

# Investigation Report

## Identification

Type of Occurrence:	Accident
Date:	1 August 2008
Location:	Near Zadar / Croatia
Aircraft:	Airplane
Manufacturer / Model:	Piper / PA-44
Injuries to Persons:	Two persons fatally injured
Damage:	Airplane destroyed
Other Damage:	None
Information Source:	Investigation by BFU
State File Number:	BFU 4X029-08

This investigation was conducted in accordance with 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 aviation and the Federal German Law relating to the investigation of accidents and incidents associated with the operation of civil aircraft (Flugunfall-Untersuchungs-Gesetz - FIUUG) of 26 August 1998.

According to the law the sole objective of the investigation shall be the prevention of future accidents and incidents. It is not the purpose of this activity to assign blame or liability or to establish claims.

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German Federal Bureau of Aircraft Accidents Investigation  
Aircraft Accident Investigation

Hermann-Blenk-Str. 16  
38108 Braunschweig

Phone ++49 531 3548-0  
Fax ++49 531 3548-246

E-Mail: [box@bfu-web.de](mailto:box@bfu-web.de)  
Internet: [www.bfu-web.de](http://www.bfu-web.de)

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## Abbreviations

ATP	Airline Transport Pilot	Verkehrspilot
BFU	German Federal Bureau of Aircraft Accident Investigation	Bundesstelle für Flugunfalluntersuchung
CFI	Chief Flying Instructor	Leiter der praktischen Ausbildung
CPL	Commercial Pilot Licence	Berufspilotenlizenz
CRI	Class Rating Instructor	Fluglehrer für Klassenberechtigungen
CVR	Cockpit Voice Recorder	Cockpit Voice Recorder
EASA	European Aviation Safety Agency	Europäische Agentur für Flugsicherheit
FDR	Flight Data Recorder	Flight Data Recorder
FI	Flight Instructor	Fluglehrer
FNPT	Flight and Navigation Procedures Trainer	synthetisches Flugübungsgerät
ft	Feet - Flight Altitude	Fuß - Flughöhenangabe
FTO	Flight Training Organisation	Ausbildungsbetrieb für Flugausbildung
GPS	Global Positioning System	Satellitennavigationssystem
HOTD	Head of Training Directive	Anweisung des Ausbildungsleiters
JAR-FCL	Joint Aviation Requirement-Flight Crew Licensing	Vorschrift für die Lizenzierung von Piloten von Flugzeugen
IAS	Indicated Airspeed	Angezeigte Geschwindigkeit
KIAS	Indicated Airspeed in Knots	Angezeigte Geschwindigkeit in Knoten
LBA	German Aviation Authority	Luftfahrt-Bundesamt
LuftPersV		Verordnung über Luftfahrtpersonal
ME	Multiengine	mehrmotorig
MEP	Multiengine Piston	mehrmotorige Kolbenflugzeuge

METAR	Aviation Routine Weather Report	Routinewettermeldung für die Luftfahrt
NM	Nautical Mile	nautische Meile
NTSB	National Transportation Safety Board	Unfalluntersuchungsbehörde der USA
OM	Operational Manual	Betriebshandbuch des Ausbildungsbetriebes
POH	Pilots Operating Handbook	Flughandbuch
SB	Service Bulletin	Anweisung des Herstellers
SEP	Single Engine – Piston	einmotorig, Kolbenflugmotor
SPA	Single Pilot Aeroplane	Flugzeug mit einem Piloten
$V_{MCA}$	Minimum Control Speed	Mindestgeschwindigkeit zur Beibehaltung der Steuerbarkeit im Fluge bei Ausfall eines Triebwerkes
$V_S$	Stall Speed	Überziehggeschwindigkeit
$V_{SSE}$	Save Single Engine Speed (POH PA-44: "Intentional one engine inoperative speed")	Sichere Geschwindigkeit für Einmotorenflug
$V_{YSE}$	Best rate of climb with one engine inoperative; "Blue Line"	Beste Steiggeschwindigkeit mit einem Triebwerk

## Synopsis

The Croatian investigation authority (Ministry of Sea Transport and Infrastructure) informed the BFU about the accident with the airplane PA-44 on 2 August. The BFU participated in the investigation of the wreckage in Croatia on 7 August. Furthermore, the BFU performed technical investigations on the airplane in Germany. For this purpose, the wreckage was transported to Braunschweig, Germany, in August 2008. Finally the entire investigation was transferred to the BFU on 24 April 2009.

The airplane was on a training flight above the sea when it disappeared from the control monitors of the Croatian air traffic control services. It had entered an uncontrolled flight attitude in approximately 5,000 ft. It is highly likely that simulated single-engine manoeuvres in the area of the Minimum Control Speed ( $V_{MCA}$ ) were performed at that time. The wreckage was found two days later on the sea floor.

The accident was due to the following immediate causes:

The airplane started to spin because the applied procedure for the conduct of the  $V_{MCA}$  training contained a low safety margin and the flight instructor did not realise it during the conduct of the training. The necessary correction measures were not initiated in time.

The following systemic factors led to the accident:

The procedures for the conduct of  $V_{MCA}$  trainings were described insufficiently.

# 1 Factual Information

## 1.1 History of the Flight

At 1121<sup>1</sup> hrs the airplane started with a flight instructor and a student pilot on board for a training flight. The training area 2L was located above the sea approximately 20 Nautical Miles (NM) south-west of Zadar Airport near the island Dugi Otok. According to the daily training schedule of the Flight Training Organization (FTO), lesson 4.39D was to be flown. An altitude of 4,000 ft to 6,000 ft was scheduled for this training. The airplane disappeared from the monitoring devices of the Croatian air traffic control services at 1229 hrs.

A search operation was initiated. The airplane was found on the sea bed on 3 August 2008, and recovered on 4 August 2008. The first recovery attempt was aborted due to the rupture of the rope. The second recovery attempt was successful.

## 1.2 Injuries to Persons

Injuries	Crew	Passengers	Total	Others
Fatal	2			
Serious				
Minor				
None				---
Total	2			

## 1.3 Damage to Aircraft

The aircraft was destroyed.

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<sup>1</sup> All times local, unless otherwise stated.

## 1.4 Other damage

None

## 1.5 Personnel Information

### 1.5.1 Flight Instructor

The 35-year-old Pilot in Command (PIC) was a Croatian citizen. He held a Croatian Commercial Pilot's License (CPL (A)), first issued on 16 December 2004, valid until 15 May 2012. His medical class 1 certificate was valid until 7 November 2008. He held a valid class rating for single and multi-engine piston aircraft as well as the instrument rating. Furthermore, he held a Flight Instructor (FI) rating. The written confirmation on the corresponding examination was issued on 25 November 2004. He was a former pilot of the Croatian Army. He also held a degree as Certified Traffic Engineer Pilot of the University of Zagreb. The Croatian armed forces confirmed a total flying experience of approximately 821 hours on the types Utva 75 and Pilatus PC-9. He obtained several military ratings, among them basic acrobatics during day time. At the cut-off date 15 May 2005, approx. 901 hours and 37 minutes, flown exclusively on single-engine aircraft, were entered into his Pilot Log Book. Another Pilot Log Book kept until 4 April 2008, showed 2,065 hours of total flying experience and 1,512 hours as flight instructor. According to the records of the FTO, he flew approximately 238 hours after 4 February 2008. This adds up to a total flying experience of approximately 2,303 hours.

He received his class rating for multi-engine piston (MEP) aircraft in the same Flight Training Organization (FTO) where he was later working as a Flight Instructor (FI). According to the records of the FTO, he completed the training on twin-engine aircraft on 13 October 2006. It was documented that the lessons designated as 4.43D, 4.35D, 4.48D, and 4.50D in the syllabus, were flown. None of these lessons specifically listed the demonstration of the Minimum Control Speed ( $V_{MCA}$ ). The FTO subsequently stated that this training phase included the following: bringing the aircraft close to  $V_{MCA}$ , simulated engine failures and the shut-off and restart of an engine. The Chief Flight Instructor (CFI) of the FTO, who also participated in the MEP training of the FI who later had the accident, stated that  $V_{MCA}$  was trained in this phase. In the course of this training, he completed 4 hours in a Flight and Navigation Procedures Trainer (FNPT) (generally called flight simulator) and 8 hours and 5 minutes in the aircraft. After that, the pilot flew 30 hours and 35 minutes as pilot in command in multi-engine aircraft. These were identified as "FI Stand" or "FI Familiarization", respectively, in the records of the FTO. There was no information about the character of the flights.

The training as Class Rating Instructor – Multi-engine Piston CRI (MEP) was completed on 14 March 2007 after 2 hours in the FNPT and 5 hours in the aircraft. The FTO stated that

during the training  $V_{MCA}$  was trained. There was no proof as to the conduct of  $V_{MCA}$  training in the Student Pilot's Proficiency Reports.

The BFU does not have any information whether a  $V_{MCA}$  lessons had been flown during this training.

Until the accident, he had flown approximately 374 hours on the PA-44, 327 hours of which as FI.

The records of the FTO state that the pilot had completed a "Proficiency Check" after his CRI MEP instruction on 24 January 2008. The scope of this check is unknown.

According to witnesses, his English language skills were good. He also had sufficient German language skills.

At the day of the accident, he had already completed a flight of 2 hours and 47 minutes. On the day prior to the accident, he had flown 4 hours and 20 minutes. These flights were performed with the aircraft that later crashed.

### 1.5.2 Student Pilot

The 19-year-old student pilot was an Italian citizen. He was in training to become an Airline Transport Pilot (ATP). He started flight training at the FTO in May 2007. His first solo flight was on 20 May 2007. He completed the first part of the training after 74 hours and 55 minutes total flight time in June 2007. This was followed by the VFR-Night, IFR flight training in the year 2008. It was concluded after another 46 hours and 6 minutes on 29 July 2008. He started the training on multi-engine aircraft (ME) on 23 July 2008. In this segment, 6 hours (lessons 4.37F, 4.38F, and 4.41F) were performed in a FNPT. Lesson 4.39D was scheduled as the next and first practical lesson.

