CIAIAC
Comisión de Investigación
de Accidentes e Incidentes
de Aviación Civil

TECHNICAL REPORT
A-005/2000

Accident of aircraft YAK-52, registration LY-EST, in El Alamo (Province of Madrid) on 10 March 2000

MINISTERIO
DE FOMENTO

Technical report

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SUBSECRETARÍA
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Foreword

This Report is a technical document which reflects the point of view of the Air Accidents and Incidents Investigation Commission (CIAIAC) regarding the circumstances in which the event being investigated happened, with the relevant causes and consequences.

In accordance with Annex 13 to the International Civil Aviation Convention and with Royal Decree 389/1998, of 13th March, which regulates the investigation of civil aviation accidents and incidents, the investigation is of an exclusively technical nature, without having been targeted at the declaration of blame or liability, or limits of personal or financial rights or liabilities. The investigation has been carried out without having necessarily performed legal evidence procedures and with no other basic aim than preventing future accidents. The results of the investigation do not determine or prejudge any disciplinary proceedings that, concerning the event, may be brought by the «Ley de Navegación Aérea» (Air Navigation Law).

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Abbreviations

00 °C	Grados centígrados
00° 00′ 00″	Grados, minutos y segundos
Ac	Altocúmulos
ACC	Centro de Control de Area
ADF	Equipo receptor de señal de radiofaros NDB
AIP	Publicaciones aeronáuticas internacionales
APP	Oficina de Control de Aproximación
ATC	Control de Tránsito Aéreo
CAT I	Categoría I OACI
Ci	Cirros
CRM	*Crew Resource Management* (Gestión de Recursos de Cabina)
CTE	Comandante
CTR	Zona de Control
Cu	Cúmulos
CVFR	Reglas de Vuelo Visual Controlado
CVR	Registrador de Voces en Cabina
DH	Altura de Decisión
DME	Equipo medidor de distancias
E	Este
EPR	Relación de presiones en motor
EM	Emisor/Emisión
ETA	Hora prevista de aterrizaje
FAP	Punto de aproximacion final
FDR	Registrador de Datos de Vuelo
ft	Pies
g	Aceleración de la gravedad
GPWS	Sistema de Avisos de Proximidad al Terreno
h. min: seg	Horas, minutos y segundos
hPa	Hectopascal
IAS	Velocidad indicada
IFR	Reglas de Vuelo Instrumental
ILS	Sistema de aterrizaje por instrumentos
IMC	Condiciones meteorológicas instrumentales
INTA	Instituto Nacional de Técnica Aeroespacial
Kms	Kilómetros
Kts	Nudos
Kw	Kilowatio
lbs	Libras
m	Metros
MAC	Cuerda media aerodinámica de la aeronave
mb	Milibares
MDA	Altitud mínima de descenso
MDH	Altura mínima de descenso
METAR	Informe meteorológico ordinario
MHz	Megahertzios
MM	Baliza intermedia del ILS
N	Norte
N/A	No afecta
NDB	Radiofaro no direccional
MN	Milla náutica
OM	Baliza exterior del ILS
P/N	Número de la Parte *(Part Number)*
PF	Piloto a los mandos
PNF	Piloto no a los mandos
QNH	Ajuste de la escala de presión para hacer que el altímetro marque la altura del aeropuerto sobre el nivel del mar en el aterrizaje y en el despegue

Abbreviations

RVR	Alcance visual en pista
S/N	Número de serie
S	Sur
Sc	Estratocúmulos
Shp	Caballos de vapor al eje
SVFR	Reglas de vuelo visual especial
TWR	Torre de Control
U T C	Tiempo Universal Coordinado
VIP	Pasajero muy importante
VMC	Condiciones meteorológicas visuales
VOR	Radiofaro omnidireccional VHF
W	Oeste

1. FACTUAL INFORMATION

1.1. History of the flight

On 10 March 2000, after lunch, at approximately 16:50 local time[1], the pilot, with one passenger aboard, began a local recreational flight from the aerodrome of Casarrubios del Monte (Toledo) in a YAK–52 aerobatic aircraft, registration LY-EST.

They took off normally and flew in the vicinity of the aerodrome for some forty minutes. It was approximately 17:30 local time when the pilot announced that he was going to make a pass over the runway and then land. He overflew the head of runway 8 at low altitude and immediately began a steep climb, at an angle of some 45°, up to a height of some 300 m (1000 ft) above the field, then leveled out into horizontal flight. The aircraft executed a half-roll and remained in an inverted position for some 25 or 30 seconds, during which it gradually lost height, following a course aligned with the axis of the runway. Then, at a height of very few meters, it completed the roll, returning to the normal flying position, but immediately crashed into the ground, at a point some 650 m to the east of the threshold of runway 26. The aircraft slid some 125 meters down a gently sloping hillside and then caught fire. The site of the accident is one kilometer north-east of the town of El Alamo (Madrid).

As a result of the impact, the two occupants of the craft were killed instantly and the aircraft was destroyed. The fire was extinguished by the fire service of the Autonomous Community of Madrid.

