DATA SUMMARY

LOCATION

Date and time	**Thursday, 25 February 2010; 17:10 local time**[1]
Site	**Vigo Airport (Pontevedra)**

AIRCRAFT

Registration	**EC-HPR**
Type and model	**CANADAIR CL-600-2B19**
Operator	**Air Nostrum**

Engines

Type and model	**GENERAL ELECTRIC CF34-3B1**
Number	**2**

CREW

	Pilot in command	Pilot flying
Age	**37 years old**	**37 years old**
Licence	**ATPL(A)**	**ATPL(A)**
Total flight hours	**9,824 h**	**5,362 h**
Flight hours on the type	**6,851 h**	**4,322 h**

INJURIES

	Fatal	Serious	Minor/None
Crew			**3**
Passengers			**20**
Third persons			

DAMAGE

Aircraft	**Minor**
Third parties	**None**

FLIGHT DATA

Operation	**Commercial air transport – Scheduled – Domestic – Passenger**
Phase of flight	**Landing**

REPORT

Date of approval	**26 January 2011**

[1] All times in this report are local. To obtain UTC, subtract one hour from local time.

1. FACTUAL INFORMATION

1.1. Description of event

The aircraft, a BOMBARDIER CL-600-2B19 (CRJ-200) had departed Bilbao Airport (LEBB) for Vigo Airport (LEVX) at 16:05.

The captain reported that as they approached the destination airport, they lined up with the runway 20 ILS when at a distance of 12 NM, after having previously gone around a cell of cumulus storm clouds located in the localizer some 15 NM away from the airport. He also reported being in IMC conditions until they approached to within 7 NM, at which time they saw the runway and kept it in sight until touchdown. According to his statement, at the 6-NM point, they noted moderate turbulence with ± 10 kt swings in wind speed, though they had not received any windshear warnings. The copilot, who was the pilot flying, disengaged the autopilot. They then moved one dot left of the localizer with three white lights on the PAPI. ATC informed them, at the Captain's request, that the wind on the ground was from 240° at 18 kt.

They established on the localizer once more and when they were 4 NM away the situation improved, though the turbulence persisted with 5-kt swings in IAS in either direction. These conditions persisted until they were on final. Since there were no windshear warnings, the Captain decided to land. He reported touching down gently but that they rose again about 0.5 m, at which time a gust of wind hit them from the right, causing the airplane to roll sharply to the left.

Both crewmembers reacted by turning their respective controls to the right to offset the roll. The airplane touched down with the right wheel first, followed by the left.

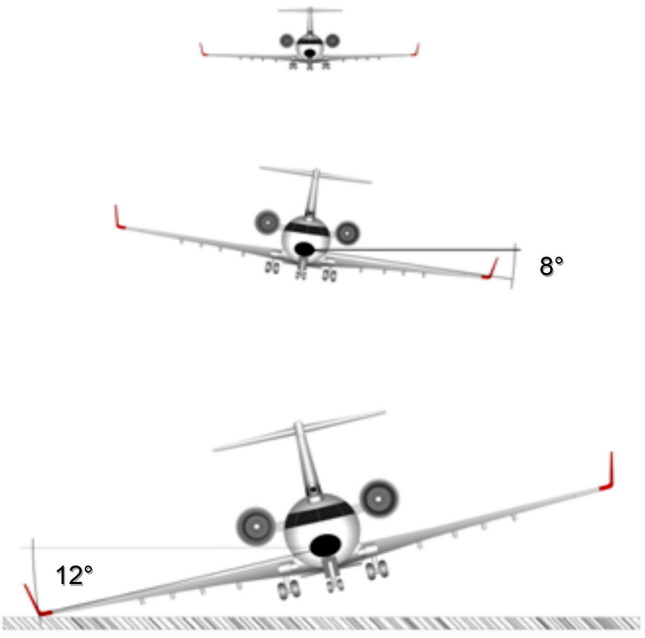

Figure 1. Diagram of landing

During the maneuver, the right wingtip hit the ground, resulting in minor damage to the underside of the wing (see Figure 2).

The airplane continued on its landing run and exited the runway normally via the first rapid exit taxiway to the right (C1) at 17:10.

Both pilots confirmed being unaware that they had struck the ground. They did confirm, however, that the rolling motion they commanded to the right to counteract the lifting action on the

right wing by the gust of wind had perhaps been excessively brusque.

The airplane's passengers disembarked normally. The crew discovered the damage that taken place during the post-incident inspection.

Figure 2. Damaged wingtip

The CIAIAC was made aware of the incident two days later by means of a notification from the airport. The operator had not informed the airport about the incident; it was the director of the airport who saw the company repairing the aircraft and collected information about the incident. Then he submitted it to the CIAIAC.

The operator notified the national Incidents Reporting System (SNS) in AESA (State Aviation Safety Agency) on March 3rd, 2010 according to the weekly list the SNS submit to the CIAIAC.

It was decided to remove only the airplane's flight data recorder (FDR), since the airplane had been energized long enough for all of the information on the cockpit voice recorder (CVR) that would have been of use to the investigation to be overwritten.

1.2. Personnel information

1.2.1. *Captain*

The Captain, 37, had a valid airline transport pilot license ATPL(A), issued in 2002, and a valid medical certificate. At the time of the incident he was not the pilot flying. He was type rated on the CL-600-2B19 and also had an instrument rating IR(A). He was also rated as a flight instructor TRI(A) and as a flight examiner TRE(A) since March 2009. He obtained his commercial pilot license CPL(A) in 1994.

He had 9,824:28 h of flying experience, of which 6,851:51 had been on the type, 4,754:09 as the Captain. He also had 1,457:10 h on the FOKKER 50, as had flown 1,515:27 h before joining the Operator.

In the ninety days prior to the incident, he had flown 183:48 h, in the thirty days prior 63:53 h, and in the twenty-four hours prior 5:45. He had rested for 16:20 h prior to the incident flight.

From 2005 until 2009, he had passed ten proficiency checks (two per year) on airplanes in the CRJ fleet, the last of them two months before the incident. He had taken

refresher training courses once a year on cockpit resource management (CRM), security, in-flight safety and (since 2006) airplane systems and one on dangerous goods every two years. Since 2006 he had also received training on emergencies every two years. In 2008, he participated in a triennial Safety and Rescue session.

1.2.2. *Copilot*

The copilot was 37 and had an airline transport pilot license ATPL(A), as well as the relevant medical certificate. He had a CRJ type rating and an instrument rating IR(A). He had a flying experience of 5,362 h, of which 4,322 had been on the type. At the time of the incident he was the pilot flying.

In the ninety days prior to the incident, he had flown 111 h, in the thirty days prior 70 h, and in the twenty-four hours prior 5:45. He had rested for 16:20 h prior to the incident flight.

From 2005 until 2009 he had passed ten proficiency checks (two per year) on airplanes in the CRJ fleet, and in 2010 he had passed another one, two days before the incident. Also since 2005 he had taken refresher training courses once a year on cockpit resource management (CRM), security, in-flight safety and one on dangerous goods every two years. Since 2006 he had also received annual training on airplane systems and on emergencies every two years. In 2005 and 2008 he participated in a triennial Safety and Rescue training session.

