Air Accident Investigation Unit Ireland

SYNOPTIC REPORT

SERIOUS INCIDENT
Avions de Transport Régional 72-201, EI-REH
Cork Airport
13 May 2012

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

FINAL REPORT

AAIU Report No: 2013-016
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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 S.I. 460 of 2009, the Chief Inspector of Air Accidents, on 13 May 2012, appointed Mr. Thomas Moloney as the Investigator-in-Charge to carry out an Investigation into this Serious Incident and prepare a Report. The sole purpose of this Investigation is the prevention of aviation Accidents and Incidents. It is not the purpose of the Investigation to apportion blame or liability.

Aircraft Type and Registration:	Avions de Transport Régional (ATR) 72-201, EI-REH
No. and Type of Engines:	2 x Pratt & Whitney PW124B
Aircraft Serial Number:	260
Year of Manufacture:	1990
Date and Time (UTC[1]):	13 May 2012 @ 17:54 hrs
Location:	Cork Airport (EICK), Ireland
Type of Operation:	Commercial Air Transport, Passenger
Persons on Board:	Crew 4 Passengers 47
Injuries:	Crew Nil Passengers Nil
Nature of Damage:	Nose Landing Gear Required Replacement
Commander's Licence:	ATPL issued by UK CAA
Commander's Details:	Male, aged 36 years
Commander's Flying Experience:	2,161 hours, of which 1,946 were on type
Notification Source:	EICK Duty Manager
Information Source:	AAIU Report Form submitted by Pilot AAIU Field Investigation

[1] **UTC:** Universal Co-ordinated Time. Add one hour for local time.

SYNOPSIS

EI-REH made an approach to Runway (RWY) 17 at EICK in gusting crosswinds and turbulent conditions. During the landing, initial contact with the runway surface was on the main landing gear wheels with a nose up pitch attitude. The aircraft bounced slightly and simultaneously pitched down sharply. The second contact with the runway was solely on the nose wheels. The Commander immediately initiated a go-around and thereafter a normal approach and landing was made on RWY 17. Subsequently, the nose landing gear was withdrawn from service since the certification basis and design criteria did not foresee such an occurrence.

1. FACTUAL INFORMATION

1.1 History of the Flight

The occurrence flight was between Manchester, UK (EGCC) and EICK and was the second sector of a scheduled four sector duty day for the aircraft and crew. The first sector had been uneventful. Before departing from EGCC, the crew had obtained the latest weather information for EICK and they noted that the forecast gusting crosswinds might be outside their limits for landing at EICK. They duly phoned their Operations Office to inform them that there was a possibility of a diversion to Shannon.

The aircraft departed from EGCC at 16.19 hrs and the flight to EICK proceeded uneventfully. The Commander, who was Pilot Flying (PF), had been upgraded to captain on 5 May 2012. As a new captain, his crosswind limit was reduced by 5 kts from the Operator's maximum crosswind limit for a dry runway of 30 kts. Also, he had not been checked out for RWY 25 at EICK which, at a length of 1,310 m, was classified by the Operator as a short runway and required particular qualification.

At 17.41 hrs, as EI-REH was descending to 4,000 ft with the intention of making an ILS[2] approach to RWY 17 at EICK, the crew was informed by Cork ATC that the preceding aircraft (same Operator and type) had carried out a go-around at one mile finals for RWY 17. ATC informed the crew that the surface wind was "*240°, 15 kts, maximum 27, minimum 7*" and offered to provide radar vectors for a VOR approach to RWY 25. This was declined since the Commander did not have a short runway qualification.

At 17.42 hrs, the crew requested another wind check and was informed, *"Surface wind 240°, 16 kts, maximum 27, minimum 7."* The crew also requested the surface state of the runway and was informed that the runway was dry. The crew discussed the surface wind and calculated that the peak crosswind component was 25 kts from the right. The Commander remarked, *"So hopefully it won't go up"*.

EI-REH reduced speed and was vectored by ATC through the localiser for RWY 17 to provide spacing for another of the Operator's aircraft which was then making an approach to RWY 25 and was ahead of EI-REH in the sequence to land.

[2] **ILS:** Instrument Landing System

At 17.51 hrs, the crew confirmed that EI-REH was fully established on the ILS for RWY 17 with 5.5 nautical miles (nm) to run, and ATC transferred them to Tower frequency.

At 17.53:27 hrs, EI-REH was cleared to land by the Tower and a wind check was passed, *"Wind 240 12 knots mean speed maximum 23 kts"*. At 17.54:09 hrs another wind check, *"240 max 23"* was passed by ATC as the aircraft descended through 30 ft radio height.

The Commander described to the Investigation how, although the approach was turbulent and gusty crosswinds were evident, it was no worse than conditions he had encountered on other flights. He experienced wind shear during the approach with fluctuating airspeed but he considered that he was maintaining the airspeed reasonably stable. He was perfectly happy to continue the approach in the given conditions.

