FINAL REPORT

ACCIDENT 580/16

Państwowa Komisja Badania Wypadków Lotniczych (PKBWL)

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FINAL REPORT

ACCIDENT

OCCURRENCE NO – 580/16

AIRCRAFT – McDonnell-Douglas MD-500E helicopter, N60EP

DATE AND PLACE OF OCCURRENCE – 7 April 2016, Suwałki, Poland

This Report is a document presenting the position of the State Commission on Aircraft Accidents Investigation concerning circumstances of the air occurrence, its causes and safety recommendations. The Report was drawn up on the basis of information available on the date of its completion.

The investigation may be reopened if new information becomes available or new investigation techniques are applied, which may affect the wording related to the causes, circumstances and safety recommendations contained in the Report.

Investigation into air the occurrence was carried out in accordance with the applicable international, European Union and domestic legal provisions for prevention purposes only. The investigation was carried out without application of the legal evidential procedure, applicable for proceedings of other authorities required to take action in connection with an air occurrence.

The Commission does not apportion blame or liability.

In accordance with Article 5 paragraph 6 of the Regulation (EU) No 996/2010 of the European Parliament and of the Council on the investigation and prevention of accidents and incidents in civil aviation […] and Article 134 of the Act – Aviation Law, the wording used in this Report may not be considered as an indication of the guilty or responsible for the occurrence.

For the above reasons, any use of this Report for any purpose other than air accidents and incidents prevention can lead to wrong conclusions and interpretations.

This Report was drawn up in the Polish language. Other language versions may be drawn up for information purposes only.

WARSAW 2020

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ABBREVIATIONS

AGL	**Above Ground Level**
EASA	**European Aviation Safety Agency**
ELT	**Emergency Locator Transmitter**
FAA	**Federal Aviation Administration**
ICAO	**International Civil Aviation Organization**
KPP	**County Police Headquarters**
LTE	**Loss of Tail Rotor Effectiveness**
NTSB	**National Transportation Safety Board**
OC	**Civil Liability**
PKBWL	**State Commission on Aircraft Accidents Investigation [Poland]**
PPL(A)	**Private Pilot License (Airplanes)**
PPL(H)	**Private Pilot License (Helicopters)**
ULC	**Civil Aviation Authority [Poland]**
UTC	**Universal Time Coordinated**
VMC	**Visual Meteorological Conditions**

GENERAL INFORMATION

Occurrence reference number:	580/16			
Type of occurrence :	**ACCIDENT**			
Date of occurrence:	7 April 2016			
Place of occurrence	Suwałki, Poland			
Type and model of aircraft:	McDonnell-Douglas MD-500E helicopter			
Registration marks:	N60EP			
Aircraft User/Operator:	Salag Sp. z o.o.			
Aircraft Commander:	PPL(H)			
Number of victims/injuries	Fatal	Serious	Minor	None
	0	2	0	0
Domestic and international authorities informed about the occurrence	ULC, EASA, NTSB, ICAO			
Investigator-in-Charge:	Andrzej Pussak			
Investigating Authority:	State Commission on Aircraft Accidents Investigation (PKBWL)			
Accredited Representatives and their advisers:	None			
Composition of Investigation Team:	A. Pussak, T. Makowski, P. Lipiec*)			
Document containing results:	FINAL REPORT			
Safety recommendations:	NONE			
Addressees of the recommendations:	NOT APPLICABLE			
Date of completion of the investigation:	14 July 2020			

SYNOPSIS

On 7 April 2016, around 14:13 hrs UTC (all times in the Report are in UTC), the pilot/owner of the MD-500E helicopter together with the passenger/assistant decided to perform a flight to take aerial photos of the newly built facilities of the company: production hall, hangar and helipad.

After take-off, the pilot made one circle over the premises of the company, and then, at a height of about 40 m, commenced hover in the area of the new facilities.

During the hover, the helicopter abruptly lowered the tailboom and then entered the right yaw with the left bank angle. In this attitude the helicopter collided with the ground and fell over on its left side.

The pilot and passenger suffered serious injuries and left the helicopter with assistance of witnesses, and the helicopter was destroyed.

The investigation into the occurrence was conducted by the PKBWL Investigation Team in the following composition:

Andrzej Pussak	- Investigator-in-Charge
Piotr Lipiec*)	- team member (until 13 Nov 2016)
Tomasz Makowski	- team member

**) As a result of organizational changes in PKBWL after 13 November 2016 and expiration of Piotr Lipiec's contract with PKBWL, in accordance with Art. 2 item 6 of the Act of 22 July 2016 amending the Aviation Law (Journal of Laws, item 1361), the investigation of the occurrence was continued by the team composed of A. Pussak and T. Makowski.*

During the investigation PKBWL determined the following cause of the accident:

The most likely cause of the accident was a stall of the main rotor caused by the pilot's excessive reaction to a thermal gust.

The factor contributing to the accident could have been the phenomenon of thermal gusts.

PKBWL has not proposed any safety recommendation after conclusion of the investigation.

1. FACTUAL INFORMATION

1.1. History of the flight

On 7 April 7 2016 at 14:13 hrs UTC (all times in the Report are in UTC), after preparation of the McDonnell-Douglas MD-500E helicopter for flight and making sure that the fuel quantity was sufficient for the intended flight, the pilot with a passenger on board took off from the helipad located at Platynowa Street in front of a small hangar on the premises of Salag Sp. z o.o. company, located in the industrial zone south of Suwałki.

In accordance with the Flight Manual, the pilot occupied the left seat and the passenger the right one. The purpose of the flight was to take aerial photos of the newly built facilities of the company: production hall, hangar and helipad.

To make it easier for the passenger to take pictures, the flight controls on the right side had been removed.

After take-off, the pilot climbed to around 40 m AGL and hovered above the company premises, while the passenger was getting ready to take photos.

About 3 minutes after take-off, the helicopter the helicopter abruptly lowered the tailboom and the pilot lost control over it. Then the helicopter entered the right yaw with the left bank angle, made two full turns around its vertical axis and collided with the ground about 230 m from the take-off site, falling over onto his left side.

The left skid was the first to come into contact with the ground (and young trees), and then the main rotor blades hit the ground (due to their deformation "into a tulip" as a result of a stall). During the collision the tailboom was broken and the tail rotor blades were cut off by the main rotor blades, which dropped elastically after the helicopter collided with the ground and then returned to the "tulip" deformation state.

During the impact the descent rate was about 11,6 m/s and produced deceleration value sufficient to activate the ELT transmitter.

As a result of the accident, the helicopter was destroyed, and the pilot and passenger suffered serious injuries and left the helicopter with assistance of witnesses.

1.2. Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	**-**	**-**	**-**
Serious	**1**	**1**	**-**
Minor	**-**	**-**	**-**
None	**-**	**-**	**-**
TOTAL	**1**	**1**	**0**

1.3. Damage to aircraft

The helicopter was completely destroyed as a result of the collision with the ground and obstacles (trees, fence post).

The condition of the helicopter after the accident is shown in the photos below and in detail in the Album of Illustrations – Annex 1 to the Report.

1 – Helicopter at the accident site, bottom view [photo: PKBWL].

2 – Helicopter at the accident site, front view [photo: PKBWL].

