FINAL REPORT No.4-02-9/2012(4-2014)

on THE ACCIDENT

of AIRCRAFT TECNAM P2006T, REGISTRATION YL-SVN ON NOVEMBER 13, 2012, GARKALNE MUNICIPALITY, IN THE LOCALITY OF BUKULTU VILLAGE

The Aircraft Accident and Incident Investigation Bureau of the Republic of Latvia is a governmental, independent of all aviation authorities, organization established by law to investigate and determine the cause or probable cause of accidents and serious incidents that occurred in the civil aviation, as well if necessary for enhancing flight safety incidents.

The sole objective of the safety investigation in accordance with Annex 13 to the Convention on International Civil Aviation, the Regulation (EU) No.996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in Civil as well as Cabinet Regulation No.423 of May 31, 2011 "Procedures of Civil Aviation Accident and Incident investigation" is the prevention of future accidents and incidents. The Report shall contain, where appropriate, safety recommendations. Safety investigation is separate from any judicial or administrative proceedings and investigation Report is not deal with purpose to apportion blame or liability but only for purpose of the safety enhancement. The Report shall protect the anonymity of any individual involved in the accident or serious incident.

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FINAL REPORT NO.4-02/9-12

ON AVIATION ACCIDENT WITH AIRCRAFT TECNAM P2006T, REGISTRATION No.YL-SVN ON NOVEMBER 13, 2012, GARKALNE MUNICIPALITY, IN THE LOCALITY OF BUKULTU VILLAGE

CONTENT

ABBREVATIONS USED IN THE FINAL REPORT

ATIS - Automatic terminal information service
GPS - Global Positioning System
VFR - Visual flight rules
UTC - Coordinated Universal Time
JAA - Join Aviation Athorities
JAR - Join Aviation Rules
PPL (A) - Private Pilot Licence (Aeroplane)
CPL (A) - Comercial Pilot Licence (Aeroplane)
ATPL (A) - Airline Transport Pilot Licence (Aeroplane)
MEP - Multi-engine piston
AGL - Above ground level

FCL - Flight crew licensing
Kts - Knot (nautical mile per hour)
CTR Control zone
SWL - Significant Weather Low Lewel Chart
OEI - One Engine Inoperative
FTO - Flight Training Organization
FE - Flight Examiner
HT - Head of training
CAA - Civil Aviation Agency
MAC - Mean Aerodynamic Chord

SYNOPSIS

All information in the final report has been provided according to UTC, unless it was othervise specified.
On November 13, 2012 at about 13:40 the aviation accident occurred with the aircraft TECNAM P2006T, registration No.YL-SVN, aviated by the pilot - Applicant of the CPL(A) issue taking skill test together with flight examiner specialized on flights with multi-engine piston aircraft.
During the horizontal flight at 1500 height, the aircraft suddenlyinclined with nose downwards, lost height and falling almost vertically collided with the ground surface in the wood, near to the Bukulti village, Garkalne municipality. The aircraft got significant damages and was completely destroyed in the collision. The pilot - Applicant of CPL(A) issue and Examiner suffered a serious injuries, which caused death in the place of accident.

Image1. The accident site on map of the aircraft TECNAM P2006T, reg. No.YL-SVN

Image2. Aircraft TECNAM P2006T reg. No.YL-SVN after the aviation accident

The notification about the aviation accident with the aircraft TECNAM 2006P, registration number YL-SVN, which occurred on November 13, 2012 in Riga region, Garkalne municipality, in the locality of Bukulti village, was received by the Transport Accident and Incident Investigation Bureau (TAIIB) through telephone at 15:40 (by local time) fom operative person on duty of the State Fire and Rescue Service (SFRS).

Arriving at the accident site, in the marshy area between trees the investigators of TAIIB found the wreckage of the aircraft TECNAM P2006T with two dead bodies under the wreckage. The investigators of TAIIB performed all necessary operations to preserve material evidences and record the contacts of witnesses, as well cooperated with rescuers of SFRS and police, who ensured guard of the scene.

In the accident site the following actions were perfomed by the investigators of TAIIB:

- Inspection of the accident site and photography;
- Taking of the fuel samples;
- Collection of the aircraft documentation on board;
- Clarification of the accident circumstances;
- Questioning of the witnesses.

In the accident site wreckage of the aircraft involved in the accident has been taken away from the marshy area to prepare them for transportation to the Riga International Airport to the hangar No.3 for storage and further investigation.

1. FACTUAL INFORMATION

1.1. History of the flight

On November 13, 2012 the accident occurred with the aircraft TECNAM 2006T, registration No. YL-SVN performing the flight skill test. The aircraft was aviated by the pilot - CPL(A) issue Applicant, having a valid flight crew member licence PPL (LVA/JAA-210P) already, who according to documents initially submittet to safety investigation authority TAIIB was taking skill test for the CPL(A) issue in compliance with the Appendix 2 JAR-FCL 1.170. The examiner-instructor was on the board.

The Applicant of CPL (A) issue in compliance with Appendix 1 JAR-FCL 1.160 & 1.165(a) (4) with aircrafts YL-ROS, YL-SVN has successfuly finished CPL (A) training course and the Head of training (HT) recommended the applicant to accomplish the CPL (A) skill test (in compliance with FTO TEKARA CPL(A) training course CERTIFICATE No 034), that on November 13, 2012 was signed by the Head of training.

On October 19, 2012 the application form on the realization of the skill test flight with training aircraft was submitted to State Civil Aviation Authority CAA.

On November 12, 2012, in compliance with the permission No.204/12 the examiner/instructor was appointed and approved by CAA inspector. In compliance with the permission No.204/12 the day of test flight was approved on November 12, 2012.

After completed Draft Finall Report FTO "TEAKARA" submitted to safety investigation authority TAIIB the copy of "Skill Test/ Proficiency Check / Aeroplane Training Application Form" for Applicant's skill test ME-IR (A) in compliance with Appendix 3 JAR-FCL 1.240 "Contents of the class/type rating/training/skill test and proficiency check on single-engine and multi-engine single-pilot aeroplanes" (***single pilot***) with the permission No.205/12 approved by CAA inspector. The same examiner/instructor was appointed and in compliance with the permission No.205/12 the same day, November 12, 2012 the skill test flight ME-IR (A) was approved.

The Applicant of CPL (A) issue in compliance with Appendix 1 to JAR–FCL 1.205 IR(A) – „Modular flying training course" with aircraft YL-SVN has successfuly completed ME-IR (A) training course and the Head of training (HT) recommended the applicant to accomplish the ME-IR (A) skill test (in compliance with FTO TEKARA ME-IR (A) training course CERTIFICATE No 033), that on November 09, 2012 was signed by the Head of training.

Actually the flight for joint skill tests was operated on November 13, 2012 from Aerodrome Spilve (EVRS).

Image 3. Aircraft TECNAM P2006T in Aerodrome Spilve

In this day it was the second flight of skills test with the aircraft TECNAM P2006T, registration No.YL-SVN. The flight with the aircraft prevoiusly was performed by another pilot, who was taking CPL (A) issue skill test with the same examiner-instructor.

Taking off from the Aerodrome Spilve, flying according to the visual flight rules (VFR), the pilot informed the air traffic controller of the control tower about the intention to fly in the control zone (CTR) right away before arrival. After flying into CTR zone the aircraft TECNAM P2006T YL-SVN performed the other tasks of the skill test in the controlled zone and after completitition continued the flight in the course of North as far as it flew out of the controlled zone (CTR).

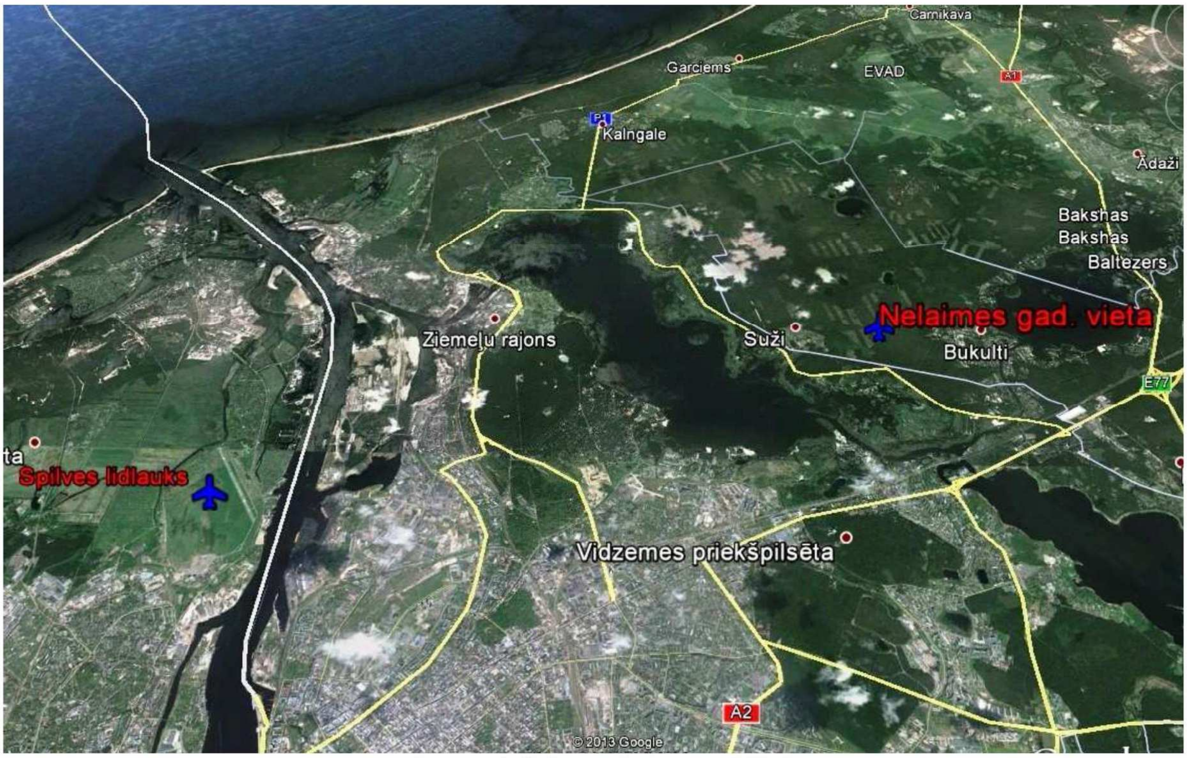


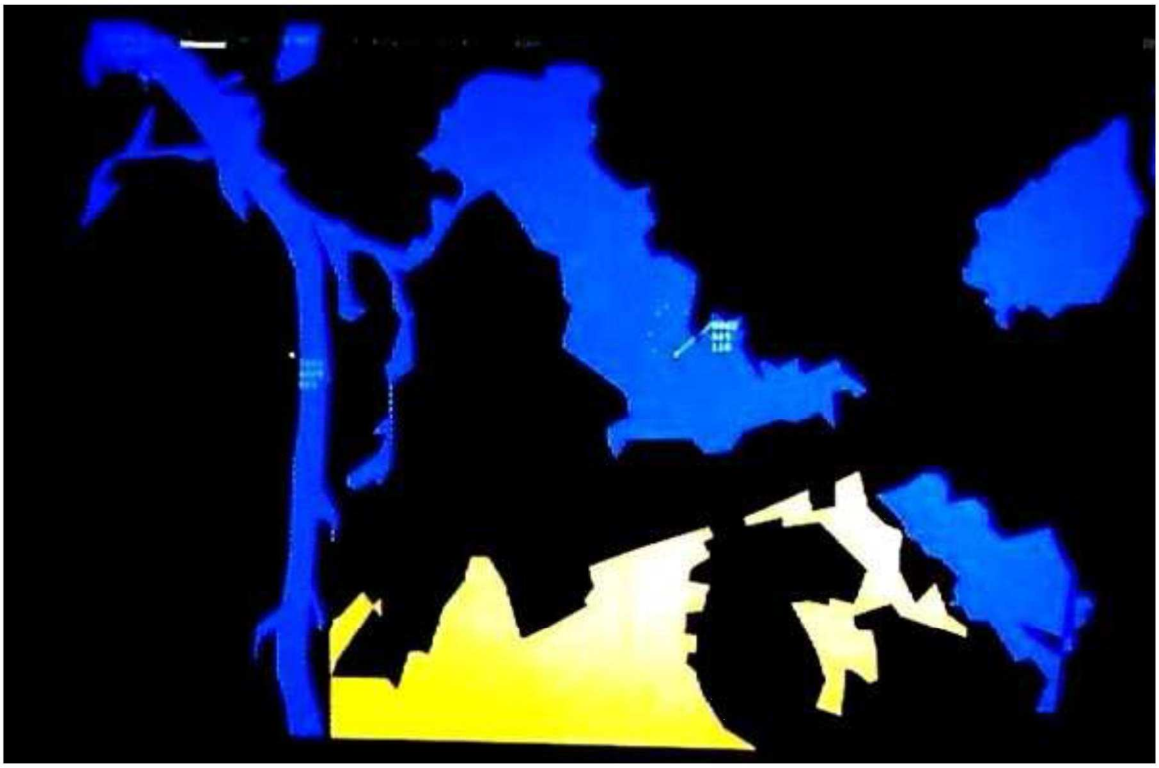
Image 4. Schematic route of flight

Radar picture 1 – Flight in Riga CTR zone

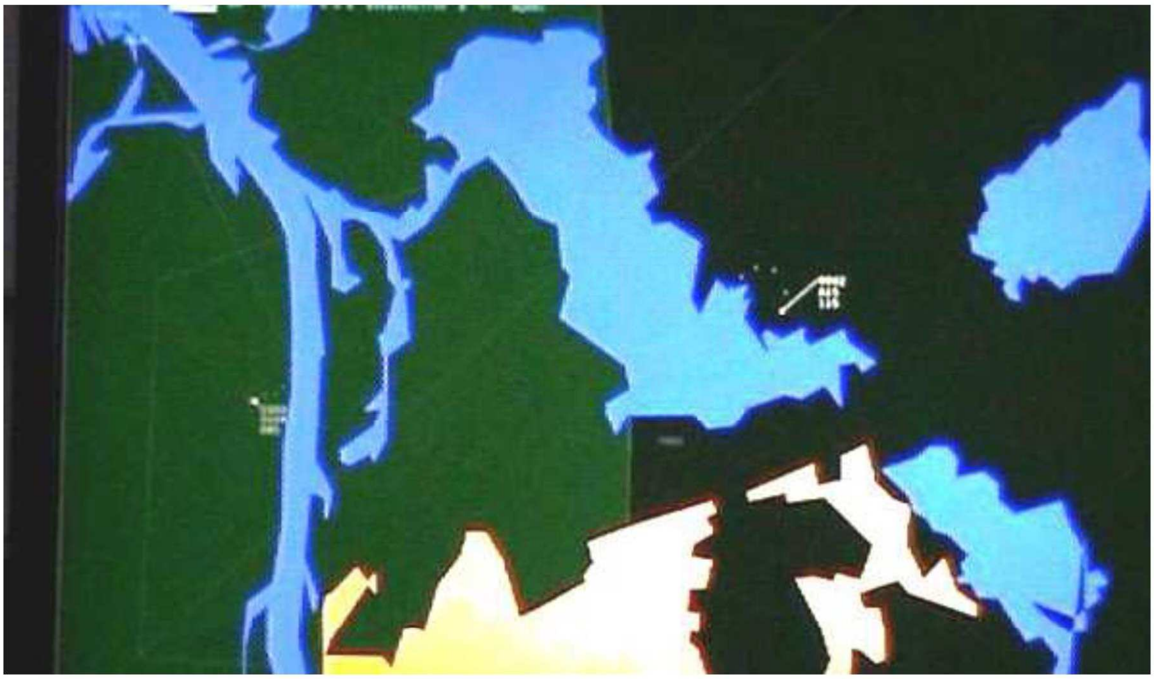
Radar picture 2 - Flight in Riga CTR zone

Radar picture 3 – The aircraft flies out of Rigas CTR controlled zone

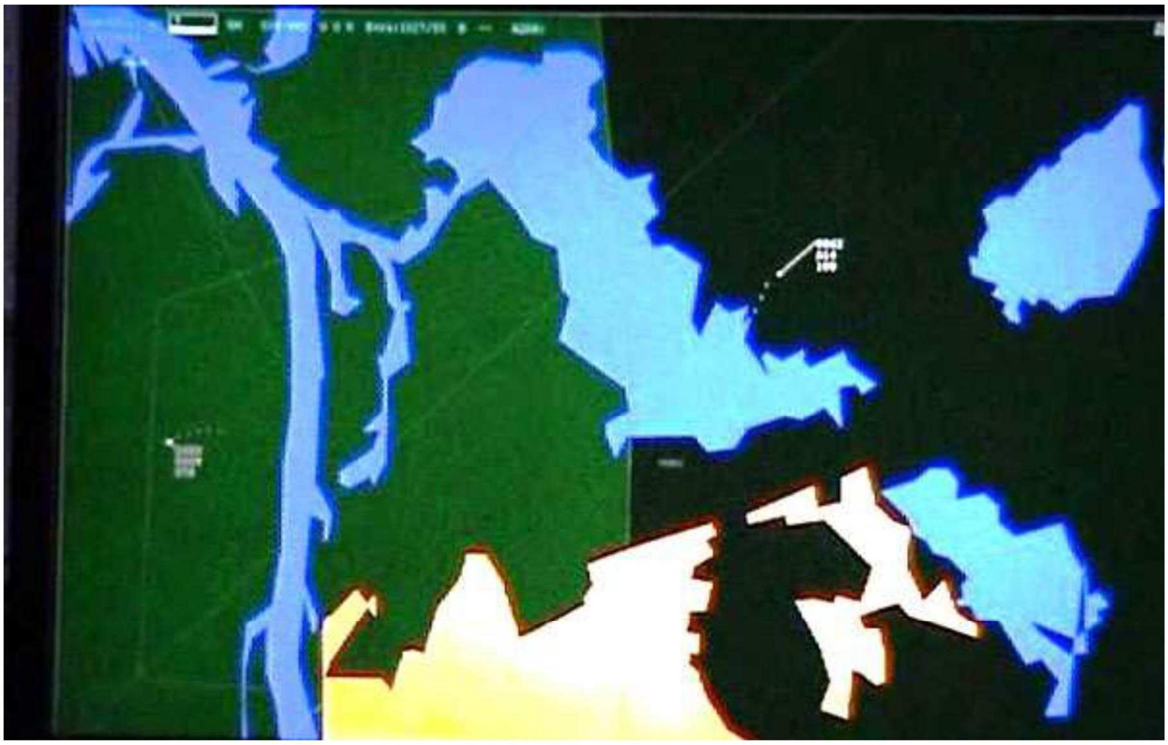
Continuing the flight at altitude of about 1500 feet the aircraft, flying over the lake Ķīšezers, performed a maneuver – turning on the left, after overflight of the lake, repeated a similar maneuver turning on the right.



Radar picture 4 – The aircraft performs a maneuvre above the lake Ķīšezers – turn on the left



Radar picture 5 - The aircraft performs a maneuvre- turn on the right, after overflight of the lake Ķīšezers



Radar picture 6 – The aircraft after performing the meneuvres continues the flight

Radar picture 7 – The aircraft after performing the meneuvres continues the flight

Aircraft flew at altitude 1500 FT with ground speed within 100 -110 kt. Continuing the flight at altitude of about 1500 feet over the wood between the populated areas of Suži and Bukulti, at about the same distance from lake Ķīšezers and lake Baltezers, the aircraft ground speed within 43 seconds sharply decreases from 100kt to 8kt, altitude decreases to 500FT and at **13:20:37** aircraft disappeared from the radar screen. At that time aircraft collided with earth surface. Approximately at the same time at 13:18 was transmitted distress signal from aircraft Emergency Locator Transmitter (ELT, country of beacon registration 275/Latvia, user class aviation/identification YL-SVN) on frequency 406.037 MHz and had received by MRCC Riga. Some difference in time appears due to lack of sinhronization with ATC

Image 5. Place of collision on a map

In the result of the aircraft collision with ground the aircraft pilot and examiner instructor suffered a lethal injury.

1.2. Injured parties

No.	Body injuries	Crew members	Passengers	Total	Other parties
1	Fatal injuries	2	No	2	No
2	Serious injuries	No	No	No	No
3	Insignificant injuries	No	No	No	No

1.3. Aircraft damages

Colliding with ground the aircraft was completely damaged, the wings were deformed and broken, the tail part with vertical stabilisers and rudder was broken off from fuselage, the front side, and pilot cockpit with instrument panel and both engines were sank in marsh and completely destroyed.

1.4. Other damages

No fundamental harm has been caused to environment.