His medical class 1 certificate was valid until 12 February 2009. According to witnesses, his English language skills were good.

## 1.6 Aircraft Information

The aircraft Piper PA-44 is a twin-engine, low-wing aircraft with a retractable tricycle nose wheel landing gear. The airplane has four seats. Both piston engines are mounted to the wings.

Aircraft manufacturer:	Piper Aircraft Corporation
Type:	PA-44-180
Manufacturer's Serial Number (MSN):	4496165
Year of manufacture:	2002
Maximum take-off mass:	1,724 kg
Total operating hours - fuselage	4,001 hours
Type of engine:	Lycoming (L)O-360-A1H6

The aircraft had a valid German certificate of registration. The last continued airworthiness certificate was issued on 18 June 2008, valid until June 2009. On 30 July 2008 the last 100-hour inspection was performed. After that, the aircraft was flown for 12 hours and 31 minutes. The last weighing was performed on 26 May 2008.

The flight manual, chapter 2, limitations stated a  $V_{MCA}$  of 56 kt for the aircraft. Procedures for demonstrating  $V_{MCA}$  were also defined in chapter 4.47. It was pointed out that the aircraft stalls at a  $V_{MCA}$  of 56 KIAS.

The procedure defining when the  $V_{MCA}$  demonstration is to be aborted is described in section 4-47 of the Pilot Operating Handbook (POH) (Refer to Appendix 5.4).

Based on the information of the flight manual a  $V_s$  of 54 KIAS at an aircraft mass of 1,588 kg (3,500 pounds) was calculated.

The Service Bulletin (SB) No. 1220 issued by Piper Aircraft Inc. on 23 April 2010 informed about a possible jamming of the engine controls and the possibly arising dangers.

One witness stated that prior to the accident 210 litres fuel were taken aboard.

## 1.7 Meteorological Information

Visual meteorological conditions prevailed at Zadar Airport at the time of the accident. According to the Meteorological Aviation Report (METAR) of Zadar, time of issue 1230 hrs, the following weather conditions prevailed:

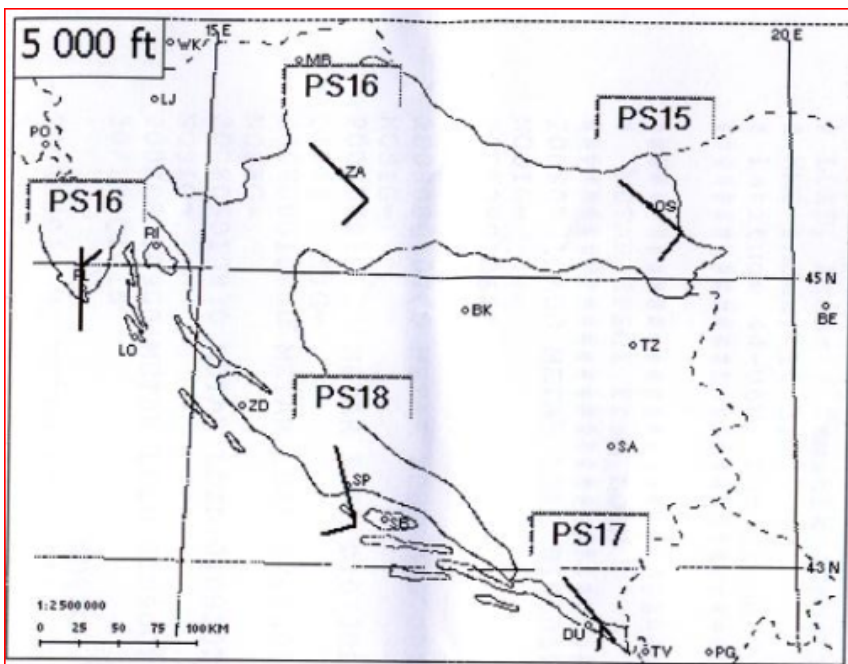
Wind velocity:	260° / 08 kt, variable between 210° und 290°
Visibility:	more than 10,000 m
Clouds:	1-2/8 in 5,000 ft
Temperature:	31°C
Dewpoint:	18°C
Air Pressure:	1,015 hPa

Other METARs had the following contents:

LDZD 011000Z VRB07KT 9999 FEW050 30/18 Q1015 NOSIG=

LDZD 010930Z 25006KT 170V320 9999 FEW050 30/19 Q1015 NOSIG=

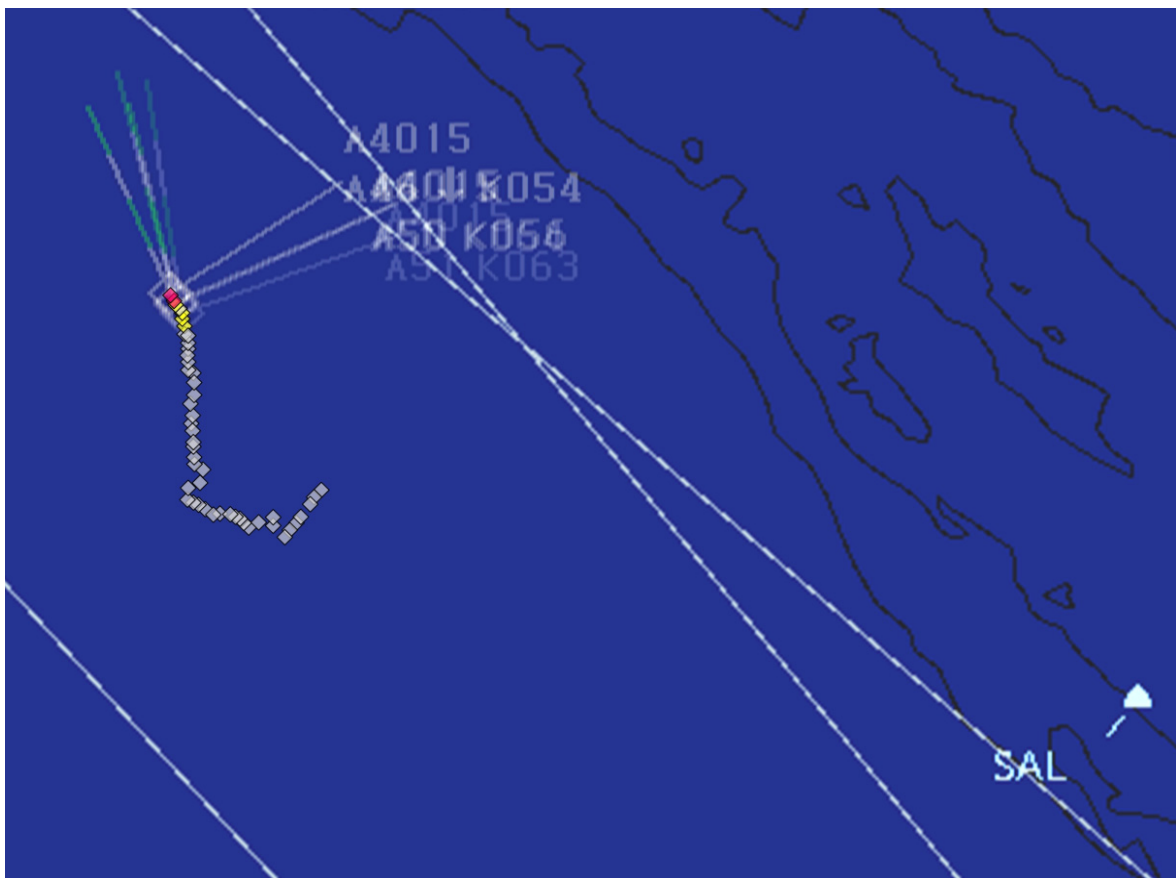
According to the weather chart of the Croatian Weather Service (Meteorological Watch Office Zagreb) there was slight wind (up to 19 km/h) from different directions at 5,000 ft.



Excerpt from the weather chart of the Croatian Weather Service

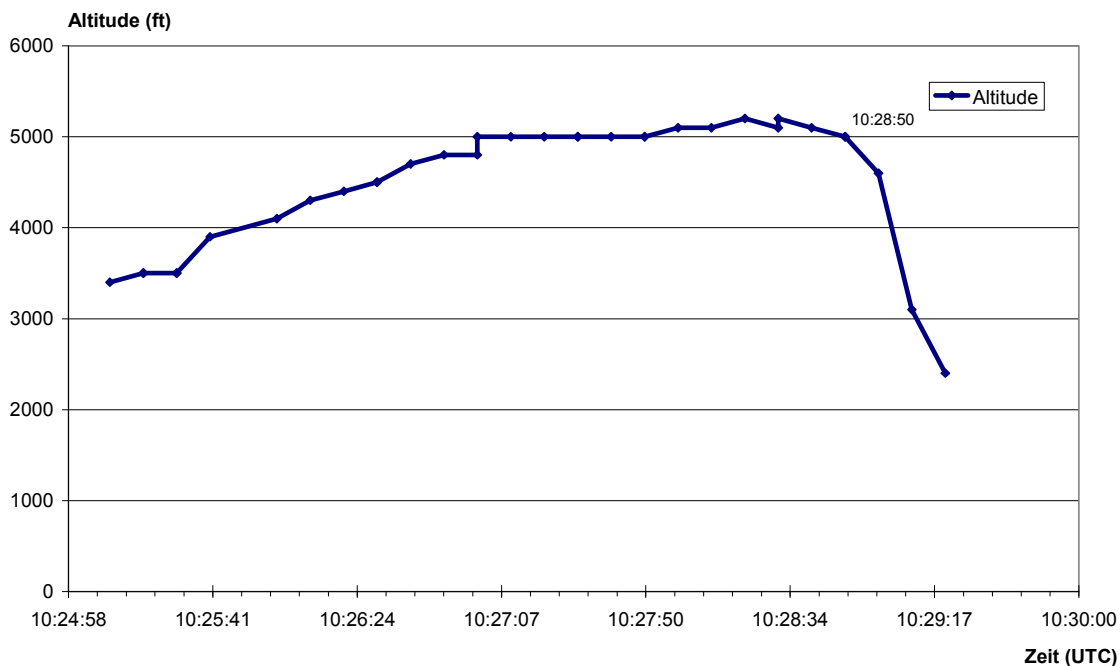
## 1.8 Aids to Navigation

The Croatian Investigation Authority supplied radar display images the air traffic control centre had recorded. The transponder code 4015 had been assigned to the airplane. Individual radar images were combined to show the development of altitude and airspeed. Some points of time had two images assigned to them. The four images between 1028:30 hrs and 1028:50 hrs (UTC) showed a ground speed of 61 to 68 kt. Afterwards the speed decreased. The average value of the four data points results in a ground speed of 64 kt this corresponds with an IAS of 54 kt if wind is not taken into account.



