DATA SUMMARY

LOCATION

Date and time	**Tuesday, 13 November 2012; 12:05 h**[1]
Site	**San Javier Airport (Murcia)**

AIRCRAFT

Registration	**EC-JYC**
Type and model	**FAIRCHILD SA-226-TC**
Operator	**Zorex**

Engines

Type and model	**HONEYWELL TPE 331-10UA-511G**
Number	**2**

CREW

	Captain	First officer
Age	**33 years old**	**31 years old**
Licence	**Commercial Pilot License (A)**	**Airline Transport Pilot License**
Total flight hours	**5,100 h**	**2,800 h**
Flight hours on the type	**3,015 h**	**1,400 h**

INJURIES

	Fatal	Serious	Minor/None
Crew			**2**
Passengers			
Third persons			

DAMAGE

Aircraft	**Important**
Third parties	**None**

FLIGHT DATA

Operation	**Commercial air transport – Non-revenue operations – Ferry**
Phase of flight	**Takeoff run**

REPORT

Date of approval	**25 September 2013**

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

1. FACTUAL INFORMATION

1.1. History of the flight

On 13 November 2012, a FAIRCHILD SA-226-TC aircraft, registration EC-JYC, owned by Zorex, had conducted a flight to transport a patient from the Pamplona Airport (LEPP) to the Murcia Airport (LECL) early in the morning.

At 12:05, approximately one hour after landing in Murcia, it was preparing to take off en route to the Huesca Airport (LEHC), with the captain and first officer onboard, the latter of whom was the pilot flying (PF).

During the takeoff run on runway 05R, the aircraft veered left and departed the runway. During its run, it crossed the first access taxiway on the left and came to a stop very close to the intersection of said taxiway and the runway.

The crewmembers were uninjured and exited the airplane under their own power.

The airplane suffered significant damage.

1.2. Investigation at the accident site

The tracks found at the accident site during the investigation indicated that the airplane started to deviate approximately 15 m before the aiming point marking; from that moment on both front gear wheels were skidding while turning left. The airplane then struck the edge of the access taxiway and crossed it, at which point the wheels returned to their normal position, with the airplane stopping a short distance further ahead (see figure in Appendix A).

As Figure 1 shows, during the portion of the run that the airplane was skidding (approximately 47 m), the tracks left by the front gear wheels came within 60 cm of those left by the left main gear wheels, whereas the normal distance between them is about 2.25 m (half of the wheel track).

There was significant damage to the right propeller and less serious damage to the left propeller, occurring as a result of the blades striking the ground when the airplane stopped. The wheels also exhibited some damage, as did the right wing, which caused a loss of fuel from the tank.

The structure that attaches the front gear to the fuselage was also damaged, though most likely it occurred not during the accident, but rather while the airplane was moved to the apron from the site of the accident.

Finally, several dents (probably from stones) were found in the right part of the fuselage, near the propeller.

An inspection of the landing gear did not reveal any mechanical faults aside from the damage caused by the runway departure. It was noted, however, that the electrical

Figure 1. Gear tracks

wires that actuate the gear components lacked any type of protection against moisture and other external agents (see photographs in Figure 2) beyond the insulation present on each wire.

