COMISIÓN DE INVESTIGACIÓN DE ACCIDENTES E INCIDENTES DE AVIACIÓN CIVIL

A-039/1997

TECHNICAL REPORT

Accident involving SCHEMPP-HIRTH NIMBUS 4DM aircraft, registration D-KDWA, in Fuentemilanos (Segovia) on 27 July 1997.

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WARNING

This Report is a technical document which reflects the point of view of the Air Accidents and Incidents Investigation Commission (CIAIAC) regarding the circumstances in which the event being investigated happened, with the relevant causes and consequences.

In accordance with Annex 13 to the International Civil Aviation Convention and with Royal Decree 389/1998, of 13th March, which regulates the investigation of civil aviation accidents and incidents, the investigation is of an exclusively technical nature, without having been targeted at the declaration or limits of personal or financial rights or liabilities. The investigation has been carried out without having necessarily performed legal evidence procedures and with no other basic aim than preventing future accidents. The results of the investigation do not determine or prejudge any disciplinary proceedings that, concerning the event, may be brought by the *Ley de Navegación Aérea* (Air Navigation Law).

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Abbreviations

00 ºC	Degrees centigrade
00º 00' 00"	Degrees, minutes and seconds
Ac	Altocumulus
ACC	Area Control Centre
ADF	NDB signal receiver
AIP	International Aeronautic Publications
APP	Approach Control Office
ATC	Air Transit Control
CAT I	OACI Category I
Ci	Cirrus
CTE	Captain
Cu	Cumulus
CVFR	Controlled Visual Flying Rules
CVR	Cockpit voice recorder
DH	Decision Height
DME	Distance measuring equipment
E	East
EPR	Engine pressure ratio
FAP	Final Approach point
FDR	Flight Data Recorder
ft	Feet
g	Gravity acceleration
h	Hours
hh:mm	Time expressed in hours and minutes
hPa	Hectopascal
IAS	Indicated Air Speed
IFR	Instrumental Flying Rules
ILS	Instrument Landing System
IMC	Instrumental Meteorological Conditions
INTA	National Airspace Technology Institute
Kms	Kilometres
Kts	Knots
Kw	Kilowatts
lbs	Pounds
m	Metres
min	Minutes
MAC	Middle aerodynamics cord of the aircraft
mb	Millibars
MDA	Minimum Descent Altitude
MDH	Minimum Descent Height
METAR	Ordinary Meteorological Report
MHz	Megahertz
N	North
N/A	Not applicable
NDB	Non-Directional Radio Beacon
MN	Nautical Mile
MPa	Megapascals
P/N	Part Number
QNH	Adjustment of the pressure scale so that the altimeter marks the airport's height above sea level on takeoff and landing
RVR	Runway Visual Range
S/N	Series Number
Sc	Stratocumulus
Shp	Shaft horse power
SVFR	Special Visual Flying Rules
UTC	Co-ordinated Universal Time
VMC	Visual Meteorological Conditions
VOR	VHF omnidirectional radio beacon
W	West

1.- FACTUAL INFORMATION

1.1.- HISTORY OF THE FLIGHT

The aircraft, a SCHEMPP-HIRTH NIMBUS 4DM motorglider, took off from runway 16 of the Fuentemilanos Aerodrome using its own engine on 27 July 1997 at 11:30[1] h. A couple of minutes later, when it was at an altitude of approximately 100 metres, it began a left turn and fell, following an almost vertical trajectory, impacting with the terrain in the backyard of a residential building in Fuentemilanos.

The aircraft occupants, a father and his son, both with a lot of experience in flying gliders, had travelled from Holland to carry out flights based at the Fuentemilanos Aerodrome, where they had arrived the afternoon previous to the day of the accident. They had made the trip by road, using a private car and had transported the aircraft on a trailer.

The motorglider had a German registration number and was under the name of a Dutch company owned by the occupants at the time of the accident.

They had brought the fuel used in the flight with them from Holland, aboard the aircraft.

