CIAIAC

COMISIÓN DE INVESTIGACIÓN DE ACCIDENTES E INCIDENTES DE AVIACIÓN CIVIL

Report A-028/2020

Accident on 23 July 2019, involving a PC-28 CRUISER operated by FLYBAI, S.L., registration EC-NAO, at Valladolid Airport (Villanubla-Valladolid, Spain)

GOBIERNO DE ESPAÑA

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Notice

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 in Article 5.4.1 of Annex 13 of the International Civil Aviation Convention; and with articles 5.6 of Regulation (UE) nº 996/2010, of the European Parliament and the Council, of 20 October 2010; Article 15 of Law 21/2003 on Air Safety and articles 1 and 21.2 of Regulation 389/1998, this investigation is exclusively of a technical nature, and its objective is the prevention of future civil aviation accidents and incidents by issuing, if necessary, safety recommendations to prevent from their reoccurrence. The investigation is not pointed to establish blame or liability whatsoever, and it's not prejudging the possible decision taken by the judicial authorities. Therefore, and according to above norms and regulations, the investigation was carried out using procedures not necessarily subject to the guarantees and rights usually used for the evidences in a judicial process.

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

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

Contents

Abbreviations

° ' "	Sexagesimal degrees, minutes and seconds
ºC	Degrees Celsius
AEMET	Spain's State Meteorological Agency
AENA	Spanish Airports and Air Navigation
AESA	Spain's National Aviation Safety Agency
AGL	Above ground level
ATPL	Airline Transport Pilot License
ATZ	Aerodrome traffic zone
ATO	Approved training organisation
CAMO	Continuing airworthiness management organisations
CPL	Commercial Pilot License
CPL(A)	Commercial Aircraft Pilot License
CTR	Control zone
DME	Distance Measuring Equipment
E	East
EASA	European Union Aviation Safety Agency
ELT	Emergency location transmitter
g	Normal acceleration
h	Hours
HP	Horsepower
hPa	Hectopascals
kg	Kilogrammes
KIAS	Knots indicated airspeed
km	Kilometres
km/h	Kilometres/hour
kt	Knots
kW	Kilowatts
l, l/h	Litres, Litres/hour
LEBG	ICAO code for Burgos Airport
LERJ	ICAO code for Logroño-Agoncillo Airport
LEVD	ICAO code for Villanubla-Valladolid Airport
m	Metres
mm	Millimetres
m/s	Metres/second
m^2	Metres squared
METAR	Aviation routine weather report
MTOW	Maximum take-off weight
N	North
NE	Northeast
PAPI	Precision Approach Path Indicator
POH	Pilot's operating handbook
PPL	Private Pilot License
rpm	Revolutions per minute

S	South
SOP	Standard operating procedures
TAF	Terminal aerodrome forecast
TWR	Aerodrome control tower or aerodrome control
UTC	Coordinated universal time
EU	European Union
V	Volts
V_A	Manoeuvring speed
V_{FE}	Maximum flaps-extended speed
VFR	Visual flight rules
V_{NE}	Never Exceed Speed
V_{NO}	Maximum speed for normal operations
V_{SO}	Minimum flight speed in landing configuration
VOR	VHF omnidirectional range
W	West

Synopsis

Owner and operator:	FLYBYSCHOOL-FLYBAI, S.L.
Aircraft:	PS-28 CRUISER, registration EC-NAP (Spain)
Date and time of accident:	23 July 2020; 13:30 UTC
Site of accident:	Valladolid Airport - LEVD (Villanubla-Valladolid)
Persons on board:	One (crew)
Type of operation:	General Aviation - Instruction - Solo
Phase of flight:	Landing - landing roll
Flight rules:	VFR
Date of approval:	26 May 2021

Summary

On 23 July 2020, the PS-28 CRUISER aircraft, registration EC-NAO, was carrying out a solo instruction flight from Burgos Airport - LEBG. While landing on runway 23 at Valladolid Airport, it hit the runway several times with its nose gear, which then collapsed, causing the aircraft to slide along the runway on its nose until it stopped.

The student pilot was unharmed, but the aircraft suffered damage to its propeller, nose gear and nose cone.

The investigation has determined the accident was caused by a poorly executed landing, which resulted in the nose gear impacting the runway several times and then collapsing.

A failure to adhere to the approach and landing procedures is considered to have been a contributing factor.

No operational safety recommendations are proposed.

1. THE FACTS OF THE ACCIDENT

1.1. Overview of the accident

On 23 July 2020, at 12:10 UTC, the PS-28 CRUISER aircraft operated by FLYBYSCHOOL, with registration EC-NAO, took off from Burgos Airport - LEBG destined for Valladolid Airport - LEVD, piloted by a student pilot who was carrying out an instruction flight.

The initial flight plan was to fly to LERJ, but that was cancelled for meteorological reasons, and the destination was changed to LEVD. The flight was uneventful, lasted approximately one hour and went according to plan.

According to the student pilot's testimony, he joined the LEVD traffic pattern to finish the flight at the left base of runway 23 (thinking that he had to fly the pattern at 3000 ft, which is the altitude of the traffic pattern at the first planned destination, LERJ). He then continued the approach, configuring the aircraft for landing according to standard school procedures. He was focusing on the approach and, in addition to worrying about the proximity of the ground, he had to make corrections for the wind in order to align himself with the runway. ATC requested acknowledgement of the landing clearance and, having not received a reply from the student pilot, re-issued the authorisation, which was then duly acknowledged.

The pilot, who according to his statement, was already at the end of runway 23, managed to align the aircraft with the runway centreline, believing the manoeuvre was controlled. However, in his own words, he did not consider the fact that his speed was less than 60 kt with power at idle and an altitude of 2800 ft.

Photograph 1. Aircraft at the accident site

According to his version of events, he entered ground effect expecting to float for a sufficient distance before making contact with the runway. Instead, the aircraft's main landing gear hit the runway, bouncing and falling several times until the nose gear hit the runway and collapsed and the wheel fork detached from the gear leg.

The aircraft slid along on the deformed nose leg until it came to a complete stop just before the PAPI signals.

The airport's fire and medical services were alerted and went to the scene of the accident.

The student pilot was unharmed and able to exit the aircraft without assistance.

1.2. Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft	Other
Fatal				
Serious				
Minor				
Unharmed	1		1	
Total	1		1	

1.3. Damage to the aircraft

The aircraft sustained significant damage to its nose landing gear, propeller and lower forward fuselage.

1.4. Other damage

There was no third-party damage.

1.5. Personnel information

The 45-year-old student pilot was taking an ATPL course and had the required authorisation from the ATO to carry out the solo flight.

He had a total of 48:30 hours of flying time, of which 26:55 hours were in the type of aircraft involved in the accident. He had flown solo previously, with satisfactory qualifications and a total of 19:10 flight hours, of which twelve hours were in the accident aircraft.

The student pilot flew the day before the accident in the same type of aircraft, making two crossings lasting 1:25 and 1:00 hours.

He had a class 1 medical certificate valid until 09/10/2020 and a class 2 medical certificate valid until 09/10/2024.

1.6. Aircraft information

1.6.1. General information

The PS-28 Cruiser aircraft is a Czech-made, Czech Aircraft Group s.r.o. two-seater, single-engine, low-wing monoplane light aircraft, with a metal monocoque structure fuselage and tricycle-type fixed landing gear.