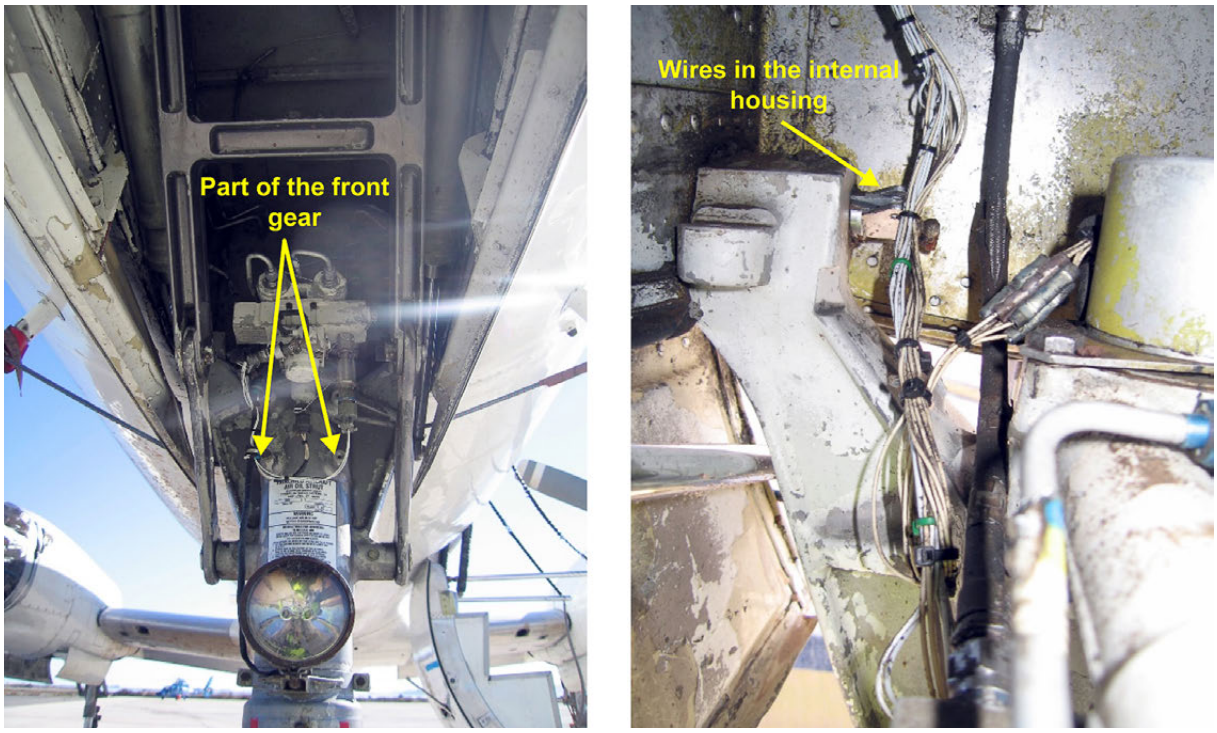


Figure 2. Nose gear housing

The gear was also cycled up and down several times to check for faults in the operation of the nose wheel steering (NWS) system. These cycles were made in dry and then in wet conditions in an effort to reproduce the conditions present at the time of the accident, since the runway was wet and water was splashing into the gear well. No faults were observed in the system, however.

1.3. Personnel information

The captain, 33, had a commercial pilot license (CPL(A)) and the following ratings: instrument flight (IR(A)), airplane type (SA226/227), flight instructor (FI(A)) and class instructor (CRI(A)). His license, ratings and corresponding medical certificate were all valid and in force.

He had a total of 5,100 flight hours, of which 3,015 had been on the type while working for the operator. He had flown 2,370 h as pilot in command of cross-country flights and multi-pilot instrument operations, of which 922 h had been night flights. As copilot, he had flown 645 h on flights with these same characteristics, 224 h on night flights.

The first officer was 31 and had an airline transport pilot license (ATPL(A)). He also had an A320 type rating and an instrument rating. His license, ratings and medical certificate were all valid and in force.

He had a total of 2,800 flight hours, of which 1,400 had been on the type. He had flown 1,305 h for the operator on cross-country flights and multi-pilot instrument operations, 735 of them on night flights.

They did not have flight simulator training because there are no simulators for that aircraft type, meaning that training for emergencies can only be done on instructional flights.

1.4. Aircraft information

1.4.1. *General information*

The FAIRCHILD SA-226-TC airplane, registration EC-JYC, was manufactured in 1979 with serial number TC-303. It had two HONEYWELL TPE 331-10UA-511G turboprop engines, a dry weight of 3,691 kg and a maximum takeoff weight of 5,699 kg.

The SA226 is a pressurized airplane used for public passenger transport. It can seat 19 passengers. It is also used to transport cargo. The original manufacturer no longer exists. The type certificate is now held by M7 Aerospace, located in Texas (USA).

The airplane is 59.35 ft long and 16.06 ft high with a 46.26 ft wingspan. Its wheel track measures 15 ft, as shown in Figure 3. The maximum demonstrated speed for operating in a crosswind is 20 kt.

