# FINAL REPORT

of civil aviation safety investigation

<table>
<thead>
<tr>
<th>CLASSIFICATION</th>
<th>Accident</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner</td>
<td>Diamond Aircraft Industries GmbH</td>
</tr>
<tr>
<td>Operator</td>
<td>SC AERO GETIC SRL</td>
</tr>
<tr>
<td>Manufacturer</td>
<td>Diamond Aircraft Industries GmbH</td>
</tr>
<tr>
<td>Aircraft</td>
<td>Diamond 42 P7</td>
</tr>
<tr>
<td>Registration country</td>
<td>Austria</td>
</tr>
<tr>
<td>Registration</td>
<td>OE-FCD</td>
</tr>
<tr>
<td>Location</td>
<td>In Vaideeni village vecinity, Vâlcea County</td>
</tr>
<tr>
<td>Date and time</td>
<td>25.09.2007 / 15:09 LT (12:09 UTC)</td>
</tr>
</tbody>
</table>

NR. A 16-02
Date: 02.06.2016
AKNOWLEDGEMENT

This REPORT presents data, analysis, conclusions and recommendations on civil aviation safety, of the Civil Aviation Safety Investigation Commission appointed by the Director General of CIAS.

The flight safety investigation was conducted in accordance with the provisions of the Government Ordinance No. 51/1999 concerning the technical investigation of civil aviation accidents and incidents, approved with amendments and additions by Law No. 794/2001, of the REGULATION (EU) No. 996/2010 of the European Parliament and of the Council from 20 October 2010 on the investigation and prevention of accidents and incidents occurred in civil aviation and repealing of Directive 94/56/EC and the provisions of Annex 13 to the Convention on International Civil Aviation signed at Chicago on 7 December 1944.

The objective of civil aviation safety investigation is preventing the occurrence of accidents and incidents, by effective determination of causes and circumstances that led to this occurrence and establishing the necessary recommendations for civil aviation safety and it HAS NOT THE PURPOSE of finding guilty, individual or collective responsibilities.

As a consequence, the use of this REPORT for other purposes than preventing the occurrence of accidents and incidents might generate misinterpretations.
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SYNOPSIS

CLASSIFICATION

<table>
<thead>
<tr>
<th>Owner:</th>
<th>Diamond Aircraft Industries GmbH</th>
</tr>
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<tr>
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<tr>
<td>Location:</td>
<td>In the vicinity of Vaideeni locality, Vâlcea</td>
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<tr>
<td>Date and time:</td>
<td>25.09.2007 / 15:09 LT (12:09 UTC)</td>
</tr>
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</table>

On 25 of September 2007, the aircraft Diamond DA42 type, registered OE-FCD, performed ground scanning flights over Oltețului Valley area. On the second flight of the day, after scanning a segment of the scan plan, the pilot faced the situation of sudden pitch change of the right hand propeller blades into feather position, which led to sudden engine stop. By not securing the propeller of the stopped engine in feather position (power lever in zero/feather position and Engine Master Switch in OFF position), the propeller pitch changed from feather into start-lock position, which resulted an increased drag coefficient. The pilot did not manage to maintain a climbing rate, and combined with a load over the permitted limit and the position of the gravity center outside the limits recommended by the manufacturer, the aircraft had a descent trend. By actuating the flaps at an improper speed and altitude, the pilot lost the aircraft control and it stalled on the right wing, entered into an uncontrolled dive and hit the ground at an almost vertical trajectory, of the estimated speed of 85 kts.

The probable cause of the accident occurrence is the inability to control the aircraft attitude with belly pod scanning system configuration, under a flight with one inoperative engine. The engine stop was due to the malfunction of the propeller pitch regulating valve (PPRV). The favoring causes are the stopped engine propeller pitch moving from feather position, the aircraft weight over the maximum permitted limit, the position of the gravity center outside the limits and the working height below the surrounding mountains quotas.

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1 FACTUAL INFORMATION

The accident in which it was involved the aircraft Diamond 42-P7 type, registered OE-FCD, occurred on 25 of September 2007. The civil aviation safety investigation commission was appointed by the Order of the Minister of Transports on 28.09.2007, according to the legislation applicable at that moment.

On 31.08.2009 was founded the Civil Aviation Safety Investigation and Analysis Center - CIAS through the Government Ordinance no. 26/2009, approved by Law 55/2010. CIAS actually began operating at the end of the year 2010, after entering in force of the legal operating standards and after budget approval, assuming a large number of ongoing investigations.

Due to the fact that the componence of the initial investigation commission no longer met the legal requirements, and the investigation of this accident was not completed, the General Director of CIAS, appointed a new investigation commission in November 2014, consisting of specialists of CIAS, according to the legal provisions applicable at the time of the decision issuance, especially with the provisions of the 

**NOTE:** Expression of time shall be made in local time (LT), for calculating the time in UTC there shall be subtracted three hours (UTC = LT – 3).
Expression of speed shall be made in KTS, with reference to the ground speed, according to the downloaded GPS data.
1.1 History of accident

A Romanian company (hereinafter referred to as beneficiary), signed a services contract with a Romanian air operator to perform ground scanning flights. In this regard, the air operator rented in „wet lease” system from Diamond Airborne Systems GmbH an aircraft of the type Diamond DA42-P7 equipped with a ground laser scanning system.

The aircraft registered OE-FCD, along with the crew consisting of the pilot and an operator of the scanning system, was positioned on Craiova International Airport (LRCV) on 24.09.2007. When arriving on Craiova Airport, according to the Romanian operator representative statements, the aircraft was fueled with 136 liters Jet A1 fuel, up to full capacity. At that moment on Craiova Airport, it was no authorized fuel provider, the supply was being made with an auto fuel supply that traveled from Bucharest for this purpose.

In the morning of 25 September 2007, at 08:25, the aircraft took-off from Craiova Airport (LRCV) for performing a ground laser scanning flight in the area of Căpățânii Mountains. On board of the aircraft were the pilot, the operator of the scanning system and a representative of the beneficiary. At 12:19, after a 3 hours and 54 minutes flight, the aircraft landed on Craiova Airport for refueling.

After 2 hours and 10 minutes break, the second mission of the day started, but with a delay of 30 minutes in comparison with the filed flight plan. The delay was caused by the late arrival from Bucharest of the fuel supplier. According to the fuel supply sheet, the airplane was fueled with 120L of fuel, with a specific density of 0.806 kg/L, having again on board full fuel capacity (196L).

The pilot of the aircraft asked for permission to start the engines at 14:21:

OE-FCD: O-CD I request permission to start the engines
CTA: CD Can you tell the mission parameters in this afternoon?
OE-FCD: just like this morning.
CTA: Do you intend to fly over the city and then to head north?
OE-FCD: Correctly, I don’t think it is necessary to fly over the city, but we will head north, over Parâng
CTA: Roger, after take-off please set your altitude, then climb to 2000 ft and head north
OE-FCD: 2000 ft and north direction, after take-off, O-CD
CTA: O-CD the start is allowed, wait for additional instructions
OE-FCD: The start is allowed, waiting for instructions, O-CD
After permission to start, the traffic controller (CTA-TWR Craiova) got in touch with the military coordination control body, since in the area were conducted military applications. As a result of coordination between the civil and military traffic bodies, the military aircraft were informed on the work mission of OE-FCD aircraft and they were repositioned in such a way that the two activities shall not overlap.

