DUTCH
SAFETY BOARD

Aircraft crashes into the North Sea

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Dutch Safety Board

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Dutch Safety Board

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NB: This report is published in the Dutch and English languages. If there is a difference in interpretation between the Dutch and English versions, the Dutch text will prevail.

CONTENT

GENERAL INFORMATION

Number of incident:	2016006
Classification:	Accident
Date and time of incident:	4 January 2016, at about 13.56 UTC[1]
Location of incident:	North Sea, 4.5 NM to the west of the Dutch coast, abeam Schoorl.
Aircraft registration:	G-ZOGT
Make of aircraft:	Cirrus SR20
Type of aircraft:	Single-engine propeller aircraft
Type of flight:	VFR private flight
Phase of the flight:	En route
Damage to the aircraft:	Destroyed
Crew:	One
Passengers:	None
Personal injury:	Pilot deceased
Other damage:	None
Light conditions:	Daylight

1 The flight took place in different time zones, which is why all the times mentioned in this report are UTC, unless otherwise stated. UTC is the coordinated world time and is the same as Greenwich Mean Time, which is the same as the local winter time in the United Kingdom. Dutch time at the time of the accident was UTC + 1 hour.

SUMMARY

On 4 January 2016, the single-engine propeller aircraft, of the make and type Cirrus SR20, registration G-ZOGT, took off for a VFR flight[2] from Gloucestershire Airport in the United Kingdom. The German pilot had recently purchased the aircraft and was planning to fly it to Osnabrück-Atterheide airport in Germany. The route selected by the pilot took him in an easterly direction, much of it over the North Sea, and the aircraft was due to reach land at Den Helder. The weather forecast for the part of the flight in Dutch airspace was such that a VFR flight was more or less impossible. At around 6 NM before reaching the Dutch coast, the pilot reported to Dutch Flight Information Services (FIS) that he was encountering visibility problems caused by sea fog. FIS assigned him an easterly course to the Dutch coast. The aircraft initially followed this course, but after some time it made a turn to the right, after which it followed a southerly course. The final radar images showed a northerly course, after which the aircraft disappeared from the radar around 4.5 NM to the west of the Dutch coast, at the same latitude as Schoorl. After contact was lost, the Dutch FIS alerted the emergency services.

Following a search, parts of the aircraft were found, both floating and on the bed of the North Sea. The body of the pilot was found and recovered on 6 January 2016. A small proportion of the wreckage of the aircraft was recovered in the subsequent weeks.

The accident was probably caused by the aircraft stalling after the pilot had become disoriented as a result of the lack of visual references due to the poor visibility.

2 A VFR flight is a flight to which visual flight regulations apply, in addition to general flight regulations.

The flight and the accident

The pilot of the G-ZOGT lived in Germany and had purchased the aircraft in the United Kingdom on 27 December 2015. G-ZOGT remained at Gloucestershire Airport (EGBJ) after annual maintenance that took place between 19 and 28 August 2015. In early January 2016, the pilot travelled to the United Kingdom in order to fly the aircraft to Germany. On 4 January 2016, the pilot filed the flight plan for his proposed VFR flight from Gloucestershire Airport to Osnabrück-Atterheide (EDWO). The scheduled departure time from Gloucestershire Airport was 10.30 and the flight was to take 3 hours and 20 minutes. The planned route ran via beacons DTY-CAM-ND-HDR to Osnabrück-Atterheide. This route is shown on the map below. According to the plan, the aircraft would leave the coast of the United Kingdom near Great Yarmouth and reach the Dutch coast at Den Helder.

Figure 1: Route of G-ZOGT according to the flight plan. (Source: Google Earth)

On 4 January 2016 at 08.30, the pilot reported at Gloucestershire Airport. The pilot spent some time talking with the broker before taking possession of the aircraft. It is not known how the pilot had prepared the flight. It is known that before his flight, he contacted his wife by phone. He indicated that the weather in the UK was good but that it would be worse in the direction of the Netherlands. In the case the weather was too bad, he would return.

After the pilot had entered the aircraft and had been taxied to fill up with fuel, he returned because he was having communication problems with air traffic control. The air traffic controller was able to hear the pilot, but he was unable to hear the air traffic controller. It appeared that he had accidentally switched off the radios. After it had been switched back on, communication was problem-free. After the pilot had put 140.25 litres of fuel into the aircraft, he took off at 11.54 in G-ZOGT for the flight to Germany.

After taking off, the pilot signed off from the Gloucestershire Tower and then had radio contact with the various air traffic control services responsible for the airspace through which he was flying. At 12.42, London Information reported to G-ZOGT that fast-moving air traffic was flying above the North Sea at 3.000 feet, and asked the pilot whether he wanted to fly over the North Sea at 3.000 feet or at 9.000 feet (FL90). The pilot then responded that he wished to continue flying at 3.000 feet.

At 13.07 the pilot reported that he had reached the coast, whereupon he switched over to the radio frequency of Anglia Radar for the flight over the British section of the North Sea.

At 13.24:29 the pilot reported to the Dutch Flight Information Services (FIS), Amsterdam Information. The pilot reported that he had just entered Dutch airspace and that he was en route to Osnabrück in Germany. The altitude was 1.200 feet and the aircraft squawked 4371. The FIS officer then confirmed that G-ZOGT was visible on the radar. At 13.43:27, the FIS officer stated that the pilot could fly directly to his destination in Germany. At 13.49:18, the pilot reported that he had a few problems and that he was flying around clouds, but that everything was in order. To the question by the FIS officer as to whether he was having navigation problems, the pilot stated that this was not the case, but that he was having difficulty with sea fog. The pilot did not initially respond to the offer made by the FIS officer for a heading, but at 13.49:59 the pilot did ask for a heading because of the clouds. He was then advised to fly a course of 100°. At 13.52:06, the FIS officer asked if the pilot was flying at a course of 100°, to which the pilot responded affirmative. At 13.52:35, the FIS officer reported that there was full radar contact and that he could take over the navigation if the pilot so wished. The pilot thanked the FIS officer but did not respond to the offer to take over the navigation. Some seconds later the FIS officer radioed the pilot that he was four minutes away from the coast.