As a result of the collision with the ground and then rescue and firefighting operation the helicopter sustained the following damage, which in practice meant its total destruction:

- main rotor blades - destroyed;
- left landing gear - destroyed (broken struts, partly detached from the fuselage);
- structure of the cabin part of the fuselage - substantially damaged (substantial damage to the lower skin during firefighting operation, dents and tears of the skin);
- windshield and glass parts of the roof and doors - broken;
- powerplant cowlings – separated and locally dented;
- tailboom - destroyed ((its rear part broken off together with the tail rotor shaft and its angular gear and vertical stabilizer, the pusher of the tail rotor blade pitch control system - bent);
- horizontal stabilizer - detached;
- tail rotor – destroyed (broken blades);
- the structures of the pilot and passenger seats – deformed;
- local displacements of the cabin inside equipment;
- puncture of the fuel tank under the cabin floor and fuel leakage.

The damage to the helicopter is shown in detail in the Album of Illustrations (Annex 1 to this Report).

1.4. Other damage

During the collision of the helicopter with the ground and the rescue and firefighting operation, about 12 meters of wire mesh fencing and 2 trees (young pines) were damaged. There was also local (point) contamination of the soil slowly leaking from the damaged helicopter fuel system with JET A-1 fuel in the amount of at least several dozen liters

1.5. Personnel information (crew data)

Commander of the aircraft (PIC) – male, aged 47, with the following data:

- Private Pilot Certificate issued by FAA (USA) on 23 October 2003;
- Ratings:
  - AIRPLANE SINGLE ENGINE LAND;
  - INSTRUMENT AIRPLANE;
  - ROTORCRAFT-HELICOPTER;
- Medical Class:Third, Medical date: 10/2015; must wear corrective lenses;
- Flight experience:
  - total – approx. 1000 flight hours;
  - on helicopters – approx. 200 hours, all on MD-500E (according to the pilot's statement).

Passenger – male, aged 35, no flight crew qualifications.

1.6. Aircraft information

Airframe: Designed and manufactured by Hughes as Hughes Model 500 / Hughes 369 (first flight 27 February 1963). When McDonnell-Douglas acquired Hughes, it was built as MD-500. The MD-500E version was first flown on 28 January 1982.

The fuselage is a semi-monocoque structure based on two 2 A-shaped frames converging at the main rotor head mounting. The legs and skids of the landing gear are also mounted to these frames.

Tailboom in the form of a conical tube made of duralumin, powerplant with engine situated behind a 4-seat cabin, engine accessible through moving covers. Metal tail empennage. Five-blade main rotor, blade structure: duralumin coating hot-glued around the spar of a special duralumin profile. Two-blade tail rotor, blade construction: duralumin skin riveted to tubular spars.

Skid-type landing gear with dampers. Mechanical (pusher) control system without hydraulic support.

The helicopter was operated in:

- UK – registered as G-TMJH (deregistered 30 March 1991);
- Germany – registered as D-HGTJ;
- Austria – registered as OE-XFB;
- Germany – registerted as D-HMEB;
- France – registered as F-GTCT (14 Mar 2001), deregistered 15 Apr 2013);
- USA – registered as N60EP (16 April 2013).

Prior to registration in the USA, the helicopter was brought into a state conforming to its type certificate (FAA Certification 2519879, issued on 30 May 2013) and approved in the Normal category.

The helicopter was intended to be registered in Poland, therefore the Polish registration marks SP-TAG were reserved for this purpose.

Year of manu-facture	Manufacturer	Airframe Serial No	Registration marks	Register No	Register date
1984	Hughes/McDonnell-Douglas Helicopter USA	0033E	N60EP	N/A	16.04.2013

Certificate of Airworthiness issued by FAA:……. 16 Apr 2013;
FAA Certificate of Airworthiness valid until:……. 30 Apr 2016;
Airframe Total Flight Time Since New:……. 2809,0 h*);
Airframe flight time since last repair or check:……. 4,8 h**);
Airframe Total Cycles Since New:…….4345*);
Airframe Cycles since last repair or check:……...6**);
Date of the last periodic inspection (100H):……. 10-12 Nov 2015.

Engine: Turboshaft Allison 250-C20B, shaft power 313 kW (420 shp), mounted diagonally in the rear part of the fuselage, drive transmission: shafts and bevel gears. Fuel system: two flexible tanks at the bottom of the fuselage (under cabin floor) and an auxiliary tank behind the rear seats with a total capacity of 312 l.

Year of manufacture	Manufacturer	Serial number
1982	Rolls-Royce/Allison	CAE 835156

Date of installation on airframe (other than 0033E): 12 Nov 1983;
Takeoff power rating…….....420shp (313kW);
Used takeoff power…….....……. 375 shp (276 kW);
Maximum continuous power…… 350 shp (258 kW);
Total time of operation since new:…… 4351 h**)

Date of the last periodic inspection (100H):…….. 10-12 Nov 2015.

**) until the last periodic inspection (20.08.2015)*

***) excluding the last flight which ended in accident*

Fuel & Lubricants prior to the flight

Fuel JET A-1: ……..no data***);

Fuel JET A-1 maks……. 312 l/260 kg;

Oil:……. approx. 3 l;

Fuel consumption…….. ~95-100 l/h;

****) prior to the flight the pilot assessed that fue quantity was sufficient*

Helicopter weight data:

- Zero fuel weight:……..…… 750,8 kg;
- Crew weight (pilot+operator, approx.):……..185,0 kg;
- Fuel weight:……..… not determined;
- Take-off weight…… not determined exactly, but below 1 200 kg;
- Maximum takeoff and landing gross weight: ..... 1362,0 kg.

Prior to registration in the USA, the helicopter had undergone 100H/20H/yearly inspections (FAA Certificate No. 2519879, issued on 30 May 30 2013), and then, already in Poland in 2015, scheduled maintenance works and component replacements were effected, which was confirmed by a licensed mechanic (who came from Denmark for this purpose). The inspection was carried out on 10-12 November 2015 on the premises of UFK Services Filip Królak (Powstańców Wielkopolskich Street 22, 64-224 Świętno). During that inspection, the interconnect shaft between the engine and main gearbox (P/N 500N5215 - see figures [6], [7], [8]) was replaced in accordance with the relevant mandatory Manufacturer's service bulletin.

The helicopter maintenance was effected in a timely manner by authorized personnel and in accordance with applicable regulations, and the applicable records were maintained properly.