1.2. Injuries to persons

Injuries	Fatal	Serious	Minor/none
Crew	1		
Passengers	1		
Others			

1.3. Damage to the aircraft

The aircraft was completely destroyed as a consequence of the impact with the ground and the resulting fire of the remains. (See photos 3, 4 and 5.)

[1] UTC is one hour less than local time.

1.4. Other damage

There was no other damage.

1.5. Personnel information

1.5.1. *Pilot in command*

Age:	67 years old
Sex:	Male
Nationality:	Spanish
License:	Private aircraft pilot, issued by the Spanish Aviation Authority. Licence validated by the Inspection of Civil Aviation of Lithuania on 27/9/1999
Number:	2552
Seniority:	22/12/1954
Pilot's license:	
— Renewal date: — Expiry date:	21/09/1999 09/09/2000
Ratings:	Single-engine landplanes / VFR–HJ (daytime visual)
Total flight hours:	32,000
Hours in aircraft type:	Unknown
Hours in last 24 hours:	4

A retired airline pilot, he had flown from DC-3's to A-300's within 1966 and 1993. Previously, as a military pilot, he had flown the Bücker, HS 42, T-33 and F-86 Sabre. He was currently working as a YAK-52 instructor.

1.6. Aircraft information

The Yakovlev YAK-52 is a two-seater military training and aerobatic aircraft of Russian origin, with structural limits of +7 g's and of –5 g's, with a Vedeneyev M14P radial piston engine and semi-retractable undercarriage. It was designed for primary instruction of military pilots who would then go on to jet aircraft; however, today it is popular throughout the western world among enthusiasts of recreational flying. (See photo 1.)

1.6.1. *Aircraft identification*

Make:	Yakovlev
Model:	YAK-52
Serial number:	833303
Delivery date in Lithuania:	30/09/1999
Registration:	LY-EST
M.T.O.W.:	1200 kg
V_{NE}:	420 km/hr
Owner:	Three private owners, including the pilot

1.6.2. *Airworthiness Certificate*

Number:	00860
Radio station license:	5402
Type:	Restricted

The Airworthiness Certificate issued by the State of Registration did not permit the aircraft to fly in Spanish air space without special authorization. It did not have such authorization.

1.6.3. *Maintenance log*

Total flight hours:	973:20
Hours since general inspection:	63:34
Hours since delivery in Lithuania:	23:40
Last 50-hour inspection:	08/03/2000
Hours since last 50-hour inspection:	Approximately 3

The aircraft had performed several flights since the last 50-hour inspection. On the morning of the day of the accident it was flown by the same pilot, who reported that it was operating perfectly. Subsequently, at approximately 14:45, before lunch, he made another flight in the company of one of the aerodrome workers, executing various maneuvers without detecting any type of problem.

1.6.4. *Engine*

Make:	VEDENEYEV
Model:	M14P
Power:	360 HP
Serial number:	KR 832053
Total hours:	381:16
Hours since last general inspection:	Unknown
Last 50-hour inspection:	08/03/2000
Hours since last 50-hour inspection:	3 (approximately)

1.7. Meteorological information

The meteorological information compiled by the airports of Madrid and Cuatro Vientos is as follows:

METAR of Madrid at 1530 UTC
Wind: 210°, 4 knots
CAVOK
Temperature: 21°; dew point –4°
QNH: 1025

METAR of Cuatro Vientos at 1500 UTC
Wind: Calm
CAVOK
Temperature: 23°; dew point: 1°
QNH: 1025

The significant weather forecast for Toledo by the Madrid GPV (Forecast and Monitoring Group) was for slightly cloudy or clear skies. Scattered morning mists and mild, variable winds, predominantly easterly.

The forecast by the Meteorological Monitoring Office of Madrid for the Central area of the Peninsula for low-altitude flights, valid for 1200 UTC, was for visibility between 1000 and 5000 meters in the valleys; no other significant phenomena were forecast. In the report for 1800 UTC, no significant meteorological phenomena were forecast.

On that day, no SIGMET alerts were issued for the FIR of Madrid.

1.8. Aids to navigation

Not applicable.

1.9. Communications

The aircraft had a radio, which the pilot used to communicate with other aircraft in flight. At one point prior to the accident, he established contact with the pilot of another aircraft in flight and informed him of his intention to make a pass and land.

1.10. Aerodrome information

The aerodrome is private, owned by Aeromobby Aviación Deportiva, S. A.

The reference point of the aerodrome of Casarrubios del Monte (Toledo) (LEMT), has the following coordinates: 40° 14,167' N, 4° 01,500 W, and an altitude of 626 m. It is within the TMA of Madrid. The aerodrome has a tarmac runway of 1000 m length with 08/26 orientations, and an unpaved landing strip of 800 m. It is authorized for VFR flights.

To the east of the aerodrome, the ground descends abruptly from the edge of the runway area towards a valley bottom. Then it rises gently towards the Fría hill (the site of the accident), which has an altitude similar to that of the aerodrome, and which is in the immediate vicinity of the town of El Alamo (Madrid), one kilometer further to the south-east. (See location map and photo 2.)

1.11. Flight recorders

The aircraft was not carrying flight recorders, which are not compulsory for aircraft of this type.

