

# CIAIAC

COMISIÓN DE  
INVESTIGACIÓN  
DE **A**CCIDENTES  
E **I**NCIDENTES DE  
**A**VIACIÓN **C**VIL

## Report A-052/2005

Accident involving a  
PZL M18A aircraft,  
registration EC-GAB,  
on 4 September 2005,  
in Requena (Valencia)



MINISTERIO  
DE FOMENTO



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SECRETARÍA GENERAL DE  
TRANSPORTES

COMISIÓN DE INVESTIGACIÓN  
DE ACCIDENTES E INCIDENTES  
DE AVIACIÓN CIVIL

Edita: Centro de Publicaciones  
Secretaría General Técnica  
Ministerio de Fomento ©

NIPO: 161-06-009-6  
Depósito legal: M. 23.129-2003  
Imprime: Diseño Gráfico AM2000

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## **Foreword**

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 and its causes and consequences.

In accordance with the provisions of Law 21/2003 and pursuant to Annex 13 of the International Civil Aviation Convention, the investigation is of exclusively a technical nature, and its objective is not the assignment of blame or liability. The investigation was carried out without having necessarily used legal evidence procedures and with no other basic aim than preventing future accidents.

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.



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## Abbreviations

00°	Degree(s)
00 °C	Degrees centigrade
AFM	Aircraft Flight Manual
CIAIAC	Comisión de Investigación de Accidentes e Incidentes de Aviación Civil (Civil Aviation Accidents and Incidents Investigation Commission)
CV	Horse power
DGAC	Dirección General de Aviación Civil (Spain's Civil Aviation Authority)
EASA	European Aviation Safety Agency
FAA	Federal Aviation Administration
FAR	Federal Aviation Requirements
FI	Flight Instructor
ft	Feet
h	Hour(s)
IAS	Indicated Airspeed
IR	Instrument Rated
kg	Kilogram(s)
kgm	Kilogram(s) per meter
km/h	Kilometers per hour
kt	Knot(s)
LT	Local time
m	Meter(s)
ME	Multi-engine
MTOW	Maximum Takeoff Weight
SE	Single-engine
STC	Supplementary Type Certificate
SSW	South-south west
TAS	True Airspeed
TSO	Time Since Overhaul
VFR	Visual flight rules
VHF	Very high frequency



## Synopsis

Owner and operator:	AVIALSA T-35, S. L.
Aircraft:	PZL M18A Dromader
Date and time of accident:	4 September 2005 at 15:55 LT
Place of accident:	Field close to the El Rebollar Aerodrome in Requena (Valencia)
Persons aboard and injuries:	1 (pilot), killed
Type of flight:	Firefighting
Date of approval:	25 July 2007

### Accident summary

On 4 September 2005, shortly after 15:51, a PZL M18A "Dromader" aircraft, registration EC-GAB, crashed into the ground moments after taking off from Requena Airport (Valencia) as it was executing a 180° turn to the left so as to proceed to the town of Montroy (Valencia) where a fire had been reported.

As a result of the impact, the aircraft was destroyed and the pilot killed.

The investigation revealed differences between the airworthiness certificate covering operation of the accident aircraft in effect on the date of the accident and the European certification issued a short time later.

The most likely cause of the accident is considered to be a stall during the execution of the left turn after the takeoff with high lateral inclination and with a speed lower than that necessary to maintain the flight attitude.

Additionally, the investigation revealed the need to ensure that pilots flying the PZL M18A aircraft under high operating weight conditions are highly qualified.

Five (5) safety recommendations have been issued to the DGAC and EASA as a result of this accident.



## 1. FACTUAL INFORMATION

### 1.1. History of the flight

Aircraft PZL M18A, registration EC-GAB, loaded with water, took off on a visual flight rules (VFR) flight with its pilot, sole occupant, on 4 September 2005 at 15:50 local time from the fire extinguishing base located at the "El Rebollar" Aerodrome in Requena (Valencia) on a fire-fighting mission.

In the operation, the first sortie that day, was another aircraft of the same type that had taken off a minute earlier and which was already en route to the site where the fire had been reported in the vicinity of Montroy, 12 km away on a heading of 228° from the departure airport.

Both aircraft used runway 30 at the aerodrome. The pilot with more seniority and flying experience took off first as mission leader and guide to the second pilot who was in command of aircraft EC-GAB.

As was customary, the aircraft took off on the first operation for the day with their fuel tanks full so as to avoid refueling delays on subsequent sorties. On the climb after the takeoff, in keeping with planned procedures, the aircraft would turn slowly to the right before making a full 180° turn to the left, avoiding obstacles located to the south and west of the airfield before proceeding directly to the site of the forest fire.

The first aircraft executed these maneuvers and was able to observe the takeoff and the start of the turn executed by the second aircraft. On passing the airfield's location he lost sight of the accompanying aircraft and tried to establish communication via VHF radio. Having received no answer, he decided to return only to notice that aircraft EC-GAB had crashed into the ground.

Parallel to and north of the "El Rebollar" runway is the A-3 motorway linking Madrid and Valencia. On this motorway, at the time the two aircraft were taking off, was an eastbound vehicle whose occupants witnessed their aerial maneuvers and the low flight of the aircraft that crashed into the ground. Although they did not see the impact with the ground directly, they were able to make out the resulting dust cloud.

Alerted by what they had seen and familiar with the surroundings, they headed directly and without delay to the aircraft wreckage to aid the pilot. At the same time they called the emergency number 112 by cell phone to inform authorities of the event.

When they arrived at the crash site, they saw that the pilot, who was still inside the cockpit, had died instantly, as confirmed a short time later by emergency medical personnel when they arrived at the accident site.

## 1.2. Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft	Others
Fatal	1		1	
Serious				
Minor				Not applicable
None				Not applicable
<b>TOTAL</b>	<b>1</b>		<b>1</b>	

## 1.3. Damage to aircraft

The aircraft was destroyed as a result of the impact with the ground.

## 1.4. Other damage

None, with the exception of the fuel spilled onto the ground surrounding the aircraft.

