Air Accident Investigation Unit Ireland

SYNOPTIC REPORT

INCIDENT
ATR 42-300, EI-CBK
Carrickfinn, Donegal, Ireland

7 September 2016

An Roinn Iompair
Turasóireachta agus Spóirt
Department of Transport,
Tourism and Sport

Foreword

This safety investigation is exclusively of a technical nature and the Final Report reflects the determination of the AAIU regarding the circumstances of this occurrence and its probable causes.

In accordance with the provisions of Annex 13[1] to the Convention on International Civil Aviation, Regulation (EU) No 996/2010[2] and Statutory Instrument No. 460 of 2009[3], safety investigations are in no case concerned with apportioning blame or liability. They are independent of, separate from and without prejudice to any judicial or administrative proceedings to apportion blame or liability. The sole objective of this safety investigation and Final Report is the prevention of accidents and incidents.

Accordingly, it is inappropriate that AAIU Reports should be used to assign fault or blame or determine liability, since neither the safety investigation nor the reporting process has been undertaken for that purpose.

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[1] **Annex 13**: International Civil Aviation Organization (ICAO), Annex 13, Aircraft Accident and Incident Investigation.
[2] **Regulation (EU) No 996/2010** of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation.
[3] **Statutory Instrument (SI) No. 460 of 2009**: Air Navigation (Notification and Investigation of Accidents, Serious Incidents and Incidents) Regulations 2009.

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In accordance with Annex 13 to the Convention on International Civil Aviation, Regulation (EU) No 996/2010 and the provisions of SI No. 460 of 2009, the Chief Inspector of Air Accidents on 7 September 2016, appointed Kevin O'Ceallaigh as the Investigator-in-Charge to carry out an Investigation into this Incident and prepare a Report.

Aircraft Type and Registration:	**ATR[4] 42-300, EI-CBK**	
No. and Type of Engines:	**2 X Pratt & Whitney PWC 120**	
Aircraft Serial Number:	**199**	
Year of Manufacture:	**1990**	
Date and Time (UTC)[5]:	**7 September 2016 @ 19.15 hrs**	
Location:	**Donegal Airport (EIDL), Co. Donegal**	
Type of Operation:	**Commercial Air Transport / Scheduled**	
Persons on Board:	**Crew - 3**	**Passengers - 17**
Injuries:	**Crew - 0**	**Passengers - 0**
Nature of Damage:	**Nil**	
Commander's Licence:	**Airline Transport Pilot Licence (Aeroplanes) issued by the UK CAA[6]**	
Commander's Age:	**47 years**	
Commander's Flying Experience:	**5,983 hours, of which 4,373 were on type**	
Notification Source:	**The Operator**	
Information Source:	**AAIU Report Form submitted by the Commander and Co-pilot**	

[4] **ATR:** Avions de Transport Régional.
[5] **UTC**: Co-ordinated Universal Time. All times in this report are in UTC; to obtain the local time add one hour.
[6] **UK CAA:** United Kingdom Civil Aviation Authority.

SYNOPSIS

The aircraft, an ATR 42-300, was landing at Donegal Airport (EIDL) in strong winds following a scheduled passenger flight from Dublin Airport (EIDW). During the landing roll, after the aircraft had touched down on the runway, it veered to the left and departed the tarmac surface onto the grass adjacent to the runway. The pilot steered the aircraft back onto the runway and came to a halt. Following a brief discussion between the crew, it was decided to continue to taxi the aircraft to the parking stand. The passengers disembarked normally. There were no injuries reported to the Investigation and the aircraft was undamaged.

NOTIFICATION

The AAIU was notified by the EIDL Air Traffic Control Officer (ATCO) via telephone within 20 minutes of the occurrence, and by the Operator within two hours of the occurrence. A Mandatory Occurrence Report was subsequently submitted through the Safety Occurrence Tracking System (SOTS) operated by the Irish Aviation Authority (IAA).

1. FACTUAL INFORMATION

1.1 History of the Flight / Occurrence

The aircraft took-off from runway (RWY) 10 at EIDW at 18.31 hrs on a scheduled passenger flight to EIDL. The Commander of the aircraft was the pilot flying (PF) and the Co-pilot was the pilot monitoring (PM). The aircraft climbed to a cruising altitude of FL140[7]. During the cruise, the Co-pilot obtained an update on the weather conditions at EIDL at 18.54 hrs from the Automatic Terminal Information Service (ATIS[8]). The reported weather conditions were suitable for landing and the wind velocity was "O*ne six zero degrees twenty knots* [kts]*".* The crew completed a briefing for the descent and instrument approach procedure for RWY 21 at EIDL. The Commander noted during the briefing that an additional item for consideration was the wind conditions at the airfield.