The G indicators were recovered from the remains of the accident, indicating maximum accelerations reached of +4 g's and –4 g's. These acceleration readings do not tell us the duration of the loads nor the moment when the maximum values were reached. (See photo 8 for information on the type of instrument.)

1.12. Wreckage and impact information

The aircraft crashed at the top of the Fría hill, on hard, stony ground with little vegetation, after flying over a two-meter high fence some 650 m from the head of runway 26 of the aerodrome of Casarrubios del Monte. The local time was approximately 17:30.

The aircraft's approximate course was 110° and it was in a normal flying attitude. The remains slid down the hillside for some 125 m., curving towards the right.

Before crashing, the aeroplane broke the tips of a number of broom shrubs in the area. The angle of the aircraft's descending trajectory, measured by the height of the broken branches and the distance from the first signs of impact, was some 15° from the ground, and the slope of the terrain was roughly 10°. The angle of the aircraft's trajectory from the horizontal plane was thus about 25°. (See photo 2.)

The first impact was hard, on a terrain which slopes slightly to the right, leaving a mark some two meters long, one meter wide and twenty centimeters deep. The perpendicular mark of the wing could be distinguished all across it, as well as various marks made by the three semi-concealed wheels of the landing gear. (See photo 3.)

The order in which the remains were scattered in the 200-meter slide following the crash as follows:

— Nose leg, in the center-right.
— Piece of the right aileron, to the right
— Pieces of the propeller blades, some 25 m. to the left.
— Main bulk of the remains with a final trail of fire marks and burnt remains of some four meters. These remains finally came to rest 125 m from the first impact point, with a southward orientation.
— Main wheel axle, to the right and ahead of the aircraft.
— Accessories and propeller spinner to the left and ahead of the aircraft.
— Engine and engine cylinder ahead of the aircraft. These finally came to a stop some 100 meters ahead of the principal remains.

The passenger's body was trapped inside the aircraft, partially charred.

The pilot's body was dragged along with the remains of the aircraft for the last fifty meters and finally came to rest outside the aircraft, under the right wing. (See photos 1 to 7 and diagram 1.)

1.13. Medical and pathological information

Both occupants of the aircraft died as a result of multiple injuries sustained in the impact with the ground.

Some witnesses indicate that he suffered from diabetes. The relevant result of the latest medical check for licence renewal, dated 9-9-1999, was 118 mg/dl of glucose (the reference or «normal» values for this parameter are 74-110).

Other reports indicate that the pilot ate copiously that afternoon, some 40 minutes before the flight.

1.14. Fire

According to eyewitness statements, when the aircraft hit the ground it caught fire, and when it came to a stop an explosion occurred.

First-aid teams arriving from the aerodrome with fire extinguishers were unable to control the flames. Two teams of firefighters from the Autonomous Community of Madrid fire service arrived and were finally able to put out the fire.

1.15. Survival aspects

Due to the violence of the impact, there were no possibilities of surviving the accident.

1.16. Tests and research

1.16.1. *Trajectory of the aircraft*

The testimony of a pilot in flight and of several witnesses at the aerodrome and in the vicinity of the crash point indicate that the aircraft made a low-altitude pass over the head of runway 08, then immediately began a steep climb, at an angle of some 45º, reaching a height of some 300 m (1000 ft) above the field, then leveled out into horizontal flight. The aircraft executed a half-roll and remained in an inverted position for some 25 to 30 seconds, during which it gradually lost height, following a course aligned with the axis of the runway. Then, at a height of very few meters, it completed the roll, returning to the normal flying position, but immediately crashed into the ground at a point some 650 m to the east of the head of runway 26. The aircraft slid some 125 meters down a gently sloping hillside and caught fire before stopping.

A shepherd who witnessed the accident stated that the aircraft had been making passes for some time and that he did not see it make any strange maneuver as he watched it fly straight into the ground. (See photo 2 and diagram 2.)

1.16.2. *Study of the remains*

1.16.2.1. Study of the harnesses

The positions of both the pilot and passenger have similar five-point harnesses composed of:

— Two belts: left and right,
— Two shoulder straps, and
— A central inner leg strap.
(See photo 7 and diagram 3.)

The five straps have extendible buckles to adjust the length to the size of each occupant and links to fasten them to the structure of the aircraft. The left belt ends in a male piece into which the end rings of the other four straps are inserted. The harness is locked or fastened by means of a pin which passes through a hole in the male piece to fix the rings in place and is then fastened to the right belt by a loop.

The anchor points of the pilot's shoulder straps were intact, while the anchor point of his central inner leg strap was broken, leading to the deduction that the pilot was secured at only three points: the two waist straps and the central inner leg strap.

The passenger's harness showed the anchor points broken and the inner leg strap fastening deformed, indicating that he was fastened at all five points.

The tension of the straps could not be determined because the fire partially consumed the belt material.

1.16.2.2. Instruments and levers

The g indication instruments have vanes which record the maximum accelerations, both positive and negative, during the flight. The values shown were +4 g and –4 g.

The engine power indicator was at 60-65% and the throttle levers were deformed by the impact, but were apparently at the half-gas position, with no abnormal details being observed.