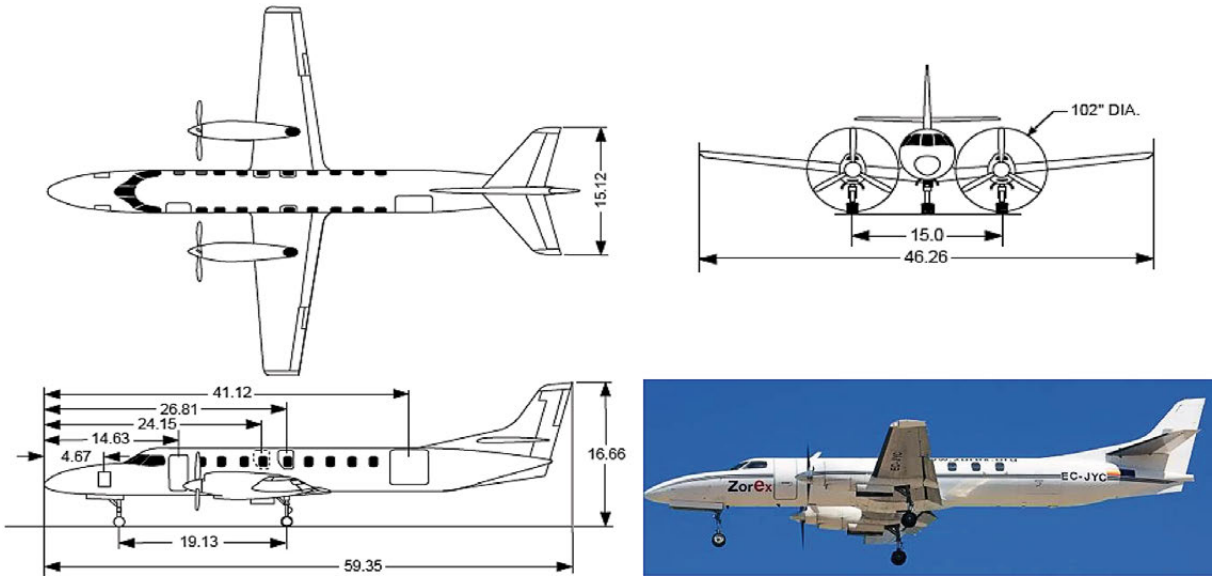


Figure 3. Aircraft dimensions

1.4.2. *Landing gear. Nose wheel steering (NWS) system*

The landing gear is a typical tricycle design with two wheels on each of the three legs. The nose gear wheels can be steered by means of a system that was implemented pursuant to Service Bulletin S.B. 226-32-037 (Nose Wheel Steering). If the NWS becomes inoperative, steering during taxi and takeoff maneuvers is accomplished by asymmetric braking of the main gear wheels and by asymmetric thrust.

The system has two hydraulic actuators that twist the internal cylinder on the front leg's strut by means of a pinion and a zipper mechanism. It is actuated by the pressure provided by a hydraulic system when electronically controlled servo valves are actuated. In the cockpit there is a control panel located on the left console that has an arming switch (ARM), a test switch (Test) and a parking button (Park).

The nose wheel can turn ± 10°, which increases to ± 63° when the "Park" button is depressed. This is used for taxiing and ground movements.

On the left side of the throttle lever is a pushbutton (Power lever button). This button is easier to access from the LH pilot's seat, as it was designed to be pressed by the right thumb.

Figure 4. Power level buttion to activate NWS

This pushbutton activates the NWS system when the selector on the control panel is in the armed position.

On the pedestal, beyond the pilots' reach, there is a small switch located in parallel with the pushbutton on the power lever and that closes the circuit when the propeller speed lever is in the LOW position.

When the system is armed and the power lever button is pressed, or the speed lever is placed in LOW, the NWS is activated and the nose wheel is steered using the pedals.

The NWS system features two indicating lights, one green, located on the annunciator panel and labeled "NWS", used to indicate that the system is armed and providing control of the wheels, and one amber, labeled "NWS FAIL", which flashes when an anomaly is detected.

The hydraulic servos and actuators comprise a single assembly installed on the head of the nose leg, which also includes the actuating solenoids. The electrical control box (amplifier) is located in the left console in the LH (captain's) piloting position.