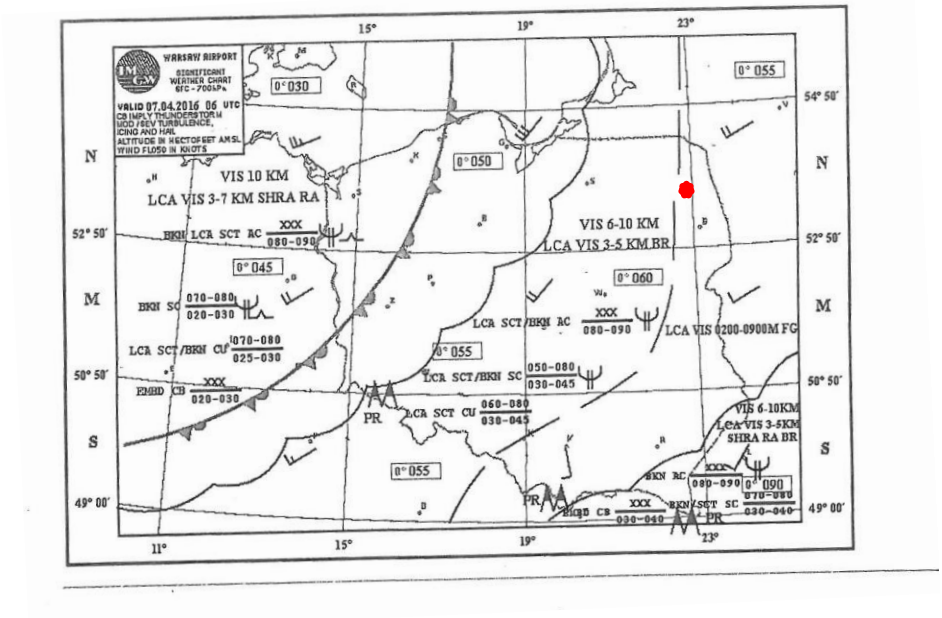
The take-off weight of the helicopter and the location of its center of gravity were within the limits specified in the applicable Flight Manual.

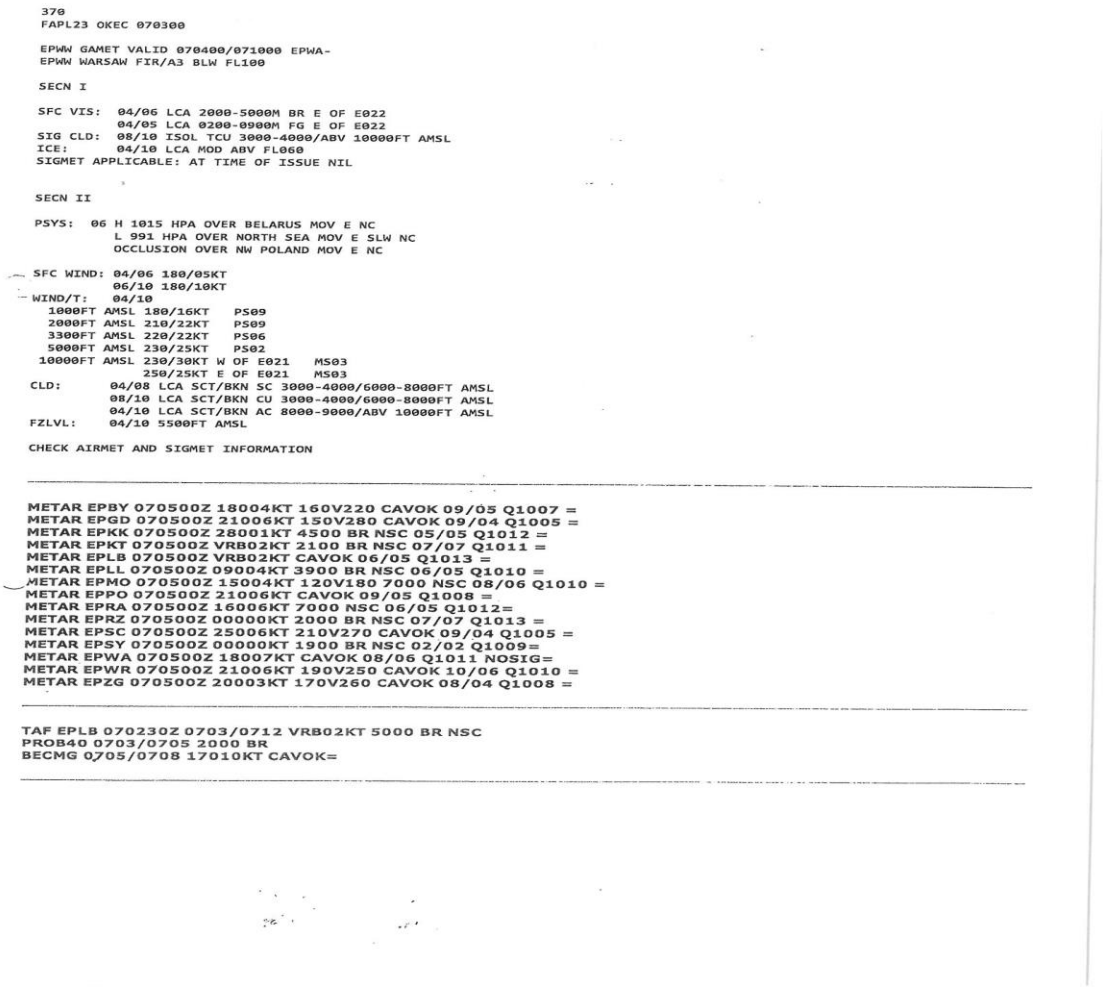
The helicopter was used sporadically - the table below provides information on its last 28 flights.The data were retrieved from the memory of Bendix-King KMD-150 data visualization system – a part of the helicopter equipment.