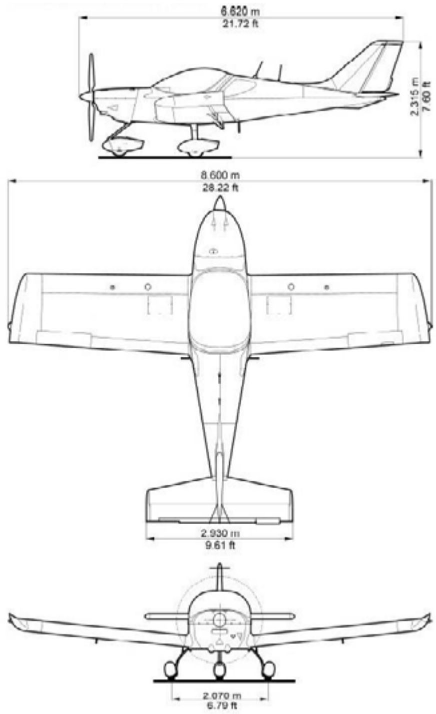


Figure 1. Accident aircraft

Structure:

- Wingspan: 8.60 m
- Length: 6.62 m
- Wing area: 12.30 m^2
- Maximum height: 2.31 m
- Empty weight: 405 kg
- MTOW: 600 kg
- Flap positions: 0° to 30°
- Wing-integrated fuel tanks with a maximum capacity of 114 l.

Performances:

- Never exceed speed (V_{NE}): 138 KIAS
- Maximum speed for normal operations (V_{MO}): 108 KIAS
- Manoeuvring speed (V_A): 88 KIAS
- (at 600 kg)
- Maximum speed with flaps extended (V_{FE}): 75 KIAS
- Minimum speed with flaps extended (V_{SO}): 31 KIAS
- Approach speed, without flaps, with flaps at 12° and 30°: 60 KIAS
- Maximum crosswind speed on landing and take-off: 12 KIAS
- Maximum operating wind speed components:
  - Transversal: 12 KIAS
  - Longitudinal: 22 KIAS

Load factor:

Maximum positive load factor limit: + 4 g
Maximum negative load factor limit: - 2 g
Maximum positive load factor limit with flaps extended: + 2 g

Maximum negative load factor limit with flaps extended: 0 g

Avionics:

The aircraft is equipped with two Dynon SkyView HDX1100 flight displays with flight and engine parameter recording.

Power plant:

ROTAX 912 ULS2-01 piston engine, s/n: 9570054.

Characteristics:

- Four-stroke, four horizontally opposite cylinders, and double ignition system (magnetos)
- Air-cooled through the two front inlets
- Maximum power: 73.5 kW
- Rated speed: 5,800 rpm

Propeller:

Sensenich p/n: 3BOR5R68C s/n: 319917C made from composite materials.

Characteristics:

- Three-blade tractor, ground-adjustable
- Maximum power: 115 HP
- Rpm range: 5,800 rpm
- Minimum/maximum diameter: 64/68"

Landing gear:

The aircraft is equipped with a fixed tricycle-type landing gear, with a wheel on each gear leg and a steerable nose wheel. The accident aircraft does not have wheel fairings.

The main landing gear shock absorber is of the fibreglass spring-type shock absorber built into the gear leg structure itself. Each main gear wheel is equipped with independent, hydraulically-operated disc brakes.

The nose gear has a rubber block shock absorber and a free-spinning nose wheel that controls the aircraft's direction through the differential and individual application of each of the main gear brakes, actuated by applying pressure to the pedals.

Both the main and nose gear have a limited lifespan of 5000 flight hours.

Instrument panel

Photograph 2. Instrument panel

Normal operating procedures

The standard operating procedures of interest to the investigation, considering the phase of the flight in which the accident took place, are, according to the pilot operations manual (POH) ref.: PS-POH-1-1-14 dated 2018-06-22, as follows:

I. Descent

1. Optimum glide speed: 60 KIAS

II. Approach

1. Approach speed: 60 KIAS
2. Power: as required
3. Flaps: position 12°
4. Compensators: as required
5. Safety belts: fastened

III. Normal landing

a. Before landing

1. Power: as required
2. Speed: 60 KIAS
3. Flaps: position 30°
4. Compensators: as required
5. 12 V sockets: disconnect any device plugged in.

b. Landing

1. Power: idle
2. Land on main landing gear
3. Brakes: apply as required after nose gear makes contact with the runway.

IV. Aborted landing:

1. Power: to maximum (taking into account that a maximum of 5800 rpm must be applied for 5′ and that the maximum continuous power is 5500 rpm)
2. Speed: minimum 60 KIAS
3. Flaps: take-off position (12º) with maximum speed 75 KIAS
4. Compensators: as required
5. Ascent: after reaching 62 KIAS
6. Flaps: retract to 0º position at safe altitude (maximum speed with flaps 75 KIAS)
7. Compensators: as required

1.6.2. Maintenance information

The aircraft was built in 2018 with serial number: C0649. The aircraft's maintenance was carried out by the AESA-approved maintenance organisation FLYBAI Mantenimiento, S.L., according to Subpart F of Part M of Regulation (EU) No.1321/2014.

The current applicable maintenance programme is.: MP-AV-PS28-FB ed.1 rev.4 of 17/07/2020, approved by the AESA-approved CAMO, AVIATION VIP, S.L., according to Part M, Subpart G, Regulation (EU) 1321/2014. The maintenance overhauls specified by the programme for the aircraft are the following:

- Pre-flight inspection with scope according to the POH,
- special propeller inspection at 25, 50 and 150 flight hours,
- scheduled inspection of the nose gear leg if the gear leg assembly is not reinforced, after 25 flight hours or 50 cycles, whichever occurs first[1],

[1] According to SB-CR-021-RO of 10/07/2014 and information included in section 5.1. of Chapter 5, Annexed to this report.

- scheduled inspection of the engine compartment, propeller and nose gear leg if the gear leg assembly is reinforced, after 50 flight hours or 50 cycles, whichever occurs first,
- scheduled inspection of the airframe, propeller and engine after 100 flight hours,
- scheduled annual inspection of the airframe, propeller and engine equivalent to the 100 flight hours inspection.

The aircraft's most recent scheduled maintenance overhaul was a fifty hours inspection when it had 698:25 flight hours, three days before the accident on 20/07/2020. During that inspection, the oil, oil filters and brake pads were changed. Coinciding with this overhaul, the scheduled 100 flight hours or twelve months propeller inspection was also carried out, as well as the fifty hours inspection of the main and nose landing gear.

At the time of the accident, both the aircraft and engine had a cumulative record of 714:40 flight hours and 1616 cycles. In the nine days prior to the event, the aircraft made 38 flights in 40:25 flight hours, with 54 landings. For reference, it should be noted that in flights to practice take-offs and landings lasting between 30' and an hour, the aircraft performed six and seven cycles per flight.

The last certificate of compliance with bulletins and directives was issued on 01/10/2018 by the aircraft manufacturer, certifying compliance with the documents SB-CR-017, SB-CR-018, SB-CR-021, SB- CR-032, SB-CR-033 and SB-CR-050.

The following service bulletins relating to the nose landing gear are relevant to the investigation:

- SB-CR-016_R6 dated 09/10/2013: This bulletin contains instructions for a repetitive inspection of the nose landing gear leg and its possible replacement. It was issued following the appearance of cracks in the lower part of the gear leg in some aircraft. The cracks develop along the weld of the tube and the bracket. Deformation/flexing of the pivot connecting the fork to the leg was also discovered, as well as cracks from the bolt holes on the fork.

- SB-CR-021_R0 dated 10/07/2014: This bulletin contains instructions for the replacement of the nose gear leg p/n: SG0270N with a new reinforced design, p/n: SG0300N, which has better fatigue resistance properties. The manufacturer especially recommended replacement with the new p/n on aircraft used in intensive flight training activity and operating from unpaved runways.

- SB-CR-032 dated 23/10/2015: This bulletin contains instructions for the installation of a set of parts that reinforce the nose landing gear leg attachment to the firewall to increase the carrying capacity of the vertical brackets. The bulletin was issued due to the appearance of cracks and deformations on the edge of the vertical brackets.