1.3. Aircraft information

The CANADAIR CL-600-2B19, known as a CRJ-200, was manufactured by BOMBARDIER in 2000 with serial number 7430. It had a valid airworthiness certificate. It was equipped with two GENERAL ELECTRIC CF34-3B1 turbofan engines with serial numbers 950158 and 950256. It had successfully completed the following maintenance checks:

Inspections	Check	Date	Flight-hours	Control hours	Periodicity
Type «C»	C-RJ2	01-11-2008	23,808	20,024	5,000 flight-h
	5C-RJ2	01-11-2008	21,336	17,689	25,000 flight-h
Regularly scheduled	YE01-RJ2	27-04-2009	22,487	18,795	1 year
	TYE06-RJ2	01-11-2008	21,336	17,689	6 years
	TYE8/4-RJ2	01-11-2008	21,336	17,689	8 years
	YE04-RJ2	01-11-2008	21,336	17,689	4 years
Type «A»	A06-RJ2	03-02-2010	24,188	20,408	500 flight-h
Type «L»	L1-B-RJ2	25-02-2010	24,325	20,555	100 flight-h
Other	2500FH-CHECK-RJ2	13-11-2009	23,747	19,965	2.500 flight-h

The dimensions of this airplane type are shown in Figure 3.

The roll is control by means of two hydraulically-operated (hydraulic systems 1 and 3) ailerons, which are attached to the rear of the wing spars on each wing through hinges. Each aileron is actuated through a cable and pulley system, which is operated by the wheels on the pilots' control columns, which are interconnected.

The two wheels are connected by means of a cable system and a torsion tube that features a disconnecting mechanism, making it possible to isolate the left and right cables should one of them become jammed.

The system has a unit with a force transducer that transmits information to the FDR on the movements made by the pilot. An artificial spring and a centering unit in each circuit provide tactile feedback for each control column.

Each aileron uses two computer units (PCU) connected to a common coupling input but which keeps the hydraulic inlets separate for each.

The ailerons feature an electrically-driven tab that is coupled to the front part of the shaft by a system consisting of a pusher and a lever.

The airplane is also equipped with two flight spoilers, two inboard ground spoilers and two outboard ground spoilers.

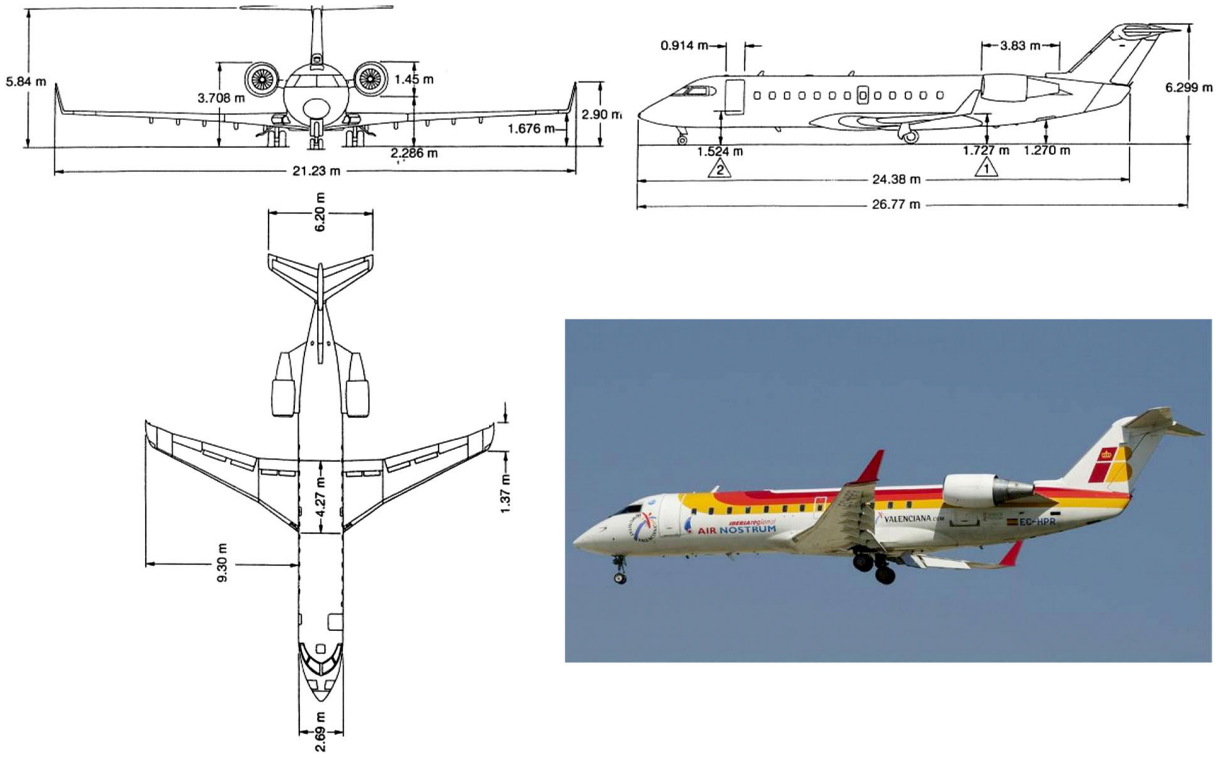

Figure 3. Views and photograph of aircraft

The primary function of the airplane's spoilers is to keep the airplane from lifting once one the ground, as an aid in rolling and for proportional elevation dampening. It also has two spoilerons that can be deployed asymmetrically to reduce the lift of one wing without increasing it in the other.

This is used to enhance the effect of the ailerons. The flaps can be deployed 8°, 20°, 30° and 45°.

The maximum speed at which the airplane can operate with the flaps down is 215 KIAS up to 20°, 185 KIAS for 30° and 170 KIAS for 45°.

The maximum allowable airspeed with turbulence is 280 KIAS or 0.75 Mach, whichever is lower. The wet runway maximum demonstrated crosswind component is 27 kt for both takeoff and landing. This wind component is not considered limiting.