No	Take-off	Date	Time	Duration	Route	Landing	Time	Remarks
1	Suwałki (?)	2.12.2014	11:59	18'	Suwałki (?)- Krynice k. Białegostoku	Krynice	12:17	Niepełny zapis lotu
2	Krynice	17.12.2014	11:12	23'	Krynice-Choroszcz-Niemczyn-Krynice (lot w rejonie Krynic)	Krynice	11:35	b/u
3	Krynice	28.12.2014	13:05	21'	Krynice-EPBK-Krynice	Krynice	13:33	7 min postoju na EPBK
4	Krynice	30.12.2014	11:18	45'	Krynice-Wasilków-Choroszcz-Krynice (lot w rejonie Krynic)	Krynice	12:03	b/u
5	Krynice	6.01.2015	12:07	33'	Krynice-Tykocin-Zawady-Krynice (lot w rejonie Krynic)	Krynice	12:40	b/u
6	Krynice	16.01.2015	11:02	26'	Krynice-Suwałki	Suwałki	11:28	b/u
7	Suwałki	16.01.2015	12:47	1h2'	Suwałki-Krynice (13:22)-Suwałki	Suwałki	13:49	lot i natychmiastowy powrót
8	Suwałki	30.01.2015	13:51	13'	Rejon Suwałk	Suwałki	14:04	lot nad miasto
9	Suwałki	17.03.2015	10:42	30'	Suwałki-Krynice	Krynice	11:12	b/u
10	Krynice	27.03.2015	11:15	29'	Krynice-Zambrów-Szumowo-Grądy	Grądy	11:44	b/u
11	Grądy	27.03.2015	12:52	29'	Grądy-Szumowo-Zambrów-Broniszewo-Krynice	Krynice	13:21	b/u
12	Krynice	11.04.2015	11:10	23'	Krynice-Białousy-Krynice	Krynice	11:33	lot w rejonie lądowiska Białousy
13	Krynice	24.04.2015	12:02	31'	Krynice-Suwałki	Suwałki	12:33	b/u
14	Suwałki	24.04.2015	13:19	57'	Suwałki-Krynice(13:46)-Suwałki	Suwałki	14:16	b/u
15	Suwałki	30.04.2015	09:52	32'	Suwałki-EPBK	Białystok Krywlany	10:25	b/u
16	Białystok Krywlany	30.04.2015	11:43	33'	EPBK-Suwałki	Suwałki	12:16	b/u
17	Suwałki	27.06.2015	13:01	11'	Suwałki - przyziemienie/długi zawis w miejscowości Zielone Królewskie	Zielone Królewskie	13:12	loty łączone
18	Z. Królewskie	27.06.2015	13:17	30'	Z.Królewskie-Miasto Suwałki- Lądowisko Suwałki	Suwałki	13:47	
19	Suwałki	27.07.2015	12:34	1h 26'	Suwałki - Nowinka (krążenie) -Grajewo- Łomża -EPBC	EPBC	14:00	niezgodnie z kręgiem EPBC
20	EPBC	10.12.2015	10:34	2h7'	EPBC-Sochaczew-Kutno-Koło-Września-EPPK	EPPK	12:41	8 min zawisu/przerwy na EPBC
21	EPPK	12.12.2015	09:45	1h 19'	kręgi (ok. 10) i rejon	EPPK	12:54	rzerwy pomiędzy lotami ok. 50 m
22	EPPK	6.01.2015	13:58	9'	3 kręgi	EPPK	14:07	b/u
23	EPPK	6.01.2016	14:33	17'	4 kręgi	EPPK	14:56	przerwa ok. 14:40
24	EPPK	26.01.2016	14:09	49'	EPPK-Łagiewniki-Gorzuchowo-Tupadły-Toruń-Wielkie Lniska k. Grudziądz	Wielkie Lniska	14:58	b/u
25	Wielkie Lniska	27.01.2016	08:20	59'	Wielkie Lniska-Łasin-Iława-Idzbark-Kątno	Kątno	09:19	krążenie w okolicy Kątna
26	Kątno	27.01.2016	11:02	1h	Kątno-Gietrzwałd-Olsztyn-Mrągowo-Olecko-Suwałki	Suwałki	12:02	b/u
27	Suwałki	30.01.2016	10:41	17'	Suwałki-Nowinka-Suwałki (lot w rejonie)	Suwałki	10:58	b/u
28	Suwałki	7.04.2016	14:17	3'	Lot w rejonie	54° 3'17.84"N 22°54'3.38"E	14:20	wypadek

1.7. Meteorological information

The flight was performed in VMC conditions, in daylight. The map received from the pilot. and table below show meteorological data available on the day of the accident





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370
FAPL23 OKEC 070300

EPWW GAMET VALID 070400/071000 EPWA-
EPWW WARSAW FIR/A3 BLW FL100

SECN I

SFC VIS:  04/06 LCA 2000-5000M BR E OF E022
          04/05 LCA 0200-0900M FG E OF E022
SIG CLD:  08/10 ISOL TCU 3000-4000/ABV 10000FT AMSL
ICE:      04/10 LCA MOD ABV FL060
SIGMET APPLICABLE: AT TIME OF ISSUE NIL

SECN II

PSYS:  06 H 1015 HPA OVER BELARUS MOV E NC
          L 991 HPA OVER NORTH SEA MOV E SLW NC
          OCCLUSION OVER NW POLAND MOV E NC

SFC WIND: 04/06 180/05KT
          06/10 180/10KT
WIND/T:   04/10
  1000FT AMSL 180/16KT   PS09
  2000FT AMSL 210/22KT   PS09
  3300FT AMSL 220/22KT   PS06
  5000FT AMSL 230/25KT   PS02
 10000FT AMSL 230/38KT W OF E021   MS03
              250/25KT E OF E021   MS03
CLD:      04/08 LCA SCT/BKN SC 3000-4000/6000-8000FT AMSL
          08/10 LCA SCT/BKN CU 3000-4000/6000-8000FT AMSL
          04/10 LCA SCT/BKN AC 8000-9000/ABV 10000FT AMSL
FZLVL:    04/10 5500FT AMSL

CHECK AIRMET AND SIGMET INFORMATION

METAR EPBY 070500Z 18004KT 160V220 CAVOK 09/05 Q1007 =
METAR EPGD 070500Z 21006KT 150V280 CAVOK 09/04 Q1005 =
METAR EPKK 070500Z 28001KT 4500 BR NSC 05/05 Q1012 =
METAR EPKT 070500Z VRB02KT 2100 BR NSC 07/07 Q1011 =
METAR EPLB 070500Z VRB02KT CAVOK 06/05 Q1013 =
METAR EPLL 070500Z 09004KT 3900 BR NSC 06/05 Q1010 =
METAR EPMO 070500Z 15004KT 120V180 7000 NSC 08/06 Q1010 =
METAR EPPO 070500Z 21006KT CAVOK 09/05 Q1008 =
METAR EPRA 070500Z 16006KT 7000 NSC 06/05 Q1012=
METAR EPRZ 070500Z 00000KT 2000 BR NSC 07/07 Q1013 =
METAR EPSC 070500Z 25006KT 210V270 CAVOK 09/04 Q1005 =
METAR EPSY 070500Z 00000KT 1900 BR NSC 02/02 Q1009=
METAR EPWA 070500Z 18007KT CAVOK 08/06 Q1011 NOSIG=
METAR EPWR 070500Z 21006KT 190V250 CAVOK 10/06 Q1010 =
METAR EPZG 070500Z 20003KT 170V260 CAVOK 08/04 Q1008 =

TAF EPLB 070230Z 0703/0712 VRB02KT 5000 BR NSC
PROB40 0703/0705 2000 BR
BECMG 0705/0708 17010KT CAVOK=
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Based on the above data and own observations, the Commission did not rule out that the weather conditions could have had an impact on the occurrence and its course due to the possibility of thermal gusts.