Initial descent clearance was given by Shannon Air Traffic Control (ATC) at 18.59 hrs. At 19.02 hrs the flight was handed over to EIDL Tower. The aircraft was cleared by the EIDL ATCO for the instrument approach procedure. The Co-pilot reported that the aircraft was overhead the airfield at 19.07 hrs and commencing the instrument approach procedure. Having completed the outbound leg of the approach, the aircraft turned back towards the airfield and commenced a final approach to RWY 21. At 19.11 hrs, landing clearance was given by ATC, which included a wind velocity of 160° at 26 kts. The Commander requested the Co-pilot to check that this figure was within the cross-wind limitations for the landing. The Co-pilot replied that 26 kts was within limits and that with a wind blowing from 50° to the runway alignment, the maximum permitted wind speed was 32 kts. The Commander confirmed that he was visual with the runway and the autopilot was disconnected at five nautical miles from the airport. The ATCO provided a wind check at 19.14 hrs of 160° at 29 kts. The Co-pilot confirmed to the Commander that the aircraft was still within the prescribed crosswind limits.

[7] **FL140:** *Flight Level 140*; equates to 14,000 feet using a barometric pressure of 1013.25 hectoPascals (hPa).
[8] **ATIS:** An automated audio radio transmission that provides airport weather and operational information.

The aircraft touched down on RWY 21 at 19.15 hrs and the Commander began to apply reverse thrust and wheel brakes. The Commander assessed that within a few seconds of touching down on the runway, the aircraft began to veer to the left and depart the centreline. He stated that he applied full right rudder to counteract the left turn, but this initially had little effect. The Commander eventually began to recover lateral control of the aircraft. However, the undercarriage nose wheel and both sets of main wheels left the runway and went onto the grass. The aircraft briefly travelled along the grass parallel to the runway prior to returning to the tarmac surface. The Commander returned the aircraft to the runway centreline and brought it to a stop. Following a brief discussion with the Co-pilot about the event and the handling characteristics of the aircraft during the latter stage of the landing roll, it was agreed to continue towards the parking stand for disembarkation. The ATCO checked if the crew needed assistance, and the crew confirmed that none was required. The aircraft taxied to the parking stand and the passengers disembarked. The Cabin Crew Member (CCM) confirmed that there were no reported injuries by the passengers. Subsequent examination confirmed that there was no damage to the aircraft. The Cockpit Voice Recorder (CVR) and the Flight Data Recorder (FDR) were de-energised and retained by the Operator for use by the Investigation.

1.2 Injuries to Persons

No injuries were reported to the Investigation.

1.3 Personnel Information

1.3.1 Aircraft Commander

The Aircraft Commander held a European Union (EU) Airline Transport Pilot Licence (Aeroplanes) issued 7 January 2011 by the UK CAA. The Commander's type and instrument ratings for the ATR 42/72 series aircraft were revalidated on 6 January 2016. The Commander's Class One Medical Certificate was valid until 10 April 2017. At the time of the event, the Commander had 5,983 hours total flying time, of which 4,373 hours were on type.

The Commander submitted an AAIU Report Form and was subsequently interviewed as part of the Investigation. The Commander stated that he had conducted an approach and landing briefing with the Co-pilot during the flight, which included specific information about the crosswind conditions at the airfield. He said that the approach and landing were uneventful. Touchdown was normal and on the centreline. He then commenced braking and applying reverse thrust. He said that within 3-4 seconds after touchdown there was, in the opinion of the Commander, what felt like a strong gust of wind from the left which caused the nose of the aircraft to veer rapidly to the left. The Commander stated that he applied full right rudder to counteract the turn, but with no effect. As the aircraft slowed and entered the grass to the left of the runway, control was gradually recovered and the aircraft was returned to the centreline of the runway. The Commander brought the aircraft to a stop on the runway to assess the situation. Following a discussion with the Co-pilot, it was decided to complete the short taxi to the parking area.

1.3.2 Co-pilot

The Co-pilot was the holder of an EU Commercial Pilot Licence (Aeroplanes) issued by the IAA on 19 June 2013. The Co-pilot's type and instrument ratings for the ATR 42/72 series aircraft were revalidated on 1 May 2016. The Co-pilot's Class One Medical Certificate was valid until 20 September 2016. At the time of the event, the Co-pilot had 1,177 hours total flying time, of which 692 hours were on type.