1.5. Crew information

Aircraft pilot: - Citizen of the Russian Federation, 30 years old;
Pilot qualification: - PPL(A) Nr.LVA/JAA-210P issued on September 26, 2011 LR CAA.
Medical certificate: - Medical certificate Class 1/2 issued on October 26, 2012 LR CAA.
Total hours of flying of the aircraft pilot: 198.4 hours

Examiner – citizen of Estonia, 48 years old

Examiner's qualification - Examiner's Authorisation No.EST/FE-CRE-TRE-IRE-FIE/004 valid till May 18, 2014
JAR conformable Flight Crew Licence No. EST-6409210112 issued on October 01, 2012

Medical certificate Class1/2 issued on April 04, 2012

1.6. Information about the aircraft

According to the manufacturer's Costruzioni Aeronautiche Tecnam S.r.l, Italy, Aircraft Flight Manual Tecnam P2006T "Doc No 2006/044 3rd Edition- Rev.0 of 2011, December 22", it is upper plate monoplane with four seats (4 persons including 1 pilot) equiped with two engines Bombardier Rotax 912 S3.
The aircraft type certificate "EASA Type Certificate No: A.185 (Dated 2009, June 5)".
The aircraft was certified as the aircraft of **normal** flight category in compliance with EASA regulation „Certification Specifications for Normal, Utility, Aerobatic and Commuter Category Aeroplanes" CS23.
In compliance with the Item CS 23.3 "Aeroplane categories" of EASA regulation, the aircraft is certified in normal category, non aerobatic operations include:

- Any manoeuvre pertaining to normal flight;
- Chandelle;
- Turns in which the angle of bank is not more than 60°;
- Lazy eights;
- Stalls (except whip stalls);

Permitted maneuvres of the aircraft Tecnam P2006T has been set in the Item 16 "Approved maneuvres"of the Section No.2 of the Aircraft Flight Manual.

On March 19, 2012 the aircraft Tecnam P2006T, serial No. 056, has been registered in the aircraft register of the Civil Aviation of The Republic of Latvia with registration number YL-SVN, owner - Hank Rearden Ltd.
On March 30, 2012 the Civil Aviation Agency issued the Certificate of Airwothiness No 97, series S and Airworthiness Review Certificate No.087 for the aircraft with registration number YL-SVN.

1.6.1. Aircraft fuselage

Manufacturer:	- Costruzioni Aeronautiche Tecnam S.r.l., Italy;
Aircraft model:	- P2006T;
Serial number:	- 056;
Reistration number:	- YL-SVN;
Certificate of Registration:	- D-365, issued on March 30, 2012;
Certificate of Airworthness :	- S-97, issued on March 30, 2012;

Airworthness Review Certificate:	- LV ARC 087 issued on March 30, 2012;
Total flight:	- 380 hours
Flyhing since the last 100 hour technical maintenance:	- 70 hours;
Registered owner:	- Hank Rearden Ltd., the Republic of Latvia

1.6.2. Engines

Engine manufacturer:	- Bombardier ROTAX, GmbH, Austria;
Engine model (piston):	- ROTAX 912 S3;
Engine No.1 serial No.:	- 4924104;
Total flying hours of engine:	- 381 hours;
After overhaul:	- has not been performed.
Serial No of Engine No.2:	- 4924100;
Total flying hours of engine:	- 384 hours;
After overhaul:	- has not been performed.
Type of certificate:	- EASA TCDS no. E121 April 1, 2008

1.6.3. Propeller

Propeller manufacturer:	- MT Propeller Entwicklung;
Propeller type:	Variable pitch – hydraulically controlled and fully featherable;
Blades/hub:	- wood/composite 2 blades with aluminium hub;
Propeller turn dirrection:	- In the clockwise direction from the side of cockpit;
Date of manufacturing:	- 2011;
Propeller model:	- MTV-21-A-C-F/CF178-05;
Propeller serial number:	- abj-41134; abj-41135;
Certificate type:	- LBA 32.130/086 (series MTV-21)

1.6.3. Fuel

Used fuel:	- Unleaded Petrol "Super", grade 98 class C1; Standard: LST EN 228:2008
Fuel amount:	- tanks overall capacity 200 litres, capacity of each wing tank 100 litres

According to the records of logbook the amount of filled fuel in the aircraft before the first flight was 200 litres. Fuel balance after the first flight was 140 liters. There are no records in the logbook before the second flight, therefore the second flight was started with 140 liters of fuel in the aircraft tanks. It was not possible to estimate the actual balance of fuel in aircraft tanks as due to the wing damages almost all fuel was spilled out on the ground.

1.6.4. Aircraft weight

Empty weight of the aircraft:	- 837 kg;
Maximum takeoff weight:	- 1180 kg;
Maximum baggage load:	- 80 kg.

1.7. Meteorological information

Information about actual weather conditions on November 13, 2012 in the time period from 14:00-17:00 has been provided in compliance with the letter Nr.4-6/1869 from November 28,

2012 of Latvian Environment, Geology and Meteorology Centre. Latvian Environment, Geology and Meteorology Centre do not perform meterological observations in Garkalne municipality. By the data of the closest University observation station of Garkalne municipality, Bukulti village (address of the station: Riga, Kronvalda boulevard 4) and operative observation data of wind speed measuring and manual observation (address of the station: Riga, Raiņa boulevard 19):
Weather conditions on November 13, 2012 from 14:00 till 14:00

Authomatic measurements:

Date	Hour	Air temperature, °C			Hours	Wind		
		Hour average	Hour maximum	Hour minimum	Average relative air humidity %	Hour average wind directions, degrees, rhumbs	Hour average wind speed, m/s	Hour maximal wind rush, m/s
13.11.2012	14:00-15:00	7.6	7.9	7.2	72	268° (west)	3.4	7.1
	15:00-16:00	7.1	7.2	7.0	74	249° (west-southwest)	2.9	6.1
	16:00-17:00	6.7	7.0	6.5	75	245° (west-southwest)	3.1	6.3

Manual observations:

Data	Observation time	Total amount of clouds, grades	Amount of lowest clouds, grades	Form of clouds	Meteorological visibility, km
13.11.2012	at 14	7	3	hight-cumulus strati-cumulus	10
	at 17	8	4	hight-cumulus strati-cumulus	10

In Riga University observation station the lowest border height has not been measured. In Riga airport observation station in the mentioned time interval the height of lowest grade above the earth surface was 670 - 700 meters.
On November 13, 2012 from 14 to 17 in Riga University observation station any kind of atmosphere phenomenons were not registered.

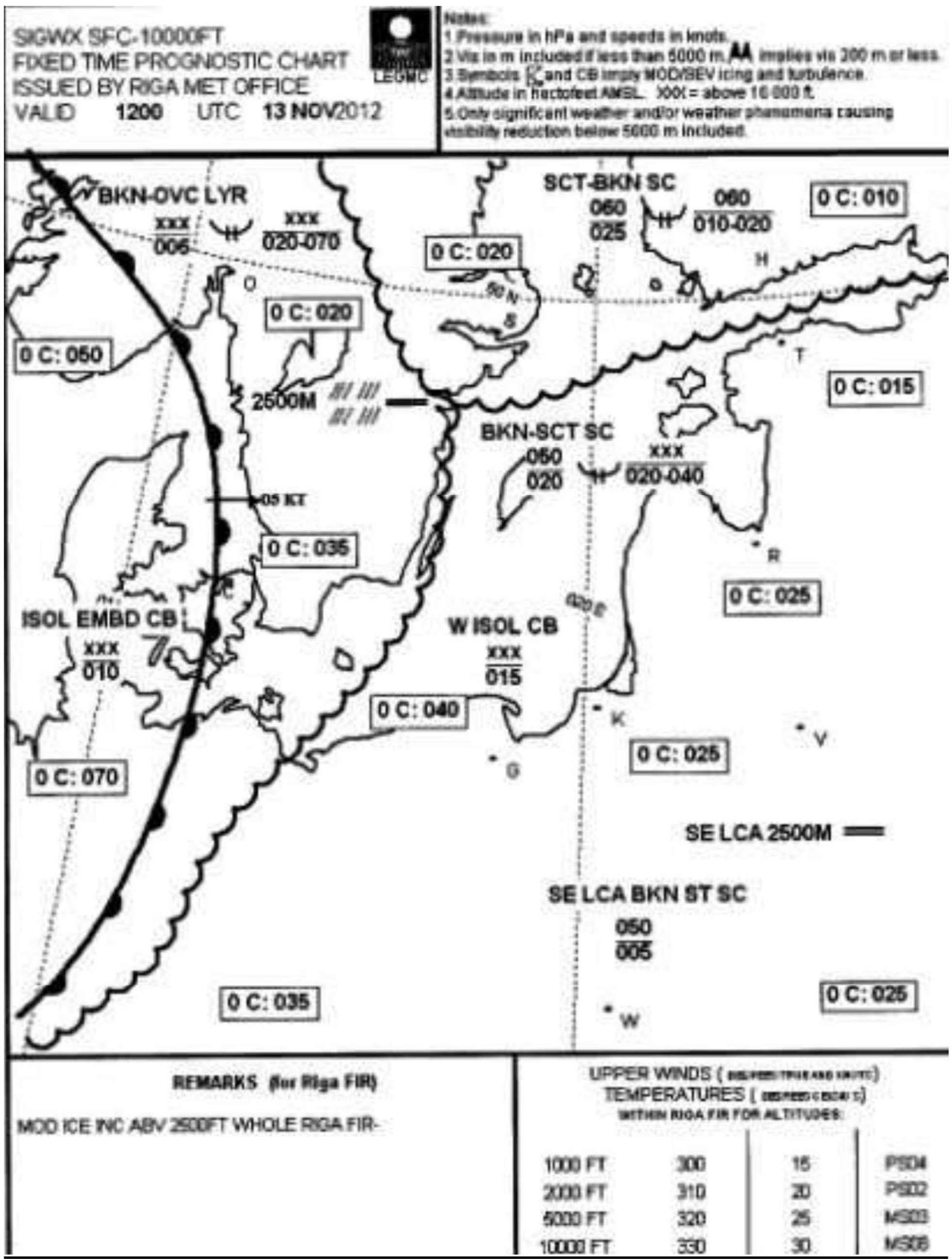
Actual time in locality of Riga landing field at 13:50-17:20 (11:50-15:20 UTC) on November 13, 2012.

METAR EVRA 131150Z 24004KT 200V300 9999 BKN023 07/04 Q1026 R18/190060 NOSIG=
METAR EVRA 131220Z 25004KT 200V300 9999 BKN023 07/04 Q1026 Rl8/190060 NOSIG=
METAR EVRA 131250Z 25004KT 180V320 9999 BKN023 07/04 Q1027 Rl8/190060 NOSIG=
METAR EVRA 131320Z 25004KT 190V300 9999 BKN022 07/04 Q1027 R18/190060 NOSIG=
METAR EVRA 131350Z 24004KT 200V300 9999 BKN022 07/04 Q1028 R18/190060 NOSIG=
METAR EVRA 131420Z 23004KT 200V270 9999 BKN022 06/04 Q1028 Rl8/190060 NOSIG=
METAR EVRA 131450Z 23004KT 190V270 9999 BKN022 06/04 Q1028 Rl8/190060 NOSIG=
METAR EVRA 131520Z 24004KT 180V290 9999 BKN022 06/04 Q1028 R18/190060 NOSIG=

GAMET prognosis with the time of activity at 14:00-20:00 (12:00-18:00 UTC) on November 13, 2012

EVRR GAMET VALID 131200/131800 EVRA
EVRR RIGA FIR BLW FL100
SECNI
SIG SFC VIS: 17/18 LCA 3000M BR 1 2 3
SIG CLD: 17/18 LCA BKN 500/1500FT AGL 1 2 3
ICE: MOD INC ABV 2500FT AMSL
SIGMET APPLICABLE: NIL
SECN II PSYS: NO MAJOR WX SYSTEM
SFCWIND: W07-12KT
WIND/T: 1000FT300/15KTPS04
2000FT310/20KTPS02
5000FT 320/25KT MS03
10000FT330/30KTMS08
SFCVIS: 8-10KM
CLD: BKN-SCT SC 2000/6000FT AGL
FZLVL: 2500FT AMSL
MNM QNH: 12/15 1026HPA FOR S 1, 1024HPA FOR2
1023HPAFOR3
15/18 1027HPA FOR S 1, 1026HPA FOR 2
1025HPAFOR3
SEA: T10HGT1.0M
OTLK: 131800/132100 SAME HAZARDOUS WX=

Above mentioned weather conditions comply with the requirements of performance of visual flights.



SWL map with forecasted metheorological situation at 14:00 (12:00 UTC)

1.8. Aids of navigation

Navigation equipment had no significance to the accident.

1.9. Communications

Aircraf was equipped with Garmin SL30 VHF COMM/NAV (operates from 108-117.95MHz)

1.10. Aerodrome information

Aviation accident occurred outside of the territory of aerodrome.

1.11. Flight recorders

The aircraft did not have any record equipment.

1.12. Wrckage and and impact information

In the aviation accident site the aircraft TECNAM P2006T, registration number YL-SVN collided with the ground and stopped without any trace of sliding, in a sharp angle with its fuselage forepart crashed into the ground and with right side wing rested on the tree trunk.

In the scene of aviation accident the following aircraft damages were detected:

Image6. The right wing has been deformed due to the impact, colliding with the tree stem;

Image7.Tail of the aircraft fuselage (rudder, fin and vertical stabiliser) is broken off from fuselage.

Image8.The aircraft fuselage is deformed, the forepart of fuselage and engines due to the impact are immersed in the ground.

Image9. Forepart of the aircraft including instrument panel is fully destroyed.

Image10. Handles of the controlling device „Central Pedestal" body are deformed and broken

On „Central Pedestal”, found at accident site, the throttle levers were in closed position, the propeller levers are in turned on position, heating of the left side engine carburettor is turned on, for the right side is turned off. Due to serious deformation it was not possible to ascertain with proof evidence the actual position of levers during flight.

Image11.

Collision place of the left side engine

Collision place of the right side engine **Collision place of ACFT fuselage forepart**

Image 12. Collision place

According to the testimonies of witnesses, who were few kilometers from the collision place, the aircraft was flying over the wood with nose down in about 45° angle. Coming closer to the ground the aircraft continued to incline with nose downwards and almost in vertically straight angle fell into the wood. Around the collision place there were large trees and inspecting their leafages there was not found any traces of breaches of tip of the trees and branches, as well fresh broken branches on the ground. Any traces of sliding on the ground were not visible, the forepart and engines of the aircraft were deeply submerged into the ground, it approves that collision angle with the ground was extremely steep.

Image 13. Trees behind the aircraft in the flight dirrection are not affected

Image 14. Tips of the trees and leafages around the place of collision are not touched

Image 15. Tips of the trees and leafages around the aircraft collision place are not touched

Image16. Tips of the trees and leafages around the aircraft collision place are not touched

Image17. Right side engine after pulling out of the ground
Propeller blade of the right side engine was in position parelel to the airflow (propeller feathered)

Image18. On the Right hand Fuel selector, found at the accident site, valve was in the position "OFF"

Image19. Left side engine after pulling out of the ground

1.13. Medical and patological information

1.13.1. On November 14, 2012 in the statement No.1065 (postmortem examination) of the forensic medical expert of the Department of Forensic Medical Pathology of the State Centre for Forensic Medical Examination was stated:

PANATOMIC DIAGNOSIS of Examiner - instructor:

Aviation injury - Polytrauma. Dull head and neck injury: wide abrasions, hypodermic haemorrhage and beaten-lacerated wounds on face and frontal area of the neck, haemorrhage on the inner surface of head skin muscle rag on the forehead area, multi-commutated fractures of face skeleton with fracture transition to the bones of skull base, hard head brain membrane rupture, haemorrhage under the gentle head brain membranes in the curvaceous surfaces of both cerebral hemispheres, haemorrhages in brain tums, unripen skull base from the 1st and 2nd cervical vertebra of the spine with full break of spinal cord and bonds, haemorrhage in the spinal cord channel. Dull injury of chest, abdomen and pelvis: abrasions and hypodermic haemorrhages in the area of chest and abdomen frontal wall, hypodermic haemorrhage in the area of phallus and scrotums, breastbone fracture: among handle and body, between the attachment site of 2nd and 3rd rib, as well as between the attachment site of 4th and 5th rib with wide haemorrhages in surrounding soft tissues, fractures of 3rd - 5th ribs at close line of breastbone, fractures of 1st – 6th ribs at center line of clavicle, fractures of 2nd-11th ribs aslant from the middle till the back line of armpit and fractures of 1st-3rd ribs along the line of shoulder bone; fractures of the left side 3rd, 4th ribs along the side breastbone line, fractures of 2nd-6th ribs along the middle line of clavicle, fracture of 5th-7th ribs along the frontal line of armpit, fractures of the 4th, 6th ribs along the middle line of clavicle, fractures of 5th-9th ribs along the backside line of armpit, fractures of 2nd-4th ribs along the line of shoulder bone and fracture of 1st rib along the side spinal line with damages in wall pleura and haemorrhages in surrounding soft tissues, fracture in

the middle third of the right clavicle with haemorrhages in surrounding soft tissues, fracture of the connection of the sacrum-iliac bones, fracture in the left side of the upper branch of pubic bone and comminuted fracture of coccyx with wide haemorrhages in surrounding soft tissues, bruise, hemorrhage in mediastinum, ruptures in aorta, both lungs, pericardium, heart, livers, spleen, mesentery of small and large intestine, haemorrhages in the areas of lung roots, heart base, entry of kidneys and spleen, in sickle cord of livers. Injury of extremities: hypodermic haemorrhages, abrasions and beaten-lacerated wounds on hands and legs, comminuted fracture on upper third of the left elbow bone, comminuted fracture on lower third of the left radius, comminuted fractures of hand baseline bones, comminuted fracture in middle third of the left femoral bone, double fractures of the both bones of the left shank in the level of middle and lower thirds, comminuted fracture of the heel bone, comminuted fracture in the lower third of the right thighbone, double fractures in the lever of middle and lower third of both bones of the right shank. External bleeding. Bleeding in pleura and abdominal cavity (together 350 ml). Liquid blood in heart sockets and large blood vessels. Irregular hemorrhage of internal organs. Cerebra and pulmonary edema. Shock. Blood aspiration. Fat embolism in lungs.

Atherosclerosis of aorta. Coronary heart disease: stenosing atherosclerosis of heart coronary artery (40%), diffusive microfocal cardiosclerosis. Chronic bronchitis.

Conclusion

The death is violent, it entered on November 13, 2012 caused by polytrauma with numerous broken skeleton bones and internal organ damages, accompanied by internal and external bleeding and which was thickened by traumatic shock.

By character the indicated body injuries can be treated as SERIUOS injuries, life-threathening, between obtained body injuries and death there is direct causative connection.

All previously mentioned body injuries emerged on November 13, 2012 in the result of influence of hard dull objects, injured party being in the aircraft and in the result of impact and colliding with gibbous parts of the aircraft cockpit, aircraft touching the ground due to the aviation injury.

In the body injuries found within the process of forensic medical examination of the corpse has not ben depicted any specific contact surface features that could permit more precisely to determine the individual preoperties of traumatic object (objects).

As the forensics experts do not know the cockpit and safety belt structure of the aircraft TECNAM with the state registration number YL-SVN, in this case it is not possble to declare if the injured party has or has not fastened the belt.

All body injuries found in the corpse examination process has emegred practically at the same time, when the injured party was alive, which is testified by blood aspiration (blood in the airway) and practical deficiency of signs of suffering in the area of body injuries. In this case it is not possible to declare the sequence of origination of the body injuries.

In the process of corpse examination other body injuries, which are not connected with aviation trauma were not found.

Considering the character and localization of body injuries found in the corpse examination process, it can be regarded that the injured party in the moment of aircraft touching the ground was in the sitting position, supported with spine part of the body against the seat.

In the blood and urine of corpse has not been found: ethyl alcohol, barbiturates, tiobarbiturates, alkaloids (including opium alkaloids), cocaine metabolites, amphetamine, metaamphetamine, MDA, MDMA, MDEA, MBDB, ephedrine, efedrone, pyrazolon, butyrophenone, thioxanthene, imidazoline, 1,4-benzodiazepine, dibenzazepine, phenothiazine compounds, benzhexol (syn. Cyclodol), diphenhydramine (syn. Dymedrol), zopiclone, zolpidem, tramadol, tryciclic antidepressants.

