



⁽¹⁾Equipped with
a Continental
engine IO-550-N.

⁽²⁾Except where
otherwise indicated
times in this
report are local.

Accident to the Cirrus SR22⁽¹⁾ registered **N19BV** on 16 May 2016 at Ailly sur Somme (Somme)

Time	At 13:03 ⁽²⁾
Operator	Private
Type of flight	Non-Commercial Operations, pleasure, cross country
Persons on board	Pilot and one passenger
Consequences and damage	Pilot and passenger seriously injured, aeroplane destroyed

This is a courtesy translation by the BEA of the Report on the Safety Investigation. As accurate as the translation may be, the original text in French is the work of reference.

Decrease in engine power in cruise, activation of emergency parachute, collision with ground

1 - HISTORY OF THE FLIGHT

The pilot is the owner of the aeroplane. Accompanied by his wife, he took off at 10:50 from Belle-Ile-en-Mer airport (Morbihan) for a VFR flight bound for Lille Lesquin airport (Nord). At 12:43, in the vicinity of the Bay of the Somme (point^② of Figure 2), the pilot started manoeuvres and descended from flight level (FL) 075 to 1,400 ft.

After crossing the Somme (point^③ of Figure 2), the pilot started a right turn and headed towards Amiens (Somme). At 12:59 (point^④ of Figure 2), the pilot made several turns in descent. Shortly afterwards, a witness on the ground saw the aeroplane pass at a low height with the emergency parachute deployed. The aeroplane struck the ground at 13:03.

2 - ADDITIONAL INFORMATION

2.1 Examination of site and wreckage

The aeroplane wreckage was orientated 180° in a large, obstacle-free field, suitable for a precautionary landing.

The absence of scars in the vegetation indicates a high vertical component. The damage observed indicates that the aircraft came into contact with the ground with a reduced horizontal speed and a nose-down attitude.

The aeroplane's emergency parachute was found deployed to the rear of the aeroplane. On a Cirrus, the first consequence of activating the emergency parachute is to slow down the aeroplane and apply a high nose-down attitude. Then, as it is deployed, the lateral straps of the parachute put the aeroplane into a level attitude. The lateral straps of the emergency parachute were found partially deployed on the left side (see Figure 1). This seems to indicate that the aeroplane had not yet recovered a level attitude on its collision with the ground.



Source: BEA

Figure 1: lateral strap of emergency parachute on left side

A large quantity of oil from the engine was observed on all of the fuselage, including the canopy. This oil release occurred in flight. The engine was removed for additional examinations.

The examination of the aeroplane did not reveal any malfunction likely to impair its controllability.

2.2 Witness statements

The pilot and his wife explained that the flight had been proceeding normally with good meteorological conditions. Shortly before the Bay of the Somme, the pilot had noticed a line of clouds. He carried out manoeuvres to drop height and pass under the cloud layer.

The pilot explained that he then saw a warning light indicating a battery problem⁽³⁾. He first thought that he would be able to reach the planned destination but quickly decided to divert to Amiens where he knew he could easily get a repair done. He was at this point manoeuvring close to Abbeville airport, which he knew well, but he did not envisage diverting to it as he thought he would be able to extend the flight and knew that a repair there would be difficult.

The pilot and his wife explained that at one point the power delivered by the engine decreased as they were approaching Amiens. Then the engine "stopped" forcing them to carry out an off-field emergency landing.

⁽³⁾The recommendation in the manufacturer's documentation is to: "Land as soon as practical."

The pilot was seriously injured. He and his wife have no memory of the sequence which immediately preceded the accident. The pilot was acquainted with the emergency parachute operation procedures and knew that it must not be used at low height. He cannot explain its activation and cannot remember activating it.

His wife is not a pilot although she was used to flying with her husband in this aeroplane. She has no memory of her husband activating the emergency parachute.

