil Aviation Regulations (CAR) 2011, 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 liability.*

*All times given in this report are Co-ordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.*

## Investigation Process

The Accident and Incident Investigations Division (AIID) was notified of the occurrence involving a Thrush S2R-H80 aircraft which occurred in Droeivlei Farm in Malmesbury near Cape Town, Western Cape, on 11 July 2023 at 0617Z. The occurrence was classified as an accident according to the CAR 2011 Part 12 and the International Civil Aviation Authority (ICAO) STD Annex 13 definitions. Notifications were sent to the State of Registry, Design and Manufacturer in accordance with the CAR 2011 Part 12 and the ICAO Annex 13 Chapter 4. The State of Design and Manufacturer had appointed a non-travelling accredited representative.

*Notes:*
*1. Whenever the following words are mentioned in this report, they shall mean the following:*
*Accident — this investigated accident*
*Aircraft — the Thrush S2R-H80 involved in this accident*
*Investigation — the investigation into the circumstances of this accident*
*Pilot — the pilot involved in this accident*
*Report — this accident report*

*2. Photos and figures used in this report were taken from different sources and may have been adjusted from the original for the sole purpose of improving clarity of the report. Modifications to images used in this report were limited to cropping, magnification, file compression; or enhancement of colour, brightness, contrast; or addition of text boxes, arrows, or lines.*

## Disclaimer

## Table of Contents

| Abbreviation | Description |
|---|---|
| °C | Degrees Celsius |
| AAII | Air Accidents Investigation Institute of the Czech Republic |
| AD | Airworthiness Directive |
| AGB | Accessory Gear Box |
| AIID | Accident and Incident Investigations Division |
| AMO | Aircraft Maintenance Organisation |
| AMSL | Above Mean Sea Level |
| AOC | Air Operating Certificate |
| CPL | Commercial Pilot Licence |
| CRS | Certificate of Release to Service |
| CVR | Cockpit Voice Recorder |
| EASA | European Union Aviation Safety Agency |
| ELB | Engine Logbook |
| FCU | Fuel Control unit |
| FDR | Flight Data Recorder |
| Ft | Feet |
| GEAC | General Electric54 Aviation Czech |
| GPS | Global Positioning System |
| GT | Generator Turbine |
| GT NGVR | Generator Turbine Nozzle Guide Vane Ring |
| hPa | Hectopascal |
| Km | Kilometres |
| Kt | Knots |
| M | Metres |
| PG | Propeller Governor |
| PT | Power Turbine |
| PT NGVR | Power Turbine Nozzle Guide Vane Ring |
| QNH | Barometric Pressure Adjusted to Sea Level. |
| RGB | Reduction Gear box |
| SACAA | South African Civil Aviation Authority |
| SB | Service Bulletin |
| UTC | Co-ordinated Universal Time |
| VMC | Visual Meteorological Conditions |
| Z | Zulu (Term for Universal Co-ordinated Time – Zero Hours Greenwich) |

## 1. FACTUAL INFORMATION

### 1.1. History of Flight

1.1.1. .On Tuesday morning, 11 July 2023, a pilot on-board a Thrush S2R-H80 aircraft with registration ZS-ARC took off on a crop-spraying mission from Rosenburg Farm in Malmesbury, Western Cape province, to Droeivlei Farm which is approximately 10 kilometres (km) south of Malmesbury near Cape Town in the same province with the intention to return to Rosenburg Farm. Visual meteorological conditions (VMC) by day prevailed at the time of the flight which was conducted under the provisions of Part 137 of the Civil Aviation Regulations (CAR) 2011 as amended.

1.1.2. The previous day, on 10 July 2023, the aircraft tanks were replenished with 24 litres (L) of Jet A1 fuel to reach a total of 863L (full capacity) with an endurance of 4.5 hours. According to the pilot, he completed the pre-flight inspection on the aircraft on the morning of 11 July 2023, and no anomalies were found. The urea fertiliser was loaded in the hopper to spray the oats crops. Thereafter, the pilot took off from Rosenburg Farm and headed to Droeivlei Farm where he commenced with the spray application. During the process, the pilot noticed that the propeller had advanced to a feathered position without his input and that the torque gauge was increasing whilst the engine was losing power. He then pulled the propeller limiter circuit breaker to correct the anomaly but was unsuccessful. He pushed the limiter circuit breaker (CB) back in to override the fuel control unit (FCU), but this also did not correct the anomaly. The engine propeller gearbox is equipped with an electronic chip detector which illuminates (red) in the cockpit if the propeller governor or the propeller gearbox has an anomaly; this allows the pilot to make an operational decision. In this case, the chip detector's red light did not illuminate.

1.1.3. The pilot then decided to conduct a precautionary forced landing in a wheat field on the neighbouring farm. During the landing roll, the undercarriage dug into the soft ground and collapsed. Consequently, the aircraft’s nose pitched down and caused the four-bladed propeller to strike the ground before the aircraft stopped. The pilot sustained minor injuries and was taken to the hospital by the farm owner.

1.1.4. The accident occurred during daylight at Droeivlei Farm approximately 10km south of Malmesbury at Global Positioning System (GPS) co-ordinates determined to be 33°36′59.7″ South 018°42′36.8″ East, at an elevation of 357 feet (ft).


**Figure 1**: The accident site. (Source: Google Earth)


**Figure 2:** The ZS-ARC aircraft post-accident. (Source: Operator)

## 1.2. Injuries to Persons

| Injuries | Pilot | Crew | Pass. | Total On-board | Other |
|---|---|---|---|---|---|
| Fatal | - | - | - | - | - |
| Serious | - | - | - | - | - |
| Minor | 1 | - | - | 1 | - |
| None | - | - | - | - | - |
| **Total** | **1** | **-** | **-** | **1** | **-** |

Note: Other means people on the ground.