PANATOMIC DIAGNOSIS of the aircraft pilot:

Aviation injury. Polytrauma. Dull open head and neck injury: numerous beaten and lacerated wounds, abrasions and hypodermic haemorrhages on the face and neck, multi-commutated fractures of skull base, pad and face skeleton, dura mater fractures, haemorrhages under the pia maters and brain ventrices, fully unripen skull base from the 1st and 2nd cervical vertebrae with breaking of spinal cord and bonds, haemorrhages in spinal cord channel. Dull injury of chest, abdomen and pelvis: wide hypodermic haemorrhages and abrasions in the area of chest and frontal wall of abdomen, beaten and lacerated wound in scrotum, sternum fractures between the handle and body, between the body and lower part, as well between the attachment place of 5th and 6th ribs with wide haemorrhages in surrounding soft tissues, fracture of the left clavicle between the middle and front third, fractures of the right side 1st – 8th ribs at close line of clavicle, fractures of 1th – 9th ribs along the middle line of clavicle, fractures of 7th – 10th ribs along the close spine line, fractures of 2nd – 4th, 7th , 8th ribs along the back line of armpit, fractures of the left side 2nd – 7th ribs along the collateral line of sternum, fractures of 1st – 8th ribs along the middle line of clavicle, fractures of 2nd, 3rd ribs along the middle line of clavicle, fracture of the 3rd rib along the middle line of armpit, fractures of 5th, 6th ribs along the shoulder line with wall pleura damages and wide haemorrhages in surrounding soft tissues, fractures of both side sacrum-iliac bone joints, commutated fracture of coccyx, ruptures of aorta, both lungs, pericardium, livers, kidneys, spleens, mesentery of small and large intestine, partial heart urip from blood-vessels, bruise of both lungs, haemorrhages in the area of pulmonary roots, heart base, kidney and spleen gate, sickle cord of livers. Injury of extremities: hypodermic haemorrhages and beaten-lacerated wounds on hands and lega, comminuted fracture on middle third of the right humerus, duplex fractures on upper and lower third of the both right forearm bones, comminuted fractures of base phalange of the 3rd, 4th finger of the right palm, comminuted fracture on upper third of elbow bone, comminuted fracture on middle third of the right thighbone, comminuted fracture on middle third of the left thighbone, comminuted fractures in the level of the lower third of both thighbones, comminuted fractures of the right foot heel bone, as well foot basic bone and boat-shaped fractures with wide haemorrhages in surrounding soft tissues and crushed soft tissue with tendon rupture, right foot unriped from the leg.

External bleeding. Bleeding in the pleura and abdomen (together 250 ml). Liquid blood in the heart cavities and large blood-vessels. Irregular perfuse in viscera.Oedema of bramins and lungs. Blood aspiration.

Conclusion

The death is violent, it entered on November 13, 2012 caused by polytrauma with numerous broken skeleton bones and internal organ damages, accompanied by internal and external bleeding and which was thickened by traumatic shock.

By character the indicated body injuries can be treated as SERIUOS injuries, life-threathening, between obtained body injuries and death there is direct causative connection.

All previously mentioned body injuries emerged on November 13, 2012 in the result of influence of hard dull objects, injured party being in the aircraft and in the result of impact and colliding with gibbous parts of the aircraft cockpit, aircraft touching the ground due to the aviation injury.

In the body injuries found within the process of forensic medical examination of the corpse has not ben depicted any specific contact surface features that could permit more precisely to determine the individual preoperties of traumatic object (objects). As the forensics experts do not know the cockpit and safety belt structure of the aircraft TECNAM with the state registration number YL-SVN, in this case it is not possble to declare if the injured party has or has not fastened the belt.

All body injuries found in the corpse examination process has emegred practically at the same time, when the injured party was alive, which is testified by blood aspiration (blood in the airway) and practical deficiency of signs of suffering in the area of body injuries. In this case it is not possible to declare the sequence of origination of the body injuries.

In the process of corpse examination other body injuries, which are not connected with aviation trauma were not found.

Considering the character and localization of body injuries found in the corpse examination process, it can be regarded that the injured party in the moment of aircraft touching the ground was in the sitting position, supported with spine part of the body against the seat.

In the blood and urine of corpse has not been found: ethyl alcohol, barbiturates, tiobarbiturates, alkaloids (including opium alkaloids), cocaine metabolites, amphetamine, metaamphetamine, MDA, MDMA, MDEA, MBDB, ephedrine, efedrone, tramadrol, benzhexol (syn. Cyclodol), diphenhydramine (syn. Dymedrol), clonidine (syn.Clofelin), zopiclone (syn. Imovane), zolpidem (syn. Stilnox), 1,4-benzodiazepine, dibenzazepine, phenothiazine, imizine, thioxanthene, butyrophenone, imidazoline, pyrazol derivates, tryciclic antidepressants.

1.14. Fire

There were not found any marks of fire during the flight or due to the aircraft collision with the ground.

1.15. Survival aspect

Due to the strong impact the aircraft pilot and examiner-instructor got fatal body injuries. In the place of accident the pilot and examiner was found under the front part of the aircraft fuselage wreckage forced in the ground and practically were not visible till the moment of removal of the wreckage.

Image 20. Pilot and examiner under the wreckage of aircraft

Image21. The remains of the pilot and examiner were released by the rescue services personnel

ELT

Image 22. ELT (Emergency Locator Transmitter)

The aircraft was equipped with ELT (Emergency Locator Transmitter) ME406, series No.197-05953. ELT is equipped with gravitation switch „G switch", which automathically turns on ELT when the aircraft suffers in accident. ELT transmits signal with frequency 121,5 MHz for local use and with frequency 406 MHz to satellite from which the signal is being transmitted to MRCC. MRCC transmits information to LGS ARCC. In the place of accident ELT found on the board of aircraft was turned on and transmitted the signals.

1.16. Tests and research

1.16.1. Experimental flight

Taking into account that the aircraft was not equipped with any kind of equipment which records the flight data parameters or voice records, as well as due to the impact colliding with ground surface the damages of the aircraft fuselage, and control inputs were damaged in an extent that practically it was not possible to define in what position they were in time of the flight before collision.The severity of airplane response following a sudden engine failure is difficult to predict by theoretical analysis. The pilot delay time in recognizing the asymmetric power condition and applying appropriate control inputs influences the magnitude of the rolling and yawing motions. Actual flight test of critical conditions is the only means of establishing safe flight boundaries. Taking into account it, the investigation decided to organize and perform an experimental flight with identical two engine aircraft P2006T, to imitate the flight modes which probably had for the aircraft, which was invoved in the accident, and to check controllability and stability characteristics, in different flight modes – normal mode and slow flight - performing maneuvers with lower speeds at which the aircraft is able to perform a controlled flight without a stall indication. Experimental flight programme included a simulation of the engines failure. 2 experimental flights were performed on May 29, 2013 from the landing field Paluknys (PALUK, N54 28’59’’ E024 59’32’’), the airport height above MSL 400FT. The flight was performed by the pilot-instructor (total hours flying with different type of aircrafts 16000 hours, licence LT-ATPL 192, qualification remarks –[FI(A)/SEP.MEP, TMG, IRI(A), TRI]. Other pilot was observer, total hours flying 2000 hours with acrobatic flight qualification. Maximum weight of taking off of the aircraft 1230 kg, weight of pilots sitting in the front seats 200kg, luggage weight which is placed in luggage section 50 kg and full fuel tanks of both wings - together 200L. The flights were performed in visual meteorological conditions. The first flight was started at 08:23:55, finished at 08:56:49 and lasted 33 min. The second flight, after the initial analysis of the flight results was started at 14:57:39, finished at 15:15:50 and lasted 18 min. Readings of the instrument panel was recorded with video camera.

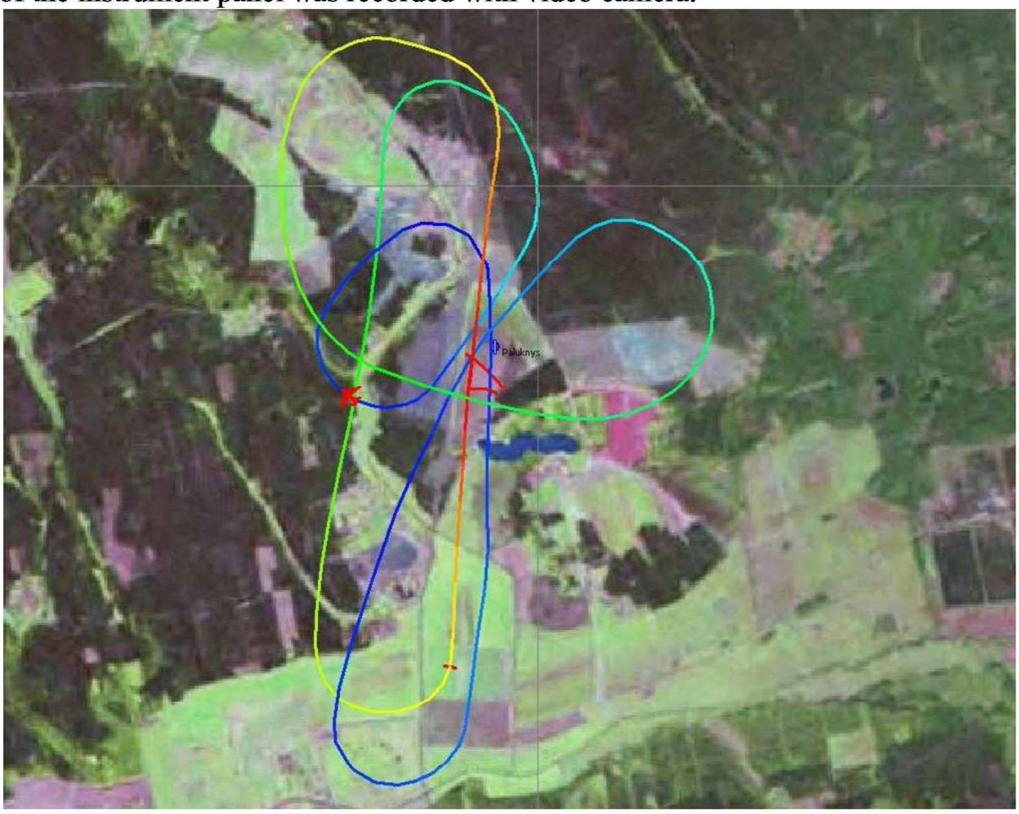


Image23. Experimental flight track of the aircraft

Reaching altitude 4000 FT and stabilizing the speed of flight to 110kt thrust of the right side engine was drecreased and the ignition switch was switched off. Propeller continued to rotate due to the impact of the air flow, but after a moment it stopped. (Image 24, 25)

Image24. Propeller rotation of the right side engine (rpm)

Image25. Propeller of the right side engine does not rotate

Assymmetric imbalance turning the aircraft towards the inoperative engine occurs, but it could be easily compensated by the rudder even at low speeds.

After locking the propeller, due to decreasing it resistance force, assymmetric imbalance effect decreased, although the increase of the thrust of the operating engine increases the moment arm.

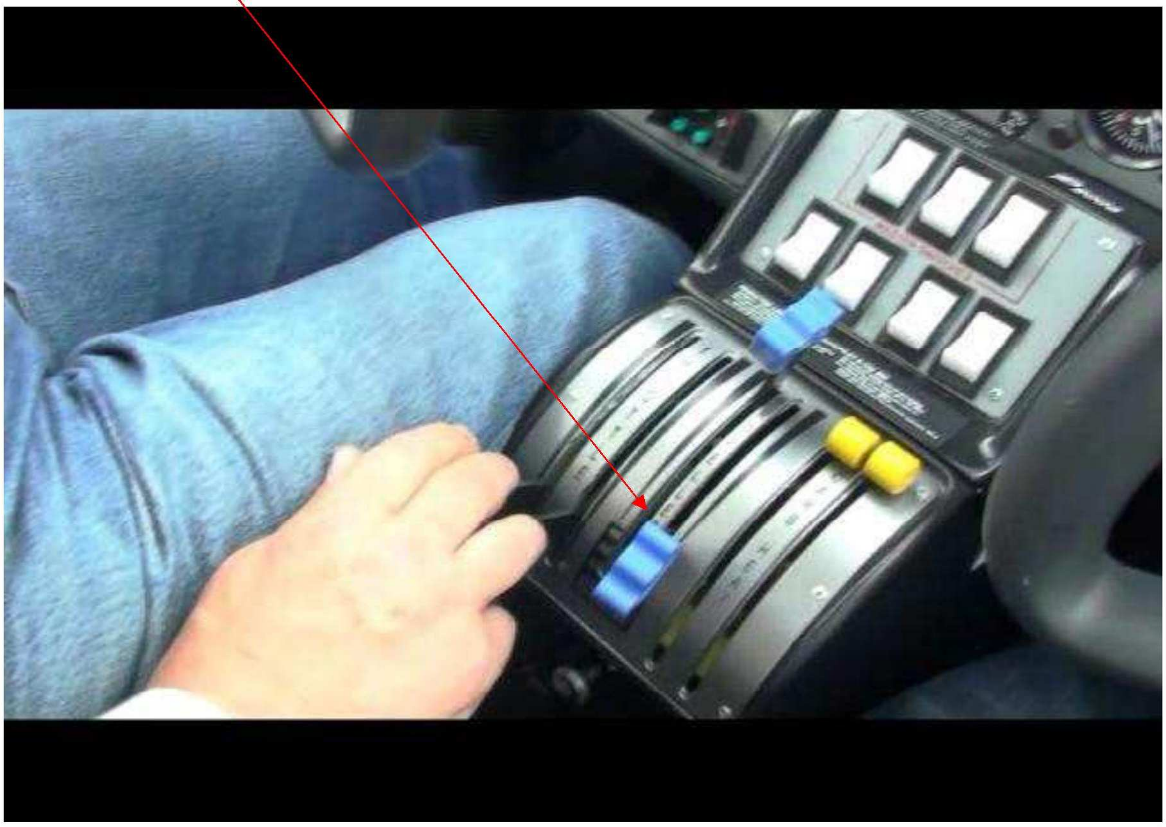


Image 26. Right side engine propeller has been locked, the throttle of the operating engine – partly closed

The moment can be fully compensated by ailerons with 15 degree bank into the operating engine. During of flight the aircraft was able to maintain the altitude and climb at a rate 200 Ft/min at the speed 90 kt. According to the methodology of the Aircraft Flight Manual starting of the engine during of flight could be completed in time of 20 sec. The left and right engine shutting-down and restarting procedures in flight were completed several times. During first procedures not more than 200 feet of altitude were lost, during the later ones- just about 50 feet or even with no loss of altitude. Inoperative engine (OEI) was started in the following sequence:

- Fuel pump -ON;
- Ignition switches- both ON;
- Throttle lever- IDLE;
- Propeller lever –FULL FORWARD;
- Start push button – PUSH;
- Propeller lever – set at desired rpm;
- Throttle lever – set as required.

During the simulation of engine failure the engine started to operate since throttle and propeller control settings are set in advance and strong moment is created towards the operative engine.

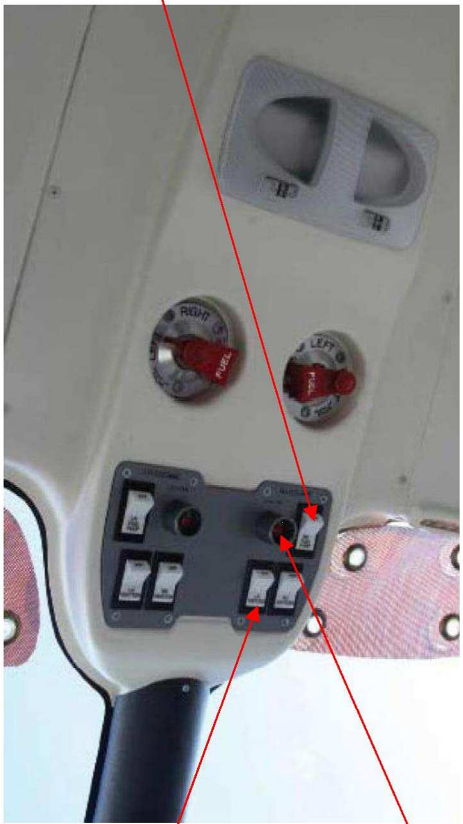


Image 27

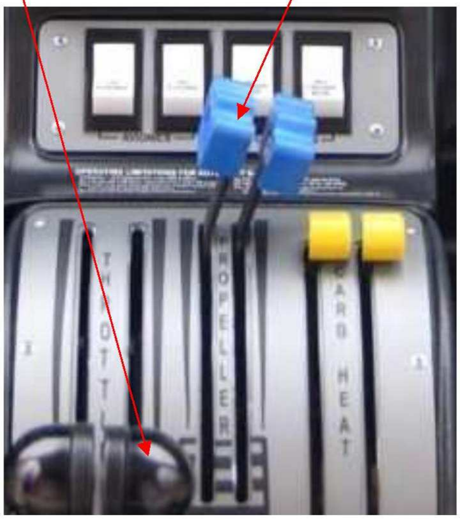


Image28. Control pedestal

Assymetrical imbalance changes the direction due to the changed trim setting used to compensate for lost engine.

During the experimental flight the investigators gained the following information and together with the aircraft pilotes made the following conclusions:

- Performing the simulation of the engine failure the significant diference between the right and the left side engines was not observed;
- The loss of altitude imitating the engine failure was not significant;
- If during the flight only two front seats were taken (for example, if the student pilot and instructor is flying) and there is no additional weight (50 kg) in the luggage compartment, the aircraft balance may move far forward;
- It may significantly change the structural characteristics of the aircraft especially in the beginning of the quick and steep spin;
- Uncoordinated control inputs of the aircraft when the thrust asimetric moment changes fast due to the assymetry of power can cause an irreversible loss of the aircraft control;
- Aircraft P2006T flying techniques for training asymmetrical thrust are not typical for this class of aircraft.

1.16.2. Inspection of the left side aircraft engine

To evaluate the possibility to perform a test of the aircraft engine No.1 in the operating mode the investigators performed an examination of the aircraft engine to determine its technical condition. The engine cleaning, disassembling and visual inspection of it components was performed. In compliance to the technical defectation statement the following was found:

- In the engine cylinders due to the water the pistons are covered with rust and mechanical details attached to them is not possible to move;
- At water access points bearings and gearwheels are covered with corrosion;
- Cooling system radiator is completely deformed;
- Oil radiator is completely deformed;
- All exaust system including the engine exaust tubes is completely deformed;
- Due to the impact the oil radiator has damaged the 1st ans 2nd engine cylinder.

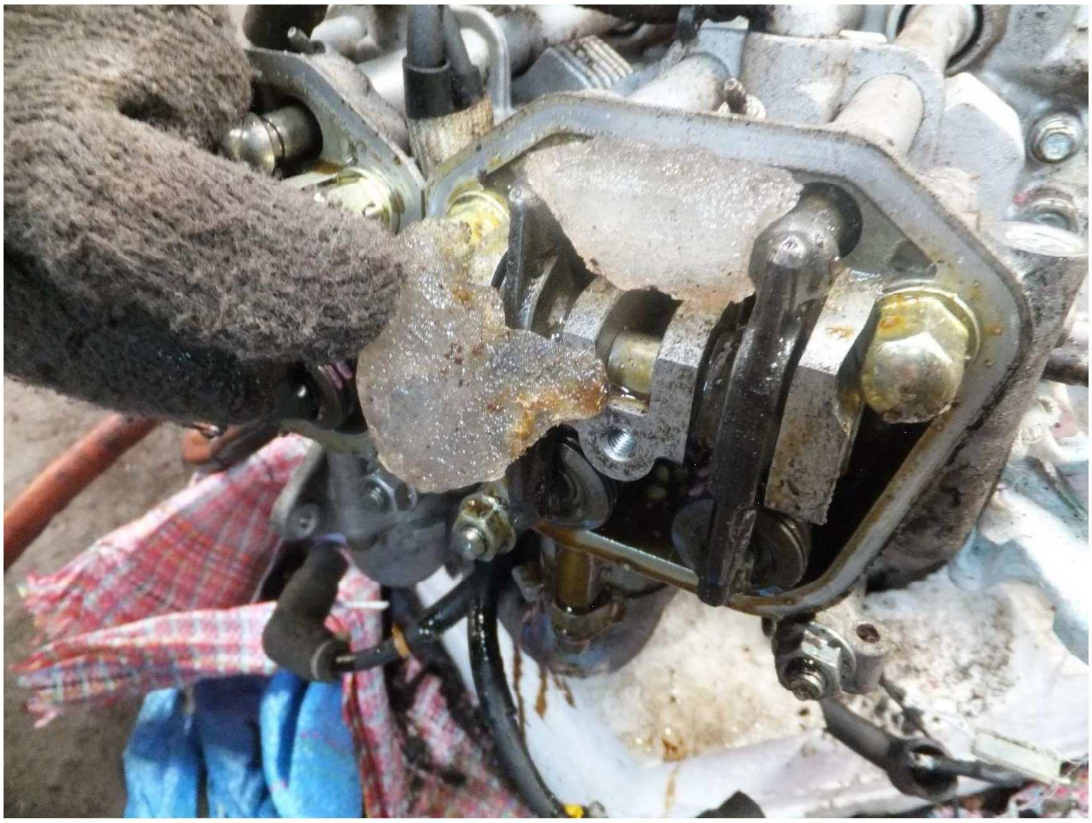


Image29. Engine parts

- Inlet - exaust valve pusher cases are deformed;
- Oil filter fastening flange at oil pump is broken;
- engine reducer shaft is bent, mechanical details and bearings are covered with corrosion which is caused by water;
- Engine inlet collector is completely damaged;