When the FIS officer saw that the aircraft had turned away to the right and that the aircraft's altitude was decreasing, he warned the pilot at 13.55:13 about the wind farm located to the south of his position and that the turbines were 400 feet in height. At first, the pilot did not respond to the warning, but after a second call the pilot responded with call sign GGT, whereupon the FIS officer again warned him, at 13.55:31, about the wind farm. This message was not acknowledged by the pilot. At 13.56:07, some noise and a carrier wave were audible for a few seconds on the radio frequency. From 13.56:30 to 13.58:40, the FIS officer called G-ZOGT several times but the calls went unanswered. A Netherlands Coastguard aircraft, which was flying in the vicinity, was immediately informed and at the same time the emergency services were alerted via the coastguard centre, whereupon the search for the aircraft was begun.

All the conversations between G-ZOGT and the British and Dutch air traffic control services were recorded. From these conversations, it appeared that radio contact between the pilot and the air traffic controllers proceeded with some difficulty. A number of calls and questions by the air traffic controllers were not answered by the pilot, or only after repeated calls.

The transcript of the communications between G-ZOGT and Amsterdam Information is enclosed as Appendix A.

The crew

The pilot was a 76-year-old German male. Since 2008, he had been in possession of a Private Pilot Licence (PPL (A)), with the ratings single-engine land aircraft (PIC SEP land), night flying qualification (NFQ) and English language skills level 4 (LPE level 4), valid until 29 February 2016. His medical licence category 2 was issued on 7 September 2015 and was valid until 7 September 2016.

His total flying experience amounted to around 543 hours; during the previous twelve months he had conducted 35 flights with a total flying time of 12:51 hours. His experience on the Cirrus SR20 was 6:30 hours of which about four hours as sole occupant. He had flown these hours during five flights in November and December 2015. The logbook of the aircraft shows that he made three flights with an instructor at his flying club and two flights as sole occupant. Before the purchase of the G-ZOGT, he had been on a test flight as a passenger on this aircraft for around twenty minutes in November 2015.

Until May 2014, the pilot had been in possession of his own aircraft, a Cessna C172, in which he had flown around 385 hours. During these flights, he had almost always been accompanied by his wife. These flights were made throughout Europe, and regularly involved long stretches over the sea. According to witnesses, he always informed himself before the flights about the weather and never flew if poor weather was forecasted. This aircraft was equipped, amongst others, with a Garmin 1000 'glass cockpit'

After selling his aircraft in May 2014, the pilot had not flown at all until late 2015. He then contacted the flying club and stated that he wanted to start flying again. He wanted to gain experience with the Cirrus SR20 because he wanted to buy an aircraft of that type. During the flights with an instructor in the SR20 it appeared that the pilot possessed extensive theoretical knowledge of this type of aircraft and that he was quickly able to control the aircraft well. During the instruction flights, he practised with all kinds of emergency situations. According to the instructor, the pilot was calm and dealt with the emergency situations effectively. The pilot also practised using the automatic pilot. The use of the emergency parachute, the Cirrus Airframe Parachute System (CAPS), was practise only theoretically. Before each training flight, this system had never been unlocked.

The aircraft

The Cirrus SR20 is a single-engine, composite aircraft with four seats. The aircraft has a six-cylinder Teledyne Continental engine. The fuel tanks have a total capacity of 229 litres, of which 212 litres are usable. With this quantity of fuel, the SR20 has a maximum flying time of 5.5 hours, depending on the selected power level and the flight altitude.

The aircraft is equipped with a CAPS facility.[3] In an emergency situation, the pilot can activate this system during flight by pulling a handle above his head. This fires off a small rocket which pulls out a parachute that is attached to the aircraft. The parachute opens and the aircraft floats downwards. The parachute and the rocket are located in a space behind the cockpit.

All the documents relating to the aircraft were on board the G-ZOGT when it crashed. None of the records were recovered, so not all the information of the aircraft was available.

The G-ZOGT was built in 2008 and was registered in the British aircraft register. The Certificate of Airworthiness was issued on 4 September 2008 and the Airworthiness Review Certificate was valid until 26 August 2016.

Most of the cockpit of G-ZOGT was fitted with digital instruments and consisted of the following equipment, among other things:

- Primary Flight Display (PFD)
- Multi Function Display (MFD)
- Automatic pilot
- Enhanced Ground Proximity Warning System (EGPWS)
- Digital flight charts
- A data link for weather information

The tail of the aircraft contained recording equipment, which stored some flight data.

The most recent annual maintenance to have been carried out on the G-ZOGT was from 19 to 28 August 2015. This maintenance was carried out by an approved maintenance organization and was in accordance with the manufacturer's maintenance programme. At the time, the number of flight hours of the aircraft and the engine amounted to 723.9 hours. Nothing of note was recorded. The next maintenance was planned at 773.9 flight hours or on 27 February 2016, whichever occurred sooner.

On 23 and 24 December 2015, the aforementioned maintenance organization carried out a so-called 'pre-buy inspection', in which a large number of aspects of the G-ZOGT were checked, in accordance with the manufacturer's schedule. At the time, the number of flight hours of the aircraft and the engine amounted to 731.2 hours. Apart from a few comments about minor irregularities, no defects on the aircraft were found. After the inspection, a 'Certificate of release to service' was issued.

3 Cirrus Airframe Parachute System.

Flight rules

The Dutch airspace above the North Sea where the flight was to have been carried out is classified as G airspace. The rules to carry out a VFR flight in this type of airspace under 3.000 feet are as follows:

- Clear of clouds
- Sight on land or water
- Horizontal visibility of at least five kilometres; visibility of 1.5 kilometres is permitted if the flight is being carried out at a speed that makes it possible to avoid other air traffic and obstacles.

The minimum flying altitude in this section of the airspace is 500 feet above the water or 500 feet above the highest obstacle in a radius of 150 metres from the aircraft.

The weather

The description of the weather is taken from information from the Royal Netherlands Meteorological Institute (KNMI) and the British Met Office.

The general description of the weather above the North Sea at the time of the accident was, according to the KNMI:"In combination with a depression near Ireland, a west-northwest - east-southeasterly oriented trough lay almost stationary from the North Sea across the south of Noord Holland and the south of Gelderland to Germany. To the north of this trough was a zone with moist air with localised dense fog and low cloud. The remains of fronts caused a great deal of cloud from which localised rain or drizzle was falling. The location of the accident was in this zone. Further towards the north-east, the precipitation was more in the form of snow with a likelihood of freezing rain. The air to the south of the trough was unstable, and over the sea in particular, there were showers with a chance of thunderstorms."

Table 1: The weather in the vicinity of the accident, according to information from the KNMI.