## 1.5. Personnel information

### 1.5.1. Pilot

Age: 35 years  
Nationality: Italian  
License: Commercial Airplane Pilot  
License issue date: 01-10-2001  
License expiration date: 01-10-2006  
Ratings:  
— Instrument (IR), valid until 12-02-2006  
— Multi-engine (ME), valid until 12-02-2006  
— Single-engine (SE), valid until 01-10-2005  
— Agricultural and forest, valid until 20-02-2006  
— Flight Instructor FI(A), valid until 20-05-2007  
Class I medical certificate: Valid until 06-06-2006  
Total flying hours: 930 h  
Hours on the type: 26:05 h

Hours in the last 72 h: 00:00 h  
Hours in the last 90 days: 22:40 h  
Hours in the last 30 days: 03:55 h

The pilot's flying experience was mainly on Cessna 172, Piper 34 and 28, and Maule M5 and M7 aircraft. His flight instruction to obtain his agricultural rating had been aboard a Piper PA-25 Pawnee aircraft with a 1,043 kg maximum takeoff weight (MTOW).

The pilot had flown 1:30 hours on the same accident aircraft on a firefighting mission on the August 17 prior to the accident, and on that occasion he had not reported any unusual circumstances in the flight log. Moreover, he had flown out of Requena Aerodrome on seven occasions.

The pilot had completed his proficiency tests, as prescribed by the company's operations manual, between 1 and 3 July 2005, with a total of 16 hours on the type.

## **1.6. Aircraft information**

The Dromader PZL M18A is a single-engine aircraft used for special aerial work involving fumigation and firefighting. It is only suitable for VFR flights. It has an additional seat, with the back to the pilot, for use by a technician facing the rear and which cannot be used during work missions.

### **1.6.1. Flight manual**

The AFM authorizes operating the aircraft with a MTOW of up to 4,200 kg. Supplement No. 1 allows general use of the aircraft up to a MTOW of 4,700 kg with a slight limitation of load factors and a modification of allowed airspeeds, but without any changes to the approved operations and unauthorized maneuvers.

Supplement 16 to the manual, published on 31-01-94, allows a MTOW of up to 5,300 kg for firefighting missions with certain additional limitations and operating conditions. The maximum jettisonable weight of water or fire-fighting agent is 2,200 kg, the available hopper volume being limited by air containers which prevent undesired shifts in the airplane's center of gravity.

Prior to the publication of Supplement 16 to the AFM, a supplementary airworthiness certificate, STC-83S, issued by the Spanish Civil Aviation Authority on 16-03-92, authorized the operator to use aircraft with a MTOW of up to 5,300 kg for firefighting missions, with certain conditions and restrictions.

An exhaustive comparison of the operating limits and conditions imposed by the AFM and Supplements 1 and 16, and by STC-835 may be found in Section 1.18 of this report.

### 1.6.2. *Airframe*

Manufacturer:	PZL
Model:	M18A
Serial number:	1Z024-02
Year of manufacture:	1993
Registration:	EC-GAB
MTOW:	5,300 kg
Owner:	AVIALSA T-35, S. L.
Operator:	AVIALSA T-35, S. L.

### 1.6.3. *Airworthiness certificate*

Number:	3752
Type:	Special restricted
Use:	Aerial work
Technical performance:	Normal, to exclude any acrobatic maneuvers
Issue date:	10-03-1995
Renewal date:	11-06-2004
Expiration date:	10-06-2005
Extension date:	10-09-2005

The validity of the airworthiness certificate had been extended by a period of three months in accordance with DGAC Circular Instruction 11-19B, Section 2.a.

### 1.6.4. *Maintenance records*

As indicated in the aircraft's logbook, the last flight had been made on 23 August 2005.

Total flying hours:	801:33 h
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Last annual inspection: 07-04-2005

Hours since last annual inspection: 780:53 h

Moreover, old maintenance records show that as part of the work done during the inspection dated 27-11-2002, an anomaly was noted concerning the condition of the pilot's safety harness, which was frayed, its replacement being recommended. No corrective action for this anomaly was noted before the accident, however.

### **1.6.5. Engine**

The engine is of the reciprocating turbocharged type, with nine radial cylinders.

Manufacturer: PZL Kalisz

Model: ASZ-62IR-M18

Máx. continuous power: 823 CV

Serial number: KAC-214006

Fuel: AVGAS 100/100LL

Last inspection: 07-04-2005

Hours since last inspection: 787:00 h

Total hours: 807:40 h

### **1.6.6. Propeller**

The propeller has four constant-speed variable-pitch blades.

Manufacturer: CNPSL

Model: AW-2-30

Serial number: W-500067

Installation date: 06-06-2005

Aircraft hours at installation: 782:43 h

TSO at installation: 00:00

**1.6.7. Mass and balance**

Using data obtained from Section 6 of the AFM and the aircraft's last weighing, an estimate was made of the aircraft's weight and center of gravity at takeoff on the day of the accident. The estimated data are shown in the following table:

Item	Weight in kg	Moment in kgm
Aircraft outfitted for firefighting	2,805	1,512
Pilot	80	198
Oil	57	-30
Fuel (714 liters)	508	490
Water (1.500 liters)	1,500	1,245
<b>TOTAL</b>	<b>4,950</b>	<b>3,415</b>

The center of gravity was within the limits specified in the flight manual.

**1.6.8. Flight characteristics for the overload Dromader PZL M18A aircraft**

Supplement 16 in Section 4.10, LEVEL FLIGHT, states: "The aircraft shows dynamic longitudinal instability with free control stick. After about 20 seconds and two vibration cycles, the aircraft shows a tendency to reach stall speed or exceed the allowable maximum flight speed."

Also, in Section 4.19 FIRE-FIGHTING, it states that airspeed is to be maintained at 170 km/h without exceeding a 15° +5 bank. "Below this speed, some changes in forces acting on the elevator may occur. The pilotage of the aircraft below 170 m/h is safe but requires increased attention on the pilot's part."

Regarding low-speed flying, it should be noted that the aircraft had an audio and visual stall warning system. In the AFM checklists for normal takeoff procedures, paragraph 4.6 calls for the Stall-warning to be ON before takeoff.

**1.6.9. Information on the stall warning system**

The Technical Description and Instructions Manual of the models PZL M18 and M18A, which includes maintenance instructions, describes the different stall warning systems in Chapter 3, Systems and Controls. It mentions that, at the option of the operator, the aircraft can have two different systems installed: the "SFI sensor" and the LUN. Each one uses a different technique to warn the pilot of an impending stall, with a margin of 9 to 18 km/h in advance.