He stated that the main landing gear wheels touched down first and that he did not feel the aircraft had bounced. This was followed by the nose suddenly and rapidly pitching down, which caused a *"noticeable impact"* of the nose-gear with the runway surface. At that point, he determined that the landing was compromised and he called a go-around straight away. The aircraft then executed a missed approach.

The Commander described to the Investigation how he had put the control column forward in order to get the nose down so that the aircraft would reduce speed and he could start to use nose-wheel steering. He stated that the technique was exactly the same as he had used previously in worse conditions.

Subsequently, the aircraft made a normal approach and landing on RWY 17. After the aircraft had parked on stand, the Commander reported the circumstances to engineering staff and wrote up the occurrence in the Technical Log. The aircraft was grounded for inspection. The Commander also decided to stand down the crew and they returned to their base by road.

1.2 Damage to Aircraft

On inspection, no visible damage was identified on the aircraft. The Operator sent the Digital Flight Data Recorder (DFDR) data to the aircraft Manufacturer for analysis. The Manufacturer responded as follows, *"I confirm that at the second touch, the aircraft touched the ground only with the nose landing gear.* ***This kind of attitude is not foreseen in the JAR/FAR[3]/ATR certification basis as design criterion neither for Landing Gears nor for Airframe****."*

[3] **JAR/FAR**: Joint Aviation Requirements (Europe)/Federal Aviation Regulations (USA)

1.3 Personnel Information

1.3.1 Commander

Personal Details	Male, aged 36 years
Licence	UK CAA ATPL - Valid
Last Periodic Check	5 May 2012
Medical Certificate	17 December 2011

Flying Experience

Total All Types	2,161 hours
Total on Type	1,946 hours
Total on Type P1	60 hours
Last 90 Days	175 hours
Last 28 Days	58 hours
Last 24 Hrs	3 hours

Duty Time

Duty Time up to Occurrence	4 hours 18 minutes
Rest Period Prior to Duty	24 hours

The Commander completed his command simulator training between 13 and 16 April and underwent his command line training between 22 April and 1 May 2012. He successfully completed his command checks between 2 and 4 May and his command line check on 5 May 2012. He had flown 36 sectors in the left seat, all supervised by training Captains, prior to the command line check. He had subsequently flown a further 9 sectors as Captain before the occurrence sector. During the command line training, comments such as *"Good crosswind landings"* and *"Good landings in rough conditions"* were made by different training Captains.

1.3.2 First Officer

Personal Details	Male, aged 25 years
Licence	IAA CPL - Valid
Last Periodic Check	24 February 2012
Medical Certificate	5 February 2012

Flying Experience

Total All Types	400 hours
Total on Type	200 hours
Total on Type P1	0 hours
Last 90 Days	200 hours
Last 28 Days	80 hours
Last 24 Hrs	3 hours

Duty Time

Duty Time up to Occurrence	4 hours 18 minutes
Rest Period Prior to Duty	24 hours

The First Officer informed the Investigation that he had commenced employment with the Operator in March 2012 and that it was his first position with an airline.

1.4 Aircraft Information

1.4.1 General

The ATR 72-201 is a high wing monoplane powered by two Pratt and Whitney PW124B engines which drive Hamilton Standard 14 SF-11 four bladed propellers. The landing gear is a hydraulically retractable tricycle type, with twin wheels and an oleo-pneumatic shock absorber on each unit. The nose gear retracts forward while the main gear retracts inward into the fuselage.

No relevant operational or technical issues with EI-REH were reported to the Investigation.

The take-off weight (TOW) for the EGCC-EICK sector was calculated to be 20,138 kg with a predicted landing weight of 19,249 kg. The TOW Laden Index was 11.6 which fell within the required Index limits of 8.0 to 13.5. The Zero Fuel Weight Laden Index was 10.8 which fell within the required Index limits of 7.1 to 12.7.

1.4.2 Aircraft Operational Information

The ATR 72 FCOM[4] Chapter dealing with Procedures and Techniques sets out, inter alia, the recommended procedure for landing in Section 2.02.12 as follows:

LANDING

In order to minimise landing distance variations the following procedure is recommended:

- *Maintain standard final approach slope (3°) and final V_{APP}[5] until 20 feet is called on radio altimeter.*
- *At «20 ft» call by PNF[6], reduce to FI[7] and flare visually as required.*
  Note: 20 ft leaves ample time for flare control from a standard 3° final slope.
  During this flare the airspeed will necessarily decrease, leading to a touch down speed of 5 to 10 kts lower than the stabilised approach speed.
- *As soon as the main landing gear is on ground*
  Control nose wheel impact…..

[4] **FCOM:** Flight Crew Operating Manual
[5] **V_{APP}:** Final Approach Speed
[6] **PNF:** Pilot Not Flying
[7] **FI:** Flight Idle

FCOM Section 3.08.02, defines V_{APP} as being equal to V_{mHB}[8] + Wind factor. The wind factor is defined as *"the highest of 1/3 of the reported headwind velocity or the gust in full, with a maximum wind factor of 15 kts"*. The FCOM notes that the wind factor is added to give an extra margin against turbulence, risk of wind shear, etc.