Thus, at 14:25 the pilot received instructions from TWR Craiova so that after taking-off from RWY09 runway to climb at the safety height, to turn left towards north and to maintain 2000 ft, till 25 NM (40 km) from VOR Craiova.

OE-FCD: After take-off we will maintain 2000 ft till 25 NM from VOR Craiova

CTA: After this altitude you can climb to any work altitude you wish

At 14:27, during rolling at the staging point for runway RWY09, the pilot received from the traffic controller the last weather information, namely wind from 070° direction with the speed of 2 m/s, visibility 10 km or more, isolated lower cloud with the base at 3000 ft and stratified at 8000 ft, ground temperature of 22°C, QNH 1015 mbar.

At 14:28 the aircraft received take-off permission for RWY09 in use. After a roll of almost 750 m, at 14:29, the aircraft took-off according to the procedure and to the received instructions. After take-off it performed a turn to the left, towards north, climbing to 2000 ft.

On board of the aircraft there were the pilot, the scanning system operator and a passenger on the front right seat (the representative of the beneficiary).

The flight was performed following visual flight rules (VFR), but according to the received instructions the pilot should have reported the altitude changes. Thus, at 14:42 the pilot reported an altitude of 6000 ft that he maintained for 20 minutes. After the data recovered from on-board instruments, the aircraft started the scanning mission from the south-west of the work area on north-east direction, at an average altitude of 1880 m (6167 ft), with a passing over Oltețului Valley (see figure 1).
The pilot scanned two segments of the scanning plan, then at 15:02 he announced a descent to 1550 m (5100 ft) and aligned the aircraft to scan the third segment, perpendicularly on Oltețului Valley, towards north-west, at an average altitude of 1710 m (5610 ft) and at an average height from the ground of 230 m (750 ft), under the quota of the surrounding mountains. When exiting the area of the third work segment, the aircraft turned right towards north (022° direction), on the valley, the pilot maintaining a relative constant ground speed of 90 kts, for scanning another segment. After this last scan at a speed of 88 kts, the pilot accelerated in order to gain speed and height to cross the obstacles quotas. At 250 m (820 ft) height from the ground and a speed of 95 kts, the pilot face a sudden pitch change of the right hand propeller blades into feather position, which led to sudden engine stop.

According to the data recovered from the engines control units, the inertial data and GPS data of the equipment installed on board of the aircraft, the pilot fully accelerated the left engine (2300 rpm) and tried to gain a height as much as possible and the aircraft rolled 17° to the right, on the side of the stopped engine. The speed reduced at 82 kts, and the height gain was small in comparison to the ground ascendant slope.

After approximately 10 seconds from the engine stop the pilot managed to stabilize the aircraft around the speed of 82 kts, on a slightly descent trajectory, with a roll of 13° on the right side. Due to this aircraft position in flight, the flight direction changed to the right, on 065°, after which the pilot performed a turn on the left side, with an inclination angle in turn, averaging 25°. During this turn, when the aircraft got close to 007° direction, the aircraft had an inclination angle in turn of 21° on the left hand side and a trim of 10° in nose up, this is when the pilot activated the flaps in
APP (Approach) position. In the following 4-5 seconds, as a consequence of the flaps actuating, the speed rapidly decreased to 72 kts, the aircraft stalled and dived uncontrollably on the right wing, with a roll angle of 42° on the right.

Due to the loss of GPS signal the investigation commission estimated the last seconds before the accident occurrence. Thus, in an uncontrolled descent position from almost 85 m (280 ft), with a high roll to the right and with a dive angle of over 20°, the aircraft hit a tree with the left wing tip and impacted the ground with the right wing, on a trajectory that was almost perpendicular to the slope of the eastern slope of the mountain, at an estimated speed of 85 kts.

The accident occurred in Căpățânii Mountains at 15:09, at the altitude of 1620 m (5313 ft), in daylight.

The coordinates of the accident site are:

Latitude – 45°17′58,60″ N; Longitude – 23°51′7,00″ E
1.2 Injuries to persons

<table>
<thead>
<tr>
<th>Injuries</th>
<th>Crew</th>
<th>Passengers</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatal</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Serious</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Minor</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>None</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

1.3 Damage to aircraft

The aircraft was totally destroyed.

1.4 Other damage

There was no other damage. A few trees were broken.

1.5 Personnel information

<table>
<thead>
<tr>
<th>Pilot</th>
<th>Male, 54 years old</th>
</tr>
</thead>
<tbody>
<tr>
<td>License</td>
<td>CPL valid until 08.02.2012</td>
</tr>
<tr>
<td>Medical certificate</td>
<td>Not found</td>
</tr>
<tr>
<td>Flight experience</td>
<td>Almost 8700 hours, out of which 600 hours in MEP class</td>
</tr>
<tr>
<td>Work time</td>
<td>4 hours 20 minutes</td>
</tr>
<tr>
<td>Rest time</td>
<td>2 hours</td>
</tr>
</tbody>
</table>
### 1.6 Aircraft information

#### Aircraft

<table>
<thead>
<tr>
<th>Manufacturer and aircraft type</th>
<th>Diamond Aircraft Industries / DA 42 P7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series number and manufacturing year</td>
<td>42.007 / 2004</td>
</tr>
<tr>
<td>Registration state and mark</td>
<td>Austria, OE-FCD</td>
</tr>
<tr>
<td>Owner</td>
<td>Diamond Aircraft GmbH, Austria</td>
</tr>
<tr>
<td>Keeper (Operator)</td>
<td>Diamond Aircraft GmbH, Austria</td>
</tr>
<tr>
<td>Airworthiness certificate</td>
<td>Flight license valid until 09.05.2007 – 26.04.2008</td>
</tr>
<tr>
<td>Total number of hours</td>
<td>443</td>
</tr>
</tbody>
</table>

#### Engines

<table>
<thead>
<tr>
<th>Engines type and series number</th>
<th>left: TAE-125-01</th>
<th>right: TAE-125-01</th>
</tr>
</thead>
<tbody>
<tr>
<td>S/N</td>
<td>02-01-0232</td>
<td>S/No. 02-01-0255</td>
</tr>
<tr>
<td>Total operating hours</td>
<td>443</td>
<td>443</td>
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</table>

#### Propeller

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>S/N</td>
<td>05244</td>
<td>S/N 05232</td>
</tr>
<tr>
<td>Total operating hours</td>
<td>443</td>
<td>443</td>
</tr>
</tbody>
</table>

The Diamond 42-P7 variant is the Diamond 42 Twin Star model modified for ground laser scanning missions, for this purpose the OAM-42-106 modification was applied to the aircraft in order to mount on the lower part of the fuselage a protection cowling for specific equipment, and the OAM-42-109/b, OAM-42-140 modifications for mounting the scanning equipment. At the date of the accident occurrence, the aircraft with specific changes was a prototype, the type certification for Diamond DA42 – M model was issued by EASA on 18.12.2007.

