



COPY

MINISTÉRIO DA ECONOMIA E DO EMPREGO  
GABINETE DE PREVENÇÃO E INVESTIGAÇÃO DE ACIDENTES COM AERONAVES

## AIRCRAFT INCIDENT REPORT

*The only aim of this technical report is to collect lessons which may help to prevent future accidents. Safety investigation is a technical process aiming to accident's prevention and comprises the gathering and analysis of evidences, in order to determine the causes and, when appropriate, to issue safety recommendations*

*In accordance with Annex 13 to the International Civil Aviation Organisation Convention, Chicago 1944, EU Regulation Nr. 996/2010, from European Parliament and Council, 20<sup>th</sup> OCT 2010 and article 11<sup>th</sup> n<sup>o</sup> 3 of Decree-Law n<sup>o</sup> 318/99, 11<sup>th</sup> AUG 1999, the sole purpose of this investigation is to prevent aviation accidents. It is not the purpose of any such investigation process and the associated investigation report to apportion blame or liability.*

<b>Date/Time:</b> 24-01-2012 @ 16:30 UTC <sup>1</sup>	<b>Proc. Nr.:</b> <b>01 / INCID / 2012</b>
<b>Operator:</b> Leiria Flying Club	<b>Type of Incid.:</b> RUNWAY EXCURSION
<b>Id. of aircraft:</b> Cessna 152, Reg. G-CGSP	
<b>Local:</b> Leiria Aerodrome ( LPJF )	
<b>Type of flight:</b> Pleasure	<b>Phase of flight:</b> Landing
<b>People on board:</b> Crew- 1 Pax- 1	<b>Injuries:</b> Nil
<b>Aircraft Damage:</b> Light	
<b>Synopsis:</b> The Cessna 152 aircraft with a British registration G-CGSP, privately owned but flying with Leiria Flying Club, was engaged on a local flight in the vicinity of José Ferrinho aerodrome, Leiria (LPJF). When performing a landing manoeuvre on runway 02, the pilot was unable to maintain the aircraft inside runway, which veered to the right, exited the tarmac and travelled for about 30m on the grass before it came to a stop. The weather was fine, with a clear sky, good visibility and wind calm, being not considered a contributory factor for the incident. Pilot and passenger exited the aircraft unharmed but the aircraft suffered light damage on its propeller blade tips, landing gear and left wing intrados.	

**GPIAA**

Homologo, nos termos do n<sup>o</sup> 3  
do art<sup>o</sup> 26<sup>o</sup> do D. L. 318/99,  
de 11 de Agosto de 1999

03 . JUN . 2012

O Director,

Fernando Ferreira dos Reis

<sup>1</sup> - All times in this report, unless other specified, are UTC time (Universal Coordinated Time). By that date, local time in mainland Portugal and Madeira was equal to UTC.