The Co-pilot submitted an AAIU Report Form and was subsequently interviewed as part of the Investigation. The Co-pilot stated that having received the briefing from the Commander for the approach and landing, he continued to monitor the wind velocity at the airfield to ensure that it remained within published limits. He stated that the aircraft touched down normally and on the centreline. He saw the aircraft veer suddenly to the left and called for "*right rudder*". He then noted that the Commander already had full right rudder applied in an effort to recover the centreline. The Co-pilot was of the opinion that the aircraft experienced a gust during the transition from high speed roll-out to low speed roll-out which caused the aircraft to veer to the left.

1.4 The Airport

Donegal Airport is a licensed aerodrome located on the north-west coast of Ireland, and is approximately two miles to the south-west of Bunbeg, Co. Donegal (**Figure No. 1**). The runway (RWY 21/03) is 1,496 m in length, 30 m in width, and is constructed from asphalt. *AIP*[9] *Ireland* states that there is a displaced threshold for RWY 03 of 209 m, and a Landing
5 Distance Available (LDA) of 1158 m. RWY21 has a displaced threshold of 129 m and an LDA of 1204 m[10]. The navigation aids include a localiser transmitter which provides lateral guidance during approaches, and Precision Approach Path Indicators (PAPIs) which provide a visual indication to assist the pilot in flying the optimum vertical approach path. The Airfield Chart states that "*Windshear and turbulence may be experienced in the lee of Mt Errigal*" which is located 8 nautical miles (nm) east of the airfield.

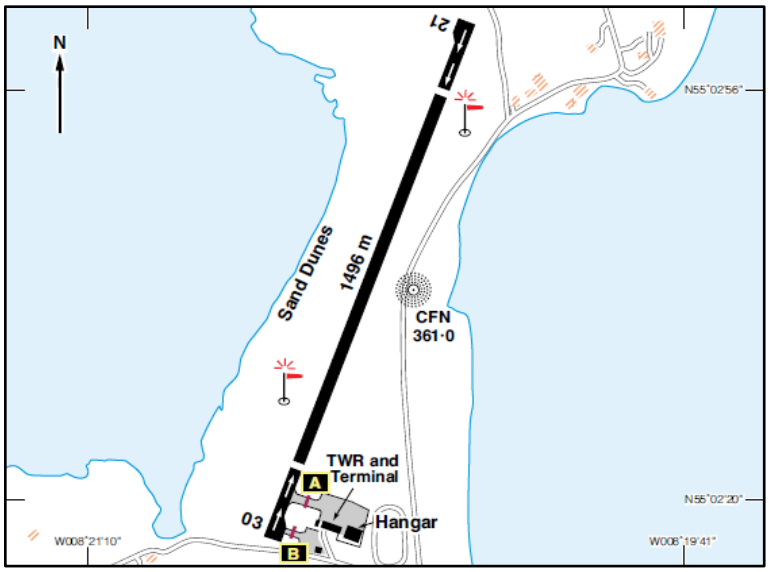

Figure 1: Donegal Airport (*Pooleys*)

[9] **AIP:** Aeronautical Information Publication for Ireland.
[10] See *AIP Ireland, Part 3 Aerodromes, Page AD2-8: Table AD2-13 EIDL Declared Distances* dated 25 May 2015.

1.5 Meteorological Equipment

Meteorological equipment located at EIDL collected data which was then provided to the aircraft via the VHF[11] ATIS system. This data included temperature, dew point, relative humidity, barometric pressure, wind direction and mean wind speed. Wind gusts exceeding the mean wind speed by 10 kts or more during the ten minutes preceding the observation could also be detected. The unit conducts a self-diagnostic process when started and was checked following the occurrence and found to be functioning normally.

The User Guide for the meteorological equipment stated that *'The sensor will hold its accuracy in all conditions for 1 year. If the rains are mostly casual or moderate, and the atmospheric corrosion is typical, the sensor accuracy will remain for 2 years.'* The equipment was last calibrated on 27 January 2016 and was found to be providing accurate information when measured against a second anemometer at the airfield, and also against calibrated equipment provided by the maintenance contractor for reference purposes. There are three anemometers at the airfield; two are located at the midpoint of the runway, with a back-up anemometer located on top of the control tower at the southern end of the airfield.

1.6 Meteorological Information

The following meteorological information for the airport was received by the crew via ATIS prior to descent towards EIDL:

> *"Donegal airport weather station at eighteen hours fifty seven minutes zulu. Wind one six zero degrees twenty knots, CAV O.K[12]. Temperature two zero Celsius, dewpoint one six Celsius, Q N H one zero zero five, Q F E one zero zero four."*

This transmission was heard by the flight crew at 18.54 hrs, which was three minutes prior to the time stated in the weather report. The terms 'zulu' and UTC are interchangeable. The Airport Senior Air Traffic Control Officer subsequently confirmed that the system time for the meteorological equipment was running three minutes ahead of UTC at the time of the occurrence.