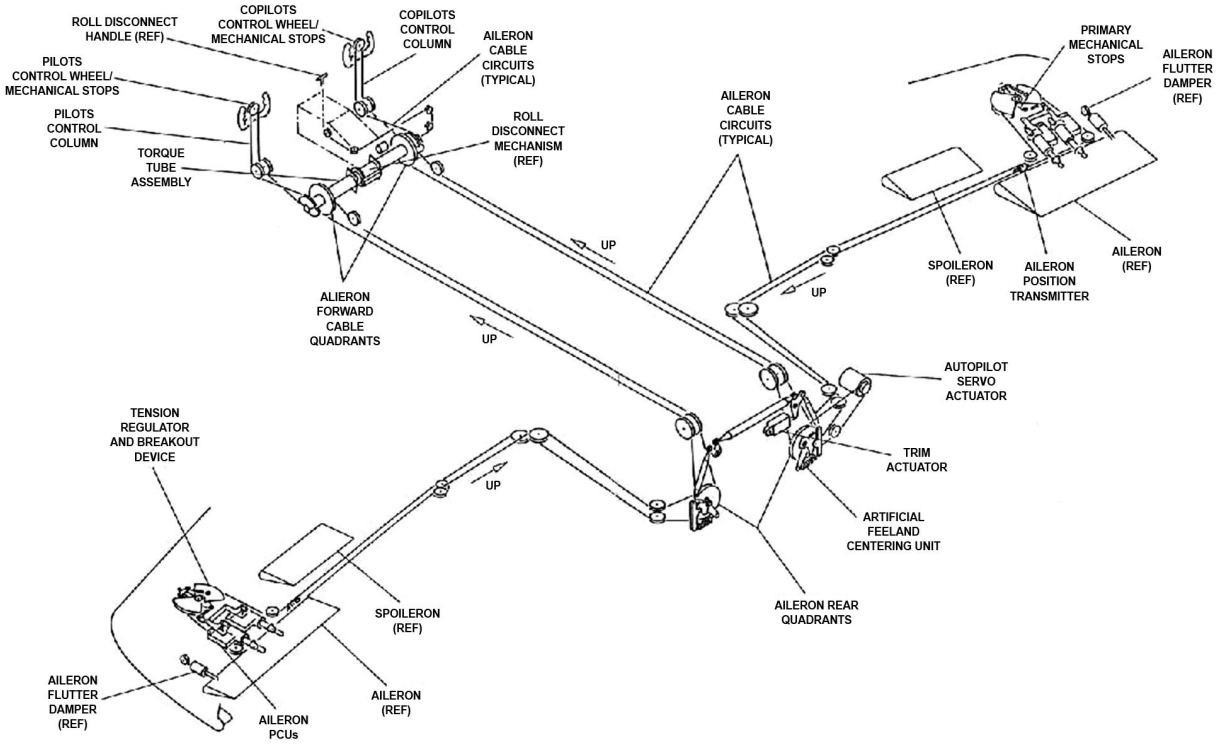

Figure 4. Roll control system

1.4. Airport information

The Vigo Airport (LEVX) is rated as an ICAO category 4-C facility[2]. Its master plan was approved by Ministry of Development Order 17395/2001, and its main activity

[2] (4) Runway length 1,800 m and over. (C) Wing span of 24 to 36 m, and outer main gear wheel span of 6 to 9 m.

involves scheduled domestic passenger traffic.

According to the information in the AIP (Aeronautical Information Publication), its reference point is at coordinates 42° 13′ 45″ N – 8° 37′ 39″ E and at an elevation of 261 m (855 ft).

It has one runway, designated 02-20, that is 2,400 m long and 45 m wide. Runway 02 has an upward 0.45% angle for the first 750 m, 0.21% for the next 810 m and 0.75% for the last 840 m. The actual runway orientation with respect to magnetic north is 15°-195°, the magnetic declination being 4° W with an annual variation of 9′ E.

It has two rapid exit runways, designated C1 and C3. The first is to the right of runway 20 in line with the reference point, and connects the runway to the platform via a 22-m wide taxiway. The other is located as a continuation of runway 20 and also connects the runway with the platform by means of a 180° turn (see Figure 5).

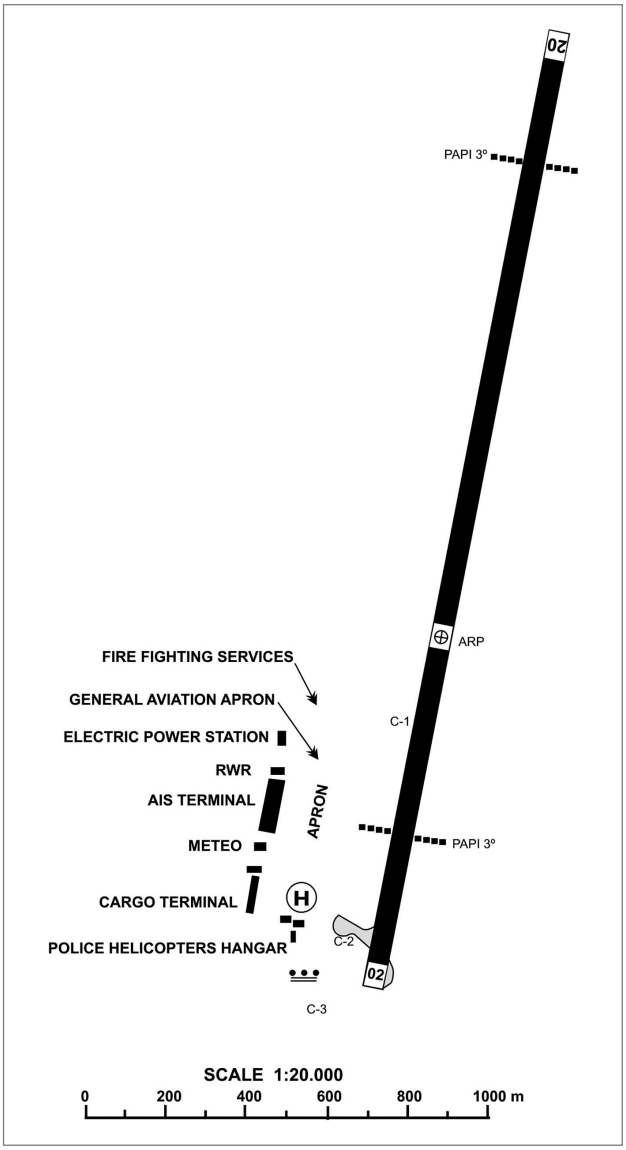

Figure 5. Map or aerodrome

1.5. Meteorological information

The National Weather Agency reported the following meteorological conditions for 16:10 on the day of the incident:

General situation in the Iberian Peninsula

Low-pressure area (980 hPa) west of France moving to the northeast. High-pressure area (1,020 hPa) over Morocco. Very active cold front crossing the Iberian Peninsula, extending from the southwest of the peninsula to the Pyrenees. Strong westerly winds at all levels over the Iberian Peninsula.

Situation on Bilbao-Vigo route

A very active cold front crossed the north of the Peninsula in the morning, leaving in its wake abundant CU, SC and AC clouds in the afternoon, along with scattered TCU and CB. There was rain and drizzle and local areas of snow and moderate to strong turbulence in mountainous regions. Icing conditions and mountain waves were also present. There were strong winds from the southwest at all levels, increasing in intensity with elevation above Galicia from 30 kt at low altitudes to 79 kt at 15,000 ft and to 98 kt at 30,000 ft. Over Vizcaya winds were 30 kt at low altitudes, 55 kt at 15,000 ft and 89 kt at 30,000 ft.

Situation at Vigo Airport

Winds from 240°, varying from 220° to 290° at 22 kt and gusting up to 37 kt. Visibility 6,000 m. Few clouds at 1,500 ft and very cloudy with TCU clouds at 20,000 ft. Rain showers. Temperature 12 °C. The 16:00 METAR for Vigo Airport was as follows:

> METAR LEVX 251500Z 24019G33KT 200V290 6000 SHRA FEW015 BKN020TCU 12/09 Q1000 WS ALL RWY=

This translates into wind from 240° at 19 kt varying from 200° to 290° and gusting at 33 kt. Horizontal visibility 6,000 m. Rain showers with few clouds at 1,500 ft and broken at 2,500 ft with towering cumulus clouds. The temperature was 12 °C and the dew point 9 °C. The QNH was 1,000 hPa and there was windshear along the entire runway.