	Winddirection	Windspeed	Temperature °C
On the ground	140	25	6
500 feet	150	25	5
1000 feet	160	25	4
2000 feet	170	20	2
3000 feet	180	20	1
5000 feet	190	20	-2

Cloud	Base	Top
SCT/ BKN OVC	0-100 feet 200 feet	Closed layer from the base to around 5000 feet; above that, layered to above FL100

Visibility: 1000-2000 metres; 500-1000 metres in places
Weather: Fog and occasional rain and drizzle
0 °C-level: 3500 feet
Ice formation: Moderate to heavy in cloud about 3500 feet
Turbulence: Light
Updraught: None

There are two observation stations that record the weather conditions in the area of the accident location. These are the 'Hoorn' platform, which lies around 17 NM north-west of the accident location in the North Sea (position 52°55'N 04°09'E) and Den Helder Airport, 'De Kooy', which lies around 16 NM north-northeast of the accident location. The observations (METARS) at the time of the accident (13.55) were:

Table 2: The current weather conditions at Hoorn platform and De Kooy.

Hoorn platform	De Kooy
EHQE 041355Z AUTO ///23KT 1100 BR SCT000 BKN002 OVC005 06/06 Q0986=	EHKD 041355Z AUTO 12014KT 080V150 1300 R21/1300N BR OVC002 02/02 Q0988 AMB 12015KT 2500 BR FEW004 SCT005 BKN006 TEMPO 1500 FEW003 SCT004=

From satellite images on the day of the accident at 14.00, it appears that the tops of the clouds at the accident location were between 500 and 1000 feet.

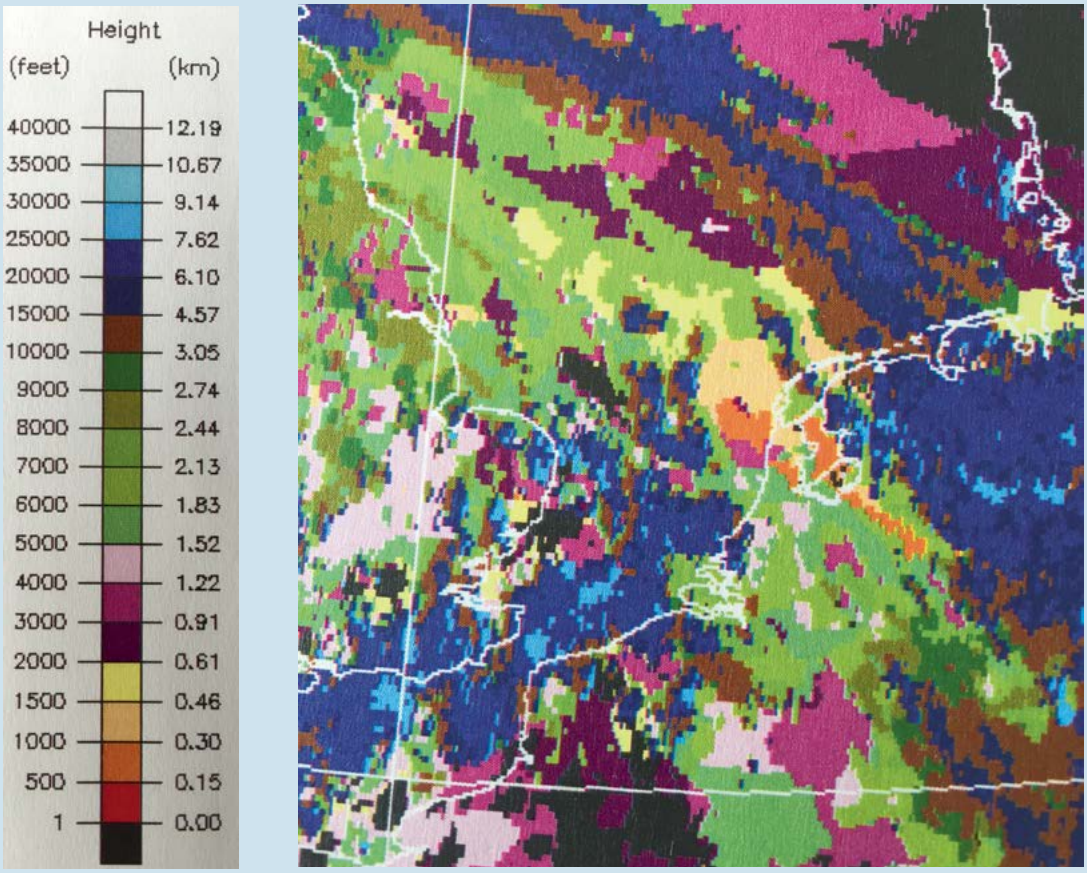


Figure 2: Satellite images of the tops of the clouds above the flying area. (Source: Met Office)

At the time of the accident, a SIGMET[4] was in force for part of the Dutch airspace. This SIGMET was valid from 12.45 to 16.45 and concerned a warning for serious ice formation (freezing rain) from the surface to 2500 feet. This applied in the area that extended to the following positions: 52°08'N 006°50'E - 52°57'N 005°06'E - 53°29'N 004°36'E - 53°53'N 007°01'E - 52°58'N 007°13'E (see Figure 3).

4 Significant Meteorological Information: warning of weather conditions that could affect aviation safety.

Figure 3: Area to which the SIGMET applied. (Source: Google earth)

The British Met Office supplied information about the weather at the time of departure from Gloucestershire Airport. According to the METAR, the current situation was:

METAR EGBJ 041150Z 20006KT 9999 -SHRA FEW007 SCT010 BKN020 08/07 00980.

The Met Office also issued the airport forecasts (TAF)[5] for the weather along the route that the G-ZOGT had covered in the United Kingdom.

Table 4: The weather forecasts for Gloucestershire, Cambridge and Norwich airports.

Gloucestershire	Cambridge	Norwich
EGBJ 041101Z 0412/0420 18008KT 9999 SCT030 PROB40 TEMPO 0412/0420 8000 SHRA BKN014	EGSC 041109Z 0412/0421 16007KT 9999 FEW022 BKN040 PROB30 TEMPO 0412/0421 7000 SHRA BKN014	EGSH 041109Z 0412/0421 15005KT 9999 FEW012 SCT025 PROB30 TEMPO 0412/0421 8000 SHRA BKN012

The forecasts for Schiphol airport and Den Helder Airport, 'De Kooy', were available. These were as follows, to the extent that they apply to the period of the flight and the accident:

5 Terminal Aerodrome Forecast.

Table 5: The weather forecasts for Schiphol and De Kooy airports.