Diamond DA42 Twin Star is a twin-engine aircraft, with four seats, two piston engines TAE 125-01 and variable pitch propellers MTV-6-A-C-F, manufactured by Diamond Aircraft Industries GmbH. The fuselage is mostly made from composite materials. This aircraft type is provided with two main fuel tanks, with a total capacity of 196.8 liters, out of which 189.2 liters usable.
Propeller

The two propellers are MTV-6-A-C-F/CF187-129 type, with variable pitch, hydraulically controlled. The control mechanism of the propeller pitch is incorporated into the engine. The propeller pitch is automatically controlled by the Engine Control Unit ECU. In order to change the propeller pitch, in the propeller pitch regulator is pumped oil from the engine. Its pressure is controlled by a proportional propeller pitch regulator valve (PPRV), which is electrically controlled by ECU. A pressure increase leads to the decrease of the blade incidence angle and higher revs. A pressure decrease has the effect of increasing the blade incidence angle and decreasing revs. Depending on the engine power settings the propeller pitch is adjusted so as to obtain the necessary revs, according to the below diagram.

Fig. 4 – Speed in relation to the power (extracted from AFM)

Propeller hydro accumulator

The propeller hydro accumulator is of nitrogen – oil type. It is connected to the oil circuit of the gearbox through its own electrical valve, which is activated by the ENGINE MASTER SWITCH. When selecting the switch in ON position this valve opens. During engine operation, the accumulator is filled with oil at a pressure of almost 20 bars (290 psi). The role of this hydro accumulator is to compensate the oil pressure when the oil pressure provided by the engine decreases due to negative acceleration. The oil pressure maintains the propeller pitch under START LOCK position or moves blades after START LOCK position.
In order to put the propeller in feather position the engine must be turned off by positioning the ENGINE MASTER SWITCH in OFF position. This will completely open the PPRV valve, the oil pressure in the regulator will decrease, allowing the blades to move in flag pitch position under counterweights action. At the same time the electric valve of the propeller hydro accumulator closes, allowing the oil storage under pressure. Positioning the propeller in feather position is possible only at propeller speeds over 1300 rpm.

**Ground laser scanning system**

Depending on the specifications of the scanning system, in the protection cowling mounted in the lower part of the fuselage there can be installed one or two LMS-Q560 laser scanners, (in our case only one scanner), an IMU Inertial Measurement Unit and a high resolution digital camera. One of the laser scanners may have a mobile montage that allows it to rotate +/- 45° around its longitudinal axis.
The operation principle is measuring the time between issuing an infrared light pulse to the scanned ground and receiving its reflection. A high frequency of emitting these pulses allows linear, unidirectional scanning and parallel scanning lines.

Aircraft performances

The aircraft performances according to the AFM approved on 28 September 2004, valid for the standard version:

**Speeds**

<table>
<thead>
<tr>
<th>Airspeed</th>
<th>IAS</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>( v_{\text{ma}} ) Maneuvering speed</td>
<td>above 1542 kg (3400 lb)</td>
<td>126 KIAS Do not make full or abrupt control surface movement above this speed.</td>
</tr>
<tr>
<td></td>
<td>up to 1542 kg (3400 lb)</td>
<td>120 KIAS</td>
</tr>
<tr>
<td>( v_{\text{mx}} ) Max. flaps extended speed</td>
<td>LDG</td>
<td>111 KIAS Do not exceed these speeds with the given flap setting.</td>
</tr>
<tr>
<td></td>
<td>APP</td>
<td>137 KIAS</td>
</tr>
<tr>
<td>( v_{\text{lo}} ) Max. landing gear operating speed</td>
<td>Extension</td>
<td>( v_{\text{lo}} ) 194 KIAS Do not operate the landing gear above this speed.</td>
</tr>
</tbody>
</table>

|  | Retraction | \( v_{\text{o}} \) 156 KIAS                                           |
|  | \( v_{\text{ma}} \) Max. landing gear extended speed 194 KIAS Do not exceed this speed with the landing gear extended. |
|  | \( v_{\text{mca}} \) Minimum control speed airborne 68 KIAS With one engine inoperative, keep airspeed above this limit. |
|  | \( v_{\text{mo}} \) Max. structural cruising speed 155 KIAS Do not exceed this speed except in smooth air, and then only with caution. |
|  | \( v_{\text{no}} \) Never exceed speed in smooth air 194 KIAS Do not exceed this speed in any operation. |
Take-off distance

<table>
<thead>
<tr>
<th>values for ISA and MSL, at 1700 kg (3748 lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Take-off distance over a 50 ft (15 m) obstacle</td>
</tr>
<tr>
<td>Take-off ground roll</td>
</tr>
</tbody>
</table>

1.7 Meteorological information

At 14:27 the Air Traffic Service from LRCV transmitted to the pilot by radio the last meteorological report. The weather conditions were the following: wind from 70° direction with the intensity of 2 m/s (3.8 kts), visibility over 10 km, isolated lower clouds with the basis at 3000 ft and stratified at 8000 ft, ground temperature of 22°C, QNH 1015 mbar. At the moment of the accident it was daylight.

At 15:30, 20 minutes after the accident, TWR Craiova tried to contact by radio OE-FCD aircraft for sending the last QNH pressure from the aerodrome namely of 1014 mb, but it received no answer. The modification of 1 mb of atmospheric pressure, uncorrected on the altimeter on board the aircraft, leads to an indication of the flight altitude with a plus of 30 ft (9,14m) from the real one.

1.8 Aids to navigation

The aircraft was equipped with instruments for IFR flights, integral part of Garmin G1000 system. For the ground laser scanning mission the aircraft was limited to VFR flights.

The ground scanning system Riegl LMS-Q560 installed on board of OE-FCD is connected to a control unit of the type IGI CCNS/Aerocontrol for guidance, positioning and control of the scanning sensor during the scanning mission. The CCNS/Aerocontrol unit incorporates a GPS positioning system and a system for measuring the accelerations on the 3 axes of the aircraft. The system is provided with two storage cards of the scanning plan and also registration of GPS data and inertial of the traveled path.

The scanning plan is displayed to the pilot on a dedicated screen, the information provide by it can be used for guidance, being forbidden for air navigation. According to DA42-M AFM Supplement M02 this equipment is not provided with a ground/traffic proximity warning system, therefore the pilot must ensure his own protection of air navigation.
In figure 8 is presented the ground scanning plan in the work area as it was downloaded from the cards of the scanning system. This plan was followed by the pilot in order to perform the scanning mission.

![Fig. 8 – Scanning plan](image)

1.9 Communications

Diamond DA42-M is equipped with an integrated avionics system of the type Garmin G1000, which contains instruments for flight control, instruments to monitor and control the engines, as well as instruments for communications, navigation and GPS.