According to the information provided by the manufacturer, the aircraft was originally certified under a normal category of FAR-23 without any stall warning system for a MTOW of 4,200 kg. Some years after, the "SFI sensor" was introduced as an option for aircraft operating in United States and with the LUN system for aircraft operating in Europe. The former system can be disconnected by means of a switch in the cockpit, apparently to avoid nuisance warnings on the ground. The LUN system cannot be disconnected from the cockpit, although it can be corrected. The LUN automatically switches off the warning under certain operational conditions on the ground and arms the system during flight. The manufacturer also informed that in Poland the LUN system was introduced during the certification of the overweight 5300 kg version and it was later required for all the M-18 of any version or weight operating in Poland (Mandatory Service Bulletin K/02.137/89, issued in 1989). This system is included in the type design of the EASA Type Certificate.

The aircraft that had the accident and all the others operated by this operator had the "SFI sensor" system installed, because this was the configuration requested by the operator at the time of delivery.

The SFI was the equipment included in the FAA Type Certificate A47EU, which configuration has been approved by the DGAC in the Spanish type certificate of the aircraft.

On the other hand, Section FAR 23.207 (Stall warning), the latest amendment, dated 3-11-96, requires that the artificial stall warning system may be mutable only for acrobatic category airplanes, provided that it is armed automatically during takeoff and rearmed automatically in the approach configuration.

This Commission has noted that in this accident the stall warning system "SFI sensor" was found switched off after the accident. This fact was consulted with several pilots and opinions were received that it can be an annoyance during the flight, because it frequently triggers at normal operational speeds and bothers the pilot.

The normal procedure of the Airplane Flight Manual requires that the aural warning must be connected for flight, although it can be disconnected during taxi to avoid annoyance. An item is included in the before take-off checklist to ensure that it is connected again.

## **1.7. Meteorological information**

The meteorological conditions in the Valencia region on 4 September between the hours of 15:00 and 16:30 were reported to be mostly clear skies with weak and variable winds, with clouds expected inland toward nightfall.

At the crash site, the winds were weak and variable, mostly from the south; the sky was mostly or completely clear and the temperature was 24 °C.

According to the patrol's first pilot, wind and visibility conditions at takeoff were good for the operation.

As a reference, at Valencia Airport there was a slight wind from the east varying between 40° and 160°.

### **1.8. Aids to navigation**

Aids to navigation were not used. It was a VFR flight.

### **1.9. Communications**

Both the accident and the accompanying aircraft were equipped with VHF transceivers, though communications between them were not established in flight.

### **1.10. Aerodrome information**

The El Rebollar Aerodrome is located within the Requena (Valencia) city limits. The runway is parallel to the A-3 motorway, which is some 250 m away. Also parallel to the runway and some 300 m to the south is a high voltage power line.

The asphalt runway is approximately 900 m long and 50 m wide. Its orientation is 12/30 and it is at an elevation of 716 m.

To the SSW at a distance of 1,100 m there is a hill, "El Boquerón," at an elevation of 827 m.

Normal takeoff procedures on runway 30 take the aircraft first toward the A-3 motorway located to the right of the runway, followed by a 400-m radius 180° turn between the highway and the hill "El Boquerón."

At this aerodrome the operating company had a detachment of two Dromader PZL M18A aircraft during the summer for conducting forest firefighting missions between 9 AM and dusk.

### **1.11. Flight recorders**

The aircraft was not equipped with a flight data recorder or a cockpit voice recorder. Neither recorder was required by the relevant aviation regulations.

### **1.12. Wreckage and impact information**

The aircraft crashed into a cultivated field located to the left of the extension of the runway used. The impact point is at an elevation of 675 m and is some 630 m away from the runway 12 threshold on a bearing of 250° (see Appendix 1).

#### **1.12.1. General description**

The aircraft wreckage came to rest just below the high voltage power lines that run along the south side of the field. The ground around the wreckage was wet from the fuel and water the aircraft was carrying, which had been spilled when the integrity of these tanks was compromised.

The main wreckage was confined to a small area and came to rest in a horizontal position on a heading of 220° and slightly tilted to the left. The landing gear had collapsed, the wings were resting on the ground, maintaining their original wingspan, the horizontal stabilizer was flexed downward and the broken engine mount had allowed the engine to shift forward.

Markings on the ground showed that the entire wreckage moved forward some 2 m after the initial impact.

Only the number 4 blade remained attached to the propeller hub. The number 3 blade shattered along the base on impact and was ejected 19 m to the right of the main wreckage. The two other blades, also shattered at the base, were buried on impact.

The wreckage allowed for the continuity between the cockpit controls and the flight control surfaces to be verified. The latches on the water discharge tanks were closed.

It was also noted that:

The left cockpit entry doors and windows were open. The left door frame was buried in the ground.

The flaps were retracted with the exception of a part of the right flap which was deflected 10°.

The tail skid was broken and the elevator counterweights bent.

#### **1.12.2. *Description of the cockpit***

An inspection of the inside of the cockpit revealed the following:

- Throttle lever at the maximum.
- Propeller pitch almost full back.
- Elevator tab slightly forward of its neutral position (toward nose down).
- The control column almost sheared halfway up and tilted to the left.
- The engine cutoff switch not activated.
- Stall warning indicator disconnected.
- Magneto switch in 1 + 2.
- Generator connected.
- Emergency fuel pump OFF.
- Hopper discharge handle not activated.
- Continuity was established between the controls and the flight control surfaces except for the ailerons.
- The shoulder straps on the safety harness were unstitched.

#### **1.13. Medical and pathological information**

According to the forensic report, the aircraft's occupant suffered injuries to the front of the head and chest, and a fracture and dislocation of the right shoulder and lower limbs.

Internally the injuries suffered by the organs located in the right half of the chest and the liver stand out, along with the fractures of the T8 and T12 vertebra in the thoracic region.

The cause of death was trauma to the head and chest.

In addition, a toxicological analysis did not reveal anything of interest to the investigation of the event.

#### **1.14. Fire**

The aircraft wreckage did not burn.

### **1.15. Survival aspects**

The first eyewitnesses, and later emergency medical personnel, arrived on the scene shortly after the accident but could do nothing to save the pilot's life.