Graph depicting the flight path based on the radar data;  
The yellow data points match a speed of 61 to 68 kt;  
Red data points match a speed of 60 kt.

Source: BFU / Croatian Investigation Authority



Display of altitude based on the radar data.

Source: BFU / Croatian Investigation Authority

## 1.9 Radio Communications

There was radio communication with the responsible air traffic control centre. The aircraft crew received clearance to use the training area L2 in an altitude of 4,000 to 6,000 ft for training flight purposes at 1135 hrs. After the disappearance of the aircraft from the monitoring devices of the responsible air traffic control centre, the centre repeatedly tried to re-establish radio communication with the aircraft, from 1233 hrs on. Another aircraft of the FTO tried to establish contact as well. Both attempts were unsuccessful.

## 1.10 Aerodrome Information

Zadar Airport (ICAO identification LDZD) is an international airport. The airport has one runway with the direction 04/22, a length of 2,000 m and a width of 45 m. An additional runway with the direction 14/32 is 2,500 m long and also 45 m wide.

## 1.11 Flight Recorders

The aircraft was neither equipped with a Flight Data Recorder (FDR) nor a Cockpit Voice Recorder (CVR). These recording devices were not mandatory. The installed GPS devices did not store any data due to their design.

## 1.12 Wreckage and Impact Information

After the accident, the aircraft sank into the sea and came to rest in a depth of approximately 68 m. The rescue divers made video recordings showing the aircraft in upside down position in a direction of approx. 300°. The Croatian Investigation Authority provided the BFU with a report about the recovery of the aircraft.



Underwater photo prior to recovery

Photo: Croatian Investigation Authority

The aircraft was recovered in two bigger pieces and stored temporarily in a hangar.

The airplane tail was laterally bent, but still connected to the fuselage. Big areas of the nose, the fuselage's lower surface as well as the wings lower surfaces extensive dents. The right aileron was torn off. The blades of both propellers did not show any or only very little damage. The main landing gears were extended. The nose landing gear was retracted. The spinners of both propellers were dented at the bottom and did not show damage at the tips. The BFU was not provided with any further information regarding the configuration of the aircraft while still on the seabed (before the recovery).

Extended damage was visible in the area of the front fuselage and the wings. The flap linkage at the wing was bent by approximately 20° on both sides. The flap lever was locked in the retracted position. The elevator trim was separated and free. It was not possible to assign a position. All controls were movable, unless they were jammed by mechanical deformation.

On the inside of the cover flaps of the nose landing gear, there were marks of components from the interior of the nose landing gear bay.

The engine operating elements were found in the following positions:

	<b>Left Engine</b>	<b>Right Engine</b>
Throttle:	Idle	Idle
Propeller:	Feather	Middle
Mixture:	Cut off	Middle
Magneto:	Right: OFF Left: ON	Right: OFF* Left: ON*
Fuel selector:	ON	ON
Electric fuel pump:	ON	ON

\*Both switches covered by an intact cover

The Battery Master Switch and the Left Alternator Switch were found in the „off“-position. The Right Alternator Switch was in the “on”-position.



Magneto switch

Photo: BF

The spinners of both propellers were only dented at the bottom and showed the contours of the propeller hub located below them.

The following findings were made during further investigation in Germany:

The cover of the rudder trim showed a clear dent mark with the contour of the indicator needle located below it, corresponding to a rudder trimming completely to the left.

No damages were found on the pistons, cylinders, crank drives and valve trains of both engines. The propellers were in the position "Start lock". The warning lamps, the speedometer and the charging pressure indicator were investigated also. There were no impact marks or dilatations of the filaments.

Further investigations showed a damaged Bowden cable at the engine throttle of the right engine. Four cable ties were tied around the outer sheath of the Bowden cable. Another cable tie was found at the Bowden cable of the left engine. According to the statements of the operator, cable ties were to keep the protection covers in place.

## 1.13 Medical and Pathological Information

The translation of the autopsy results for both pilots were available to the BFU. According to these reports, the flight instructor suffered non-survivable injuries. The student pilot had various injuries and died from drowning. According to the data of the autopsy results, both pilots were sober at the time of death. Traces of drugs were not detected.

## 1.14 Fire

There was no fire.

## 1.15 Survival Aspects

The accident site was about 11 km away from the next coast line. The next major harbour was in a distance of 37 km.

## 1.16 Tests and Research

Not applicable

## 1.17 Organisational and Management Information

### 1.17.1 Flight Training Organisation (FTO)

The procedures for operation were described in the Operational Manual (OM). The FTO stated that the OM consisted of the parts OM-A (General flight operations procedures), OM-B (aircraft manual) and OM-D (Training and contents; the so-called Training Manual (in this report referred to as Document A)). In addition, there was an Appendix to the OM-D the so-called "ATP Integrated Course Flight Training" (in this report referred to as Document B). The FTO stated that the content of this appendix was already put into effect as Training Directive on 2 November 2006 by the Head of Training (HOTD, in this report referred to as Document C). The FTO further stated that an OM consisting of these two parts (Documents A and B) effective as of 14 April 2008 were published electronically within the FTO and also sent as CD to the LBA. Neither OM-D document contained an approval from the LBA. The LBA stated that at the time of the accident an OM-D was approved in which the training flight had the training number 4.43D.

Overview of the two OM-D versions and the HOTD:

<b>Document A<sup>2</sup></b> Training Manual / OM-D	1st edition valid from: 2007-01-01	Edition No: -2-	Rev. Date: 2008-06-01
<b>Document B</b> Basic Fight Training Syllabus ATP Integrated Course Flight Training	1st edition valid from: 2007-11-15	Edition No: -1-	Rev. Date: n/a
<b>Document C</b> Training Directive of the Head of Training	02.11.2006		

The OM-B corresponded with the POH of the PA-44-180; among others the description of the  $V_{MCA}$  training (Refer to 1.6). The FTO stated that the procedure was completely and sufficiently described in accordance with the manufacturer data. The FTO further stated that certain lessons were not changed due to safety critical considerations and for reasons of liability, among others the  $V_{MCA}$  lesson.

Furthermore, the appendix to the OM-B included the specifications for individual flight elements (Flight Charts); the FTO stated, these constituted airline training specific additions. They included exact specifications about how to fly individual lessons, i. e. there were indications on speeds, altitudes, engine power settings, flap settings, etc. The following elements were described for the airplane PA-44:

Normal Takeoff / Traffic Pattern / Visual Approach / Clean Stall / Approach Stall / Steep Turns / Slow Flight / Precision Approach / Non Precision Approach / Noise Abatement Approach / Non Standard Speed Approach / Circling Approach / Engine Failure after Takeoff / Single Engine Traffic Pattern and Landing / One Engine Inop. IFR Approach.

The Basic Fight Training Syllabus „ATP Integrated Course Flight Training“ (Document B) contained tables with the flying lessons. In addition, there was a Lesson Card (Refer to Appendix 5.5) for each lesson.

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<sup>2</sup> BFU Term

Phase 4b – Time Scale – ME IFR													
Lesson	Date	Aircraft Registr.	TakeOff Time	Landing Time	Flight Time	Planned Time	D (Block time)	SPIC (Block time)	Solo (Block time)	XC (Block time)	IFR (Block time)	Night (Block time)	FNPT
Intro.													
4.37 F						02:00							02:00
4.38 F						02:00							02:00
4.39 D						02:30	02:30			02:30	02:30		
4.40 C						02:30		02:30		02:30	02:30		
4.41 F						02:00							02:00
4.42 D						02:30	02:30			02:30	02:30		
4.43 C						02:30		02:30		02:30	02:30		
4.44 F						02:00							02:00
4.45 C						02:30		02:30		02:30	02:30		
4.46 D-N						02:30	02:30			02:30		02:30	
4.47 F						02:00							02:00
4.48 C						02:30		02:30		02:30	02:30		
4.49 C-Q						02:30		02:30		02:30	02:30		

Excerpt Basic Flight Training / Syllabus ATP Integrated Course Flight Training

The student pilot was trained in accordance with the Syllabus of the HOTD and the Document B, respectively.

Lessons 4.39D and 4.40C did not include arrangements for any abnormal or emergency procedures. In the cards for lessons 4.37F to 4.49C, no flights for  $V_{MCA}$  trainings were specified. The FTO stated that the  $V_{MCA}$  lesson was part of the element "Airwork".

The present OM-D does not contain a definition of "Airwork" and its respective flight manoeuvres. There was no specific information as to when  $V_{MCA}$  lessons are to be conducted. The FTO stated that all manoeuvres of Chapter 4, Normal Procedure (among others  $V_{MCA}$  lessons) have been part of the element "Airwork". Therefore, a clear distinction to the POH, Chapter 3 Emergency Procedure (e.g. real engine failures, spinning) was given.