## 1.3. Damage to Aircraft

1.3.1. The aircraft sustained substantial damage.


**Figure 3**: The front view of the aircraft at the accident site. (Source: Operator)

## 1.4. Other Damage

1.4.1. None.

## 1.5. Personnel Information

| | | | | | |
|---|---|---|---|---|---|
| Nationality | South African | Gender | Male | Age | 43 |
| Licence Type | Commercial Pilot Licence (CPL) | | | | |
| Licence Valid | Yes | Type Endorsed | Yes | | |
| Ratings | Instrument and Agricultural ratings | | | | |
| Medical Expiry Date | 31 October 2023 | | | | |
| Restrictions | None | | | | |
| Previous Accidents | None | | | | |

Note: Previous accidents refer to past accidents the pilot was involved in, when relevant to this accident.

**Flying Experience:**

| | |
|---|---|
| Total Hours | 11 044 |
| Total Past 24 Hours | 5.7 |
| Total Past 7 Days | 16.6 |
| Total Past 90 Days | 59.6 |
| Total on Type Past 90 Days | 59.6 |
| Total on Type | 9 924.6 |

1.5.1. The pilot was initially issued a Commercial Pilot Licence (CPL) by the Regulator on 16 October 2000. The licence was reissued on 6 June 2023 with an expiry date of 30 June 2024.

1.5.2. The pilot was issued a Class 1 medical certificate on 26 October 2022 with an expiry date of 31 October 2023.

1.5.3. The hours in the table above are extracted from the pilot's logbook which was last updated on 10 July 2023.

1.5.4. A day prior to the accident flight (10 July 2023) the pilot flew the aircraft for 5.7 hours with no anomalies noticed. The accident flight (11 July 2023) was his first load of the day.

## 1.6. Aircraft Information

1.6.1. Thrush S2R-H80 (Source: https://thrushaircraft.com/aircraft/510p)

*The Thrush S2R-H80 has a GE Aviation Czech GE H80-100 engine. The aircraft is fitted with a 4-blade variable pitch Hartzell propeller. It has a 510-gallon hopper and is fitted with an MVP-50P engine monitor. It also has low wings and 228-gallon fuel tanks, as well as light-emitting diode (LED) and strobe lights.*

**Airframe:**

| | | |
|---|---|---|
| Manufacturer/Model | Thrush S2R-H80 | |
| Serial Number | H80-124 | |
| Year of Manufacture | 2013 | |
| Total Airframe Hours (At Time of Accident) | 3 794.8 | |
| Last Inspection (Hours & Date) | 3 789.0 | 5 July 2023 |
| Hours Since Last Inspection | 5.8 | |
| CRS Issue Date | 8 July 2023 | |
| C of A (Issue Date & Expiry Date) | 6 September 2013 | 30 September 2023 |
| C of R (Issue Date) (Present Owner) | 5 September 2013 | |
| Type of Fuel Used | Jet A1 | |
| Operating Category | Agricultural Operations (Part 137) | |
| Previous Accidents | None | |

Note: Previous accidents refer to past accidents the aircraft was involved in, when relevant to this accident.

**Engine:**

| | |
|---|---|
| Manufacturer/Model | GE Aviation Czech / H80-100 |
| Serial Number | 181007 |
| Part Number | Unknown |
| Hours Since New | 1 295.4 |

| | |
|---|---|
| Hours Since Overhaul | Time between overhaul (TBO) not yet reached – TBO is 3 600 hours |

**Propeller:**

| | |
|---|---|
| Manufacturer/Model | Hartzell HC-B4TW-3 |
| Serial Number | QVA139 |
| Part number | HC-B4TW-3 |
| Hours Since New | 1 295.4 |
| Hours Since Overhaul | 843.8 (TBO is 3 000 hours) |

1.6.2. According to available information, the aircraft was first registered to the present owner on 5 September 2013. The latest Certificate of Release to Service (CRS) was reissued on 8 July 2023 with an expiry date of 7 July 2024 or at 3 889.0 airframe hours, whichever occurs first.

1.6.3. A new engine and propeller were installed in the airframe on 30 September 2021 as the engine had to be sent to the manufacturer for repairs.

1.6.4. According to the engine manufacturer, the engine gearbox is equipped with a chip detector which activates (illuminating a red light) in the cockpit to indicate to the pilot that there is an anomaly. The pilot stated that the chip detector's red light did not illuminate.

1.6.5. The engine manufacturer reported that in some cases, propeller speed fluctuations would be reported by operators before the propeller governor fails. In other cases, there would be a chip detector warning. However, there would be instances with none of the stated indicators.

1.6.6. According to the certificate relating to the maintenance of an aircraft, the chip signals were inspected at a 300-hour engine inspection on 30 June 2023; they were found in satisfactory condition.

1.6.7. The propeller governor is maintained during engine overhaul (3 600 hours TBO), it is also checked for condition during operation/engine runs.

## 1.7. Meteorological Information

1.7.1. The weather information below was obtained from the Meteorological Aerodrome Report (METAR) that was issued by the South African Weather Service (SAWS), recorded at Cape Town International Airport (FACT) on 11 July 2023 at 0600Z. FACT is located 54km from the accident site.

| | | | | | |
|---|---|---|---|---|---|
| Wind Direction | 030° | Wind Speed | 4kts | Visibility | 10km |
| Temperature | 3°C | Cloud Cover | None | Cloud Base | Clear |
| Dew Point | 2°C | QNH | 1038 hPa | | |

1.7.2 According to the weather report, the weather was ceiling and visibility okay (CAVOK). When the weather is CAVOK, it means that visibility is good, there are no significant weather phenomena, and the cloud base is above 5000 feet above mean sea level (AMSL). The absence of significant weather phenomena suggests that the aircraft was not affected by any adverse weather conditions that could have impacted the safety of the flight.

### 1.8. Aids to Navigation

1.8.1. The aircraft was equipped with standard navigational equipment as approved by the Regulator (SACAA). There were no records indicating that the navigational system was unserviceable prior to the flight.