Image 30. Oil filter fastening flange at oil pump is broken

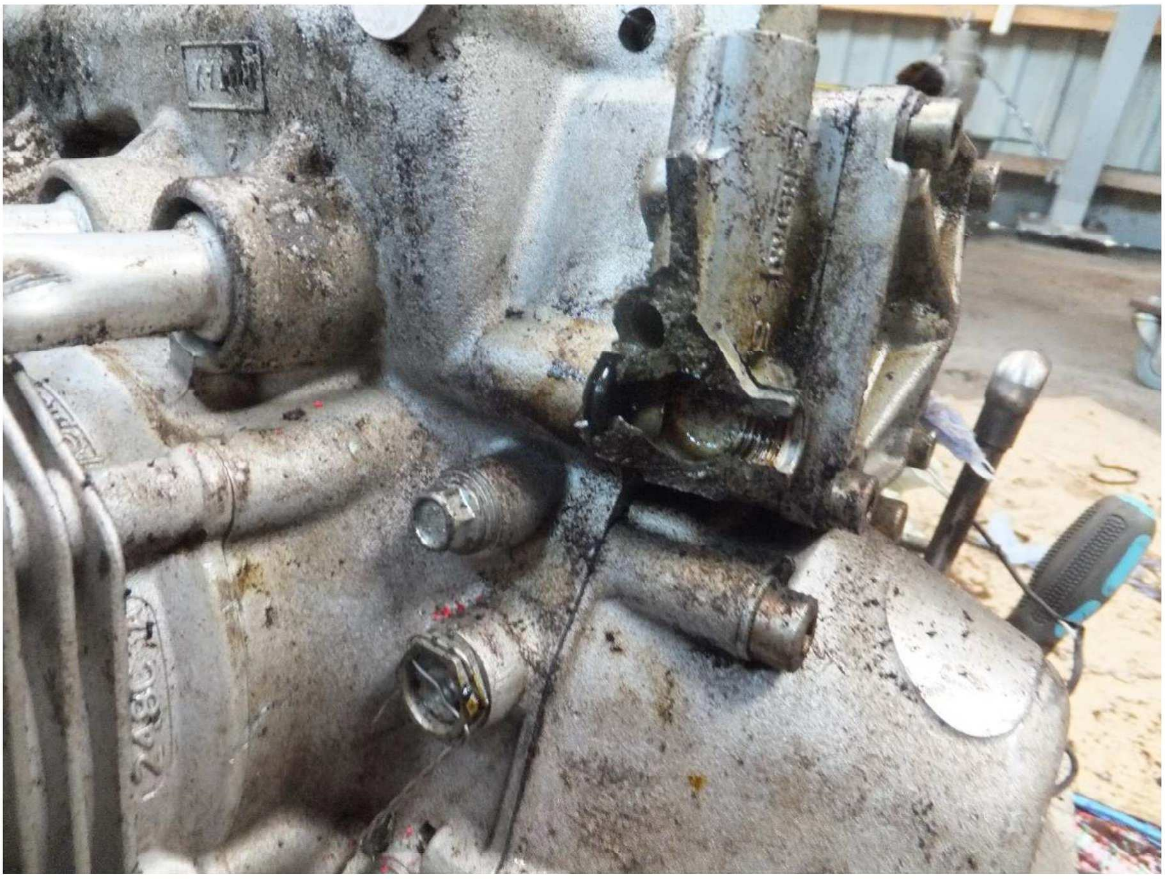


Image31. Engine damages

- Additional generator can not be restored due to the penetration of moisture and dirt;
- Oil pump gearwheel are rusty;
- Carburetor gear details are damaged;
- All fuel and oiling system tubes are damaged;
- Air supply and cooling system tubes are damaged;
- Oiling system metalic tubes are damaged;

Due to the damages of parts of control and regulation mechanism it was not possible to establish actual condition of the propeller of engine No.1; After the partial disassembling and examination of the engine No.1, Bombardier ROTAX 912 S3, series No. 4924100 it was found that starting of the engine for testing in the operating mode is not possible due to the damages, resulted from the aircraft collision with ground.

1.16.3. Inspection of used fuel

- Inspection of the used fuel was performed in Ltd. Latvijas sertifikācijas centrs laboratory, testing reports No. 68028 (the left side engine), No. 68029 the right side engine.

1.17. Organizational and management information

1.17.1. Flight Training Organisation FTO TEKARA

On December 30, 2011 FTO Tekara submitted an "Application Form for Approval of Training Organizations" to CAA Civil Aviation agency of the republic of Latvia for approval of training organization of professional qualification of aviators.
Inspection of the aviator professional training organization of the Civil Aviation Agency in composition of three inspectors (inspection leader and two inspectors) performed FTO Tekara compliance test JAR- FCL 1.055 „Applicability", JAR- FCL 1.055 „Training organizations and registered facilities" (App 1a) and Interpretative And Explanatory Material (IEM) No1, 3 to JAR FCL 1.055 requirements.

First inspection results were fixed in the documents of the Civil Aviation Agency „Lidotāju profesionālās sagatavošanas organizācijas Pārbaudes Lapas –FTO Inspection checklist" signed by CAA inspectors at 23 March, 2012. According to results of inspection fixed in the checklist there were found many deficiencies to JAR-FCL 1.055 App1a, on 1-33 requirements. Deficiences in different documentation, for example, Training Manual (TM), Operation Manual (OM), available of training materials for knowledge instruction and other deficiences to ensure qualitative training.

In the FTO/TRTO/RF control card of FTO Tekara Application, which includes 14 documents, on January 17, 2012 the CAA inspector has found various non-compliances in about 10 documents. Main documents relevant for providing training such as OM, TM, QM were not designed yet. In documents signed at January 20, 2012 - „Remark pages FTO Tekara, FTO Opeational Manual Chesklist, approved by one of CAA inspector it is given, that the deficiences have been partially prevented.

On March 23, 2012 in the Training Organization Inspection of the Civil Aviation Agency, in chapter 21 "Inspection results" it was established, that in compliance with the requirements 1.055 of JAR-FCL, FTO Tekara has been satisfactory prepared for the training process in applied courses and can issue an approval certificate for 1 (one) year. The first inspection shall be performed no later as within 30 days after beginning of the training process.

The approval of Flight Training Organizations is area of responsibility of the State Civil Aviation Authority, therefore the Civil Aviation Agency of the Republic of Latvia has confirmed, that FTO Tekara complies with all requirements of the Joined Aviation Requirements (JAR-FCL), which applies on establishment of the training organization and on April 16, 2012 it has issued an Approval Certificate No LVA/FTO/06 and authorised the professional training organization FTO TEKARA to perform the following courses:

- PPL(A) Training Course Including Night Qualification (JAR-FCL 1.125);
- SE IR(A) Modular Flying Training Course (App.1 to JAR-fcl 1.205);
- CPL(A) Modular Flying Training Course (App.1 to JAR-FCL 1.160&1.165(a)(4);
- ME IR(A) Modular Flying (JAR-FCL 1.205);
- MEP(A) Training Course (JAR-FCL 1.261).

With the following confirmed training aircrafts:

- No approved training equipment;

Types of aircrafts and registration marks:

- P92-JS: YL-ROS, YL-ANT
- Beechcraft C23 Sundowner , YL-BEE
- Tecnam P2006T, YL-SVN.

Taking into account the deficiencies fixed in the inspection documents of the Civil Aviation Agency and analysing process of getting Approval sertificate in whole, the opinion of safety investigation authority TAIIB is, that FTO Tekara preparation process for training was low-grade, careless and involved specialists did not have full understanding how to organize the training process. The posts of the Head of training and the Quality Manager were combined in the FTO TEKARA that is allowed according to IEM No 1 to JAR-FCL 1.055 "Quality system for FTOs/TRTOs", Item 4.3 in case of small FTOs. According to requirements of the same document - JAR-FCL 1.055 "Quality system for FTOs/TRTOs" the primary role of the Quality Manager is to verify, by monitoring activities in the field of training, that the standards and any additional requirements are being carried out properly under the supervision of the Head of training, therefore as the Head of Training is responsible for organization of whole training process, it comes out that he controlled himself, moreover having a part time job at Tekara FTO Ltd. and such system could not promote establishment high standards of training. Quality audits in the FTO TEKARA should be conducted by the personnel of independent organization but taking into account short time of operation since Approval Certificate issuing such audit was not performed yet.
ICAO Doc 9841/AN456 „Manual on the Approval of Training Organisations", Appendix B „Quality Assurance and the Quality Sistem of the ATO" paragraph 2.1 defines too that the main task of the quality management system manager is to perform a inspection in the field of training quality to be sure that all activities of approved training organization comply with the requirements of definite standards and other requirements, set by the Approval Ceritficate issuing institution.

In accordance with CAA term to provide first inspection after 30 days after beginning of the training process and performed after issue of Approval Certificate, the inspector of the Civil Aviation Agency has stated and included in Finding Clearance Report of June 05, 2012 the following 2 (two) non-compliances:

- ***„There is no evidence of HT activities in organisation, supervision and standartisation of flight training";***
- ***„As a formal result the training flights documentation was filled not in accordance with OM requirements".***

These deficiencies describe quality of training organization in the FTO TEKARA afer Approval Certificate issuing. CAA did not stop training on time for prevention deficiencies. The Head of

Training (HT), of FTO Tekara, responding to non-compliances, in the column corrective actions of Finding Clearance Report points out:

- ***„HT has done standartisation training"*** about first non-compliance;

- ***„In future we will make documentation in accordance with OM".***

Investigation considers, that training organization quality of FTO TEKARA was unsatisfactory, which is testified by established deficiences. In disposal of investigation there is not any documental information whether the Head of Training of FTO Tekara improved the flight training process considering declared non-compliances, when in time of inspection there was not found any signs of work organization, supervision and standartization activities.

According to remark in the Finding Clearance Report of 05.June, 2012 there were done instructions by CAA inspector to FTO TEKARA by phone and next Report will be expected. Such instructions documentation are missing.

Second declared non-compliance was not prevented till the accident with the aircraft TECNAM P2006T, registration No.YL-SVN. After June 2012 the activity of FTO TEKARA was not controled by the issuer of Approval Certificate- the Civil Aviation Agency.
The training manual of FTO Tekara Ltd., prepared by the Head of Training of FTO Tekara, was approved by the manager of Aviation Personel Certification Department of the Civil Aviation Agency on July 10, 2012.

1.17.2. Training process of the aircraft pilot involved in the accident

Pilot of the crushed aircraft – the citizen of Russia, who already had a flight crew member certificate - PPL(A) - (private pilot license) has been applied to educational training organization Tekara Ltd, to complete the training course in compliance with the requirements of the Joined Aviation Authorities (JAA) JAR-FCL1 and to get the commercial pilot license CPL(A).

The applicant of CPL(A) issue has submitted a certificate that he had finished 650 hours theoretical training course in Oxford Aviation Academy, which in compliance with the requirements of JAR-FCL is necessary to get the ATPL license. In certificate neither the time of training, nor the period and the date of issue is not provided.

By the request of the Civil Aviation Agency the Oxford Aviation Academy on April 3, 2012 informed in written that pilot in distance learning has finished the Phase 1 of 650 hours JAA ATPL (A) course and on September 10, 2012 successfully finished the Phase 2 of 650 hours JAA ATPL (A) course.

The applicant of CPL(A) issue has successfully finished theoretical exams in Latvian Civil Aviation Agency within the period of time from April 12, 2012 to October 18 and considering the results of examination the Civil Aviation Agency on October 18, 2012 issued a Certificate No. 09/2012ATPL(A) to the applicant as a confirmation of successful pass of theoretical exam ATPL(A) JAR-FCL 1.285 CQB.

On July 10, 2012 the applicant of CPL(A) issue has submitted an Application FTO Tekara Ltd where he points out, that in this Flight Training Organization he would like to pass the training courses of the following flight modes and categories:

- SE IR(A) – Single engine-Instrument rating (Aeroplane);
- MEP(A) - Multi engine piston (Aeroplane) in visual flight mode;
- ME IR(A) - Multi engine- Instrument rating (Aeroplane);
- CPL(A) - Commercial pilot license (Aeroplane) to obtain a license;

In compliance with the records in Student Workbook of the applicant of CPL(A) issue, made during the training, the applicant has performed the flights both with one engine and multi-engine aircrafts, with different flight instructors (FI) and solo, to have flying hours corresponding to the requirements of JAR-FLC for getting the commercial pilot license in different flying modes during the day and night.

Considering the completion of practical flight training courses FTO Tekara issued to the Applicant the following certificates:

- Certificate No.025 from October 20, 2012 that the Applicant has finished SE –IR(A) Training course in accordance with the App. 1 to JAR-FCL 1.025 requirements within the period of time from August 14, 2012 to October 20 with the aircraft Beechcraft Sundowner, registration YL-BEE, according to which the Head of Training of FTO Tekara recommends the applicant to perform SE –IR(A) skill test;

- On October 25, 2012 the certificate No.28, that the Applicant within the period of time from September 22, 2012 to October 19 has finished MEP(A) Training course in accordance with the JAR-FCL 1.261 requirements with the aircraft P2006T, registration YL-SVN, according to which the Head of Training of FTO Tekara recommends the applicant to perform MEP(A) skill test;

- On November 09, 2012 the certificate No.033 that the applicant within the period of time from October 31, 2012 to November 09 has finished ME –IR(A) Training course in accordance with the App. 1 to JAR-FCL 1.205 requirements with the aircraft P2006T, registration YL-SVN, according to which the Head of Training of FTO Tekara recommends the applicant to perform ME –IR(A) skill test;

- On November 13, 2012 the certificate No.034, that the applicant within the period of time from October 30, 2012 to November 09 has finished CPL(A) Training course in accordance with the App. 1 to JAR-FCL 1.160&1.165(a)(4) requirements with the aircraft P2006T, registration YL-SVN, according to which the Head of Training of FTO Tekara recommends the applicant to perform CPL(A) skill test.

- On October 19, 2012 the Head of Training of FTO Tekara submitted in the Civil Aviation Agency the Skill Test/Proficiency Check/ Aeroplane Training Application form according to App 3 JAR-FCL 1.240 "Contents of the class/type rating/training/skill test and proficiency check on single-engine and multi-engine single-pilot aeroplanes".In the Application form was given the type of aircraft Tecnam P2006T, planned date of flight was October 22, 2012.

The Civil Aviation Agency reviewed the application, in compliance with JAR-FCL 1/2.030(d) assigned the examiner and issued a permission No.192/12 to perform the skill testing flight. An examiner was a citizen of the Republic of Estonia, who had submitted the required authorization documents:

- Examiner's Authorization No. EST/FE-CRE-TRE-IRE-FIE/004, issued by the Estonian Civil Aviation Agency;
- Flight Crew License No EST-6409210112;
- Medical Certificate class1/2

Flying skill test was performed on October 27, 2012 from Spilve Aerodrome (EVRS) with the aircraft Tecnam P2006T, registration No.YL-SVN. The aircraft took off at. 11:05 and landed at 12:40. In the test the practices were performed in compliance with Appendix 3 to JAR-FCL 240, Section 1-Section 6 and the results of testing were fixed in the form of the Civil Aviation Agency "Class. Type, ratings/skill test and proficiency check on single engine and multi-engine single pilot aeroplanes including proficiency checks for instrument rating" with remark for ME.

Completion of the practices in the sections of the form was confirmed with signature of examiner, in the column „Results of test-Final results".

The Section 5, Item 5.5 „Engine shutdown and restart (ME skill only)" in the Civil Aviation Agency form "Class. Type, ratings/skill test and proficiency check on single engine and multi-engine single pilot aeroplanes including proficiency checks for instrument rating" is signed by Examiner and it suggests that such execise was performed.

The Section 6, Item 6.1 „Simulated engine failure during take-off (at a safe altitude unless carried out in FS or FNPT II) in the Civil Aviation Agency form "Class. Type, ratings/skill test and proficiency check on single engine and multi-engine single pilot aeroplanes including proficiency checks for instrument rating" the column "A/C" is marked with X that means – "*Simulators shall be used for this exercise, if available, otherwise an aircraft shall be used if appropriate for the manoeuvre or procedure*" and the column "Type/class rating skill test/prof check" is marked by M – " *When the letter 'M' appears in the skill test/proficiency check column this indicates the mandatory exercise or a choice where more than one exercise appears*". The column „*Examiners initials when test completed*" for Item 6.1 is signed by Examiner and it suggests that such execise was performed.

In the Section "Final results" of rating form the examiner has remarked „**Passed-all items passed**". In the section remarks, the examiner has noted „**Can use ME privileges. Flight performed with some remarks**". Content of such remarks unknown and probably were discussed with Applicant orally.

On November 09, 2012 the Head of Training of FTO Tekara signed two forms - Skill Test/Proficiency Check/ Aeroplane Training Application for submitting to the Civil Aviation Agency on testing of applicant's flying skills in the aircraft in compliance with **App 3 JAR-FCL 1.240** "Contents of the class/type rating/training/skill test and proficiency check on single-engine and multi-engine single-pilot aeroplanes" and **App 2 JAR-FCL 1.170 (CPL issue).**

The Civil Aviation Agency inspector reviewed the Application forms, in compliance with JAR-FCL 1/2.030(d) assigned the examiner and issued the permissions No. 204/12 and No. 205/12 to perform the skill testing flight. In the both Application forms was given the type of aircraft P2006T, planned date of flight was November 12, 2012. Acording to this information it suggests that both skill tests were planned to perform during one flight.

The Applicant has performed all the required training flights with the same type and class of aircraft, which shall be used for skill test in compliance with App 1 JAR-FCL 1.170 skill test for the CPL(A) issue and has flew solo with aircrafts as a pilot 70 hours and according to the JAR-FCL 260 Class rating – Conditions, could repeat the flying skill examination-test CPL(A) with multi-engine (ME) aircraft, as a pilot, as on October 27, 2012 he has successfully passed ME skill test.

1.17.3. Requirements for skill test for of CPL(A) issue

- An Applicant for a skill test for the CPL(A) issue shall have satisfactorily completed all of the required training, including instruction on the same type/class of aeroplane to be used in the test;

- The Applicant has to pass all proper sections of the skill test. If any item in a section is failed, that section is failed. If the Applicant has failed in more than one section the applicant will to take the entire test again. An Applicant failing only one section shall take the failed section again. Failure in any section of the re-test, including those sections that have been passed on a previous attempt, will require the Applicant to take the entire test again. All sections of the skill test shall be completed within six months.

1.17.3. 1. Conduct of the test

- The State Authority of Civil Aviation will provide the FE with adequate safety advice to ensure that the test is conducted safely.

- Should the Applicant choose to terminate a skill test for reasons considered inadequate by the FE, the Applicant shall retake the entire skill test. If the test is terminated for reasons considered adequate by the FE, only those sections not completed shall be tested in a further flight;

- At the discretion of the FE, any manoeuvre or procedure of the test may be repeated once by the Applicant. The FE may stop the test at any stage if it is considered that the Applicant's demonstration of flying skill requires a complete re-test;

- An Applicant shall be required to fly the aeroplane from a position where the pilot-in-command functions can be performed and to carry out the test as if there is no other crew member. Responsibility for the flight shall be allocated in accordance with national regulations;

- The **route to be flown shall be chosen by the FE** and the destination shall be a controlled aerodrome. The route may end at the aerodrome of departure or at another aerodrome. The **applicant shall be responsible for the flight planning and shall ensure that all equipment and documentation for the execution of the flight are on board**. The duration of the flight shall be at least 90 minutes;

- An Applicant shall indicate to the FE the checks and duties carried out, including the identification of radio facilities. Checks shall be completed in accordance with the authorised check list for the aeroplane on which the test is being taken. During pre-flight preparation for the test the applicant is required to determine power settings and speeds. **Performance data for take-off, approach and landing shall be calculated by the Applicant in compliance with the operations manual** or flight manual for the aeroplane used;

- The FE shall take no part in the operation of the aeroplane except where intervention is necessary in the interests of safety or to avoid unacceptable delay to other traffic.

1.17.3. 2. Skill test content for CPL(A) issue

- The aeroplane used for the skill test shall meet the requirements for training aeroplanes and shall be certificated for the carriage of at least four persons, have a variable pitch propeller and retractable landing gear.

- The route to be flown shall be chosen by the FE and the destination shall be a controlled aerodrome. The route may end at the aerodrome of departure or at another aerodrome. The Applicant shall be responsible for the flight planning and shall ensure that all equipment and documentation for the execution of the flight are on board. The duration of the flight shall be at least 90 minutes.

The Applicant shall demonstrate the ability to:

- operate the aeroplane within its limitations;
- complete all manoeuvres with smoothness and accuracy;
- exercise good judgement and airmanship;
- apply aeronautical knowledge; and
- maintain control of the aeroplane at all times in such a manner that the successful outcome of a procedure or manoeuvre is never seriously in doubt.

1.17.3. 3. The skill test contents and sections for a rating for multi-engine single-pilot aeroplanes:

In compliance with Appendix 2 to JAR-FCL 1.170 (similar for App3 JAR- FCL 1.240) contents of the skill test for the issue of a CPL(A) the Applicant shall accomplish the test points at the following 6 sections realated with flying skills, aircraft operation following the external visual orientators, application of anti-icing treatment and de-icing procedures, observation of threat and error management principles.