During the time the accident occurred, meteorological conditions were adequate for carrying out visual flight and the wind was calm.

1.2.- INJURIES TO PERSONS

INJURIES	FATAL	SERIOUS	MINOR / NONE
FLIGHT CREW	1		
PASSENGERS	1		
OTHERS			

1.3.- DAMAGE TO AIRCRAFT

The aircraft was completely destroyed as a result of its impact with terrain.

[1] All times in the report are UTC, unless otherwise state. To obtain local time, 2 hours must be added to the UTC time on the date of the accident.

1.4.- OTHER DAMAGE

The aircraft impacted with the backyard of a residential building and caused damages in the roof area of a building in that backyard.

1.5.- PERSONNEL INFORMATION

1.5.1.- Pilot in Command

Age/ Sex:	59 years old/Male
Nationality:	Dutch
License:	Glider Pilot
Qualifications:	Aero tow and winch tow, flight instructor, motorglider and radiotelephony operator.
Number:	77-0020
License Issue Date:	19/04/1977
License Expiration Date:	01/05/1998
Medical Certificate Valid Until:	01/05/1998
Flight Experience:	More than 1200 hours on gliders and motorgliders

1.5.2.- Passenger

The passenger, son of the pilot in command, was also a glider pilot. The following information pertains to him:

Age/ Sex:	24 years old/Male
Nationality:	Dutch
Diploma:	Glider Pilot
Qualifications:	Aero tow and winch tow and radiotelephony operator.
Number:	89-0018
Total Flight Hours:	330 hours, approximately.
Hours on type:	50 hours, approximately.
License Issue Date:	11/05/1989

License Renewal Date: 29/05/1997

License Expiration Date: 01/05/1999

Medical Certificate Valid Until: 01/05/1999

1.6.- AIRCRAFT INFORMATION

1.6.1.- Airframe

Make: SCHEMPP-HIRTH FLUGZEUGBAU GmbH

Model: NIMBUS - 4 DM

Manufacturing Number: 9

Year of Manufacture: 1995

Registration: D-KDWA

M.T.O.W.: 820 kg

Owner: DREAM WINGS AVIATION B.V.

Operator: DREAM WINGS AVIATION B.V.

The Nimbus-4DM is a motorglider with a length of 7.83 metres and a wing span of 26.5 metres. It is a glider with high performance qualities that allow it to fly great distances with almost no loss of velocity or altitude. The rate of glide is 1/60.

It has a power plant that remains inside the fuselage and usually only the propeller is unfolded for takeoff. This feature allows for improved aircraft performance during flight, decreasing drag.

1.6.2.- Airworthiness Certificate

Number: L 20220

Type: Private

Issue Date: 6/03/1996

Renewal Date: 4/02/1997

1.6.3.- Maintenance Record

Total Flight Hours: 221.32 hours

Last Annual Inspection: 04/02/1997

Last Annual Inspection Hours: 130.00 hours

1.6.4.- Engine

Make: ROTAX

Model: 535C (2 cylinder)

Power: 60 HP

Serial Number: 3461589

The last inspection coincides with that of the airframe.

1.7.- METEOROLOGICAL INFORMATION

According to witness testimonies, the wind was calm on the day of the accident. Visibility conditions and the cloud ceiling were adequate for carrying out visual flights.

1.8.- AIDS TO NAVIGATION

Navigation aids were not used.

1.9.- COMMUNICATIONS

They do not affect the investigation.

1.10.- AERODROME INFORMATION

The Fuentemilanos Aerodrome is located next to a town with the same name. Its geographic location is 40º 54' N, 4º 14' W and has an elevation of 1001.8 metres.

It has two parallel runways, one asphalted and the other unasphalted with a 16-34 orientation. It also has a concrete apron for taxiing and parking, and

fuel supply is available. There is a Control Tower for traffic information with meteorological information offices.

The aerodrome's frequency is 123.4 MHz.

1.11.- FLIGHT RECORDERS

The aircraft did not have any flight recorders. They are not mandatory for this type of aircraft.