1.6. Communications

The most relevant communications between the tower and the airplane were as follows:

Time	Station	Message content
17:05:15	Approach	Handing off 8962
	Tower	I have the AIR Nostrum
17:05:32	ANE 8962	Vigo, good afternoon, Air Nostrum 8962
	Tower	Air Nostrum 8962 Vigo Tower, good afternoon, cleared to land runway 20 wind 240 degrees 19 kt gusts 29
	ANE 8962	Cleared to land 20, 8962
	Tower	Air Nostrum 8962 wet runway and for your information an Airbus 320 reported windshear below 1,000 ft about two and a half hours ago
	ANE 8962	Roger 8962
17:09:19	Tower	Wind 230, 18 kt
	ANE 8962	Roger

Time	Station	Message content
17:09:40	Tower	Vigo, I have the Air Nostrum in sight
	Approach	Handing off 0570
	Tower	Copy, I have the Iberia
17:10:07	Tower	Wind 250, 23 kt
	ANE 8962	Copy
17:11:12	Tower	Air Nostrum 8962, vacate first right proceed with marshaller to parking, report whether you encountered windshear
	ANE 8962	Yes, the machine gave no indication of windshear, but yeah, there were sudden changes in windspeed
	Tower	Air Nostrum 8962 roger, good day
	ANE 8962	Good day
17:12:50	ANE 8962	Yes, Vigo, the yellow one, where did it go?
	Tower	I'll confirm right away
	ANE 8962	It looks like it's coming, let's see if he finds us a good spot
	Tower	Let's see if we're lucky
17:13:08	Tower	Go ahead
	Coordinator	Hello, look, initially it was slated for 9, if you want orient it so it goes to 9
	Tower	The marshaller is in front of you, I don't know what the problem was but it looks like it's solved

1.7. Information on alignment and stabilization on final approach

According to the operator's Operations Manual, a successful final approach and safe landing demand a stabilized approach in the required configuration with the airplane lined up with the runway.

The manual defines the airplane as being stable when the following parameters are present simultaneously: airplane on correct path (lined up with runway); speed above V_{REF}[3] and below V_{REF} + 20 kt; descent rate below 1,000 ft/min; ILS within one dot of the LOC/GS; briefing and checklists completed and proper landing configuration (gear and flaps) as described in the Operations Manual (Part B).

The airplane is considered to be lined up with the runway when it is within a maximum of ± 5° with the runway centerline on non-precision approaches, and within ± 1 dot on the localizer indicator.

[3] V_{REF} is the landing reference speed at a height of 50 ft above the runaway threshold in the normal landing configuration. The maximum V_{REF} is 141 kt.

If during a VMC instrument or visual approach the airplane is not stable when at 500 ft above the touchdown zone elevation (TZDE), the crew shall perform a go-around. In any event, the wings must always be level by 300 ft above the TDZE.

If for reasons beyond the crew's control (ATC requirements, emergency or any other unforeseen circumstance), any of the parameters used to define a stable approach cannot be maintained, the Captain shall give a special briefing so as to ensure the safe conduct of the approach.

The Operations Manual also specifies that when the copilot is performing the landing, he shall carry out all of the relevant operations (reverse thrusters, etc.), unless specified otherwise by the Captain during the briefing.

The Captain shall assume control of the airplane prior to slowing to 60 kt. The transfer of control is to be unambiguous and unequivocal.

1.8. Flight data recorders

1.8.1. *General parameters*

The recorder installed on the airplane was an L3 COMMUNICATIONS FA2100 solid-state (SSFDR) model.

The following table shows a selection of the most significant flight parameters over a time interval that includes the instant at which the right wingtip struck the ground.

Time	Alt. (ft)	Wind		Roll (°)	Pitch (°)	Speed		Ailerons (°)		Flaps (°)		Spoileron		Spoilers	
		Vel.	Dir.			IAS	G.	L	R	L	R	L	R	L	R
17:09:42	19	32	248	3	–2	146	137	–10	–10	45	43	1	6	0	0
17:09:43	15	32	248	0	–1	152	136	–1	0	45	43	1	1	0	0
17:09:44	10	32	248	1	–3	150	145	–9	–10	45	43	1	6	0	0
17:09:45	8	32	247	3	–1	146	141	0	1	45	43	1	1	0	0
17:09:46	5	32	247	3	–1	140	136	4	1	45	43	1	1	0	0
17:09:47	5	32	247	0	–1	144	129	–4	–2	45	43	1	1	0	0
17:09:48	**2**	**32**	**247**	**–8**	**–3**	**146**	**137**	**2**	**0**	**45**	43	**1**	**1**	0	0
17:09:49	**2**	**30**	**246**	**12**	**–1**	**137**	**132**	**–21**	**–17**	**45**	43	**1**	**17**	0	0
17:09:50	1	30	246	–4	0	129	125	7	–4	45	43	1	4	0	0
17:09:51	1	30	246	–1	0	123	116	–9	–10	45	43	50	50	49	50
17:09:52	1	30	246	1	0	124	112	–12	–14	45	43	50	50	50	50
17:09:53	0	30	245	0	–1	116	108	–14	–15	45	43	50	50	49	50

An analysis of the data reveals that at the instant when the airplane rolled left due to the wind, it was approximately 2 ft above the ground and was flying at an IAS of 146 kt. The wind was from 247° at 32 kt.

When the crew commanded a roll to the right immediately following the gust to correct for the roll induced by the wind, the aircraft was at practically the same altitude and the IAS was 137 kt (9 kt lower).

Both the wind direction and speed remained practically unchanged from one instant to the next. The airplane did not accelerate laterally over that interval, and its vertical acceleration was only 1 m/s^2 (the acceleration is not shown on the table).

The position of the flight controls over the same interval shows that at 17:09:48, when the airplane was at a height of 2 ft (60 cm), its roll angle went from 8° left to 12° right in 1 s.

The ailerons went from having a negative angle before the impact to having a positive angle. The spoilers were retracted prior to impact and started to deploy 2 s later of impact, as did the spoilerons.

The flaps were extended to around 44°. The actual data show 45° for the left side and 43° for the right, that is, fully extended.

The spoirles deployed 2 s after impact, once the airplane was on the ground.

1.8.2. *Stabilized approach parameters*

During approach, the aircraft intercepted the localizer and the glideslope at 17:04, at 15 NM from the runway, with the autopilot engaged. The recorded wind at that time was 52 kt from 261°, resulting in a crosswind component that forced the aircraft to fly with a drift angle of 12° leftwards in order to counteract the wind action.

At 17:07:34, at 4,9 NM from the runway, the crew deflected the flaps at 45°. At that moment the aircraft was configured for landing and has 150 kt of IAS. During approach, with the autopilot engaged, there were no deviations in the localizer or in the glideslope, and the descent rate went from 600 ft/min to 800 ft/min. Up to that moment the approach was stable.