1.16.2.3. Propeller and engine

The two wooden blades of the propeller, broken at their root in the hub, indicate engine power on impact. The tracks and marks in the last pinions of the reduction gear confirm fast rotation at the last instant. The remains of the blades were recovered twenty-five meters to the left and ahead of the first impact.

The remains of the radial engine showed its two lower cylinders detached. The first impact occurred with the nose-down attitude. (See photos 6 and 7.)

1.16.2.4. Flight controls

The right aileron was found detached and broken to the right of the trail left after the impact.

The other controls showed only impact damage and turned freely.

1.17. Organizational and management information

Not relevant.

1.18. Additional information

1.18.1. *References to information on aeronautical medicine and the G effect*

Reproduced below are fragments of several documents referring to aerobatic flying and the physiological alterations they cause in the human body, which may bear some relation to the events studied here.

References:

— FAA AC N° 91-48
— FAA AC N° 91-61
— FAA AIM, Chapter 8, Medical Facts for Pilots
— NTSB Safety Recommendation A-99-1 and 2
— BASI Research Report 872-1017
— Medical Physiology, Guyton & Hall, Ed. Saunders

«The main effect of accelerations on the vertical axis is exerted upon the cardio circulatory system. The effect of +Gz acceleration, which is experienced in pulling the stick in coming out of a dive, moves blood towards the lower extremities of the body; thus, the amount of blood that enters and leaves the heart is reduced, also diminishing the supply of blood to the eyes and brain, which both need a continuous flow of blood to function properly. The reduced blood flow and thus, the supply of oxygen to the head may cause perturbations of vision and loss of consciousness.»

«Loss of consciousness, which has been studied experimentally in human centrifuges, lasts an average of 15 seconds, followed by an additional interval of 5 to 15 seconds of partial incapacity. Thus, should a loss of consciousness occur, there will be a period of 20 to 30 seconds, or even more, in which the pilot does not control the aircraft.»

«Blood vessels in the brain can successfully bear a negative acceleration at an average degree of – Gz, but the increased blood pressure in the chest and neck lead to a reduction in the cardiac rhythm. In some individuals, the reduction of cardiac rhythm is so pronounced that the interval between beats can be several seconds. Reduction of the cardiac frequency and alterations in the rhythm are added to a situation of blood pooling in the brain, which may cause a loss of consciousness.»

«Although the numerous factors involved make it difficult to predict what degree of acceleration any given individual can bear, individual tolerance is related to duration,

intensity, direction and speed of the start of acceleration. Other factors such as height, age, elasticity of the blood vessels, fatigue, physical condition and health are crucial in determining an individual's degree of tolerance.»

«The tolerance threshold at Gz + (positive accelerations in the longitudinal axis) depend on the individual, and are subject to variations among the population, and even for a single individual. Population averages range from 4 to 6 g's [...] in exposures longer than four seconds.»

«Recent studies have revealed that instantaneous loss of consciousness is a possibility in medically normal individuals at acceleration levels as low as 2 to 3 Gz.»

«Blood pressure, both systolic and diastolic, falls from normal levels» of 120/80 mmHg, «to levels below 22/22 mmHg in a few seconds when a positive acceleration is applied suddenly and maintained in the vertical axis +3.3 g's for a seated person. Then it recovers to levels of 55/20 mmHg in a period of some 10 to 15 seconds. This secondary recovery is caused mainly by a reflex activation of the baroreceptors.»

«An important aspect in tolerance to acceleration in the vertical axis is the rapid change of direction from +G to –G, or vice versa. As such changes occur in aerobatic maneuvers, the reduction in individual tolerance can be highly significant. For example, it is known that when a person is subjected to –Gz, the blood baroreceptors in the brain and thorax respond to the higher pressure and cause a reflex reducing the cardiac rhythm. A rapid change to +Gz (for example, when the pilot executes a half spin), makes the pressure drop suddenly in those receptors, quickly increasing the cardiac rhythm in order to maintain the pressure; but, because the reflex system needs a certain amount of time to perceive the change, the heart might lag in its response, thus leaving the brain with an insufficient blood flow.»

«Watch what you eat. Proper exercise and diet help to maintain correct sugar levels. A low level may reduce resistance to acceleration. A copious meal may retain a certain amount of blood in the digestive tract and diminish tolerance to G's, reducing the amount of blood available for general circulation.»

1.18.2. *Regulations in force on the operation of aircraft with registration*

Reproduced in Appendix C is the Spanish AIC of 17 August 1999, which sets out Spanish regulations on the operation of aircraft with registration in Spanish air space.

1.19. Useful of effective investigative techniques

Not used.

2. ANALISYS

2.1. Flight

Based on the meteorological data contained in point 1.7, it may be assumed that the weather at the aerodrome of Casarrubios del Monte was good, with mild winds, predominantly from the east, slightly cloudy or clear skies and good visibility. The conditions were suitable for VFR flying.

The aircraft did not have specific authorization for aerobatic flying in Spanish airspace because it had foreign certificate of airworthiness and registration that only permitted it to engage in ordinary flight. This type of aircraft operates and is accepted in countries of the European Union, the United States of America and New Zealand. With its powerful 360 HP radial engine, low weight and robust structure capable of bearing +7g and –5g, it is considered an excellent aerobatic aircraft.