1.6.3. Airworthiness status

The accident aircraft was registered with AESA's record of active registrations on 31/05/2019, with registration number 10226. The registration certificate lists the aircraft's leaseholder as the operating school at the time of the accident, with validity until 30/08/2025.

The aircraft had an airworthiness review certificate issued by the AESA-approved Continuing Airworthiness Management Organisation (CAMO), AVIATION VIP, S.L. valid until 29/11/2020.

In addition, the aircraft had a valid aircraft station license authorisation issued by AESA featuring various pieces of equipment, including a GARMIN GNC 255A communications and navigation unit, a TRIG TT21 transponder, and an ELT KANNAD 406 AF-COMPACT.

The last valid aircraft weight and balance sheet was completed by the pilot involved in the accident on 23/07/2020.

1.7. Meteorological information

1.7.1. General situation

There was an extensive Atlantic anticyclone at low levels with low relative pressures over the centre and southeast of the Peninsula.

1.7.2. Conditions in the area of the accident

At Valladolid Airport, around the time of the accident (13:30 UTC), with natural daylight conditions, the METAR and TAF aerodrome reports were:

> METAR LEVD 231300Z 28009KT CAVOK 32/10 Q1019=
> METAR LEVD 231330Z 34009KT 270V020 CAVOK 32/11 Q1019=
> METAR LEVD 231400Z 30008KT 250V350 CAVOK 32/09 Q1019=
> (*Transcription: Valladolid Airport, conditions described by the METAR at 13:00, 13:30 and 14:00 UTC were wind between 8 and 9 kt, variable direction, temperature 32ºC, high visibility, dew point between 9º and 11ºC, and QNH of 1019 hPa*.)
>
> TAF LEVD 230200Z 2303/2403 VRB04KT CAVOK TX34/2316Z TN17/2305Z=
> (*Transcription: Valladolid Airport, conditions described by the TAF from the 23rd at 02:00 UTC, valid until the 24th at 03:00 UTC, were variable 4 kt wind, high visibility, maximum temperature at 16:00 UTC of 34ºC and minimum temperature at 05:00 UTC of 17ºC*)

According to the METAR information, the average surface wind conditions were a 4.5 kt crosswind and a 9 kt longitudinal wind.

Visibility was good and temperatures were high with a light wind (less than 10 kt) from the west/northwest, primarily oscillating in direction in the fourth quadrant.

1.8. Aids to navigation

The LEBG airport runway is equipped with a PAPI 3° system for visual approaches and VOR/DME air navigation aids.

The flight was operating under visual flight rules (VFR), so radio aids were unnecessary. However, no type of navigation system failure was reported.

1.9. Communications

Given that LEVD is located within the Villanubla Air Base, which is also open to civil traffic, the Air Force is responsible for providing the air traffic control service.

According to the ATC records, at 13:32 UTC, the controllers in the tower saw the EC-NAO aircraft make a hard landing and stop in the middle of the runway on a level with C5 in the R4 section. They tried to communicate with the aircraft but were forced to declare an emergency when they couldn't get a response because the pilot had lost contact with the control tower after the impact.

AENA, which operates LEVD as part of its airport management network, activated its emergency protocol as a result of the accident, reporting that the aircraft had blocked the runway after its nose gear collapsed during the landing.

Once the unit's fire service, the police and the airport fire service had been deployed, they moved the aircraft to the civilian apron.

The runway was then inspected, and the landing gear debris was removed. There was no operational impact on the planned commercial schedule, and the runway reopened at 14:06 UTC.

1.10. Aerodrome information

Valladolid Airport is located within the Air Base open to civil traffic located in the municipality of Villanubla, in the province of Valladolid, 10 km west of the provincial capital. The Air Force is responsible for providing the air traffic control service.

The airport's GPS coordinates are 41°42'57.56"N - 004°50'20.42"W.

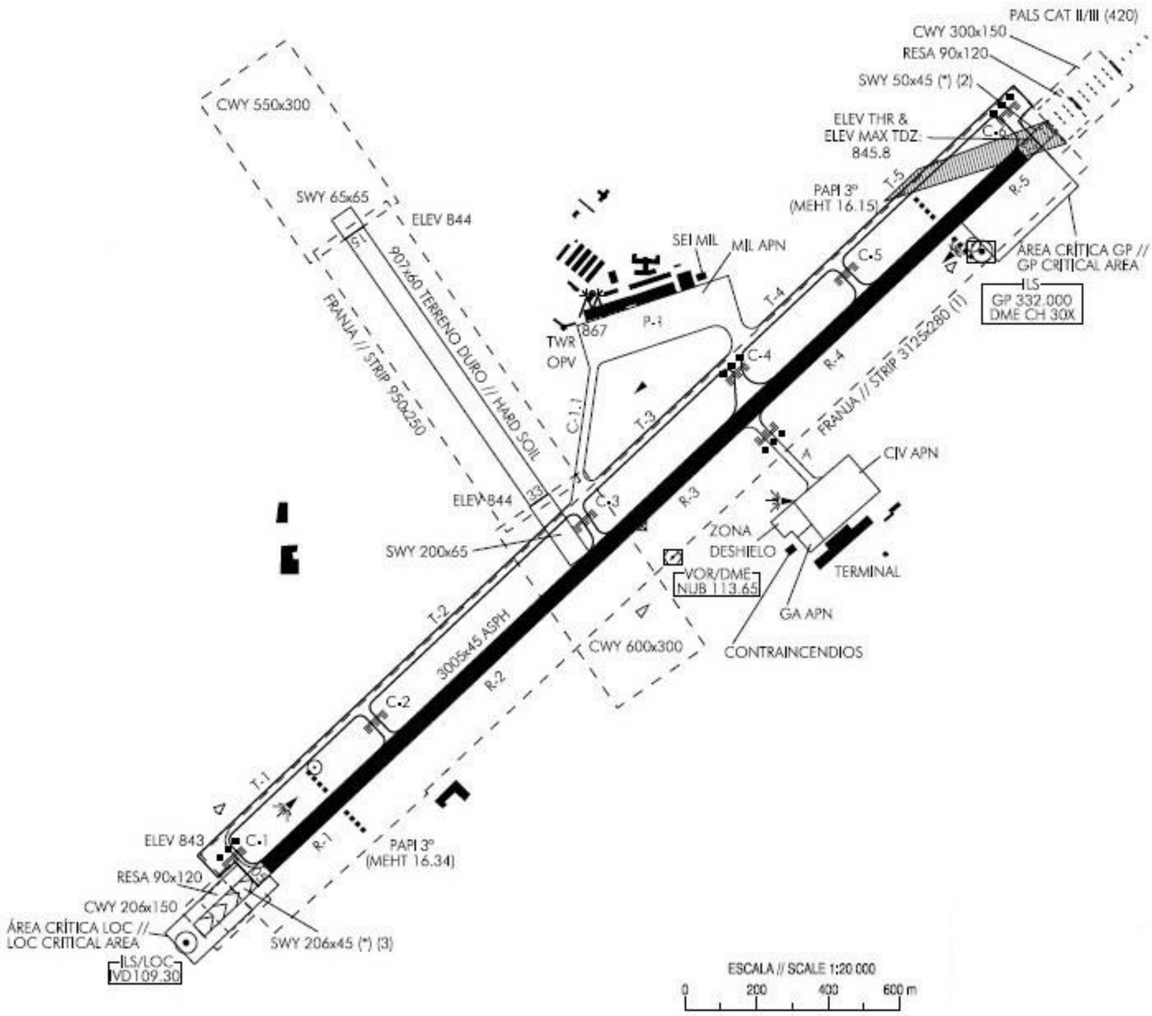


Figure 2. Plan of Valladolid Airport

It has a paved 3005 m long by 45 m wide runway with a 05/23 orientation, and another 907 m long by 60 m wide unpaved runway with a 15/33 orientation. Its elevation is 846 meters AMSL (2775 ft).