At 17:08:25, i.e., 9 seconds before disconnecting the autopilot, the indicated airspeed started to go down from 152 kt to 132 kt. At a specific moment it reached a pitch angle of 40°; then it changed to a 0.70° rearing angle.

At 17:08:34, some 2.6 NM from the runway, the crew disconnected the autopilot. At the moment the aircraft was at a QNH altitude of 1,700 ft (870 ft with regard to the runway threshold).

From the very moment the autopilot was disconnected, the aircraft suffered bank changes, which were corrected by the pilot flying. 9 seconds later he centered it again. At the same time the pitch angle suffered from important variations. During these variations of bank and pitch angles the aircraft started to deviate to the left of the localizer and above the glideslope. The deviation from the localizer reached a maximum of 1,21° to the left, but when the aircraft was at 0,4 NM from the runway it was aligned with the centerline again.

On the contrary, the deviation from the glideslope reached a maximum of 2,07° on top. At 17:09:28, at 0,625 NM from the runway, the aircraft went down under the glideslope. At 17:09:36, during final approach, when the aircraft was at 137 ft. of height with respect to the runway 20 threshold, it was recorded a Ground Proximity Warning System (GPWS) that lasted 7 seconds, thus evidencing the deviation of the glideslope.

The maximum recorded deviation under the glideslope was 3,64°. During the warning the indicated airspeed changed between 154 kt and 144 kt. At no time there were efforts from the crew in order to correct the warning. The minimum descent rate, while the aircraft above the glideslope, was 1,400 ft/min.

During the final landing, when the aircraft was at 50 ft, N1 power was at 75,5%. Since that moment on, the power lowered to 32% at the exact time of the touchdown (the N1 power at idle is 25%).

Before the landing, the pilot flying corrected the wink angle with rudder, aligning the aircraft and with a right bank angle of 2°.

The nose landing gear was the first to contact the runway, with the aircraft at a pitch angle of –0,79°. When the NLG contacted the runway, the aircraft made an uncommanded left bank up to 8,09°. The crew reacted by turning the controls sharply to the right, producing a right bank angle of 11,7°. As a consequence the right plane tip rubbed the ground.

The parameters that indicate whether the approach was stable are shown in the table below, starting from 49 s prior to the impact of the wingtip with the ground, when the airplane was at 1,459 ft.

Keeping in mind that the altitude shown in the table, obtained from the radio-altimeter, is only recorded for specific times, and that the vertical rate is not recorded on the FDR, the descent rate was derived by calculating the change in altitude over time.

Thus, the airplane was at 1,459 ft at 17:09:01 and at 2 ft at 17:09:48.

This means that in 47 s, it descended 1,457 ft, which translates into a descent rate of 1,862.56 ft/min. If a smaller interval is considered, for example, from 17:09:01 until 17:09:24, when the altitude was 695 ft, then the descent rate for those 23 s was 1,993.045 ft/min.

In transitioning through 500 ft, it went from being at 524 ft at 17:09:31 to being at 219 ft at 17:09:35, which yields a descent rate of 4,575 ft/min.

Time	ALT (ft)	Gear	Speed (kt)		Flaps (°)		ILS deviation (°dot)	
			IAS	G.S.	L	R	Localizer	GS
17:09:01	1.459	DOWN	155	140	45	43	1	1.8
17:09:02		DOWN	155	140	45	43	1	1.8
17:09:03		DOWN	148	136	45	43	1	1.9
17:09:04		DOWN	161	146	45	43	1	1.9
17:09:05	1.361	DOWN	160	148	45	43	1	1.9
17:09:06		DOWN	160	146	45	43	1	1.9
17:09:07		DOWN	160	138	45	43	1	2
17:09:08		DOWN	155	135	45	43	1	2
17:09:09	1.198	DOWN	154	128	45	43	1	1.9
17:09:10		DOWN	148	121	45	43	1	1.9
17:09:11		DOWN	147	123	45	43	1	1.8
17:09:12		DOWN	145	120	45	43	1	1.8
17:09:13	1.102	DOWN	148	128	45	43	1	1.7
17:09:14		DOWN	144	121	45	43	1	1.4
17:09:15		DOWN	149	126	45	43	1	1.4
17:09:16	940	DOWN	146	123	45	43	1	1
17:09:17		DOWN	145	123	45	43	1	1
17:09:18		DOWN	143	124	45	43	1	0.7
17:09:19		DOWN	143	125	45	43	1	0.7
17:09:20	794	DOWN	147	133	45	43	1	0.4
17:09:21		DOWN	148	135	45	43	1	0.4
17:09:22		DOWN	146	134	45	43	1	0.1
17:09:23		DOWN	148	141	45	43	1	0.1

Time	ALT (ft)	Gear	Speed (kt)		Flaps (°)		ILS deviation (°dot)	
			IAS	G.S.	L	R	Localizer	GS
17:09:24	695	DOWN	158	145	45	43	0	–0.1
17:09:25		DOWN	153	139	45	43	0	–0.1
17:09:26		DOWN	147	128	45	43	0	–0.2
17:09:27		DOWN	144	125	45	43	0	–0.2
17:09:28	611	DOWN	144	129	45	43	0	–0.3
17:09:29		DOWN	142	127	45	43	0	–0.4
17:09:30		DOWN	138	123	45	43	0	–0.4
17:09:31	524	DOWN	137	126	45	43	0	–1.1
17:09:32		DOWN	145	134	45	43	0	–1.1
17:09:33		DOWN	154	148	45	43	0	–2
17:09:34		DOWN	154	144	45	43	0	–2
17:09:35	219	DOWN	155	143	45	43	0	–2.5
17:09:36		DOWN	149	138	45	43	0	–2.5
17:09:37		DOWN	157	140	45	43	0	–2.9
17:09:38		DOWN	146	129	45	43	0	–2.9
17:09:39	83	DOWN	144	128	45	43	0	–3.5
17:09:40		DOWN	146	126	45	43	0	–3.5
17:09:41		DOWN	151	138	45	43	0	–3
17:09:42	19	DOWN	146	137	45	43	0	–3
17:09:43	15	DOWN	152	136	45	43	0	–3.2
17:09:44	10	DOWN	150	145	45	43	0	–1.3
17:09:45	8	DOWN	146	141	45	43	0	–1.3
17:09:46	5	DOWN	140	136	45	43	0	2.2
17:09:47	5	DOWN	144	129	45	43	0	2.2
17:09:48	**2**	DOWN	**146**	**137**	**45**	**43**	**0**	**1.1**
17:09:49	**2**	DOWN	**137**	**132**	**45**	**43**	**0**	**1.1**
17:09:50	1	DOWN	129	125	45	43	0	1
17:09:51	1	DOWN	123	116	45	43	0	1
17:09:52	1	DOWN	124	112	45	43	0	–1.9
17:09:53	0	DOWN	116	108	45	43	0	–1.9