### 1.9. Communication

1.9.1. The aircraft was equipped with a standard communication system as approved by the Regulator. There were no recorded defects with the communication system prior to the flight.

### 1.10. Aerodrome Information

1.10.1 The accident did not occur at or near an aerodrome; it occurred approximately 10km south of Malmesbury, Western Cape province.

### 1.11. Flight Recorders

1.11.1. The aircraft was neither equipped with a flight data recorder (FDR) or a cockpit voice recorder (CVR), nor was it required by regulation to be fitted to the aircraft type.

### 1.12. Wreckage and Impact Information

1.12.1. The aircraft impacted the ground with its tail wheel and skidded approximately 20 metres (m) during which the main landing gears broke and collapsed as they dug into the soft soil. The propeller impacted the ground before the aircraft stopped; it faced north when it rested. The left wing sustained substantial damage. The right wing and the tailwheel had remained intact.

**Figure 4:** The path created by the aircraft's wheels in the wheat field. (Source: Operator)

**Figure 5**: The front view of the broken right main gear. (Source: Operator)


**Figure 6:** Rear view of the right-wing trailing edge and right main gear. (Source: Operator)

## 1.13. Medical and Pathological Information

1.13.1. None.

## 1.14. Fire

1.14.1. There was no evidence of a pre- or post-impact fire.

### 1.15. Survival Aspects

1.15.1. The accident was considered survivable as the aircraft's cabin remained intact. The pilot had used a safety harness during the flight.

### 1.16. Tests and Research

1.16.1 On 17 July 2023, the aircraft was recovered to a hangar in Malmesbury. The engine, a GE Aviation Czech GE-H80-100 model with serial number 181007, was removed from the airframe on 19 June 2023. The operator took pictures of the engine before he sent the engine to the manufacturer, GE Aviation Czech in Prague, Czech Republic (see Figure 7 below). The external condition of the engine showed no abnormalities, cracks or deformation. However, the operator reported that they were unable to rotate the propeller shaft by hand.

1.16.2 The engine reached Prague on 30 August 2023.

**Figure 7:** The engine before it was removed from the shipping container. (Source: engine manufacture)

1.16.3 The engine tear-down inspection was conducted from 31 August 2023 to 1 September 2023 in the presence of the operator's accredited representatives, Avia Propeller, as well as the Air Accidents Investigation Institute (AAII) from the Czech Republic. The engine was in good condition with no visible damage.

1.16.4 The main oil filter and its cavity were contaminated with debris. The auxiliary gearbox (AGB) magnetic plug was contaminated with magnetic debris. The AGB chip detector and AGB chip detector screen were contaminated with debris (See Figure 8).

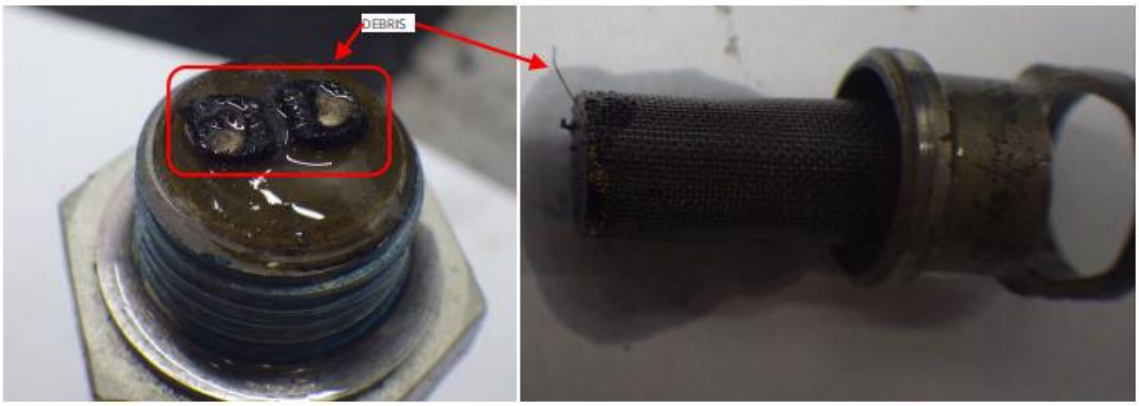


**Figure 8:** The auxiliary gearbox chip detector and chip detector screen. (Source: Engine manufacturer)

1.16.5 The reduction gearbox (RGB) chip detector was contaminated with debris (See Figure 9).

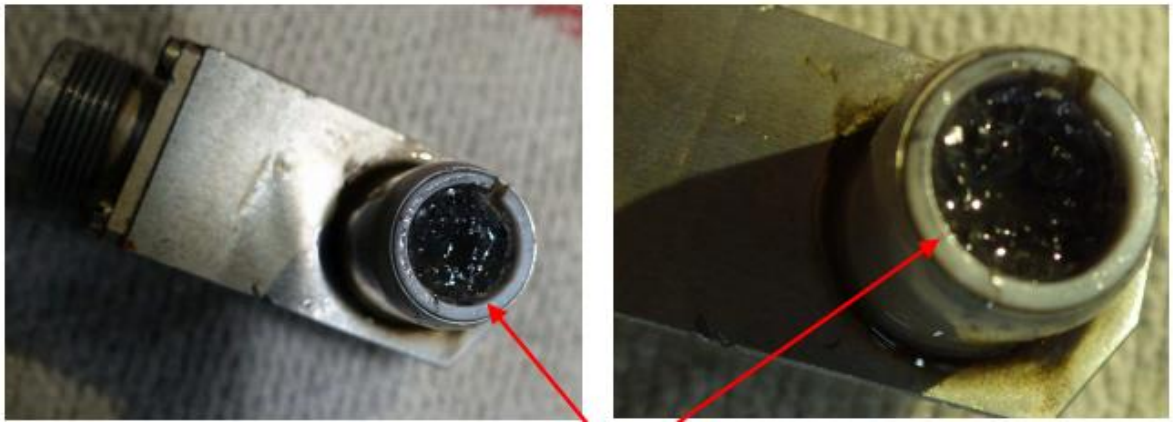

**Figure 9:** RGB Chip detector with arrows pointing to debris. (Source: Engine manufacturer)

1.16.6 Debris was observed around the oil control channel in the propeller shaft which connects the oil pressure from the propeller governor to the propeller (see Figure 10).

