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Report
ULM A-016/2017

Accident involving a Tecnam P-92-Echo aircraft, registration EC-LDZ, operated by ULM ESCUELA DE VUELO, in Villaminaya (Toledo, Spain) on 7 October 2017

GOBIERNO DE ESPAÑA
MINISTERIO DE FOMENTO

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SUBSECRETARÍA
COMISIÓN DE INVESTIGACIÓN DE ACCIDENTES E INCIDENTES DE AVIACIÓN CIVIL

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This report is a technical document that reflects the point of view of the Civil Aviation Accident and Incident Investigation Commission (CIAIAC) regarding the circumstances of the accident object of the investigation, and its probable causes and consequences.

In accordance with the provisions in Article 5.4.1 of Annex 13 of the International Civil Aviation Convention; and with articles 5.5 of Regulation (UE) nº 996/2010, of the European Parliament and the Council, of 20 October 2010; Article 15 of Law 21/2003 on Air Safety and articles 1., 4. and 21.2 of Regulation 389/1998, this investigation is exclusively of a technical nature, and its objective is the prevention of future civil aviation accidents and incidents by issuing, if necessary, safety recommendations to prevent from their reoccurrence. The investigation is not pointed to establish blame or liability whatsoever, and it's not prejudging the possible decision taken by the judicial authorities. Therefore, and according to above norms and regulations, the investigation was carried out using procedures not necessarily subject to the guarantees and rights usually used for the evidences in a judicial process.

Consequently, any use of this report for purposes other than that of preventing future accidents may lead to erroneous conclusions or interpretations.

This report was originally issued in Spanish. This English translation is provided for information purposes only.

CONTENTS

Abbreviations

AEMET	Spain's National Weather Agency
AESA	Spain's National Aviation Safety Agency
AGL	Above Ground Level
AVGAS	Aviation fuel
EASA	European Aviation Safety Agency
EU	European Union
FAA	United States Federal Aviation Administration
Ft	Feet
H, hr	Hours
HP	Horsepower
KG	Kilograms
Km	Kilometers
Kph	Kilometers per hour
m	Meters
MOGAS	Automotive fuel
N/A	Not affected
RPM	Revolutions per minute
SIB	Standard Information Bulletin
STC	Supplemental type certificate
TMA	Terminal control area
ULM	Powered ultralight aircraft
VFR	Visual flight rules

Synopsis

Owner:	Private
Operator:	ULM ESCUELA DE VUELO
Aircraft:	Tecnam P-92 Echo; registration EC-LDZ
Date and time of accident:	Saturday, 7 October 2017 at 14:00[1]
Site of accident:	Villaminaya (Toledo, Spain)
Persons on board:	1 crew, seriously injured; 1 crew, slightly injured
Type of flight:	General aviation-Flight training-Dual control
Flight rules:	VFR
Phase of flight:	Landing
Date of approval:	28 November 2018

Summary of event:

An instructor and a student were on board aircraft EC-LDZ on an instruction flight.

They were going to the aerodrome of Villaverde, in Sonseca (Toledo), when the engine suddenly lost power and stopped. The instructor re-started it, but it did not supply much power, only 2000 RPM. He then moved the throttle control forward and back, but the engine did not respond, holding at 2000 RPM. So he decided to turn everything off (except the master, in order to operate the flaps) and make an emergency landing in a nearby plowed field.

During the landing, the aircraft traveled forward several meters along the ground before flipping forward and ending up in an inverted position.

The instructor received minor injuries and the student serious injuries. The aircraft sustained heavy damage.

The investigation has determined that the accident was caused by the execution of an emergency, off-field landing in an unprepared field due to an engine malfunction caused by the presence of water in the fuel system.

No safety recommendations are issued.

[1] Unless otherwise specified, all times in this report are local.

1. ACTUAL INFORMATION

1.1. History of the flight

Aircraft EC-LDZ had taken off from the aerodrome of Ocaña (Toledo), where it was based. On board were the instructor and a student, who were doing a training flight.

After taking off, they flew to the aerodrome of Lillo, where they did a touch-and-go. They subsequently flew to the aerodrome of Villaverde in Sonceca (Toledo).

When they were some 6 km away from their destination, the engine experienced a sudden loss of power. The instructor restarted it, but it did not supply much power, only 2000 RPM. He then moved the throttle control forward and back, but the engine did not respond, holding at 2000 RPM. So he decided to secure everything (except for the master so he could operate the flaps) and make an emergency landing in a nearby plowed field.