2.3 Examination of computers

The aeroplane was equipped with an Avidyne EX5000 avionics suite composed of a PFD (Primary Flight Display) to display the flight parameters and a MFD (MultiFunction Display) to display the engine parameters.

The PFD does not record data. The MFD records numerous flight and engine parameters. The flight of the day of the accident was recorded.

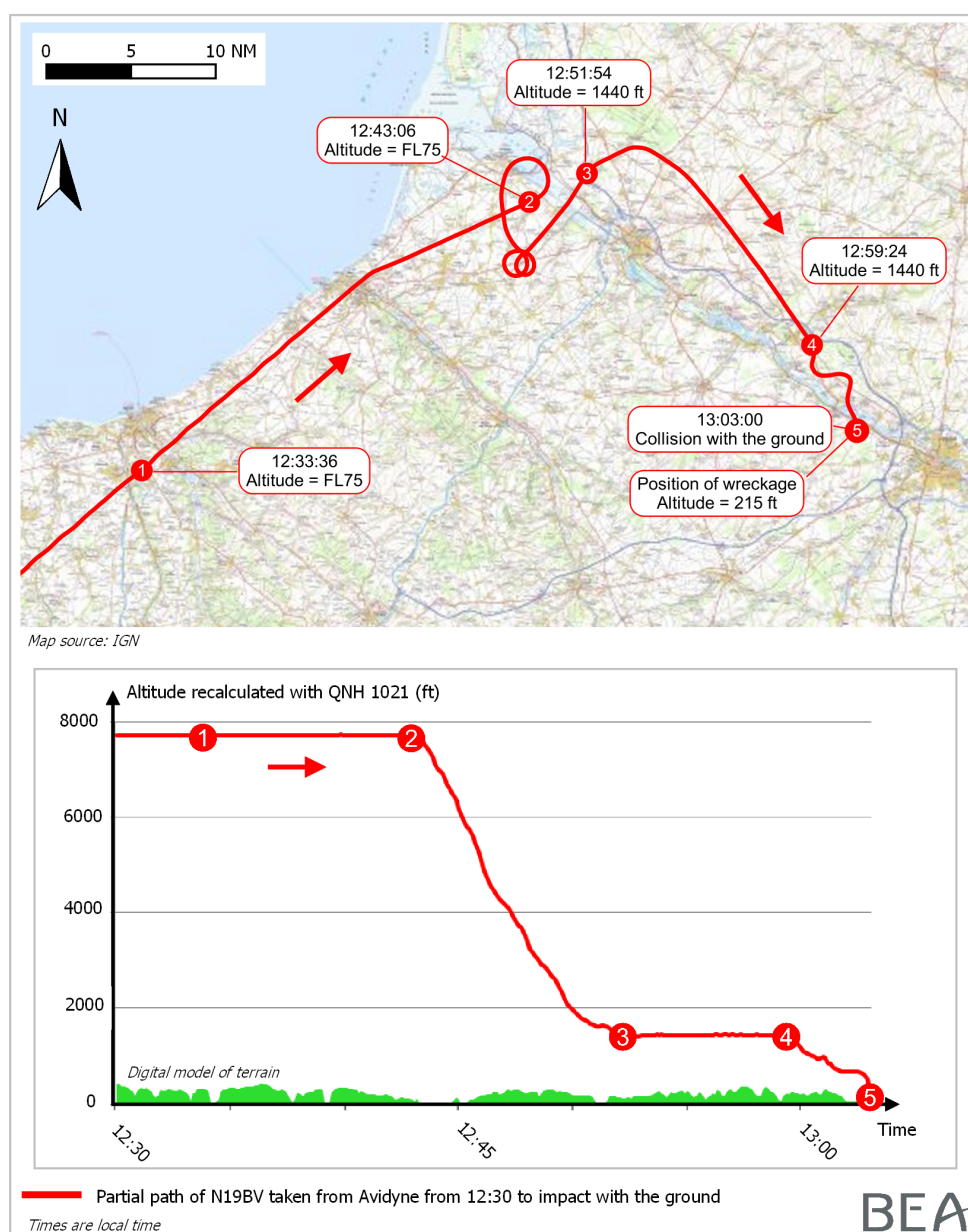


Figure 2: N19BV path

⁽⁴⁾The flight manual recommends that the pilot shuts down the engine before activating the emergency parachute.