1.7 The Aircraft

1.7.1 General

The aircraft was manufactured in 1990 and powered by two Pratt & Whitney PWC-120 turbo-prop engines. The Certificate of Airworthiness was issued by the Irish Aviation Authority on 8 January 2008. The Airworthiness Review Certificate (ARC) was valid until 11 January 2017. The ATR 42 aircraft has a high wing, which provides the propeller blades of the wing-mounted engines with significant ground clearance during taxi, take-off and landing which makes it ideal for operating into regional airfields. However, the high-wing configuration can make operation in cross-wind conditions challenging.

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[11] **VHF:** Very High Frequency

[12] **CAV O.K.:** A contraction of the term '*Ceiling and Visibility OK*' meaning no cloud below 5,000 ft, a horizontal visibility of greater than 10 km, and no significant weather activity such as precipitation in the vicinity.

Photo No. 1: An ATR 42-300 similar to EI-CBK

1.7.2 Aircraft Control

The aircraft is controlled laterally in flight by deflecting the ailerons and rudder into the airflow to alter the aerodynamic forces acting on the aircraft. On the ground at slow speeds, there is insufficient airflow rate for the control surfaces to be effective. Lateral control on the ground is achieved through the use of a small control wheel on the left side of the cockpit that is connected to the aircraft nose gear leg. The pilot manoeuvres the aircraft through the use of this nose wheel steering while taxiing. This nose wheel steering is also used during the initial stages of the take-off and the final stage of the landing when there is limited control surface effectiveness due to insufficient airflow over the control surfaces. Moving the rudder pedals in the ATR42-300 does not turn the nose wheel. During a landing in crosswind conditions, the aircraft tends to 'weathercock' into the wind due to the force of the wind acting on the large surface area of the vertical tail fin and rudder. The challenge for the pilot is to align the aircraft in pitch, roll and yaw with the runway centreline at the moment of touchdown in order to land safely. Once on the ground, the aircraft is decelerated through the use of wheel brakes and engine reverse thrust. As the speed reduces, rudder effectiveness also reduces due to the reduced airflow rate, and the nose wheel steering will become more effective as the tyres grip the runway surface. However, during this transition from high speed to low speed, the aircraft can be vulnerable to strong or gusting crosswinds as the airspeed is too low to use the rudder alone to maintain the runway centreline, and the aircraft is travelling too fast for the nose wheel to effectively grip the runway surface.

1.8 Recorders

1.8.1 General

The aircraft was equipped with a FA2100 Cockpit Voice Recorder (CVR) and a FA2100 Flight Data Recorder (FDR), both manufactured by L3 Communications, U.S.A. The Operator provided both recorders to the AAIU immediately following the occurrence. The recorders were successfully downloaded at the AAIU facility in Dublin.

1.8.2 CVR Information

The CVR recorded four separate audio channels during the subject flight; the Commander's audio channel, the Co-Pilot's audio channel, the Cabin Crew Member's audio channel (including passenger Public Address System), and the Cockpit Area Microphone. The CVR recording indicated that the flight was conducted without incident until the aircraft touched down on the runway. During the flight, the Commander provided a comprehensive briefing to the Co-Pilot for the approach and landing at EIDL. Specific reference to the wind velocity at the airport was made by the Commander during the brief, and the crew established and confirmed the wind limitations for continuing the approach, both in terms of speed and direction. During the approach, the flight crew continued to review the wind checks provided by ATC to ensure that the prevailing conditions were within the limits specified in the table in the Pilots Cockpit Checklist for landing on narrow runways [13](**Figure No. 2**).

X-Wind Table - Maximum Allowable Wind										
Limit	Angle from Runway →	10°	20°	30°	40°	50°	60°	70°	80°	90°
15kt	LVO Landing		43	30	23	19	17	15	15	15
20kt	LVO Take-Off		58	40	31	26	23	21	20	20
25kt	Short/Narrow Landing			50	38	32	28	26	25	25
28kt	Wet Take-Off & Landing			56	43	36	32	29	28	28
35kt	Dry Take-Off & Landing				54	45	40	37	35	35

Note: Refer to OMB 1.11 for X-wind limitations on contaminated runways

Figure No. 2: Cross Wind Limitations – ATR42/72 Cockpit Checklist

1.8.3 FDR Information

The FDR data indicated that the aircraft approach was stable and that it remained crabbed into wind until approximately 20 ft above the runway. At this point right rudder was applied to align the nose of the aircraft with the runway while applying an angle of left bank towards the wind to prevent drift. The engine thrust was reduced to idle power and the aircraft landed in the touchdown zone at an indicated airspeed of 105 kts with the left main wheels touching down first. The FDR indicated a momentary left rudder application which counteracted the right roll and yaw that accompanied the period between touchdown of the left main and right main undercarriage followed by the application of full right rudder.