They found him with his helmet still on and with his harness attached. The straps for both shoulders were unstitched and loose from their anchorages and were faded from exposure to the sun. The belts also showed preliminary tears where they attach to the metallic ends of the clasp.

The helmet had been subjected to a strong impact on its left side.

Due to the fuel that spilled from the aircraft, the pilot was moved some distance away from the wreckage.

### **1.16. Tests and research**

#### **1.16.1. Shop tests on disassembled components**

The shop inspection of the aircraft's various components yielded the following results:

#### **Propeller**

A disassembly of the propeller from the engine showed that the pitch control actuator for number 1 blade was broken, along with some of the assembly's axial bearings. The alignment marks on three blades were misaligned with the exception of blade number 4, which was the only one not sheared by the impact with the ground.

The deformations and fractures of the blades indicate that they were rotating under power.

#### **Engine**

Disassembly of two of the cylinders revealed the engine's sudden stoppage. An internal inspection, to include the rotating components, showed no signs of seizing.

#### **Magneto key**

The operation of the magneto key was observed by noting that in the magneto 1 position, magneto 2 was not completely bypassed to ground. Likewise when magneto

2 was selected, magneto 1 was not properly grounded. With magnetos 1+2 selected, however, both magnetos were properly insulated.

When the key was disassembled to determine the cause of this improper operation, it was noted that the contact plate could freely move in its housing and that the contact points were dirty.

Once installed after being cleaned and adjusted, it not only worked properly in all positions, with no anomalies being noted in the shunt to ground in the non-selected magneto, but it also locked into place more firmly upon actuation.

### **1.16.2. *Aircraft performance and control characteristics***

For a co-ordinated 15°-bank turn at a true airspeed (TAS) on the order of 170 km/h, the turn radius is approximately 850 m. With bank angles of 30° and 45°, the turn radius at the same speed will be approximately 400 m and 225 m, respectively.

As a result of the increased lift required to compensate for the weight and centrifugal forces in such turns, the load factor increases to 1.035, 1.155 and 1.414 for bank angles of 15°, 30° and 45°, respectively.

When the total lift provided by the wing in a turn is increased, the induced aerodynamic drag also increases, thus reducing the aircraft's climbing ability.

### **1.16.3. *Eyewitness statements***

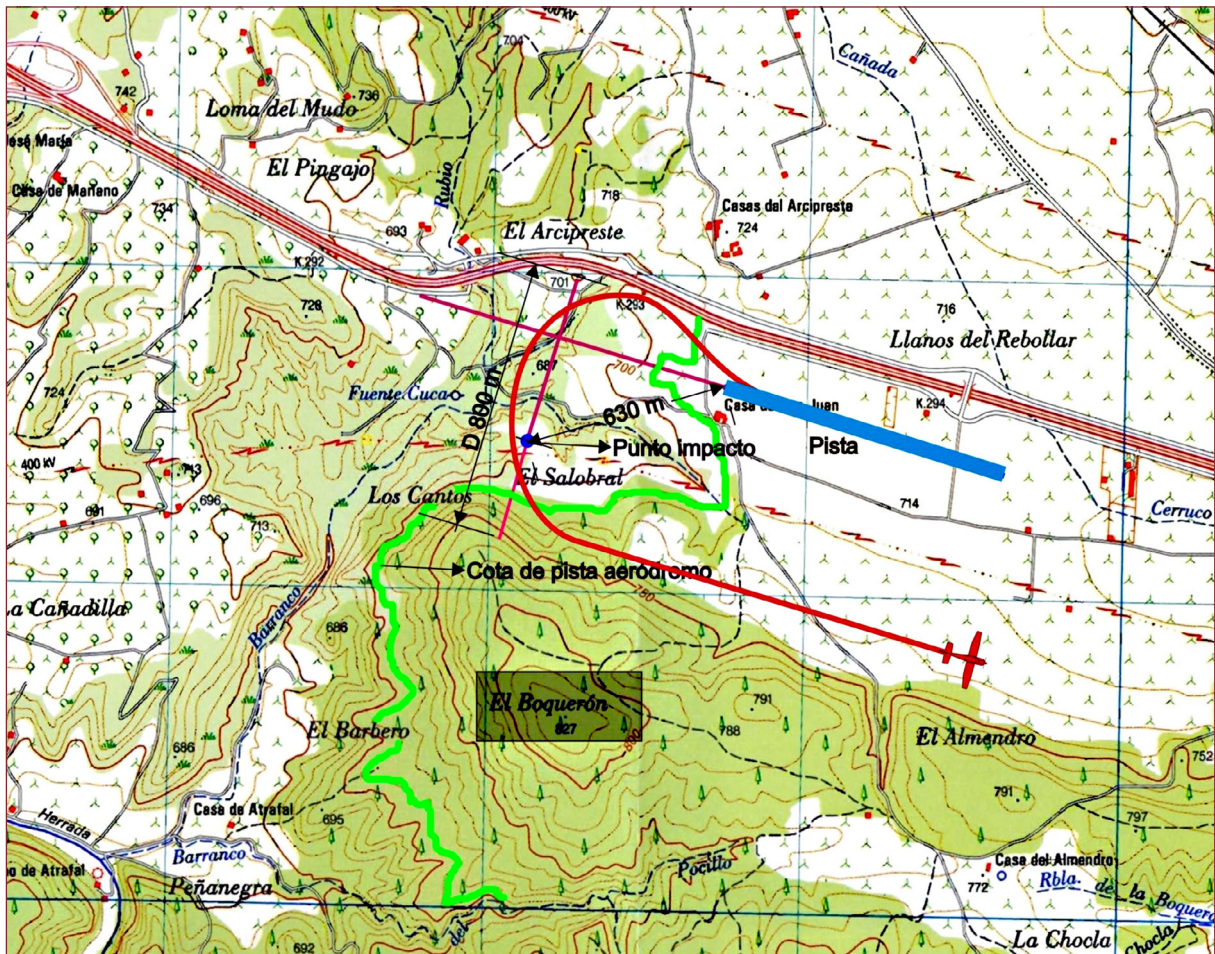
Statements were taken from people who witnessed at least a portion of the flight.