The recordings show that at 12:33, while the aeroplane was in the vicinity of Dieppe (point 1 of Figure 2), the battery charge went from “not low” to “low”: the electrical power supply voltage (main bus) suddenly went from 28 V to 24 V. Subsequently, this voltage continued to progressively decrease. The battery discharged and its voltage went from a nominal level to a low level.

The analysis of the recorded data found that the emergency parachute was deployed while the aeroplane was at an estimated height of less than 300 ft. It seems that the engine was voluntarily shutdown by the pilot⁽⁴⁾.

2.4 Examination of engine and its accessories

The SR22 is equipped with a Continental engine IO-550-N and two alternators:

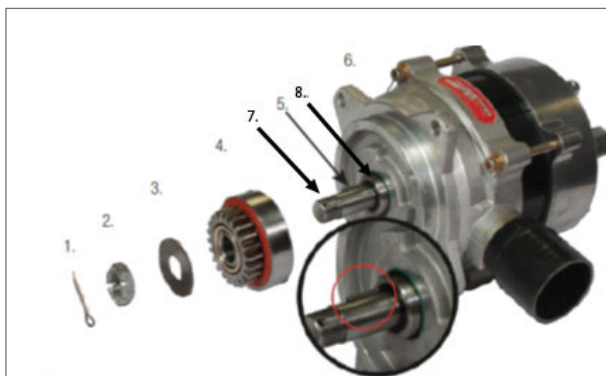
- ☐ alternator 1, at the front, with its driven gear;
- ☐ alternator 2, at the rear, with its drive gear.

Alternator 1 is a Hartzell ES-10024. The term “alternator” in the rest of this report will designate alternator 1.

2.4.1 Visual examination of engine exterior

Substantial damage was observed on the engine. This was the result of the aeroplane’s collision with the ground.

The alternator driven gear (No 4 on Figure 3), situated at the front right side of the engine was found embedded in the inner left wall of the engine housing which was pierced, also puncturing a machined oil duct in the housing (see Figure 4).



Source: RAM Aircraft

Figure 3: schematic installation diagram of alternator driven assembly

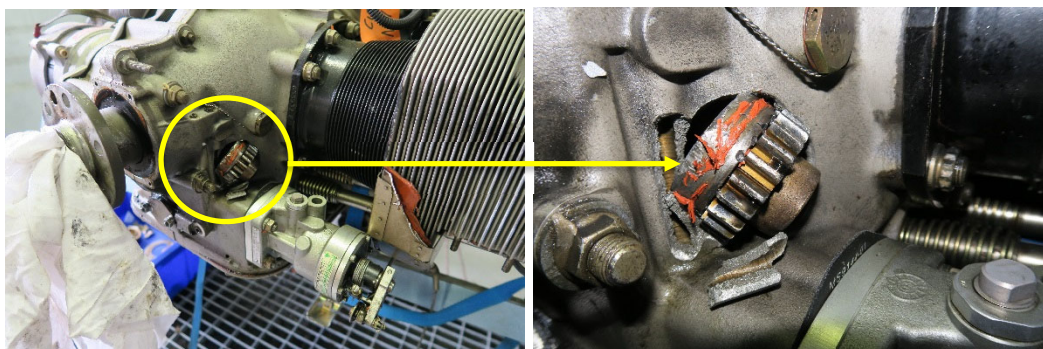


Figure 4: alternator driven gear embedded in wall of engine housing

⁽⁵⁾See Continental Aircraft Engine IO-550 Permold Series Engine Maintenance and Overhaul Manual of February 2015.