The engine reverse thrust was applied symmetrically within two seconds of touchdown. At approximately four seconds after touchdown the aircraft heading changed, indicating that a left turn of 15 degrees occurred as the aircraft decelerated through 76 kts indicated airspeed. The FDR does not record nose wheel steering inputs. However, there was no flight control input identified on the FDR that would account for the aircraft's sudden and rapid change in direction. Full right rudder was maintained until the aircraft heading turned to the right again. Reverse thrust on the left engine was reduced to idle during the excursion, effectively producing an additional turning moment to the right.

[13] The Operator's Part B stated 35 kts as the crosswind limit for a standard 45 m wide runway. The runway at EIDL is 30 metres wide, which the Operator categorised as narrow.

The Investigation downloaded the FDR parameters in order to calculate an estimated crosswind component acting on the aircraft during the latter stages of the approach. The final 25 seconds of the flight prior to landing is summarised in **Table No. 1**. The analysis of the FDR parameters indicated the presence of a gusting crosswind during the approach, with a frequency of 5-10 seconds between the wind gusts. The Commander and the Co-pilot were of the opinion that there was a significant gust of wind after touchdown which caused the aircraft to veer to the left on the runway.

Time to landing (seconds)	Height above ground (ft)	Crosswind component (kts)
25	200	28
15	120	21
10	100	24
9	88	26
8	75	27
7	60	28
6	44	30
5	32	30
4	24	27
3	15	27
2	8	24
1	5	20

Table No. 1: Calculated crosswind during approach of EI-CBK to EIDL

1.9 Previous Occurrences

9

In 2011, there was an accident involving an ATR-72 nose wheel collapse on the runway during landing at Shannon Airport. The AAIU Final Report No. 2013-008 noted the cause as "*Excessive approach speed and inadequate control of aircraft pitch during a crosswind landing in very blustery conditions*". In association with the Final Report, Safety Recommendation IRLD2013017 was issued, which recommended that ATR should provide improved guidance regarding landing techniques for the different models of ATR aircraft during turbulent crosswind conditions. In response, in 2014, ATR circulated the document *Safety Note #1: Be Prepared for Crosswind Landing* (See **Appendix A**) to ATR operators.

Safety Note #1 described the recommended handling techniques to be used when conducting an approach, flare and landing under crosswind conditions. It recommended that the aircraft be crabbed into the wind while maintaining the centreline of the runway during the approach. It was then recommended that at approximately 20 feet (ft) above the runway, the pilot should apply a combination of downwind rudder and into wind aileron to align the aircraft with the runway while preventing the aircraft from drifting in the crosswind. The aircraft wheels should touch down as soon as this manoeuvre is completed. If touch down is too late then the aircraft will be blown off the runway centreline by the wind. If touchdown is too soon then the aircraft will be misaligned, causing control problems on the runway and scuffing to the tyres on the main undercarriage wheels. The Operator's published guidance for pilots conducting a landing in crosswind conditions complied with the manufacturer's guidance contained in *Safety Note #1*.

In June 2016, ATR re-issued the guidance in conjunction with a Flight Operations Information Message (FOIM) on the subject of crosswind landings, with the purpose of reminding operators of good practice during a crosswind landing. The FOIM stated:

"We highlight that the ATR fleet has encountered 4 runway excursions in recent months (no injuries were reported during the emergency evacuation). In each case there was a crosswind component … Each event occurred during landing roll at approximately 70 knots with over-correction of heading deviation associated with rudder inputs up to the mechanical stop."

1.10 Excursion details

The Investigation received photographs of the runway from the Operator and measurements of the site from the Airport Manager. Tyre tracks indicated that the aircraft lost directional control[14] at 660 m from the runway threshold, and departed the edge of the runway surface at approximately 700 m from the threshold. The tyre tracks on the runway indicated that the aircraft was on the centreline prior to the left turn (**Photo No. 2**). Nose wheel tyre tracks first appear on the runway after the excursion begins; between the runway centreline and the point at which the aircraft entered the grass. There was no scuffing visible on the aircraft nose wheel.