1.12.- WRECKAGE AND IMPACT INFORMATION

The impact angle (the angle formed by the plane's trajectory and the terrain) was high, approximately 70º.

The aircraft fell in the back yard of a residential building in Fuentemilanos.

The impact was practically vertical such that the nose and the cockpit were totally destroyed. The main wreckage was concentrated in a 40 square metre area, which is the area of the backyard where the plane fell. Given the large wing span of the aircraft, the right plane broke off and fell on the street adjacent to the backyard. The left plane broke similarly but remained within the residential building's backyard. Lastly, the back part of the fuselage broke after the impact, but did not come apart from the rest of the fuselage. It remained leaning against the roof like the rest of the aircraft's tail.

The motorglider propeller was unfolded in working position and the tips of the blades were intact. One of the blades was dented as a result of the impact.

1.13.- MEDICAL AND PATHOLOGICAL INFORMATION

Both occupants died of multiple traumas caused by the impact with the terrain.

1.14.- FIRE

There was no fire.

1.15.- SURVIVAL ASPECTS

Given the accident's characteristics, there was practically no chance of survival for the occupants of the aircraft.

1.16.- TESTS AND RESEARCH

1.16.1.- Inspection of the Power Plant

During the external inspection of the system, the following observations were made:

1. The propeller was unfolded in working position and the tips of the blades were intact.

2. The engine was not seized since it was possible to turn it by hand.

3. The fuel pipes entering the fuel pump and the one that goes from the fuel pump to the carburetor showed sharp bends with signs that choking was about to occur.

To carry out the internal inspection of the engine, it was stripped from the fuselage and taken to the Alcazarén Aerodrome workshops. Once the head was disassembled, the following observations were made during the visual inspection of the pistons and spark plugs:

1. Piston #1 had a hot spot with a pronounced crater on its crown.

2. Deposits of molten aluminium were found in the head, on the walls of cylinder #1 and between the electrodes of spark plugs #1 and #2 corresponding to cylinder #1, which were short-circuited as a result.

3. The #1 and #2 head gaskets were of a different colour, #1 was blue and #2 was red. The manufacturer uses red head gaskets, so it can be affirmed that cylinder #1 had been repaired.

1.16.2.- Aircraft Trajectory

The aircraft took off from runway 16 of the Fuentemilanos Aerodrome and began its ascent aligned with the runway axis. When it was at an altitude of approximately 100 metres, it turned towards the left and began an almost vertical descent until it impacted with terrain at an approximate angle of 70º.

1.17.- ADDITIONAL INFORMATION

1.17.1.- Fuel Used

This type of engine uses a mixture of gasoline and oil in a 50 to 1 proportion. The octane number[2] of the fuel varies with the proportion of oil in the mixture, so that the anti-knock capability of the fuel decreases as the mixture becomes richer in oil.

No fuel samples of the aircraft were collected so the proportion of oil in the mixture that was being used at that moment is not known.

1.17.2.- Description of the Knocking Phenomenon

When a reciprocating engine is running under especially hard conditions, such as a combination of high load and excessive timing range, or with an air-fuel ratio unsuitable for engine speed and temperature, an abnormal combustion of the fuel in the cylinders can result, of a detonating type. This phenomenon is commonly known as “a pinging sound” due to how it manifests itself.

This phenomenon depends on the properties of the fuel. The higher the compression ratio and the richness of the air-fuel mixture, the easier it is for this phenomenon to result.

Inside the cylinders, the knocking can produce high local temperatures, giving rise to the “hot spots” or zones that reach such high temperatures that the material of the cylinder heads melts and produces craters of greater or lesser size. The detached material tends to deposit on the cylinder walls, in the heads and in the spark plugs, possibly short-circuiting the electrodes of the latter.

[2] The octane number indicates the antiknock capability of the fuel.