The aircraft Manufacturer computes the *"gust in full"* as the difference between the maximum gust velocity reported by ATC and the steady state wind velocity.

A Table in the FCOM gives the V_{mHB} for an aircraft weight of 19,000 kg under normal conditions and at Flap 30 as being 106 kts indicated airspeed (IAS), while that for an aircraft weight of 20,000 kg is 110 kts IAS. The Load and Trim Sheet for the occurrence flight had predicted the actual landing weight to be 19,249 kg. The Operator's procedure in such cases is to round up the weight to the nearest 1,000 kg, i.e. to 20,000 kg in this case. Thus the V_{mHB} was 110 kts IAS for this approach.

The Operator informed the Investigation that, at the time of the occurrence, the Operations Manual (OM) Part D - Training referred to speed deviation calls when the aircraft was stabilised on a Cat I ILS approach and the speed deviated by +10kts/-0kts from V_{APP}.

1.5 Aerodrome Information

The main runway at EICK is RWY 17/35 which has a published length of 2,133 m and a width of 45 m. The secondary runway is RWY 07/25 which has a published length of 1,310 m and a width of 45 m.

1.6 Flight Recorders

The DFDR was downloaded shortly after the occurrence and a copy of the data was provided to the Investigation. The Cockpit Voice Recorder (CVR) was downloaded at the UK Air Accident Investigation Branch (AAIB) facility in Farnborough UK, under the supervision of the Investigation.

1.6.1 DFDR

The DFDR data confirms that the final minutes of the flight were flown in gusting and turbulent conditions. The DFDR records IAS once per second. A mean IAS of 126.7 kts was recorded as the aircraft descended from a radio height of approximately 580 ft, when the autopilot was disengaged, down to 19 ft. This peaked at 133 kts and had a minimum recorded value of 116.3 kts which was approximately coincident with a radio height of 136 ft. Between approximately 200 ft and 19 ft radio height, the mean recorded IAS was 124.4 kts.

The minimum IAS of 116.3 kts was immediately preceded by a recorded value of 127 kts and followed by a value of 126 kts. In the seconds following the IAS of 116.3 kts, the power lever angles are seen to increase from approximately 40° to approximately 56° with corresponding increases in engine torque.