## 1. FACTUAL INFORMATION

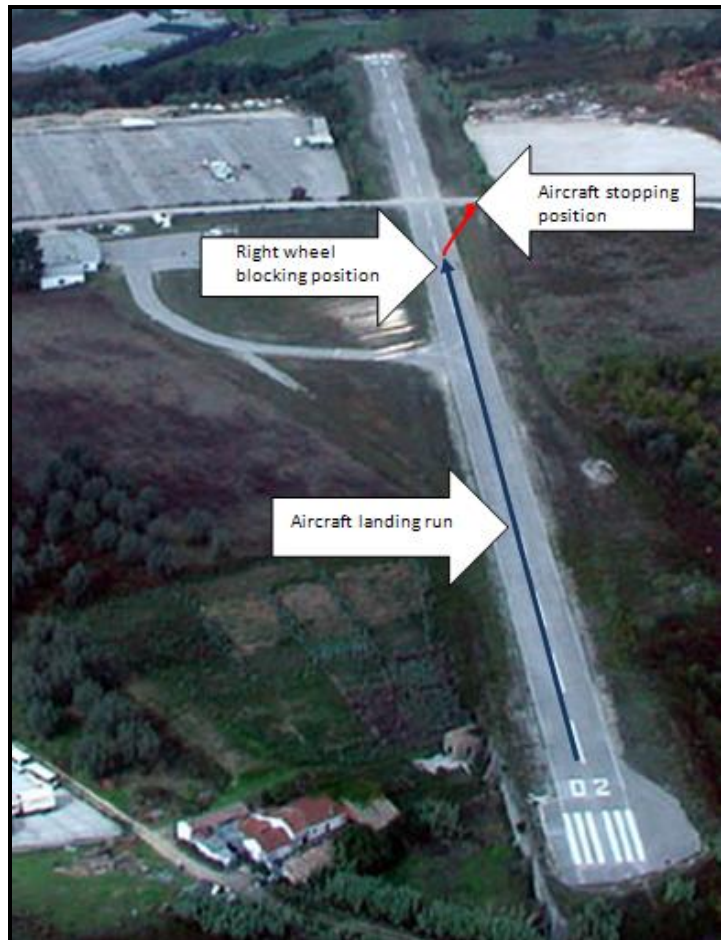
### 1.1 History of the Flight

The Cessna C-152 aircraft, s/n 82543, with U. K. registration G-CGSP, was performing a local flight, in the vicinity of José Ferriño aerodrome, Leiria, carrying two people on board, one pilot and one passenger.

As per pilot declaration, by 16:30 he landed on the beginning of runway 02 (first 50 to 80m) and let speed decrease (till speedometer stop indicating) before starting brake application, which occurred after covering about 200m.

As pedal pressure was increased, the aircraft started veering to the right and he tried to compensate with higher force on left pedal, but without success.

At a certain time he felt that right wheel was blocked and the aircraft run out of runway, covered about 30m on the grass and came to a stop near the road that crosses the runway (picture nº 1 – pilot drawing).



Picture Nº 1

Pilot and passenger exited the aircraft by their own, suffering no injuries.

The aircraft was towed into Leiria Flying Club hangar, in order to proceed to required examinations for determination of the incident causes.

### 1.2 Aircraft Damage



Picture Nº 2

The soil in runway edges was not compacted enough and the nose wheel dig a deep groove along its path, until coming to a halt in a terrain depression, causing nose wheel steering left command rod to break.

At same time, propeller to ground clearance was shortened and propeller blades contacted the ground causing blade tips to bent (picture nº 2).

### 1.3 Personnel

Steering the aircraft was a male Portuguese pilot, aged 34, holder of a Commercial Pilot License (CPL(A)) issued in 01-03-2011 by Portuguese Civil Aviation Authority (INAC).

His last medical examination was on 08-08-2011 and he got a class 1 classification, with the restriction to wear corrective lenses and carry a spare pair of spectacles (VDL).

On his Logbook a total flying experience of 250 hours was registered, being 85 on same aircraft type. During the last 90 days he flew 03:40 hours, being 01:20 in the last four weeks and 00:35 on incident's day.

### 1.4 Aircraft

#### 1.3.1 General

The aircraft was a single engine propeller, high wing monoplane, fixed tricycle landing gear airplane, with room for two people, a Maximum Take-Off Mass (MTOM) of 758kg and following technical references (*table nº 1*):

Reference	Airframe	Engine	Propeller
<b>Manufacturer:</b>	Cessna Aircraft. Corp.	Lycoming Eng.	McCaughey
<b>Model:</b>	C 152	O-235-L2C	1A103/TCM6958
<b>Serial Nº:</b>	82543	L-22298-15	PI145
<b>Year of Manuf.:</b>	1979	2007	-
<b>Flight Time:</b>	8601:40	774:59	834:55

Table Nº 1

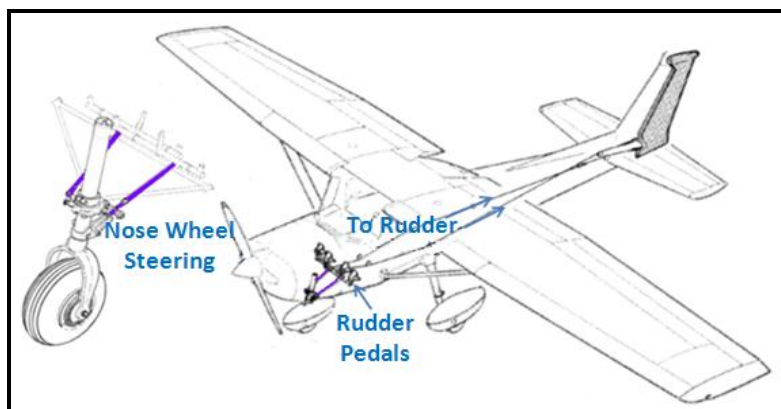
Aircraft Airworthiness Certificate, issued by U. K. Civil Aviation Authority (CAA) was valid and last maintenance scheduled inspection (100 hours inspection) had been performed on 20-12-2011. After that the aircraft flew 38:30 until the incident, without any deficiency or limitation registered on its Logbook.