There is a power control relay located in the circuit breaker panel that switches the electrical actuating signals for the solenoids on the servos when the system is armed, when the power lever button or the speed lever switch is activated and when the landing gear is down.

The NWS hydraulics also include hydraulic fluid filters, an arming valve, a mode selector valve, a variable servo valve, two variable flow restrictors and a relief valve.

1.4.3. *Procedures in the Airplane Flight Manual*

The emergency procedures section differentiates between two malfunctions of the NWS system, whether electrical or hydraulic:

- In the event of an electrical fault, indicated by a flashing green NWS light, by an uncommanded change in steering direction and/or by the parking light turning on without the "Park" button having been pressed, the actions to take are as follows:

  1. Release the 'NWS Power lever Button',
  2. Advance the right speed lever approximately 1/2 inch forward of the LOW position,
  3. Steer using the rudder, brakes and/or thrust,
  4. Disarm the system by placing the switch in "Off", and
  5. Trip the circuit breaker.

- In the event of a hydraulic fault, indicated by the amber light (NWS FAIL) turning on, press and hold the NWS power lever button.

1.4.4. *Maintenance information*

No irregularities were detected when the maintenance documentation was inspected.

The original design of the NWS has been modified by the following Service Bulletins:

SB 226-32-037 Improved Nose Wheel Steering. Implemented the nose wheel steering system on 01-06-1984.

SB 226-32-056 Nose Gear Steering Operational Check. Its implementation by the Operator was verified on 26-09-2006 via Work Order 2006-16.

SB 226-32-071 RH Power Lever - Nose Wheel Steering (NWS) Switch. Implemented by the Operator on 17-12-2008 as per Work Order 2008-22.

SB 226-32-072 One Time Inspection of the Nose Landing Gear Steering Test Switch Solder Terminals on back of Switch. Implemented by the Operator on 17-12-2008 as per Work Order 2008-22.

SB 226-32-074 Improved P/L Nose Wheel Steering (NWS) Switch. Not implemented. Scheduled for completion during maintenance phase 5 (472 hours remaining).

SB 226-32-075 Nose Gear Steering Park Switch Modification. The switch had not been replaced because a spare part was not found on the market and they were waiting for it to break.

SB 226-32-076 Installation of Caution Placard on Nose Wheel Steering Actuator (PCW). Not implemented. Scheduled for phase 3 (170 hours remaining).

1.5. Aerodrome information

The San Javier (Murcia) aerodrome is a controlled, dual-purpose civil and military aerodrome whose designator is LECL.

It has two runways. One is designated 05R-23L. It is 2,320 m long, 45 m wide and is used by civil traffic. The other, designated 05L-23R, is used for military operations and measures 1,577 m long by 45 m wide.