As for the state of maintenance of the aircraft in question, no prior material problem was detected either in previous flights or in the examination of the remains after the accident. The flight controls performed well and the engine had power. The fact that the fragments of the propeller blades were thrown twenty-five meters to the left confirms that the propeller had movement of its own in addition to that of its forward motion with the aircraft.

There is evidence that the aircraft had been performing aerobatics for some time during the flight and that high degrees of acceleration were reached, in that or in previous flights, of +4g and –4 g, if we are to trust the indicator vanes of the recovered instruments. The inclination of the trajectory, of some 25°, was maintained in an inverted position from the vertical of the strip at a height of around 300 m to the impact point some 1000 m to the east. Only at the end was the normal flight attitude regained. The separation of the right aileron upon impact may indicate that it was still tilted downwards, possibly to consciously correct the aircraft's slight inclination to the right prior to impact, because it struck a right-sloping terrain with the full width of its wings. The engine was turning at a little more than half power, and the propeller, which spins to the left, broke upon hitting the ground, throwing the fragments still further to the left. The tracks of the nose, the engine minus its two lower cylinders and the three different tracks of the landing gear indicate a violent impact with a slight downward angle.

The airspeed would be some 200 km/hr, because it took some 30 seconds to cover the 1650 m between the head of strip 08, where it climbed after the pass, to the point of impact. The inertia of the impact broke the safety harnesses, and the pilot's body, which was secured at only three points, was dragged outside the aircraft. The rigging of the harnesses, though sufficient for the in-flight accelerations, was not sufficient to bear those of the impact. Although the passenger was properly belted into his seat, he would

not have survived the great violence of the impact. The fire and subsequent explosion charred the remains.

There is a belief in aeronautical circles in general aviation that the risks of aerobatic flight mainly arise from exceeding the aircraft's limits of structural resistance. Nevertheless, in these flights, the combination of aircraft and pilot may be weaker on the pilot side than the aircraft side: the human body cannot repeatedly withstand the same accelerations that the aircraft can bear.

In this case, the information gathered on the events point towards some sort of incapacitation of the pilot during the final phase of the flight. It cannot be considered normal to maintain an inverted attitude for 20 or 30 seconds, or to fail to react or use the flight controls when approaching the ground.

This incapacitation may have been simply positional. During prolonged inverted flight, the pilot's body hangs from his straps. Three-point fastening is sufficient if the straps are well-adjusted and with no slack. If the straps are not tight, the pilot may find himself slipping away from the flight controls and unable to operate them, leading to an uncontrolled dive to the ground.

It is considered much more probable that the incapacity to continue controlling the aircraft suddenly occurred for physiological reasons. Based on the information contained in point 1.17, which is often unfamiliar to pilots who perform aerobatics, it is known that a lack of blood flow to the brain and its lack of oxygen lead to loss of sight and loss of consciousness. The general blood circulation can be diminished by the general state of health of the cardiovascular system, atherosclerosis, a lack of elasticity of the arteries, or the diversion of blood flow to the digestive tract during digestion. For simply hydrostatic reasons, positive vertical acceleration moves blood towards the lower extremities of the body and the heart stops receiving blood to be pumped towards the head. Under normal conditions, the limit of positive acceleration that can be tolerated by the human body for more than four seconds is usually considered to be 4 to 5 g's, beyond which gray sight disorders begin, followed by total loss of vision, which usually precede loss of consciousness. Differences between individuals, training, tobacco use, age, physical condition, medication, etc., can determine different personal limits of resistance to acceleration that are lower, perhaps only +2 or +3 g's. The results of the level of glucose in the blood during the latest medical check are not conclusive regarding the influence of that level of glucose in the accident.

The loss of consciousness caused by acceleration, according to tests conducted in centrifuge chambers, lasts an average of 15 seconds, followed by a further interval of 5 to 15 seconds of disorientation.

In this accident, the pass and rapid climb described by eyewitnesses entail a strong positive vertical acceleration followed by a negative vertical acceleration, in a maneuver exe-

cuted by a pilot of advanced age, a smoker, in the process of more or less heavy digestion. The pilot's long experience was unable to prevent or compensate for the syndrome of loss of consciousness. Following the probable incapacitation of the pilot, the aircraft would glide on its own in an inverted position, during the gap in consciousness; and when the pilot began to recover consciousness, still disoriented, he could only straighten the aircraft into a normal flying attitude but was unable to prevent the impact.

3. CONCLUSIONS

3.1. Findings

— The pilot was qualified for the flight and had a valid licence.
— The aircraft had a valid Airworthiness Certificate issued by the state where it was registered, which did not permit aerobatic flight in Spanish air space.
— The meteorology was suitable for visual flying.
— A maintenance inspection had been conducted 4 hours before the accident, without detecting any problems.
— The aircraft was performing aerobatic flights which subjected the aircraft, passenger and pilot to high levels of vertical acceleration.
— The aircraft described a descending trajectory in an inverted position for the abnormally long period of 20-30 seconds, which ended with the impact against the ground moments after regaining a normal flying attitude.