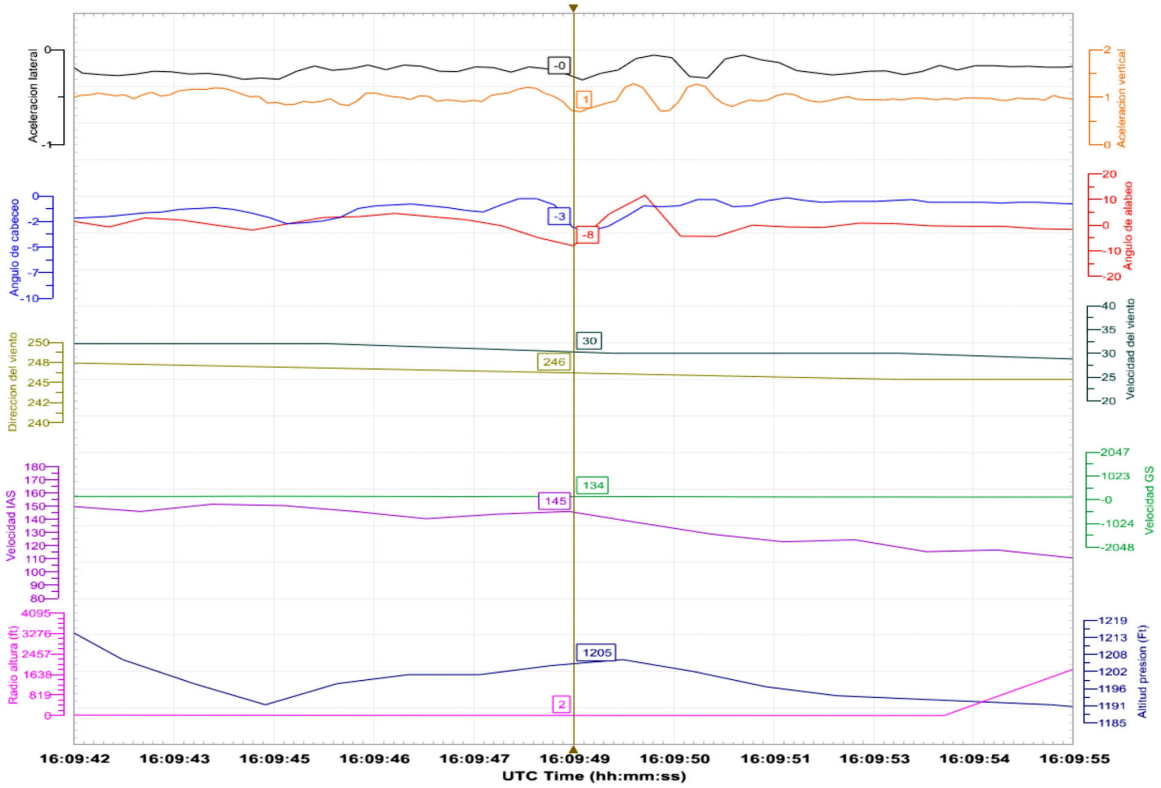

Figure 6. General parameters during roll to left

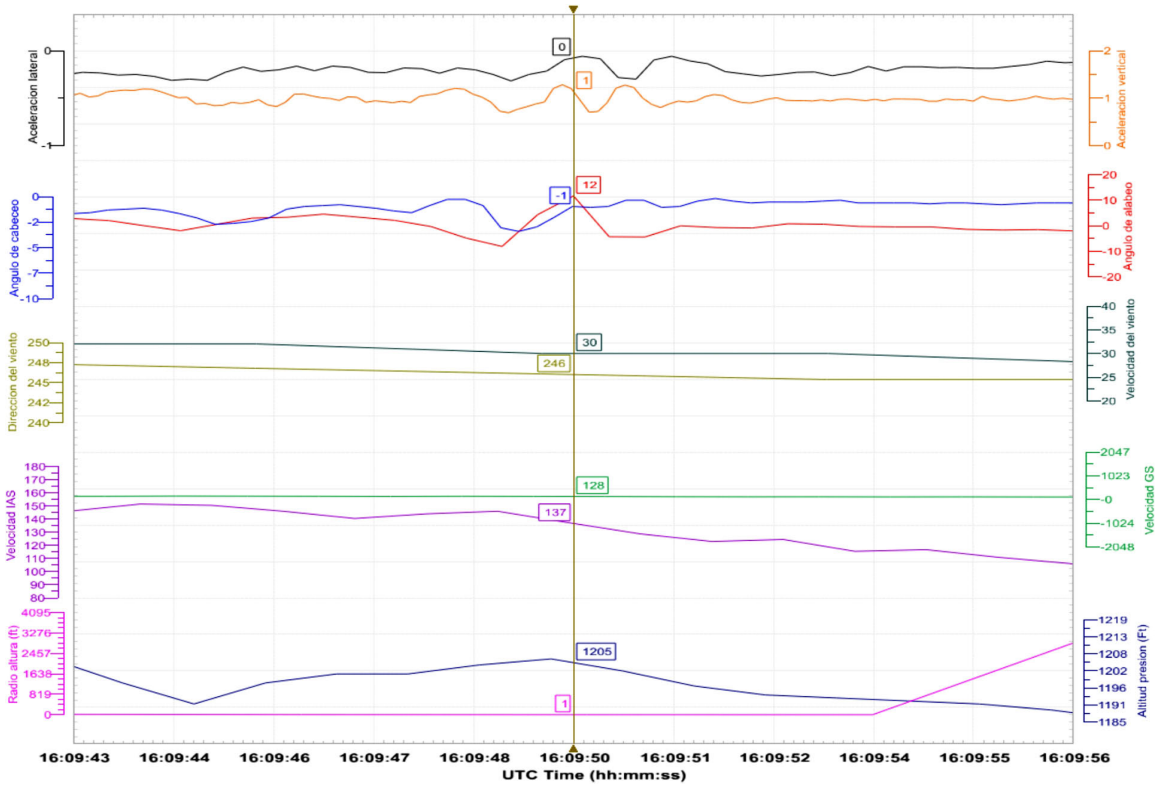

Figure 7. General parameters during roll to right

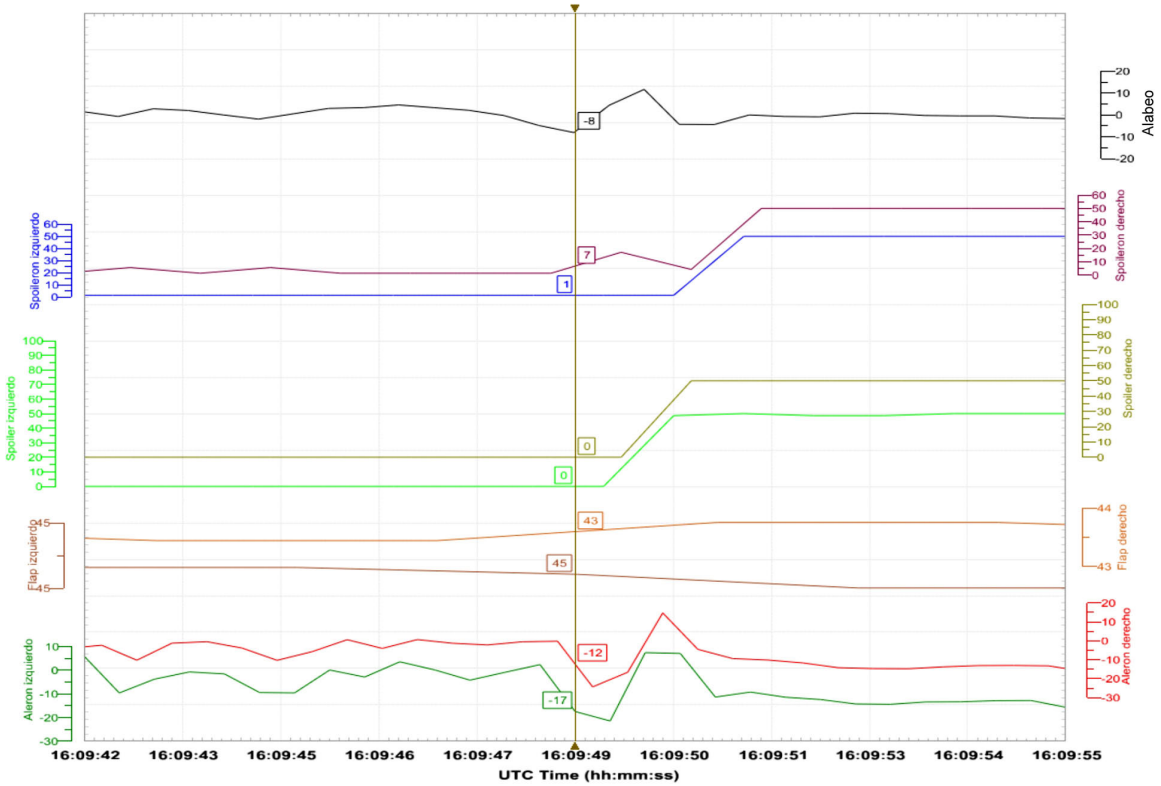

Figure 8. Flight controls during roll to left

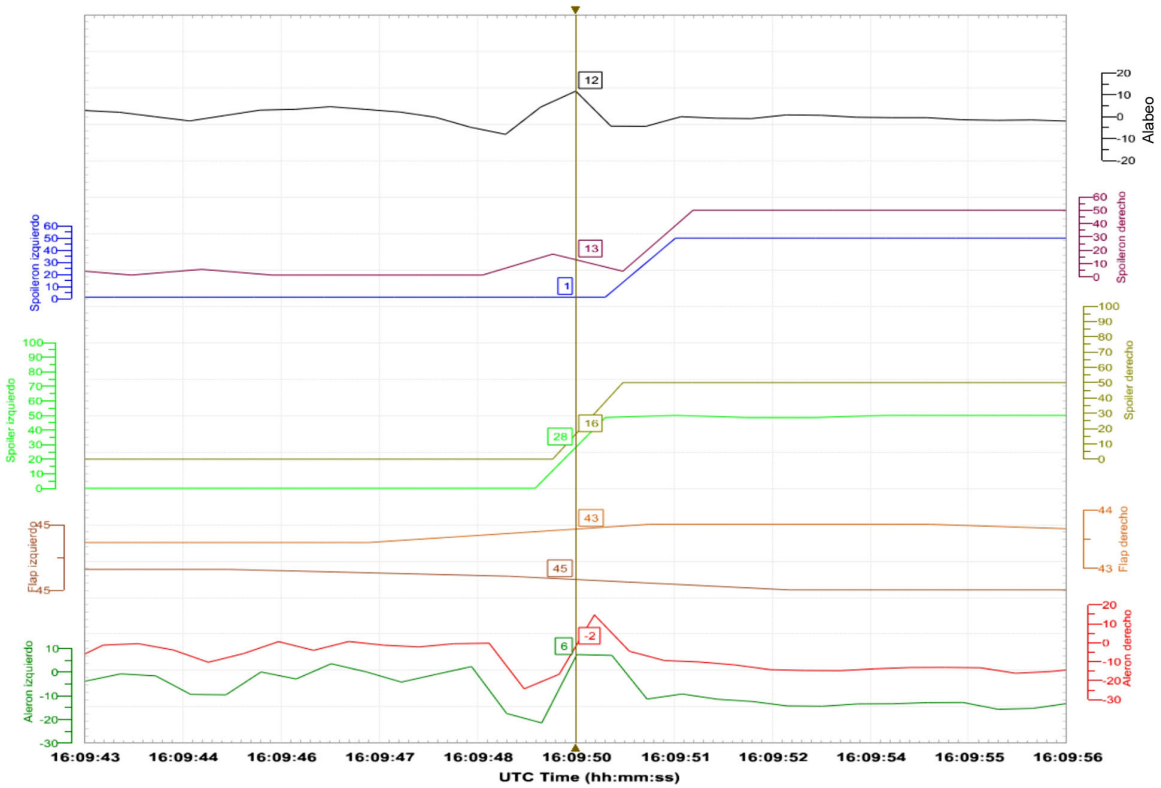

Figure 9. Flight controls during roll to right

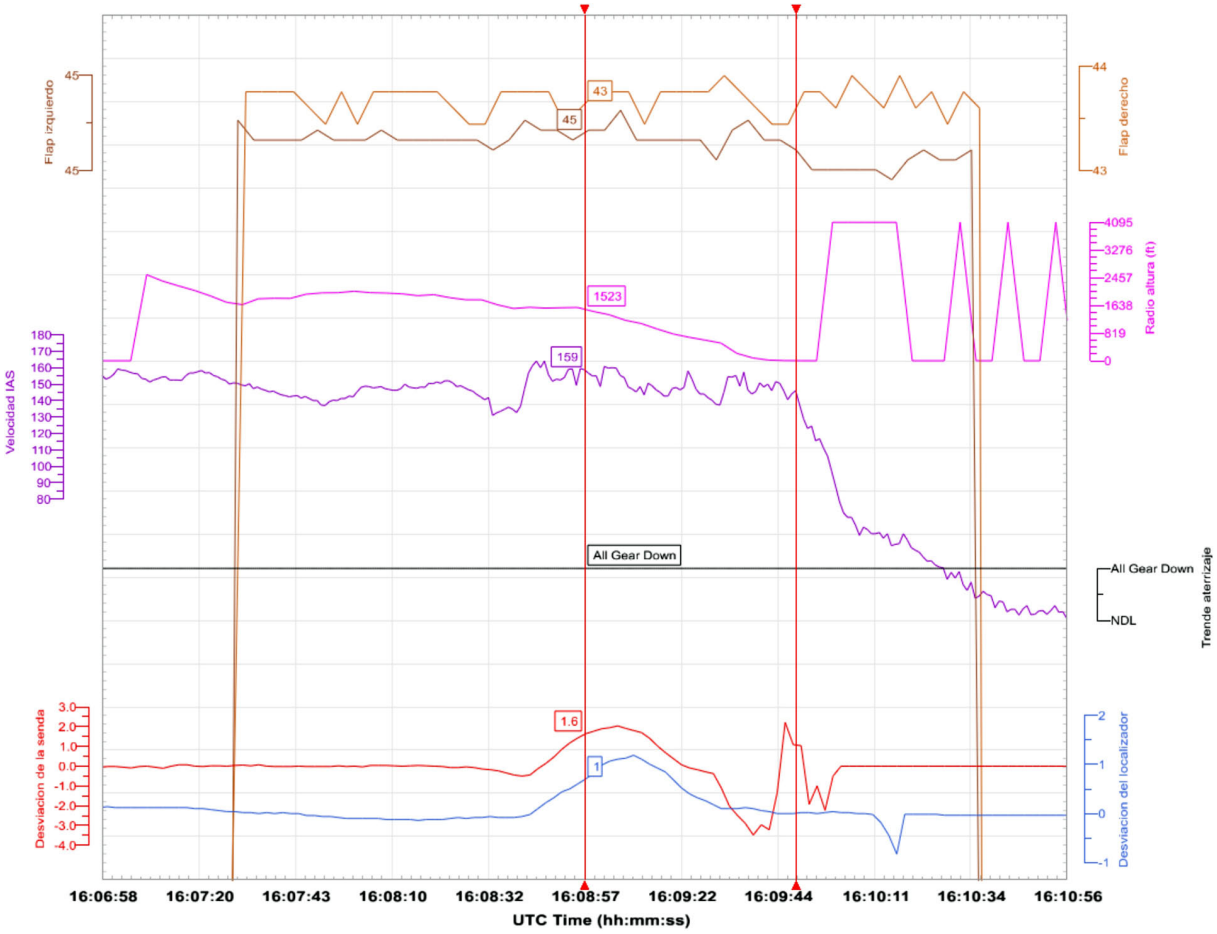

Figure 10. Stabilized approach parameters

1.9. Corrective actions taken by the Operator

According to the information provided by the operator after the incident, all the flight parameters were analyzed and a detailed report was issued, reflecting the crew performance during approach and landing phases.

The operator also informed that, as part of their Safety Management System and Risks Assessment and by means of a computer program, they monitor monthly the flight parameters and the tendencies concerning the destabilized approaches, focusing on where and why they are produced and taking the pertinent corrective measures.

The data obtained in this analysis are part of the operator's safety indicators and they are monthly submitted to the State Aviation Safety Agency (AESA).

The operator also informed that after the incident the following corrective measures were taken:

- A communication was sent to all the company pilots, reviewing the landing techniques for the CRJ-200.
- It was prepared a presentation which is shown in every refreshing course at the end of the "lessons learnt" from this incident part.
- A scenario in the simulator was created in order all the pilots to face similar meteorological situations to those encountered in Vigo.
- The operations department has reduced the crosswind component at Vigo airport to 20 kt.

2. ANALYSIS

The company's Operations Manual indicates that both making a final approach and landing safely require a stable approach. In keeping with this, it clearly defines those conditions that must be satisfied in order to comply with these requirements, these conditions matching those standards published by the Flight Safety Foundation[4].

An approach is considered stable when all of the following conditions hold: the airplane is lined up with the runway; the IAS is between V_{REF} and V_{REF} + 20 kt; the descent rate is below 1,000 ft/min; the ILS deviation is at most one dot on both the localizer and glideslope; both the briefing and checklists are complete and the landing gear and flaps are configured as described in the Operations Manual (Part B).