![Fig. 9 – Garmin G1000](image)
Throughout the duration of the first flight in the occurrence day, as well as during the first part of the second flight, the pilot communicated with TWR Craiova using the on-board station without any problem.

In order to be informed the traffic controller requested the pilot to report any altitude change. Thus, at 14:32 the pilot reported an altitude of 2000 ft (610m), a few minutes later he reported a distance of 25 NM from Craiova Airport (LRCV), and at 15:03 the pilot reported descent to 5100 ft (1554 m).

At 15:30, TWR Craiova (20 minutes after the accident occurrence) called OE-FCD in order to transmit an atmospheric pressure change, without receiving any answer. In this period of time neither TWR Craiova nor the Military Control Center received no emergency call from OE-FCD.

1.10 Flight field data

N/A.

1.11 Flight recorders

The aircraft is not equipped with flight data recorders (FDR) or cockpit voice recorders (CVR).

The aircraft engines are equipped each with an Engine Control Unit of ECU that registers the engines operation parameters. These units are provided with non-volatile memory out of which data have been extracted for the analysis of this accident.

Also, another source of information was the CCNS/Aerocontrol unit which is provided with two storage cards of the scanning plan and of the inertial data, as well as of GPS data of the traveled path.

1.12 Wreckage and impact information

The accident took place in a wooded mountain area, with the slope of almost 60°, having a high density of trees. The wreckage was found with the front part stuck in the ground, with the cockpit turned down, slightly inclined backwards.

Small pieces of the aircraft were spread within a radius of 15 m, and the tip of the left wing was found next to the tip of the first cut tree. Taking into account the aircraft contact marks with the trees and the relatively small area of wreckage parts spreading the commission estimated that the wreckage trajectory before impact was almost vertical.
The investigation commission estimated that the impact with the ground took place at first with the right wing at high speed, the aircraft being inclined on the right hand side and a large dive angle. After the impact the aircraft stopped rolled, with the cockpit towards the ground, right wing completely destroyed, tail assembly broken and turned to the left.

Fig. 10 – Right wing completely destroyed

Fig. 11 – Tail assembly

When examining the wreckage it was noticed the flaps position on APP, as well as the flaps selector position in the appropriate control position.
Fig. 12 – Left wing flaps and flaps selector in APP position

It was also noticed the position of the rudder trimmer selector to the right.

Fig. 13 – Steering compensator selector

Due to the impact with the ground with high speed and dive angle the aircraft was totally destroyed.

1.13 Medical and pathological information

According to forensic reports none of the aircraft occupants drunk alcohol. The commission has no other relevant information.

1.14 Fire

N/A.
1.15 Survival information

There were no survivors.

1.16 Tests and research

During the accident investigation there were performed tests, the following elements being analyzed and interpreted:

a) Photos and recordings taken during flight by the passenger on the front right hand seat (with the support of TSB Canada) – The investigation commission found on site of the accident the passenger’s destroyed cell phone. The memory card of the cell phone was analyzed and there were recovered several photos and short video recordings, taken by the passenger exactly before the accident occurrence.

These data were analyzed by the special photographic laboratory of TSB Canada, leading to the conclusion that the right engine was stopped when the photo was taken. From the photo below it can be noticed that the propeller pitch was not in feather position, but it was in start-lock position.

![Fig. 14 – Right propeller in fine pitch](image)

b) Data downloaded and interpreted from the two ECU engine units – the data were downloaded by the equipment provided by the operator and they were interpreted with the aid of BFU Germany.

c) Download and interpretation of GPS data – downloading the cards of IGI/Aerocontrol system, which contained also the GPS data, was made at the headquarters of BFU Germany.
d) Fuel analysis report – due to the fact that the aircraft fuel tanks were completely broken no fuel samples were taken, but there were taken fuel samples from the cistern used to supply this aircraft. They were analyzed by an authorized laboratory, without discovering deviations from standards.

e) Engines expertise (especially for the right engine), the propeller hubs and the ones of the propellers hydraulic accumulators were performed with the aid of BFU Germania.

The two engines were sent for evaluation and inspection to their manufacturer Thielert Aircraft Engines GmbH aiming especially to determine the causes that led to the uncommand right hand engine stop.

The conclusions of the right hand engine inspection were the following:

1. the gear box / clutch: had no operation abnormalities, the oil filter was not blocked;
2. pistons and cylinder head: no abnormalities were noticed, the performed compression test reveals that for each cylinder the compression was in normal limits;
3. main shaft and cam shaft: no abnormalities were noticed.

Taking into account the above mentioned, the investigation commission established that the right engine was functional, but stopped at the moment of the accident occurrence.

There were also inspected the two propellers, their hubs and the hydro-accumulators, at the headquarters of the manufacturer MT-Propeller, from Straubing locality - Germany.

When inspecting the left engine propeller, the propeller pitch change assembly was found destroyed, indicating an impact with the propeller in rotation. The Start Lock position of the left propeller is determined by the impact.

When inspecting the right engine propeller, a guide rod was found under Start Lock position. This rod had longitudinal scratches on its surface, indicating that the right propeller wasn’t spinning at the moment of the impact. It was estimated an angle of the propeller pitch between 12 and 20 degrees.

The two hydro-accumulators were tested on the test bench. The air valve of the right propeller hydro-accumulator was damaged. After its replacement the accumulator has been tested. It was found that both hydro-accumulators were functional at the moment of the accident occurrence.

f) Analysis of propeller pitch regulating valve (PPRV)

During the inspection of the right engine, it was also check the electric circuit of the proportional propeller pitch regulating valve (PPRV) because it was found a
trace of cabling strangling. Thus, the valve cabling was submitted to a radiological control.

Fig 15 – Electrical cabling of PPRV valve

The valve electrical connector had no abnormalities and one of the cabling wires was found damaged, but not enough to affect the valve operation.

Fig 16 – Electrical connector of PPRV valve and its cabling

It was checked the right engine proportional propeller pitch regulating valve (PPRV). It was performed a series of measurements to determine the electrical resistance of the valve electrical coil at an ambient temperature of 24°C, according to the document issued by Thielert „Befundungsvorgang Proportional Druckreduzierventil Bosch Rexroth FTDRE4“, from 2008-07-01.
All measurement indicated resistance values higher than 500 ohm, and the reference value for this type of measurements is of 12 ohm.

Fig 17 – Measurement with 4 wires using Kinley 2000 multi-meter

To accurately determine the winding condition of PPRV valve electrical coil, it was performed a destructive analysis test.

Thus, the mechanical part of the valve was separated from the electrical part (coil). The plastic coating of the coil was dissolved with formic acid (CH2O2) concentration of 85% in order to check the electrical winding of the coil. After two days the plastic coating of the coil was completely dissolved.

Fig. 18 – Coil body before (left) and after dissolution (right)
One of the coil heads presented a breakage in the bending area.