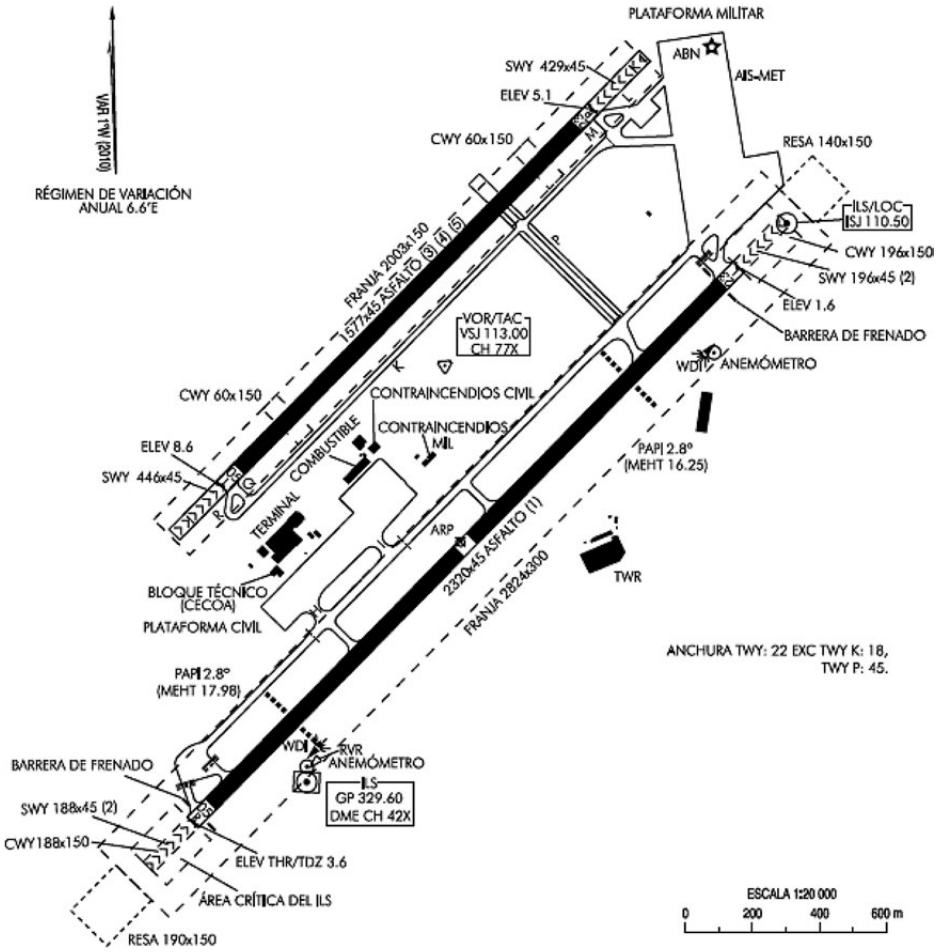


Figure 5. Map of aerodrome

1.6. Information provided by the crew

Based on the information provided by the captain, the aircraft accessed runway 05R via taxiway B and proceeded to the threshold. The first officer took over the controls for the takeoff. During the run the first officer did not release the NWS button until the airplane reached a speed of approximately 60 kt, as per the usual procedure. It was then that the airplane started veering left, at which time the captain retook control of the aircraft, stepped on the right pedal and actuated the reversers asymmetrically, placing slightly more demand on the right.

The captain also stated that the wind was from about 250° at a speed of between 4 and 5 kt, that the runway was wet and that he did not recall seeing the amber light on, which would have indicated a fault in the NWS system.

The first officer reported that in the days before the accident, they had noted the NWS operating somewhat more roughly than usual, especially when turning. They did not

think much of it, but did comment it among themselves. He also said that the same thing had happened the day before the accident while taxiing after landing in Zaragoza (LEZG), but they did not report it to Maintenance.

After this they made several flights, to the Canary Islands, Jerez, Bilbao, Pamplona and Murcia, without noticing anything unusual.

As regards the accident flight, the first officer stated that the captain had taxied to the threshold and that once there, he took over the controls to conduct the takeoff.

He confirmed that the NWS is usually checked on the first flight of the day, but he could not be certain if they had done the check on the day of the accident.

He commented that before the takeoff, with the NWS button armed, the captain pressed the button and advanced the speed lever, noting nothing unusual during this check.

As the captain had stated, he confirmed that during the takeoff run he pressed the button to arm the NWS and advanced the speed lever to the high RPM position. He held the button pressed until they reached 60 kt.

At this point he released the NWS button since at this speed the airplane can be steered aerodynamically using the pedals.

When he released the button, the airplane veered a little to both sides before turning left a few seconds later.

He stated that the takeoff was aborted with the airplane travelling at approximately 70 kt.

When the airplane turned left, he applied right pedal. On seeing they were exiting the runway, they aborted the takeoff. The captain took the controls, applied reverse thrust and braked using the right pedal.

Both pilots braked, especially using the right foot. The captain applied slightly more thrust on the right reverser.

They noticed that the airplane veered much more to the left and was not responding to their inputs, but they did not notice it skidding.

In his statement he did not note the NWS system as being problematic in general.

The mechanic responsible for the aircraft's maintenance was also interviewed. He seemed to recall the existence of previous electrical problems with the NWS in wet conditions, but could not provide any details. He confirmed that at no time recently had he been told of any problems involving the NWS.

1.7. Meteorological information

As reported by Spain's National Weather Service (AEMET), at around 12:05 local time on the day of the accident, the weather conditions at the airport at the time of the accident were as follows: average wind direction 340°, average speed 12 kt (22.2 kph), surface visibility 10 km, drizzle. Cloud cover was 1 to 2 octas (FEW) with the cloud base at 2,400 ft (732 m) and 5 or 6 octas (BKN) with the cloud base at 3,800 ft (1,158 m).