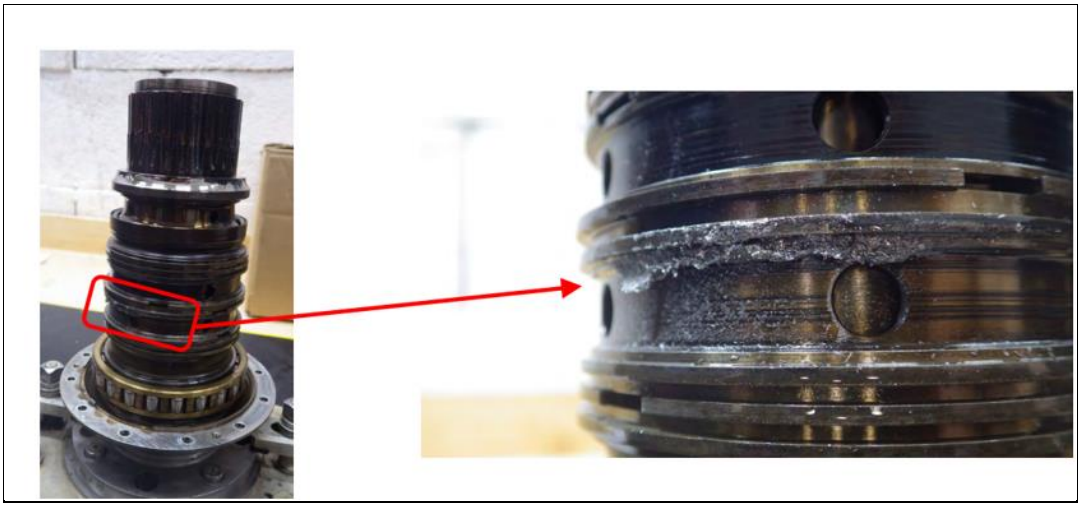

**Figure 10:** Propeller governor drive shaft assembly shows debris on the oil control channel. (Source: Engine manufacturer)

1.16.7 The propeller governor drive shaft is designed to shear during overload to avoid damaging the gears in the reduction gearbox (RGB) when the rotation of the propeller governor is blocked. The propeller governor drive shaft did not shear as designed, but it was damaged, which contributed to the damage of the gears in the RGB after the propeller governor had stopped operating (see Figure 11).

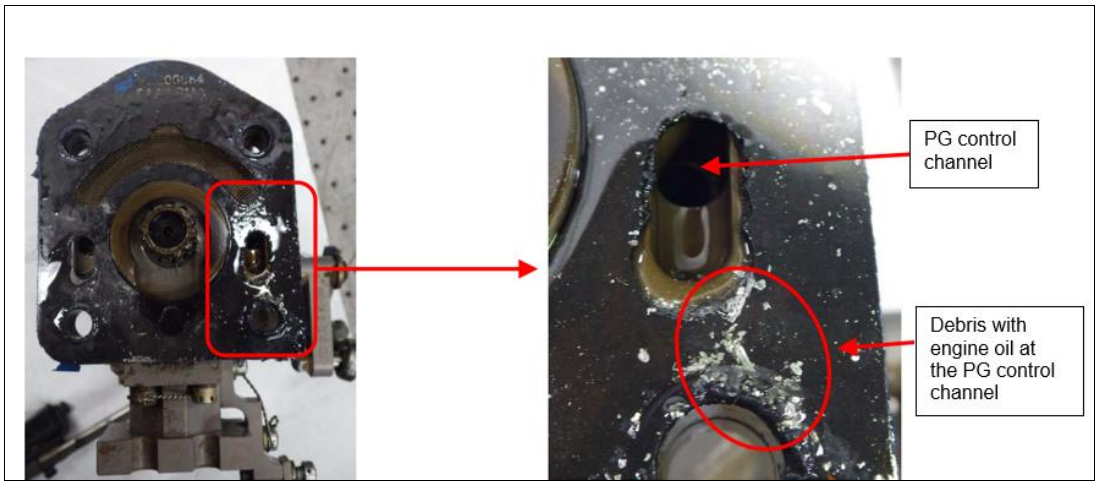


**Figure 11:** The propeller governor flange and gasket after the removal of the propeller governor. (Source: Engine Manufacturer)

1.16.8 The idler gear of the gear pump was misaligned due to the destruction of the gear pump's idler gear needle bearing. The misalignment caused excessive rubbing and damage to the body and cover of the gear pump (see Figure 12 below).