During the landing, the aircraft traveled forward several meters along the ground before flipping forward and ending up in an inverted position.

The instructor received minor injuries and the student serious injuries. The aircraft sustained heavy damage.

Figure 1. Final position of the aircraft

1.2. Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft	Other
Fatal				
Serious		1	1	
Minor	1		1	N/A
None				N/A
TOTAL	1	1	2	

1.3. Damage to aircraft

The aircraft sustained heavy damage to its propeller, landing gear, fuselage and wings.

1.4. Other damage

Fuel spilled onto the plowed field where the aircraft landed.

1.5. Personnel information

1.5.1. Information on the crew

Instructor

Age:	54
Nationality:	Spanish
Medical certificate:	Class 2; valid until 10/06/2018
ULM pilot license:	Issued by AESA, initial issue date 27/01/2011
Ratings:	
• Multi-axis, fixed-wing ultralight instructor	Valid until 31/01/2018
• Multi-axis fixed-wing	Valid until 31/01/2018

Private airplane pilot license:	Issued by AESA, initial issue data 23/11/2012
Ratings:	
• Single-engine piston	Valid until 30/11/2018
• Touring motor glider	Valid until 30/04/2019

Total flight hours:	706
Total hours on the type:	683 (465 as an instructor)
Hours in previous 28 days:	18
Hours on the type in previous 28 days:	18, all on aircraft EC-LDZ.

He also had 1150 hours as the pilot in command on gliders, of which 580 had been as an instructor.

Student

Age:	30
Nationality:	Spanish
Medical certificate:	Class 2; valid until 05/10/2021
Student pilot card	Issued by ULM ESCUELA DE VUELO on 01/12/2016

The student had a total of 18 hours in the training course, all of them on aircraft EC-LDZ.

1.6. Aircraft information

The Tecnam P-92-Echo powered ultralight is a high-wing, fixed tricycle landing gear airplane with two side-by-side seats and a maximum authorized takeoff weight of 450 kg.

Aircraft EC-LDZ was manufactured in 2009 with serial number P-92-E-040. At the time of the accident, it had 1042 hours.

Installed on the aircraft was a Rotax 912 UL engine, manufactured in 2009 with serial number 4409456. At the time of the accident, the engine had 1042 hours. It had the following characteristics:

- Piston engine with four, horizontally opposed four-stroke cylinders.
- Dual carburetor.
- Electric starter.
- Maximum takeoff power at 5800 RPM: 81 HP.

Restricted certificate of airworthiness

Issued by	National Aviation Safety Agency (AESA)
Issued date	1/12/2009
Category	School 3-Normal
Validity	Indefinite

Registration certificate

Issued by	National Aviation Safety Agency (AESA)
Issue date	27/12/2014
Validity	Indefinite

Maintenance

The last maintenance inspection had been on 16 September 2016, with 1020 flight hours on the aircraft and engine. According to the documentation provided, a 100-hr check was conducted, as per the aircraft Maintenance Manual. The spark plugs were changed to install the new Rotax model. The oil and oil filter were also changed.

1.7. Meteorological information

According to Spain's National Weather Agency (AEMET), on the day of the accident there was a high-pressure area at low levels in the north of the Spanish peninsula. In the central region, the atmosphere was stable and the skies clear.

AEMET does not have a station in Villaminaya. The nearest stations are in Toledo (some 20 km northwest) and Tembleque (some 30 km east). The data recorded at these stations at around the time of the accident were as follows:

Toledo:

Wind: From the east, ranging from 050 to 120º, with average wind speeds rising from 6.5 to 13 kph and gusting to 12-22 kph.

Temperature: Rising from 28 to 29º C.

Relative humidity: Dropping from 41 to 31%.

Tembleque:

Wind: No data

Temperature: Rising from 27 to 28º C.

Relative humidity: Dropping from 48 to 42%.

1.8. Aids to navigation

Not applicable. The airplane was flying under visual flight rules.

1.9. Communications

There were no radio reports involving the emergency. The instructor explained that he was executing the emergency procedure and since they were flying below 300 meters, he had not had time.

1.10. Aerodrome information

Not applicable. The emergency landing was not carried out at an aerodrome.