![Fig. 19 – Interior coiling breakage](image)

It was performed a microscopic analysis of the breakage surfaces to determine the breaking manner of the coil wire. Thus, on the breakage surfaces, both on the one from the coil but also on the one from the connector, there can be noticed marks of the fatigue breakage due to vibrations.
Until the date of this Report, the manufacturer implemented a design change concerning the montage of the unit that maintains the propeller constant speed from the propeller reducer by adding an elastic buffer aiming to absorb the reducer vibrations (SB-TM-TAE 125-0020, Constant Speed Unit - Vibration Isolator).

1.17 Management and organization information

The aircraft owner was Diamond Aircraft Industries GmbH Austria. The lease agreement under "wet lease" was signed between the Romanian operator and Diamond Airborne Sensing GmbH, a 100% subsidiary company of Diamond Aircraft GmbH at the moment of the accident occurrence. According to the agreement OE-FCD aircraft was leased between 17th of September – 30th of November 2007, with the purpose of performing laser scanning air missions on behalf of a Romanian beneficiary. None of the parts provide to the investigation commission the complete wet lease agreement, including its annexes.

Based on the studied documents and the received information the investigation commission found that at the moment, Diamond 42-P7 aircraft, registered OE-FCD, with the manufacture series 42.007, was a prototype, the activities that could have been perform with this aircraft were included in the document PERMIT TO FLY valid between 09.05.2007 – 26.04.2008 and in its annex EASA Form 18B, issued by the
Austrian aviation authority. The type certification for this configuration was issued by EASA at 18.12.2007.

According to this permit to fly, this aircraft was able to perform the following activities: development, demonstrating compliance with certification regulations and specifications, training the pilots from design or production organization, marketing survey, including training the beneficiary’s pilots, aviation exhibitions or meetings (just static presentation).

On 05 of October 2007 the general manager of Diamond Airborne Sensing issued a declaration stating that between this company and the beneficiary of the scanning activity it was concluded a verbal agreement to demonstrate the aircraft capabilities so that the beneficiary shall purchase an aircraft of the same type (marketing survey). After exchanging addresses with Romanian CAA, the investigation commission established that the activity of performing a marketing survey in Romania with a prototype aircraft registered in another state is not regulated in the national legislation.

According to RACR-AOA 0040 (c)(2), for issuing the Approval Letter which allows the Romanian operator to lease an aircraft in “wet lease” system, a series of documents shall be submitted to AACR. As a result of the documents submitted by the Romanian operator, the Romanian Civil Aeronautical Authority issues „the Approval Letter” which allows him to lease the aircraft in “wet lease” system and designates the operator Diamond Aircraft Industries GmbH as responsible for the aircraft operation and maintenance.

The investigation commission did not receive from AACR the following documents stipulated in RACR-AOA 0040 (c)(2) requirements:

- The aircraft airworthiness certificate – the aircraft was a prototype, having a permit to fly with commercial flight restrictions.

- The copy of the authorization document belonging to the foreign air operator (according to the written statement of CEO Diamond Aircraft GmbH Austria this company was never an air operator).

- The written confirmation from the aeronautical authority of the registration state concerning its insurance of airworthiness and functional surveillance of the aircraft.

On 08 of April 2015 the investigation commission received a statement from CEO Diamond Aircraft Industries GmbH and its subsidiary Diamond Airborne Sensing GmbH that none of these two organizations was and is not an air operator.

The Romanian air operator had at that moment an Air Operator Authorization which allowed him to perform aerial work of aerofotogrammetria, with the specification that the aerofotogrammetria operations are limited to air photo shooting and filming, and the owned aircraft was an Antonov AN-2 type.
2 ANALYSIS

In analyzing the last part of the flight the investigation commission could not benefit from the information provided by a flight data recorder (FDR) and/or by a cockpit voice recorder (CVR). In this situation, investigation commission used the data registered by the ECU units of the two engines, as well as the GPS data and the inertial data registered by the CCNS/Aerocontrol system which are considered objective data and that may lead to a correct hypothesis on how this accident happened.

![Aircraft evolution after the stop of the right engine](image)

**Fig. 21 – Aircraft evolution after the stop of the right engine**

<table>
<thead>
<tr>
<th>Event</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opreire motor</td>
<td>Engine stop</td>
</tr>
<tr>
<td>Sfârșitul urcării</td>
<td>End on climb</td>
</tr>
<tr>
<td>Acționare Flaps</td>
<td>Flap Actuating</td>
</tr>
<tr>
<td>Pierderea controlului</td>
<td>Loosing control</td>
</tr>
<tr>
<td>Impact</td>
<td>Impact</td>
</tr>
</tbody>
</table>

Analyzing the aircraft evolution in the last part of the flight, the commission found that the pilot was facing the right engine uncommanded stop, at a speed of 95 kts and a height of 250 m (820 ft) from the ground (flight altitude of 1707 m (5600 ft)). This engine stop took place after scanning a segment situated along Valea Oltețului,
flying on north direction (022°), a few seconds after the pilot actuated the controls to gain speed and height.

According to the aircraft flight manual, the condition for obtaining a climb rate is that the aircraft has the following configuration: flaps in 0° position, functional engine at full power (2300 rpm), propeller of stopped engine in feather position, speed of 82 KIAS and secured stopped engine (power lever in zero/feather position and Engine Master Switch in OFF position).

From the passenger's photos analyzed at TSB Canada, it was noticed that the right engine propeller was not spinning and the pith was not in feather position. The fact that the prop pitch wasn't secured in feather position, transformed the propeller into an additional aerodynamic drag on this side.

According to the available data the pilot accelerated the left engine to the maximum (2300 rpm) and he tried to climb so that he would pass the quotas of the surrounding mountains peaks. The speed reduced at 82 kts and the airplane registered a yaw movement of almost 17° on the side of the stopped engine. The gained altitude was 20 m (65 ft), a small gain compared with the increase of the ground quota along the followed flight trajectory.

The pilot tried to maintain this speed, because the 82 kts speed is according to the flight manual the optimum speed of obtaining a climbing rate. In the same time, it is also the speed at which can be obtained the lowest descent rate.

After the right engine stop, the aircraft managed to perform a climbing flight for only 10 seconds. At that moment it flew on 039° direction, inclined 13° on the right side, with a nose up of 5°. In order to counteract the tendency to yaw and tilt on the right hand side, as well as to obtain an aircraft attitude with a minimum drag coefficient, it should be applied a steering rudder to the functional engine side and to maintain the inclination position of 3° - 5° on the left. The pilot managed to obtain this flight altitude after 22 seconds of flight since the engine stopped, the aircraft being already oriented on 070° direction, heading towards the eastern slope of the mountain and with an average descent rate of 1 m/s (196 ft/min).

Taking into account that when examining the wreckage, the rudder trimmer was found in a compensation position to the right hand, the investigation commission considers that the accentuated change of direction to the right hand side (off 48°) was caused by the steering rudder of the aircraft direction to the right hand side, probably used during previous maneuvers. This was amplified by the yaw effect to the right and had as consequence a bigger effort in the rudder pedals and a longer time for counteracting the aircraft turning tendency.