The "Lesson Card" created for the student pilot documented that lessons 4.37F, 4.38F and 4.41F were completed. Lesson 4.39D was the first one to be conducted with this aircraft.

### 1.17.2 Certification and Supervision of the FTO by the LBA

The Flight Training Organisation was approved as FTO by the Luftfahrt-Bundesamt (LBA) on 27 April 2007 for the last time. The certification documents did not stipulate which revision of the OM was valid. An incidental provision to the certification documents dated 28 September 2004 stipulated that the LBA had to consent to any changes in the manuals. The FTO stated that they had informed the LBA about each change in the training documentation but did not ask for approval since only consent was necessary. The LBA stated that all changes to the OM-D in particular the Syllabi had to be approved. Basis for the approval was JAR-FCL (German) 1,055, Appendix 1a. An application would have been necessary. The e-mail correspondence between the FTO and the LBA showed that both parties had the OM, Revision 1 June 2008 available.

The flight instructor acquired the authorisation to become active as FI for training the Class Ratings SEP (A) (land), Private Pilot Licenses, Commercial Pilot Licenses and Instrument Ratings according to JAR-FCL, Appendix 1, 1.300, on 24 June 2005. This authorisation was limited until 24 June 2008. On 20 July 2007, the LBA received a list of flight instructors which included the FI. In this list the FTO stated that the flight instructor held the license CRO/A - 000046 with the ratings CRI SEP, MEP, FI-CPL-IR(A).

According to the LBA, the training of this student pilot was conducted on the basis of a syllabus as described in the JAR-FCL, Amendment 2, Appendix 1 dated 15 April 2003; 1.160 and 1.165 (a)(1).

This Syllabus contained flights for  $V_{MCA}$  training (Refer to 1.18.4).

The FTO informed the LBA of the accident on 3 August 2008. The Operational Manual Part D available to the LBA stated lesson 4.43D as first flight lesson for the training on the aircraft PA-44. On 1 September 2008, the LBA requested the FTO to clarify this contradiction between the scheduled lesson 4.43D (LBA version of the OM, Version A) and the actually planned lesson 4.39D. The FTO stated that they changed the Syllabus in 2006 and that the LBA had been informed accordingly.

After the accident, the LBA sent a circular letter, dated 23 September 2008, to all FTOs performing training on the aircraft PA-44 recommending that the "blue line" should not be undershot during the  $V_{MCA}$  demonstration. That is the speed  $V_{YSE}$  which is at 88 KIAS for the PA-44.

The LBA audited the FTO in 2007 and 2008, among others. The LBA made different discoveries which were sent to the FTO in writing. From the LBA point of view, the FTO is respon-

sible for the standardization of instructing personnel. There was no specification about how often a certain lesson had to be performed in the scope of the standardisation process.

The LBA stated that in the meantime procedures were established which ensure an unambiguous marking of the OM Revision and, therefore, make a check during audits possible. The LBA also stated that the term "Airwork" encompassed all "General Flight Lessons" in accordance with JAR-FCL (German). Except for the outer limits of the flight envelope at lower speeds, including approaching  $V_{MCA}$ , all other abnormal flight manoeuvres are not part of the flight lessons listed in "General Flight Lessons".

## 1.18 Additional Information

### 1.18.1 Similar Accidents

The database of the National Transportation Safety Board (NTSB) includes three accidents with the aircraft model PA-44 during training flights with subsequent spinning. These accidents occurred in the years 1989, 2003 and 2004. In one of these cases the NTSB concluded that the engines did not deliver any power at the moment of impact. An interrupted fuel supply during spinning was assumed to be the cause. In a second case, a witness observed that the engines were standing still during the spin. In all cases, spinning was not recovered

### 1.18.2 Flight Crew Licensing (Aeroplane) (JAR-FCL 1 German) / Acquisition of Ratings

The requirements for the acquisition of the class rating for piloting multi-engine aircraft and the instructor rating are determined in JAR-FCL 1 (German). In order to acquire the rating, paragraph JAR-FCL 1.261 required, among other things, flight training with a duration of at least 2 hours and 30 minutes under normal conditions and 3 hours and 30 minutes with engine failure and asymmetrical flight conditions.

The following requirements apply, among other things, for instructor rating:

*JAR-FCL 1.380 CRI(SPA) – Requirements; (a) Multi-engine aeroplanes*

*An applicant for the issue of a CRI(SPA) rating for multi-engine aeroplanes shall have:*

*(1) completed at least 500 hours flight time as a pilot of aeroplanes;*

(2) completed at least 30 hours as PIC on the applicable type or class of aeroplane, of which 10 hours at least within the last 12 months;

(3) completed an approved course at an approved FTO or TRTO including at least five hours flight instruction on the aeroplane or a flight simulator given by a flight instructor approved for this purpose.

JAR-FCL 1.380, Appendix 1 describes the course for the acquisition of the single-pilot multi-engine class rating instructor rating (Aeroplane) (CRI (SPA)). Accordingly, a flight training of at least five hours must be completed with an instructor. The syllabus for the flight instruction is published separately in Appendix 1J to the 1. Executive Order to the Regulation on Personnel Licensing (LuftPersV).

JAR-FCL 1.055, Appendix 1a specifies the required documents an FTO must submit approval.

### 1.18.3 Flight Crew Licensing (Aeroplane) (JAR-FCL 1 German) / Conduct of $V_{MCA}$ Lessons

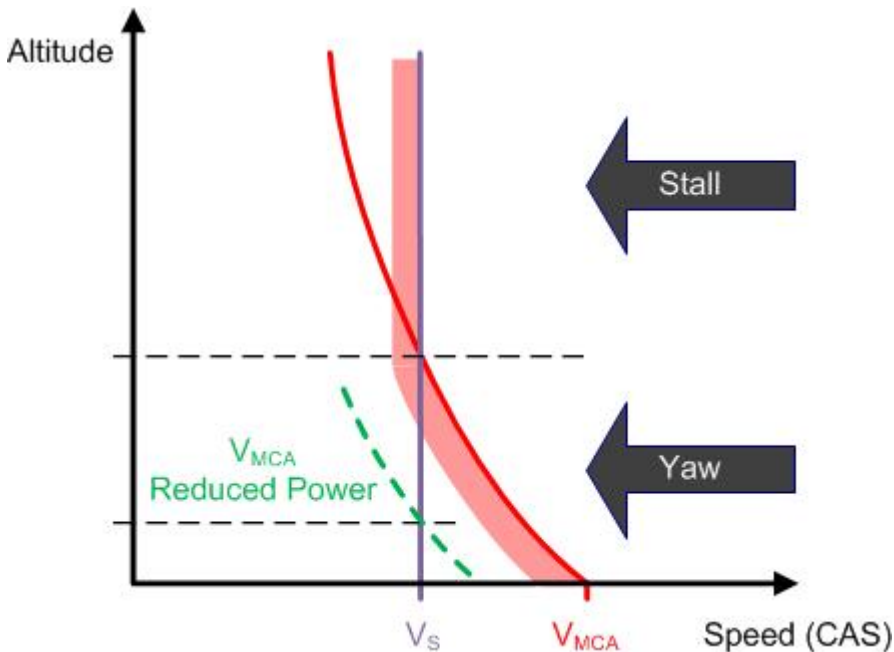
JAR-FCL 1.240, Appendix, 3 Content of type and class ratings on single and multi-engine aircraft with one pilot, stated the necessity of  $V_{MCA}$  lessons.

Abschnitt 2							
2	Flugübungen (VMC)						
2.1	Geradeaus- und Horizontalflug bei verschiedenen Geschwindigkeiten, einschließlich Grenzflugzustände im unteren Geschwindigkeitsbereich mit und ohne Landeklappen (einschließlich Anflug bis zur $V_{MCA}$ , soweit zutreffend)		P---->	---->			

The JAR-FCL did not stipulate the aim of the lessons or how they are to be conducted. There were no indications as to the safety margin with which this lesson was to be flown. There was another stipulation in the 1. Executive Order to the Regulation on Personnel Licensing (LuftPersV) Appendix 1J that no demonstration of  $V_{MCA}$  should occur. This appendix did contain stipulations for the acquisition of an instructor rating.

### 1.18.4 Conduct of $V_{MCA}$ Lessons

Contrary to the  $V_s$  the  $V_{MCA}$  (CAS) decreases in higher altitudes. Depending on the altitude either  $V_{MCA}$  or the stall speed is reached when speed is decreased in single-engine flight.  $V_{MCA}$  also decreases if the engine power is set to a less asymmetrical condition. Due to this, the altitude decreases by which the  $V_{MCA}$  becomes lower than the stall speed.



### 1.18.5 Design Requirements

The design requirements FAR 23 did not stipulate any proof for spinning recovery for twin-engine aircraft. On the other hand however, are flight tests on the spinning characteristics with different combinations of mass, centre of gravity and power mandatory for single-engine aircraft. The aircraft manufacturer stated that he does not have any further proof about the spinning characteristics of the aircraft PA-44.

## 1.19 Useful or Effective Investigation Techniques

The Croatian investigation authority supplied the BFU with a statement of a former student pilot concerning the conduct of  $V_{MCA}$  lessons. It showed that the flight instructor, who later suffered the accident, demonstrated this manoeuvre in a way that it resulted in a considerable nose down attitude of the aircraft.

Thus, four former student pilots of the FTO were interviewed. This interview showed that the flight instructor demonstrated the different lessons very carefully and that he was geared to the utmost safety of the training.

One student pilot stated that  $V_{MCA}$  lessons and flights with a simulated engine failure were performed in the scope of lesson 4.40C. During the  $V_{MCA}$  lesson, the aircraft was decelerated until  $V_{MCA}$ . The aircraft then adopted an abrupt nose down attitude. He also stated that stalls and simulated engine failures were trained in the element "Airwork", among other things.