Photo No. 2: Tyre tracks indicating location of the excursion from the centreline

The aircraft returned to the paved surface 62 m beyond the exit point (**Photo No. 3**) and measurements of the tyre tracks indicated that the left main undercarriage wheel reached a maximum lateral displacement of 8 m beyond the edge of the 30 m wide runway. The lateral distance between the main wheels of the ATR42-300 is 4.1 m, and 2.05 m from nose wheel to each main wheel. This equated to a maximum displacement from the runway centreline of 23 m for the left wheel, and approximately 21 m for the nose wheel. There was no report of damage to any airport infrastructure or equipment as a result of the excursion.

[14] Loss of directional control is defined as the aircraft main undercarriage wheels crossing the runway centreline.

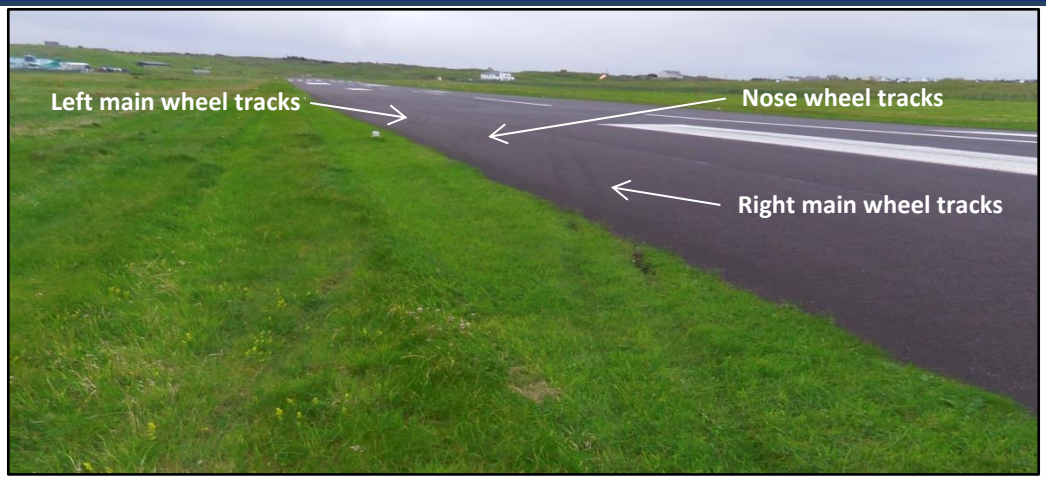

Photo No. 3: Tyre tracks indicating point of re-entry to the runway

1.11 Maintenance Action

Following the excursion, the Operator contacted the aircraft Manufacturer and requested details of the required maintenance actions prior to returning the aircraft to service. This included, inter alia, the following tasks which were completed in accordance with the aircraft manufacturer's instructions:

- Inspection of nose undercarriage tyres, wheels, and gear legs.
- Inspection of left and right main undercarriage tyres, wheels, brakes and gear legs.
- Removal of CVR and FDR.
- Installation and certification of CVR and FDR.

The inspections did not identify any defects with the flight controls, undercarriage or nose wheel steering system.

The undercarriage manufacturer required, in addition, that both left and right main undercarriage legs and the associated side braces be removed from the aircraft for inspection. The undercarriage legs were removed and replacement components were installed and certified by the Operator at EIDL. The aircraft was returned to service three weeks after the occurrence. The subsequent inspection conducted on the removed components indicated that no damage had been sustained by the aircraft or the undercarriage.

2. ANALYSIS

2.1 General

The aircraft was conducting an approach to land at EIDL in blustery wind conditions, with a crosswind component that was reported to be close to the maximum authorised by the Operator's Operations Manual. The crew statements and the CVR information indicated that the crew were aware of the wind conditions and had briefed accordingly. The technique used by the flight crew for the crosswind landing at EIDL complied with the guidance issued by the aircraft manufacturer in *Safety Note #1: Be Prepared for Crosswind Landing.*

2.1.1 Meteorological Conditions

The figures calculated during analysis of the FDR indicated that the crosswind dropped to 20 kts just prior to landing. It was not possible to accurately calculate the crosswind from FDR parameters after the aircraft touched down on the runway. However, based on the gust frequency during the approach and the flight control surface deflections recorded on the FDR immediately prior to the excursion, it is probable that there was a wind gust from the left side of the aircraft approximately 4-9 seconds after touchdown. The absence of nose wheel tyre marks at the initial point of excursion in the photographs indicates that the Commander had not transitioned from the rudder to the nose wheel steering for directional control. Furthermore, the absence of scuffing of the nose wheel would indicate that at touch down, the aircraft was aligned with the runway. Based on the measurements taken by the Airport Manager combined with the FDR data, it was estimated that the elapsed time from the loss of directional control until the aircraft left the tarmac was approximately 1.5 seconds.