### **Pilot on the aircraft that preceded the accident aircraft**

The pilot who was accompanying the accident pilot stated that he took off on runway 30 and, after opening up a bit to the right, made a 180° turn to position his aircraft on a heading to the site of the forest fire. The path he followed is shown on the following diagram.

Once the 180° turn was completed, he saw how aircraft EC-GAB became airborne following its takeoff run, but lost him from view after passing next to him. When he tried to communicate via VHF radio with the other aircraft, he did not receive a response. After spending a short time trying to establish communications unsuccessfully, he returned to the base and saw the other aircraft on the ground.





When asked about the procedures he followed, he noted that he took off with 10° of flaps and that he maintained that configuration throughout the subsequent turn until he was on the destination heading.

### Occupants of a vehicle heading toward Valencia on the A-3 motorway

The A-3 highway runs parallel to the El Rebollar runway. The climb maneuver was witnessed by the occupants of a vehicle that was headed toward Valencia, and who were able to witness the maneuver almost directly ahead of them. They stated that they saw two aircraft take off and that both made a 180° turn on a heading toward Valencia. When the second aircraft was making the turn, it crashed into the ground, "flipping over twice on its axis." They were unable to see the impact with the ground directly, but did see the resulting dust cloud.

### Other statements taken during the investigation

Opinions from several pilots familiar with the operation of this type of aircraft were received over the course of the investigation. It was concluded that there are no set

criteria for executing normal in-flight procedures and that variations do exist, in contrast to what is prescribed in the flight manual.

A possible tendency was noted among pilots to disconnect the stall warning system so as to avoid its more or less frequent and bothersome warnings.

### **1.17. Organizational and management information**

The Avialsa T-35 Operations Manual, in "Part D", titled Training, has a chapter on required courses, among them a "JA-85 Pilot Course on the use of the Dromader M-18-A airplane for fighting forest fires." The referenced chapter also contains a section on "Refresher training and periodic pilot proficiency testing."

The course in question has a theoretical part which aims to provide the student pilot with the knowledge necessary to operate the aircraft. Then, to complete the course the student takes part in a practical section with progressive training flights. The total time of these flights comes to at least 13 hours.

In part "A" of the operations manual, there are sections on minimum flight altitudes/levels for VFR flights and criteria for determining proper airport usage. The first section notes that, as a general rule, flights are not to be made at levels/altitudes below 1000 feet above the highest obstacle within a 1,000 m radius of the aircraft's in-flight position. The second section studies the adaptation between the pilot, the aircraft and the airfield so as to properly operate out of any aerodrome. In this second section, however, no approach charts are given, either in the operations manual or through an organization internal circular, for any of the bases in which it will eventually operate. General instructions are given, however, on proper airport operations.

It was noted that among the various documents on the aircraft, the operator does not have checklist cards which can serve as a quick reference in-flight.

### **1.18. Additional information**

In this section we compare the differences between the various certifications for operating the aircraft with different MTOWs as indicated in the AFM, supplements 1 and 16 to the AFM, and the AFM modification made pursuant to STC-83S under which the accident aircraft was operating.

The third subsection lists the actions taken by the CIAIAC and EASA in the early summer of 2006.

1.18.1. *Differences in limits and flight parameters*

Shown in the following table:

Section	Subsection	Supplement No. 16 to the manufacturer's flight manual applicable to the modification of the 5,300-kg MTOW design (according to EASA.A.056 Type Certificate)	Supplement to the flight manual issued by Avialsa applicable to the modification of the 5,300-kg MTOW design (according to DGAC STC No. 83-S)
2	8	Max. bank angle in turns 15 +5°	Max. bank angle in turns above 5,000 kg 30°
2	11	Establishes pilot qualifications: "Having regard to the specific pilotage of the aircraft in the overload fire-fighting version with the weight of 5,300 kg, the pilot must have the following qualifications: — Total flown time – 2,000 hours; — Authorization to conduct agricultural operations; — 1,000 flown hours in agricultural and fire-fighting operations, including 200 hours on the PZL M18A; — Authority to perform fire-fighting missions. The abovementioned requirements do not apply to test pilots."	No specific guidelines are given. Does not figure in the operator's operations manual, though the pilot is required to have a valid agricultural rating and the experience and requirements listed in R.D. 1684/2000.

1.18.2. *Differences in the required pilot ratings*

No special training is required by STC-83S for pilots engaged in firefighting missions with high MTOW. The company's operations manual does not list any limitations or guidelines in this regard either. Nevertheless, the STC-83S applicants proposed to the DGAC that the following qualification criteria be included, which in the end were not adopted in either the company's flight or operations manuals:

- Possession of the appropriate Certificate and License.
- Have over 500 total flying hours, 200 of them in agricultural or firefighting operations.
- Have over 50 flying hours on the PZL M18A DROMADER airplane in actual agricultural or firefighting operations.
- Have successfully completed a training course on the airplane's new restrictions.

Supplement 16 to the AFM, however, establishes the following pilot qualifications::

"In regard to the specific pilotage of the aircraft in the overload fire-fighting version with a weight of 5300 kg, the pilot must have the following qualifications:

- Total flown time – 2,000 hours.
- Authorization to conduct agricultural operations.

- 1,000 flown hours in agricultural and fire-fighting operations, including 200 hours on the PZL M18A.”

It also states that instructor-pilots granting other pilots the authorization to conduct firefighting missions must undergo training under the supervision of instructor-test pilots at the WSK PZL MIELEC manufacturer’s facility.

### **1.18.3. *Previous steps taken by the CIAIAC and EASA in early summer 2006***

As part of the investigation into this accident, and in light of the differences in the airworthiness certificates endorsing the aircraft, the CIAIAC issued a safety recommendation to EASA dated 26 July 2006 to revise the differences between the approval requirements for Airworthiness Certificates granted by the DGAC in Spain and the A.056 Type Certification issued by the EASA for the design modifications of PZL M18 and M18A aircraft, in order to increase the MTOW to 5,300 kg.

In reply to that recommendation, the EASA issued an emergency airworthiness directive dated 27 July 2006 (see Appendix 3) which revoked the PZL M18 operating conditions established by various STCs issued by the DGAC in Spain, adopting instead the conditions set out in Supplement 16 to the AFM.

The EASA issued an A.056 certificate for the 5,300-kg overload version of the PZL M18 on 24 October 2006.