Another student pilot stated that  $V_{MCA}$  was flown during the first lesson on the PA-44. He said that the flight instructor intervened immediately when  $V_{MCA}$  was undershot. According to his statement stalls and simulated engine failures were trained in the element "Airwork", among other things.

A third student stated that the aircraft was decelerated to an airspeed of 56 kt during the  $V_{MCA}$  lesson. The aircraft thereby adopted a slight nose down attitude.

With respect to the power settings of the engines, all students stated that the engine simulated to have failed was set to idle. Two statements contained the information that the remaining engine was set to full power; according to one statement, the remaining engine was operated slightly below full power.

A flight instructor of the FTO stated that he sets one engine to maximum power and the engine simulated to have failed to zero thrust for a  $V_{MCA}$  lesson. Then the elevator would be pulled and the aircraft decelerated to the 56 kt indication (red line). He also stated that another FI of the FTO would never decelerate the aircraft to that value. All FIs had undergone training with the Chief Flight Instructor (CFI) in the simulator. The students had completed at least 2 to 3 lessons in the simulator. He furthermore stated that normally no emergency training would be performed during the first flight with the PA-44. There were differing statements as to whether  $V_{MCA}$  lessons were flown during the first lesson.

The FTO stated that  $V_{MCA}$  lessons were flown if "some time" was still available during training flights. The opinion was voiced that the exercise would be made easier if the remaining engine would not be operated with full power. The power settings described by the interviewees would be a deviation toward the safe side which would also create a larger safety margin and would, therefore, be justifiable. This could be interpreted as "Airmanship".

The BFU interviewed some FTOs operating PA-44 about the conduct of  $V_{MCA}$  lessons. They made different, partially contradictory statements on the conduct of the  $V_{MCA}$  lessons. These statements concerned the airspeed at which the lesson is aborted, the power setting of the engines and the training methodology.

## 2. Analysis

### 2.1 Damage to and Configuration of the Aircraft

The extensive damage on the bottom side of the aircraft allows the conclusion that the aircraft hit the water surface with a horizontal attitude. The damage to the propeller spinners confirms this. Whereas the lower sides showed the contours of the propeller hub, the upper sides and the tips of the spinners were almost undamaged. From these facts it can be derived that the aircraft hit the water surface with a high vertical and a low horizontal speed.

The deformations of the fuselage and the wings showed that the aircraft turned to the left around its vertical axis during impact.

After the recovery of the wreckage parts, it was impossible to determine which position the controls and the engine power levers had at the moment of impact. The relative position of the rear fuselage and the two engines with respect to the main wreckage was changed several times during the recovery process; finally, these parts were separated from the main wreckage. This, of course, led to a change of the position of linkages and Bowden cables.

It was impossible to clearly determine the position of the flaps. Although the lever in the cabin was locked in the retracted position, the bending in the linkage showed that the flaps were extended in the first position. It is possible that the position of the flap lever as well as the bending of the linkage were caused by the recovery process. The landing gear was retracted, because the impact marks at the inside of the nose landing gear doors could only have been caused in the retracted position. It is very probable that the main landing gears moved to the retracted position due to the missing hydraulic pressure and the lift force of the tires under water.

The positions of the Battery Master Switch and the Alternator Switch cannot be related to the accident, because the electrical system functioned properly at the time of the accident. This was verified by the transponder, whose signals were received down to an altitude of 2,400 ft. The positions of the switches may have been changed by the crew during the accident or by the recovery crew.

Due to the fact that no exact information on the actual fuel quantity was available, mass and centre of gravity were calculated for full tanks as well as for the refilled quantity of 210 litres. Mass and centre of gravity were in the approved range in both cases.

There was no indication of a technical failure as a possible cause for the accident.

## 2.2 Engine Power and Engine Control

The absence of serious damage to the propellers shows that the engines delivered little or no power at all at the moment of impact with the water surface. This also confirms that the forward speed was low, because the propellers were not bent back-ward. The discovered position of the engine operating levers did not allow any conclusion as to their position during the impact, because the engines had been moved several times with respect to the fuselage and had finally been separated from the wings. This could have led to multiple movements of the Bowden cables, changing the position of the engine operating levers. The undamaged protection caps of the magneto switches show that the right magnetos of both engines were switched off. It is possible that they were not switched back on again during the pre-start check. It is also possible that during an in-flight engine shut-down the right magneto switches of both engines were inadvertently switched off, instead of both magneto switches of the right engine. There are no further indications for both possibilities, so that they cannot be considered for the analysis of the accident. It is very probable that the position of the magneto switches is not related to the cause of the accident

In two accidents investigated by the NTSB it was observed that the aircraft spun and the engines did not run. In one of the cases, the propellers were also in the “start-locks”. The aircraft manufacturer assumed the possibility of an impaired fuel supply caused by the side-slipping condition during spinning. Since the investigation did not reveal any damage of the engine, it is very probable that they failed due to side-slipping conditions. A simultaneous double engine failure is improbable, because in this case the crew would have tried ditching. The absence of radio transmissions and the above-mentioned impact traces rule this out.

The SB No. 1220 issued by Piper in April, describes problems with the engine control. Inquiries at the aircraft manufacturer confirmed that the Bowden cables were completely jammed during the occurrences which resulted in the publication of the SB. This was not found in the crashed aircraft; thus, the damages that led to the issuance of the SB can be ruled out for this aircraft.

It is very probable that the discovered damage on the Bowden cable of the right engine control was caused by the accident. According to the statement of the operator, cable ties are used to fix the rubber protection caps to the ends of the Bowden cables. Thus, they did not have any influence on the accident. There were no indications that an engine failure or any other technical malfunction had caused the accident.

## 2.3 Physiological Performance of the Crew

The FI held a valid class 1 medical certificate. At the day of the accident he had performed only one previous flight. Based on this fact no indications were determined that his performance was impaired. The student pilot also held a valid medical certificate. The performance of both pilots was not impaired due to drugs or alcohol.

## 2.4 The Flight Path and its Causes

It was possible to determine the development of the flight altitude on the basis of the radar data. Due to their system-immanent inaccuracies the speed indications (Ground Speed) on the radar images and the not unambiguously determinable wind conditions were not used to calculate the true airspeed. The data shows, however, that the aircraft moved relatively slowly in the last 30 seconds prior to the loss of altitude. The altitude indications were used for the analysis. A severe loss of altitude began at 1228:50 hrs (1028:50 UTC). The mean rate of descent determined from the last three data points was approx. 5,200 ft/min. This rate of descent was not caused by a nose dive, because the damage to the aircraft does not allow the conclusion of a high horizontal airspeed. It is highly probable that the loss of altitude was caused by the fact that the aircraft was spinning. When the aircraft hit the water surface, the aircraft pitch was low.

Due to missing recording devices as e.g. FDR or CVR, it was impossible to determine the exact sequence of flight crew actions which led to the initiation of the spin. Requirement for a spin are a stalling condition and asymmetrical forces around the vertical axis. In flight training, these conditions are approached during the following training elements:

- Slow flight and stall
- Single-engine operation
- $V_{MCA}$  lesson

Neither of the switch lever positions in the cockpit described in Chapter 1.12 indicate unambiguously that one of the flight manoeuvres mentioned above were conducted. These three elements were not part of the FTO's syllabus for this lesson. According to the opinion of the FTO they were part of the element "Airwork" and, therefore, they could be trained during this lesson. It can be gathered from the statements of the interviewed student pilots that these elements were already practised during the first lessons. Therefore, it is probable that one or more of these elements were practised during this particular flight. It is highly probable that the  $V_{MCA}$  lesson was flown during this flight, because the aircraft is stalling or almost stalling

with a simultaneous asymmetrical force around the vertical axis. The recorded radar images showing the low speed of the aircraft also indicate that the  $V_{MCA}$  lesson was conducted.

## 2.5 Conduct of the $V_{MCA}$ Lesson

In the regulations, there were two different procedures in regard to the speed for the conduct of  $V_{MCA}$  lessons. The JAR-FCL stipulated that an approach up to the  $V_{MCA}$  should occur, whereas the 1. Executive Order of the Regulation on Personnel Licensing (LuftPersV), Appendix 1J stated that it should not be a demonstration of  $V_{MCA}$ . This is a significant difference especially in regard to the speed at which the lesson is to be aborted. The information reached from 56 KIAS stated in the POH, Chapter 4.47 (as a possible criteria to abort) to the  $V_{YSE}$  advised in writing by the LBA on 23 September 2008.

The speed given in the POH, Chapter 4.47 corresponds with the  $V_{MCA}$  stated in Chapter 2, Limitations. Chapter 4.47 specifically states that the procedures and specifications contained therein are in accordance with the  $V_{MCA}$  demonstration. The BFU does not understand why the procedures described in the POH, Chapter 4.47 were considered to be sufficient for the training by the LBA and the FTO despite the fact that several FIs rated the direct approach to the  $V_{MCA}$  as critical and did not conduct it. The acceptance of this procedure is also contradictory to the stipulations of the 1. Executive Order of the Regulation on Personnel Licensing (LuftPersV), Appendix 1J and the basic view of the LBA that no demonstration should occur.

This lesson was trained differently within the FTO but also in other FTOs due to missing further information as to the conduct of the  $V_{MCA}$  lesson in the JAR-FCL as well as further specifications by the LBA. This becomes especially clear with the low speed to which the aircraft was decreased during the lesson.

The differences in the conduct of the lesson have special significance for the analysis of the accident. This becomes especially evident with the different statements as to when the lessons were aborted and how the aircraft then responded. Some witnesses stated that the aircraft adopted a significant nose down attitude in some cases. It would have been appropriate to give maximum allowable direction changes and bank angles at the end of the lesson to ensure a consistent standard.