1.11. Flight recorders

There were no flight recorders installed on the aircraft, as these were not required by law for the aircraft type.

1.12. Wreckage and impact information

The aircraft landed in a plowed field located in Paraje de La Cañada de Villaminaya (Toledo). This field is 6.5 km away from the aerodrome of Villaverde.

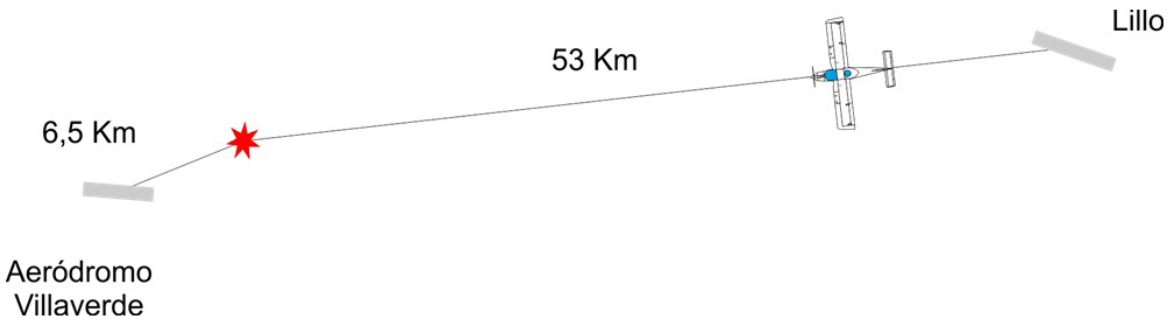

Figure 2. Location of accident site relative to nearby aerodromes

Three parallel trenches of variable length were found on the ground. The central one was longer and wider than the side trenches, as shown in Figure 3. The aircraft was found at one end of the longest and widest trench. It was upside down and leaking fuel. No parts detached from the airplane either during the flight or when it impacted the ground.