Then the pilot decided to make a turn to the left hand side, towards north, most likely to gain time and space for maneuvering. From the analysis of the inertial data the investigation commission noticed that the turn on the left was performed with...
an angle between 24° and 31°, but with an aircraft nose up tendency during its all performance. The nose up tendency is explained through the center of gravity which positioned a lot to the rear (see the load and balance analysis below).

When examining the wreckage the investigation commission noticed that the flaps were in APP position as a consequence of a cockpit control. By correlating GPS and inertial data, the Commission considers that the moment when the flaps were actuated was at approximately 33 de seconds after the engine stopped, when exiting from the last turn. The speed at that moment was 78 kts and the altitude 1710 m (5610 ft).

Taking into account that in the aircraft flight manual, when flying with only one engine, flap actuation is allowed only during the landing phase and when a firm landing is decided, the investigation commission considers that it is possible that the reasons on which it was based the pilot’s decision of acting the flaps at that moment, may be one of the following:

a) The pilot tried to prepare a forced landing at as lower speed as possible, probably observing the flight direction, at almost the same altitude and at a distance of 1 km, an deforested area

b) The pilot tried to increase the lifting force and to decrease the stall speed, given the aircraft evolution was of descent and speed reduction.

c) The pilot tried to counteract the aircraft nose up tendency by displacing the pressure center closer to the gravity center position.

The effect of this flap actuation, under asymmetric thrust conditions, was to induce a new drag factor which led to reducing speed at 72 kts. Additionally, when the flaps are extended, the aircraft is laterally less stable due to pressure center displacement closer to the wing embedding. This increases the aircraft tendency to be more instable in rolling, which may lead to the increase of the wing critical angle. In such configuration, in order to stabilize the aircraft, it is required a wider use of the ailerons, but their use must be carefully monitored, because when the flaps are extended the aircraft can stall sooner on a wing.

Assuming that the pilot was trying to stabilize the aircraft by inclination control to the left (a natural reaction), the effect of lowering the right aileron, combined with the flaps actuating, was to increase even more the friction coefficient on the right wing and to increase the wing angle of attack. At that moment the right wing lost the lifting force, causing a rolling moment to the right. The rolling movement increased even more the right wing angle of attack and it delayed the engagement of the left wing, emerging an asymmetric stall phenomenon on the right wing, phenomenon amplified also by the airflow induced by the left engine to a maximum rpms. The aircraft dived on the right, with an inclination angle of 42°. The investigation commission considers that due to this descent flight with a pronounced dive angle,
due to the turbulences created by the flaps lowering, as well as due to the tail assembly in T form, the pilot also faced an ineffectiveness of the elevators control.

It was also found that the GPS receiver lost the signal from satellites 3-4 seconds before the impact, which confirms the dive at a high rolling angle. Due to GPS signal loss, the commission estimated the last seconds of the flight. Thus, being in uncontrolled dive on the right wing at an angle of 45°-60°, the aircraft hit the top of a tree with the left wingtip, which amplified the rolling moment to the right and it hit the eastern slope of the mountain with the right wing, almost perpendicularly, at an estimated speed of 85 kts. The accident occurred at approximately 45 seconds from the stop of the right engine.

The investigation commission considers that in this situation, taking into account the flight at low height from the ground, the aircraft equipping configuration, the pilot had little time at disposal and limited options to intervene in due time to recover the aircraft from its evolution, evolution with only one operative engine and with the propeller of the stopped engine inducing an additional drag resistance force. The ground configuration, which on the flight direction was with increase of slope altitude, may be considered an additional element that reduced even more the required time for recovering the aircraft.

**ECU data**

There were downloaded and interpreted the data registered by the two engine control units (FADEC), S/N1740A (left hand engine) and S/N1742A (right hand engine). Thus, it was determined that the right engine stopped 45 seconds before the aircraft impact with the trees/ground (see figure 22).
Fig. 22 – Right engine parameters
(blue – power lever position, black – engine speed, red – intake manifold pressure)

<table>
<thead>
<tr>
<th>Comanda accelerare</th>
<th>Acceleration command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Momentul opririi motorului 2</td>
<td>Moment of engine no. 2 stop</td>
</tr>
</tbody>
</table>

From the chart above it was noticed that the pilot gave control to accelerate the engine, and after almost 15 seconds the right engine stopped uncommanded (pressure decreasing in the intake manifold and engine speed decreasing before reducing the gas lever position). At approximately a second later the pilot reduced the gas lever of the affected engine. The continuing registration of the engine parameters by ECU indicates that the pilot did not put the RH ENG MASTER switch in OFF position, as required by the propeller securing procedures in feather position (according to AFM 3.5.3). A sudden speed decrease and the uncommanded engine stop indicates a high engine load, inappropriate for the power settings at the time. This phenomenon is associated with the rapid and uncontrolled increase of the propeller pitch, which leads to a high aerodynamic load on its blades.

**Aircraft performances with one operative engine**

According to the statements of the Romanian operator representative, when arriving on Craiova airport, a day before the accident occurrence, the aircraft was fueled with Jet A1 fuel type at maximum capacity.

On the day of the accident, the aircraft performed a first ground scanning flight of 3 hours and 54 minutes, landing on Craiova Airport for refuel.
In order to perform the second flight of the day, the aircraft was fueled with 120L of fuel, with the specific density of 0.806 kg/L, having again on board the maximum amount of fuel (196L). This is also confirmed by the long take-off run distance of, approximately 750 m (2460 ft), almost double in comparison with the distance of 348 m (1142 ft) specified in AFM.

The weight of the empty aircraft, according to the latest weighing bulletin from the 10 of November 2006, was 1397 kg, bigger than the standard weight due to the lower cowl and to the installed laser scanning system.

To calculate the total actual weight of the aircraft on takeoff, the investigation commission took into consideration the following data:

- average weight of a passenger (male): 82 kg (x 3 persons)
- weight of empty aircraft: 1397 kg
- weight of fuel onboard: 189L x 0.806 kg/L = 152 kg

Thus, the aircraft weight on takeoff was 1795 kg, with 95 kg over the maximum take-off weight of 1700 kg certified at that moment for this aircraft.

Using the data downloaded from FADEC units of the engines and of the consumption chart from AFM, the commission calculated the fuel consumption from the engines start till the accident occurrence, it was of almost 38 liters. Considering this specific density, the weight of the consumed fuel is 30 kg. Therefore, when the right engine stopped the aircraft weighted 1765 kg.

To calculate the exterior temperature when the accident occurred there are taken into account the following elements:

- Temperature change rate with the height of 2°C / 1000 ft.
- Quota of Craiova Airport is of 626 ft (191 m) MSL.
- Ground temperature 22°C.
- Flight height of the airplane when the engine stopped was of 5675 ft.

Based on these data the commission calculated the air temperature at the flight height of 12°C.