The engine settings were also selected differently. The data ranges from idle to zero thrust in case of the engine with the simulated engine failure. The remaining engine was either selected to maximum or reduced power. These power settings of the simulated and the remaining engine did not increase the safety margin like the FTO claimed. Already in lower altitudes, a decreased yaw movement results in a  $V_{MCA}$  lower than the stall speed. These selections did not correspond with the provisions in the POH, Chapter 4.47.

It would have been necessary to define which observations the student pilot is to make and what educational objective is to be reached. The BFU is of the opinion that there is a difference between demonstrating the limits of the controllability with the rudder and demonstrating the stall speed. The JAR-FCL does not make these stipulations. The 1. Executive Order of the Regulation on Personnel Licensing (LuftPersV), Appendix 1J does give a somewhat clearer information regarding this lesson but lacks a detailed description concerning the above-mentioned aim.

Especially with this lesson where the operational limit is almost reached, a higher degree of safety would have been given, if there had been detailed specifications regarding the conduct of the  $V_{MCA}$  lesson. The generally accepted training guideline that the educational objective and the risk should be properly balanced should have been applied by the formation of the  $V_{MCA}$  lesson.

## 2.6 Planning and Conduct of the Flight Training

The elements to be flown during the ATP Integrated Course Flight Training were stipulated in the JAR-FCL. The  $V_{MCA}$  lesson was, among other things, also scheduled there. In the OM of the FTO there was no specification as to when exactly this element was to be trained in the lesson sequence, because in the opinion of the FTO it was part of the element "Airwork". There were, however, no written specifications which lessons the element "Airwork" encompassed. The FTO stated that all lessons described in the POH, Chapter 4 are part of the element "Airwork". This, however, was not practised consequently because certain lessons of Chapter 4 (e.g. "One Engine Inoperative Flight") were mentioned in other lessons and, therefore, not assigned to the element "Airwork".

The different statements of FIs of the FTO whether or not the  $V_{MCA}$  lesson was flown in the first lesson does not indicate that this lesson was conducted in a planned way within the FTO. The accident showed that already during the first training lesson on the PA-44 the  $V_{MCA}$  lesson was flown. These lessons were also flown whenever there was time left. The FTO stated that the student pilots had trained those lessons in previous lessons in the FNPT and, therefore, were able to fly this lesson during their first flight in the PA-44. This lesson could have been flown in lesson 4.45D (ME-Engine Out; among others „Flight with asymmetric thrust“) and in 4.48C (ME-Engine Out/XC) since based on their content they could be assigned to single-engine flight as it is described in the 1. Executive Order to the Regulation on Personnel Licensing (LuftPersV), Appendix 1J.

The BFU is of the opinion that the time for the conduct of the  $V_{MCA}$  lesson should be precisely defined in the Syllabus. The lesson should only be flown when it was previously planned and not because there was time left.

The insufficient stipulations in the FTO allowed that the  $V_{MCA}$  lesson was trained differently. This was confirmed by the statement of the FTO which accepted and called the different engine settings and procedures "Airmanship". These deviations were not improvements of the training but increased the possibility that the airplane would enter stall conditions (Refer to 2.5). The tilting and the subsequent resulting attitude with extreme bank and negative aircraft pitch after a  $V_{MCA}$  lesson, observed by the witness during the preceding flight, allows the conclusion that the aircraft was stalling in this flight also. Whereas the OM-B and OM-D contained further stipulations, for example, for stall lessons and single-engine flights, there were no such stipulations for the  $V_{MCA}$  lessons. The result was that some FIs strictly adhered to the POH stipulations whereas others consciously deviated due to safety reasons. A standardisation of this lesson to the necessary extent did not occur.

At the time of the accident the OM-D of the FTO did not have an LBA approval. The FTO interpreted the imprecise formulation "consent" in a way that documents were sent to the LBA and thus the approval assumed. This made a simple and flexible working method of the FTO possible. However, it did not meet the requirements of JAR-FCL 1.055, Appendix 1a. The people responsible at the time should have known the difference between reporting obligation and approval obligation.

## 2.7 Activity of the Flight Instructor

Due to his total flying experience of 2,303 hours, the flight instructor can be regarded as experienced. The FI held a valid Croatian license which included the activity as FI for MEP. Since this license did not correspond to the JAR-FCL guidelines, the FTO filed an application with the LBA in 2005 for an authorisation to work for a JAR-FCL approved FTO. This authorisation had already expired before the accident on 24 June 2008. At the time of authorisation by the LBA in 2005, the FI did not have the MEP rating yet; thus, it was not possible to authorise his activity as trainer in multi-engine aircraft.

Lessons with switched-off engines were documented in connection with his training for the acquisition of the class rating for multi-engine aircraft. In this part of the training there was no documentation whether or not the  $V_{MCA}$  lesson was flown. After he obtained the rating for multi-engine aircraft, 30 hours were flown so that training on multi-engine aircraft as a flight instructor could be conducted. There were no indications whether or not  $V_{MCA}$  lessons or any

other air exercise at the outer limit of the envelope were conducted during these flights. The same applies for the training to acquire the instructor rating.

On the basis of the present information it cannot be determined whether or how often the FI has flown supervised  $V_{MCA}$  lessons during his training to acquire the class rating for multi-engine aircraft, in his CRI (MEP) training or at any other point in time. It is doubtful whether the skills acquired in the two training sections (CR (MEP), CRI (MEP)) are sufficient to teach this element safely without further instruction and standardization. With a total flying experience of approximately 327 hours as FI on multi-engine aircraft, the flight instructor was by no means inexperienced. His experience was limited to the procedures taught within the FTO and to the aircraft type PA-44.

According to witness statements he allowed a partially distinctive tilting of the airplane when it reached  $V_{MCA}$ . This is a contradiction to the statements made by all witnesses who said that he was a particularly careful and conscientious flight instructor. Thus, it can be assumed that he was not aware of approaching the outer limits of the flight envelope and of the hazards associated with it. Otherwise the FI would have taken corrective measures when exposed to immediate danger. During the flight on 1 August 2010 he could not prevent the airplane from spinning. Therefore, the conclusion has to be drawn that he

- did not recognise the hazard during the conduct of the  $V_{MCA}$  lesson or any other lesson at the outer limit of the flight envelope, and
- could not prevent the spinning, and
- could not recover the situation.

It is to be assumed that the FI wanted for the student pilot to experience the  $V_{MCA}$  as realistically as possible and, therefore, unconsciously reduced the necessary safety margin.

The possibility cannot be excluded completely that the FI could not recover a possibly uncoordinated reflex of the student pilot after the beginning of the tilting or spinning. However, the FI could not have expected such a reaction of the student pilot since an abrupt change in flight attitude would have occurred unintentionally.

## 2.8 Supervision by the LBA

In the scope of the supervision of the FTO by the LBA, it was not established that:

- the FTO used a version of the OM which was not approved by the LBA
- there were no precise specifications as to when and how the  $V_{MCA}$  lesson was to be flown.

In the scope of the approval of manuals and the periodic audits of the FTO the missing specifications on the flight lessons should have been discovered. During the supervision of the FTO, the LBA could have discovered the deviations mentioned above, by comparing the procedures and lesson sequences described in the approved OM with the actually practised procedures and lesson sequences.

Based on the very different statements of other FTOs regarding the conduct of  $V_{MCA}$  lessons, the BFU comes to the conclusion that this lesson was generally trained differently. Given the limited stipulations in the JAR-FCL (German) regarding the conduct of the  $V_{MCA}$  lesson and the determined differences in the conduct of the lesson show, that further stipulations by the LBA would have been necessary. The opinion that the  $V_{MCA}$  lesson was not a  $V_{MCA}$  demonstration was not conveyed clearly enough to the FTOs in the past. Unclear stipulations like they were made in the recommendation dated 23 September 2008 to conduct the lesson up to  $V_{YSE}$  did not create the necessary clarity for the FTOs after the accident.

The LBA is of the opinion that the term "Airwork" encompassed all "General Flight Lessons" in accordance with JAR-FCL (German). This is partially contradictory with the opinion of the FTO which viewed the procedures of the POH, Chapter 4 as definition for the term "Airwork". Both definitions are not congruent.

Due to the different statements of the FTO and the LBA in regard to the transmission of the OMs, it could not be determined unambiguously when which version was sent to the LBA for approval. The BFU holds the view that the OM was subject to on-going changes and, therefore, new versions had to be approved. It is, however, not understandable why on the one hand changes were requested by the LBA (among others at the annual audit in 2008) but on the other hand the approval of the changed OMs was not given or the missing formal prerequisites (application of the FTO for approval) was not consequently required by the LBA.

## 2.9 Earlier Accidents

On enquiry the National Transportation Safety Board, NTSB, informed the BFU about three other accidents. In all cases the NTSB concluded that the aircraft entered a stalling condition and started spinning due to insufficient speed control. In two cases it was observed that the aircraft spun. Both engines failed in these cases. Pictures of one of these accidents were presented to the BFU. They show a destruction of the aircraft cell similar to the accident aircraft.

For this aircraft there are no specifications, gained by flight tests, about a recovery of the spinning. Thus, it cannot be stated whether and how the aircraft type PA-44 can be recovered safely and under all conditions from a spin. Therefore, it is all the more important to

avoid spinning during training flights. That implies that for flight elements flown at the outer limits of the flight envelope (e.g. slow flight and/or asymmetrical thrust) training procedures must be stipulated precisely and adhered to.

## 3. Conclusions

### 3.1 Findings

The aircraft had a valid Certificate of Airworthiness. There was no evidence of any defect or malfunction in the aircraft that could have contributed to the accident.

The weather was sufficient for the flight and did not have any influence on the accident.

The aircraft came began to spin in approx. 5,000 ft; it could not be recovered.