[8] **V_{mHB}:** Minimum speed for approach

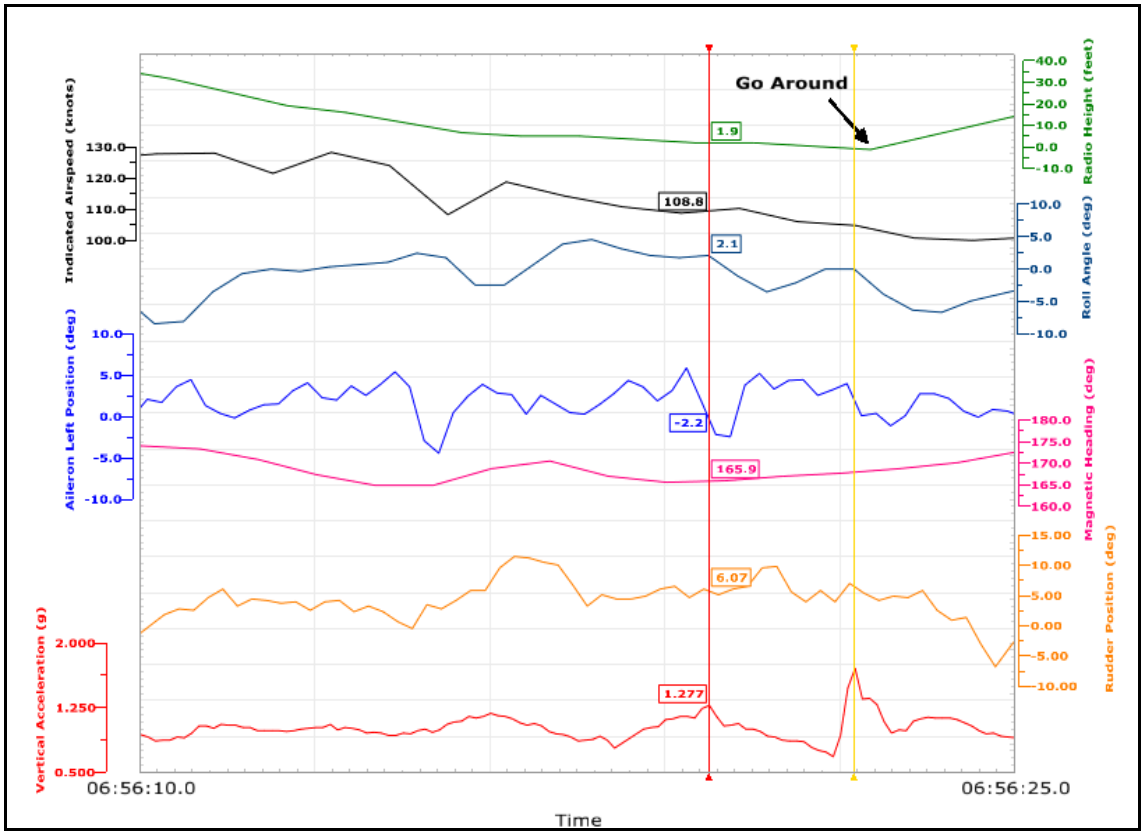

Figure No. 1: DFDR Data During Occurrence

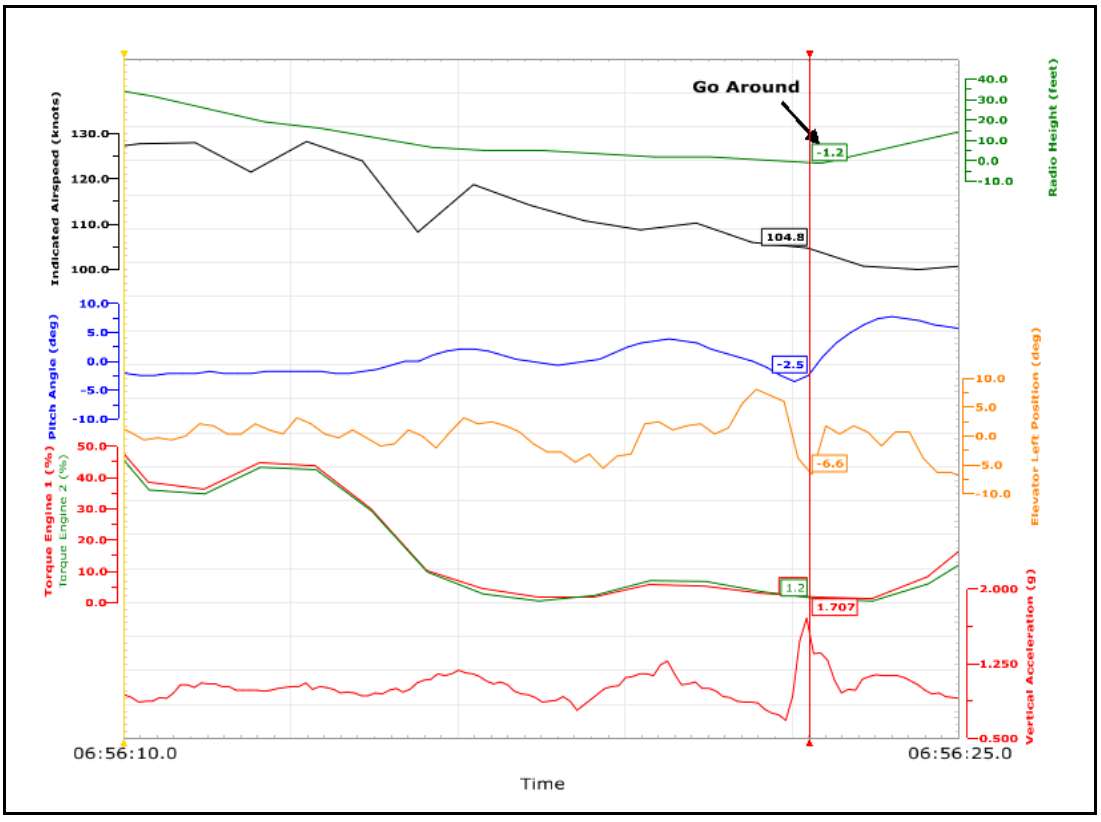

Figure No. 2: Further DFDR Data During Occurrence

Between autopilot disengagement and 19 ft, the mean roll attitude of the aircraft was recorded as -1.67° (negative roll values indicate left wing down and right wing up) with roll angles recorded between -8.1° and +3.52°. The mean recorded aircraft magnetic heading during this time was 176.4°, which when compared to the published RWY 17 heading of 166°, indicates a mean drift angle in excess of 10°. During this phase of the approach, the aircraft remained stabilised on the localiser and on magnetic heading.

Figures No. 1 and 2 illustrate the most relevant DFDR parameters over a 15 second time interval around the time of the occurrence. The point where the go-around was commenced is marked on the uppermost trace (radio height) in each Figure. The lowest trace in both Figures represents vertical acceleration.

During a period of approximately five seconds preceding the first peak in vertical acceleration of 1.277g, the recorded rudder position varied from -0.47° to +11.45° (indicating a left pedal input) and then back to approximately +5°, while the magnetic heading varied from 164.9° to 170.5° and subsequently decreased, being recorded at approximately 165.9° concurrently with the 1.277g.