Using the aircraft weight, the flight height and the exterior temperature, it can be calculate the climbing rate with only one engine, using the appropriate chart available in AFM (see figure below).
Fig. 23 – Climbing rate with only one engine

A calculated climbing rate of 70 ft/min (0.4 m/s) is obtained. According to AFM Supplement M01 no.7.01.05-E/21Nov2007, due to the aerodynamic changes by adding the belly pod, the climbing performances are altered with 50 ft/min, resulting a calculated theoretic climbing rate of 20 ft/min (0.1 m/s), a climbing rate too small for passing the surrounding mountain peaks. AFM Supplement M01 no.7.01.05-E/21Nov2007 was issued after the accident occurrence. In reality, due to the weight above the maximum limit, as well as to the inadequate flight attitude for the flight with only one functional engine, the aircraft did not manage to obtain a climbing rate.

According to the aircraft flight manual, the condition to obtain a climbing rate is that the aircraft shall have the following configuration: flaps in 0˚ position, functional engine at maximum power (2300 rpm), stopped engine propeller pitch in feather position, speed of 82 KIAS and secured stopped engine (power lever in zero/feather position and Engine Master Switch in OFF position).

Another condition to put the propeller in feather position (in order to obtain an as small as possible friction coefficient) is that its rotation speed to be over 1300 rpm. According to the charts presented in figures 4 and 22 the propeller speed at the time of fault was of 2200 rpm. Based on the operation principle described above, the right propeller entered in feather position under the action of counterweights. But in order to remain in this position it is necessary to put the ENGINE MASTER SWITCH in OFF position to prevent discharge of the propeller hydro-accumulator and propeller movement from feather position. From data analysis and taking into account that the right engine ECU recorded parameters till the moment of the impact, the investigation...
commission found that the pilot failed to act on the propeller securing procedure in feather position from AFM cap. 3.5.3., having as consequence the transition of the propeller pitch from feather to start-lock position (with increased drag effect).

The AFM M01 supplement was published after the accident occurrence. After the discussions had with the representative of the aircraft owner the commission could not establish if the pilot at the moment of the accident, have knowledge about the alteration of aircraft performances due to structural modifications.

**Flight Manual (AFM)**

The investigation commission analyzed Chapter 3 – Emergency Procedures of the Flight Manual for this aircraft type, especially 3.5 – One engine inoperative procedures, containing the following subchapters:

3.5.1. – Detecting the inoperative engine
3.5.2. – Engine troubleshooting
3.5.3. – Engine securing (feathering) procedure
3.5.4. – Unfeathering & Restarting the engine in flight
3.5.5. – Engine failure during take-off
3.5.6. – Engine failures in flight
3.5.7. – Landing with one Engine Inoperative
3.5.8. – Go-around/Balked Landing with one engine inoperative

It was noticed that this chapter recommends the performance of a restart procedure of the stopped engine before securing the propeller in flag pitch (see figure 24). Even if the subchapter 3.5.2. – Engine troubleshooting contains warning and notifications on the priority of obtaining an adequate control of the aircraft, among them it is not found any warning or observation regarding the necessary condition of maintaining the propeller speed over 1300 rpm for placing it in feather position. This element can lead to the very likely situation in which the pilot tries to restart the stopped/damaged engine, without knowing exactly the cause of the engine stop and without acknowledging that by applying this procedure the propeller will remain in start-lock position.
Also, even in the subchapters 3.5.3. – Engine securing (feathering) procedure and 3.5.4. – Unfeathering & Restarting the engine in flight is not specified this notification on the propeller minimum speed for placing it in feather position, nor the risk that, in case of a failed restart, the propeller pitch shall remain in start-lock position, becoming a drag force.

Concerning the warning system of the stalling speed described in subchapter 7.12 – Stall Warning System, the investigation commission found no reference on the speed at which the warning is issued in relation to the approach to the stalling speed (see figure below). Also, it is not specified the wing critical angle of attack at speed limit.
7.11 PITOT-STATIC SYSTEM

Total pressure is measured at the leading edge of a Pitot probe under the left wing. Static pressure is measured at two orifices at the lower and rear edges of the same probe. To protect against dirt and condensation there are filters in the system, which are accessible from the wing root. The Pitot probe is electrically heated.

With the alternate static valve, the static pressure in the cabin can be used as static pressure source in the event of a failure of the Pitot-static system.

7.12 STALL WARNING SYSTEM

The lift detector of the DA 42 is located on the front edge of the left wing below the wing chord line. It is supplied electrically and provides a stall warning, before the angle of attack becomes critical. The stall status is announced to the pilot by a continuous sound in the cockpit.

The lift detector vane, the mounting plate and the complete housing are heated to prevent icing. Heating is engaged together with the Pitot heating.

Fig. 25 – Extracted from AFM chap. 7.12 – Stall Warning System

Load and balance

<table>
<thead>
<tr>
<th></th>
<th>Mass (kg)</th>
<th>Moment arm (m)</th>
<th>Mass Moment (kg/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empty mass</td>
<td>1397.00</td>
<td>2.48</td>
<td>3470.15</td>
</tr>
<tr>
<td>Front seats</td>
<td>164.00</td>
<td>2.30</td>
<td>377.20</td>
</tr>
<tr>
<td>Rear seats</td>
<td>82.00</td>
<td>3.25</td>
<td>266.50</td>
</tr>
<tr>
<td>Nose baggage compt.</td>
<td>0.00</td>
<td>0.60</td>
<td>0.00</td>
</tr>
<tr>
<td>Cockpit baggage compt.</td>
<td>0.00</td>
<td>3.89</td>
<td>0.00</td>
</tr>
<tr>
<td>De-icing fluid</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>Total mass &amp; total moment with empty fuel tanks</strong></td>
<td><strong>1643.00</strong></td>
<td><strong>2.50</strong></td>
<td><strong>4113.85</strong></td>
</tr>
<tr>
<td>Usable fuel, main tanks</td>
<td>152.40</td>
<td>2.63</td>
<td>400.85</td>
</tr>
<tr>
<td><strong>Total mass &amp; total moment with fuel</strong></td>
<td><strong>1795.40</strong></td>
<td><strong>2.51</strong></td>
<td><strong>4514.66</strong></td>
</tr>
</tbody>
</table>
From the above diagram, extracted from AFM, it is noticed that the gravity center is far outside the safety tire, 2.51 m respectively, behind the maximum reference value of 2.49 m.

These values might explain why the aircraft had a descent evolution, even if there were met the speed conditions for maintaining the altitude with a non-functional engine. If the center of gravity is behind the rear limit this leads to the reducing of the longitudinal stability, the aircraft becomes unstable, and the gliding angle is difficult to maintain due to the aircraft tendency to nose up.

**Scanning procedure**

After discussions with the aircraft owner, the investigation commission could not obtain an Operational Manual or an approved procedure for the performance of ground scanning missions. The aircraft owner was not an authorized air operator, and the Romanian operator did not have such a procedure, his authorization being limited to air photo shooting and filming.
The investigation commission did not receive any clear ground scanning procedures, but after the discussions, after studying the collected data and the technical performances of the technical equipment, the investigation commission makes the following analysis:

- The flight took place only by following the scanning plan, developed and loaded in the scanning equipment by Diamond Airborne Sensing.