1.8. Aids to navigation

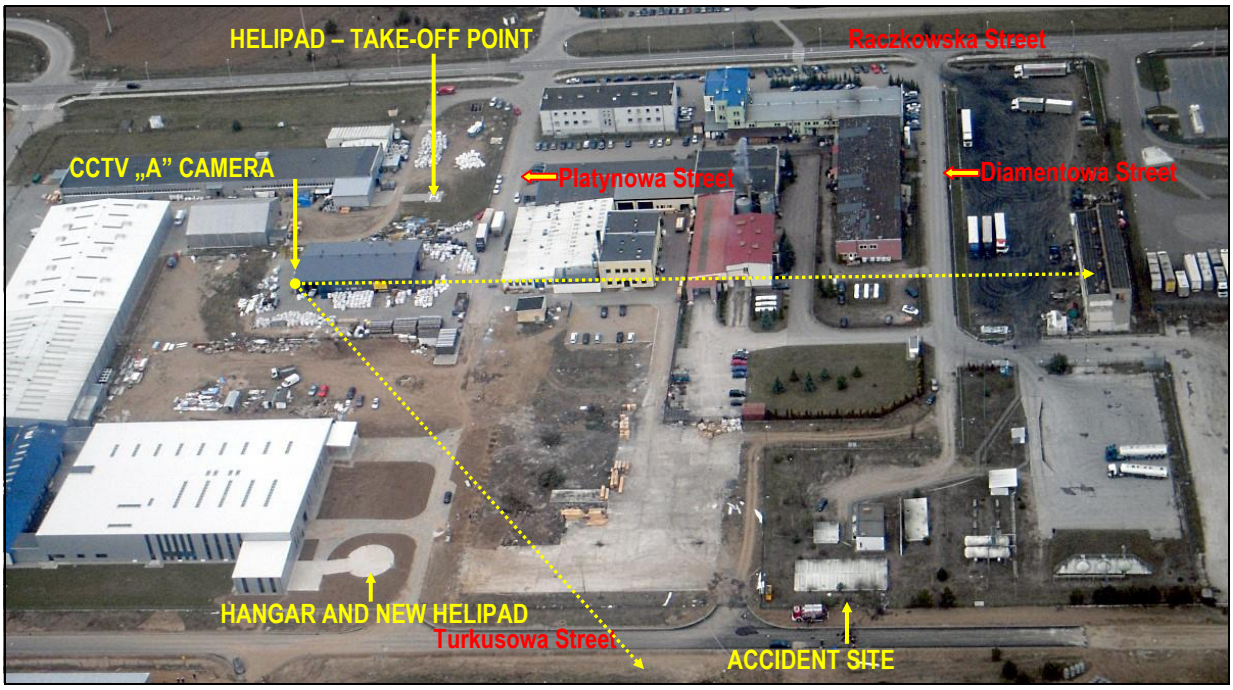
Not applicable.

1.9. Communications

The The helicopter was equipped with on-board communication radio stations: KY-196A Bendix King and KX-165, Bendix-King KT-76C transponder, Garmin GMA-340, Artex ME-406 ELT, ID: ADC6492654DC2D1 and Bendix King KMD-150 Multifunction Display.

1.10. Place of occurrence information

The helicopter took off from the helipad in front of a small hangar at Platynowa Street on the premises of Salag Sp. z o.o. and collided with the ground within the industrial zone south of Suwałki at Turkusowa Street near Diamentowa Street, approx. 230 m from the take-off point.



3 – Salag Sp. z o.o. premises – aerial photo. CCTV „A" camera angular range marked with yellow dotted line. Photos on Fig.[8] are from „A" camera. [photo.I.Przybyła, Suwalska Szkoła Lotnicza].

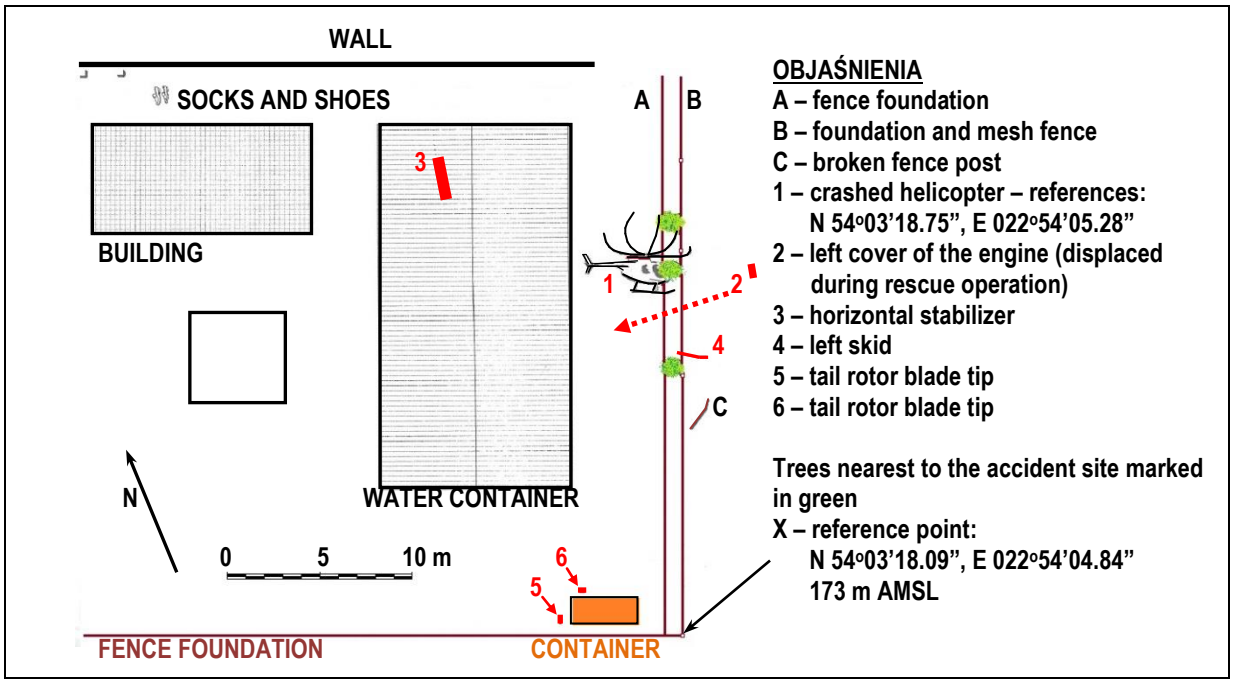
1.11. Flight recorders

The helicopter was not equipped with flight recorders.

1.12. Wreckage and impact information

When the pilot lost control over the helicopter, it entered the right yaw with the left bank angle. The left skid was the first to come into contact with the ground (and young trees growing at the site), and then the main rotor blades (due to their deformation "into a tulip").

This sequence of collision with the ground and then breaking off the left skid and the left struts contributed to the absorption of part of impact energy. During the collision with the ground, the tail beam was also broken and the tail rotor blades were cut off by the main rotor blades, which dropped elastically after the helicopter hit the ground, and then returned to the state of deformation "in a tulip". No part of the helicopter was found to have fallen off the helicopter prior to impact with the ground.



4 – Sketch of the accident site [based on materials from Suwałki police station].

During the impact the descent rate was about 11,6 m/s and produced deceleration value sufficient to activate the ELT transmitter.

1.13. Medical and pathological information

As a result of the accident the pilot and the passenger suffered serious injuries, requiring immediate hospitalization. The pilot suffered a multi-organ trauma, periodic memory loss and a fracture of the left forearm.

The passenger suffered the right arm fracture and pelvic injury.

The pilot and the passenger were not under the influence of alcohol.

1.14. Fire

The fire did not occur.

1.15. Survival aspects

Lost of control over the helicopter during recovery from a hover at a height of about 40 m AGL created a very high degree of risk to the pilot and the passenger and resulted in a collision with the ground with a significant left bank angle (in that attitude, the level of protection by seat belts is significantly reduced). The final portion of the helicopter flight path sloped at an angle of about 50 degrees and the vertical speed reached the value of approx. 11,6 m/s.

Serious injuries suffered by the pilot and passenger were a direct consequence of the described attitude during the collision with the ground and their scope was only due to a happy coincidence. The attitude in which the helicopter collided with the ground and the energy of the collision (resulting from the forward and vertical speed of descent) created a significant risk to the health and life of the occupants.

It was found that the pilot and passenger had their seat belts correctly fastened.

1.16. Tests and research

In the presence of the prosecutor from Suwałki, the traces and the wreckage distribution at the accident site were examined. The kinematic continuity of the flight control system in the fuselage was found intact up to the fracture of the tailboom.