During the same period, the recorded left aileron position went from +5° to -4.4° (indicating a control input to lift the right wing) and then back to +5.5°. The recorded roll angle decreased from approximately +2° to -2° (right wing moving from down to up), then increased to +4.5° and then went back to +2°.

In the same timeframe, the recorded elevator position decreased from +3.16° to -4.02°, indicating a control input to initiate the flare by pitching the nose up. At the commencement of the flare manoeuvre other recorded parameters were in the order of:-

- Pitch angle 0°
- Radio Height 10 ft
- IAS 114 kts
- Power Levers Flight Idle
- Torque 0%
- Magnetic Heading 171°
- Roll Angle +4°

At the end of the flare, the recorded pitch angle was approximately 3.2° (nose up). Simultaneously the left aileron position rapidly decreased from +5.5° to -2.4° and then increased to +4.1°. The roll attitude went from +2° to -3° (right wing moving down to up).

At the time of the first peak in vertical acceleration of 1.277g , recorded parameters were in the order of:-

- Pitch angle 3.9° (nose up)
- IAS 109 kts
- Magnetic Heading 166°
- Roll Angle 2°

During the next 3 seconds, the recorded elevator position moved from -4.02° to +8.08°, resulting in the recorded pitch angle changing from +3.5° (nose up) to -3.2° (nose down). In the same time period, the aileron position moved from +5.5° to -2.4° and then back to +4.1°.

In the next second the recorded elevator position decreased from +8.08° to -6.19°, a control input to pitch the nose up. The latter figure was approximately co-incident with the maximum vertical acceleration of 1.707g experienced by the aircraft during the occurrence, at which time the pitch angle of the aircraft was approximately -2.5° (nose down). Other recorded parameters at that time were in the order of:-

- IAS 105 kts
- Magnetic Heading 167°
- Roll angle 0°

Thereafter, the pitch angle rapidly increased to approximately 7° and the radio height can be seen to increase as the go-around was commenced.

The DFDR data did not include a "Weight-on-Wheels" parameter.

1.6.2 CVR

The CVR showed that during the cruise and the descent towards EICK the flight was routine. Normal cockpit procedures were carried out and checklists and Standard Operating Procedures (SOPs) were adhered to.

After the preceding aircraft (from the same Operator) had carried out a go-around at 17.41 hrs, Cork ATC passed a wind check to EI-REH, "*240°, 15 kts, maximum 27, minimum 7*".

This was not heard clearly by the crew and they requested another wind check which was passed at 17.42 hrs, *"Surface wind 240°, 16 kts, maximum 27, minimum 7."*

At 17.50 hrs, the Commander called for *"Flap 15".* The crew then discussed the surface wind and agreed that it was *"240°, 17 gusting 27".* The Commander said, *"I'm going to bug 120"* and then, *"120 on the V_{APP}".*

At 17.51 hrs, the Commander called for *"Gear down"* and at 17.52 hrs for *"Flap 30"* and then the landing checklist was carried out.

At 17.53:20 hrs the First Officer called *"500 above"* and at 17.53:46 hrs the Commander called, *"Three whites correcting"*. At 17.53:55 hrs an automated call of *"200"* was made by the aircraft systems followed seven seconds later by *"100"*. The First Officer called *"Speed"* and the Commander responded *"Correcting"* between those two automated calls.

The Commander called *"Go-around"* at approximately 17.54:20 hrs, following which the crew raised the landing gear and carried out the after take-off checklist.

During the subsequent minutes, the crew discussed the occurrence. The Commander remarked, *"That came down heavy on the nose gear didn't it"* and the First Officer replied, *"A little bit heavy yeah"*. The First Officer said, *"There was a gust just as we rounded out about 20 feet"* and *"Just got very very gusty and horrible there all of a sudden"*. The Commander asked the First Officer, *"Did you notice any indication problems when you raised the gear"*.

The First Officer replied, *"No actually everything was normal"*. The Commander continued, *"You had three greens before you retracted it"* and the First Officer responded *"Yeah I did. There were no anomalies at all"*.

The Commander stated, *"The mains had definitely touched down because I felt it wasn't a heavy landing on the mains, the nose just came down"*. The First Officer replied, *"Yeah, it came down very quickly"*. The Commander continued, *"We didn't bounce after the mains did we, I don't think so"* and the First officer replied, *"No, to be quite honest now we didn't"*.

Later on the Commander remarked, *"How I wish I was approved for* [RWY] *25"*.

1.7 Meteorological Information

Met Éireann, the Irish Meteorological Service, provided the following weather report to the Investigation.