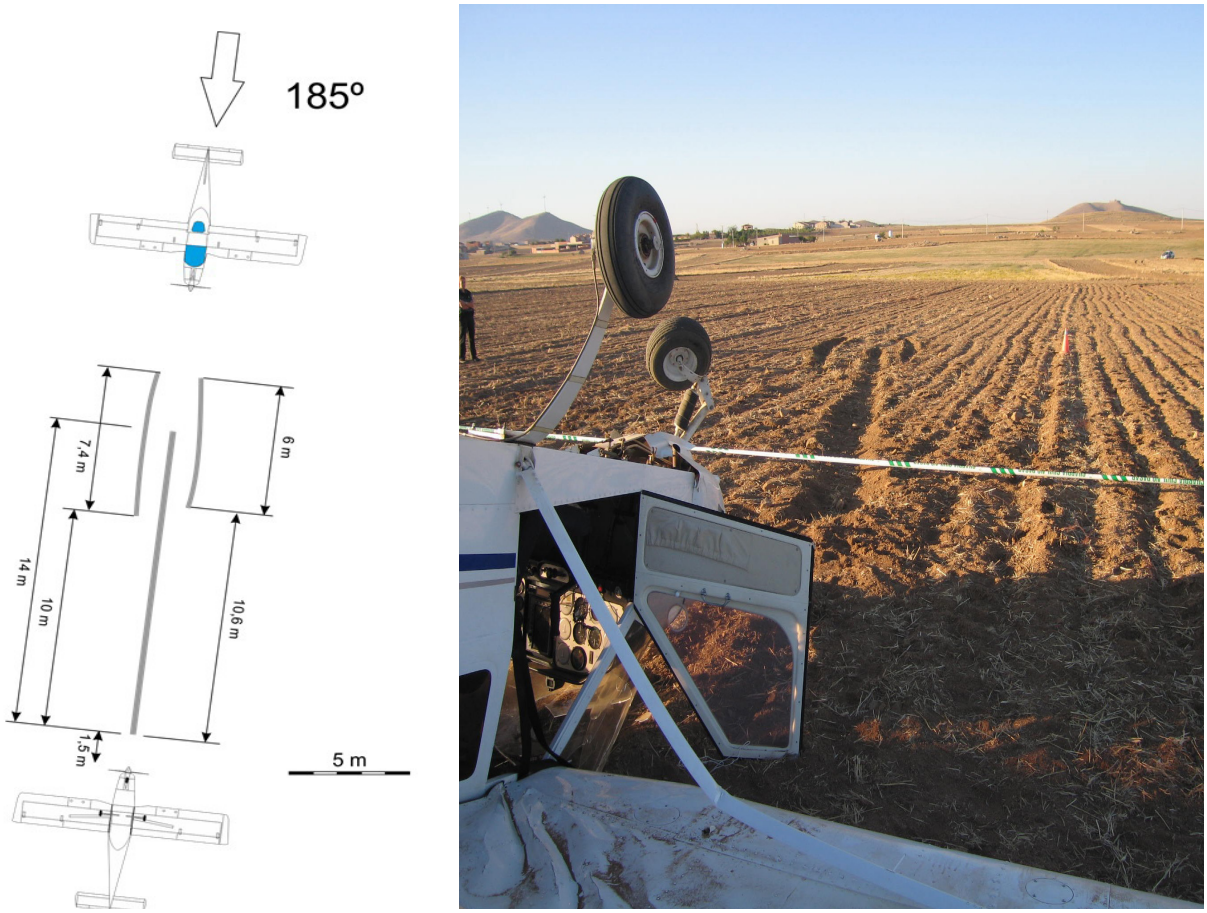

Figure 3. Marks on the ground left by the aircraft

Figure 4. Cracks in the propeller

The propeller cone was heavily damaged and the blades had cracks as a result of digging into the ground when the aircraft overturned in the forward direction (see Figure 4). The blades did not exhibit signs of having been turning at the time they impacted the ground.

All aircraft systems were found disconnected and the fuel stopcock was in the off position. The flaps were fully deployed.

1.13. Medical and pathological information

As a result of the accident, the student sustained a fracture at the base of the sternum, and the instructor a minor injury to his head and some bruising.

1.14. Fire

There was no fire.

1.15. Survival aspects

The seat harnesses were in good condition and worked correctly.1.16. Ensayos e investigaciones

1.16. Tests and researc

1.16.1. Statement from the instructor

The accident flight was the instructor's fourth flight on the aircraft that day. He was doing a training flight. Even though the fuel tanks were half full, before leaving the aerodrome of Ocaña, they loaded 8 liters of fuel into each tank. The fuel was 98-octane automotive fuel, which the instructor himself had purchased that same morning at a gas station near the aerodrome. He had filled three containers, each of which had a 22-liter capacity, but he filled them with just 16-17 l to make it easier to handle them. Before the flight started, he placed all the contents of one container in the aircraft. He had been refilling the containers at that gas station for months and had never had any problems before. He stated that the fuel dispenser

had had a very low pressure for 2-3 weeks, and that it took a long time to fill the containers. The personnel at the gas station had informed him that the pump was broken but that it would be fixed soon. He always used the same containers to transport the fuel. They were approved containers that he kept inside bags, He always made sure that both the containers and the bags they were kept in were properly closed.

During the morning's first flight, they drained the wing tanks and the gascolator. No water was found.

It had been 35-40 minutes since they departed from the Ocaña aerodrome, at about 13:20. They then reached the Lillo aerodrome, where they did a touch-and-go before continuing on to the aerodrome of Villaverde (Sonseca).

The engine problem occurred 15 to 20 minutes after taking off from the aerodrome of Lillo. They were flying in zone 16-17 of the Madrid TMA at 1000 ft AGL. There was no visible humidity in the area, so they did not turn the carb heat on. He had checked the engine parameters with the student a short time earlier and they were fine, with the engine at 4600-4800 RPM. They were flying with both tanks open.

They had the town of Sonseca in sight when the engine suddenly lost power and stopped. The instructor restarted it, but it did not supply much power, only 2000 RPM. He then moved the throttle control forward and back, but the engine did not respond, holding at 2000 RPM. So he decided to turn everything off (except the master, in order to operate the flaps) and make an emergency landing in a nearby plowed field. Once a safe landing was guaranteed, he engaged full flaps, turned off the master, released the student's side door so it would not jam and they took off the sunglasses they were wearing.

The landing was good and they travelled a few meters when an hole in the ground made the front gear wheel dig in, causing the aircraft to flip forward and stop in an inverted position.

The main gear was fine but the front gear was bent. When it turned over, the top of the aircraft's tail impacted the ground and part of the fuselage was bent.