Schiphol	De Kooy
EHAM 041043Z 0412/0518 12008KT 7000 OVC008 PROB40 TEMPO 0412/0506 4000 -SHRA BKN005 SCT015CB	EHKD 040932Z 0410/0422 11013KT 4000 BR BKN004 TEMPO 0410/0412 3000 -DZRA PROB30 TEMPO. 0411/0416 -DZRA -SHRA SCT003 BKN005 SCT015CB

The destination airport, Osnabrück-Atterheide, does not issue weather reports. That is why, for the airport forecasts, the TAFs of the nearby Münster Osnabrück and Rheine Bentlage airports were used that were known about on the day of the incident before the departure of G-ZOGT from Gloucestershire Airport. Given the geographical circumstances, the forecast by Rheine Bentlage was the most representative for the weather in the vicinity of Osnabrück-Atterheide. The relevant forecasts were as follows:

Table 6: Overview of the weather forecasts for the Münster Osnabrück and Rheine Bentlage airports.

Münster Osnabrück	Rheine Bentlage
EDDG 040500Z 0406/0506 10007KT 2500 -SNRA BR BKN004 TEMPO 0406/0412 5000 BR BKN010 BECMG 0421/0424 5000 BR BKN015=	ETHE 040827Z 0409/0418 10007KT 3000 -RASN SCT005 BKN008 TEMPO 0409/0418 11010KT 1500 RASN BKN005 OVC010=

Survival aspects and recovery

After the emergency services had been alerted following the disappearance of the G-ZOGT, a search and rescue was launched, coordinated by the Netherlands Coastguard. The aim of the rescue mission was to find the aircraft and to save the pilot. Aircraft, helicopters, and ships from the Netherlands Coastguard, the Royal Netherlands Navy, and the police were deployed in the rescue mission; lifeboats and privately-owned vessels also assisted with the mission.

After a search, floating pieces were found in the vicinity of the last known position of the aircraft. Just over half an hour later, at around 14.33, most of the parts of the aircraft had been located on the bed of the North Sea - part of the cockpit, part of the fuselage including the tail, and the wings were visible. These parts lay at position 52°42.967'N 4°30.803'E. The body of the pilot was found by divers two days later, on the morning of 6 January 2016. The pilot was in his seat, outside the wreckage. He was wearing a life jacket and the safety belts were fastened. The pilot was not wearing clothing that would protect him against cold water temperature if he would end up in the water.

After the discovery and recovery of the body of the pilot, the search and rescue mission under the leadership of the Netherlands Coastguard was halted. The positions of the wreckage items were established, after which the mission to recover the wreckage items was launched, under the leadership of the Dutch Safety Board. Because of the organisation of the recovery and the deteriorating weather conditions, the work to recover the wreckage items could not begin until 18 January 2016. However, the wreckage items were no longer at the positions that had been previously been established.

After a new search mission that was carried out by a Rijkswaterstaat vessel, possible wreckage items were found hundreds of metres from the original position. After searches carried out by divers, several wreckage items were found and recovered. These were the engine, part of the cockpit, and parts of the fuselage and wings. The recovery attempts were halted on 21 January 2016.

The aircraft

The aircraft G-ZOGT had valid certificates of airworthiness and registration. The aircraft had been maintained in accordance with the instructions of the manufacturer, and the prescribed annual maintenance had been carried out from 19 to 28 August 2015. No irregularities were found during this maintenance check. The maintenance limits for the next inspection had not yet been reached. After the purchase, the maintenance organization carried out a pre-buy inspection and issued a 'Certificate of release to service' on 24 December 2015.

A technical investigation was carried out on the remains of the aircraft that were recovered. Because the aircraft was far from complete and the engine was seriously damaged, the technical investigation was of limited scope. Neither the parts that were recovered nor the engine gave any indication as to what could have caused the accident.

Before departure, the pilot added 140.25 litres of fuel to the fuel tanks of G-ZOGT. As it was not known how much fuel was still in the tanks, it is not known either what the total quantity of fuel was before departure. During the final part of the flight, the aircraft climbed which requires greater power from the engine (see the section 'The flight') and the pilot did not report any problems in relation to fuel. It is therefore not likely that the aircraft crashed as a result of a lack of fuel. In addition, in the event of a problem with the engine, whether due to a lack of fuel of not, it would have been possible to use the CAPS facility or even to make an emergency landing on the water.

From the photographs of the wreckage taken by the divers, and from the parts that were recovered, it appears that the CAPS was outside the aircraft, but that the parachute had not unfolded and the parachute lines were still tied together. It can be concluded from this that the system was not activated by the pilot, but was probably dislodged from its storage space as a result of the impact with the water. It could not be determined whether the system was unlocked prior to the flight.

There are no indications that the accident was caused by a technical aspect or lack of fuel.

The pilot

The pilot had a valid pilot licence and a valid medical certificate. He had extensive flying experience which he had gained mostly with flights in his own aircraft, a Cessna 172. He also carried out long flights with this aircraft throughout Europe, which also regularly involved crossing large bodies of water. This aircraft is of a different type to the Cirrus SR20, in which he had flown 6:30 hours in November and December in Germany. He had flown around 4 hours with this type as the sole pilot. In addition, there were differences between the version of the Cirrus SR20 at the flying club in Germany and that of G-ZOGT. The biggest difference was that the cockpit instruments of G-ZOGT were largely digital, while the instruments in the German Cirrus SR20 were mostly analogue. The pilot had some experience with the operation of digital cockpit instruments because his Cessna 172 was also equipped with such equipment. However, this equipment was of a different brand and type.

In spite of the fact that witnesses had said that the pilot possessed a great deal of theoretical knowledge of the Cirrus SR20, it is possible that the limited number of flight hours with the Cirrus SR20, in combination with the different version of the cockpit affected the way he conducted the flight. The communication problems resulting from the unintentional disengagement of the radio before the start is an example of this. As well as theoretical knowledge, practical knowledge of the aircraft and of the instruments is important, especially if any irregularities or problems occur during a flight. Because the digital cockpit instruments of G-ZOGT differed from those of the Cessna 172, the pilot could not rely on his experience he had with those instruments.

The pilot was in possession of a night flying qualification. This means that he was authorised to carry out VFR flights at night. Apart from the basic instrument rating training that is required for a private pilot licence, he had no experience, as far as is known, of instrument flying. It therefore cannot be assumed that he was familiar with instrument flying or with circumstances in which flying by sight was not possible.

The flight plan and the route flown showed that the pilot had chosen to make the crossing from the UK to the Netherlands over a wide area of the North Sea. It is advisable to flights where a longer time will be flown above water, especially in a single-engine aircraft and a low water temperature, to use of protective clothing. The pilot had chosen not to do this, so the chances of survival in case of a ditching, given the temperature, severely reduced.