The manual also states that, in any event, the wings must be level by 300 ft above the touchdown zone elevation and that if the airplane is not stabilized by 500 ft above said point, a go-around must be executed.

As shown by the data obtained from the flight data recorder, the IAS was maintained within the stable approach limits, since at no time was it below V_{REF} or above V_{REF} + + 20 kt.

The descent rate, in contrast, was outside the established margins throughout the final approach, at times even reaching values almost double those stipulated.

The ILS localizer was also beyond the established limits, but not the glideslope.

Both the landing gear and flaps were in a proper configuration during the approach.

Since all of the requirements defined for a stable approach were not simultaneously present, the reasonable course of action would have been to go around.

[4] Independent aviation safety organization that defines internationally recognized quality standards.

The Operations Manual specifies that, if for reasons beyond the crew's control (ATC requirements, emergency or any other unforeseen circumstance), any of the parameters used to define a stable approach cannot be maintained, the Captain shall give a special briefing so as to ensure the safe conduct of the approach

Since the cockpit voice recording was unavailable, it was impossible to determine whether the crew completed the checklists, whether tasks were effectively distributed or whether they were aware that they were outside the established margins for a stabilized approach, and if, as a consequence, the Captain held the special briefing required by the Operations Manual.

The Operations Manual also specifies that when the copilot is performing the landing, he shall carry out all of the operations involved in the landing unless specified otherwise by the Captain during the briefing, and that in any event, the Captain shall assume control prior to slowing to 60 kt, said transfer of control being unambiguous and unequivocal

This item could also not be corroborated, though in light of the information provided by the crew, it seems clear that at no time was the control transferred; rather, the captain provided an input to the controls and added his actions to the copilot's, who was the pilot flying.

In this sense, the number of flight hours accumulated by the copilot (5,362), of which 4,322 had been on the type, as well as the refresher training he had taken, appear to indicate that the impact of the wingtip with the ground was not the result of a lack of experience or skill. The time he had flown in the previous ninety days clearly shows that the copilot's flight activity had not lapsed.