SECTION 1 — PRE-FLIGHT OPERATIONS AND DEPARTURE

SECTION 2 — GENERAL AIRWORK

SECTION 3 — EN ROUTE PROCEDURES

SECTION 4 — APPROACH AND LANDING PROCEDURES

SECTION 5 — ABNORMAL AND EMERGENCY PROCEDURES

- Simulated engine failure after take-off (at a safe altitude unless carried out in a flight simulator), fire drill;
- Equipment malfunctions;
- Including alternative landing gear extension, electrical and brake failure;
- Forced landing (simulated);
- ATC liaison: compliance, R/T procedures;
- Oral questions.

SECTION 6 — SIMULATED ASYMMETRIC FLIGHT AND RELEVANT CLASS/TYPE ITEMS

- Simulated engine failure during take-off (at a safe altitude unless carried out in a flight simulator);
- Asymmetric approach and go-around;
- Asymmetric approach and full stop landing;
- **Engine shutdown and restart;**
- ATC liaison – compliance, R/T procedures, Airmanship;
- As determined by the Flight Examiner – any relevant items of the class/type rating skill test toinclude, if applicable:
  1. Aeroplane systems including handling of autopilot.
  2. Operation of pressurisation system.
  3. Use of de-icing and anti-icing system.

If were provided two joined skill tests according to Appendix 2 to JAR-FCL 1. 170 and App3 JAR- FCL 1.240 there are foreseen procedures - **engine shut down and restart (ME skill test only) as well as Simulation of asymmetric flight.**

General recomendations for Examiner, that the following limits can be permitted:
The FE shall make allowance for turbulent conditions and the handling qualities and performance of the aeroplane used.
Height:

- During a normal flight ±100 feet;

- With simulated engine failure ± 150 feet;

- Tracking on radio aids ± 5 º;

Heading:

- During a normal flight ±10º ;
- With simulated engine failure ± 15º ;

Speed:

- Takeoff and approach ±5 nodes ;
- All other flight rergimes ± 10 nodes ;

1.17.4. Authorization of Flight Examiner (FE) and stated requirements for flight skill testing.

In accordance with the requirements of JAR-FCL 1.030 Arrangements for testing, (a) Authorisation of examiners (which was in a force in the moment of accident) authorized institution – Civil Aviation Agency designates and authorises as examiner, suitably qualified persons of integrity to conduct on its behalf, skill tests and proficiency checks. Minimal qualification requirements for examiner are set out in JAR-FCL (Aeroplane), Subpart I.

In compliance with JAR-FCL 1.425 „Examiners General" Examiners will be briefed by the Civil Aviation Aauthority on the JAR–FCL requirements, the conduct of skill tests and proficiency checks, and their documentation and reporting. Examiners should also be briefed on the protection requirements for personal data, liability, accident insurance and fees, as applicable in the State.

The Examiner authorized by the Civil Aviation Agency for CPL(A) issue skill test flights had a licence issued by Estonian Civil Aviation Agency on May 19, 2011 „Examiner's Authorisation" No. EST/FE-CRE-TRE-IRE-FIE/004 valid up to May 18, 2014. with the following qualification marks and rights to perform the following flight skill tests with aircrafts in compliance with the requirements of JAR-FCL:

Examiners Authorization:
FE(A) –Flight Examiner
CRE(A) –Class Rating Examiner
TRE(A)- Type Rating Examiner
IRE(A)- Instrument Rating Examiner
FIE(A)- Flight Instructor Examiner

Skill TEST:
PPL(A)-Private Pilot Licence
CPL(A) –Commercial Pilot Licence
CR(A(ME/SE/SP - Class Rating
ATPL(A);TR(A)
IR(A)- Instrument Rating
FI(A) –Flight Instructor

Proficiency check
CR(A) ME/SE/SP Class Rating
TR(A) –Type Rating
IR(A)-Instrument Rating
FI(A)- Flight Instructor

The following types of aircrafts, which examiner can use for skill testing, were provided in the licence: SEP(A) land, MEP(A) land, B737 300-900, CRJ100.

The privileges of a FE(A) are to conduct skill tests for the issue of a CPL(A) and skill test and proficiency checks for the associated single-pilot class/type ratings provided that the examiner has completed not less than 2000 hours flight time as a pilot of aeroplanes, including not less than 250 hours flight instruction.

1.18. Additional information

JAA document JAR –FCL1 SECTION 2 - ACCEPTABLE MEANS OF COMPLIANCE (AMC)/ [INTERPRETATIVE AND EXPLANATORY MATERIAL (IEM)] sets recommendations for use of JAR-FCL requirements in practice.
In compliance with JAR –FCL1 SECTION 2 section AMC/IEM I – EXAMINERS paragraph AMC FCL 1.425 „Standardisation arrangements for examiners" for competent institution, which assigns the examiner, had to perform an instructing of examiner regarding the performance of skill and qualification testing in compliance with requirements of JAR-FCL, document processing and reporting, requirements of personal data protection, responsibility, accident insurance and charges etc..
The information or documents regarding the performing of the following instructing with Examiner was not submitted at disposal of investigation;

- During a working day an examiner can plan no more as 3 (three) PPL, CPL, IR skill tests;
- During a skill test an examnier should maintain a flight log and assessment record during the test/check for reference during the post/flight de-brief. This record should be compiled without alerting or attracting the attention of the applicant;
- Communications in flight should only be necessary to prompt the applicant regarding required sequence of events using concise and easily understood intentions (e.g. following a go-around).

1.18.1. Recommendations for examiner monitoring the skill test flight CPL(A)

- Every task of examination section shall be performed and evaluated separately. The sequence of the discussed flight order in preflight instruction in normal conditions shall not be changed. All flight sections shall be performed during one flight. Flight section sequence can be changed according to the obstacles and examiner has to include in instruction the expected flight profile.

- Section 3 normally takes about 1 hour and 15 minutes and Sections 2 and 4 takes about 1 hour. The Section 5 at the discretion of examine may be combined with the Sections 1 to 4 and section 6, where applicable, to combine with sections 1 to 5. The whole test could, therefore, take up to 2 hours and 30 minutes.

1.18.2. The composition of the flight crew and role of the Examiner

An applicant of **CPL(A)** issue shall fly the aircraft from a position where the pilot-in-command functions can be performed and to carry out the test. The Flight Examiner (FE) **shall take <u>no part</u> in the operation of the aircraft, except when intervention is necessary in the interests of safety** or to avoid unacceptable delay to other traffic. The minimum flight crew necessary for the conduct of skill tests conducted as single pilot operations must comprise of the applicant and the Examiner. The **applicant shall fly the aeroplane and will be acting as the Pilot in Command.**

1.18.3. Recommendations for examiner monitoring accomplishment of the section 5 and 6

In compliance with the recommendations of JAA „Flight Examiners Manual Aeroplane and Helicopter":

- The items of Section 5 may be combined with Sections 1 through 4. The Examiner will simulate an abnormal or emergency situation, the Applicant is expected to carry out the appropriate emergency actions. If drills involve the operation of fuel cocks, fuel shut off valves, mixture controls and any critical engine control, operations should be simulated by **"touch actions" only**.
- Applicants attempting the Skill Test in a multi engine aeroplane (not centre-line thrust) **will be expected to fly the exercises in Section 6.** At a **safe height** after take-off the Examiner will simulate an engine failure by closing one of the throttles. **The applicant will be expected to retain control of the aeroplane, identify the 'failed' engine and carry out the appropriate engine shut down and propeller feathering procedures; using touch drills.** On completion of these drills, because the Applicants actions would have resulted in the engine security and propeller pitch being set as required, the **Examiner will be responsible (if there are not Safety pilot) for setting zero thrust and the management of the (simulated) failed engine.**
- Skill test flight can be conducted in compliance with the requirements of Flight Manual of the used aircraft;

The CPL Skill Test is very demanding. It is appreciated that even the most 'professional' or 'talented' pilots can make mistakes.

1.19. New investigation methods

The investigation of the aviation accident is performed in compliance with Annex No.13 to Chicago Convention on International Civil Aviation and regulation of European Parliament and Council (ES) Nr.996/2010 from October 20, 2010.

2. ANALYSIS

2.1. Introduction

To determine the possible causes of the aircraft accident which occurred on November 13, 2012 in Riga region, Garkalne municipality near to Bukulti willage, with the aircraft P2006T, registration No.YL-SVN, the investigation analysing the flight considered the tasks, which has to be taken by CPL(A) isue Applicant performing the skill test, examiner's set tests, recommendations in accordance with JAR-FCL, the inspection results of the aircraft engine and wreckage, results of inspection at accident site, results of experimental flight with analogical type aircraft, requirements and limitations set by the aircraft manufacturer, results of certification and evidences given by witnesses.

The above mentioned aircraft shall not be equipped with flight recorders and cockpit voice resorders, the aircraft were flying out of the air traffic management controlled zone, the aircraft operation and control elements were substantially damaged. Accordingly the investigation did not have enough information, to determine the cause or causes of the accident.
In compliance with the requirements of section 6 „Simulated asymetric flight" the engine shutting down and restarting shall be performed. Investigation does not have any information in what way this procedure was performed. In the JAA „Flight Examiners Manual" it is recommended to control mechanisms shut down the engine throttle and imitate engine failure operations by control mechanisms **"touch actions" only**.

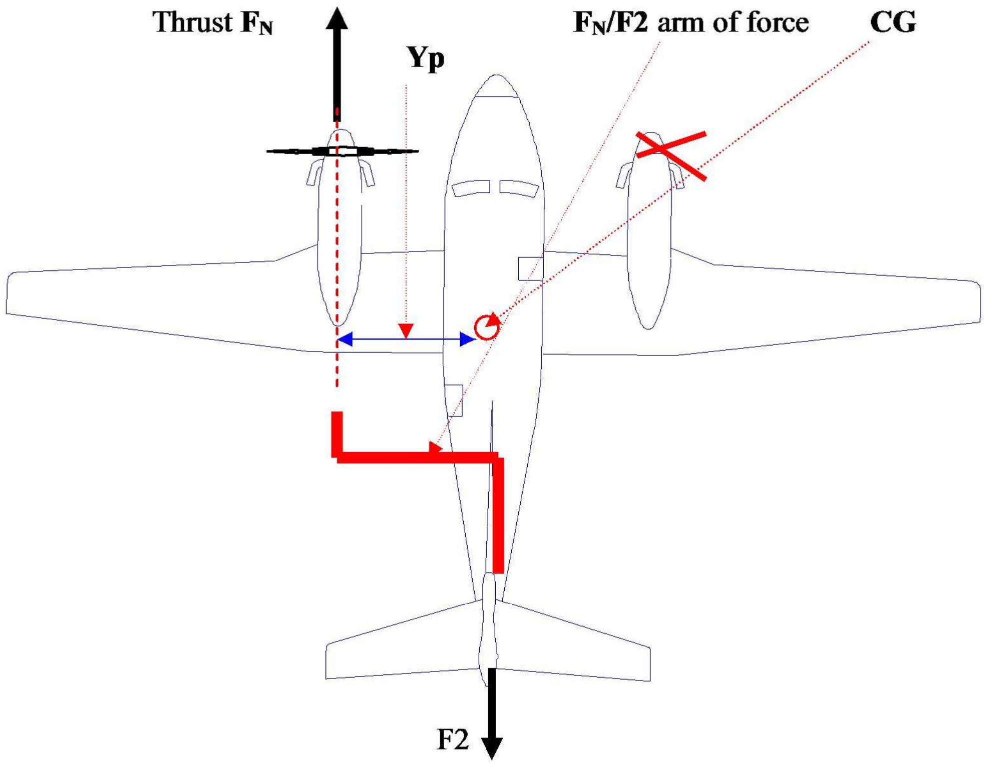
According to the testimonies provided by the aircraft pilot, who has performed skill test with the same examiner in the same day, the instruction to shut down the engine during the flight was not given.

2.2. Aspects and analysis of the flight of small twin-engine piston aircraft with one engine failure.

There are several unique characteristics of multiengine airplanes that make them worthy of a separate class rating. Knowledge of these factors and proficient flight skills are a key to safe flight in these airplanes. The basic difference between operating a multiengine airplane and a single-engine airplane is the potential problem involving an engine failure. The penalties for loss of an engine are twofold: **performance and control**. The most obvious problem is the loss of 50 percent of power, which reduces climb performance 80 to 90 percent, sometimes even more.

The other is the **control problem** caused by the remaining thrust, which is now asymmetrical. **Attention to both these factors is crucial to safe OEI flight.**

If a multi-engine airplane suffers right side engine (No2) failure when airborne, there are two immediate aerodynamic effects. The initial effect is the yawing that occurs due to the asymmetry of the thrust line, due to the thrust developed by operative left side engine $\mathbf{F_N}$ and negative thrust of inoperative right side engine that is caused by drag **F2**. These two forces with lever of arm among them create yawing moment, which causes change the direction where the airplane is pointing without any immediate change in the direction the airplane is going.



Aerodynamical resistance force F2

Image32. Schematic ilustration of aerodynamical effect impact during asymmetric flight

The size of this initial yawing moment N_T depends upon the engine thrust F_N, the distance Y_P between the thrust line and the airplane's center of gravity (CG), and the airplane's directional stability, which tends to oppose the asymmetric yawing moment. The yawing moment is also affected initially by the rate of thrust decay of the 'dead' engine and ultimately by its drag. In addition, the yaw is aggravated by the drag effect of the windmilling propeller. The total moment can be very large, particularly when the airplane is at high power and low speed.

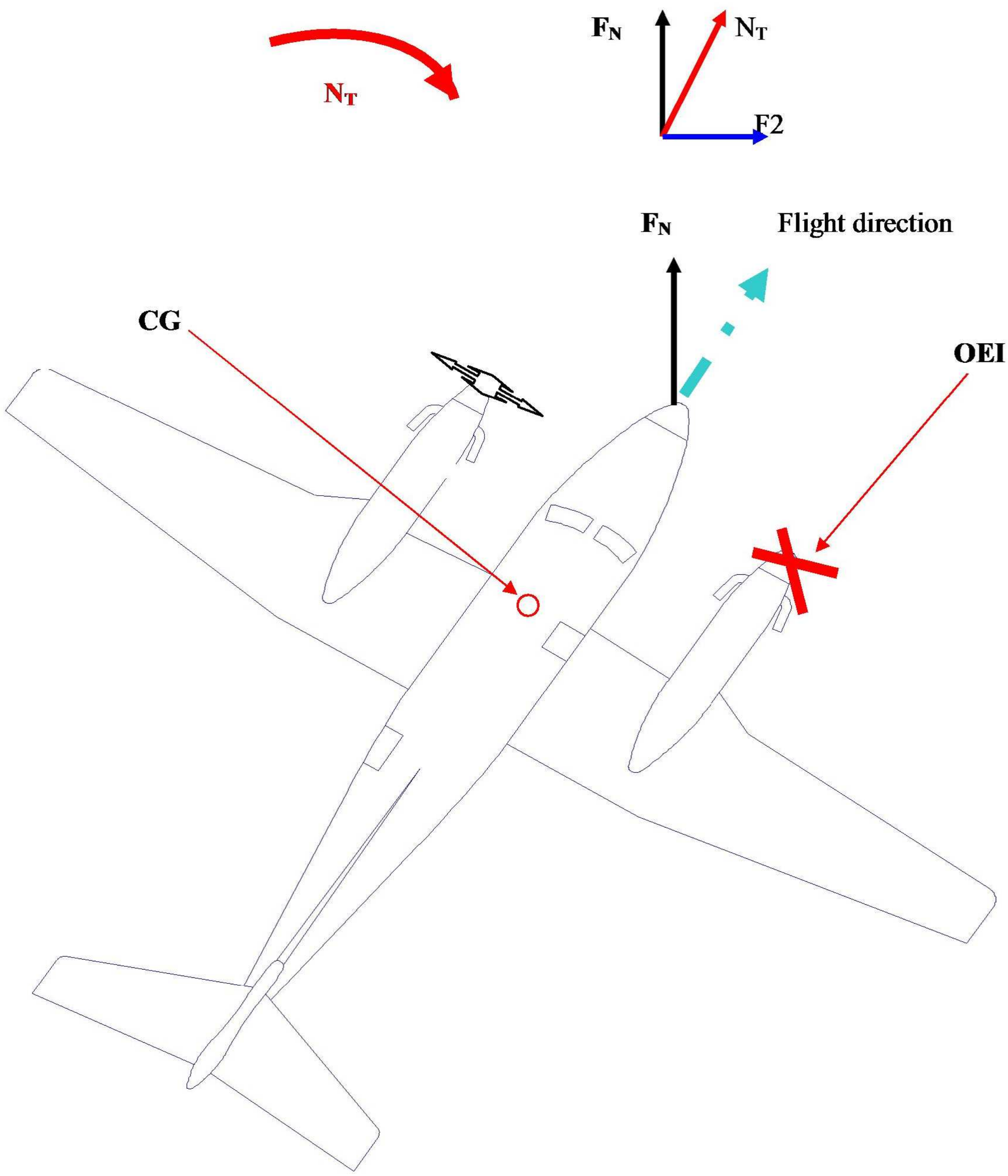


Image33. Yawing moment N_T due to the assymetry of forces

The impact of the second effect is roll, which occurs when the airplane continues to yaw towards the failed engine, resulting in a decrease in lift from the 'retreating' wing and a yaw-induced roll towards the failed engine.

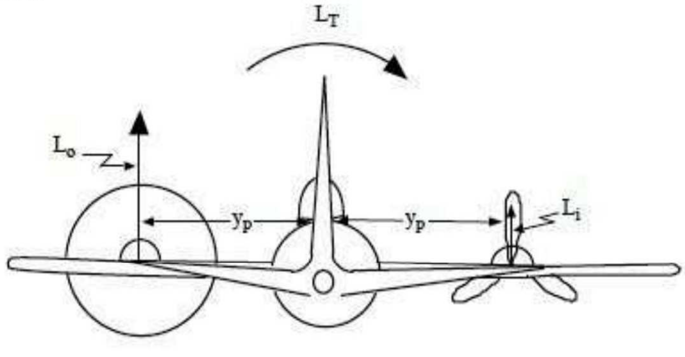


Image 34

This roll is reinforced by the offset of the wings and the loss of the slipstream lift in airplanes with the propeller in front of the engine.

Higher dynamic pressure over wing with operative engine generates unbalanced lift vectors and rolling moment, $\mathbf{L_T}$, toward inoperative engine wing

$$\mathbf{L_T = L_0\,Yp - Li\,Yp = Yp\,(L_0 - Li)}$$

Yp – distance from center of gravity to asymmetric thrust vector measured in wing plane

Although the yawing moment is the main cause of the problem, there are two different control inputs that can be used to counteract the asymmetrical thrust of a failed engine:

- yaw from the rudder;
- the horizontal component of lift that results from bank with the ailerons.

Used individually, neither is correct. Used together in the proper combination, zero sideslip and best climb performance are achieved.

It is **not correct** to use these control inputs **individually**. **Categorically** for the extra yawing control with rudder the **bank must be neutralized using the ailerons**. Only using them **together in right combination** the asymmetrical flight of the aircraft with one inoperative engine can be ensured without side-slip and with the best performance of climb. If the yaw and roll **are not being corrected, the aircraft will spiral** into the failed engine.

An airplane can maintain a constant heading under asymmetric power with an infinite number of bank and sideslip combinations with aileron and rudder settings.

The main aircraft affecting forces are the following:

- The sideforce on the fuselage and fin due to the sideslip. The total force is stabilizing, and will act behind the CG.
- The sideforce on the rudder hinges, caused by rudder deflection, which pivots the airplane about its CG.
- Any lateral component of weight, produced by banking.
- Thrust from operative engine;
- Total drag.

In addition to these major factors, there are the minor, but appreciable, effects, for example such as:

- Propeller torque, which increases with power, tends to roll the airplane in the opposite direction to that of the propeller's rotation;

- Asymmetric Blade Effect. When the plane of rotation of the propeller is not at rightangles to the flight path, the center of thrust of the propeller does not coincide with its physical center.

When the one engine of multi-engine aircraft does not operate, the aerodynamic drag is the smallest in the position with zero side-slip, when the smallest possible profile in relation to the air flow is, and it is called **as coordinated flight**.