#### 1.3.2 Landing Gear

Cessna 152 landing gear is a tricycle non retractable type gear, composed by two main legs and one nose leg, all of them equipped with one wheel each, usually protected by a fairing plastic structure, in order to reduce drag.

Nose gear leg is provided with an air/oil shock absorber and a steering control system actuated by rudder pedals, allowing an 8.5° amplitude turn to each side (*picture nº 3*).

Assisted by differential braking, this amplitude may be extended to 30°.



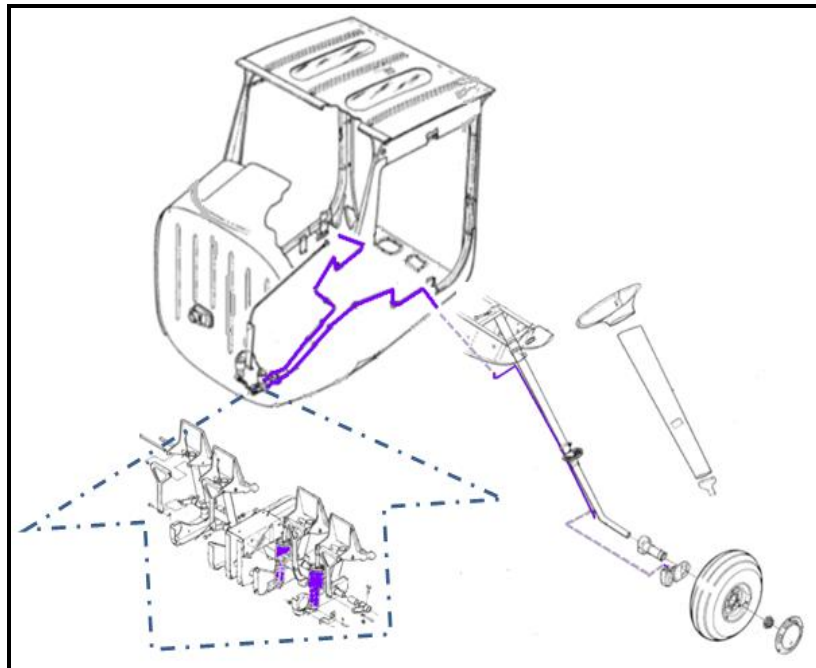
Picture Nº 3

Main landing gear is equipped with a hydraulically actuated disc-type braking system, installed on the inboard side of each wheel, and shock absorption is provided by the tubular spring-steel main landing gear struts plastic deformation.

### 1.3.4 Braking System

Main gear wheels are equipped with a disc-type hydraulic braking system (picture nº 4).

When pressing the rudder pedals, respective main cylinders (hydraulic pumps) are actuated, creating a pressure increase inside. This increased oil pressure is transmitted along the oil line and acts on brake cylinders and compresses the brake pads against the rotating disc, connected to the wheel, forcing it to reduce rotating speed, due attrition force.



Picture Nº 4

This permits a differential or simultaneous braking on both wheels, proportional to the force exerted on the pedals. Releasing pedal pressure, oil pressure decreases and allows recovering springs to put brake pads away from disk surface and let the wheel rotate freely.

In order to grant parking braking capability, a cable mechanism acts on main cylinders, keeping internal pressure and consequent wheel braking.

### 1.5 Meteorology



Picture Nº 5

At January 24<sup>th</sup>, 2012, the weather in Portugal was determined by the presence of a High pressure situation, originating a clear sky and light variable wind (picture nº 5).