After the recovery, an autopsy was carried out on the body of the pilot. It emerged from this that the pilot died as a result of the impact on the water. No indications were found that could have explained the accident. However, it was established that he had a congenital cardiac defect. According to the pathologist's report, such a defect would not have devolped any symptoms for the person involved, but it could give rise to sudden pains in the chest or disruptions to the heartbeat. However, these symptoms cannot be established by an autopsy.

From the communications between the pilot and the various air traffic control services, there was no indication from the pilot that he had physical problems. If he had had any such problems, it is fair to assume that he would have mentioned this and diverted to the nearest airport to his position at the time. When near to the Dutch coast, too, the pilot gave no indication that he wanted to divert to Den Helder Airport because of physical problems - on the contrary, the pilot asked for permission to fly to the south of Den Helder in order to be able to fly directly to his destination. It is therefore not likely that the aircraft crashed as a result of the pilot experiencing physical problems.

The pilot had a valid pilot licence and a valid medical certificate. The pilot's lack of experience of solo flying and insufficient practical knowledge of G-ZOGT may have played a role in the causes of the accident. It is not likely that the accident took place as a result of, or was influenced by, the pilot experiencing physical problems.

The weather

From the general description of the weather on the section of the route taken by G-ZOGT above the land mass of the United Kingdom, it appears that the situation there was good. Visibility was good; there were a few light showers but the cloud base was sufficiently high. There was some light cloud at 700 feet and it was half to heavily clouded with a base at 2000 feet. These conditions meant that this part of the VFR flight over the United Kingdom was possible, without any problems being expected.

From the weather forecast for the area of the destination in Germany, it appeared that conducting a VFR flight in the area was possible, but that the conditions were not ideal. In particular, the forecast of snow and rain, limited visibility and a cloud base from 400 feet could make flying difficult.

Above the North Sea, the weather was different; from the centre of the North Sea there were medium to heavy showers and heavy cloud which had the potential to develop into storm clouds. Towards the Dutch coast, the conditions became even worse. The closest weather stations reported slight to half cloud-cover conditions from 0 feet to complete cloud cover from 200 to 500 feet. Horizontal visibility was limited to around 1100 to 1300 metres, because of fog. Above 3500 feet, moderate to heavy ice formation was present in the clouds. These weather conditions made a VFR flight impossible. In these conditions, it was not possible to fly at least 500 feet above the water and remain out of the clouds and retain visibility of the water. The horizontal visibility was also insufficient to meet the requirement of at least 1500 metres.

The weather at the location at the time of the accident was largely in line with the forecasts by Schiphol and Den Helder Airport 'De Kooy' that were available at the time of the departure of the G-ZOGT from Gloucestershire. In particular, the forecast by De Kooy gave a picture from which it was apparent that flying under VFR conditions in the vicinity of the Dutch coast was more or less impossible.

From information, it appears that the pilot had viewed the current weather conditions the day before departure using his personal account with Germany's National Meteorological Service (DWD). It is not known whether and how he informed himself of the weather forecast on the day of his departure, in relation to his proposed flight. Both the current weather conditions and the weather forecasts at the departure and destination airports, and those in the vicinity of his proposed route, such as Den Helder, were available at Gloucestershire Airport and were also available on the internet.

The meteorological information that was known before the start of the flight was available to the pilot. It was therefore possible to know that the weather above the North Sea in particular could have made conducting a VFR flight difficult, if not impossible, because of the visibility and the low cloud. The weather at the destination location was also expected to be borderline. The pilot was known to delay his flights if the weather prospects were not good. It is therefore not clear why the pilot carried out the flight from the United Kingdom to Germany, even though the weather forecast suggested that a VFR flight would be more or less impossible. Since he told his wife that he would return in the case the weather was too bad, it can be assumed that he studied the actual and forecasted weather for his flight.

The SIGMET containing the warning for serious ice formation was in force while the flight was being carried out. However, the area to which the SIGMET applied was to the north-east of the route of G-ZOGT. Nonetheless, moderate to heavy ice formation was present on the proposed route in clouds above 3500 feet. From the radar data, it appears that G-ZOGT never reached this altitude while over the North Sea. Although it cannot be excluded completely, it is therefore not likely that the aircraft was affected by the formation of ice.

The weather conditions in the area of the location of the accident very probably were a major factor in the causes of the accident. Both the weather forecast that was known before the start of the flight and the current weather conditions suggest that the part of the flight that took place above the Dutch part of the North Sea could not be carried out in VFR conditions. It is not clear why the pilot nonetheless decided to carry out the flight.

The flight

Flight data from the Enhanced Ground Proximity Warning System (EGPWS)

The recording equipment that is located in the tail of the aircraft and which stores flight data could not be used because the tail of the aircraft was not found. All the instruments that were found in the cockpit post-recovery were examined to see whether they contained data carriers that store flight data. Ultimately, it appeared that only the EGPWS contained a chip that stores some of the flight data under certain conditions. The EGPWS, of the brand Bendix/King, model KGP560, records the flight data every second and, among the circumstances in which it stores them are if there is a danger of collision with the ground or obstacles. In such cases, the system gives a vocal and visual warning.

Depending on the extent of the danger, these warnings are 'caution terrain', 'terrain', 'sink rate', and 'pull up'. The flight data are recorded only in the twenty seconds before, and the ten seconds after, such a warning is given. The EGPWS does not record the time - it only records the data during the time that has elapsed since the EGPWS is engaged for the first time after being installed in the aircraft. The parameters of altitude, roll and ground speed are nor directly recorded but computed by the EGPWS system.

The EGPWS of G-ZOGT recorded the start of the flight at 1060:46:57 system time[6] and the recording of the flight ended at 1062:49:48. From this, it follows that the flight lasted a total of 2.02.51 hours. Compared to the recorded start time from Gloucestershire Airport (11.45) it may be concluded that G-ZOGT crashed around 13.56. This matches with the time that was derived from the RT conversation with Air Traffic Control the Netherlands (LVNL), from which it appears that the aircraft probably crashed at 13.56:07.

From the analysis of the EGPWS data, it appears that a situation occurred several times during the flight in which a warning was generated, whereupon the flight data were recorded. The first time that flight data were recorded was shortly after take-off. For most of the flight over the North Sea, no data are available; only in the final eight minutes before the G-ZOGT came down were the flight data recorded.