No damage was found, except for those that occurred when the helicopter hit the ground, described in item 1.3., and as a result of the firefighting operation.

It was found that the part of the flight control system between the front seats was not covered (cover not installed).

Further tests of the wreckage were carried out at the place of its storage in the police premises in Suwałki.

1.17. Organizational and management information

The accident was reported to rescue services by witnesses at 16:24 hrs. The first rescue unit arrived at the accident site 7 minutes after notification. The State Fire Service used 5 m^3 of water and 100 liters of AFFF frothing agent. The electric power sources of the helicopter were disconnected. The scene was secured and handed over to the police. Further actions of firemen and police were focused on securing the scene during PKBWL and removing the helicopter wreckage. PKBWL members took a series of photos of the crashed helicopter and the scene and obtained aerial photos of the vicinity of the accident site. The witnesses were interviewed. Recordings from two surveillance cameras showing the course of the accident, a meteorological forecast covering the period of the accident and copies of documentation collected by the Police (including photos on a CD/R) were obtained.

On 12 October 2016, in the police premises in Suwałki, the ELT transmitter located in the wreckage was activated. When PKBWL was notified about this fact, it immediately sent to the police relevant illustrated information and policemen deactivated the ELT. The most likely cause of the ELT activation was a short circuit caused by moisture in the wreckage storage area.

1.18. Additional information

On 26 June 2020, pursuant to §15 of the Regulation of the Minister of Transport, dated 18 January 2007 (Dz.U.35 poz.225), the pilot-owner of the helicopter got acquainted with the Draft Final Report. The pilot made comments, which were partially taken into account in the content of the Report. Comments rejected by PKBWL are contained in the "Record of familiarization with the draft final report".

1.19. Useful or effective investigation techniques

Standard investigation techniques were used.

2. ANALYSIS

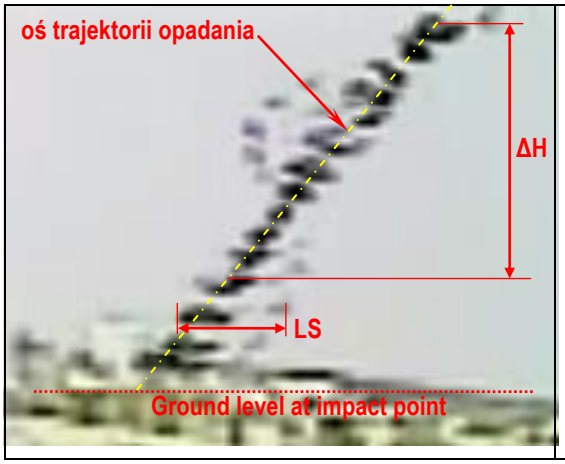
2.1. Training level

The level of the pilot's training, his qualifications and experience on the day of the accident was recognized by PKBWL as sufficient to complete the planned flight.

The pilot met the formal requirements, but he performed the helicopter flights sporadically and with long breaks.

2.2. Analysis of the flight and occurrence course

Based on the analysis of the video recording obtained from the "A" CCTV camera (camera position – see Fig. [3] above), the vertical component of the speed during the descent was estimated to be approx. 11,6 m/s (see figure [8]).



ΔH – loss of height for one complete revolution

LS – helicopter length (LS ≈7,2 m)

ΔH/LS ≈ (from the measurement in the photo) = 2,4 → ΔH ≈ 17 m

ΔT – time of a complete revolution (ΔT = 1,4652 s)

W – descent rate

W = ΔH/ΔT

W ≈ 11,6 m/s

5 - Successive phases of the helicopter's movement during the descent (based on analysis of the recording from "A" camera and the calculation of the vertical component of the descent rate. Noticeable decrease in the angular speed of the helicopter's rotation around the vertical axis in the last portion of the descent phase.

The above assessment could be confirmed by analyzing the video recording from "B" camera, located at a greater distance from the scene (its location in relation to the accident site is shown in the Album of Illustrations – Annex 1 to this Report).

After review of the recording and interviewing the pilot and witnesses, PKBWL concluded that the cause of the accident was the stall of the helicopter main rotor. The phenomenon of rotor stall can happen very often, among others, in hovering and in the low speed range. In principle, helicopters are constructed in such a way that the blades operate in the area of subcritical angles of attack.

In the investigated case, most likely as a result of the pilot's sudden and excessive reaction to thermal gust, the blades reached the critical angle of attack, or even exceeded it, and the main rotor was stalled. Despite the increase in collective pitch and the engine running at full power, the helicopter began to descend, and the main rotor RPM decreased. At the same time a loss of directional control and rotation of the helicopter in the direction opposite to the direction of rotation of the main rotor occurred.

The loss of directional control could be explained by the fact that after exceeding the critical angle of attack by the main rotor blades, the coefficient of their drag force increased and the rotor RPM decreased. In that situation the Loss of Tail Rotor Effectiveness (LTE) phenomenon could also have happened.

In order to balance the resistance torque, it was necessary to increase RPM or pitch of the tail rotor blades or both. The RPM could not have been increased, because the engine was operating at maximum power, and the pedals could not have been moved, because they were fully deflected. The above phenomenon worsens by itself, if the pilot does not or cannot perform the correct actions.

The described sequence of phenomena must have caused the loss of control over the helicopter, regardless of the pilot's further actions, and prevented a recovery from abnormal situation - in this particular case there was not enough height and speed (accelerating the rotor to initiate autorotation was no longer possible) .

The change in load on the main rotor blades as a result of stalling caused their characteristic "tulip" deformation.