Meteorological Situation:	*EICK lay in a warm sector with a cold front approaching from the west in a strong westerly flow.*	
Wind:	*Surface:*	*240/15-20KT gusting 25 to 30 KT*
	2000 FT:	*270/35KT*
Visibility:	*30km*	
Weather:	*No significant weather*	
Cloud:	*FEW/SCT 2000FT BKN 10,000FT*	
Surface Temp/Dew Pt:	*10/6 deg. C.*	
MSL Pressure:	*1024 hPa*	
Freezing Level:	*Circa 8000 FT*	
Other Comments:	*Crosswind component of approx 25KT assuming wind of 240/17G27KT (typical of the time in question). If there was no gust but mean wind of 17KT from direction of 230 degrees the crosswind would be approx 15KT*	

Met Éireann informed the Investigation that by far the highest frequency of wind direction at EICK is from between northwest and southwest and that higher wind speeds occur from those directions also.

1.8 Additional Information

1.8.1 Operator Guidance on Wind Limitations

The Operator provided the following guidance to flight crews in OM Part B.

> *1.9 Wind Limitations*
>
> *From a flight planning perspective or prior to commencing an approach, the reported gust may be disregarded when calculating the x-wind component. However, once on an approach, any reported gust must be taken into account and a landing may not be attempted unless the x-wind (including gusts) is within the stipulated limits.*

1.8.2 Operator Policy for Short or Narrow Runway Operations

When the Operator introduced the ATR 72 into service some years ago, a restriction was implemented for operations involving short and/or narrow runways. The Operator considered a runway to be short if the Take Off Runway Available (TORA) was less than 1,500m/4,920ft and narrow if the published width was less than 35m/115ft.

The OM stated that the following procedures, inter alia, would apply to all ATR 72 operations involving short or narrow runways.

> ***Approach & Landing.***
>
> *Landing performance is to be calculated using applicable FOS[9] tables and with regard to all the normal aircraft limitations. In addition the following procedure will apply:*
>
> - *Suitably qualified captains only to perform the landing.*
> - *Condition Levers must be set to 100% for landing. On PEC[10] equipped aircraft 100% NP override should be selected.*
>
> *A captain will be deemed to be suitably qualified following a line check that includes a minimum of one satisfactory approach and landing on a short runway. This requirement may be waived by the Flight Operations Manager after taking previous ATR 72 experience into account.*

Note: The short/narrow runway qualification has since been removed by the Operator, refer to **Section 2.3**.

[9] **FOS:** Flight Operations Software
[10] **PEC:** Propeller Electronic Control

1.8.3 Operator Restrictions on new Captains

The Operator has a number of restrictions on new captains, the most relevant of which is:

Until a newly appointed captain has completed a minimum of 100 hours flight time or 100 sectors on the aircraft (whichever occurs last) and has completed a minimum of 2 months consecutive line flying as a Company Commander, the following increments to published minima will apply.

- ***Crosswind Limits*** *Reduced by 5 kts for CAT I operations.*

1.8.4 Operator Response to Previous Safety Recommendation

AAIU Final Report 2013-008 reported on an accident to another ATR 72 operated by the Operator which occurred at Shannon Airport (EINN) in July 2011. The Report included Safety Recommendation IRLD2013015 which recommended that the Operator should review the training provided to its pilots regarding crosswind landings and standard speed call outs during approach.

Following the EINN accident and some other crosswind landing occurrences including the subject event, the Operator had detailed discussions with the Manufacturer and the AAIU, analysed DFDR and FDM[11] data and carried out research with a view to elimination of such landing occurrences.

In August 2013, the Operator responded to the Safety Recommendation, stating that they had implemented a number of procedures and had amended their training programme to address the Recommendation. These procedures included the following:-

- Latest training profiles for simulator recurrent training and command training have introduced conditions of maximum cross-winds, turbulence and wind-shear.

- Significant emphasis has been placed on stabilised approaches with information promulgated in FCI[12] 12 12 (this information has now also been incorporated in OM Part B).

- Emphasis on stabilised approaches and standard speed call out has been included in the latest publication of OM Part B 2.1.21 and 2.5.3.1

- Guidance on landing technique has been expanded in the latest publication of OM Part B 2.6.3

- Expanded guidance on the application of wind gusts with regard to calculating approach speeds in the latest edition of OM Part B 2.6.1

[11] **FDM:** Flight Data Monitoring
[12] **FCI:** Flight Crew Instruction

- Through the Operator's Flight Safety Office, an ongoing emphasis is placed on monitoring of approaches to ensure compliance with the Operator stabilised approach policy through use of Flight Data Monitoring.

2. ANALYSIS

2.1 General

It is clear from analysis of the DFDR and CVR data that the approach was flown in gusty and turbulent crosswind conditions. Two wind checks passed by ATC at 17.41 hrs and 17.42 hrs, before the approach commenced, both gave a peak gust of 240° at 27 kts. This equates to a headwind component of 9.2 kts and a crosswind component of 25.4 kts on RWY 17. Subsequent wind checks passed by the Tower during the final minute of the first approach were both 240° maximum 23 kts, which meant that the crosswind component had then reduced to 21.6 kts.