The air temperature was 14 °C and the dew point 10 °C. The QNH pressure was 1,015 hPa.

The forecast did not anticipate any significant changes in the next two hours.

All of the above information was reflected in the following METAR:

METAR LELC 131100Z 34012KT 9999 -RA FEW024 BKN038 14/10 Q1015 NOSIG=

1.8. Organizational and management information

The aircraft was based at the Pamplona Airport (LEPP), though maintenance tasks were performed at the Huesca Airport (LEHC). The operator had a fleet of two identical airplanes, though only the accident airplane was in use at the time of the accident.

The flight staff consisted of two pilots with the rank of captain, and a third pilot who when he flew, always did so as the first officer.

They flew (mainly private flights) five days a week for two consecutive weeks, with the third week off. They did not fly on weekends.

1.9. Similar accidents and incidents

The CIAIAC investigated two similar incidents in 2004 involving two airplanes with similar characteristics and performance, a Fairchild SA227-BC and a Swearingen METRO III.

One of them (IN-026-2004) took place on 21 May 2004 at the Palma de Mallorca Airport and involved aircraft EC-ITP, which veered to the right during the takeoff run and departed the runway. There were no personnel injuries or significant damage to the airplane during the incident. The front wheels locked without any input from the crew, but the fault that caused the malfunction of the NWS could not be identified.

This incident resulted in the CIAIAC's issuance of Safety Recommendation **REC 32/2007** to the holder of the type certificate, M7 Aerospace, in two regards.

The first was that it draft supporting information for operators of the Fairchild SA227-BC airplane regarding the effects of a malfunction of the NWS system during the takeoff run, and the second urged M7 Aerospace to reevaluate the emergency procedures for the Fairchild SA227-BC airplane in the event of an NWS system failure to facilitate the identification of the malfunction and so that the steps to be carried out in said procedures ensure the safety of the aircraft.

This recommendation remains open awaiting a response, since the addressee (M7 Aerospace) never replied to it. The CIAIAC has reiterated its recommendation in writing to M7 Aerospace, but has yet to receive a reply.

The other incident, IN-037/2004, took place on 17 June 2004 at the Valencia Airport with aircraft EC-GXE, which also veered right during the takeoff run and departed the runway. There were also no injuries in this case and the aircraft sustained minor damage.

The investigation into this incident was also unable to determine the cause of the wheels locking. No safety recommendations were issued.

During the investigation the manufacturer was asked to provide information regarding the number of aircraft of this type in service, but could not, as it was unaware of the figure.

M7 Aerospace and the investigating body of the United States, the National Transportation Safety Board (NTSB), were also asked for information on similar accidents and incidents to see if there was a high occurrence rate.

The manufacturer did not provide any information. The NTSB sent a list of 48 events with similar characteristics, but only one involved the same aircraft model. It had taken place on 29 August 2006 at the Casper-Natrona County International Airport (Wyoming) and involved an aircraft with registration N235BA, which had departed the runway during the takeoff run. It had veered right when the nose leg wheels locked. There were no injuries and the airplane sustained damage to its left engine propeller. As in the two other cases mentioned earlier, the reason for the wheels blocking and turning could not be determined.

2. ANALYSIS

As was the case in the previous incidents, the fault in the system could not be reproduced during the post-accident investigation.

It was also impossible to determine the incident rate of this type of fault, since no reliable data on the number of aircraft in service are available.

Both the design of the system and the various service bulletins issued after the fact in an effort to improve its configuration include safety mechanisms that seem sufficient to ensure its proper operation. During the investigation, however, it was noted that all of the wiring for the NWS system, and specifically the wires that go to the actuators in the nose gear well, does not seem to be adequately protected against moisture or any other inclement weather conditions. So CIAIAC is issuing a recommendation to M7 Aerospace asking that generate appropriate documentation (Service Bulletin, Service Letter, etc.) with specific instructions for the maintenance of Nose Wheel Steering electrical system wiring of the FAIRCHILD SA-226-TC METRO II aircraft, ensuring effective protection of the system from a humid environment.