2.2.1. Several options of the use of control inputs during Equilibrium Asymmetric Power Condition (view from above and side)

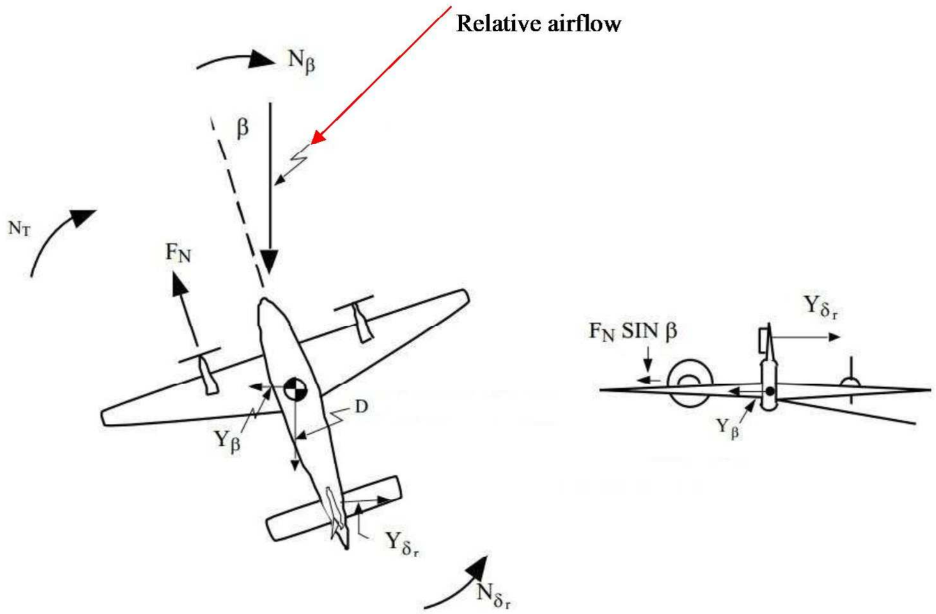
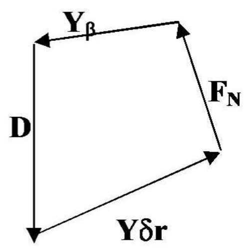


Image35. Equilibrium Asymmetric Power Condition with Zero Bank Angle without sideslipping (view from above and side)

D- drag ; **N_T** – thrust yawing moment; **β** - sideslip angle; **N_β** - yawing moment due to the sideslip; **F_N**- thrust; **Yδr**- - sideforce due to rudder deflection; **Nδr**- yawing moment due to rudder deflection; **W** -weight; **Y_β** - sideforce due to sideslip; **F_N sin β**- sideslip force; **δr** – rudder surface deflection; **β** - Sideslip angle – angle between longitude axis and relative air flow (relative wind).

In steady asymmetric flight at a constant heading and height, the forces and any moments by the forces must add up to zero. A convenant way of representing this is to draw a polygon of forces, the sides of the polygon, when drawn to vector scale (direction and magnitude) will form a closed figure if the forces balance.



Polygon of forces

With one engine out in wings level balanced flight, without any banking (image 28), the aircraft will be sideslipping, it will slip on the side of failed engine and its heading and direction of travel will be different. The yaw caused by the asymmetric thrust will be offset by the rudder. In this case large aerodynamical drag, large deflection angle of operation control mechanism (rudder) is required and due to the sideslip the side force due to rudder deflection (**$Y\delta r$**) and stabilizer leteral forces (**Y_β**) works opposite to each other. Performance of climb shall decrease due to the sideslip.

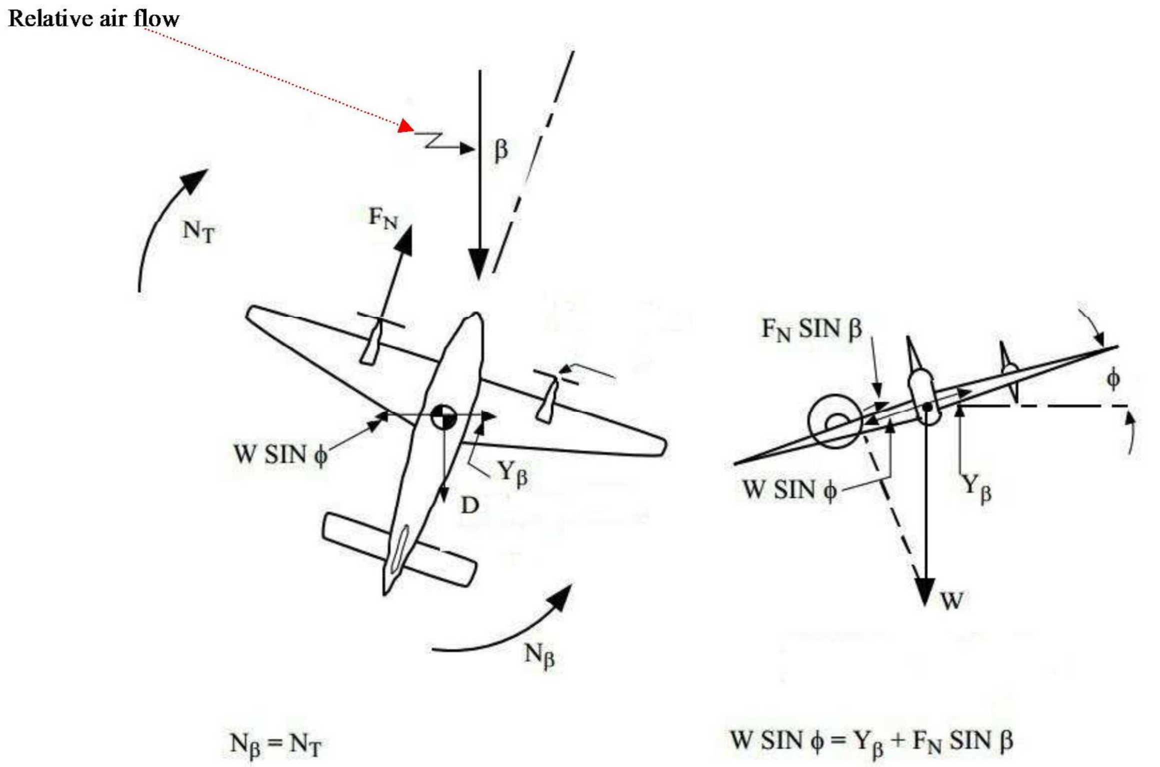
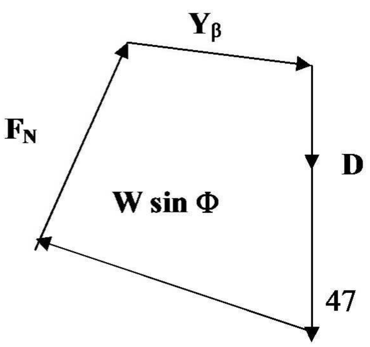


Image 36. Equilibrium Asymmetric Power Condition with banking and Zero Rudder Deflection (view from above and side)

D- drag; **N_T** – thrust yawing moment; **β** - sideslip angle; **N_β** - yawing moment due to the sideslip; **F_N**- thrust; **$Y\delta r$**- side force due to rudder deflection; **$N\delta r$**- -yawing moment due to rudder deflection; **W** -weight; **Y_β** -sideforce due to sideslip; **Φ**- bank angle; **W sin Φ** - side force due to gravity; **δr** – rudder surface deflection;

The asymmetric flight of the aircraft with Equilibrium Asymmetric Power Condition can be insured without using rudder, using elerons alone creating a bank angle (8-10°) towards operating engine. Then the aircraft will attempt to turn against the torque about the CG due to the asymmetric thrust. A stable situation will occur when a sideslip develops towards the live engine and the weathercock yawing moment produced by the airplane's directional stability will balance the thrust yawing moment and the weight component produced by the bank will balance the sideslip side force The sideslip towards the live engine will produce a rolling moment that must be balanced by the ailerons. **In this case large sideslip on the side of operating engine shall significantly decrease climb performance.**

Attempting to control an aircraft in asymmetric flight without using the **rudder is potentially dangerous,** since the large sideslip angle required could lead to fin stall and subsequent loss of control. In addition, adverse aileron yaw may **significantly increase the yawing moment to be controlled,** and the drag produced by the extreme yaw attitude may be so high that level flight cannot be maintained.



Polygon of forces

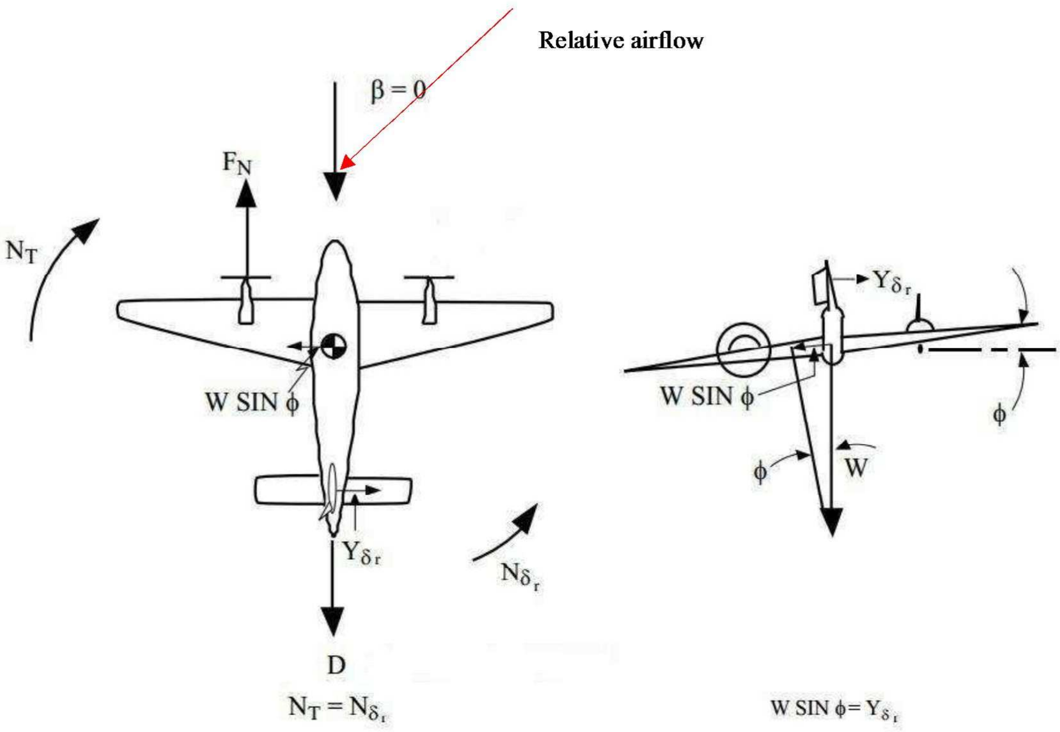
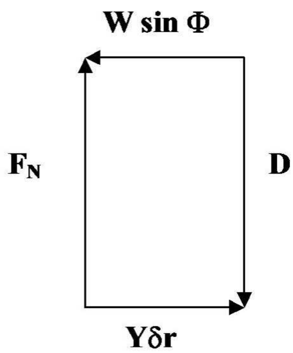


Image 37. Equilibrium Asymmetric Power Condition with Zero Sideslip with small bank angle on the side of operating engine

β- sideslip angle; Y_β -sideslip force; Φ- banking angle; **W sin Φ**-weight lateral force; **Yδr** - sideforce due to rudder deflection;

Rudder and ailerons used together <u>in the proper combination</u> will result in a small bank towards the operative engine. If a asymmetric yawing moment N_T is positive (the right side engine inoperative) the trailing edge left (positive) rudder deflection is required, therefore a negative (left) bank angle Φ is necessary to maintain equilibrium flight (Image 30).
In most cases, the bank angle requirement is fairly small (approximately 5 degrees). In this case bank on the side of operating engine, smaller drag (D) due to zero sideslip (β=0), a maximum climb performance and smaller required deflection of control element surfaces. **Maximal** speed V_{MC} under these circumstances can be higher as it is published.



Polygon of forces

If we bank an aircraft, the lift (F) produced by the wing banks or tilts, too. We can break up the tilted lift into two parts, the vertical and the horizontal. After an engine fails, and we bank towards the operative engine, the horizontal component (**F_h**) of the tilted lift opposes the yawing moment (**N_T**) into the dead engine. If we increase our bank into the good engine, sure, we increase the horizontal component of lift, and we don't need as much rudder. From one side if a little bank is good, then more must be better, but from other side as you bank the aircraft, the vertical component of lift (F_V) decreases, and the aircraft starts to descend. The manufacturer Aircraft Flight Manual for improoving directional control definēs that it is advisable to bank the aircraft of about 5° to the side of the operating engine. The 5 degrees of bank chosen for the Vmc demonstration is entirely arbitrary, and has nothing to do with achieving maximum performance at the higher single engine best rate of climb speed, known as Vyse, which is painted on the ASI as a blue line.

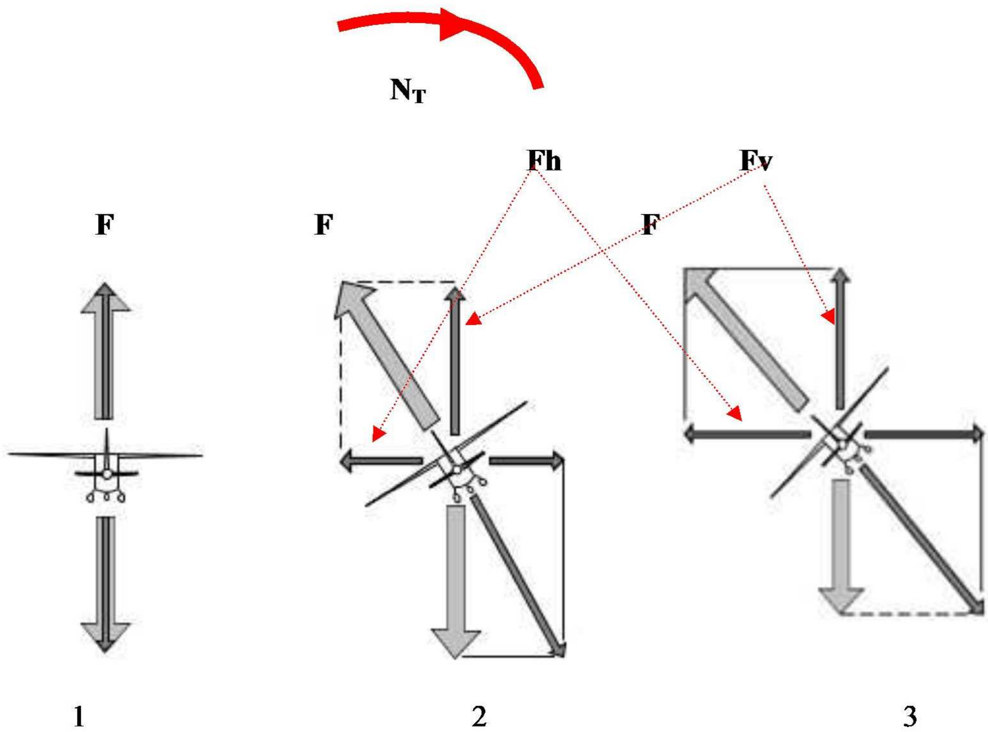


Image38 Schematic interpretation of lift vectors when aircraft banked

For pilot it's important to realize when flying multi-engine aircraft that <u>control</u> and <u>performance</u> are totally separate issues, and in fact are usually at odds with one another. Excessive bank at Vyse, which is nice but not needed for control, really hurts climb performance, which is usually already hurting, factors which are beneficial for minimal speed **Vmc** or yawing control by all means are not beneficial for performance. In the case of one engine failure the best rate of climb speed **Vyse** shall be set, as it will provide the best climb performance, but at particular conditions this best climb performance can be only decreasing of altitude. For lightweight multi-engine aircrafts climb is not always guaranteed.

2.2.2. Theoretical aspects of one Engine failure during flight

When the pilot intentionally secures as engine in flight, the transient motions are generally mild and easily controlled if adequate control authority is available. However, sudden engine failures may occur **under low altitude, low airspeed**, high power flight conditions in a high lift or high drag configuration, such as during take-off or wave-off.

The sudden engine failure in these cases may generate severe, potentially divergent rolling and/or yawing transients. The pilot may induce a similar situation by sudden application of asymmetric power to initiate a wave-off from an engine-out-approach.

2.2.2.1. Asymmetric Power Equilibrium Flight Conditions Right Engine Failed

The same factors which cause lateral-directional control problems in steady asymmetric flight conditions also are applicable to the sudden or dynamic engine failure. However, the control authorities required to arrest the motion following a sudden engine failure are usually larger than the control authorities necessary to maintain equilibrium flight. The severity of airplane response following a sudden engine **failure is difficult to predict by theoretical analysis, the pilot delay time in recognizing the asymmetric power condition and applying appropriate control inputs influences the magnitude of the rolling and yawing motions**. Actual flight test of critical conditions is the only means of establishing safe flight boundaries. The following hypothetical situation may aid in understanding some of the problems encountered with sudden engine failures (Image 32).

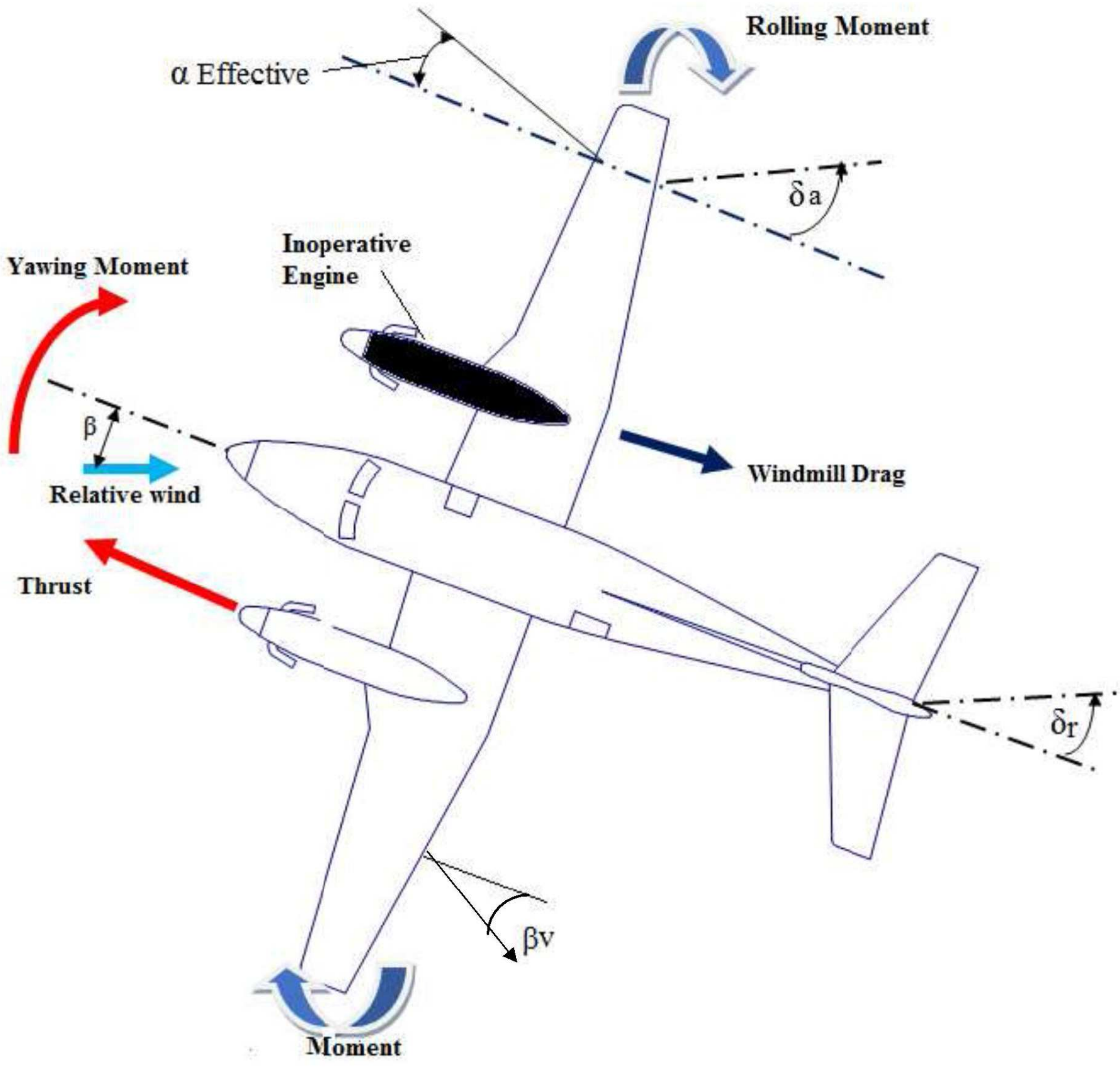


Image39 Flight Conditions Right Engine Failed

β- sideslip angle. **δr** - rudder deflection angle. δα- aileron deflection angle.

1. Assume the aircraft is in flight and one engine failed.

2. For example the pilot experienced a sudden power failure on the right engine. Because of the surprise factor, the pilot does not immediately react to the situation. The large yawing moment generated by the asymmetric power causes a large sideslip angle to develop from the operative engine side. If the sideslip angle reaches large enough proportions, the vertical tail may stall. An increase in drag accompanies the increase in sideslip, compounding an already (possibly) serious performance deficiency.

3. A rolling moment toward the inoperative engine will probably be generated by the yaw rate. This rolling moment will be increased if the airplane exhibits positive dihedral effect. Propeller-driven airplanes may rapidly diverge in roll due to slipstream effects, particularly if the wings are completely immersed in slipstream prior to the engine failure.