At Leiria, the wind remained calm all day and there was a light precipitation (0.1mm only), by 09:00, becoming sky clear for the rest of the day. Air temperature varied between +1°C (at 08:00) and +17°C (at 16:00), with a rapid descent afterwards.

Atmospheric pressure varied slightly, around 1022hPs and 1021hPs, as per meteorological readings from Air Force Base of Monte Real, in the proximity, shown below:

**METAR LPMR 241500Z 12006KT CAVOK 16/07 Q1022**

**METAR LPMR 241600Z 16005KT 130V190 CAVOK 17/08 Q1021**

**METAR LPMR 241700Z 18005KT CAVOK 17/07 Q1021**

## 1.6 Aerodrome

José Ferrinho aerodrome, operated by Leiria Flying Club, is located at Gândara dos Olivais, Leiria, being surrounded by an industrial area and some farmland and small forests, without significant natural obstacles, but several manmade obstacles (*power lines, antennas, high buildings, etc.*) and there are some roads around, with one of them crossing the runway (*picture nº 6*).



Picture Nº 6

There's only one landing strip, orientated on a Northeast/Southwest direction (*020°/200° magnetic*) being its runways designated **02 & 20**. Access to the runway from ramp and hangar is made by one single asphalted taxiway or an alternate gravel track.

Reference point is situated at coordinates **N 39° 46' 56''**, **W 008° 49' 11''** and runway's thresholds of runways 02 & 20 are at an altitude of 133ft & 130ft, respectfully.

In order to grant aircraft's safety operation, any time there are take-off or landing maneuvers, the gates which prevent road traffic from crossing the runway must be activated.

Because the aerodrome is situated inside Air Force Base nº 5 (Monte Real) reserved air space, its use is conditioned by the air activities of that Base, being necessary to coordinate with BA5 Control Tower (122.10MHz) prior to operate in the aerodrome, which becomes restricted to radio equipped aircrafts.

**VFR Manual**, promulgated by Civil Aviation Authority (INAC) and issued by NAV-EP, presents all information and operating procedures, regarding this aerodrome, like **Roteiro das Pistas Portuguesas**, prepared by Nuno César and publicized by Ultralight Aircraft Pilots Association (APAU), on its webpage ([http://roteiro.apau.org/zp\\_leiria.html](http://roteiro.apau.org/zp_leiria.html)).

VFR Manual		Roteiro das Pistas Portuguesas																																																	
<b>LEIRIA AD</b> .....		<b>LEIRIA</b>																																																	
<b>11 LOCAL RESTRICTIONS</b>		<b>Loc. N 39° 46,79' - W 008° 49,21'</b>																																																	
Obstacles:		QFU	Comp	Larg	Piso	T.Aer.	Declive																																												
RWY02 - Power lines 1300m day marked		02/20	600m	9m	Asfalto	Ligeiras	0%																																												
RWY20 - Barrier																																																			
Aerobatics:		<b>INFORMAÇÕES:</b>																																																	
Occasional aerobatics activity - suspended whenever aerodrome traffic occurs		Pista certificada - Sim																																																	
<b>12 PROCEDURES</b>		Localização - Junto a Gândara dos Olivais -- 1 Km N de Leiria																																																	
Due to the fact of the aerodrome being crossed by a public road, previous permission is required for granting safety conditions of runway use.		Responsável - Aero clube de Leiria																																																	
PPR to AD or AD director phone		Tel - 244 840 193																																																	
The aerodrome location within MONTE REAL MCTR, requires clearance by MONTE REAL TWR (freq. 122.100MHZ). Aircraft entry and exit only allowed with two way radio communications		Director - Vítor Moita																																																	
Approach and landing circuit to RWY02/20 shall be performed by WEST, avoiding overflight of Vila de Marrazes where are located several obstacles and buildings protruding the obstacle clearance surface.		Horário - Diurno																																																	
		Manga de vento - Sim																																																	
		Marcas na Pista - Sim																																																	
		Combustíveis - AVGAS 100LL																																																	
		Hangar - 1																																																	
		Guarda - Permanente																																																	
		Restaurante - em Leiria																																																	
		Transportes - Táxi e autocarro																																																	
		<b>Aero clube de Leiria</b>																																																	
		Tel - 244 814 483 - Leiria																																																	
		Tel - 244 840 193 - No aeródromo																																																	
		Morada:																																																	
		SEDE - Centro Associativo Municipal - Largo																																																	
		Maringá - 2410-128 Leiria																																																	
		<b>AERÓDROMO</b> - Aeródromo José Ferrinho -																																																	
		Gândara dos Olivais - 2400 LEIRIA																																																	
		Email - <a href="mailto:aeroclube.leiria@gmail.com">aeroclube.leiria@gmail.com</a>																																																	
		Net - <a href="http://www.acleiria.org">http://www.acleiria.org</a>																																																	
		<b>NOTAS:</b>																																																	
		<b>Aeródromo de Leiria – LPJF</b>																																																	
		<b>Rádio - 122.30</b>																																																	
		<b>Pista atravessada por estrada.</b>																																																	
		<b>Verifique bem se não há trânsito de camiões antes de descolar ou aterrar</b>																																																	
		<b>Aeródromo situado na MCTR de Monte Real.</b>																																																	
		<b>Obrigatório contactar Monte Real TWR em 122,10 para aproximações e descolagens</b>																																																	
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## 1.7 Tests & Research