Transferring a type certificate to a new holder should not imply reduced tracking and monitoring of the aircraft, as this can be detrimental to the maintenance of airworthiness and to the safety of operations.

Certain deficiencies in this regard were already detected during the investigation into incident **IN-026/2004,** which resulted in the issuance of CIAIAC Safety Recommendation **REC 32/2007,** which required the manufacturer to provide supporting information to operators of the SA227-BC Fairchild airplane on the effects of a malfunction of the NWS system during the takeoff run, and to reevaluate the emergency procedures for the SA227-BC Fairchild airplane in the event of a failure of the NWS system so as to facilitate the identification of the source of the malfunction and so that the steps contained in said procedures adequately ensure the safety of the aircraft.

The last 15th May 2013 M7 Aerospace responsed to the REC 32/07 saying the following: "We have not found concret evidence about of the NWS caused the loss of control of the aircraft and the subsequent damage and that that the information currently can be found in the corresponding aircraft flight Manual does not require any change in terms of the effects of a malfunctioning of the NWS system, nor the emergency procedures related to this bug. If there were more evidence that the failure was caused by this system, we would of course appreciate this information".

This response has been considered unsatisfactory, so the recommendation remains open.

As for the maneuver itself, it does not seem as if the wind had much of an influence on the runway departure, since the wind was from 340° and the runway faces north, meaning the wind component from the left was minor, and would have resulted in the airplane veering right, not left, as happened in this accident. Moreover, the wind speed was far below the maximum demonstrated crosswind speed.

Once faced with the emergency, the crew was able to quickly brake the aircraft and, even though it could not keep it from exiting the runway, the length of the departure run was not excessive.

Also worth noting is the fact that at the speed at which the aircraft was moving, there is some lift, which diminishes the effectiveness of the brakes. When the airplane departed the runway, the vibration and shaking undoubtedly impeded the captain from being able to firmly press the brake pedals.

Although the airplane can theoretically be steered on the ground with a failed NWS system, since it has powerful means for correcting an uncommanded yaw on the ground, the emergency that resulted from the uncontrolled deflection of the front wheel was unexpected, which conditioned the response of the pilot flying, making it difficult to offset the aircraft's tendency to depart the runway. This is because when the front wheel turned, this resulted in lateral forces and an asymmetry that was exacerbated by the decreased grip offered by the wet surface.

Regarding the use of reverses, which is effective at high speeds, this has the drawback of the time delay required for the engines and propellers to be able to supply reverse thrust. When the captain took over the controls, however, he judiciously used the reverse thrusters in an asymmetrical fashion, since their efficacy is irrespective of the condition of the runway and they can be more effective in correcting an undesired orientation of the front wheel on a wet runway.

Even if the crew had reported the fault that had taken place the day before to the technician responsible for the aircraft's maintenance, and even if the system had been checked, the fault of the NWS could hardly have been prevented since all of its components were in good condition. This notwithstanding, any faults must be reported as soon as possible after being detected. As a result a safety recommendation is issued to the operator so that it implement the means it deems most appropriate to ensure its crews always report any anomaly detected as quickly as possible so that the proper preventive actions can be taken.

Lastly, the fact that the company's personnel is so geographically widespread has a negative effect on the communications between crews, maintenance technicians and safety supervisors.

3. CONCLUSION

The cause of the fault in the nose wheel steering system could not be determined, as it was impossible to reproduce it in the tests conducted after the accident. All of the system's components were found to be in good condition.

It is possible, however, that the lack of protection for the wires, beyond that provided by the insulation, along with the adverse moisture conditions and a possible contaminated runway, could have caused an instantaneous failure of some component in the electrical system resulting in an improper contact that was corrected during the

runway departure when the wheel struck the edge of the access taxiway, returning the wheel to return to its normal position.