They were unable to make any radio calls because they were flying below 300 meters AGL. After exiting the airplane he phoned the flight director at the Ocaña aerodrome.

The instructor had been flying the aircraft that morning and did not notice any problems. Before the flight they did the engine test, which was satisfactory. When

asked if they had felt vibrations before the engine stopped, he answered that there had been no vibrations nor a gradual drop in power, which occurred suddenly and drastically. There had been problems starting the engine when it was cold (typical in such conditions), but this was different.

Months after the accident, during a conversation with the instructor, he explained that they had started using a fuel filter that separated water from the fuel when filling the aircraft's tanks.

1.16.2 Statement from the student

The fuel tanks were about half-full, so they loaded approximately 10 liters into each tank from a 20-liter container.

They did the pre-flight inspection, like they did every day. The engine started normally and the engine test was satisfactory.

They flew to Lillo. The engine was warm from the previous flight and worked well. They did a touch-and-go without any problems. They then flew to the west, toward Sonseca. They climbed to 5000 ft to clear a small mountain and the outside temperature dropped to 20º C. He noticed that the engine was at 5100 RPM, the engine temperature was in the yellow arc and the oil pressure in the green. The engine sounded good. They then began to descend. As they passed the Mora Castle, they were at about 3400 ft and they tuned the radio to the frequency of the aerodrome near Sonseca.

Suddenly, over just 3 seconds, the engine lost all power. The student was not sure if the engine stopped by itself or if they had stopped it. When they restarted it, it would not go above 2000 RPM, so they turned it off and made an emergency landing. He released his door before the impact and both used it to exit.

The only problems they had had before the accident had been when starting the engine when it was cold, but that had not been the case that day.

1.16.3 Engine inspection

The engine controls were checked and verified to be working normally.

The carburetors were in good condition and maintained their integrity. When they were removed, water contamination was found in the pans of both carburetors, as shown in figures 5 and 6.

Figure 5. Carburetor of cylinders 1 and 3

Figure 6. Carburetor of cylinders 2 and 4

The engine was removed from the aircraft and tested on a test bench with new fuel. One of the B ignition pickups had been damaged by the accident, so the bench tests were conducted with only half of the spark plugs. The engine started and reached 5000 RPM, without stopping or misfiring at any point.

1.17. Organizational and management information

The aircraft was operated by "ULM ESCUELA DE VUELO S.L.U.", which had been authorized by AESA as a ULM flight school on 5 September 2016. The authorization listed the Aerodrome of Ocaña as the primary base of operations, and the Aerodrome of Lillo as the secondary base.

1.18. Additional information

1.18.1.1. EASA Safety Information Bulletin (SIB) 2009-02

This SIB warns of the danger of using fuel not intended primarily for aircraft with a piston engine, such as automotive fuel (commonly known as MOGAS). The fuel specifications for automobiles allow for wider variations in several parameters and in fuel composition (Annex 1).

1.18.1.2. FAA Special Airworthiness Information Bulletin CE-07-06

In this bulletin, the FAA (Federal Aviation Administration) explains the various reasons for not using automobile fuel containing alcohol in aircraft, and recommends that gasolines with methanol or ethanol be used unless they are specifically approved in the type certificate or STC (Annex 2).

1.18.2. Fuel authorized for use on the Tecnam P-92 Echo aircraft

The datasheet on type airworthiness certificate No. 231 contains the certification data for the P-92 Echo. It specifies that the aircraft must use unleaded automotive gasoline with a minimum octane rating of 95, or AVGAS 100LL. It also instructs checking the engine manufacturer's manual.

1.18.2.1. Instructions from Rotax

The Rotax 912 UL Operations Manual indicates the fuels that can be used in the engine. The MOGAS section includes three fuels that satisfy the European standard: EN 228 normal (90-octane gasoline), EN 228 super (95-octane gasoline) and EN 228 super plus (98-octane gasoline).

1.18.2.2. Instructions from Tecnam

Tecnam carried out tests on the fuel system in the P92 aircraft using fuel with a maximum ethanol content of 10%. According to the manufacturer, no testing has been done using fuels with an ethanol content in excess of 10%; as a result, their use is not authorized by Tecnam.

1.19. Useful or effective investigation techniques

Not applicable.