2.1.2 The Aircraft

The ATR42-300 is a high wing, turboprop aircraft designed to operate into regional airfields. The basic design provides good performance on short and narrow runways but, as with many high-wing turboprop aircraft, directional control can be challenging in strong crosswind conditions. The transition from high speed to low speed can result in a momentary situation where there is insufficient rudder authority or nose wheel steering effectiveness to maintain directional control in crosswind conditions. This transition typically occurs approximately within the 70-80 kts airspeed range. In 2014, the manufacturer provided specific guidance for flight crews on appropriate techniques to be used during landing in crosswind conditions. These techniques were incorporated into the Operator's published guidance for flight crews. In 2016, the manufacturer re-issued the guidance in conjunction with a FOIM on the subject of crosswind landings, noting "*four runway excursions in recent months … In each case there was a crosswind component … each of which occurred at a speed of approximately 70 kts…*"

This excursion occurred in weather conditions that were within the Operator's published crosswind component limits of 25 kts for narrow runway operations, and well below the manufacturer's demonstrated crosswind component limit of 35 kts. Nevertheless, this occurrence highlights the challenges presented to flight crews in controlling high-wing, turboprop aircraft when landing in blustery crosswind conditions, especially on narrow runways. It also demonstrates the potential difficulties that can be experienced during the transition from high speed to low speed handling during the landing roll after the aircraft touches down in crosswind conditions.

3. CONCLUSIONS

3.1 Findings

1. The aircraft's ARC was valid at the time of the flight.
2. The Flight Crew members were suitably qualified to conduct the flight.
3. The reported meteorological conditions were within the Manufacturer's and Operator's respective published limitations to fly the approach and landing.
4. The Commander conducted a comprehensive approach and landing briefing, which included consideration of a gusting crosswind.
5. The meteorological equipment at EIDL had been calibrated on 27 January 2016, and was checked following the flight. It was found to be functioning normally.
6. FDR data indicated that the approach was stable and that the aircraft touched down on the runway centreline in the touchdown zone.
7. Engine thrust was reduced symmetrically prior to touchdown.
8. Reverse thrust was applied symmetrically within two seconds after touchdown.
9. The aircraft commenced a left turn approximately four seconds after touchdown at approximately 76 kts indicated airspeed. The FDR did not record flight control inputs that could account for the turn.
10. The aircraft exited the runway and travelled along the grass for a distance of 62 m.
11. The aircraft returned to the tarmac runway and subsequently taxied to parking.
12. The aircraft was undamaged and there were no reported injuries.

3.2 Probable Cause

Runway excursion during the aircraft's landing roll due to a strong gusting crosswind.

3.3 Contributory Cause(s)

1. A narrow runway of 30 m in width.
2. The susceptibility of high-wing aircraft to control difficulties during the landing roll in crosswind conditions.

4. SAFETY RECOMMENDATIONS

This Investigation does not sustain any Safety Recommendations.

Appendix A

ATR SAFETY NOTE #1: Be Prepared for Crosswind Landings.

SAFETY NOTE # 1

BE PREPARED FOR CROSSWIND LANDING

When crosswind conditions are reported on arrival airport, it is essential to anticipate by reviewing the landing technique and to prepare an action plan before starting the approach. This "Be prepared for crosswind landing" provides an overview of operational factors involved in planning and conducting the approach and flare under crosswind conditions, as well as some recommendations regarding handling techniques.

Key points for a safe and successful crosswind landing

- Review and brief crosswind landing technique.
- Strictly adhere to computed Vapp.
- Ensure strengthened crew cooperation.
- Be prepared for a go-around.
- Look for a reduced air/ground transition.
- Keep aileron into wind during landing roll.

MAXIMUM RECOMMENDED CROSSWIND

The crosswind value given in the AFM performance section (6-01) as maximum demonstrated crosswind shall be understood as the maximum crosswind under which the capacity of the ATR aircraft for landing was demonstrated during flight tests. It shall be considered as the maximum recommended crosswind.

The operators may consider establishing operating conditions, based on crews experience or airfields specificities, for which the maximum crosswind would be reduced.

During the approach briefing the pilot flying shall evaluate his/her own ability to land in announced crosswind condition and get prepared for a go-around and/or a diversion.