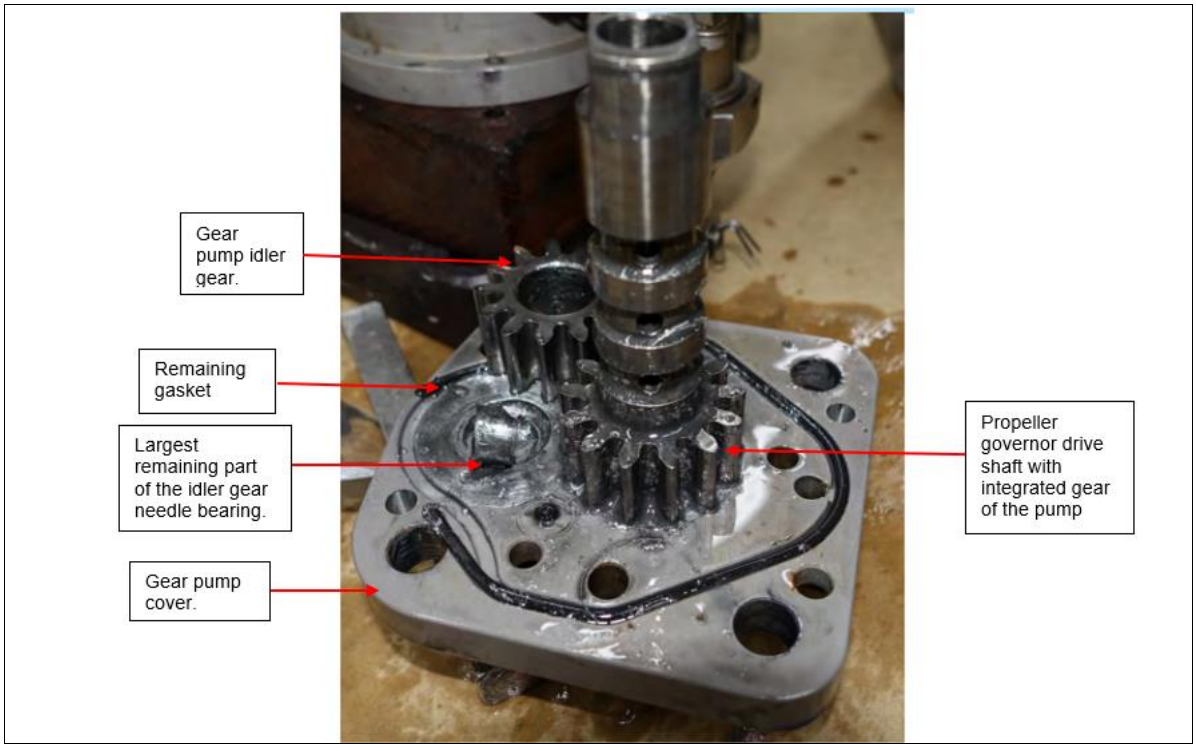


**Figure 12:** The disassembled propeller governor gear pump. (Source: Engine Manufacturer)

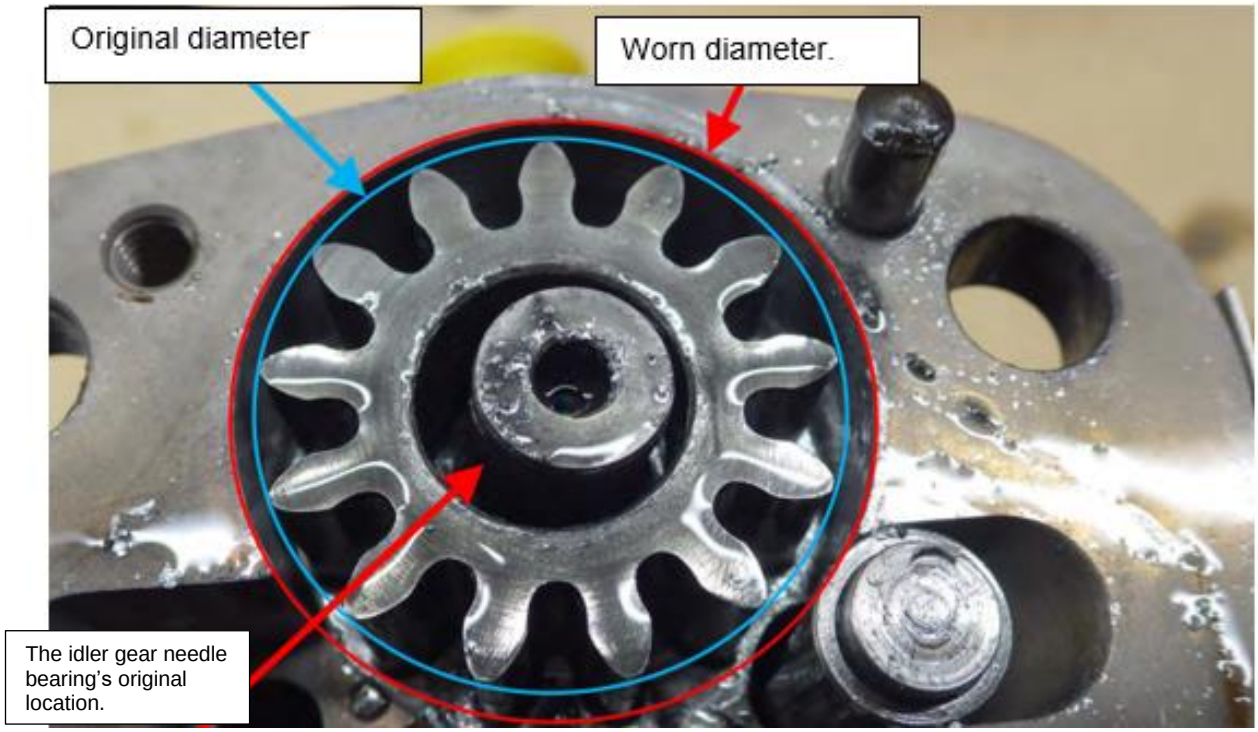


**Figure 13**: The damaged propeller governor gear pump body.

1.16.9 The engine lost oil pressure to the propeller control system which caused the propeller blades to advance to feathered position. This was due to the damaged propeller governor which had not been replaced at the time according to the required airworthiness directive (AD). European Union Aviation Safety Agency (EASA) issued the AD on 1 December 2022, which was effective from 15 December 2022 with compliance within 40 months. The AD mandated the replacement of the propeller governors P-W11-1 with P-W11-4, and P-W11-2 with P-W11-5 on single-engine applications by the end of March 2026. The damaged propeller governor debris increased friction in the propeller governor, propeller shaft, RGB scavenges and torque meter pump.