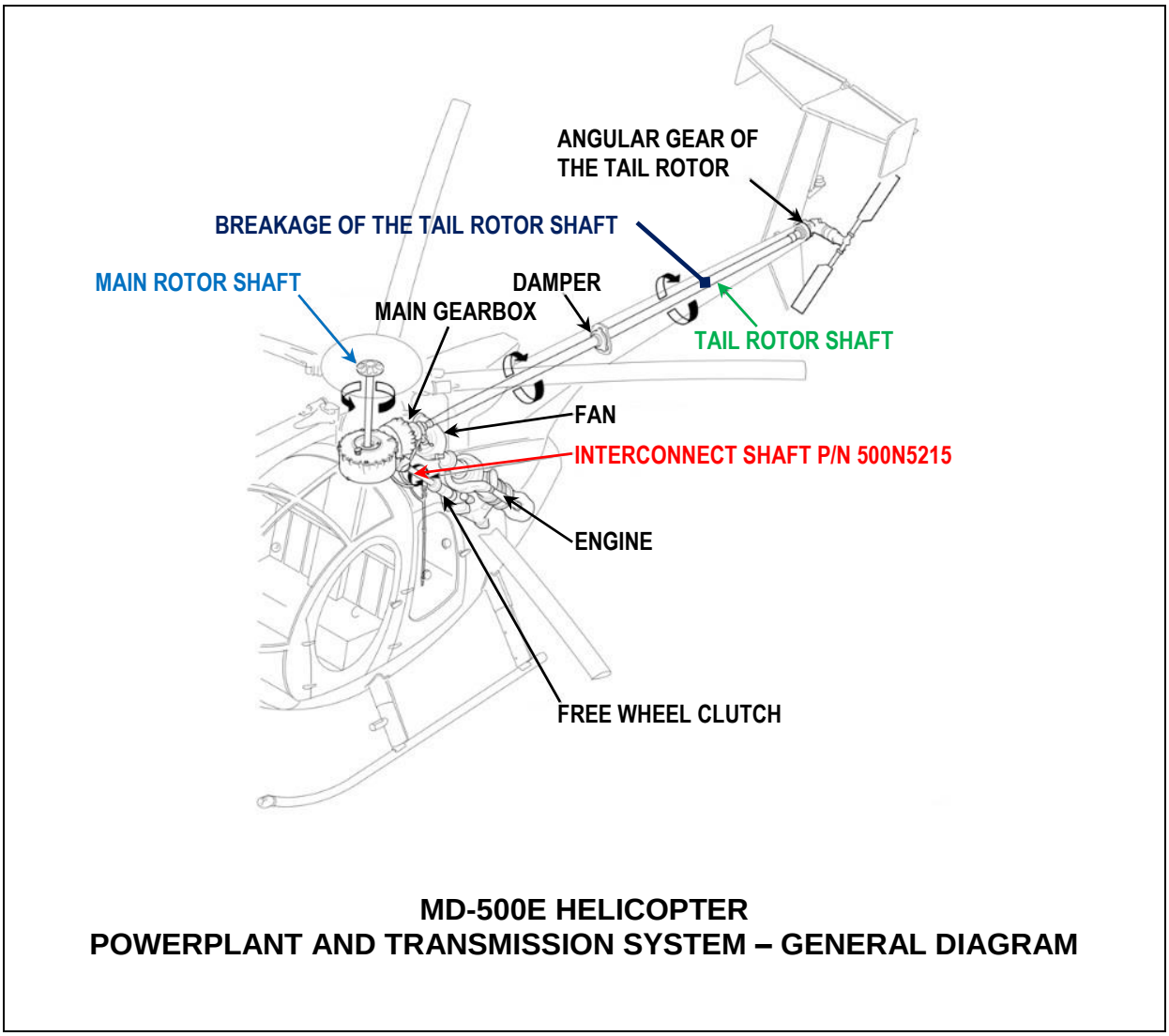
2.3. Technical analysis

During the investigation the Investigation Team reviewed NTSB reports on investigation into accidents to other helicopters of the same type in the USA and various technical information available on the Internet.

During the visual inspection of the helicopter at the scene, it was found that in the cockpit the cover of the flight control system between the front seats was missing. The pilot-owner of the helicopter was not able to explain when it was removed and why was not mounted again (it could have happened during the removal of the flight controls on the right side , which had been done at his request before the accident flight). No foreign object was found to fall into the control system and cause it to malfunction. In PKBWL opinion, the absence of the cover had no impact on the occurrence.

After the accident, the helicopter control system preserved its functionality and kinematic continuity up to the point where the tailboom was broken (at this point the pusher of the tail rotor blade pitch control system was damaged (bent)).

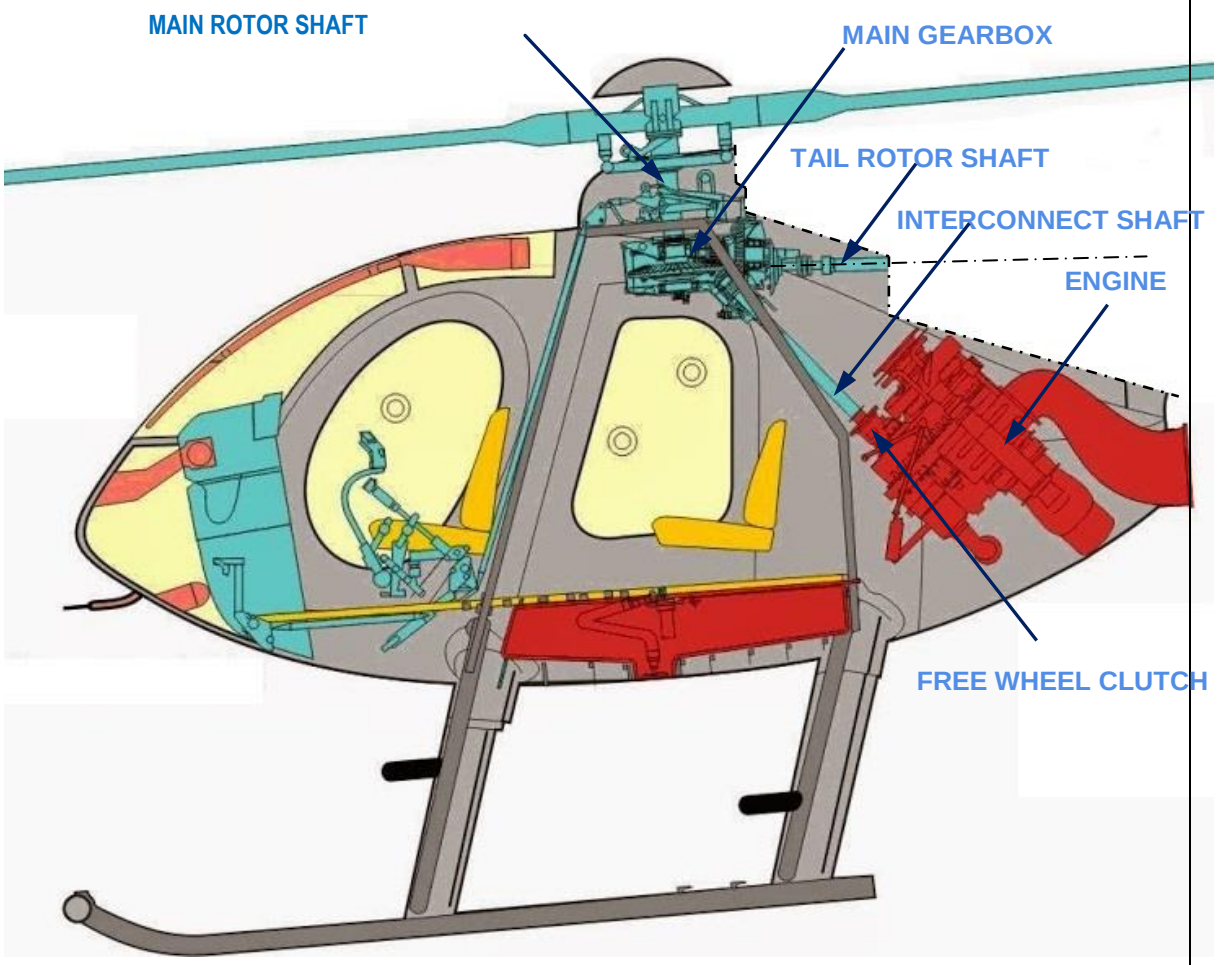
During the inspection of the helicopter at the scene the main rotor with deformed blades could be turned freely and without any effort around its axle; the tail rotor shaft also freely rotated inside the tailboom without any abnormal noises or resistance. It was concluded that the transmission system of the main rotor and tail rotor was not damaged (apart from the breakage of the tail rotor shaft as a result of its collision with the ground).