The FI was an experienced pilot. He held a valid Croatian license. His flight experience as FI on twin-engine aircraft was limited to the procedures taught within the FTO and to the aircraft type PA 44. There was no proof about how often he had practised the  $V_{MCA}$  lessons.

The FTO was approved for training according to JAR-JCL.

Within the FTO an OM was used which did not carry an LBA approval note.

There was no specification in the syllabus as to when to fly the  $V_{MCA}$  lesson. The inexact interpretation of the term "Airwork" favoured this.

There were no definite stipulations how the lesson described in the JAR-FCL, Appendix 3, 1.240 "Approach up to the  $V_{MCA}$ " was to be conducted during the training.

Within the FTO, there were procedures for the conduct of the  $V_{MCA}$  lessons which corresponded with the POH.

Within the FTO, there were procedures for the conduct of the  $V_{MCA}$  lessons which were not suited for the training.

The LBA required for the training in accordance with JAR-FCL a  $V_{MCA}$  lesson but not a  $V_{MCA}$  demonstration.

Within the FTO these  $V_{MCA}$  lessons were conducted differently.

The supervision by the LBA allowed deviations within the FTO which led to inconsistent flight training.

During flight instruction, the aircraft was operated in a way that it was at the limits e of spinning

There was information about how to recover a spin but these were not proven by flight tests.

## 3.2 Causes

### Immediate Causes:

The airplane started to spin because the applied procedure for the conduct of the  $V_{MCA}$  lesson contained a low safety margin and the flight instructor did not realise it during the conduct of the training. The necessary correction measures were not initiated in time.

### Systemic Factors:

The procedures for the conduct of  $V_{MCA}$  lessons were described insufficiently.

## 4. Safety Recommendation

The BFU has issued the following safety recommendations:

Recommendation no.: 15/2012

In the scope of supervision, the LBA should ensure that all FTOs have established standardised and precise specifications as to when and with which methods " $V_{MCA}$  lessons" should be trained.

Recommendation no.: 16/2012

In the scope of supervision, the LBA should ensure that the  $V_{MCA}$  lessons become permanent part of the standardisation of Flight Instructors (FI) in order to ensure a standardised safety level during conduct of the lesson.

Recommendation no.: 17/2012

The Flight Training Organisation (FTO) should ensure that the  $V_{MCA}$  lessons become part of the permanent standardisation of the Flight Instructors (FIs) to guarantee a standardised safety level in the conduct of the lesson.

Recommendation no.: 19/2012

The Flight Training Organisation (FTO) should ensure that the Operating Manual (OM) of the FTO stipulates unambiguously which elements are to be trained under the general term of "Airwork".

Investigator in charge: Thomas Karge  
Field Investigation: Thomas Karge  
Operational Aspects: Jens Eisenreich  
Braunschweig: 25 July 2012