Altitude and speed

Around six minutes after take-off from Gloucestershire Airport the first warning was generated - 'caution terrain' - followed seven seconds later by the warning, 'pull up'. These warnings were initiated after G-ZOGT went below 1500 feet in a descent, where the height of the terrain was 900 feet, and when the situation was not resolved within seven seconds. After G-ZOGT started to climb, the warnings stopped.

From 13.48:19, when the aircraft was flying over the North Sea at around 14 NM to the west of the Dutch coast, the EGPWS generated a 'pull up' and 'terrain' warning. These warnings were generated because G-ZOGT was in a steep descent, in which it approached the surface of the water to within 214 feet. The descent then became an climb, followed a short time later by a steep descent. This pattern repeated itself several times. In the process, the altitude of the aircraft varied between 214 and 1428 feet above the surface of the water. During each descent, the warnings 'sink rate' and 'pull up' were generated.

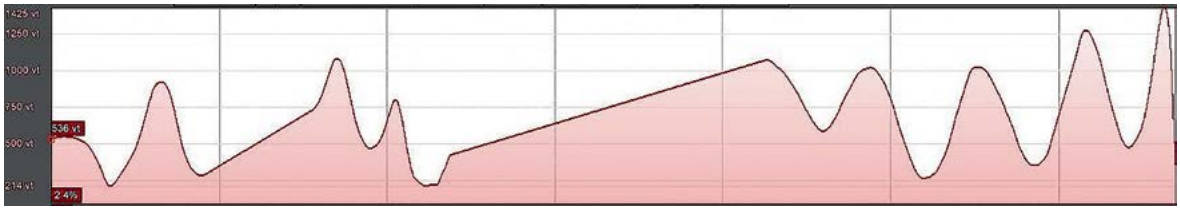


Figure 4: Altitude profile during the activation of the EGPWS over the North Sea.

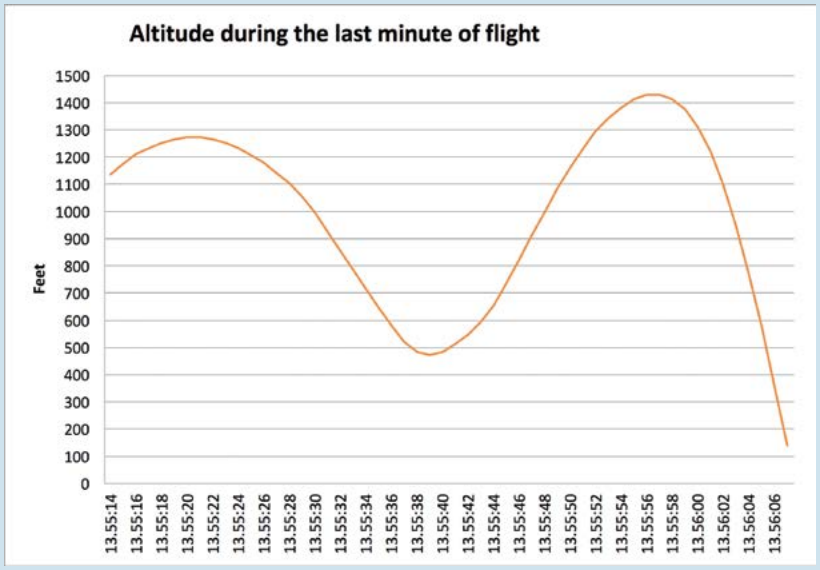
6 The recording starts three seconds after the aircraft reaches a ground speed of 45 knots.

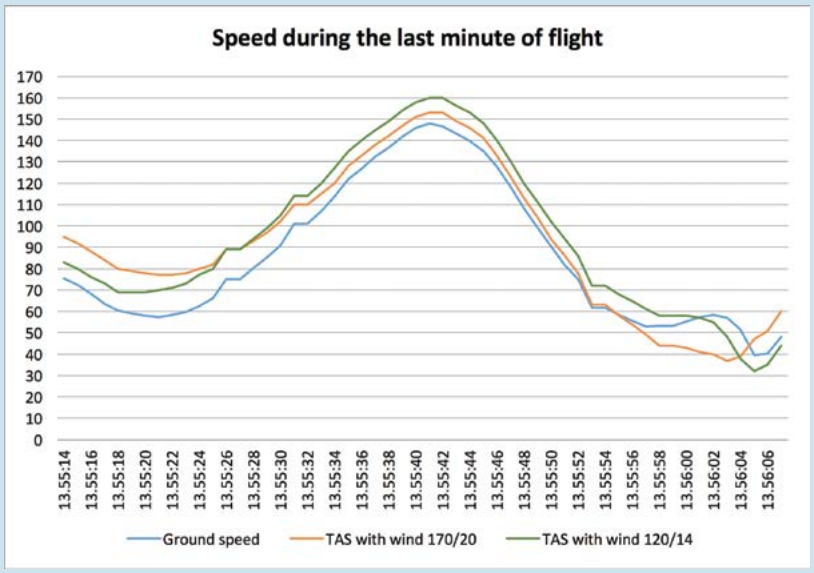
The flight data were permanently recorded from 13.55:14 until the end of the flight. At that time, G-ZOGT climbed to 1136 feet above the sea, at a ground speed of 75 knots. This climb stopped at an altitude of 1272 feet, at which time the aircraft had a ground speed of 57 knots. The aircraft was rolling to the left at around thirteen degrees.

At around 13.55:22, the climb became a descent, twelve seconds after which a 'sink rate' and 'pull up' warning were given. The ground speed of the aircraft was 114 knots at this time, and the rate of descent was 4093 feet per minute. At that time, the aircraft was rolling to the left at around seventeen degrees.

Shortly afterwards, the rate of descent decreased and at 13.55:40 the aircraft started to climb again. The climb rate increased within ten seconds to 5339 per minute, while the ground speed decreased. The altitude of the aircraft continued to increase and the rate of ascent and the ground speed gradually decreased. In the process, the aircraft rolled even more to the left. The maximum altitude reached was 1428 feet above the sea. At that point, G-ZOGT had a ground speed of around 53 knots. The aircraft then descended, with the rate of descent increasing all the time. The rolling to the left over the roll axis also increased at this time. Within a few seconds, the rate of descent increased to a maximum of 10,376 feet per minute and the rolling to the left reached a maximum of 49 degrees. The recording of the flight data ceased at 13.56:07.

The speed, altitude, and the rolling of G-ZOGT from 13.55:14 are shown in the diagrams below. The ground speed has been converted to the true air speed using wind data. Information from the KNMI (170/20) and from Den Helder Airport 'De Kooy' (120/14) has been used for this.