6 – Powerplant and transmission system of the MD-500E helicopter - general diagram.

During an additional inspection of the helicopter wreckage, the Investigation Team conducted a detailed inspection of the interconnect shaft (P/N 50N5215) and its clutches (upper and lower). It was done at the request of the pilot, who expressed his assumption that the replacement of the shaft might have been effected in an improper way (it was the subject of maintenance works in the period immediately preceding the accident and was the only activity that might have had a technical impact on the occurrence).

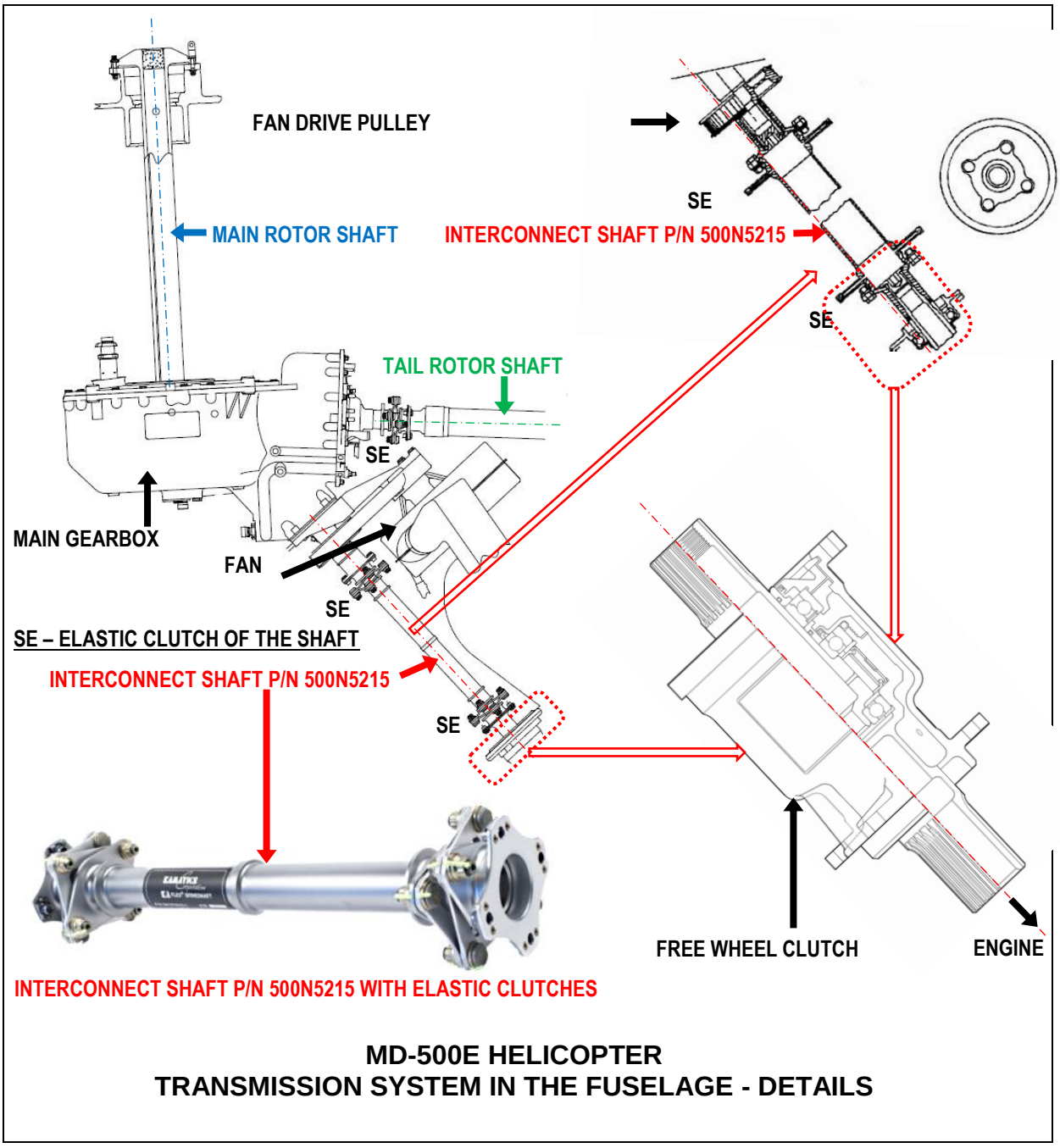
No irregularities related to the interconnect shaft P/N 50N5215 were found.



7 – MD-500E helicopter powerplant and transmission system in the fuselage – general diagram

The replacement of the interconnect shaft P/N 50N5215 effected in the scope of 100H inspection on 10-12 November 2015, was the implementation of the Mandatory Service Bulletin of the helicopter manufacturer of 22 December 2010, covering its six versions. Numbering of this bulletin for each version of the helicopter was: SB369H-250, SB369D-208, SB369E-103, SB369F-088, SB500N-044 and SB600N-052.

To sum up, after several inspections of the helicopter wreckage (over three years), no technical failure, which could have affected the occurrence, was found.



8 – Transmission system of the MD-500E helicopter – details. Interconnect shaft P/N 500N5215 marked in red.

3. CONCLUSIONS

3.1. Commission findings

1) The helicopter was properly prepared for the flight and its airworthiness was properly documented.

2) During visual inspection of the wreckage no symptoms of any detectable technical failure of the aircraft were found.

3) The helicopter engine was operating at the time of the accident, and it stopped only during the collision with the ground.

4) The main gearbox and drive transmission remained functional after the accident and preserved continuity up to the point where the tail rotor shaft fracture.

5) After the accident, the helicopter control system retained its functionality and kinematic continuity up to the point where the tail boom was broken (at this point the pusher of the tail rotor blade pitch control was bent).

6) The right hand flight controls were removed and the control system cover between the front seats was missing.

7) The helicopter was not insured on the day of the accident (the copy of the insurance document provided to PKBWL shows that it expired on 4 July 2015).

8) The amount of fuel on board was assessed by the pilot as being completely sufficient for the planned flight.

9) At the time of the accident he mass and balance of the helicopter were within the limits specified in its Flight Manual.

10) The helicopter was properly maintained.

11) The helicopter was operated sporadically.

12) No technical failure during the flight was found, which could have affected the occurrence course.

13) The pilot had the appropriate ratings and qualifications to perform the intended flight.

14) The pilot performing the flight was not under the influence of ethyl alcohol.

15) The pilot was rested at the time of the accident.

16) The pilot and passenger had their seat belts fastened, which, due to the course of the accident, had an impact on their survivability.

17) In the opinion of the Investigation Team, the weather conditions on the day of the accident could have had an impact on the occurrence due to the possibility of thermal gusts.

3.2. Cause of the accident

The most likely cause of the accident was a stall of the main rotor caused by the pilot's excessive reaction to a thermal gust.

3.3 Factors contributing to the occurrence were:

The factor contributing to the accident could have been the phenomenon of thermal gusts.

4. SAFETY RECOMMENDATIONS

PKBWL has not proposed any safety recommendation after conclusion of the investigation.

5. ANNEXES

1. Album of Illustrations

THE END

Investigator-in-Charge

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