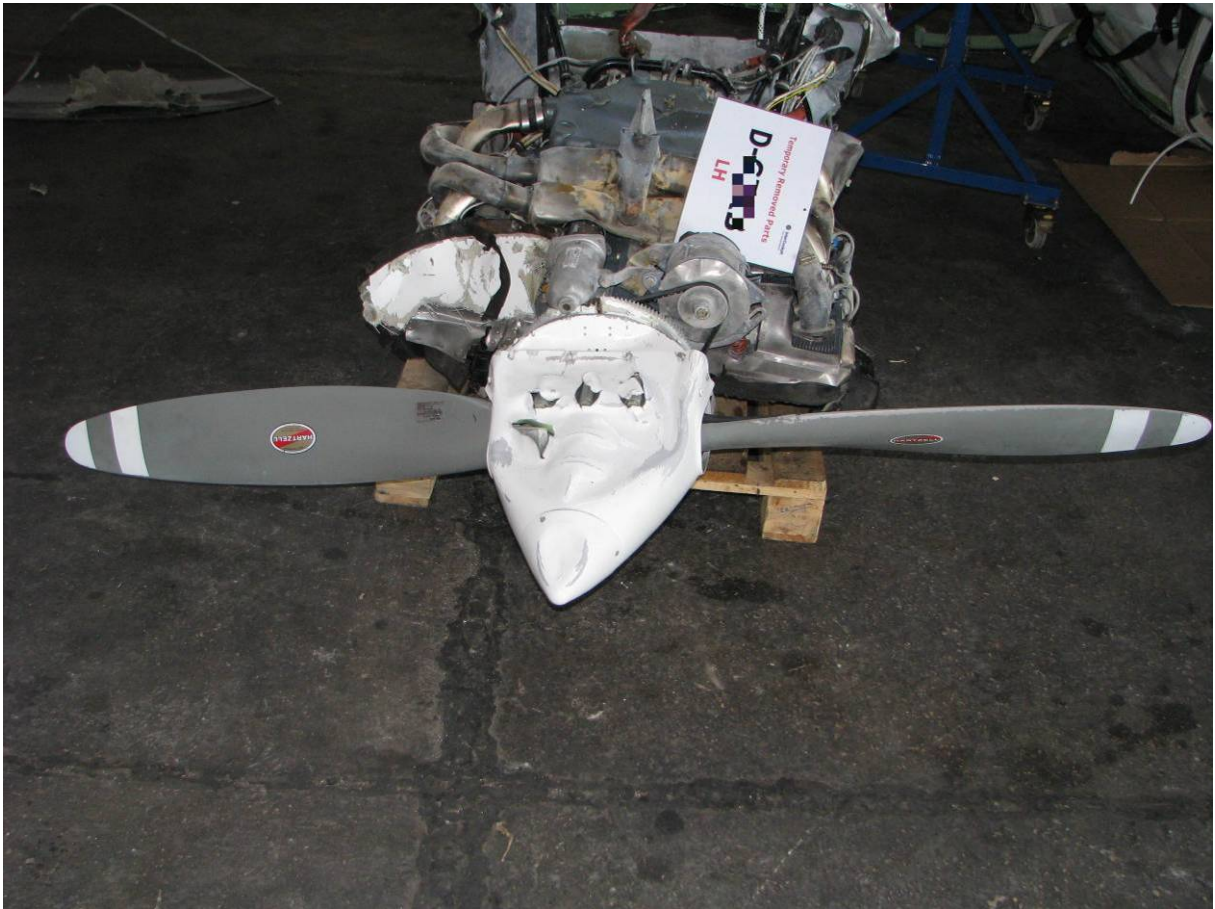
## 5. Appendices

### 5.1 Pictures of the aircraft after recovery



Aircraft lower surface in the hangar after recover

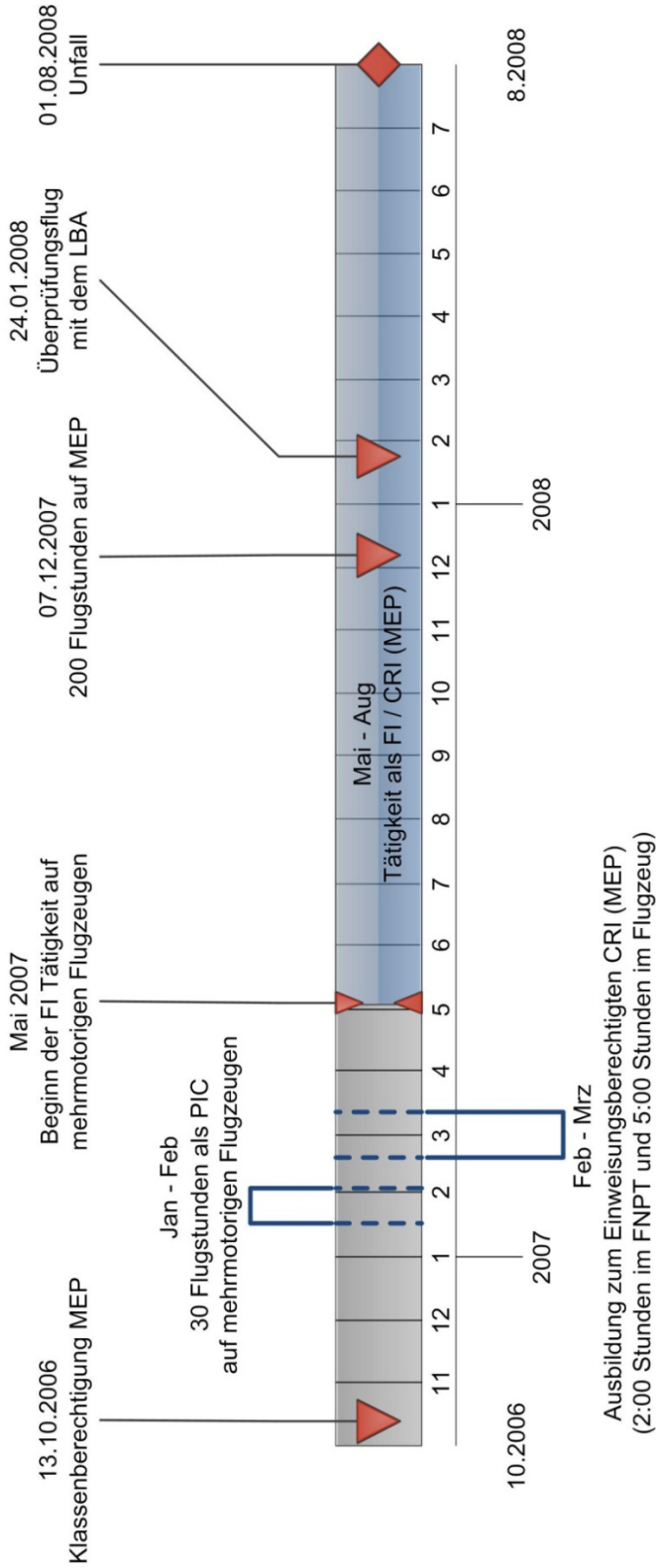
Photo: BFU



Left propeller

Photo: BFU

## 5.2 Aviation development of the flight instructor



## 5.3 Excerpts from the NTSB reports

### **MIA89FA146**

THE FLT WAS FOR CREW COORDINATION TRAINING & WAS ADMINISTERED BY FLT SAFETY INTL FOR AER LINGUS, A FOREIGN AIRLINE, AN INSTRUCTOR (CFI), & 2 FOREIGN PLTS WERE ABOARD (STUDENT'S HAD PREVIOUSLY GOTTEN U.S. CERTS WITH SINGLE/MULTI-ENG RATINGS). BEFORE THE ACFT, THE ACFT WAS HDG NE. RADAR DATA SHOWED THAT IT TURNED EAST WHILE MAINTAINING A CONSTANT ALT OF 3500'. AFTER TURNING EAST, IT'S GND SPD SLOWED TO 83 KTS. THE ACFT THEN BEGAN A RGT TURN AT A RATE OF 125 DEG/MIN. AFTER TURNING SOUTH, THE ACFT'S GND SPD SLOWED TO 37 KTS. THE ACFT THEN ENTERED A DSCNT, WHICH INCREASED TO 8000'/MIN. WITNESSES SAW THE ACFT SPINNING LEFT, IN A NOSE DWN ATTITUDE, BEFORE IT IMPACTED IN THE OCEAN. NO PREIMPACT PART FAILURE/MALFUNCTION WAS FND. THERE WAS EVIDENCE THAT DRG IMPACT, NEITHER ENG WAS OPERG, FLAPS WERE EXTND'D & THENOSE GEAR WAS IN TRANSIT. THE ACFT MANUFACTURER RPRTD THAT A SPIN MAY CAUSE AN INTERRUPTION OF FUEL TO THE ENGS BY EXCEEDING THE CARB LIMITATIONS. INTENTIONAL SPINS WERE PROHIBITED. VMC & STALL SPDS WERE 56 & 54 KTS, RESPECTIVELY.

The National Transportation Safety Board determines the probable cause(s) of this accident as follows:  
 INADEQUATE SUPERVISION BY THE INSTRUCTOR PILOT (CFI), AND FAILURE OF THE CREW TO MAINTAIN SUFFICIENT AIRSPEED, WHICH RESULTED IN AN INADVERTENT STALL/SPIN AND SUBSEQUENT LOSS OF ENGINE POWER FROM POSSIBLE INTERRUPTION OF FUEL.

### **ATL03FA104**

The purpose of the instructional flight was to add-on multi-engine, instrument onto the dual students certified flight instructor rating. The flight departed at 1315, the instrument flight plan was cancelled and the flight continued under visual flight rules. Examination of the radar data shows the airplane conducting maneuvers at altitudes between 4,200 and 4,700 feet above ground level. Approximately 1340, an eyewitness heard the airplane flying overhead and then heard the engine sound stop. They looked up and saw the airplane spinning towards the ground. The witness did not recall hearing the engines running during the final descent. The pilot prior to the accident reported no flight control or mechanical anomalies. No anomalies with the airplane were noted during the post-crash examination.

The National Transportation Safety Board determines the probable cause(s) of this accident as follows.

The certified flight instructor's (CFI) failure to maintain flying speed that resulted in a stall/spin and the uncontrolled collision with the ground.

### **LAX04FA207**

The airplane collided with terrain in a spin following an in-flight loss of control. The multiengine instructional flight departed to the west practice area. Radar data indicated that the crew climbed to 6,000 feet, but didn't maintain that altitude. The altitude varied (climbing and descending) about 500 feet for the next several minutes. About 20 miles west-northwest of the airport, they began a figure-eight type of track, and then went into a descending 360-degree turn before the last radar contact. The last radar return was just abeam the main wreckage area at a mode C transponder reported altitude of 3,900 feet. A witness saw the airplane spinning as it headed toward the ground in a nose low attitude. The preceding target was 18 seconds earlier at a mode C altitude of 5,200 feet. Investigators established control continuity, and noted no anomalies that would have precluded normal operation of the airframe or either engine.

The National Transportation Safety Board determines the probable cause(s) of this accident as follows.

The flight instructor's failure to maintain sufficient airspeed to avoid a stall/spin while maneuvering the airplane with a dual student.

## 5.4 Excerpt from the Pilot's Operating Handbook 4.47 (Pages 4-40 and 4-41), Edition 12 July 1995

SECTION 4  
NORMAL PROCEDURES PA-44-180, SEMINOLE

### 4.47 VMCA - AIR MINIMUM CONTROL SPEED

VMCA is the minimum flight speed at which a twin-engine airplane is directionally and/or laterally controllable as determined in accordance with Federal Aviation Regulations. Airplane certification conditions include one engine becoming inoperative and windmilling; not more than a 5° bank toward the operative engine; landing gear up; flaps in takeoff position; and most rearward center of gravity.

VMCA for the PA-44-180 has been determined to be 56 KIAS and is a stalled condition.

The VMCA demonstration, which may be required for the FAA flight test for the multi-engine rating, approaches an uncontrolled flight condition with power reduced on one engine. The demonstration and all intentional one engine operations should not be performed at an altitude of less than 4000 feet above the ground. The recommended procedure for VMCA demonstration is to reduce the power to idle on the simulated inoperative engine at or above the intentional one engine inoperative speed, VSSE, and slow down approximately one knot per second until the FAA Required Demonstration Speed, stall buffet or warning, rudder or ailerons at full travel, or VMCA (red line on the Airspeed Indicator) is reached.

### VMCA DEMONSTRATION

- (a) Landing Gear .....UP
- (b) Flaps.....UP
- (c) Airspeed .....at or above 82 KIAS (VSSE)
- (d) Mixture.....FULL RICH
- (e) Propeller Controls .....HIGH RPM
- (f) Throttle (Simulated Inoperative Engine).....IDLE
- (g) Throttle (Other Engine).....FULL FORWARD
- (h) Airspeed .....Reduce approximately 1 knot per second until either STALL WARNING, FULL CONTROL TRAVEL or VMCA is obtained

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SECTION 4  
NORMAL PROCEDURES PA-44-180, SEMINOLE

### 4.47 VMCA - AIR MINIMUM CONTROL SPEED (Continued)

#### CAUTION

Use rudder to maintain directional control (heading) and ailerons to maintain 5° bank towards the operative engine (lateral attitude). At the first sign of either VMCA (airspeed indicator redline) or stall warning (which may be evidenced by: inability to maintain heading or bank attitude, aerodynamic stall buffet, or stall warning horn), immediately initiate recovery; reduce power to idle on the operative engine, and immediately lower the nose to regain VMCA and continue accelerating to VSSE.

#### CAUTION

One engine inoperative stalls are not recommended.

Under no circumstances should an attempt be made to fly at a speed below VMCA with only one engine operating.

### 4.49 PRACTICE ONE ENGINE INOPERATIVE FLIGHT

Simulated one engine inoperative flight can be practiced without actually shutting down one engine by setting the propeller rpm of an engine to approximate zero thrust. This is accomplished at typical training altitudes with the throttle adjusted to produce the appropriate engine speed shown below and the mixture full rich, or leaned as required for smooth low power operation.

Propeller rpm for Zero Thrust	
KIAS	RPM
82 VSSE	1850
88 VYSE	2180
100	2510
110	2690

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REPORT: VB-1616  
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## 5.5 Lesson Card 4.39D

Lesson 4.39D	▪ ME-Intro	2:30 hrs
<ul style="list-style-type: none"> <li>▪ Lesson summary</li> </ul>		
<ul style="list-style-type: none"> <li>▪ Introduction to normal ME operation on PA44 aircraft</li> </ul>		
<ul style="list-style-type: none"> <li>▪ Lesson objectives</li> </ul>		
<ul style="list-style-type: none"> <li>▪ Introduction to the airplane</li> <li>▪ Outside checks</li> <li>▪ Normal operation</li> </ul>		
<ul style="list-style-type: none"> <li>▪ Items</li> </ul>		<ul style="list-style-type: none"> <li>▪ Reference</li> </ul>
<ul style="list-style-type: none"> <li>▪ Air plane documentation</li> <li>▪ Mass and balance calculations</li> <li>▪ External checks, Internal checks</li> <li>▪ Harness, seat/rudder pedal adjustment</li> </ul>		<ul style="list-style-type: none"> <li>▪ OM-D</li> <li>▪ OM-B</li> <li>▪ OM</li> <li>▪ AIP</li> </ul>
<ul style="list-style-type: none"> <li>▪ Briefing</li> </ul>		
<ul style="list-style-type: none"> <li>▪ Use of checklists</li> <li>▪ Checks prior to starting, Checks after starting</li> <li>▪ Mass and balance and performance considerations</li> <li>▪ Starting and shutdowns of engines, Engine Checks</li> <li>▪ Radio nav/com checks, Autopilot operation, Altimeter checks and altitude alerter setting procedures, System checks, programming of flight plans</li> <li>▪ airplane serviceability documents</li> <li>▪ Escape drills, Location and use of emergency equipment and exits</li> </ul>		
<ul style="list-style-type: none"> <li>▪ Flight data</li> </ul>		
<ul style="list-style-type: none"> <li>▪ Crew: 2 POB's</li> <li>▪ Fuel: standard</li> <li>▪ Route: specified airport</li> </ul>		
<ul style="list-style-type: none"> <li>▪ Air Exercises</li> </ul>		
<ul style="list-style-type: none"> <li>▪ Directional control and use of power</li> <li>▪ Landing gear operation, Flap operation</li> <li>▪ Engine synchronization</li> <li>▪ Airwork</li> <li>▪ Use of A/P and altitude alerter</li> <li>▪ Precision and Non Precision Approaches</li> <li>▪ Action in the event of fire in the air and on the ground</li> </ul>		