3.2. Causes

The probable cause of the accident is considered to be the pilot's sudden inability to use the aircraft's flight controls, in suffering a loss of consciousness induced by the effect of a high level of vertical acceleration resulting from the maneuvers he had just performed.

The pilot's tolerance threshold for vertical acceleration may have been lowered by his own physical conditions and his age, in addition to the transitory situation of digestion of the recent consumption of food.

4. SAFETY RECOMMENDATIONS

None.

APPENDICES

APPENDIX A
Photographs

Photo 1. *Aircraft of the type in the accident*

Photo 2. *Threshold of the runway, on the other side of the valley bottom, seen from the point of impact. Wire fence and nearby broom shrubs overflown by the aircraft*

Photo 3. *First impact*

Photo 4. *Main bulk of remains*

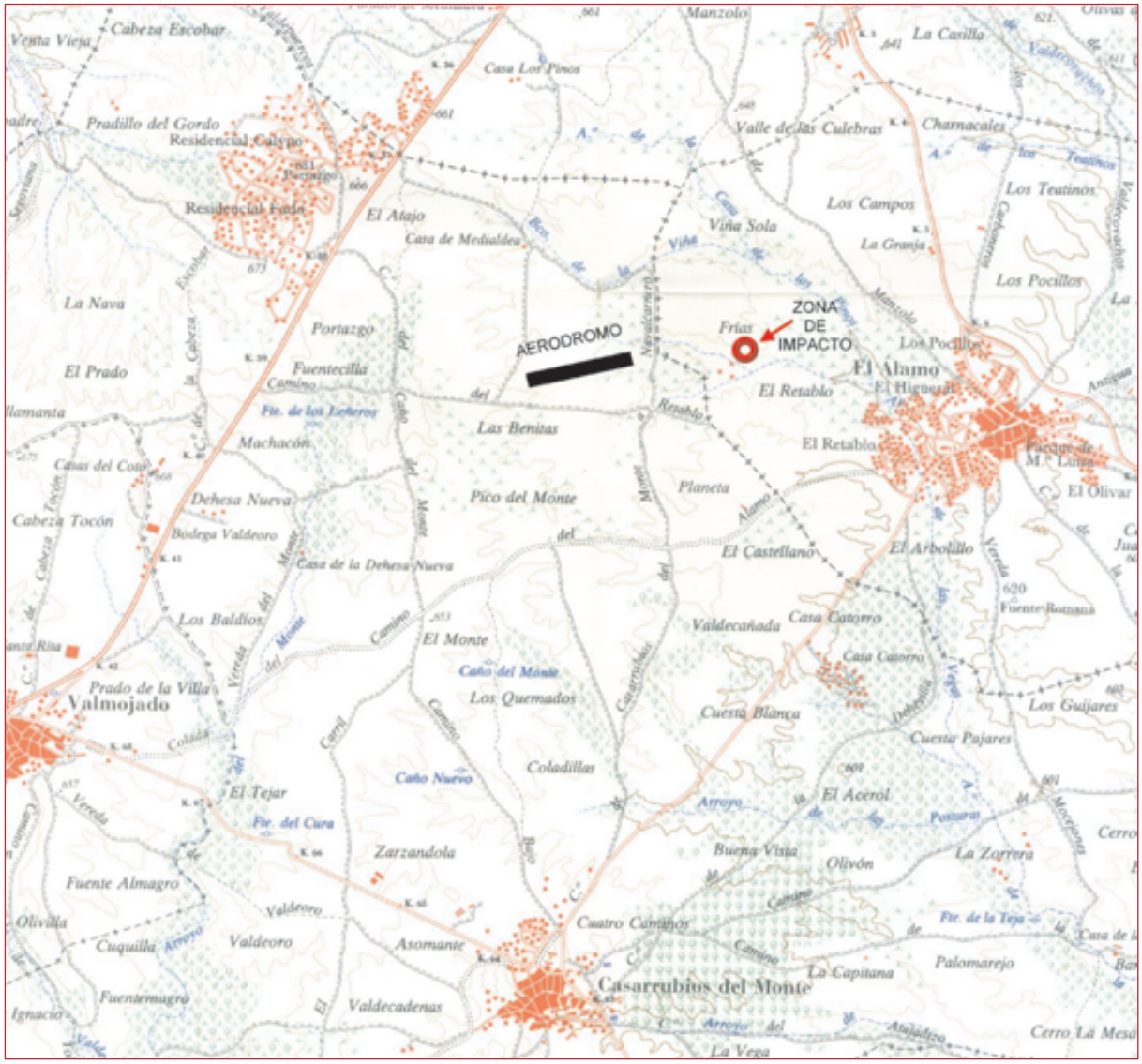
Photo 5. *Remains of the engine*

Photo 6. *Propeller shaft*

Photo 7. *Harnesses of the type installed in the accident aircraft*

Photo 8. *Indicator of the type carried by the accident aircraft*

APPENDIX B
Maps and diagrams



Map 1. *Location of the accident site*

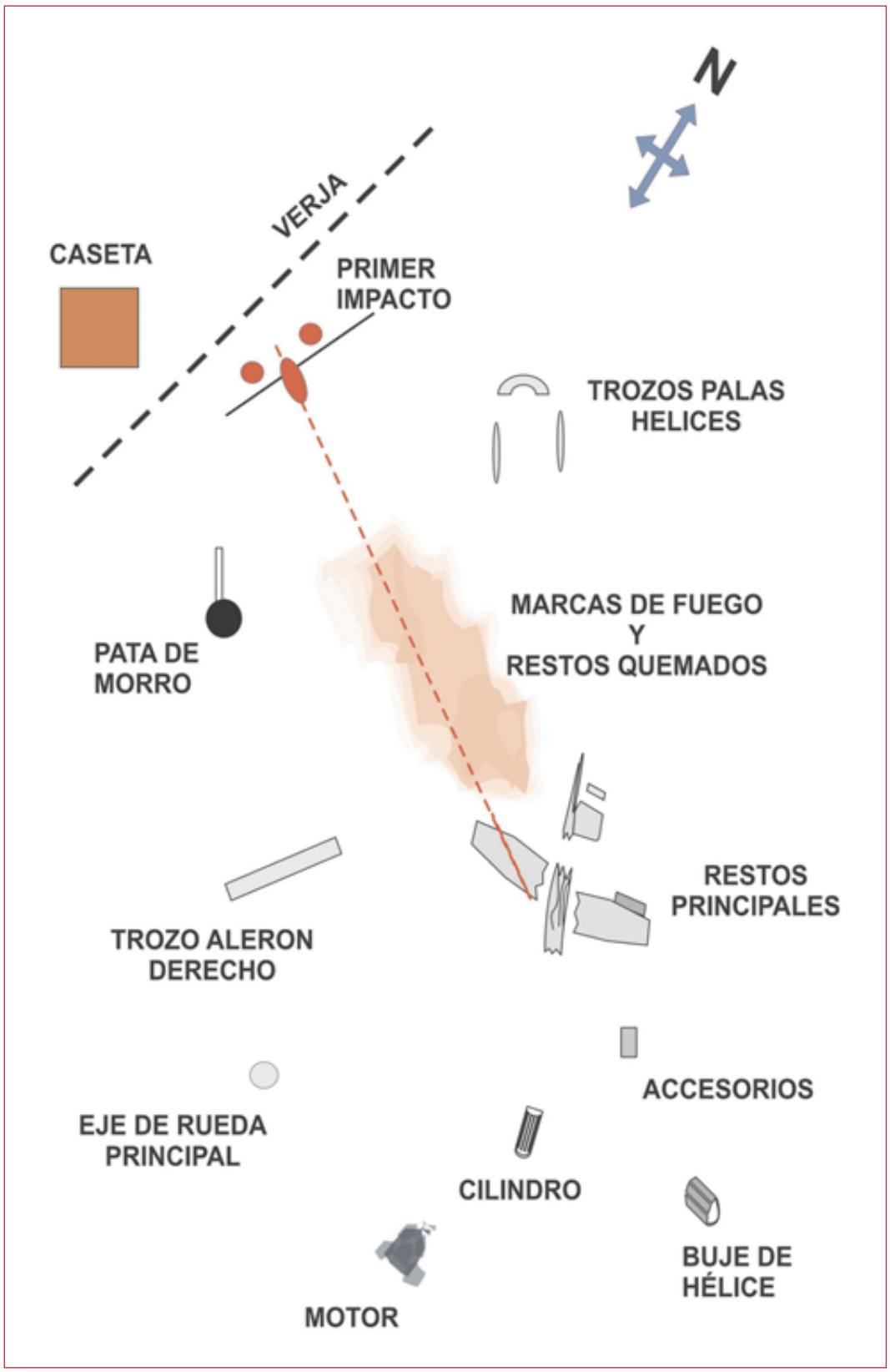


Diagram 1. *Final position of the remains*

Diagram 2. *Trajectory of the impact*