4. The pilot will likely apply large rudder and lateral control inputs to attempt to arrest the yawing and rolling motion. The large rudder input increases the tendency for the vertical tail to stall and may result in "rudder lock" if the control system is reversible. The lateral control input may generate an adverse yawing moment which increases the yawing moment toward the inoperative engine side. The large lateral control deflection, coupled with the rolling velocity, may cause the down-going wing to exceed stall angle of attack

5. If the pilot **is unable to achieve** equilibrium flight **with full lateral and directional control inputs**, a **power reduction on the operative engine side** and/or an **increase in airspeed will be required to prevent catastrophic consequences**. Obviously, these measures may not be possible **in a low altitude**, marginal performance flight condition.

2.3. Meaning of Critical Engine

The critical engine is that engine of a multiengined airplane, the failure of which produces the **most critical condition** to the pilot. The most critical condition will probably occur at high thrust and low airspeed (high CL) as is the situation during take-off or waveoff.
Under this condition, lateral or directional control cannot be regained and maintained following a sudden engine failure below a certain airspeed. The critical engine is the engine for which this minimum airspeed is higher than that associated with failure of any other engine. The critical engine may generally be **predicted for a propeller airplane**. Providing that the airfoil surfaces (wings, vertical, and horizontal stabilizers) are symmetrically attached to the fuselage and that the available control surface deflections are symmetric, the critical engine may be predicted from several factors:

a) as the angle of attack increases (high CL), the down-going propeller blade sees a relatively higher local angle of attack than the up-going blade, which results in moving the thrust vector laterally on the propeller disk toward the down-going blade side;
b) air flow swirl about the fuselage created by the rotating propeller(s) can affect the flow at the vertical tail so as to create a sideslip angle in one direction or the other, depending on the direction of the rotation of the propeller(s).

For clockwise rotation of the propeller(s) (as viewed from the rear), the above effects usually result in the left outboard engine being the critical one.

In case of aircraft Tecnam P2006T with ROTAX 912 S3 in the clockwise direction from the side of cockpit **if the right engine fails**, and aircraft slows down, looking at a twin from behind, the **downgoing blade** of the left engine will **be inside the nacelle**, closer to the fuselage. This results in a shorter arm for the thrust, which means less torque, or yawing.

But **if the left engine fails**, and aicraft slows down, looking at the twin from behind, the **downgoing blade** of the right engine is **outside the nacelle**, away from the fuselage, which means more torquing or yawing, which means you need more rudder. This is why the **left engine** is called the **"critical"** engine for such aircraft as Tecnam P2006T or similar..

2.4. Investigation process

In investigation process the following possible scenarios, which could cause the accident, was reviewed and analysed:

- After possible engine No.2 failure the wrong action of pilot or noncoordinated actions of pilot or examiner with the aircraft control inputs;;
- Performing the task of Section 6 of the skill test „**Engine shutdown and restart**" accidental shut down of engine No.2 with following noncoordinanted use of the aircraft operation and control elements during the rapid wawing;
- Performing the task of the section 6 of the skill test "**Engine shutdown and restart**" after the imitation of the engine No.2 failure performed by examiner, the applicant by mistake shut down the engine No.1.

2.5. Incorrect action of pilot or uncoordinated operation with aircraft control inputs of the pilot and examiner after ethe engine No.2 failure.

Considering the current weather conditions (air temperature t° 6-7°C, relative moisture about 75%) as well the flight with performance of maneuvers flying above the water (Ķīšezers) can allow the possibility the engine No.2 failure occurred due to carburettor icing. The right side engine lost the thrust, but other engine operated with proper power, created thrust and aircraft yawed towards the right side failed engine No.2.due to the moment created by asymmetry of power. The dead engine, in addition to no longer providing thrust, also created drag, since the propeller was windmilling, the drag the windmilling propeller created also causes the aircraft to yaw towards the dead engine. Instinctively, the pilot tried to stop the yaw by stomping on the rudder pedal on the side of the engine which still produced thrust, as the mnemonic rule is *"operating foot – operating engine, nonoperating foot- nonoperating engine".* In fact, this is how a pilot identifies the fault engine; At this point, the pilot "feathers" the dead engine. The propeller control was pulled all the way back, beyond the feather detent, and the prop blades rotate to maximum coarse pitch (90% parallel to the propeller axis), which minimizes drag, as the propeller of the engine No.2 in this condition was found on the ground in the accident site. In fact, at this point, the propeller of the dead engine stopped rotating. As in this case the left side engine has been working the flight could be continued with one engine, as well the failed engine could restarted, but considering the result, it can be concluded that activities of the pilot or instructor were not correct or were not coordinated enough.

In the paragraph 7, Section 3 „One engine inoperative procedures" of the aircraft manufacturer "Flight manual" it is prescribed that in the case of the engine failure it is essential to maintain the direction of flight compensating the lower traction through the operating engine and counteracting the yawing effects through the use of pedals and rudder trim. To improve the efficiency, it is preferred to bank the aircraft to the side of the operating engine by about 5°.

In this situation speed played significant role. The amount of asymmetric thrust is not depending of speed, but only from operating engine power. In contrary of that the force, created by the rudder depends on speed and amount rudder deflection. It is well- known that as slow down, flight controls get sloppy — they lose effectiveness. **Below a certain speed, the rudder will not have enough authority to oppose the yawing into the fault engine.** This results in the aircraft rolling inverted into a spin.

It is usually recommended in this situation to reduce the power of the good engine, and **to lower the nose to increase airspeed and dive until achieving V_{MC} and then advance the throttle on the working engine.** In order to maintain control of the aircraft the examiner, as a pilote with large experience, knew this fact and probably performed such actions.Neither of these is a particularly desirable choice at low altitude. As a result, climbing at slow speeds is strongly frowned upon in twins. So strongly, in fact, that this minimum yaw control speed, known as Vmc, is painted as a red line on the airspeed indicator, in addition to Vne (speed limit that may not be exceeded).

Total decrease of the aircraft thrust and extended deflection of control element surfaces leaded to decrease of the aircraft performance. In compliance with the paragraph 7.2., Section 3 „Characteristic airspeeds with one engine inoperative" of the "Flight manual P2006T" minimal aircraft control speed with one engine inoperative - **Vmc** is **62kt**. The aircraft speed Vmc could never be less than it is provided in the manual and painted with the red thick line on the speed indicator, as if the speed is higher, the efficiency of the aircraft side and direction control elements is higher as well.

Image 40. Tecnam T2006P left side instrument panel

Probably, when the operating engine power was reduced to decrease the yaw towards the failed engine and taking into account that the speed has been reduced close to critical limits, the pilot (or pilots) tried to lower the nose of aircraft, to increase the speed. As well it is recommended by the instructions of flight manual. As the aircraft was flying only about at 1500 feet altitude, there was not enough time and enough efficiency of control inputs, at low speed to get back the control over the aircraft and regardless the fact that one engine was working, aircraft was loosing the altidude and at steep angle collided with ground. The theory of flying with multi-engine aircrafts does not recommend to perform these procedures during the takeoff and in low altitude.

When probably the aircraft engine No.2 failure occurred and due to the power asymmetry the aircraft yawed on the side of the failed engine, due to insufficient attention and concetration the power of operating engine was not reduced fast, consequently the yawing angle increased. In addition due to decreasing of the speed to prevent a sideslip the bigger amount of the rudder deflection was required because it lost effectiveness due to speed decreasing.. Probably these actions were uncoordinated and performed quickly and precisely. At such conditions the stall of the rudder occurred and suddenly the uncontrolled yawing motion has started. Because of the yawing motion, the wingtip on the side with the good engine had a higher airspeed than the wingtip on the other side. Because of the difference in airspeed (plus the difference in propwash patterns) the good-side wing will produce much more lift, as a result uncontrollable roll started. As the inside wing drops, it will probably stall (since there was already a low airspeed) and the aircraft was now in a spin. There is no guarantee that it will be possible to recover from such a spin; multi-engine airplane certification regulations do not require spin recoveries. Here was not guarantee that it will be possible to recover from such a spin (the altitude was only 1500 feet). Multi-engine airplane certification regulations do not require spin recoveries as well as aircraft P2006T certification according to EASA CS23 does not require that the aircraft has to be certified of spin recovery. One more factor which affected Vmc is the aircraft centre of gravity (CG). Published Vmc is determined with the CG at it's maximum aft location.

2.6. Determination of the aircraft C.G. loction and its affect to aircraft balance and flight characteristics

The Balance point (Centre of Gravity - CG) is very important during flight because of its effect on the stability and performance of the aircraft. It must remain within carefully defined limits at all stages of flight. The effect of the position of the CG on the load imposed on an aircraft's wing in flight is significant to climb and cruising performance. An aircraft with **forward loading** is **"heavier"** and consequently, slower than the same aircraft with the CG further aft.

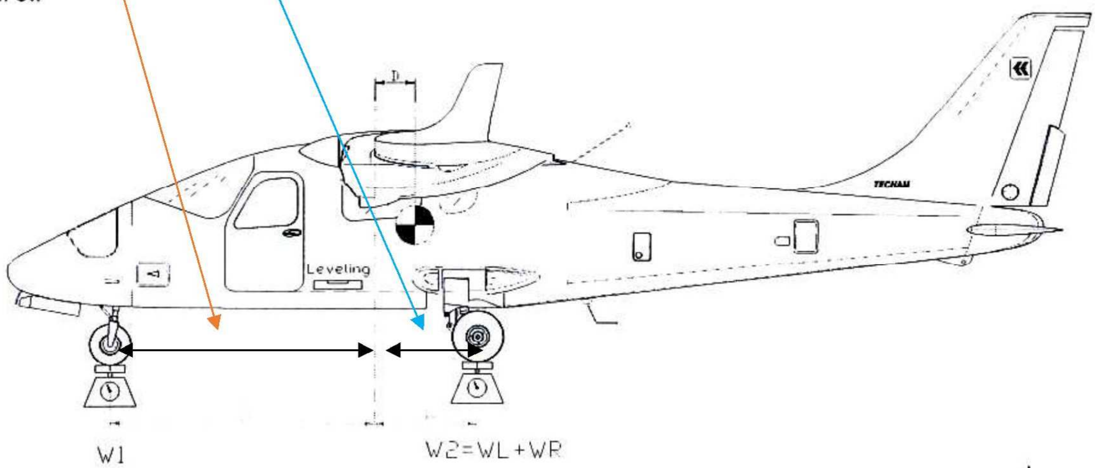
With forward loading, "nose-up" trim is required in most aircraft to maintain level cruising flight. Nose-up trim involves setting the tail surfaces to produce a greater down load on the aft portion of the fuselage, which adds to the wing loading and the total lift required from the wing if altitude is to be maintained. This requires a higher AOA (Angle of Attack) of the wing, which results in more drag and, in turn, produces a higher stalling speed.

According to Weight and Balance Report data submitted by aircraft manufacturer measured distance between the reference line and both main and nose wheel axis are following;
Distance A = 815.0mm
Distance B =2130.0mm

A manufacturers

COSTRUZIONI AERONAUTICHE TECNAM P2006 Tecnam	Aircraft S/N: 056	Mark: YL-SVN	Date: 29.02.2012	Report n° 056B-T/12
Produced by: Costruzioni Aeronautiche TECNAM s.r.l. – Via Maiorise (CE) – Italy Tel.: 0823.62.01.34				

This weight and balance report including:
-All parts showed on A.I.H.
-Unusable fuel
-Full oil



Using recorded data was defined CG position by means of the manufacturers chart from Aircraft Flight Manual.

Nose wheel weight W_N=115.0kG
Left hand wheel weight W_L=366.0kG
Right hand wheel weight W_R=356.0kG
Empty weight $W_E = W_N + W_L + W_R$=115+366+356=837.0kG

MAC =1339.0mm

Distance C.G. from datum $D = \frac{(W_L + W_R) x A - (W_N x B)}{W_E}$ $\frac{(366+356)x0.815m-(115x2,13m)}{837}$

Distance C.G. from datum D=0.41037m= 410,4mm

Empty weight moment M= (D x W_E) = 0.41037m X837.0kG=343.48(m kG)

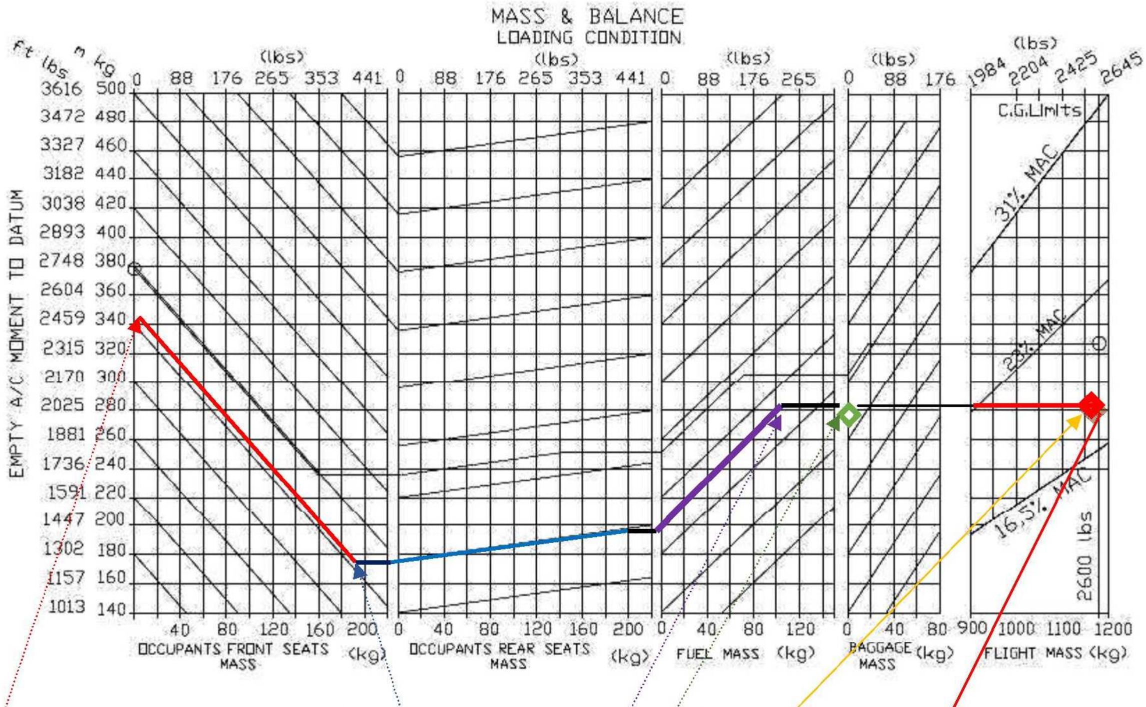


Image33 Mass and balance chart

If ACFT empty mass moment is 343 kG x m CG

ACFT empty mass 837 kG

Pilot's weight in front seats 195 kG (data of the medical expertise)

Rear seats occupants mass 0 kG

Fuel about 140Lx0.72= 100.8 kG

Luggage mass 0 kG

Maximal take off weight 1180 kG

According to Item 15 "Center of gravity range" of the P2006T Aircraft Flight Manual the following limits for CG established by the manufacturer is:

Forward limit is 0,221 m (or 16.5% MAC) aft of datum for all weights;

Aft limit is 0.415m (or 31% MAC) aft of datum for allweights;

According to calculation results performed by investigation for skill test flight and its schematic presentation by using Mass and balance chart it is obvious that, although CG was within allowable established limits, actually with data of the aircraft during the flight, if the crew (pilot and examiner) sit in front of the aircraft, absence rear seats occupants, empty baggage compartment and absence of ballast, the position of CG was moved far closer to the front limit. It affected Vmc. Vmc is determined with CG at its maximum aft location. If the CG is moved forward, Vmc decreases because the "arm" of the rudder gets longer, so it can create more torque. The yawing moment generated by the rudder, is the multiplication of the moment arm or distance from CG to the aerodynamic force developed by the rudder. If the CG is at its approved aft limit, the yawing moment generated by the vertical tail and rudder deflection is smallest. If the CG is more foeward, the moment arm to the rudder force is longer and rudder deflection can be smaller to counteract the same asymmetrical thrust yawing moment. The airspeed could be further decreased until rudder deflection is again maximum, that means that the actual Vmca with a forward center of gravity is lower.

If the CG is too far forward, the downward tail load will have to be increased to maintain level flight. This increased tail load has the same effect as carrying additional weight, the aircraft will have to fly at a higher angle of attack, and drag will increase.

A more serious problem caused by the CG being too far forward **is the lack of sufficient elevator authority**. At slow speeds, the elevator might not produce **enough nose-up force**.

A forward CG location increases the need for greater back elevator pressure. **The elevator may no longer be able to oppose any increase in nose-down pitching. Adequate elevator control is needed to control the aircraft throughout the airspeed range down to the stall.** Professional experienced pilots, which has performed an experimental flight with identical type of aircraft Tecnam P2006T, used and accented and importance of the necessity of additional ballast during the flight with the same type of aircraft.

Also in the paragraph 21.8 „Rear seats" of the "Flight Manual" of the aircraft manufacturer it is provided that during the most critical moments as taking off, landing (including emergency) **the back seats have to be moved apart in maximal position backwards, even if there would be 4 people on the board and the special warning poster were placed.**

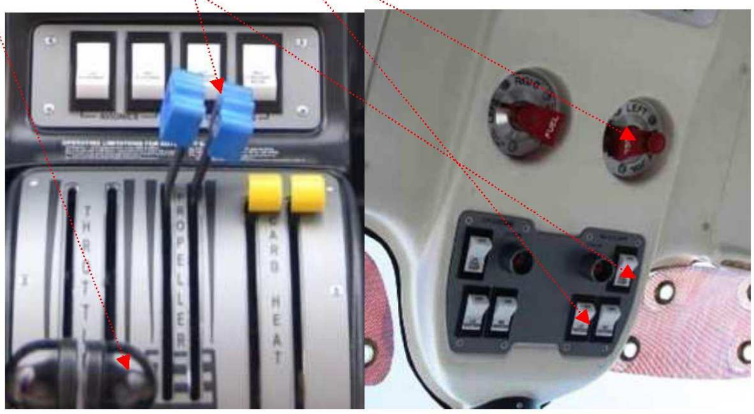
It is not possible to exclude that at situation developed during one engine failure or intentionally shut down by examiner or pilot by mistake (when suddenly asymmetric flight occurred), with moved CG far forward, the elevator might not produced enough nose up force due to the lack of sufficient elevator authority, espacially at slower air speed, that could made strong affect to he flight when aircraft with nosedz down at steep angle collided with ground.

2.6. Perfoming the task "Engine shutdown and restart" of the Section 6 of the skill test accidental shutdown of the engine No.2 with following uncoordinated use of the aircraft inputs during the fast aircraft yawing.

In compliance with Appendix 2 to JAR-FCL 1.170 „Contents of the skill test for the issue of a CPL(A)" the applicant must accomplish the paragraphs of the test in 6 sections.
SECTION 5 ABNORMAL AND EMERGENCY PROCEDURES provide one of the tasks „Imitated engine failure after taking off **(in safe height)**, fire alarm imitation;
SECTION 6 SIMULATED ASYMMETRIC FLIGHT AND RELEVANT CLASS/TYPE ITEMS provides one of the tasks **„ Engine shutdown and restart";**
As during the skill test the task of asymmetric flight simulation with shutting down and restart of the engine had to be performed, the investigation considers that the simulation of shutting down was performed.
The investigation could not clarify how and in what consequence the tasks of thees 6 (six) sections were performed, including the asummetric flight simulation with shutting down and restarting of the engine, as in the accident site any written records of examiner among other taken documents in any degree of damages were not found, therefore it can be concluded that examiner, probably, has not made any records, despite the recomendation that examiner during the skill test must keep the logbook and evaluation records. The requirement foresees that several skill test sections can be joined including section 5 with 6. Regarding the condition of propeller after the accident the investigation considers that examiner rather could have performed the asymmetric flight imitation using the engine no.2 closing the engine choke. In the case of one engine failure for the aircraft Tecnam P2006T the "critical" engine is the left side engine (as the engines ROTAX 912 S3 turns clockwise from the view of pilot seats), the failure of which due to P-factor has the most negative effect on yawing control.

The applicant should to maintain control over the aircraft operation, identify the failed engine and perform the procedures of shutting down of the engine and perform propeller feathering. In compliance with CAA inspection documentation the investigation found out that the training organization did not have any training unit or simulator to simulate emergency situations, as well it does not have any information if and in what amount the asymmetric flight imitation procedures was worked off together with instructors during the training flights. Accordingly the investigation considers that it can not exclude the situation, when applicant being subjected to certain psychological stress due to the test, as the operation of the skill test flight takes extreme effort, demonstrating actions in compliance with the task of one engine failure, performed these actions incorrectly, in wrong order, using the control inputs without proper coordination, identified the engine failure too late or even accidentally turned off the engine No.2. The skill test procedures during the flight shall be performed in compliance with the requirements of the aircraft manual. In compliance with the paragraph 4 "Engine securing" of the section 3 of the "Flight Manual" of manufacturer, the following procedure is applicable to shut down engine in flight:

Throttlelever - idle (could be considered that it was done by examiner);
Ignition switches (both) – turn off;
Propeller lever - feathered;
Fuel selector - turn off;
Fuel pump - turn off.