2.4.2 Opening of engine housing

During the examination, it was found that the housing contained practically no oil. A large quantity of debris was found inside the engine housing. The thrust washer (see Figure 5 and No 3 on Figure 3) was found around the fractured alternator shaft (No 7 on Figure 3) with its copper colour face on the nut side (No 2 on Figure 3). The Continental documentation specifies that the washer must be installed with its copper colour face towards the alternator⁽⁵⁾.

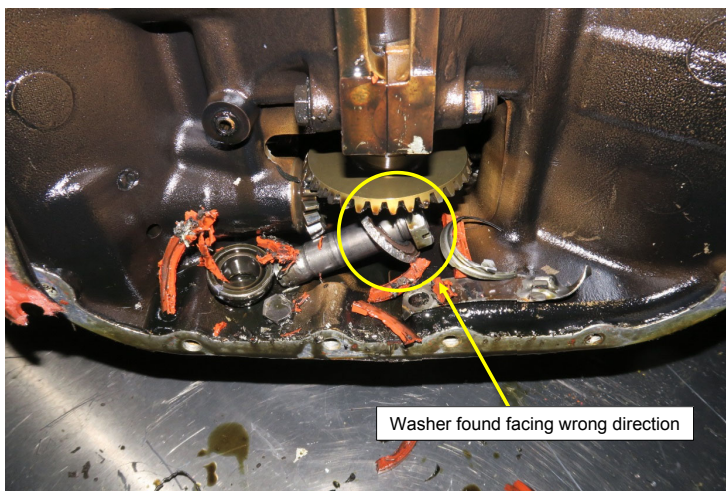


Figure 5: photo taken by the BEA on opening the engine housing

The parts found on opening the housing principally came from the mechanical coupling between the alternator shaft and the crankshaft. There were interference marks on the crankshaft bearings but these were not sufficiently pronounced to have caused the engine to shut down due to crankshaft seizure.

2.4.3 Examination of alternator and its mechanical coupling with crankshaft

The following illustration shows the position of the mechanical coupling between the crankshaft and alternator shaft. Several parts were closely examined at the BEA, in particular, the alternator shaft, thrust washer and driven gear.

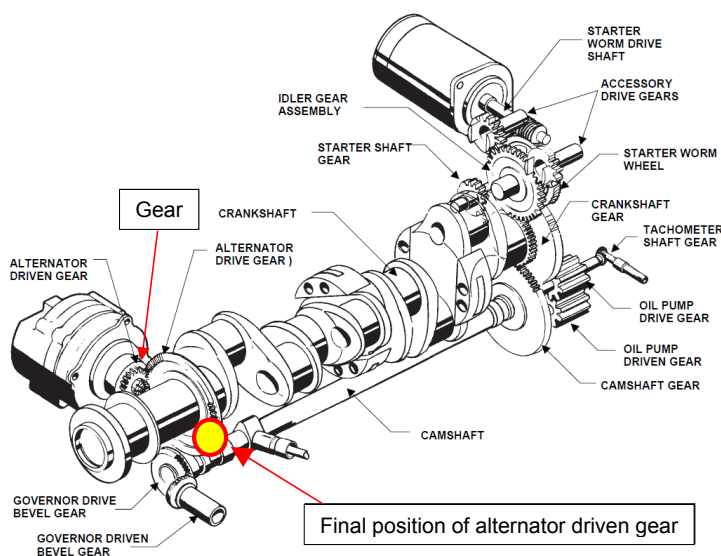


Figure 6: initial and final positions of alternator driven gear with respect to crankshaft