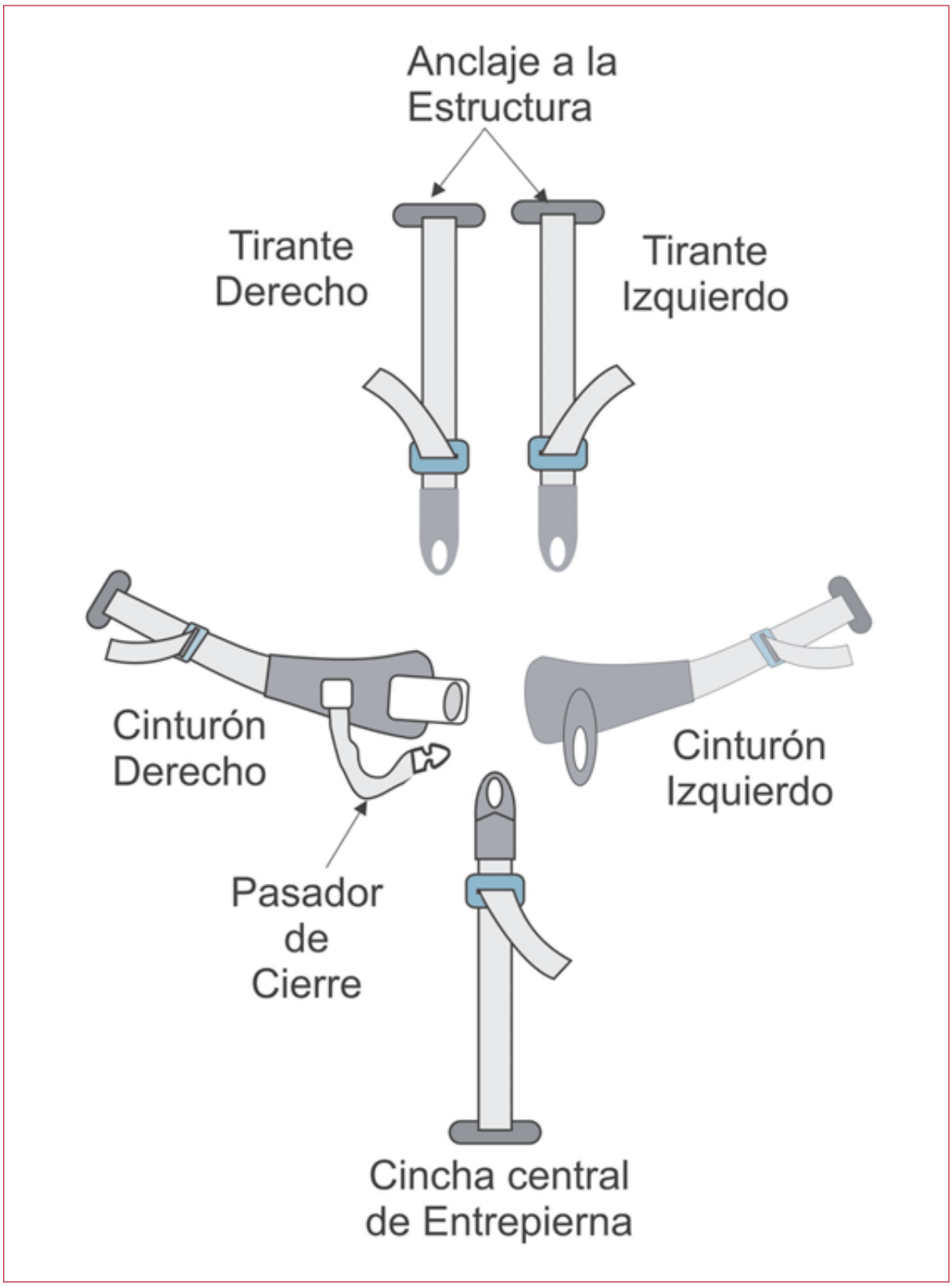


Diagram 3. *Harnesses*

APPENDIX C
AIC NATIONAL, dated 17 August 1999

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OPERACIÓN DE AERONAVES CON MATRÍCULA EXTRANJERA EN EL ESPACIO AÉREO ESPAÑOL

De acuerdo con el artículo 1 "Soberanía" del Convenio sobre Aviación Civil Internacional, de 7 de diciembre de 1944, todo Estado tiene soberanía plena y exclusiva en el espacio aéreo situado sobre su territorio. Así mismo la Ley 48/1960 sobre Navegación Aérea, reserva a "las aeronaves nacionales la utilización del espacio aéreo español". Las aeronaves extranjeras podrán hacer tránsito inocuo en el espacio aéreo español, en virtud de Convenios con otros Estados, Tratados o mediante permisos especiales.

Por otro lado, los operadores españoles de aeronaves están obligados a inscribirlas en el Registro de Matrícula de Aeronaves, según establece el Artículo 20 de dicha Ley 48/1960. En definitiva, la situación quedaría resumida de la siguiente forma:

1. Las aeronaves extranjeras solo pueden hacer un "tránsito inocuo" sobre el territorio nacional, no estando permitidas por tanto, salvo autorización especial, ninguna operación distinta a aquella. No se considera "tránsito inocuo" las operaciones de lanzamiento de paracaidistas, acrobacia, etc., realizadas con aeronaves extranjeras en espacio aéreo español.

   Hacen excepción a dicha norma las aeronaves registradas en un Estado de la Unión Europea, en virtud de las obligaciones derivadas del Tratado de la Unión Europea, reservándose, en cualquier caso, a la Dirección General de Aviación Civil el derecho a efectuar eventuales inspecciones de las mismas, sin perjuicio de las obligaciones que corresponden al Estado de matrícula.

2. Los operadores españoles vienen obligados a registrar sus aeronaves en el Registro de Matrícula de Aeronaves de la Dirección General de Aviación Civil, siendo necesario para ello la previa expedición del Certificado de Aeronavegabilidad que exige la Ley 48/1960 en su artículo 36.

CONCLUSIÓN

La importación de aeronaves requiere por tanto, para su operación en el espacio aéreo español, estar inscrita en el Registro de Matrícula de Aeronaves. Para evitar situaciones confusas y aportar las mayores garantías, la Dirección General de Aviación Civil viene informando a todo aquel que lo solicita, sobre la viabilidad de la expedición o convalidación del Certificado de Aeronavegabilidad, como paso previo a la inscripción registral, en:

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