2. ANALYSIS

2.1. Emergency landing

The marks on the ground and final condition of the aircraft indicated that the propeller was not under power and that the aircraft's speed was low, which is consistent with a landing with the engine stopped, as the occupants explained.

The marks indicate that the emergency landing was carried out correctly, with the wings level and a shallow descent attitude so as not to impact the terrain too severely (there were no bounce marks on the terrain).

2.2. Engine failure

The engine controls were checked and verified to be working correctly during the aircraft inspection.

A detailed inspection of the engine revealed water contamination in both carburetor trays. The possibility of water entering the carburetors after the accident can be ruled out since the carburetors were in good condition and maintained their integrity.

The water present in the fuel reached the engine, causing a loss of power.

After the detailed inspection, the engine was tested on a bench and it worked correctly.

2.3. Source of water found in carburetors

The water detected in the carburetors came from the fuel tanks.

3. CONCLUSIONS

3.1. Findings

1. The student had a student pilot card and medical certificate, both of which were valid and in force.
2. The instructor had a flight license and medical certificate, both of which were valid and in force.
3. The instructor had extensive experience and knowledge in ULM flights.
4. Neither the student nor the instructor made an emergency call.
5. The weather conditions were not limiting to the flight.
6. The aircraft had a Registration Certificate issued by Spain's National Aviation Safety Agency on 27 December 2014.
7. The aircraft had a Special Restricted Certificate of Airworthiness issued by Spain's National Aviation Safety Agency on 1 December 2009.
8. A detailed inspection of the engine revealed water contamination in both carburetor trays.
9. The engine controls worked correctly. When the engine was tested on a bench, it also worked correctly.
10. The temperature and humidity conditions were not conducive to icing in the carburetor for the speeds at which the engine was running.
11. The drop in power was drastic and sudden.
12. Both the engine and the aircraft were approved to use automotive fuel with a maximum ethanol content of 10%.

3.2. Causes/Contributing factors

The accident was caused by the execution of an emergency, off-field landing in an unprepared field due to an engine malfunction caused by the presence of water in the fuel system..

4. SAFETY RECOMMENDATIONS

No safety recommendations are issued.

ANNEX 1

EASA SIB No: 2009-02

EASA Safety Information Bulletin

SIB No.: 2009-02
Issued: 22 January 2009

Subject: **Piston Engine Powered Aircraft, Operated on Automotive- or Jet Fuel**

Ref. Publication: None.

Description: This SIB is published to inform all owners and operators of piston engine powered aircraft about operation on non-aviation fuels and about operation of compressed ignited (diesel) piston engine powered aircraft on jet fuel.

Concerns have been raised by oil companies about the use of fuels not primary intended for piston engine powered aircraft like automotive fuel (commonly known as mogas), diesel fuel or jet fuel. Automotive fuel specifications allow wider variations of several fuel parameters and in the fuel composition. The jet fuel specifications do not cover diesel engine related parameters like the cetane number, a measurement of the combustion quality of diesel fuel during compression ignition.

It is the responsibility of the engine/airframe (S)TC holders to ensure the safe operation with all approved fuels. Similar safety issues have been addressed in the type certification processes of spark and compressed ignited piston engines and aircraft (e.g. by special tests concerning vapour pressure, fuel contamination, low fuel temperature, low cetane numbers etc.). Where necessary, additional limitations have been implemented; see also EASA Safety Information Notice (SIN) 2007-01 and FAA Special Airworthiness Information Bulletin (SAIB) CE-07-06. (S)TC holders are required to monitor possible future changes in fuel parameters and composition by appropriate means, e.g. by participating in fuel standard committees and cooperating with oil industry.

Owners and operators of piston engine powered aircraft that operate on automotive or jet fuel are reminded to use only approved fuel as listed in the (S)TC holders documentation. Use of non-approved fuels, or use of approved fuels outside the approved limitations, may result in unsafe conditions.

Applicability: All aircraft powered by piston engines and approved for use of automotive or jet fuel.

EASA SIB No: 2009-02

Contact: For further information contact the Airworthiness Directives, Safety Management & Research Section, Certification Directorate, EASA. E-mail: ADs@easa.europa.eu.

ANNEX 2

SPECIAL AIRWORTHINESS INFORMATION BULLETIN

Aircraft Certification Service
Washington, DC

U.S. Department of Transportation
Federal Aviation Administration

CE-07-06
October 27, 2006

http://www.faa.gov/aircraft/safety/alerts/

This is information only. Recommendations aren't mandatory.