According pilot statement, the aircraft touched down on runway first 80m and rolled freely for more 200m, in order to dissipate speed. Only after speedometer stopped to indicate (<40kt), the pilot started to brake gently and the aircraft started veering to the right. Assumable right main wheel blockage occurred near runway right edge (*picture nº 6*), about 300m from runway threshold.

Tracing running distances and groove deepness, dug by aircraft wheels on runway and edge terrain, we must admit that aircraft speed was greater than expected speed, based on previous description.

That is to say that runway mark extension and chroma (picture nº 6) as well as soil dug grooves' extension and deepness (picture nº 7) don't conciliate with an aircraft speed of less than 50-60kt.



Picture N° 6



Picture N° 7

After the incident, the aircraft was towed to Leiria Flying Club hangar and no sticking was noticed on the wheels. Braking system was tested and investigated by a qualified mechanic, who expressed the following conclusion:

*"...a detailed inspection to right main landing gear was performed. It was confirmed that the wheel was turning freely, before disassembly; it was also confirmed that right brake assembly is operating perfectly, that means it brakes and releases; after disassembly of brake unit, it was checked braking pads are in good operating condition. Bearings were disassembled and verified in good condition and well lubricated."*

In face of this confirmation it must be considered there was no blockage of right wheel, but may not be excluded the possibility of air contamination in brake fluid line, which could interfere with left wheel braking capacity. To mention the fact that there was another aircraft, subjected to the same type of inspection (100h), with same maintenance organization and at same time period, which was involved on a runway excursion, caused by the presence of air contamination in brake fluid, apparently due to lack of purge after system service.

## 2. ANALYSIS

### 2.1 Cessna C-152 Landing Performance

Due its relatively low approach speed, C 152 may operate on short runways and doesn't require long distances for stopping, even when following normal landing procedures, recommended on "Pilot's Operating Handbook" (POH):

**NORMAL LANDING**

1. Airspeed -- 60-70 KIAS (flaps UP).
2. Wing Flaps -- AS DESIRED (below 85 KIAS).
3. Airspeed -- 55-65 KIAS (flaps DOWN).
4. Touchdown -- MAIN WHEELS FIRST.
5. Landing Roll -- LOWER NOSE WHEEL GENTLY.
6. Braking -- MINIMUM REQUIRED.

Normal landing approaches can be made with power-on or power-off at speeds of 60 to 70 KIAS with flaps up, and 55 to 65 KIAS with flaps down. Surface winds and air turbulence are usually the primary factors in determining the most comfortable approach speeds.

Actual touchdown should be made with power-off and on the main wheels first. The nose wheel should be lowered smoothly to the runway as speed is diminished.

In extreme conditions (very short runways) it's possible to land on less than 1300ft runway, using more accurate procedures (short field landing procedures):

**SHORT FIELD LANDING**

1. Airspeed -- 60-70 KIAS (flaps UP).
2. Wing Flaps -- 301 (below 85 KIAS).
3. Airspeed -- MAINTAIN 54 KIAS.
4. Power -- REDUCE to idle as obstacle is cleared.
5. Touchdown -- MAIN WHEELS FIRST.
6. Brakes -- APPLY HEAVILY.
7. Wing Flaps -- RETRACT.