### **1.19. Useful or effective investigation techniques**

Not used.

## 2. ANALYSIS

### 2.1. General

After being notified of the fire in the vicinity of Montroy (Valencia), the two PZL M18A aircraft based at the El Rebollar aerodrome in Requena prepared to take off on a firefighting mission. At 15:50 local time the first aircraft took off from runway 30 and followed a climb path between the highway and the "El Boquerón" hill while making a 180° turn. Since some 800 m are available to make the turn, it is calculated that the aircraft used a 30° bank angle (see path in Appendix 2).

The second aircraft, registration EC-GAB, was to follow the same path. It took off normally, as verified by the first pilot who had already executed the 180° turn and was able to see him before going past him. Its maneuvers after takeoff were also seen by the occupants of an automobile that was approaching the airfield from the west, who stated that it crashed into the ground as it was making the turn, "flipping over twice on its axis." It has not been established whether by "flipping over twice on its axis" the eyewitnesses meant that the aircraft turned over 360° at the end of runway 12 or that it barrel-rolled or spun over twice during the dive.

These eyewitnesses were not able to see the direct impact with the ground, but they did see the resulting dust cloud. The aircraft was flattened against the ground after the landing gear collapsed. The wings came to rest on the ground, keeping the original wingspan. The tail section impacted the ground hard and the engine was displaced forward after detaching from its mount. The aircraft only moved two meters as it bounced and dragged along the ground. The condition of the wreckage along with the ground trail indicate that the airplane was level in the final instants of the flight and that it had a very high vertical descent rate and a very low horizontal speed. The airplane impacted the ground horizontally at a point with a lower elevation than the runway it had used just a few seconds earlier.

The fuel in the gas tanks, some 700 liters, spilled on impact, but the simultaneous spillage of the water impeded the wreckage from catching on fire.

### 2.2. Causes of the accident

The accident took place suddenly. There was no time for a radio communication or for the discharge of the firefighting water the aircraft was carrying. Good meteorological conditions rule out weather as a cause and there was no evidence of any aircraft system breakdowns or malfunctions prior to the accident. A technical cause thus appears unlikely. The flight controls exhibited continuity and the engine was under power as shown by the fractures and warping of the propeller blades.



Consequently, the causes of the accident are suspected to involve the piloting and the flight characteristics of an aircraft operating under relatively high weight conditions, 4,950 kg, and low airspeed.

According to the manufacturer's documentation, this type of airplane, with weights in excess of 4,700 kg and up to 5,300 kg, has a limited climbing ability and altered flight stability characteristics, requiring smooth piloting with turns not exceeding 15° bank angles.

That is why the manufacturer states that pilots should have ample flying experience, specified as over 2,000 flying hours, 1,000 of them in agricultural or firefighting operations and of these, 200 on PZL M18 aircraft.

In comparison with these requirements, the accident pilot's experience was of 930 total flying hours, 26 on the PZL M18 aircraft. In addition, the pilot was executing a turn, like his partner, with bank angles that were double those specified in Supplement 16 to the AFM, or even more if he was trying to shorten the outbound turn to catch up with the airplane ahead of him. What is more, he had the stall warning system disconnected.

It is estimated that even though the weight was not excessively high, the loss of performance in the turn and the increased stall speed under those conditions led to unstable flying conditions resulting in decreased speed and a stall without the corresponding system warning.

The pilot, with his limited experience, only managed to level the plane without being able to stop its elevated descent rate. There is no reason to believe, however, that the aircraft executed any strange turns as reported by the eyewitnesses who saw its maneuvers at the head of runway 12.

### **2.3. Survival aspects**

The strong vertical blow from the aircraft's impact with the ground resulted in lethal, and probably unavoidable, injuries to the pilot's spinal column. A secondary blow to the helmet resulted in head injuries. However, since the shoulder straps failed where they were joined to the hooks due to wear in the stitching, it is reasonable to consider if more a favorable survival scenario would have resulted had the shoulders been restrained, keeping the backbone vertical and restricting head movement. Therefore, so as to ensure the proper operating condition of this operator's pilot restraint systems, a relevant recommendation is included.

### **2.4. Certification and operating requirements for overload operations**

It has become obvious that special theoretical and practical training and qualifications are necessary to operate this airplane.

A study and analysis of the different certification documents revealed discrepancies between the DGAC and EASA approvals for an increase in the aircraft's MTOW to 5,300 kg. The less restrictive limitations involving turn bank angles found in the Spanish STC-83S allowed for operations to be planned in the past with maneuvers that reduced safety margins.

Likewise, the selection and authorization requirements for crews operating under overload conditions with this aircraft should preclude entrusting high-risk operations to inexperienced pilots. Lead pilots and instructors who authorize new pilots to fly in overload conditions are also required to undergo training at the manufacturer's own facilities.

The operating manuals for the companies that employ PZL M18A airplanes with overload conditions should adopt these specific training and qualification requirements for pilots and fleet managers or chief pilots.

The company manuals should likewise describe the normal procedures for this type of aircraft in light of the restrictions prescribed, adopted if possible for the operating environment in effect at the aerodromes where they are usually stationed.

## **2.5. Analysis of the operating company's manuals and procedures**

As for the Operations Manual, it was noted that although the operator did usually use certain airports, there were no updated tables detailing aircraft performance and operating procedures (takeoffs, landings, patterns) adapted to these bases. It also did not include crew experience requirements for the specific type of operation in question.

To analyze the operation, the normal procedures in the AFM were studied. Since it is difficult for the pilot to consult the manual in-flight, an inquiry was conducted into whether the pilot had in the cockpit other checklists which might be of use as a quick reference for the pilot, and which summarize the information contained in the flight manual procedures. It was determined that no such documentation was in use at the company, although its existence was recognized in the operations manual itself. It is therefore advisable to ensure that consistency is maintained between the contents of the different manuals, especially as concerns the aircraft operating instructions. A recommendation is included in this regard.

## **2.6. Analysis of the stall warning system**

The stall warning system installed on the accident aircraft had a switch in the cockpit that allowed the pilot to disconnect it. Apparently, the warning often sounds during

normal operation of the aircraft and there could be certain tendency of the pilots to disconnect it to avoid the annoyance.