As a newly promoted Captain, the Commander had a 5 kts decrement applied to the Operator's maximum crosswind limit for a dry runway of 30 kts, i.e. in this case the maximum crosswind component allowable was 25 kts. The OM stipulated that, prior to commencing an approach, the reported gust could be disregarded when calculating the crosswind component. However the OM required that, having commenced an approach, any reported gust must be taken into account and a landing could not be attempted unless the crosswind (including gusts) was within the stipulated limits. Therefore, the Commander commenced the approach in accordance with OM requirements.

His comment regarding the wind, *"So hopefully it won't go up"*, indicates that he was aware that any increase in the crosswind would necessitate a go-around. The wind checks during the final minute of the approach indicated a reduction in the crosswind component and accordingly he was authorised to continue the approach to a landing under the OM requirements.

Prior to making the approach, the Commander had computed V_{APP} as being 120 kts IAS. Using Operator procedures, he rounded up the aircraft landing weight of 19,248 kg to 20,000 kg which gave a V_{mHB} of 110 kts. Due to the large crosswind component and low headwind component, the wind factor was the *"gust in full"* in accordance with the FCOM, up to a maximum value of 15 kts. ATC passed a wind check of 240° 16 kts, maximum 27 kts immediately before the calculation of V_{APP}, giving a gust in full of 11 kts, i.e. 27 less 16 kts. Thus the V_{APP} in accordance with Operator procedures was 121 kts. While there was some slight confusion among the crew about the wind velocity, the Commander arrived at a V_{APP} of 120 kts, a valid value in this case. A wind check received from ATC when the aircraft was on short finals gave a mean speed of 240° 12 kts with a maximum of 23 kts. Thus, although the wind velocity had reduced somewhat, the gust in full remained at 11 kts and the V_{APP} remained at 121 kts.

Between disconnection of the autopilot at approximately 580 ft down to 19 ft radio height, the IAS was recorded at an average value of 126.7 kts. Between 200 ft and 19 ft radio height, the average was 124.4 kts.

During this phase of the approach, the IAS dropped to its minimum recorded value of 116.3 kts at a radio height of 136 ft. The First Officer called *"Speed"* and the Commander called *"Correcting"* between the automatically generated calls of "200" and "100" heard on the CVR. It is probable that these calls were in response to the drop in airspeed, the Commander increased power and the next recorded value of IAS increased to 126 kts. The Investigation notes that, at the time of the occurrence, OM Part D – Training required speed deviation calls to be made at V_{APP} +10kts/-0kts.

In general, the hand-flown approach from 580 ft radio height down to approximately 20 ft was stabilised in the gusty and turbulent conditions. The average IAS exceeded the V_{APP} that the Commander had calculated by approximately 6 kts.

In the seconds immediately preceding the initiation of a flare, the rudder position indicated a considerable left pedal input. This is likely to have been the Commander's control input to de-crab the aircraft left onto the runway heading. However, the aircraft heading increased, i.e. it turned right, which was the opposite of the expected aircraft reaction. It is probable that this was due to the aircraft weather-cocking into a strong gust from the right. There was also significant rolling motion during these seconds, resulting from the gusts and turbulence being experienced by the aircraft.

By the time that the Commander initiated the flare, the IAS had reduced to 114 kts and the radio height was approximately 10 ft. The power levers were at flight idle and the engine torques had reduced to 0%. During the flare manoeuvre the nose pitched up to a maximum recorded angle of 3.9°, the IAS further decreased to 109 kts and the aircraft heading decreased to 166° to match runway heading. There were considerable control inputs of the ailerons as the aircraft flared, probably due to the Commander continuing to deal with the gusty conditions.

The aircraft initially touched down on its main landing gear at a low vertical velocity in the order of 0.4 m/s and a pitch angle of approximately 3.2° nose up. This vertical velocity at the aircraft centre of gravity was computed by integrating the vertical acceleration values recorded on the DFDR. The maximum vertical acceleration recorded at this time was 1.277g.

The recorded values of elevator position then show it moving rapidly from a negative value to a positive value with a consequent rapid downward change in the aircraft pitch angle from approximately 3.2° (nose up) to a value of -3.2° (nose down). Double integration of the DFDR vertical acceleration values carried out by the Manufacturer and verified by the Investigation show that, simultaneously with the nose pitching down rapidly, there was an upward change of displacement of the aircraft centre of gravity in the order of 0.7 m. This essentially means that the aircraft bounced slightly on its main landing gear and that, at the moment of the second contact with the runway surface, the main wheels were off the ground and the contact was solely on the nose wheels. The maximum vertical acceleration recorded during this part of the manoeuvre was 1.707g, which accounts for the *"noticeable impact"* recalled by the Commander. The fact that the average approach speed exceeded the calculated V_{APP} by approximately 5 kts, when combined with the gusty conditions experienced during the flare, may have contributed to the bounce.

The data shows that the Commander then reacted very quickly by pulling the control column back to lift the nose again. It is probable that during this sequence the main landing gear wheels made contact with the runway for a second time. Thereafter the Commander made the decision to execute a go-around which was followed by a second approach and successful landing on RWY 17.