VFR aircraft arrivals must contact TWR at points N (Becilla), NE (Quintana del Puente), E (Peñafiel), S (Olmedo) or W (San Cebrián de Mazote) to request permission to enter the CTR, maintaining 1000 ft AGL if they come from points E and S and 1500 ft AGL if they come from points W, N and NE. The TWR authorises entry to the CTR assigning points N-1 (La Mudarra) for traffic coming from N or W and S-1 (Zaratán) for traffic coming from S, E or NE, to enter the aerodrome's traffic pattern.

Departing aircraft must notify TWR of their required departure point before take-off. Aircraft departing under VFR must leave the Valladolid ATZ through notification points N-1 or S-1. Subsequently, they must exit the CTR through points E (Peñafiel) and S (Olmedo), maintaining 1000 ft AGL, or 1500 ft AGL if leaving through points W (San Cebrián de Mazote), N (Becilla) and NE (Quintana del Puente).

In general aviation, visual flights fly between 800 and 1000 feet above the airport's elevation, although some airports establish different altitudes, usually depending on the weight of the aircraft and the speed of approach.

1.10.1. Airport operator's report

In its accident report, the airport operator, AENA, noted that the damage to the aircraft had been identified as a broken propeller blade and damaged nose landing gear.

It also reported that the student pilot landed at the head of runway 23 and that he stated he had lost lift. After bouncing hard on the runway several times, the front landing gear buckled and broke, causing the aircraft to slide along it on its nose gear leg and breaking a propeller blade.

AENA identified the left edge of runway 23, just before the PAPIS, as the area of impact.

1.11. Flight recorders

The aircraft was not equipped with a conventional cockpit voice recorder but it had a Dynon SkyView HDX1100 system that records flight data and engine parameters, and this information was downloaded by the manufacturer.

Given the circumstances of the accident, we deemed it relevant to extract and analyse the recorded data (240 records per minute) for the period of time corresponding to touchdown. Thus, it starts at t=1, which corresponds to 13:28:59 UTC, and ends at t=4, which corresponds to 13:31:38 UTC.

The aircraft's altitude, pitch, roll, vertical acceleration, indicated speed, wind speed, engine rpm, and flap position parameters during this period were analysed and are illustrated in the attached graphs 1, 2 and 3. In the graphs, the following time positions are differentiated (recorder parameter called "session time"):

- t=1, recording: 4677.19 corresponding to 13:28:59 UTC, start of the analysis.
- t=2, recording: 4825.44 corresponding to 13:31:28 UTC, start of GEES alert activation[2].
- t=3, recording: 4831.94 corresponding to 13:31:34 UTC, moment of contact with the runway.
- t=4, recording: 4835.69 corresponding to 13:31:38 UTC, end of the analysis.

The results of the analysis of the data recorded during touchdown yielded the following conclusions:

- The moment the aircraft made contact with the runway was at 13:31:34 UTC, after which the aircraft moved at a speed of 36.5 KIAS before stopping 4" later. At 13:31:34 UTC, the pitch was -13.6° and roll was -2.7°, with 0 rpm and 0.8 g of vertical acceleration.

- The pitch records illustrated in graph 2 show a trend curve (in turquoise) with three peaks and dips during the analysed period. The maximum positive and negative limits were 8.6° and -18.1°, corresponding to the aircraft bouncing off the runway at 13:31:30 and 13:31:38 UTC.

- The roll records illustrated in graph 2 show a trend curve (in turquoise), as with the last parameter, with three peaks and dips during the analysed period and limits of 9° and -22.8°, corresponding to an unstable final approach at 13:29:44 and 13:31:03 UTC.

- The vertical acceleration had its maximum and minimum values of 3.1 g and 0.2 g at 13:31:28 and 13:31:31 UTC. For reference, the maximum positive load factor limit with flaps extended for this type of aircraft is 2 g, and the maximum negative limit is 0 g. From 13:31:28 UTC (4825.44) to 13:31:32 UTC (4829.38), the "GEES" alert was registered, which is displayed when the "g" meter is in the yellow range of the indicator (i.e. it's between the values of -0.5 and 3 g).

Photograph 3. Set up of the "g" meter in the flight display

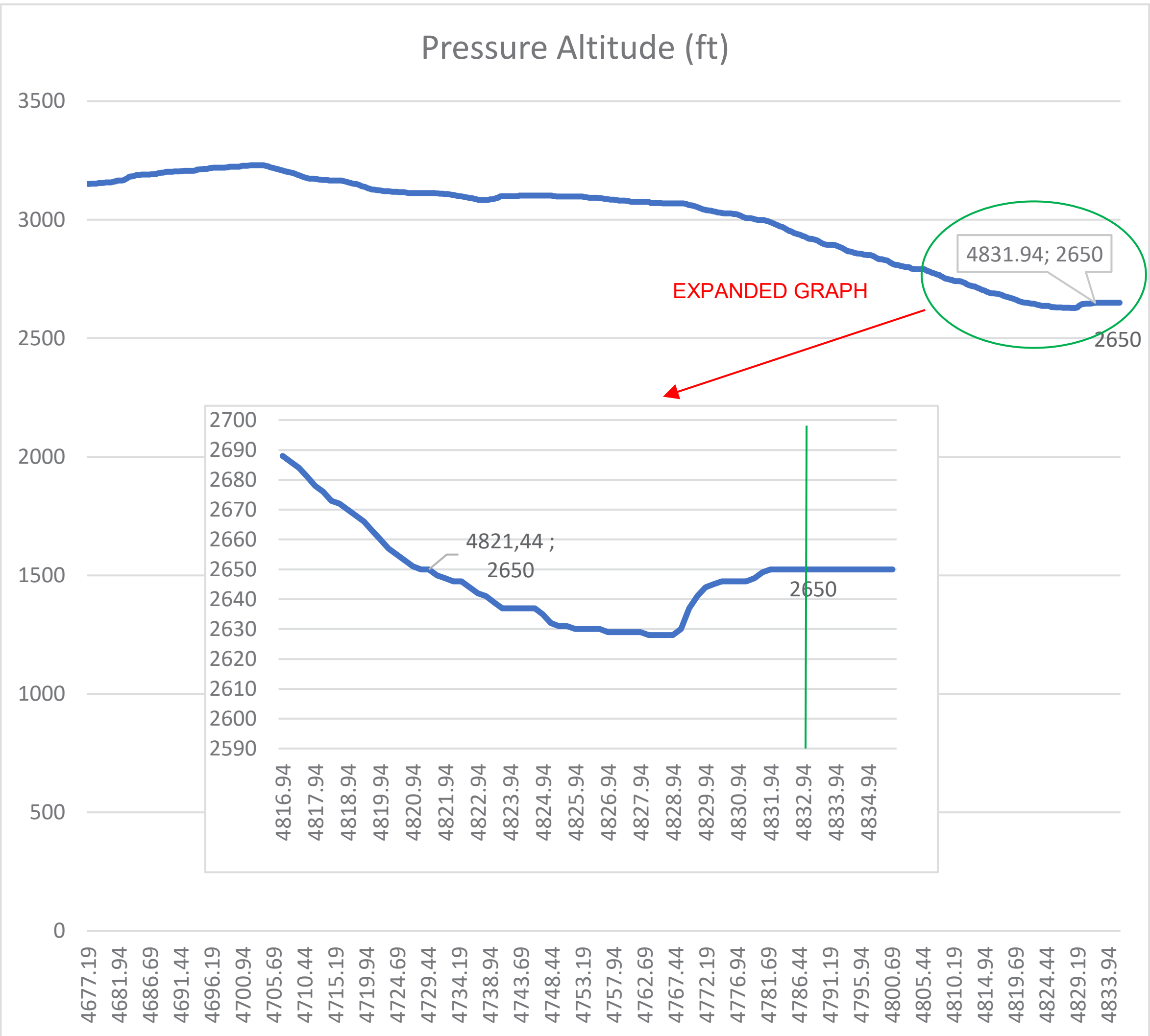
- The indicated speed had its maximum and minimum values of 90.20 kt and 0 kt at 13:29:07 and 13:31:38 UTC, respectively. Consequently, the aircraft came to a stop at 13:31:38. This aircraft has a maximum flaps-extended speed of 75 KIAS and a maximum flaps-extended approach speed of 60 KIAS. Up to 13:30:42 UTC (4779.38), the FLAPS OVERSPEED alert was registered, with minimum speeds of 75.5 KIAS.