1.16.10 However, the increased axial movement in the propeller shaft did not contribute to the accident. The impact of the propeller on the ground may have caused the power turbine blades to rub against the PT nozzle guide vane ring, preventing the propeller shaft from rotating freely when the engine was fully assembled.

1.16.11 The propeller governor manufacturer also performed a separate investigation. The propeller governor report stated that there was contamination in the needle-bearing race, which led to the crack on the cage or idler gear-bearing needle, and thus, the damage to the bearing. This damage caused the idler to move out of the axis which caused misalignment. As a result, the pin was bent, and the governor body and the relief valve were damaged. This misalignment caused the teeth of the drive shaft and idler to jam, creating a shock load.

1.16.12 The operator had performed and recorded all the required maintenance, recommended Service Bulletins (SBs)and mandatory ADs on the engine, except for the AD (EASA_AD_2022-0234_1) that required replacement to the propeller governor in the engine, which was not yet conducted (compliance period for the PG replacement is March 2026).

1.16.13 The damage to the propeller governor caused loss of oil pressure to the propeller control system, which then caused the propeller blades to advance to the feathered position. Additionally, the propeller governor debris increased friction of the propeller governor, propeller shaft, RGB scavenge and torque meter.

### 1.17. Organisational and Management and Torque

1.17.1. The flight was conducted in accordance with the provisions of Part 137 (Agricultural Operations) of the CAR 2011 as amended.

1.17.2. The aircraft maintenance organisation (AMO) which conducted the last maintenance inspection on the aircraft prior to the accident flight had an AMO approval certificate that was issued by the Regulator on 17 August 2022 with an expiry date of 31 August 2023.

1.17.3. The Air Operating Certificate (AOC) was issued to the operator on 27 June 2023 with an expiry date of 30 June 2024. The ZS-ARC aircraft was endorsed on the operator's operations specifications.

### 1.18. Additional Information

1.18.1. None.

### 1.19. Useful or Effective Investigation Techniques

1.19.1. None.

## 2. ANALYSIS

### 2.1. General

From the available evidence, the following analysis was made with respect to this accident. This shall not be read as apportioning blame or liability to any organisation or individual.

## 2.2. Analysis

2.2.1 The Regulator issued the pilot a Commercial Pilot Licence (CPL) on 16 October 2000 in accordance with Part 61 of the South African CAR 2011; an agricultural rating was endorsed on his licence. The licence was revalidated on 6 June 2022 with an expiry date of 30 June 2024. The pilot was issued a Class 1 medical certificate on 26 October 2022 with an expiry date of 31 October 2023.

During the first crop-spraying detail, the propeller advanced to a feathered position without the pilot's inputs, and the torque decreased which resulted in engine power loss. Consequently, the pilot executed a forced landing on a ploughed field. The aircraft skidded approximately 20m before it came to a stop. The main landing gears failed, the propeller blades struck the ground, and the left wing sustained substantial damage.

2.2.2 The AMO which conducted the last maintenance inspection on the aircraft had an approved AMO Certificate that was issued by the Regulator on 17 August 2022 with an expiry date of 31 August 2023. The last MPI on the aircraft was conducted on 5 July 2023 at 3 789.0 airframe hours. The aircraft was issued a CRS on 8 July 2023 with an expiry date of 7 July 2024 or at 3 889.0 hours, whichever occurs first.

2.2.3 The operator was last audited by the Regulator on 23 June 2023, and the AOC was issued on 27 June 2023 with an expiry date of 30 June 2024. The ZS-ARC aircraft was endorsed on the operator's operations specifications.

2.2.4 After the accident, the engine was sent to the manufacturer for a teardown examination. The engine was found in good condition with no visible damage. Based on the engine teardown examination report (see Appendix 5.1), the damage in the propeller governor caused the engine to lose oil pressure to the propeller control system, which caused the propeller blades to advance to a feathered position. This was due to damage to the propeller governor which had not yet been replaced as per the relevant AD. The propeller governor debris increased friction in the propeller governor, propeller shaft, RGB scavenge and torque meter pump. However, the increased axial play in the propeller shaft did not contribute to the accident. The impact of the propeller on the ground may have caused the power turbine blades to rub against the PT nozzle guide vane ring, which prevented the propeller shaft from rotating freely when the engine was fully assembled.

2.2.5 The propeller governor manufacturer performed a separate investigation which revealed contamination in the needle bearing race. This caused a crack in the cage or bearing needle, and thus, damaged the bearing. Moreover, this damage caused the idler to move out of the axis and,

thus, the resultant misalignment. The pin bent and both the governor body and the relief valve were damaged. The misalignment also caused the teeth of the drive shaft and idler to jam, which created a shock load.

2.2.6 The engine propeller gearbox is equipped with an electronic chip detector which activates (red light) to alert the pilot in the cockpit if there is an anomaly with the propeller governor or the propeller gearbox; this allows the pilot to make an operational decision. The pilot stated that the chip detector's warning light did not illuminate in the cockpit. In some cases, there are chip detector warnings, and in others, there are none. If the chip detector light had illuminated in the cockpit it would have given the pilot a chance to make an operational decision before the propeller governor failure.

2.2.7 According to EASA AD No.2022-0234, the propeller governor (P-W11-1) was to be replaced with a plain bearing in a new type of propeller governor P-WI 1-4 (see appendix 5.2). Based on the information provided, the operator had performed and recorded all the required maintenance, recommended SBs and ADs on the engine except for the AD (EASA_AD_2022-0234_1) that required replacement to the propeller governor in the engine, which was not yet conducted. The compliance period for the PG replacement is March 2026.

2.2.8 The prevailing weather conditions at the time of the accident were considered not a factor.

## 3. CONCLUSION

### 3.1. General

From the available evidence, the following findings, causes and contributing factors were made with respect to this accident. These shall not be read as apportioning blame or liability to any organisation or individual.