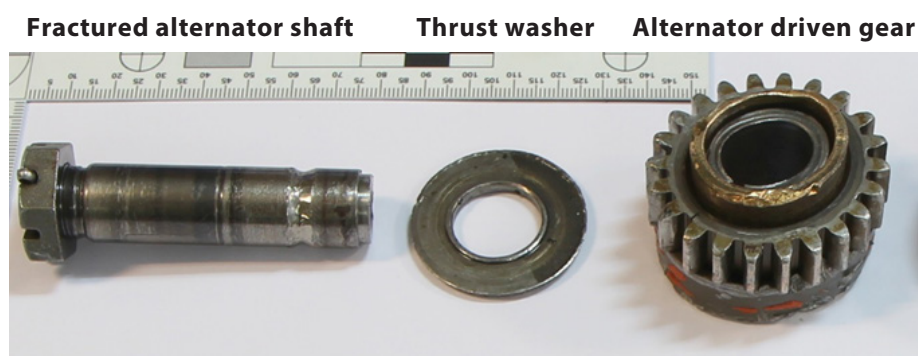


Figure 7: parts examined in BEA laboratory

The alternator driven gear is nominally positioned on the shaft using a key. The latter was found sheared with part of it still in its keyway in the shaft. The keyway on the gear side had substantial wear.



Figure 8: Keyway on alternator shaft side

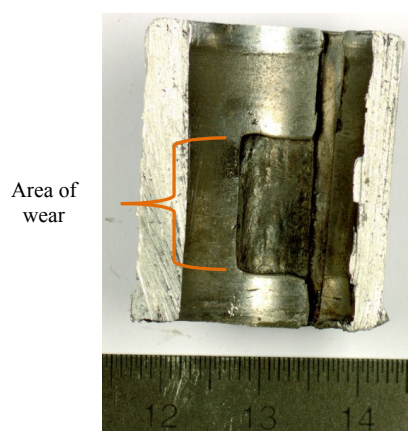


Figure 9: Section of gear inner ring with keyway

The thrust washer has a copper colour face which was heavily damaged and showed heterogeneous wear. The metal colour face on the other hand, had little damage.



Figure 10: thrust washer

The alternator shaft was found broken into two parts, one of which was found loose in the bottom of the housing. The fractographic analysis of the fracture found the characteristics of a fatigue fracture caused by rotating bending. The characteristics of the material from which the alternator shaft was made, were checked at the BEA and were consistent with the manufacturer's specifications.

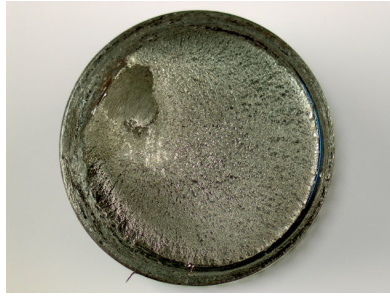


Figure 11: fracture surface of alternator shaft

2.5 Maintenance

2.5.1 Work performed on engine and its accessories

The aeroplane was serviced by Aérolithe, the Cirrus aeroplane importer in France, who also ensured its airworthiness. Aérolithe specified that the alternator had been assembled during scheduled maintenance on 17 October 2011. It was received new with the shaft, nut and key. The Continental maintenance manual requires the installation of a new washer when assembling the alternator. Aérolithe stated that they had duly replaced the washer⁽⁶⁾. The alternator driven gear was not replaced and was reassembled on the new shaft.

The engine log book mentions operations carried out between 2011 and the date of the accident by an FAA-approved inspector. There were several inspections of the engine in this interval but no inspection or disassembly concerned the alternator.

Since the entry into service of the aeroplane engine, the Continental documentation has always warned of the importance of the direction of assembly of the washer:

CAUTION: The special thrust washer must be installed with the bearing surface (copper color) toward the alternator.

2.5.2 Aeroplane manufacturer's scheduled maintenance operations

Continental SB 11-2 published in January 2011 recommends an alternator driven gear inspection every 500 hours or two years and an overhaul every 2,000 hours. These maintenance tasks require the disassembly of the gear and the assembly of a new washer.

In 2014, Cirrus modified the time limits concerning the alternator in its maintenance manual: previously it had recommended an overhaul every 500 hours. Since 2014, it recommends an overhaul every 2,000 hours or 12 years and a gear inspection every 500 hours or two years.