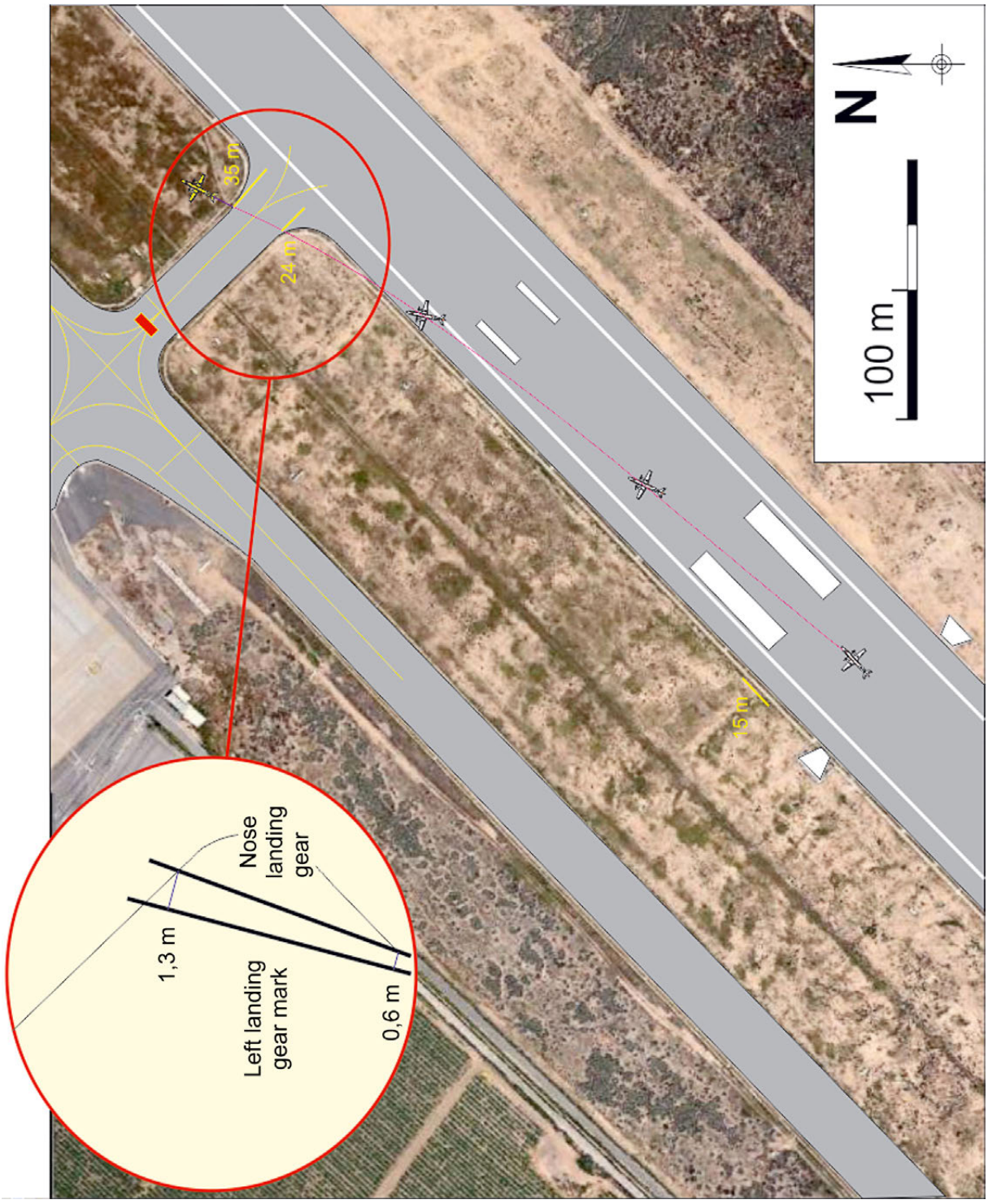
The use of asymmetric reverse thrust by the captain was critical to controlling the extent and distance of the departure.

4. SAFETY RECOMMENDATIONS

REC 46/2013. It is recommended to M7 Aerospace to generate appropriate documentation and in the form considered the most suitable (Service Bulletin, Service Letter, etc.) with specific instructions for the maintenance of Nose Wheel Steering electrical system wiring of the FAIRCHILD SA-226-TC METRO II aircraft, ensuring effective protection of the system from a humid environment.

REC 47/2013. It is recommended that Zorex ensure its crews always report as quickly as possible any anomaly that is detected both to maintenance and to flight safety, as required by applicable regulations.

APPENDIX A
Path taken by the aircraft


N
100 m
35 m
24 m
15 m
Nose landing gear
1,3 m
Left landing gear mark
0,6 m