FAR Section 23.207 currently only allows disconnection of the stall warning system for aerobatic aircraft as long as the system is armed automatically during take off and approach.

On the other hand, the frequent activation of the stall warning system is a consequence of the narrow margin existing between the normal operation speed and the stall speed when operating at weights up to 5,300 kg.

The type design approved by the EASA Type Certificate (TCDS EASA A.056) includes an installation of the stall warning system that does not allow its manual disconnection. However, the aircraft covered by the type certification in Spain have the system "SFI sensor" that does allow the disconnection because the FAA type certificate was the one accepted in this case.

It is considered that the aural stall warning system is of very important to prevent accidents and, therefore, a safety recommendation is issued to EASA to make sure that this equipment cannot be disconnected manually from the cockpit in all aircraft M-18 and M-18A.

On the other hand, a safety system should not produce spurious or annoying messages during the normal operation of the aircraft.



### 3. CONCLUSIONS

#### 3.1. Findings

- The pilot had a valid license and was approved for the flight.
- The aircraft had an airworthiness certificate subject to a three month extension per DGAC Circular Instruction 11-19B that was within five days of expiring.
- No failures or malfunctions were logged for the aircraft following the test flights and other flights made after its last maintenance inspection.
- The visual meteorological conditions were adequate for the operation in question.
- Another aircraft with the same characteristics and load conditions had taken off and executed a 180° turn to the left without any incident prior to the accident aircraft.
- The weight of the aircraft was relatively high, 4,950 kg (above the maximum listed in the basic flight manual of 4,200 kg), as permitted by the Supplementary Type Certificate STC-83S under which it was operating.
- In comparing the experience of the accident pilot with that required by the manufacturer, the pilot's total experience was noted to be very limited.
- Moments before the accident, the aircraft was executing a banked turn at or in excess of 30° when the manufacturer specifies a maximum angle of 15° +5. The STC-83S Supplementary Type Certificate under which the aircraft was operating did allow turns with 30° bank angles.
- The stall warning system was disconnected.
- The tests carried out on the aircraft's components did not reveal any signs of a malfunction which could have affected the flight. The engine was operating at high power at the time of the impact with the ground.
- The impact with the terrain took place with the aircraft in level attitude with a high descent rate and a low airspeed.
- It is possible that the suddenness of the descent prevented the pilot from discharging the water in the hopper.

#### 3.2. Causes

The most likely cause of the accident was a stall during the left-turn maneuver after takeoff with a high bank angle and with insufficient speed to maintain the flight attitude.

The pilot's insufficient qualification is considered a contributing factor.



## 4. SAFETY RECOMMENDATIONS

### 4.1. Previous safety recommendations

As indicated throughout this report, in light of the differences between the conditions applied to the 5,300-kg design modification for firefighting operations in the DGAC's Supplementary Type Certificate and the EASA's Type Certificate, the following recommendations were issued on 26 July 2006:

**REC 36/06.** It is recommended that EASA review the conditions approved in the Supplementary Type Airworthiness Certificates issued by the DGAC in Spain, as well as those authorizing the basic design modifications to the PZL M18 and PZL M18A, which increase the MTOW to 5300 kg for firefighting operations and which are covered by the EASA.A.056 Type Certificate.

On 27 July 2006 the EASA issued Emergency Airworthiness Directive 2006-0229-E in response to this recommendation. The actions taken by the EASA are considered satisfactory and in keeping with the intent of the recommendation.

**REC 37/06.** Immediately upon release, the DGAC is recommended to inform Spanish operators of PZL M18 and M18A aircraft of the resolution resulting from the EASA's evaluation of the operational limits that are applicable to these models resulting from a review of their design characteristics.

### 4.2. New recommendations

As a result of the investigation, the following recommendations are issued to complement the previous ones:

**REC 33/07.** It is recommended that the DGAC require the AVIALSA company to inspect the condition of the harnesses in its Dromader PZL fleet of aircraft and that it replace them as needed.

**REC 34/07.** It is recommended that the DGAC verify the consistency between AVIALSA's different operations manuals, ensuring that they include checklists adapted to this operator's specific situation and that they serve as a quick reference to crews.

**REC 35/07.** It is recommended that EASA take the necessary action to ensure that the stall warning system of aircraft PZL M-18 and M-18A equipped with the SFI sensor system cannot be manually disconnected from the cockpit.