The Commander described how he had *"put the control column forward"* to get the nose down after the first touchdown, as he believed that the main landing gear wheels were on the ground and he did not physically feel the aircraft bounce. The DFDR data shows that the elevator position changed rapidly thus causing the nose to drop quickly with the consequent significant impact of the nose gear with the runway surface. It is likely that, in the gusty conditions which were evident during the flare and which required considerable control inputs on the ailerons and rudder, the Commander's control of the elevator was insufficient to prevent it from moving rapidly downwards with a consequent sudden pitch down of the nose. This occurred simultaneously with the slight bounce of the aircraft on its main gear and caused the aircraft's second contact with the runway surface to be solely on the nose wheels. As the Manufacturer stated following their analysis of the occurrence, there are no certification criteria laid down for such a situation and accordingly the nose landing gear was withdrawn from service.

2.2 Operator Follow-up Actions

This occurrence followed other crosswind related landing events involving the Operator's aircraft and, in particular, an accident at EINN in July 2011. Arising from studies carried out internally as well as detailed interaction with the Manufacturer and the AAIU, the Operator has made several relevant changes to its OM including revised simulator training for crosswind landings, stabilised approaches and standard speed call outs and guidance on landing technique. The AAIU notes these changes, and considers that no further Safety Recommendation arising from these aspects of this Investigation is required.

2.3 Runway Availability

The Operator placed a restriction on captains landing on short or narrow runways if he/she had not completed *"a line check that includes a minimum of one satisfactory approach and landing on a short runway."* Runways less than 1,500 m in length were classified by the Operator as short and thus included RWY 25 in EICK which has a published length of 1,310 m. At 45 m wide, RWY 25 was not classified as a narrow runway.

On the day in question, the wind was coming from a direction of 240°, and therefore the crosswind component of a 27 kts gust would have been less than 5 kts for a landing on RWY 25. However, as the Commander had not completed the requisite short runway line check, he was precluded from making an approach to that runway. EICK is a regular destination for Operator aircraft. The highest frequency of wind direction at EICK is from between northwest and southwest and higher wind speeds occur from those directions also. The Investigation is of the opinion that the Operator should consider the qualification of Commanders for landings on RWY 25 in EICK at the earliest opportunity following their upgrade to captain. A Safety Recommendation is issued in this regard.

In its response to the Draft Final Report of the subject Investigation, the Operator informed the Investigation that it issued, in November 2013, a Flight Crew Instruction removing the short/narrow runway qualification and replacing it by revised operational and training procedures.

3. CONCLUSIONS

(a) Findings

1. The Flight Crew were properly licenced for the flight.

2. There were no relevant operational or technical issues with the aircraft.

3. An operational restriction on the Commander meant that he could not make an approach to RWY 25, as it was classified by the Operator as a short runway.

4. Crosswinds on RWY 17 were strong and gusty in a strong westerly flow.

5. The mean airspeed during the first approach to RWY 17 was approximately 5 kts in excess of the calculated approach speed $V_{APP.}$

6. The aircraft experienced strong gusts and turbulence during the flare manoeuvre on its first approach to RWY 17.

7. The first contact with the runway surface was on the main landing gear wheels with a nose up pitch attitude of approximately 3.2°, at a low vertical velocity of 0.4 m/sec.

8. The aircraft bounced slightly with an upward change of displacement of the centre of gravity in the order of 0.7m.

9. The control column moved forward and, concurrently with the bounce, the aircraft pitched down rapidly to an angle of approximately -3.2°.

10. The second contact with the runway surface was on the nose wheels only. A maximum vertical acceleration value of 1.707g was recorded.

11. As there are no certification criteria for such an occurrence, the nose landing gear was withdrawn from service.

(b) Probable Cause

1. Inadequate control of aircraft pitch in the flare during a crosswind landing in gusty and turbulent conditions.

(c) Contributory Causes

1. The average approach speed exceeded the calculated V_{APP} by approximately 5 kts which, when combined with the gusts experienced during the flare, may have contributed to the bounce.

2. An operational restriction on the Commander meant that he could not make an approach to RWY 25, which had a significantly lower crosswind component than that experienced on RWY 17.

4. SAFETY RECOMMENDATIONS

No.	It is Recommended that:	Recommendation Ref.
1.	Aer Arann should consider qualifying all captains for approaches to RWY 25 at EICK at the earliest opportunity following upgrade.	IRLD2013028

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- END -

In accordance with Annex 13 to the Convention on International Civil Aviation, Regulation (EU) No. 996/2010, and Statutory Instrument No. 460 of 2009, Air Navigation (Notification and Investigation of Accidents, Serious Incidents and Incidents) Regulation, 2009, the sole purpose of this investigation is to prevent aviation accidents and serious incidents. It is not the purpose of any such investigation and the associated investigation report to apportion blame or liability.

A safety recommendation shall in no case create a presumption of blame or liability for an occurrence.

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