- After analyzing the data contained by the memory card of the scanning equipment the commission found that the working height on the third segment of the scanning plan varies between 312 m (1023 ft) and 84 m (275 ft).

- The scanning plan was filed by the pilot with the equipment settings, the repetition rate of 175 KHz respectively, the scanning angle of $60^\circ$, the scanning speed of 90 kts. According to the discussions had with the manufacturer of the scanning equipment, the scanning height for such settings could have been up to maximum 600 m AGL (Above Ground Level).

- Even if the decision of performing the mission and the manner in which it took place belonged to the pilot in command, the investigation commission considers that using a partial scanning plan below the quotas of the mountains peaks was determined by economic reasons, a scanning from a lower height having as result only one passing above the area, a flight height at the maximum limit of the equipment requiring at least two crossings over for the same resolution.
3 CONCLUSIONS

3.1 Findings

The safety investigation commission makes the following findings:

1) The aircraft was a prototype, the type certification for this variant being issued by EASA on 18.12.2007, after the accident occurrence;

2) The aircraft had no Airworthiness Certificate;

3) The aircraft had a PERMIT TO FLY with EASA Form 18B annex valid between 09.05.2007 – 26.04.2008, issued by the Austrian aviation authority which allowed Diamond Airborne Systems to perform the following activities: development, demonstrating compliance with certification regulations and specifications, training the pilots from design or production organization, marketing survey, including training the beneficiary’s pilots, aviation exhibitions or meetings (just static presentation);

4) There is a discrepancy between the object of the aircraft wet lease agreement (the activities that the aircraft was supposed to carry out) and the aircraft PERMIT TO FLY (activities that the aircraft was allowed to carry out);

5) The aircraft Flight Manual was not amended with the new modifications OAM-42-106, OAM-42-109/b and OAM-42-140. Its supplements were approved after the accident occurrence;

6) Between the aircraft owner and the scanning activity beneficiary was concluded a verbal agreement to prove the aircraft capabilities in order for the beneficiary to purchase an aircraft of the same type;

7) Romanian CAA issued the Letter of Approval although the requirements of RACR-AOA 0040 (c) (2) were not fulfilled;

8) Romanian Civil Aeronautical Authority, through the “Letter of Approval” no. 19266 / 20.09.2007 designated as responsible for operating and maintaining the aircraft, the operator Diamond Aircraft Industries GmbH; CEO Diamond Aircraft Industries GmbH and its subsidiary Diamond Airborne Sensing GmbH issued a statement according to which none of these two organizations was and is not an air operator;

9) No Operational Manual or approved procedure for the performance of ground scanning missions could have been obtained;

10) Between the aircraft owner and the Romanian air operator was concluded a wet lease agreement;

11) The flight was performed under (VFR) visual flight rules;

12) The pilot had the valid license;

13) The accident occurred in the second flight performed in that day;
14) When the accident took place the left engine functioned at maximum speed, and the right engine was stopped;
15) The engine stopped due to the failure of the propeller pitch regulating valve (PPRV);
16) When the accident occurred the right hand propeller was not in feather position;
17) RH ENG MASTER SWICH was found in ON position;
18) The flaps were found in APPROACH position;
19) Positioning and maintaining the propeller in feather position depends on compliance with a specific procedure which is manually performed by the pilot;
20) In chapter 3.5 – One engine inoperative procedures of the Flight Manual it is not mentioned the propeller minimum rotation of 1300 rpm as a necessary condition to put the propeller in feather position;
21) In Chapter 3 – Emergency procedures, of the Aircraft Flight Manual there is no warning regarding the risk of the propeller pitch to remain in start-lock position in case of engine restart failure;
22) The aircraft weight was over the maximum admitted limit;
23) The center of gravity was outside the limits recommended by the manufacturer;
24) The aircraft was fueled at maximum capacity;
25) The flight height was not maintained with only one operative engine, the aircraft performances were altered by its weight over the admitted limit and by the difficulty of applying the procedures from AFM for the flight with an inoperative engine.

3.2 Causes of accident occurrence

The probable cause of the accident occurrence is the inability to control the aircraft attitude with belly pod scanning system configuration, on a flight with one inoperative engine

Favoring causes:
1) Right engine stop due to the failure of the propeller pitch regulating valve (PPRV).
2) Stopped engine propeller pitch moving from feather position.
3) Flaps actuation without the aircraft being stabilized after exiting the turn and in speed limit conditions.
4) Aircraft weight over the maximum admitted limit.
5) Center of Gravity behind the rear limit provided by the manufacturer.
6) Performing the scanning mission in a mountainous area, below the quotas level of the surrounding mountains.
4 RECOMMENDATIONS

The investigation commission makes the following safety recommendations:

1. It is recommended for Diamond Aircraft Industries to modify the propeller pitch control system so that it allows, in emergency situation, the propeller feathering in case of an engine failure restart.

2. It is recommended for Diamond Aircraft Industries to amend the Flight Manual by modifying in chapter 3.5 – *Single engine operation procedures* the order of sub-chapters so that the pilot receives the information of propeller securing in feather position, of obtaining a safety flight profile (speed and height) before identifying the cause of the engine stop and the restart in flight procedure.

3. It is recommended for Diamond Aircraft Industries to amend the Flight Manual by introducing in chapter 3.5.4. – *Moving from feather position and engine restarting* the warning on the risk that the propeller pitch might remain in start-lock position in case of unsuccessful restarting during flight of the stopped engine.

4. It is recommended for Diamond Aircraft Industries to amend the Flight Manual by modifying in chapter 5.3.4. – *Stall speeds* with the completion of the critical incidence angle at speed limit.

5. It is recommended for Diamond Aircraft Industries to amend the Flight Manual by introducing in chapter 7.12 – *Stall Warning System* the speed at which it is issued the stall warning in relation with approaching to the stall speed.

6. It is recommended for the Ministry of Transports and Romanian CAA to regulate the conducting manner on the territory of Romania of the test flights for aircraft with a „Permit to Fly” authorization, registered in another state.

7. It is recommended for the Ministry of Transports and Romanian CAA to regulate the conducting manner on the territory of Romania of the capabilities demonstration flights (market survey) for aircrafts with a „Permit to Fly” authorization, registered in another state.

8. It is recommended for Romanian CAA to specify in the „Letter of approval” for the acceptance of an aircraft wet lease agreement by an authorized air operator, of an aircraft with a „Permit to Fly” authorization issued by EASA or by the authority of the registration state, of the type of the activities that the aircraft is allowed to perform, according to the limitations within the “Permit to Fly”.
9. It is recommended for Romanian CAA to carry out the ramp inspection for aircrafts with „Permit to Fly” authorization each time they are positioned in Romania for performing any air operations.

Note: The documents and analysis objects used for the issuance of the flight safety investigation Report are confidential and are archived at the Civil Aviation Safety Investigation and Analysis Center, according to legal provisions.