Introduction

This Special Airworthiness Information Bulletin (SAIB) alerts you of an airworthiness concern where you could have **alcohol (ethanol or methanol) present in the automobile gasoline on any General Aviation airplane** type certificated (TC) to use automobile gasoline or with automobile gasoline supplemental type certificates (STCs).

Background

Fuels have to conform to a specification in order to be approved for use in type-certificated aircraft. The American Society for Testing and Materials (ASTM) developed specifications for automobile gasoline as well as aviation gasoline. These specifications are ASTM D 910 and ASTM D 6227 for aviation gasoline and ASTM D 439 or ASTM D 4814 (latest revision) for automobile gasoline.

Automobile gasoline STCs were developed using fuel blended to ASTM specification D 439 or D 4814. The Environmental Protection Agency (EPA) regulations require the addition of oxygenates in some regions of the country, as do some local regulations. The most widely used oxygenates are alcohol (ethanol or methanol), Methyl Tertiary Butyl Ether (MTBE), and Ethyl Tertiary Butyl Ether (ETBE).

There is an increasing use of ethanol in automobile gasolines. The Energy Policy Act of 2005 replaces the 2 percent oxygen standard with the Renewable Fuels Standard (RFS), which requires an ever-increasing amount of ethanol and biodiesel to be used across the country through 2012. Ethanol will continue to see increasing use in the United States.

There are two primary sources of automobile gasoline STCs for general aviation aircraft: the Experimental Aircraft Association (EAA) and Petersen Aviation. Neither the EAA STCs, nor Petersen Aviation STCs, allow the use of automobile gasoline containing alcohol (ethanol or methanol). Automobile gasolines containing MTBE or ETBE are acceptable.

Automobile gasoline containing alcohol is not allowed to be used in aircraft for the following reasons:

- The addition of alcohol to automobile gasoline adversely affects the volatility of the fuel, which could cause vapor lock.
- Alcohol present in automobile gasoline is corrosive and not compatible with the rubber seals and other materials used in aircraft, which could lead to fuel system deterioration and malfunction.
- Alcohol present in automobile gasoline is subject to phase separation, which happens when the fuel is cooled as a result of the aircraft's climbing to higher altitude. When the alcohol separates from the gasoline, it may carry water that has been held in solution and that cannot be handled by the sediment bowl.

- Alcohol present in automobile gasoline reduces the energy content of the fuel. Methanol has approximately 55 percent of the energy content of gasoline, and ethanol has approximately 73 percent of the energy content of automobile gasoline. The greater the amount of alcohol in the automobile gasoline, the greater the reduction in the aircraft's range.

Recommendation

We recommend that you do the following about operating airplanes using automobile gasolines:

1. Use automobile gasoline that conforms to the specifications listed in the airplane flight manual or automobile gasoline STC flight manual supplement:
    a. Verify the fuel has the proper octane rating
    b. Verify the fuel has the allowable oxygenates:
        i. Automobile gasolines containing MTBE or ETBE are acceptable.
        ii. Automobile gasolines containing alcohol (methanol or ethanol) are not acceptable, unless specifically approved by the TC or STC.

2. If you are unsure about the presence of alcohol in your automobile gasoline, the following test can be performed:
    a. Using a glass or chemical-resistant plastic (such as TPX) container, mark ten equally spaced volumes. A graduated cylinder is ideal; however, a non-tapered glass jar, such as a large (quart) olive bottle, will work.
    b. Add one part water (approximately 100 ml) into the container, fill to the first mark, and then add nine parts (approximately 900 ml) of automobile gasoline, fill to the top mark. Shake thoroughly, let stand for 10 minutes or until automobile gasoline is again bright and clear. Record the apparent level of the line between the automobile gasoline and water.

3. If alcohol is present in the automobile gasoline, the water will absorb it, and the amount of water will appear to increase, indicating the automobile gasoline should not be used in the aircraft. However, if the water level remains the same, no alcohol is present in the automobile gasoline, and it can be used in the aircraft.

4. If you cannot obtain automobile gasoline that conforms to the specifications listed in the airplane flight manual or automobile gasoline STC flight manual supplement, use aviation gasoline conforming to ASTM specification D 910.

For Further Information Contact

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