For a short field landing in smooth air conditions, make an approach at 54 KIAS with 301 flaps using enough power to control the glide path. After all approach obstacles are cleared, progressively reduce power and maintain 54 KIAS by lowering the nose of the airplane. Touchdown should be made with power-off and on the main wheels first. Immediately after touchdown, lower the nose wheel and apply heavy braking as required. For maximum brake effectiveness, retract the flaps, hold full nose-up elevator, and apply maximum brake pressure without sliding the tires.

Slightly higher approach speeds should be used under turbulent air conditions.

Complying with POH procedures, for short field landing, required distance to land this aircraft would be (*table nº 2*):

Outside Air Temperature	Landing Distance (covering a 50ft obstacle)	Ground Roll (with heavy braking)
20°C	1215ft	485ft
10°C	1185ft	465ft

Table Nº 2

## 2.2 Leiria Aerodrome Landing

Leiria aerodrome is served by a runway with 1706/1968ft length and should not be considered as a *short field*, even if its characteristics, with a public road cutting the runway in half and a power line crossing RW 02 approach path, are not normal for an airfield.

From table nº 2 analysis we may infer that, crossing runway threshold above 50ft, the aircraft would touchdown on 390ft zone, approximately, letting about 1570ft available for ground roll and braking usage would be quite unnecessary to bring the aircraft to taxi speed, which would be accomplished almost due attrition, or using a light brake pressure, as recommended for a normal landing.

The presence of a high voltage power line, in RW 02 approach area, sometimes induces the pilots to make an approach path slightly above normal 3° slope.

In such conditions, it should be considered the use of normal landing procedures, but selecting flaps to a "*FULL FLAP*" position and reducing speed to the minimum corrected approach speed, avoiding the need to apply heavy braking and controlling brake pressure according aircraft performance and behaviour, during deceleration after touchdown.

## 2.3 G-CGSP Aircraft Landing

Spectators, positioned at hangar entrance, on parking ramp, declared they have seen the aircraft performing a relatively high approach and above normal approach speed, touching down close to the middle of runway length.

In this circumstance, pilot would have only 1000ft distance available for ground roll, even so, the double of required distance (470ft) to stop the aircraft with maximum braking and using short field landing procedures, as defined on POH.

Everything suggests that, after landing far, in order to avoid runway end excursion or trying to stop before road crossing, the pilot applied heavy braking and, inadvertently, used more braking pressure on right pedal, forcing the aircraft to deviate to the right.

We may not exclude the possibility of air contamination in brake fluid line to left main wheel, interfering with left wheel braking capability.

The short runway width and loss of directional control made the aircraft veer to the right and exit the runway into the grass zone where it sunk.

Coming to a halt near the road, with nose wheel buried in a relatively deep groove, the clearance between propeller tips and the ground was shortened and propeller blades, rotating at reduced speed, hit the soft soil and road tarmac, in sequence, causing the tips to bent forward and rearwards as shown on picture nº 8, where sliding effect is well visible.



Picture N° 8

### 3. CONCLUSIONS

From the above we may infer that the pilot performed an approach slightly above recommended glide slope and speed, which prevent the use of all distance available and the aircraft touched down near the middle of the runway.

When trying to avoid runway end excursion, or stop the aircraft before the crossing road, the pilot applied a heavy braking, possibly a predominant right foot braking, which led to loose directional control and the aircraft to leave the runway by the right edge.

A left wheel insufficient braking, due to brake fluid contamination with air, is not excluded, unless the examination performed to braking system showed no sign of it, but considering that a similar incident occurred with another aircraft, inspected by the same maintenance organization, on same time period, where the presence of air bobbles in brake fluid lines was confirmed, due incorrect servicing procedures and lack of purge.

Due soft terrain, the nose wheel dug a significant groove, before coming to a halt, close to the crossing road. Left nose wheel steering actuating rod, collided with the ground and broke out. Level difference between nose wheel dug grass hole and tarmac allowed propeller blades to contact the ground and bent their tips.

Lisbon, May the 30<sup>th</sup>, 2013

The Investigator in Charge,  
(António A. Alves)