- The engine rpm had its maximum value of 4981 rpm at 13:29:06 and a minimum value of 0 rpm from 13:31:33 UTC to the end of the analysis at 13:31:38 UTC.

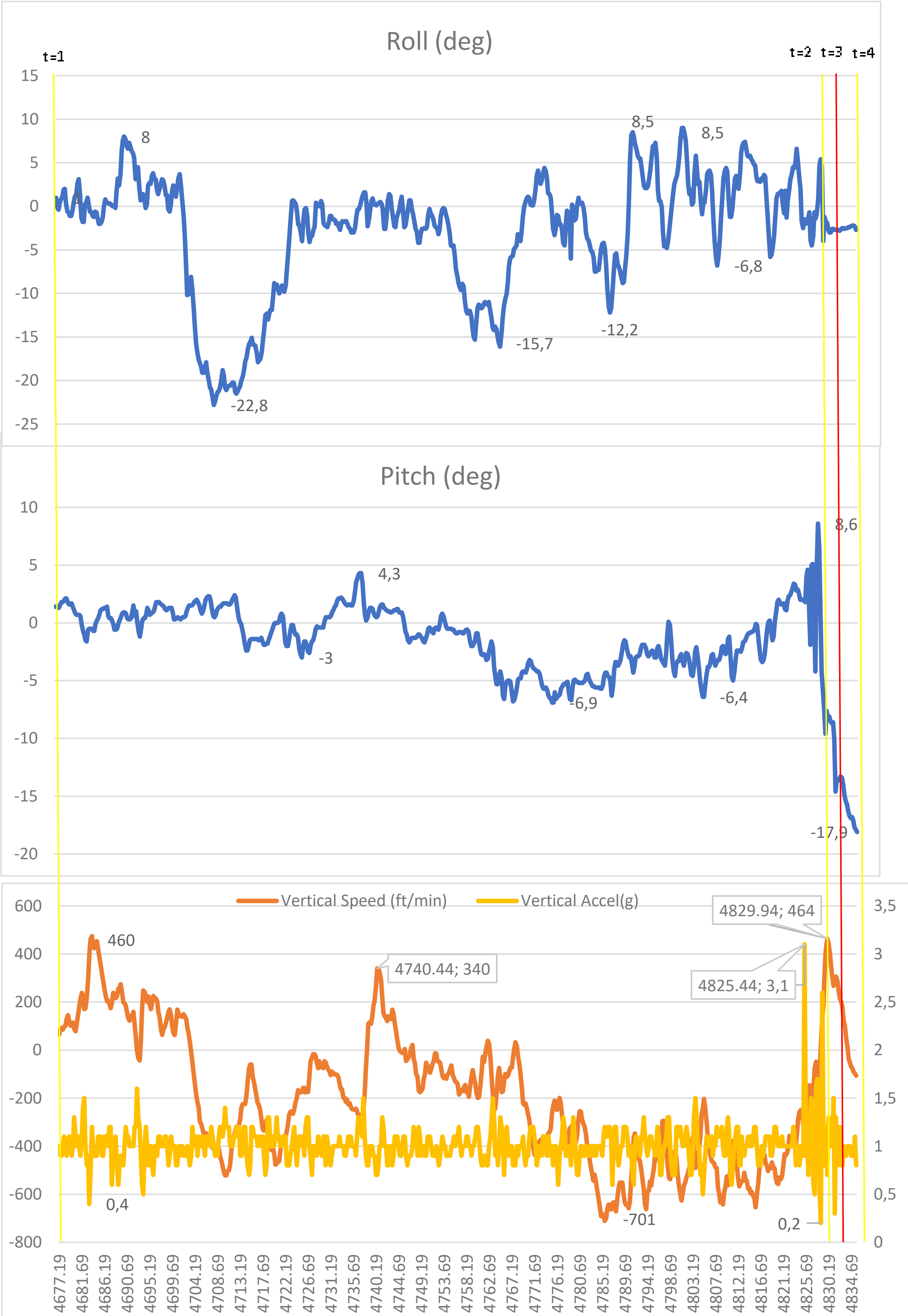
- The aircraft landed on runway 23 at LEVD. Before landing, a wind direction of 333° and speed of 10 kt was recorded, representing a transversal component of 9.7 kt and a longitudinal component of -2.2 kt. According to the POH, the aircraft can operate safely in a maximum transversal wind speed of 12 KIAS and a longitudinal wind speed of 22 KIAS.

  During the rest of the period analysed, the wind direction was between 284° and 300°, with speeds between 8 and 13 kt, which means the transversal and longitudinal speeds were between 6 -12 kt and 4 - 5 kt respectively.

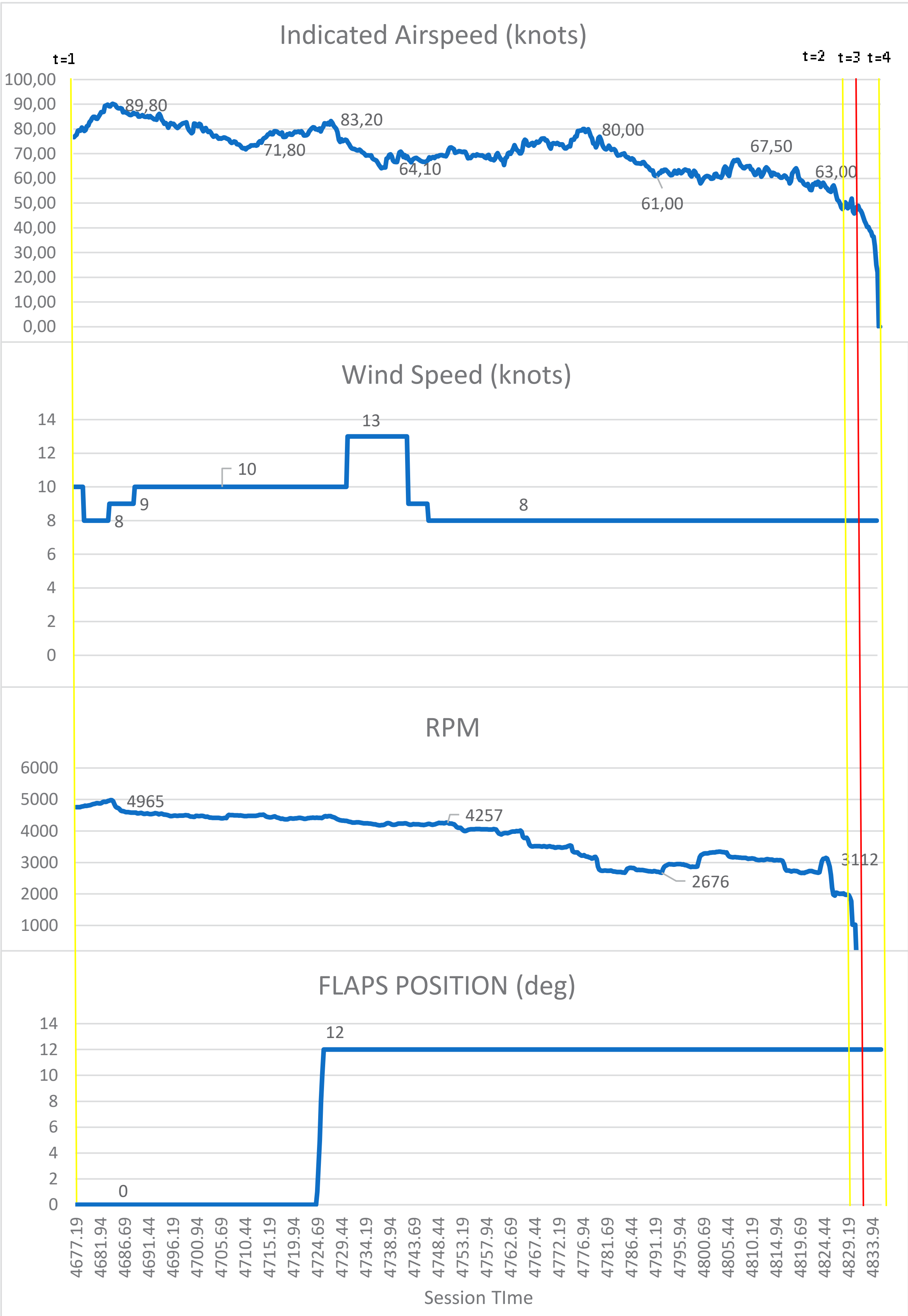
- The flaps setting was changed from 0° to 12° at 13:29:47 UTC. This flaps position is used for approach and was maintained throughout the period analysed. On final, they should have been fully extended.