The version of the Cirrus maintenance manual used during an inspection carried out in September 2015 recommends inspecting the gear/shaft assembly every 500 hours or two years.

The accident occurred after 1,780 engine operating hours (Hobbs). The alternator operating time was 430 hours over a period of 4.6 years. No inspection or disassembly of the alternator had been carried out since its entry into service.

⁽⁶⁾The BEA was not supplied with the invoice for the new washer.

2.6 Similar event

In June 2017, Continental reported to the BEA, a case of a fractured alternator shaft discovered during maintenance on a Cirrus SR22 equipped with an IO-550-N engine. The examination carried out by Continental revealed that the thrust washer had been incorrectly assembled, with the copper face towards the nut. Continental determined that the abnormal wear of the washer led to a loss of tightness of the assembly which subjected the shaft to abnormal loads leading to it fracturing.

3 - LESSONS LEARNED AND CONCLUSION

3.1 Probable scenario

Around 12:33, while the aeroplane was cruising at FL 075, a failure of the alternator led to a sudden reduction in the electrical power supply voltage. This failure was not detected by the pilot and the battery continued to power the aeroplane's electrical systems.

Around 12:50, after descending to 1,400 ft to fly under a cloud layer, the pilot explained that he noticed a warning light indicating a battery problem.

The pilot analysed the situation: after envisaging continuing to his initial destination, he quickly decided to divert to Amiens which he reasonably thought he could reach.

Around 12:59, a degradation in the flight conditions made the pilot decide to perform an emergency landing.

When the alternator driven gear was thrown by the moving parts of the engine against the engine housing in which it became embedded, oil from the engine was sprayed outwards in an abundant quantity. The pilot's view through the windshield may have been substantially affected by this. The pilot controlled the deployment of the emergency parachute while the aeroplane was at an estimated height of less than 300 ft according to the recorded parameters. The investigation was not able to determine why the parachute was deployed at this height.

3.2 Use of emergency parachute

Setting up a descending path on deployment of the parachute on a Cirrus SR22 requires a considerable loss of height which was measured by the manufacturer as 400 ft during deployment tests in stabilized straight flight⁽⁷⁾.

During the accident flight, the activation of the emergency parachute at an estimated height of less than 300 ft compromised this manoeuvre from being carried out safely. The lateral straps of the emergency parachute were observed to be incompletely deployed on the left side, showing that the aeroplane was not yet in a level attitude on collision with the ground. The pilot knew his aeroplane well though and was aware that the emergency parachute must not be activated at a low height.

⁽⁷⁾The loss of height depends on the flight conditions. It was thus measured as 920 ft by the manufacturer during a release test after a spin turn.

3.3 Cause of alternator shaft fracture

The thrust washer was found assembled in the wrong direction on the alternator shaft, with the copper face on the nut side. This copper face showed considerable wear which probably caused a loss of tightness of the assembly which led to the application of abnormal loads at the mechanical coupling between the driven gear and crankshaft drive gear. The hypothesis of a loss of tightness is corroborated by the unusual wear of the keyway.

The abnormal loads at the mechanical coupling between the alternator driven gear and crankshaft drive gear were transmitted to the shaft which led to its fatigue fracture caused by rotating bending and then the release of part of the driven assembly which became embedded in the wall of the engine housing, puncturing an engine oil duct.

The thrust washer was incorrectly assembled in October 2011 when the alternator was replaced. Thereafter, the aeroplane flew less than an additional 500 hours but more than four years. However, the maintenance shop did not carry out the scheduled 500 hour/two year inspection. This inspection requires the disassembly of the alternator driven gear and the installation of a new washer. Carrying it out might have allowed the abnormal wear of the washer to be observed before the fracture of the alternator shaft and might have prevented the accident. The investigation did not determine why the washer was assembled in the wrong direction and why the inspection calendar interval was not complied with.