The AFM 6-01 also provides maximum recommended crosswind applicable in case of contaminated runway.

APPROACH SPEED

The FCOM (3.08.02) defines the approach speed as Vapp = VmHB + wind factor where the wind factor is the maximum of either 1/3 of the headwind velocity or the gust in full (to be understood as the difference between the maximum reported wind and the steady wind, without considering wind direction). **In any case the wind factor to be added is limited to 15 kt.**

For example, when landing in Toulouse Blagnac airport on runway 14R, with a wind reported as 200° / 18 kt gusting at 30 kt, 1/3 of headwind component is 3 kt while the gust in full is 12 kt (30-18). Hence the wind factor to be considered for the approach speed computation will be 12 kt.

The wind factor shall not be increased further, even in strong crosswind conditions. An excessive approach speed increases the duration of the flare (while under crosswind conditions, it is preferable to shorten the transition from air to ground), , it also increases the risk of landing with nose landing gear first and it increases the landing distance . Long flare and "greased" landings are not recommended by ATR.

PREPARING THE APPROACH

The best defence against crosswind conditions is anticipation through a reminder of the landing technique before starting the approach. While preparing for the approach, the crew shall check the applicable maximum demonstrated crosswind, calculate the estimated drift on final, the approach speed and associated preset values (pitch and torque). The pilot flying shall evaluate his/her own ability to land in forecasted conditions and the crew shall review the available means to timely detect any change in wind conditions, and how changes will be communicated. **It is of utmost importance that the crew organizes their resources in order to build and maintain proper situational awareness on final approach.**

ATR

https://www.atraclive.com

CONDUCTING THE APPROACH

ATR recommends performing a crabbed approach. : wings level and drift correction.

ATR recommends disconnecting the autopilot and yaw damper at the latest at 500 ft in order to have time to establish manual control.

Crosswind conditions are often associated with turbulence. In any case, the crew shall strictly adhere to the stabilized approach criteria in force within the applicable operator Standard Operating Procedures. Any deviation shall be called out and corrected. Performing a go-around is an option that shall be considered at any time until a safe landing is ensured.

During final approach, the crew shall pay particular attention to changes in wind direction and strength and maintain a high level of cooperation.

DECRAB AND FLARE TECHNIQUES

ATR recommends the standard decrabbing technique: the pilot flying decrabs the aircraft by coordinating downwind rudder input, with into wind aileron input. These actions enable to align the aircraft with runway axis.

This manoeuver shall be initiated at the latest at 20 ft but could be started earlier. The resulting aircraft position must be maintained up to the touchdown. Correction of flight path deviation, if necessary, will be performed around this new position.

Power reduction shall be initiated passing 20 ft. **The touchdown shall occur with power levers at Flight Idle.** In coordination with power reduction, the pilot flying progressively adjusts aircraft pitch to flare the aircraft, until upwind main landing gear contacts with the runway.

As wind intensity increases, manoeuvers dynamic should be implemented toward a faster executed set of simultaneous actions.

Aileron deflections are exaggerated for a better visual understanding.

AIRCRAFT HANDLING DURING LANDING ROLL AND DECELERATION

The upwind main wheels contact the ground first, followed by downwind main wheels. After both main landing gears contact, the pilot flying assists the nose landing gear towards the ground and selects the power levers to Ground Idle. Selecting power levers on Ground Idle causes an effective reduction of energy. If further deceleration is needed the crew could use reverse or brake to minimize landing roll.

During the landing roll, the pilot flying holds the control column in nose down position to increase directional efficiency, maintaining aileron input into the wind. In case of insufficient aileron input, crosswind gusts will lift the upwind wing and make the aircraft turn (accentuated by weather cock effect). To avoid that, the pilot flying must gradually increase the aileron input into the wind (up to maximum deflection if necessary). In addition, rudder pedals shall be used to keep the airplane on runway axis and **any heading deviation must be corrected smoothly, especially in upwind direction.**

In case of lateral deviation tendency, reverse shall be released and the pilot shall primarily use rudder pedals to regain lateral control. Asymmetrical braking can also be used to assist lateral control as rudder efficiency decreases with airspeed.

Below 70 kt, The Captain controls airplane alignment with nose wheel steering and the First Officer maintains aileron input into the wind until the aircraft comes to a complete stop.

Note: the use of reverse is more efficient at high speed and brake at low speed. Reverse shall be selected only after pilot monitoring has checked and announced the 2 low pitch green lights.

Any comment or question on this document can be sent to **flight-ops-support@atr.fr**

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