The same statements may be applied to the Captain, as supervisor of the operation.

The maximum crosswind component gusting from the right, though within the limitations demonstrated specified for this airplane, made it difficult to keep the airplane from rolling to the left to some extent, even though the crew was aware of the meteorological conditions. Nevertheless, given the copilot's experience and training, the pilot's intervention, which resulted in his corrective actions being added to those the pilot had already been making during the approach, seems unnecessary.

Perhaps it was the proximity to the ground that caused the Captain to take the controls instinctively instead of relying on procedure, thinking that between the two of them they could better counteract the wind-induced roll.

The impact could undoubtedly have been avoided had there been more effective communications between the crew members.

3. CONCLUSION

3.1. Findings

- The wind at the airport during the approach was from 240º at 22 kt, varying between 220º and 290º and gusting up to 33 kt.
- During the final approach, the tower informed the crew on at least two occasions of the prevailing weather conditions at the airport.
- The investigation did not detect any type of anomaly with the airplane or any maintenance deficiencies.
- The data obtained from the DFDR revealed that a non-stabilized approach was conducted in that it was outside desired margins both in terms of descent rate and ILS localizer position.
- Prior to the impact the airplane rolled left, attaining a maximum angle of 8º.
- The airplane then rolled right, attaining a maximum angle of 12º.
- The right wingtip hit the ground when the airplane was at an altitude of just over 2 ft.
- The airplane exited the runway normally. It was not until later that the damage was discovered and repaired.

3.2. Causes

The root cause of the incident is considered to be the brusque actions taken by both crewmembers to roll the airplane to the right in an effort to counteract a wind-induced roll to the left.

A contributing factor was the fact that a non-stabilized approach was made instead of deciding to go around, as specified in the procedure.

4. RECOMMENDATION

During the investigation it has been verified that the operator has implemented a Flight Operations Quality Assurance. This system allows identifying, studying and proposing corrective actions to, among other, the destabilized approaches. Therefore the issuance of a safety recommendation on this regard has been considered unnecessary.