Air-fuel mixture regulation system is self-adjusting.
If the engine was shut down, than due to the power asymmetry the aircraft yawed rapidly to the side of the failed engine and probably the pilot did not identified on time the engine failure as the propeller continued to rotate. From experience of other accidents it is known that windmilling often has give mistaken perception for the pilots of multi-engine aircrafts, that that the failed engine is still developing useful thrust, resulting in a psychological reluctance to feather, as feathering results in the cessation of propeller rotation Therefore the power of the working engine was not rapidly decreased and propeller was feathered, to decrease the drag as a result there was a sudden uncontrollable yawing motion. Restarting of the engine performing the test flight in normal conditions takis about 20 seconds, but in stress conditions it has took even more. In the result of significant yawing and and sidesleed the aircraft lost the altitude and speed. Performing the experimental flight after the locking of one engine the maximal loss of altitude was 200 feet. The sitation was unexpected and there is a large possibility that there were uncoordinated opearation with control inputs, to prevent the asymmetric power moment and its consequences, due to which the situation became critical. As the altitude of flight were just 1500 feet and it continued to decrease after the engine shutting down (from 1500 FT to 500FT and more when aircraft disappeared from radar) , than in this situation actually there were the impact of the same forces on the aircraft observed in similar situation, as it is described at previous paragraph 2.4, there were not enough time at such altitude for diving airctaft (nose down) to increase the speed and recover the control over the

aircraft, to climb and increase the altitude. Such behaviour of aircraft have confirmed by the interviewed witnesses.

In OEI flight at low altitudes and airspeeds pilots must operate the airplane so as to guard against the three major accident factors:

- loss of directional control;
- loss of performance;
- loss of flying speed.

All have equal potential to be lethal.

When an instructor simulates an engine failure, the student should respond with the appropriate memory items and retard the propeller control towards the FEATHER position. Assuming zero thrust will be set, the instructor should promptly move the propeller control forward and set the appropriate manifold pressure and r.p.m. It is vital that the student be kept informed of the instructor's intentions. At this point the instructor may state words to the effect, "I have the right engine; you have the left. I have set zero thrust and the right engine is simulated feathered." There should never be any ambiguity as to who is operating what systems or controls.

Following a simulated engine failure, the instructor should continue to care for the "failed" engine just as the student cares for the operative engine. If zero thrust is set to simulate a feathered propeller, the cowl flap should be closed and the mixture leaned. An occasional clearing of the engine is also desirable. If possible, avoid high power applications immediately following a prolonged cool-down at a zero-thrust power setting. The flight instructor must impress on the student multiengine pilot the critical importance of feathering the propeller in a timely manner should an actual engine failure situation be encountered.

As was noticed earlier a windmilling propeller, in many cases, has given the improperly trained multiengine pilot the mistaken perception that the failed engine is still developing useful thrust, resulting in a psychological reluctance to feather, as feathering results in the cessation of propeller rotation.

USA Federal Aviation Agency, for example, determines that all actual propeller feathering should be performed at altitudes and positions where safe landings on establishedairports could be readily accomplished. Feathering and restart should be planned so as to be completed no lower than 3,000 feet AGL.

The FAA recommends that all in-flight simulated engine failures below 3,000 feet AGL be introduced with a smooth reduction of the throttle. Thus, the engine is kept running and is available for instant use, if necessary. Throttle reduction should be smooth rather than abrupt to avoid abusing the engine and possiblycausing damage. All inflight engine failures must be conducted at VSSE (recomended safe simulated OEI) speed or above.

2.7. Performing the task of the Section 6 "Engine shutdown and restart" after the simulation of the engine No.2 failure the applicant accidentally shut down the engine No.1;

During the process of investigation the version that testing the applicant skills to control the operation of the aircraft during the asymmetric flight, in the some way engine No.2 failure was simulated (for example closing the thruttle of engine No.2 or changing thrust by changes of propeller pitch angle) and pilot CPL(A) licence applicant probably did not immediately indentify the engine, which did not have thrust, but began restarting procedures inoperative engine No.2, by mistake shut down the left side engine No.1.

Though, if the examiner simulated the asymmetry with the right side engine the aircraft should to yaw on the side of the right side engine, because disbalance of the engines power created the torque, which accordingly caused changes of the initial heading. It means the change the direction

the airplane is **pointing** without any immediate change in the direction the airplane is **going**. There will also be a tendency for the wing to drop on the side with the non-working engine: partly because of reduced propwash over the wing, and partly because of differential wingtip velocity due to the aforementioned yawing motion. Then, after a short time (a second or so), the torques will come back into equilibrium, because of the airplane's natural yaw-wise stability, that is, the uncoordinated airflow hitting the rudder will create a torque that opposes the asymmetric thrust.
In a high-power low-airspeed situation, engine failure is extremely noticeable In other situations, with more airspeed and/or less power, engine failure may be harder to perceive especially if it is a gradual failure. Perceiving the initial yaw is particularly tricky during a turn — the turn just proceeds a little faster or slower than normal. The subsequent turn may not be super-easy to perceive, either.
Observing the suddenly yaw or wing suddenly dropping the rudder must be immediately used in opposite direction.
A commonly-used technique is to roll the wings level and then apply the rudder as needed to stop the turn. The advantage of this procedure is that it can be done without reference to instruments. The main disadvantage is that it doesn't help you regain or retain control in a turn but there in situation where an engine has failed it is not necessary to *want* to be turning. If using the pedal of rudder the reaction to the change of direction is on time, the direction balance can be got. Then if pilot has got the wings level and the turn stopped, he should establish the optimal zero-slip condition, by raising the dead engine a few degrees and releasing some of the rudder pressure.
During the process of investigation it was not possible to find out in what speed was, when asymmetric flight simulation has been started, what was the power of operating engine.
It can be admitted that the aircraft was flying with the average speed that is characteristic for standard test flights. There are possible to admit that applicant of CPL licence noticing the yawing due to the asymmetry of power on the right side caused by the right side engine failure and performing actions accordingly to flight rules in such situation for decreasing aircraft yaw, changed the rudder deflection angle to the left side, decreased the power of operating engine as well changed the aircraft pitch angle downward to increase the speed.
Controlling and reaching enough speed, he shifted forward the thruttle lever of working engine, but performing the imitation of the rest procedures to close the failed engine, touching the control instruments of the engine No.2 in compliance with the order set in the paragraph 4 „Engine securing" of the section 3 of the "Flight manual", he accidentially shutted down the operating engine No.1. Probably it could happen because the control instruments of the engine No.1 are placed closer and pilot in stress condition authomatically mistaked them, as before he increased the power for operating engine No.1 with thruttle lever, which caused uncoordinated manipulations with operation control inputs. This scenario can not be completely excluded.

2.8. Technical maintenance of the aircraft before the accident

The following technical services were performed for the aircraft before the accident:

From 03.08 to 08.08.2012, 200 hours maintenance after 210 flying hours, performed SB-102-CS-R0 (elerons hings inspection), changed oil, oil filter and spark-plugs;

23.08.2012, 50 hours maintenance after 260 flying hours, changed oil and oil filter;

From 21.09 to 22.09.2012, 100 +300 hours maintenance after 310 flying hours, performed SB-102-CS-R0 (elerons hings inspection), changed oil and oil filter;

22.10.2012, 50 hours maintenance after 350 flying hours + (change of stabilizer impulse lamp).

All technical services has been perfomed in organization Qnord 145, (servicing organization approval certificate EASA Part 145 Approval Certificate Reference: LV.145.0016), in compliance with the technical documentation of the aircraft MP YL-SVN R0, Aircraft Maintenance Manual P2006T N0.2006/045, the servicing was perfomed by certified professional (seal No.4). No technical incompliances were found during the servicing.

2.9. Human factor influence on the accident

Regular working place of the invited and CAA approved examiner was airline, where he took the position of the flight operation director. In compliance with information obtained in the process of investigation, he had serious issues with the management of airline regarding the issues about the use of pilot personel. He was not relieved from job, but he was without rights to perform flights, without any explanations from the aviation company management. Considering the information obtained from his work collegues, for him it was a serious psychological trauma. In this condition he was before going to perform the duties of examiner to the country of the accident. Accordingly the investigation considers that it can not be excluded, that this psychological trauma could be a reason for low ability of concentration and slow reaction in nonstandard situation performing the flight skill testing.

2.10. Regulations of planning, authorization and performance of the training flights.

Special regulations for training flights are developed and approved in Civil Aviation Agency (AIP SUP: 013/2011) only for the International Riga Airport (EVRA) - „Riga aerodrome (EVRA) Procedures for Planning Authorization and Execution of Training Flights in Riga Aerodrome".

The procedures of training flights are determined in the in the regulations both regarding the regulations of visual flights (VFR), and instrumental flights (IFR). Areas for training flights with Civil Aviation aircrafts in safe height with safe landing options during emergency situations have not been set (TSA- Temporary Segregated Area) or (TRA - Temporary Reserved Area).
There may be established TRA only for aerobatic flights within the Riga FIR in accotdance with the Cabinet of Ministers Regulation Nr.306.

In compliance with AIP ENR 1 GENERAL RULES AND PROCEDURES ENR 1.1 GENERAL RULES the responsible institution fro the management of the airspace structure (Airspace Management-ASM) is Civil Aviation Agency.

Requests shall be submitted to the CAA.

3. CONCLUSIONS

- The aircraft pilot, applicant of CPL(A) issue had valid flight crew member certificate PPL;
- The aircraft was flying according to visual flight rules (VFR) at altitude about 1500 feet ;
- On November 13, 2012 it was the second CPL(A) issue skill test flight with this aircraft and examiner;
- The applicant of CPL(A) issue has submitted a certificate, that he had finished 650 hours training courses in Oxford Aviation Academy;
- The applicant of CPL(A) issue has successfuly passed the theorethical exams in Latvia Civil Aviation Agency and regarding the exam results the Civil Aviation Agency on October 18, 2012 it has been issued to the applicant the certificate No. 09/2012ATPL(A) as an approval of successful pass of the theorethical exam (A) JAR-FCL 1.285 CQB;

- Applicant of CPL (A) issue has successfully finished the CPL (A) training cource in compliance with Appendix JAR-FCL 1.160 & 1.165(a)(4) with training aircrafts and have received the recommendation of head trainer (HT) to perform CPL (A) skill test flight;

- In compliance with EASA regulation „Certification Specifications for Normal, Utility, Aerobatic and Commuter Category Aeroplanes" CS23 the aircraft was certified as the aircraft of **normal** flight category, the aircraft type certificate „EASA Type Certificate No: A.185 (Dated 2009, June 5);

- The aircraft has valid Airworthiness and Airworthiness Review Certificate issued by Civil Aviation Agency Republic of Latvia;

- Performing inspection of FTO „Tekara" for issuing of the certified professional flight training organization licence, CAA inspectors found many serious deficiences to the requirements of the paragraph 1-33 of JAR-FCL 1.055 App1a;

- Deficiencies disclosed in the FTO Inspection checklist, Inspection Reports, Finding Clearance Reports and other inspection documents witness that the process of preparation to the training of FTO Tekara was low-grade, careless and involved specialists at the initial phase of preparation did not have full comprehension how to organize the training process;

- In the section of the inspection report of the professional training organization of Civil Aviation Agency the Inspection results stated that FTO Tekara is in compliance with JAR-FCL 1.055 has been satisfactory prepared for training process for applied courses and it can receive the acceptance cesrtificate for 1 (one) year with remark – the first inspection shall be performed no later as within 30 days after beginning of the training process;

- CAA admitted that FTO SIA Tekara complies with all the requirements of Joined Aviation Institutions (JAR-FCL), related with the establishment ot training organization and on April 16, 2012 issued the Approval Certificate No.LVA/FTO/06 for one year;

- FTO Tekara was authorized as a organization of preparation for pilot professional training (FTO) to provide the training courses CPL(A) Modular Flying Training Course (App.1 to JAR-FCL 1.160&1.165(a)(4);

- The Head of Training of FTO Tekara in the organization had a part time job and in the order of combining of the positions tooked the position of Quality Manager and accordingly in a fact he was controlling himself that did not promote quality of training process;

- When during the inspection, after issuing of the Approval Certificate any evidences regarding the activities of Head of Training during the organization of the training process, in supervision and flight training standartization actually were not found, as well the significant deficiences in the flight training documentation, the approval certificate was not canceled, the instructions on preventing the deficiences were provided by phone;

- In compliance with CAA inspection documentation it was stated that the training organization did not have training unit or simulator, tosimulate the emergency situations on the ground;

- After issuing of the Appropval Certificate some deficiencies stated during FTO Tekara inspection were not fully prevented till the day of accident;

- In compliance with records in the Student Workbook the applicant during the training has been performed the flights both with single and multi engine aircrafts, with different Flight Instructors (FI) and to get the licence of commercial pilot in compliance with the requirements of JAR-FCL has flew without assistance the required flying hours in different flying modes;

- The Examiner of the flight skill test had JAR conformable Flight Crew Licence and examiner's qualification in compliancwe with JAR-FCL 1.425 „Examiners General";

- There is no documentally approved information regarding the Examiners instruction performed by competent institution (CAA) as it is foreseen by the paragraph AMC FCL 1.425 „Standardisation arrangements for examiners" of the section AMC/IEM I – EXAMINERS of the JAR –FCL1 SECTION 2;

- At October 27, 2012 the applicant of CPL(A) issue had performed the Class/type rating skill test and proficiency check on multi engine single pilot aeroplane flight with remark for „ME" with this aircraft Tecnam P2006T, registration No. YL-SVN and the same Examiner. The Examiner's resolution was positive: „*Can use ME privileges. Flight performed with some remarks*";

- The aircraft used in the skill test complied to the requirements of the training flights with variable pitch propeller, dragged in chassis and was certified for transportation of at least four persons;

- Actual meteorological weather conditions in the day of the accident complied with the requirements for visual flight rules;

- In the aircraft luggage compartment were no additional load for ballast, and in the case when only the front seats was occupied (pilot- student and Examiner) could move the balance of the aircraft far forward, close to the limit, that may significantly change the structural characteristics of the aircraft especially in the beginning of the spin;

- Due to significant aircraft damages it was not possible to estimate the actual place of the back seats;

- In the accident site of the aircraft TECNAM P2006T, registration number YL-SVN was immersed into the ground and stopped practically without any traces of sliding, which witness that the aircraft collision angle with the ground was extremely steep;

- Inspecting the crowns of the trees around and close to the place of accident any breaking of the tree tops and branches there was not found;

- The aircraft was equipped with Emergency Locator Transmitter (ELT). In the place of accident the ELT which are placed on the board of the aircraft was turned on and transmitted the signals;

- During the investigation process after visual inspection and partial dismounting of the aircraft engine Nr1, Bombardier ROTAX 912 S3, series Nr. 4924100 it was stated that turning on of the engine and testing in the operation mode is not possible due to the damages, which occurred due to the impact when the aircraft collided with ground;

- After extraction from the ground the propeller of the right side engine (No.2) were locked, the end parts of the broken blades were placed parallel to the airflow (propeller feathered), according to this it can be witnessed that during the accident the engine was turned off;

- The actual condition of the left side engine (No.1) propeller before the accident was not possible to determine due to the damages of the engine connection, details of the control and operation mechanism;

- In the process of investigation, it was not possible to get the information on how in compliance with the requirements skill testing "Simulated asymmetric flight" the shutting down and restarting of the engine was performed;

- In "JAA Flight Examiners Manual Aeroplane and Helicopter" it is recommended to turn off the throttle of the engine and simulate the shutting down of the engine with the operation and control inputs recommended by manufacturer;

- In compliance with the statement of the pilot, who earlier in the same day performed CPL(A) issue skill test flight with the same examiner, during the flight there was not given any instructions to shut down some of the engines;

- In the result of investigation and examination of the wreckage of the engine (No.1), due to significant damages, no evidences were found which could testify that engine could faile due to the technical reasons;

- Regarding the meteorological conditions (temperature , humidity), as well the flight with performance of maneuvers above the water it was not possible to exclude the carburettor icing that caused the failure of the engine No.2;

- In the accident site among the all documents any written notes of the examiner were not found in any stage of damages, accordingly it could be stated that the examiner probably were not making any records during the flight;

- Regarding that the regulations of the aircraft certification does not prescribe that the aircraft has to be certified on going in spin, and intentional spin is forbidden, in case when unintentional spin occurred it is difficult to recovery out the aircraft from spin, but at altitude of 1500 feet it is not possible actually with classic recovery manoeuvre recommended bu manufacturer;

- It is possible that uncoordinated operation with control inputs was performed to prevent the asymmetric moment and its caused consequences;

- Probably performing the simulation of shut down the engine No.2, touching the engine No.2 control tools in compliance with the order set in the paragraph 4 „Engine securing" of the section 3 of the "Flight Manual" the pilot accidentally turned off the operating engine No.1;

- Only using the rudder and ailerons together in the correctly coordinated combination the asymmetric flight of the aircraft can be ensured with one failed engine without any sideslip and best climbing performance;

- In compliance with the technical maintenance documentation the technical servicing of the aircraft was performed in approved technical maintenance organization Qnord 145 according to the aircraft MP YL-SVN R0, AMM P2006T N0.2006/045;

- In compliance with the paragraph CS 23.3 „Aeroplane categories" of EASA regulation the restrictions to perform acrobatic flight elements has been set for the aircraft of **normal** flight category Tecnam P2006T;

- **The results of experimental flight approves that performing the coordinated use of the flight operation control inputs (rudder, ailerons, settlement of propeller pitch angles and throttle lever of operating engine) during the asymmetric flight the flight of the aircraft can be easily controlled when one or other engine is shut down, by the condition that the luggage section has additional ballast if only the both font seats of pilots are occupied;**

- **The flight altitude was not safe (only 1500 feet) for performance of flight skill test with shutting down or simulating the shutting down one engine;**

- No technical incompliances of the aircraft were found during the servicing;

- The fuel amount according to records in the documents was sufficient;

- The psychological trauma of examiner could be a reason for lower concentration ability and slow reaction in extraordinary situation performing the skill test;

- In compliance with the resolution No.1065 of the Expert of Tanatology Department of the Forensic Medicine Pathology Department of the State Forensic Medicine Expertise Centre, the effect of alcohol, drugs, psychotrophic substances were not found in chemical examination of the blood and urine of pilot and examiner;

- Body injuries of the pilot and examiner in general by their character can be treated as SERIUOS injuries, as life-threatening, between the body injuries and death is direct causal connection;

- The aircraft were not equiped with any kind of equipment, which could fix the flight parameters or voice records;

- The flight techniques of the aircraft Tecnam P2006T for training asymmetrical thrust are not typical for this class of aircraft;

- The areas for performance of the Civil Aviation aircraft training or test flights in safe height and with safe options of landing in emergency situation are not set in the state.

3.1. Causes of the aviation accident:

1.1. Possible causes of the aviation accident

- Performing the task of the section 6 of the skill test "Shutting down and restarting the engine", accidental turning off of the engine No.2 after which the uncoordinated use of the aircraft operation control inputs during the suddenly and fast aircraft yawing;

- Wrong action of pilot and noncoordinated operation of pilot and examiner with the aircraft control inputs and operation elements after the failure of engine No.2 due to the carburettor icing;

- Performing the task of the section 6 of the skill test "Turning off anf rerun of the engine" after the imitation of the engine No.2 failure performed by examiner it is possible that the applicant accidentally has turned off the engine No.1.

3.2. Contributing causes of the aviation accident

- Specific aircraft centre of gravity (CG) placement features of the used aircraft;
- Absence of the additional ballast in the luggage compartment;
- Flight of the aircraft in low height (1500 feet), which was not enough to recovery the aircraft from spin;
- The areas for performance of the training or test flights of the Civil Aviation aircrafts in safe height and with safe landing possibility in the State;
- Air temperature and flight above the water surface;
- The aircraft was not certified for recovering from spin (in compliance with certification regulations it is not required);
- Low-grade process of training assurance and insufficient control of the training process;
- Psychological condition of the examiner;

4. FLIGHT SAFETY RECOMMENDATIONS

The following safety recommendations were addressed to the Civil Aviation Angency:

Recommendation 1– 2014:

To consider the option regarding the placement of the definite area for performance of the test flights for Civil Aviation Agency aircrafts in safe height and with safe safe landing possibility in the case of emergency.

Recommendation 2– 2014:

Perform step by step extraordinary inspection of the approved professional training organizations (FTO) in the State.

Riga, July 07, 2014

Investigator in Charge

Head of the of Aircraft Accident and
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The director of the Transport Accident and
Incident Investigation Bureau — Ivars Alfrēds Gaveika