Graph 1. Altitude data during touchdown and expanded detail



Graph 2. Flight data during touchdown



Graph 3. Flight data during touchdown (continued)

1.12. Aircraft wreckage and impact information

The aircraft left a rounded mark on LEVD runway 23. It measured roughly 20 cm in diameter. There was another continuous linear mark more than 20 m long leading to the point where the aircraft finally stopped.

Photograph 4. Marks on the runway

The detached nose wheel lay on the runway, to the right of the centreline.

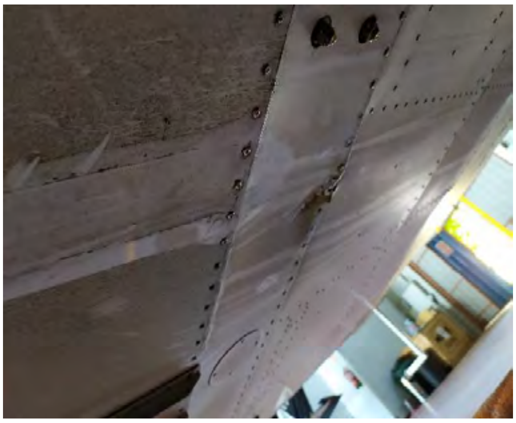
Photograph 5. Damage to the propeller

The following damage to the aircraft was identified:

- Propeller: one of the blades came out of its housing, and the other two sustained damage to their tips.
- Nose gear assembly - destroyed with fork and nose wheel having detached completely.
- Underside of the fuselage: deformed around the anchoring areas of the main landing gear and nose.
- Damaged exhaust manifolds.
- Deformed rear seat reinforcement and lower tail anchor fin eroded with loss of material.

Photograph 6. Damage to the tail anchor point

Photograph 7. Damage to the nose landing gear and Photograph 8. Detail of the left photo: damage to the side of the nose leg



Photograph 9. Damage to underside of fuselage

Photograph 10. Damage to main landing gear

Photograph 11. Connecting plate for the nose gear wheel fork

Photograph 12. Buckled nose gear leg

Photograph 13. Bolts that fix the fork to the nose gear leg after the accident

Photograph 14. Nose landing gear wheel and fork

Photograph 15. Area where the fork attaches to the nose gear leg

Photograph 16. Lower part of the nose gear leg that dragged along the runway

1.13. Medical and pathological information

Not applicable.

1.14. Fire

Not applicable.

1.15. Survival aspects

Not applicable.

1.16. Tests and research

Not applicable.

1.17. Organisational and management information

The aircraft was operated by a training organisation (ATO) approved by AESA on 13/11/2019. Its main operational base is at Burgos airport - LEBG, where it delivers pilot license training courses for ATPL, PPL and CPL permits, as well as various ratings.

In relation to the scope of the training relevant to the investigated event, when landing, if any of the parameters are incorrect, the students are specifically trained to abort the manoeuvre and execute a "go-around" to minimise risks and restart the manoeuvre safely, applying the "aborted landing" procedure.

According to the ATO's operating manual, the landing procedure described in section "c.1.4 LANDING" says:

> "Once the aircraft is in the traffic pattern, pilot's must perform the pre-landing procedures following the checklists. The aircraft must be configured for landing, maintaining speed according to the flight manual's requirements until it touches the ground.
>
> It's important to bear in mind the flight manual's instructions in regard to landing distances and approach and stall speeds depending on the characteristics and direction of the crosswind. Pilots should make the necessary calculations for the runway."

According to section A-5.2.2. of the operations manual, after the initial "ready to fly" flight clearance from the head of teaching or flight instruction, the flight instruction manager will assign an instructor to each student and monitor their progress.

Before students can make their first solo flight, the head of teaching or flight instruction must receive a favourable progress report from their instructor during the flight phase of the training programme. The corresponding authorisation should then be issued, specifying the departure base and the type of flight (local, crossing, night), among other information, complying with the specific format in the manual.

Section c.4.1. of the operating manual also establishes the minimum required meteorological conditions for conducting solo flights: visibility 7000 m, clouds 2500 ft (bkn/ovc[3]) and crosswind of 10 kt.

Lastly, the landing technique for VFR traffic established by the ATO according to its SOP is as follows[4]:

- Begin the approach procedure on the tailwind leg at 1000' AGL.
- On reaching the runway head threshold, perform the pre-landing checklist by configuring the aircraft, connecting the fuel pump, extending the flaps to 12º and adjusting the speed to 75 KIAS.
- In the base leg, start the descent to 700` AGL and decrease speed to 70 KIAS.

[3] Metar coding to indicate the level of cloud cover. BKN (broken) identifies broken cloud, with cloud cover between 5 and 7 oktas. OVC (overcast), cloudy/overcast, with 8 oktas of cloud cover

[4] SOP: Standard operating procedures.

- On the final leg, achieve 500´ AGL by adjusting the power as required to adapt the speed to 60 KIAS.
- Upon reaching the runway threshold, move the throttle to the idle position and, keeping the aircraft parallel to the runway and never exceeding the first 1/3 of it, land.

In the school's manoeuvring analysis document, the approach speed is defined as 65 KIAS with flaps at 15°, and the reference speed with flaps fully extended is 55 KIAS.

1.17.1. Accident risk analysis report from the training organisation

Following the occurrence of several similar events during training, all of which involved a loss of aircraft control on the final approach to the runway (ballooning) and unstable landings that caused significant damage to the aircraft, the ATO conducted a risk analysis in order to adopt measures and actions to improve safety, rating the events in terms of seriousness/severity and possibility/recurrence according to the risk matrix in figure 3.