2.-ANALYSIS

2.1.- FLIGHT SEQUENCE

The motorglider took off, using its own engine, from runway 16 of the Fuentemilanos Aerodrome. During the ascent, it followed a rectilinear trajectory until, when it was at an altitude of approximately 100 metres, it began a left turn, probably intending to return to the aerodrome.

While it was performing the turn, the aircraft went into a stall and then into a very steep spin from which it was not able to recuperate due to the fact that it was at a low altitude. The aircraft impacted with terrain at an angle of approximately 70º and the wreckage was concentrated in the back yard of a residential building where the aircraft impact occurred.

During the inspection of the aircraft wreckage, the propeller was found unfolded in working position and with the tips of the blades intact. Only one of the blades was damaged due to the impact with terrain. This last observation indicates that the propeller was not turning at the moment of impact and, consequently, that the engine was stopped.

Taking this into account, it is likely that, due to the engine loss, the occupants of the motorglider decided to return to the airfield gliding and manoeuvred the corresponding turn at an inadequate velocity for the aircraft's configuration which is what took it into the stall condition from which they were not able to recuperate.

2.2.- ENGINE ASPECTS

During the inspection of the power plant it was demonstrated that it could be turned by hand, thus discarding the possibility that it had seized and, consequently, discarding any lubrication deficiencies.

Once the head was disassembled, it was observed that the piston of cylinder #1 had a continued hot spot that had produced a crater in its crown. This piston had released melted aluminium particles that had deposited on the head, on the cylinder walls and on the two spark plugs of the same cylinder, thus short-circuiting their electrodes.

This shows that a knocking phenomenon took place in this cylinder and so a situation developed in which there was no spark between the electrodes of the two spark plugs, causing the cylinder to stop working as a result of lack of ignition.

In addition, it was observed that the head gaskets were of a different colour in each cylinder: #1 was blue and #2 was red. The manufacturer uses red head gaskets. It can be deduced from this that cylinder #1 had been repaired, most likely in order to better its compression ratio.

Although the proportion of oil in the mixture that was being used at the time of the accident is unknown, it is likely that the detonation in cylinder #1 was produced as a result of using a mixture with an excess of oil, and consequently, having an octane number lower than required. Another factor that could probably have contributed to the occurrence of this phenomenon is the fact that this cylinder had a higher compression ratio after the repair work done on it.

On the other hand, the size of the crater found on the crown of piston #2 leads to believe that the process required a great number of cycles, which could mean that it did not occur all at once and consequently had occurred during previous flights. The possibility also exists that it could have been produced entirely during this flight, considering the high speed of these types of engines which produces a large amount of cycles in very short time. Without more information, either of the two possibilities could have taken place.

2.3.- ACTIONS BY THE PILOT IN COMMAND

The initial trajectory of the aircraft, with an adequate rate of climb until it reached an approximate altitude of 100 metres, indicates that the engine functioned properly up until that moment.

When the knocking process began, the engine started to vibrate and lose power. In this situation, it is probable that the pilot in command took the throttle down and that the engine stopped not being able to maintain a low turning rate with only one cylinder working.

It is discarded the possibility that, as power was being lost, the pilot flying tried to add power. Had that been done, the engine would have continued running, supplying the necessary power to assure a return to the airfield and a landing.

It is likely in this situation that the occupants of the motorglider decided to return to the airfield gliding. Both had enough experience on gliders and on this type of aircraft to estimate whether the manoeuvre was feasible and they must have considered it so.

The corresponding turn was carried out at an inadequate velocity for the configuration of the aircraft, which is what caused it to go into the stall condition from which they were not able to recuperate.

It is likely that the pilot in command carried out the manoeuvre without taking into account the fact that the propeller was unfolded and that, with that configuration, the characteristics of the aircraft glide are strongly penalised by the increase produced in the aerodynamic drag.

3.-CONCLUSIONS

3.1.- EVIDENCES

The pilot was qualified for the flight and had a valid license.

The aircraft had a valid Certificate of Airworthiness and its maintenance had been done according to the established maintenance plan.