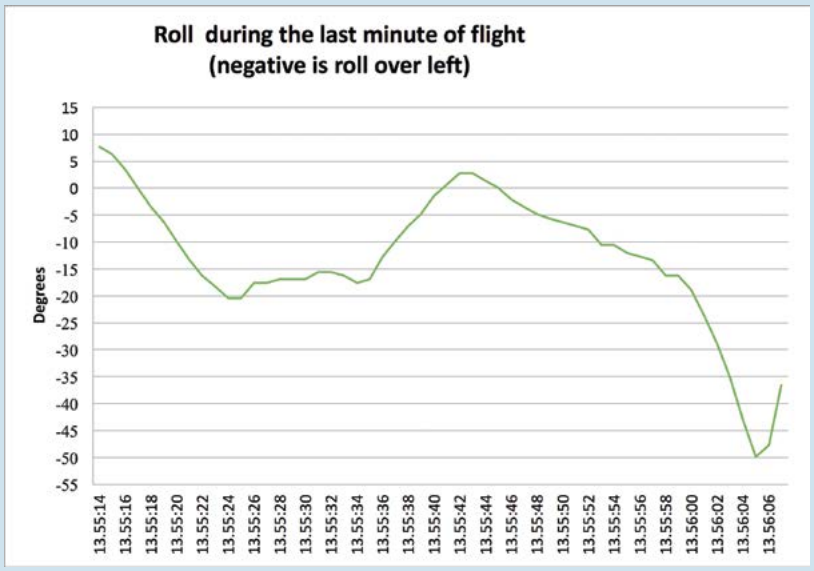


Figure 5: Graphs of the altitude, speed, and roll of G-ZOGT during the final minute of the flight.

The aircraft manual for the Cirrus SR20 lists the stalling speeds of the aircraft. These speeds depend on, among other things, the mass, the centre of gravity, and the roll. The stalling speed without flaps and with a roll of between 0 and 15 degrees lies between 66 and 68 knots calibrated airspeed, depending on the centre of gravity. From the speed graph, it appears that G-ZOGT fell below the stalling speed during the final part of the flight.

Course

Both the radar images from LVNL and the data from the EGPWS show that G-ZOGT maintained a more or less constant easterly course from the time it entered Dutch airspace. At around 13.48:22, this course changed and the aircraft made a right turn of 360 degrees, resuming its original course at around 13.50:08. The time of this turn corresponds to the time that the pilot said to the FIS officer that he was flying around clouds. After this turn, G-ZOGT followed a southerly course. At around 13.52:00, the aircraft followed a more or less easterly course. This time is slightly later than the time at which the FIS officer gave the pilot the heading of 100 degrees. From 13.53:49, G-ZOGT turned slowly to the south until at around 13.55:10 it was flying on an almost southerly course. At around this time, the FIS officer warned the pilot for the first time about the presence of a wind farm that lay to the south and which reached a height of 400 feet. After some time, the course of G-ZOGT changed again, to the east. This happened after a second warning from the FIS officer about the wind farm. Several seconds later, the aircraft made a sharp turn to the left, after which it disappeared from the radar.

Figure 6: The route in Dutch airspace according to the radar data from LVNL (the dots under the route indicate the wind farm).

Figure 7: The route in Dutch airspace according to the radar data from the EGPWS.

From the flight profile, in the vertical, horizontal and lateral planes, it appears that the flight was not stable. This flight profile indicates that the automatic pilot was not activated at this time and that the pilot was therefore controlling the aircraft himself.

During the final part of the flight, G-ZOGT made steep climbs and descents, with the speed alternately increasing and decreasing sharply. Nor was the aircraft following a straight course. The 360-degree turn can be explained as a manoeuvre by the pilot to avoid clouds, but the movements that G-ZOGT made subsequent to this indicate a reduced awareness of the position and angle of the aircraft, as a result of which the aircraft made uncontrolled movements. The aircraft alternated between steep climbs

and descents, during which the speed sharply decreased and increased respectively. The surface of the water was also approached up to a low altitude. In the process, the EGPWS generated warnings almost continuously. Just before the flight ended, the aircraft climbed steeply, during which the speed decreased and the roll to the left increased. This took the aircraft below the stalling speed. The aircraft then rolled further to the left and descended at great speed. From this, it can be deduced that the aircraft probably stalled, after which it rolled over the left wing and crashed into the water.

During the final part of the flight, when the flight data were recorded, the aircraft alternately climbed and descended steeply, as a result of which the speed of the aircraft decreased and increased. During the final ascent, the speed of the aircraft decreased. Because of the reduced speed and the increasing roll, the speed of the aircraft fell below the stalling speed, whereupon the aircraft stalled, rolled over the left wing, and crashed into the sea.

Spatial disorientation

In aviation, the danger of spatial disorientation is a familiar one. Various international studies have shown that spatial disorientation causes 6 to 32% of serious accidents, and 15 to 26% of fatal accidents. The actual level of spatial disorientation is very probably underestimated. It is vitally important that pilots recognise that no-one is immune to the dangers of spatial disorientation. It can happen to every pilot, at any time, in every aircraft, and during every flight, depending on the circumstances.[7]

It is likely that circumstances arose during part of the flight that increased the chance of spatial disorientation:

- When approaching the Dutch coast, visibility was poor, and there was cloud with a very low base. The aircraft therefore probably flew into the cloud and the horizon would no longer have been visible.
- When looking alternately at the instruments and outside, the pilot will have made head movements.

Probably as a result of this disorientation, the aircraft made movements that exacerbated the disorientation:

- During the final minute, the aircraft flew with a roll to the left.
- The aircraft climbed and descended alternately.

Because the aircraft probably flew in the clouds, there were no external visual references for the pilot. This is a situation in which spatial disorientation can occur. From the report on spatial disorientation, it appears that a person no longer senses any rotation after around ten to fifteen seconds, but instead has the illusion of flying in a straight line.

7 ATSB transport safety investigation report B2007/0063: "An overview of spatial disorientation as a factor in aviation accidents and incidents."

In the final part of the flight, G-ZOGT ascended with a roll for around half a minute. Because this position was maintained for some time, the balance organs (vestibular system) will have lost the sensation of this change of angle. The combination of a high pitch angle with the roll of the aircraft and the making of head movements when looking alternately inside and outside, would give false information about the angle and direction of the aircraft.