Matriz de Clasificación de Riesgos	PROBABILIDAD				
	Extrem. Improbable	Improbable	Remota	Ocasional	Frecuente
GRAVEDAD Catastrófica	Tolerable	Inaceptable	Inaceptable	Inaceptable	Inaceptable
Peligrosa	Tolerable	Tolerable	Inaceptable	Inaceptable	Inaceptable
Considerable	Aceptable	Tolerable	Tolerable	Tolerable	Tolerable
Escasa	Aceptable	Aceptable	Aceptable	Aceptable	Tolerable
Insignificante	Aceptable	Aceptable	Aceptable	Aceptable	Aceptable

Figure 3. Risk matrix

The ATO proposed the adoption of the following mitigating measures:

On a general level:

1. they deemed it necessary to raise awareness among personnel (instructors, pilots and student pilots) via an informative circular on the importance of a stable approach and landing and, failing that, the obligation to execute evasive manoeuvres to ensure acceptable safety levels are maintained.
2. distribute an operational circular on how to avoid a "bounced landing" and, should it occur, how to resolve the situation, to instructors and students.
3. refresh, at a theoretical and practical level, the procedure to follow in the event of an unstable approach and landing.
4. reinforce the training process in the advanced phases of training through dual flight missions to keep the student and instructor up to date and facilitate the resolution of future similar situations to avoid accidents.
5. include refresher sessions and recurrent training on emergency procedures and resolving irregular situations in critical flight phases (landing and/or take-off) in the training plan.

With specific application to the student involved in the accident:

- immediately and provisionally suspend his solo flight clearance, assigning him a minimum of four additional retraining missions to reinforce and consolidate emergency and safety procedures and request a favourable report from the instructors before re-issuing the solo flight clearance.

According to the ATO, implementing the proposed mitigating measures will reduce the risk of a similar event being repeated to acceptable levels.Therefore, the probability of a similar event occurring is deemed unlikely, and with the seriousness of the event classified as considerable, they qualify the overall risk as tolerable.

1.17.2. Measures proposed by the training organisation

As a consequence of the mitigating measures proposed by the training organisation to reduce the risk of this type of event happening again, we are not issuing any safety recommendations. However, confirmation that the proposed measures have been implemented will be required.

Mitigating measures implemented by FLYBYSCHOOL-FLYBAI, S.L.:

1. Emission and distribution of a circular to raise awareness among personnel (instructors, pilots and student pilots) of the importance of a stable approach and landing and, failing that, the obligation to execute evasive manoeuvres to ensure acceptable safety levels are maintained.
2. Distribution of an operational circular on how to avoid a "bounced landing" and, should it occur, how to resolve the situation, to instructors and students.
3. Provision of theoretical and practical refresher training on the procedure to follow in the event of an unstable approach and landing.
4. Reinforcement of the training process in the advanced phases of training through dual flight missions to keep the student and instructor up to date and facilitate the resolution of future similar situations to avoid accidents.
5. Inclusion of refresher sessions and recurrent training on emergency procedures and resolving irregular situations in critical flight phases (landing and/or take-off) in the training plan.
6. Applicable specifically to the student involved in the accident: immediately and provisionally suspend his solo flight clearance, assigning him a minimum of 4 additional retraining missions to reinforce and consolidate emergency and safety procedures and require a favourable report from the instructors before re-issuing the solo flight clearance.

1.18. Additional information

1.18.1. Study of similar accidents

A confluence of four similar accidents involving the same type of aircraft (the PS-28 CRUISER) operated by the same ATO has been identified within a period of approximately one year. With this in mind, we decided to assess those events from a systemic point of view, in addition to the systematic approach to causality employed in the individual investigations of each of the accidents.

The following aspects common to all the accidents have been studied:

1. The flight phase in which the accidents occurred.
2. The ATO training and operating procedures.
3. The condition of the nose landing gear from a maintenance point of view.
4. The design of the nose landing gear: the tyre, shock absorber and the fixings of the nose gear leg and wheel fork.

The fact that all the flights were "solo" training flights with or without a pre-landing crossing. In all the accidents, the nose gear collapsed on touchdown after two or three bounces, causing the fork to detach from the nose wheel. As a result, the aircraft all sustained similar damage.

As shown in the attached table (Figure 4), all the aircraft had a high number of cycles for the number of hours flown (average of 2.37 cycles/flight hour), as is the norm in aircraft used for training.

Registration	Accident	Date-Location	Aircraft flight hours	No. of cycles	Speed on touchdown
EC-NAO	A-031/2019	11/07/19-LEBG	459:25	1076	unknown
EC-NCP	A-041/2019	03/08/19-LEOS	266:55	647	60 kt
EC-NAO	A-028/2020	23/07/20-LEVD	714:40	1616	Lower than 60 kt
EC-NAP	A-029/2020	30/07/2020-LEBG	1022:20	2530	68 kt

Figure 4. Accident comparison table

All the touchdown speeds are similar, being in the area of the "before landing" speed of 60 KIAS, as per the operating procedures.

It should be noted that the EC-NAO aircraft was involved in two of the accidents analysed and that after the accident on 11/07/2019 at LEBG, the aircraft was sent to the manufacturer for repair and recommissioned on 21/01/2020.

1.18.1.1. Assessment of the operation

All the cases, regardless of the students' flight hours or whether it was their first solo flight or not, involved unstable landings where the aircraft bounced off the runway several times, which, after several impacts, caused the nose gear to collapse and the wheel fork to detach.

These "hard" landings were caused by insufficient control of the aircraft during the landing phase, in particular during touchdown and flare. The speed values and height parameters did not match those required for the manoeuvre.

Instead of a smooth transition from the nose-down attitude adopted during the descent to the slightly nose-up attitude required to fly parallel to the runway until touchdown, the change in attitude was executed at a higher than usual approach speed, which would have required more altitude to ensure stability.

In the analysed accidents, the aircraft touched down with the main landing gear, keeping the nose wheel in the air, but at a higher speed than necessary for the manoeuvre and with insufficient control over the controls. In some cases, this was because the controls were pulled back very slowly, causing the aircraft to hit the runway; and in others, it was because they were pulled back very quickly, resulting in a "balloon" effect that also caused the aircraft to impact the runway when the nose lowered abruptly. When an aircraft is close to the ground it's affected by the ground effect, which keeps it in the air at a lower speed, a phenomenon not taken into account in any of the cases analysed.

1.18.1.2. The ATO's training and operating procedures

In all the accidents analysed, the applicable operating procedures were those established for the "before landing" and "landing" phases.

According to the ATO, although the students are specifically taught that if any of the parameters are incorrect during the landing, they should abort the manoeuvre and execute a "go-around", not one of them contemplated doing so.

In the cases studied, the student pilots had the necessary authorisations to carry out the flights, having met the established training and experience requirements. The meteorological conditions were also within the acceptable limits, with some of the flights modifying their initial flight plan to ensure this was the case.

However, a failure to comply with the ATO's approach procedure was a factor in all the accidents. The approach speeds were higher than those established for the operation, and in the cases where it has been possible to verify the flap position, they were not fully extended on final in order to land with a controllable vertical speed. All the accidents were affected by an unstable landing. Furthermore, the checklist included in the ATO's SOP establishes an approach speed of 65 KIAS with flaps at the first extension point and a landing speed of 55 KIAS with fully extended flaps while the POH states 60 KIAS for both phases.

1.18.1.3. Nose landing gear maintenance condition

The maintenance of the landing gear and in general of the aircrafts analyzed in the different events, was adequate and its record showed that the scheduled reviews established every fifty flight hours had been completed, in accordance with the approved maintenance program. In all events, the total flight hours of the aircrafts was less than 5000 flight hours, which is the useful life of the main and nose landing gear as established by the AMM, after which it must be replaced.

In the particular case of the EC-NAO, after the first accident occurred on 07/11/2019, the nose landing gear was replaced as a result of it, therefore, in all cases, the landing gear was distant in many hours to reach its useful life at the time of accidents.

1.18.1.4. Nose landing gear design

The design of the different components of the nose landing gear has been studied and has been considered adequate, although it could be improved in the particular case of aircrafts intended for training, where hard landings are common, reinforcing some of the components such as the tyres and the damping system, using higher performance ones, or the nose wheel fork fixing, using completely metallic self-locking nuts (instead of nuts with plastic inserts) that perform better under traction / compression stresses.

1.19.Useful or effective investigation techniques

Not applicable.