To serve the objective of this investigation, the following sections are included in the conclusion heading:

- **Findings —** are statements of all significant conditions, events, or circumstances in this accident. The findings are significant steps in this accident sequence, but they are not always causal or indicate deficiencies.
- **Causes —** are actions, omissions, events, conditions, or a combination thereof, which led to this accident.
- **Contributing factors —** are actions, omissions, events, conditions or a combination thereof, which, if eliminated, avoided or absent, would have reduced the probability of the accident occurring, or would have mitigated the severity of the consequences of the accident. The identification of contributing factors does not imply the assignment of fault or the determination of administrative, civil, or criminal liability.

### 3.2. Findings

3.2.1 The pilot was issued a Commercial Pilot Licence (CPL) on 16 October 2000 by the Regulator in accordance with Part 61 of the South African CAR 2011; an agricultural rating was endorsed on the pilot's licence. The licence was revalidated on 6 June 2022 with an expiry date of 30 June 2024.

3.2.2 The pilot was issued a Class 1 medical certificate on 26 October 2022 with an expiry date of 31 October 2023.

3.2.3 The latest update on the flight folio was inputted on 10 July 2023, a day before the accident flight.

3.2.4 The AMO which conducted the last maintenance inspection on the aircraft had an approved AMO certificate that was issued by the Regulator on 17 August 2022 with an expiry date of 31 August 2023.

3.2.5 The last mandatory periodic inspection (MPI) conducted on the aircraft was on 5 July 2023 at 3 789.0 airframe hours. The aircraft was issued a CRS on 8 July 2023 with an expiry date of 7 July 2024 or at 3 889.0 hours, whichever occurs first.

3.2.6 The operator was last audited by the Regulator on 23 June 2023, and the AOC was issued on 27 June 2023 with an expiry date of 30 June 2024. The ZS-ARC aircraft was endorsed on the operator's operations specifications.

3.2.7 The propeller governor failed due to contamination in the needle-bearing race which caused complete bearing damage and misalignment. This resulted in the idler moving out of the axis which caused misalignment, and thus, the pin bent and both the governor body and the relief valve were damaged. The misalignment also caused the teeth of the drive shaft and idler to jam, which created a shock load.

3.2.8 The engine lost oil pressure to the propeller control system because of the damage to the propeller governor which caused the propeller blades to advance to feathered position. This was due to the damage to the propeller governor which had not yet been replaced in accordance with the required AD.

3.2.9 The engine propeller gearbox electronic chip detector light which warns the pilot in the cockpit of the propeller governor or the propeller gearbox anomaly did not activate. The pilot did not have prior warning of the imminent failure of the propeller governor.

3.2.10 According to EASA AD No.2022-0234, the propeller governor (P-W11-1) was to be replaced with a plain bearing in a new type of propeller governor (P-WI 1-). The propeller governor in the engine was not yet conducted. The compliance period for the PG replacement is March 2026.

3.2.11 Clear weather conditions prevailed at the time of the flight.

### 3.3. Probable Cause/s

3.3.1 The engine lost power during the crop-spraying detail which resulted in an unsuccessful forced landing on a ploughed field.

### 3.4. Contributory Factor/s

3.4.1 The propeller governor (PG) failed which led to the loss of oil pressure in the propeller control system; this caused the propeller blades to advance to a feathered position.

## 4. SAFETY RECOMMENDATIONS

### 4.1. General

The safety recommendations listed in this report are proposed according to paragraph 6.8 of Annex 13 to the Convention on International Civil Aviation and are based on the conclusions listed in heading 3 of this report. The AIID expects that all safety issues identified by the investigation are addressed by the receiving States and organisations.

### 4.2. Safety Recommendation/s or message

4.2.1 None.

## 5. APPENDICES

5.1. Appendix 1: Engine tear-down report summary.
5.2. Appendix 2: 5.2 AD (EASA_AD_2022-0234_1

**This report is issued by:**
**Accident and Incident Investigations Division**
**South African Civil Aviation Authority**
**Republic of South Africa**

**Appendix 1**

# INVESTIGATION REPORT

| | | | |
|---|---|---|---|
| **Jurisdiction** | Commerce Dept. | **Czech Republic (CZ)** | N/A |
| **ECCN/ITAR Designation** | NLR 9E991 | **CZ Military** | N/A |
| **Export License** | N/A | **EU Dual Use** | NLR |

## 181007 H80-100| GEAC-841 | TOR-000194 | Thrush | H80-100 | Power loss and forced landing | South Africa | Orsmond Aerial Spray

IR-000330/02

## Summary


**Findings:**
No significant damage or deformation of any engine part was visually observed, except one of the Engine Mount Bolts and RGB Idler Gear.
Increased Propeller Shaft axial play was observed.
Substantial debris contamination of the whole Engine Oil System was observed.
The damaged Propeller Governor was the initial source of the magnetic and non-magnetic debris which was observed in the engine oil system.
The Propeller Governor manufacturer performed a separate investigation, report with details about the Propeller Governor is attached, see Attachment no. 2.

**Conclusion:**
The operator has performed and recorded all required maintenance, recommended Service Bulletins and mandatory Airworthiness Directives on the engine – except an effective AD (EASA_AD_2022-0234_1) to the Propeller Governor installed on this engine, which was not yet accomplished (compliance time for the PG replacement is due in April 2026).
MVP-50T Engine Data analysis showed Propeller Speed drop and Engine Torque rise before the impact while other engine parameters remained stable – refer to Engine Data Analysis in this Report.
The damage of the Propeller Governor caused the loss of oil pressure for the Propeller control system, this caused the Propeller blades moving into feather position.
Additionally, the debris contaminants from the damaged Propeller Governor caused the increased friction of the Propeller Governor, Propeller Shaft and RGB Scavenge + Torquemeter Pump.
The increased Propeller Shaft axial play did not contribute to the event.
The impact of the Propeller with ground likely caused the rubbing of the Power Turbine Blades with the PT Nozzle Guide Vane Ring and that was the reason why the Propeller Shaft did not rotate freely in fully assembled engine condition.