Meteorological conditions were adequate for carrying out visual flight and the wind was calm.

A knocking occurred in cylinder #1 of the aircraft engine which resulted in the loss of engine power.

The aircraft reached the ground with the engine stopped and the propeller unfolded.

The pilot in command performed a turn at an inadequate velocity for the configuration of the aircraft which made it to get into a stall condition.

3.2.- CAUSES

The accident resulted from the aircraft getting into a stall condition during a turn performed without power and at an inadequate velocity for the configuration the aircraft had at that moment.

The engine of the aircraft had most likely stopped when, upon taking the throttle down, a knocking phenomenon was produced in cylinder #1 that affected its ability to produce power. It is also likely that the knocking was produced as a result of using fuel with an octane number lower than required.

4.-SAFETY RECOMMENDATIONS

This accident has demonstrated how important it should be to the flight crew to have precise knowledge about the characteristics of the aircraft they are operating, especially in terms of their actions, limitations, and both normal and emergency procedures. This point acquires special meaning when referring to private flights, not subject to the same operating standards that are required in commercial civil aviation activities.

In light of this, it is recommended that all flight crews in general aviation operations of a private character carry out training for emergency situations and especially in procedures for engine failure during take off in order to familiarise themselves with the aircraft response in these cases and to be able to face real emergencies with higher safety guarantees. (**REC 22/02**)

ANNEX A

PHOTOGRAPHS

Photograph #1 Aircraft wreckage

Photograph #2 Detail of propeller blade

Photograph #3 Spark plugs 1 and 2 with aluminium remains

Photograph #4 Piston #1 with crater and blue head gasket

Photograph #5 Piston #2 without any sign of damage with red head gasket

Photograph #6 Detail of aluminium deposited in cylinder #1

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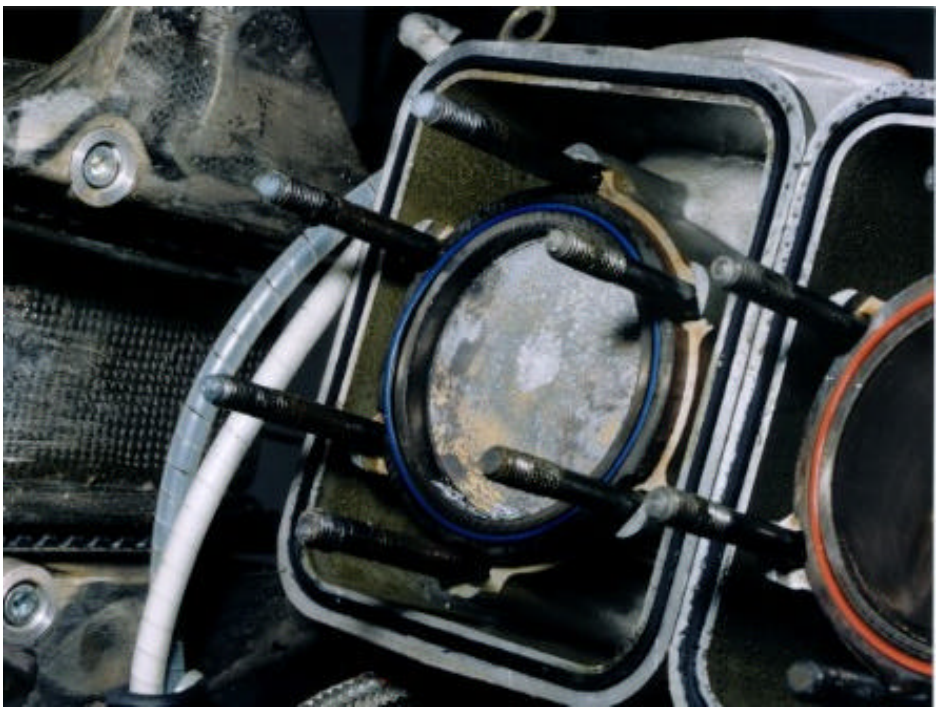

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