2. ANALYSIS

2.1. Analysis of the meteorological conditions

The meteorological conditions at Valladolid Airport around the time of the event (13:30 UTC) were not limiting for the flight.

According to the METAR information, the average surface wind conditions were 4.5 kt of crosswind and 9 kt of longitudinal wind. This is consistent with the data recorded on the aircraft around the time of touchdown.

According to the data recorded just before touchdown, the wind direction was 333º the speed was 10 kt, representing a transversal component of 9.7 kt and a longitudinal component of -2.2 kt. Moments later, the direction changed to 300º with a speed of 13 kt to stabilise during the landing at 284º and 8 kt. These variations are consistent with the testimony of the student pilot, who said he had to momentarily focus his attention on compensating for the wind variations during the final leg.

Therefore, the transversal and longitudinal wind speeds were between 6 to 12 kt and 4 to 5 kt, respectively. Bearing in mind the aircraft is designed for maximum transversal and longitudinal components of 12 and 22 kt, respectively, we do not believe the wind influenced the aircraft's performance decisively during the operation.

Consequently, we have determined that adverse conditions were not a factor in the accident.

2.2. Operational analysis

The flight involved in the accident was a solo flight as the student was in an advanced phase of the course and had the necessary authorisation to carry out this type of flight with satisfactory assessments from his instructors.

In order to perform the flight correctly, the student must plan it properly. For visual flights, such as the one under investigation, they must pay special attention to the elevations of the destination airport runways because the elevation dictates the altitude to be maintained in the traffic pattern.

In this case, the student had initially planned to fly to Logroño Aerodrome (LERJ), which has a traffic pattern altitude of 3000 ft. However, due to the adverse weather conditions in Logroño, he had to change the destination to Valladolid Airport (LEVD).

In Valladolid, runway 05/23 has an elevation of 2775 ft, so the pattern should be flown at around 3500 ft (between 800 and 1000 ft above the airport elevation).

As the student himself recognised when joining the LEVD traffic pattern (circuit to the left of runway 23), he thought he was flying a little low. Still, deciding that it was a subjective perception, he felt he must be mistaken because he was under the impression that he had to fly the pattern at 3000 ft. In reality, the student was flying less than 300 feet above the ground, which was excessively low.

Although the flight was planned and dispatched correctly, he didn't comply with the provisions of the Operational Flight Plan because he failed to verify the LEVD entry requirements concerning altitudes and flew the pattern at 3000 ft, which was the required altitude for the original destination that he cancelled due to bad weather.

This planning error was possibly due to the fact that, when changing destination, he had to prepare a new plan without sufficient time to adequately assimilate all the information necessary for the flight, including, in this particular case, the elevation of the runway and the altitude at which the traffic pattern should be flown.

During the approach to LEVD runway 23, the student had to focus his attention on the proximity of the ground, forgetting to check his speed and not acknowledging the first landing clearance from ATC, who had to re-issue the authorisation to get an affirmative response. The student was most likely more concerned with the proximity to the ground than acknowledging the ATC landing clearance.

On final, the student focused on aligning the aircraft with the runway centreline and neglected to monitor his approach speed, causing the aircraft to stall.

As the student himself stated, it took him by surprise when the aircraft sank and hit the runway, bouncing on its main landing gear several times.

Another factor is that the nose-up attitude required for aircraft with tricycle landing gear impedes the pilot's view of the runway centreline. Thus, when training, students often have a tendency to adopt a low nose attitude and high descent speed to keep the centreline in view.

The student was unaware he had significantly deviated from the basic flight parameters, particularly in relation to speed and altitude. This impeded his ability to react appropriately and control the aircraft when it dropped due to its low speed and probably its high angle of attack.

The student was so taken aback by the unexpected situation that he failed to adopt any type of corrective measure. Instead, the aircraft continued to bounce until, on the last impact, the nose gear made contact with the ground. According to the records, this produced an excessive vertical acceleration with flaps extended, reaching 3.1 g, and the subsequent collapse of the nose gear and detachment of the wheel fork. From that moment on, the aircraft slid along the runway on the buckled nose leg before coming to a stop.

Maintaining the nose-down attitude caused the aircraft to continue bouncing off the runway, eventually collapsing the nose gear.

When the aircraft came to a stop, the student correctly secured the cockpit and evacuated without assistance.

The accident, therefore, occurred as a result of an irregular touchdown, which caused the nose gear fork assembly to detach. This irregular touchdown or hard landing was probably caused by the aircraft travelling too fast and not adopting the correct attitude during the approach phase, resulting in excessive vertical acceleration during the landing.

2.3. Analysis of the aircraft wreckage

The rounded 20 cm mark on the runway was made by the nose gear leg when it hit the asphalt after the wheel fork detached. The wheel fork remained on the asphalt to the right of the runway centreline.

The aircraft then travelled on its nose leg and main gear, producing a continuous linear mark of more than 2 m in length, leading to the point where it came to a stop.

The damage to the propeller, nose gear and underside of the fuselage is consistent with the aircraft's nose impacting the runway after the wheel fork detached and the leg buckled in the direction of travel.

The wheel fork's mounting bolts and the nose leg were bent in the direction of the nose's impact with the runway, but there were no signs of any flaws or damages to suggest they were in a questionable condition prior to the event. The nuts and washers came off as a result of the impact.

2.4. Analysis of the aircraft's maintenance

The post-accident examination did not detect any pre-existing maintenance issues that may have been a factor in the event.

The maintenance records were in order, the aircraft and engine manufacturers' service bulletins were implemented correctly, and the scheduled overhauls and inspections carried out did not identify any issues relevant to the investigation.

In regard to the attachment of the wheel fork and nose leg, we do not think it likely that the nuts and bolts were insufficiently tightened because the last maintenance intervention took place three days before the event and after that, the aircraft flew for 16:15 hours and performed 28 landings without incident, two of which were during two earlier flights on the day of the accident.

2.5. Analysis of the organisation and management

The actions of the training organisation, both in terms of its compliance with the requirements for the student pilot and the condition of the aircraft, etc., were adequate and not considered a factor in the accident.

However, in all the cases analysed, there was a failure to comply with the approach procedures established by the ATO. The approach speeds were higher than those established for the operation, and in the cases where it has been possible to verify the flap position, they were not fully extended on final as required by the procedures. In all cases, there was an unstable landing.

The fact that the checklist included in the ATO's SOP establishes an approach speed of 65 KIAS with flaps at the first extension point and a landing speed of 55 KIAS with fully extended flaps, while the POH states 60 KIAS for both phases, could lead to confusion. Therefore, it would be better to unify the information in all the ATO's documents.

On the other hand, the ATO's management and analysis of this accident and the similar events that have occurred over the last year, all of which involved a loss of control on the final approach to the runway (ballooning), with unstable landings that caused significant damage to the aircraft, are considered adequate on the grounds of the organisation's proposed mitigation measures (section 1.17.1.).

3. CONCLUSION

3.1. Findings

- The analyses of the aircraft wreckage and maintenance records have not revealed any fault or defect attributable to the condition of the aircraft prior to the event.
- The student pilot did not touchdown correctly on landing.
- The aircraft travelled along the runway on the buckled nose gear leg without a wheel until it came to a standstill.
- All the nuts and washers on the wheel fork and gear leg mounting system came off; the bolts buckled but remained in the fork base plate.
- The wreckage, marks on the runway, recorded flight data, and the student pilot's statement are all consistent with an unstable hard landing.
- In one year, there have been four similar events involving solo flights operated by the same ATO on the same type of aircraft.

3.2. Causes

The investigation has determined the accident was caused by a poorly executed landing, which resulted in the nose gear impacting the runway several times, causing it to collapse.

A failure to adhere to the approach and landing procedures is considered to have been a contributing factor.

4. RECOMMENDATIONS

No operational safety recommendations are proposed.