**NOTE:** Corrective action available, see EASA_AD_2022-0234_1. Corresponding ASB-000411 introduces new models of Propeller Governor P-W11-4 and P-W11-5 and provides instruction for replacement of Propeller Governors P-W11-1 with P-W11-4 and P-W11-2 with P-W11-5 for single engine application, see Attachment no. 3. EASA AD issued on 15th December 2022 with compliance time of 40 months.

**Appendix 2**



European Union Aviation Safety Agency

# Airworthiness Directive

**AD No.: 2022-0234**

**Issued: 01 December 2022**

Note: This Airworthiness Directive (AD) is issued by EASA, acting in accordance with Regulation (EU) 2018/1139 on behalf of the European Union, its Member States and of the European third countries that participate in the activities of EASA under Article 129 of that Regulation.

This AD is issued in accordance with Regulation (EU) 748/2012, Part 21.A.3B. In accordance with Regulation (EU) 1321/2014 Annex I Part M.A.301, or Annex Vb Part ML.A.301, as applicable, the continuing airworthiness of an aircraft shall be ensured by accomplishing any applicable ADs. Consequently, no person may operate an aircraft to which an AD applies, except in accordance with the requirements of that AD, unless otherwise specified by the Agency [Regulation (EU) 1321/2014 Annex I Part M.A.303, or Annex Vb Part ML.A.303, as applicable] or agreed with the Authority of the State of Registry [Regulation (EU) 2018/1139, Article 71 exemption].

**Design Approval Holder's Name:**
GE AVIATION CZECH s.r.o.

**Type/Model designation(s):**
M601, H75, H80 and H85 engines

Effective Date: 15 December 2022
TCDS Number(s): EASA.E.070
Foreign AD: Not applicable
Supersedure: None

## ATA 76 – Engine Controls – Propeller Governor – Replacement

**Manufacturer(s):**
GE Aviation Czech (GEAC) s.r.o., formerly Walter Engines a.s.

**Applicability:**
M601E-11AS, M601E-11S, M601FS, H75-100, H80-100 and H85-100 engines, all serial numbers, when installed on single-engine aeroplanes.

These engines are known to be installed on, but not limited to, Air Tractor AT-400 and AT-500 series; Allied Ag Cat Productions Inc. (formerly Grumman) G-164 series; and Thrush Aircraft (formerly Quality, Ayres, Rockwell) 510G and S-2R series.

**Definitions:**
For the purpose of this AD, the following definitions apply:

**The ASB**: GEAC Alert Service Bulletin (ASB) SB-M601F-76-00-00-0071, SB-M601E-76-00-00-0121, SB-H85-76-00-00-0052, SB-H75-76-00-00-0063 and SB-H80-76-00-00-0108, as applicable (issued as a single document).

**Affected part**: Propeller governors, having Part Number (P/N) P-W11-1 or P/N P-W11-2.

**Serviceable part**: Propeller governors, having P/N P-W11-4 or P/N P-W11-5.

**Groups**: Group 1 are engines having an affected part installed. Group 2 are all engines which are not Group 1.

**Reason:**

Occurrences were reported of multiple needle bearing failures, installed in the affected part. Further investigation revealed that those failures were caused by needle bearing debris self-generation, which led to oil contamination.

This condition, if not corrected, could lead to loss of propeller control oil pressure, possibly resulting in an engine failure and consequent reduced control of, and damage to, the aeroplane.

To address this potential unsafe condition, GEAC developed a new design propeller governor, and issued the ASB, as defined in this AD, providing replacement instructions.

For the reason described above, this AD requires replacement of affected parts for engines installed on single-engine aeroplanes. This AD also prohibits (re)installation of affected parts.

**Required Action(s) and Compliance Time(s):**

Required as indicated, unless accomplished previously:

**Replacement**:

(1) For Group 1 engines: Within 40 months after the effective date of this AD, replace the affected part with a serviceable part, in accordance with the instructions of the ASB.

**Part(s) Installation**:

(2) Do not install an affected part on any engine, as required by paragraph (2.1) or (2.2) of this AD, as applicable.

(2.1) For Group 1 engines: After replacement as required by paragraph (1) of this AD.

(2.2) For Group 2 engines: From the effective date of this AD.

**Ref. Publications:**

GEAC ASB SB-M601F-76-00-00-0071, SB-M601E-76-00-00-0121, SB-H85-76-00-00-0052, SB-H75-76-00-00-0063 and SB-H80-76-00-00-0108 (issued as a single document) original issue dated 11 August 2022.

The use of later approved revisions of the above-mentioned document is acceptable for compliance with the requirements of this AD.

**Remarks:**

1. If requested and appropriately substantiated, EASA can approve Alternative Methods of Compliance for this AD.

2. This AD was posted on 25 October 2022 as PAD 22-144 for consultation until 22 November 2022. No comments were received during the consultation period.

3. Enquiries regarding this AD should be referred to the EASA Safety Information Section, Certification Directorate. E-mail: ADs@easa.europa.eu.

4. Information about any failures, malfunctions, defects or other occurrences, which may be similar to the unsafe condition addressed by this AD, and which may occur, or have occurred on a product, part or appliance not affected by this AD, can be reported to the EU aviation safety reporting system. This may include reporting on the same or similar components, other than those covered by the design to which this AD applies, if the same unsafe condition can exist or may develop on an aircraft with those components installed. Such components may be installed under an FAA Parts Manufacturer Approval (PMA), Supplemental Type Certificate (STC) or other modification.

5. For any question concerning the technical content of the requirements in this AD, please contact: GE Aviation Czech, Beranových 65, 199 02 Praha 9 – Letňany, Czech Republic, Telephone: +420 222 538 999, Website: https://www.geaviation.cz/customer-support, E-mail: tp.ops@ge.co.