If such a situation occurs, it would require from the pilot the discipline to rely solely on the information from the flight instruments and not the signals from his own body. The knowledge, experience, training, and skills of the pilot in keeping an aircraft under control in such circumstances would play a role here. It is not apparent that the pilot possessed this knowledge, training, or experience. From the information about the pilot's flight experience, it appears that he probably have had no recent experience of this situation. This makes the chance of his experiencing spatial disorientation during the final minute of the flight likely.

The movements made by G-ZOGT in the last part of the flight indicate a reduced awareness of the position and the angle of the aircraft on the part of the pilot. This was very probably caused by the lack of visual references in combination with the lack of experience in instrument flying. This probably resulted in spatial disorientation.

The recovery and the role of the Netherlands Coastguard

During the search and rescue mission, which was coordinated by the Coastguard, the largest part of the aircraft was found by divers on the seabed. After the pilot had been recovered by the divers, the Dutch Safety Board asked the Netherlands Coastguard for their help in recovering the aircraft. This would have been efficient, as both employees (divers and recovery crew) and material (ships with lifting equipment) were already on site. The management of the Netherlands Coastguard did not comply with this request. Salvaging ship- and aircraft wreckages is no legal task for the Coastguard in the case these wreckages do not constitute a direct danger for shipping, according to the management. The result of this situation was that important data carriers and other relevant components could not be used in the investigation because after two weeks, part of the wreckage of the aircraft could no longer be found. It also meant that additional costs were incurred. This could all have been avoided if the management of Netherlands Coastguard had taken a more flexible attitude.

CONCLUSION

The following conclusions can be drawn from the investigation:

- The pilot carried out the flight from the United Kingdom to Germany, despite the weather forecast for the North Sea area suggested that a VFR flight would be very difficult, if not impossible.
- During the flight, the pilot probably got into difficulties as a result of the poor visibility and the low cloud.
- The flight profile from the final minute of the flight indicates that the pilot eventually became disoriented, whereupon the aircraft speed decreased and the aircraft stalled and crashed.
- The pilot's limited flight experience with G-ZOGT could have played a role in this.

APPENDIX A

TRANSCRIPT OF THE COMMUNICATIONS BETWEEN AMSTERDAM INFORMATION, G-ZOGT AND NETHERLANDS COASTGUARD.

AMS = Amsterdam Information
G-ZOGT = Cirrus SR20 G-ZOGT
CG = Netherlands Coastguard

TIME (UTC)	FROM	CONTENTS
13.24:29	G-ZOGT	Amsterdam Information, G-ZOGT
13.24:33	AMS	G-ZOGT, good afternoon
13.24:37	G-ZOGT	G-ZOGT, good afternoon Amsterdam Information, SR20, departure Gloucester, destination EDWO, just crossing the FIR border, 1,200 feet, squawk 4371
13.24:58	AMS	GGT is identified, the QNH is 988
13.25:03	G-ZOGT	QNH 988, identified, many thanks, GT
13.25:09	AMS	Your routing direct?
13.25:11	G-ZOGT	Eh..next waypoint will be Den Helder and thereafter direct, GT
13.25:17	AMS	Roger, you may proceed from present direct to Den Helder then
13.25:21	G-ZOGT	Many thanks
13.42:56	AMS	GGT Amsterdam?
13.43:01	AMS	G-ZOGT Amsterdam?
13.43:06	G-ZOGT	G-ZOGT
13.43:09	AMS	You are still tracking to HDR beacon?
13.43:13	G-ZOGT	I am still tracking to eh … Hengelo eh … to Den Helder, will I pass south of Den Helder in order to have a direct approach to EDWO?
13.43:27	AMS	It is all yours, you may proceed direct to the destination
13.43:31	G-ZOGT	Many thanks … GT
13.49:15	AMS	GGT, Amsterdam
13.49:18	G-ZOGT	GGT Amsterdam, I have some (???) I still fly around some clouds, GT, but all is OK
13.49:29	AMS	Ok, do you have navigation problems then?
13.49:32	G-ZOGT	No, GT, many thanks, I am OK, we just had some sea mist, but it is OK now, GT

TIME (UTC)	FROM	CONTENTS
13.49:41	AMS	Roger, let me know when you need a heading
13.49:44	G-ZOGT	Many thanks
13.49:59	G-ZOGT	Amsterdam, you could give me a heading now, clouds are getting … a little (???)
13.50:04	AMS	You make it initially heading 100
13.50:09	G-ZOGT	100
13.52:06	AMS	GGT is now heading 100?
13.52:10	G-ZOGT	GGT, I am on 100
13.52:14	AMS	Roger
13.52:17	AMS	Do you have an indication of the cloud base over there?
13.52:35	AMS	GGT, for your information, we have fully radar contact with you, so I can take over the navigation if necessary
13.52:43	G-ZOGT	OK, many thanks, I am still on..eh..
13.52:53	AMS	GGT, you have four minutes to fly to the coast line, four minutes to the coast line
13.52:58	G-ZOGT	OK, four minutes …
13.55:13	AMS	GGT, for your information, there are windmills south of your position at 400 feet
13.55:27	AMS	GGT, Amsterdam
13.55:30	G-ZOGT	GGT
13.55:31	AMS	There are windmills south of your position overhead the sea at 400 feet
13.56:07	G-ZOGT	…… (???)……
13.56:30	AMS	GGT, Amsterdam
13.56:51	AMS	GZOGT, Amsterdam
13.57:16	AMS	GZOGT, Amsterdam
13.57:59	AMS	GZOGT, Amsterdam
13.58:40	AMS	GZOGT, Amsterdam
13.59:08	AMS	Coast Guard 01, Amsterdam
13.59:10	CG	Go ahead
13.59:11	AMS	For your information, I lost an aircraft just in front of the coast line, south-west of the Kooy, for your information
13.59:17	GC	OK, we are in communication with the Coast Guard Centre, thank you, Coast Guard 01
13.59:22	AMS	Ja, and it was last known at 300 feet, but I have no contact with him any more

TIME (UTC)	FROM	CONTENTS
13.59:28	GC	OK, copied, thank you Coast Guard 01
14.00:19	AMS	GZOGT, Amsterdam
14.00:34	AMS	Coast Guard 01, did you report it already to the Coast Guard?
14.00:36	GC	OK, the Coast Guard 01 is now proceeding direct inbound the Kooy,we are now in communication with the Coast Guard Centre.
14.00:44	AMS	Thank you
14.00:45	GC	And I (???) that you contact them as well
14.00:48	AMS	Ja, I will do that. It is an SR20 aircraft

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