# APPENDICES



# **APPENDIX 1**

## **Aircraft wreckage**







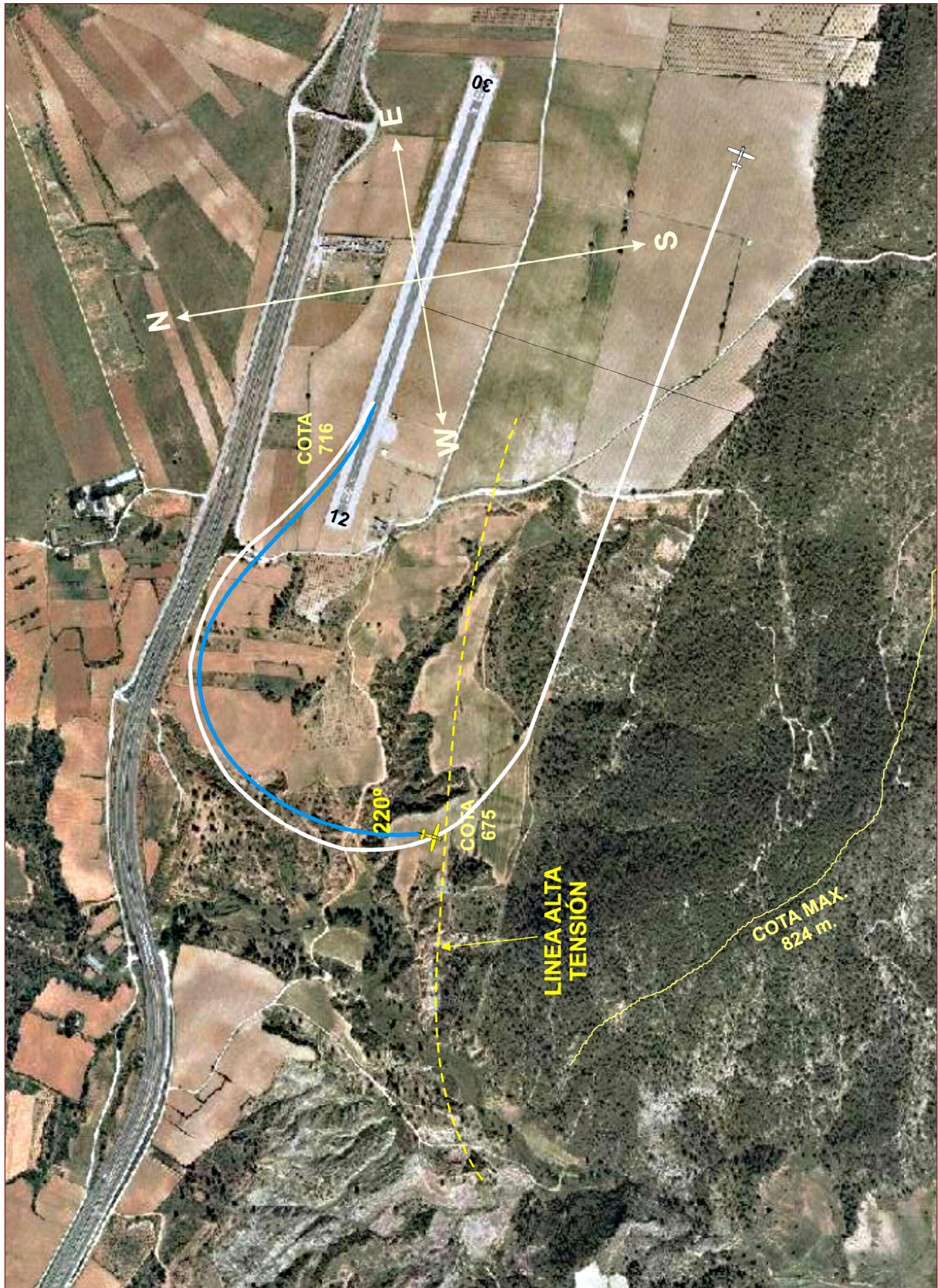


## **APPENDIX 2**

### **Aircraft trajectory**










**APPENDIX 3**  
**Emergency Airworthiness**  
**Directive 2006-0229-E**





<b>EASA</b>	<b>EMERGENCY AIRWORTHINESS DIRECTIVE</b>
	<p><b>AD No : 2006 - 0229 –E</b> <b>[Corrected]</b></p> <p><b>Date: 27 July 2006</b></p>
No person may operate an aircraft to which an Airworthiness Directive applies, except in accordance with the requirements of that Airworthiness Directive unless otherwise agreed with the Authority of the State of Registry.	
<p><b>Type Approval Holder's Name :</b></p> <p>ADEFA AVIALSA BAQUERO SERVICIOS AÉREOS MARTIN ECHEVARRIA MARTINEZ RIDAO</p>	<p><b>Type/Model designation(s) :</b></p> <p>PZL-M18, -M18A, operating in accordance with DGAC-Spain Supplemental Type Certificates No. 83-S, 87-S, 88-S, 89-S, 101-S, 102-S and 130-S</p>
STC Numbers : DGAC-ES 83-S, 87-S, 88-S, 89-S, 101-S, 102-S and 130-S	
Foreign AD : none	
Supersedure : none	
<b>ATA 04</b>	<b>Limitations – Change of Aircraft Flight Manual Supplement</b>
Manufacturer:	WSK PZL
Applicability:	<p>PZL-M18, -M18A airplane any serial numbers that are operated up to a Maximum Take-off Weight of 5.300 Kg., in fire fighting operations, in accordance with the following DGAC-Spain STCs:</p> <p>No. 83-S (AVIALSA) No. 87-S (MARTIN ECHEVARRIA) No. 89-S &amp; No. 101-S (MARTINEZ RIDAO) No. 88-S &amp; 102-S (BAQUERO SERVICIOS AEREOS) No. 130-S (ADEFA).</p>
Reason:	In the course of the investigation of an accident of a M18A operated in accordance with DGAC-Spain STC nr. 83-S, occurred in Spain on 4 September 2005, the Spanish Civil Aviation Accidents and Incidents Investigation Commission, having noted the differences in operational limitations that apply to the type design modification to operate up to 5300

	<p>kg of MTOW in fire fighting operations, between the EASA.A.056 Type Certificate Data Sheets and associated documentation and the above mentioned STCs issued by DGAC Spain, has issued a draft Safety Recommendation to EASA, to revise these differences.</p> <p>EASA has decided that both sets of limitations must be standardised to those contained in the PZL Supplement nr. 16 to the Aircraft Flight Manual.</p> <p>[Correction: Compliance date corrected]</p>
Effective Date:	28 July 2006
Compliance:	<p>From the effective date of this AD, replace the Aircraft Flight Manual Supplements of the Spanish STCs quoted above by AFM Supplement No. 16 to Aircraft Flight Manual of PZL M18 "DROMADER", published by PZL, referenced in TCDS EASA.A.056. In addition to this, replace all placards located in the cockpit containing limitations associated with the Aircraft Flight Manual Supplements of the aforementioned Spanish STCs by those established in AFM Supplement No. 16, to Aircraft Flight Manual of PZL M18 "DROMADER" published by PZL.</p>
Ref. Publications:	<p>AFM Supplement No. 16 to Aircraft Flight Manual of PZL M18 "DROMADER" published by PZL, referenced in the a/c TCDS EASA.A.056.</p>
Remarks :	<ol style="list-style-type: none"> <li>1. If requested and appropriately substantiated the responsible EASA manager for the related product has the authority to accept Alternative Method of Compliance (AMOCs) for this AD.</li> <li>2. The safety assessment has requested not to implement the full consultation process and an immediate publication and notification.</li> <li>3. Enquiries regarding this AD should be addressed to Mr. M. Capaccio, AD Focal Point, Certification Directorate, EASA. E-mail: <a href="mailto:ADs@easa.europa.eu">ADs@easa.europa.eu</a></li> <li>4. For any question concerning the technical content of the requirements in this AD, please contact Dirección General de Aviación Civil. Paseo de la Castellana, 67. 28071 Madrid Ph: +34 91597 8859; +34 91597 8641 ; Fax: +34 91597 8584</li> </ol>