SERIOUS INCIDENT

Aircraft Type and Registration:	ATR42-300, EI-FXA
No & Type of Engines:	2 Pratt & Whitney Canada PW 120 turboprop engines
Year of Manufacture:	1992 Serial no: 282
Date & Time (UTC):	22 February 2012 at 0700 hrs
Location:	On approach to Glasgow Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	58 years
Commander's Flying Experience:	6,389 hours (of which 3,900 were on type) Last 90 days - N/K hours Last 28 days - 25 hours
Information Source:	AAIB Field Investigation

Synopsis

During a radar-vectored ILS approach, the aircraft's speed reduced and the stall alert activated. Corrective action led to an overspeed. Following further corrective action the speed reduced close to a second stall alert. Tiredness or fatigue may have been a factor.

History of the flight

The flight crew reported for duty at Manchester at 2130 hrs on 21 February to operate a series of three cargo flights. Following normal pre-flight preparations they flew an ATR-72 to Paris Charles de Gaulle, arriving at 2246 hrs; the commander was pilot flying on this sector. They undertook duties on the ground and relaxed in the crew room at the airport, before boarding EI-FXA for the remaining two sectors. The aircraft departed for Newcastle on time at 0330 hrs, with the co-pilot as pilot flying. The aircraft departed for Glasgow at 0607 hrs with the commander as pilot flying.

Shortly after takeoff at Newcastle, the aircraft entered cloud and the flight crew selected level two ice protection[1]. During the flight, both above and below FL100, the commander initiated conversation on a range of topics, speaking at length on some of them[2]. The co-pilot's responses were polite but brief. The commander yawned from time to time during the flight. Both flight crew members missed, or mis-heard,

Footnote

[1] See 'Ice protection' below.
[2] The operator had a 'sterile flight deck' policy, which restricted conversation below FL100 to operational matters.

communications from ATC during the flight. Some standard operating procedures were not adhered to.

The co-pilot obtained the Glasgow ATIS report, which stated that Runway 23 was in use and was 'wet' throughout its length; the surface wind was 220°/21 kt; visibility was 8 km in moderate rain; cloud was 3-4 oktas at 1,300 ft aal, 3-4 oktas at 2,000 ft aal, and 5-7 oktas at 3,800 ft aal; the temperature was 11 °C and the dewpoint 10°C, and the QNH was 1,007 mb. Having calculated that the landing weight was 13.0 tonnes, he prepared the landing data card. The calculated approach speed, for flap 30, with wind correction, was 99 KIAS for non-icing speeds and 114 KIAS for icing speeds. He noted that the approach could be completed using non-icing speeds[3], although level two ice protection was still ON.

When briefing the approach the commander did not state whether icing or non-icing speeds would be employed for the approach and did not address other topics stipulated in the company's procedures.

The Glasgow approach controller provided radar vectors and descent instructions. During descent to 3,500 ft amsl, the co-pilot selected the terrain display ON to show the terrain north of the final approach, and the flight crew discussed the proximity of high ground.

At 0648 hrs the flight crew received a final approach vector from ATC to position the aircraft onto the ILS localiser. Having turned the aircraft onto the ILS intercept heading using the autopilot, the commander commented that he would reduce airspeed as ATC was positioning them onto a "NICE SHORT FINAL". The aircraft was 9.8 nm north-east of the airport at 3,000 ft amsl and 215 KIAS, and engine torque was reduced from 65% to about 15% on both engines. The approach controller instructed a descent to 2,000 ft amsl and cleared the aircraft to establish first on the localiser and then on the glideslope. The commander commented "I'LL HAVE TO COME DOWN A BIT QUICKER THAN THAT, WON'T I" and increased the selected vertical speed.

As the flight director captured the localiser the commander instructed the co-pilot to arm the approach mode. Engine torques were reduced to approximately 0% and the rate of descent was reduced. The aircraft was now 8.2 nm from the runway at 2,500 ft and 185 KIAS (see Figure 1, Point A).

At 140 KIAS and 2,100 ft amsl, flap 15 was deployed and the engine torque was increased to about 20%. Approximately 15 seconds later, the autopilot levelled the aircraft at the selected altitude of 2,000 ft amsl. Engine torques were reduced to about 3% (see Figure 1, Point B), airspeed reduced, and the autopilot progressively pitched the aircraft nose-up as it maintained 2,000 ft amsl. Neither of the flight crew mentioned the gradually reducing airspeed.

The co-pilot commented that they were 6.5 nm from the runway, but that the autopilot had not yet captured the glideslope. With the aircraft below the glideslope, the approach controller inquired whether it was established on the ILS. As the first officer keyed the radio to respond, the stall alert sounded and the stick shaker activated. Simultaneously, the autopilot disconnected (see Figure 1, Point C). The aircraft was approximately 1,700 ft agl at 111 KIAS and the angle of attack was +11.2°. The co-pilot called "FLY THE AIRCRAFT [EXPLETIVE]". The commander almost immediately pitched the aircraft nose down to -10° and advanced the power levers almost to full power (see Figure 1, Point D), saying as he did so "I'VE GOT IT I'VE GOT IT DON'T WORRY".

Footnote

[3] Icing speeds must be used when level two ice protection is used. Level two ice protection should be selected on at an outside air temperature of 7 °C or less for flight in visible moisture.

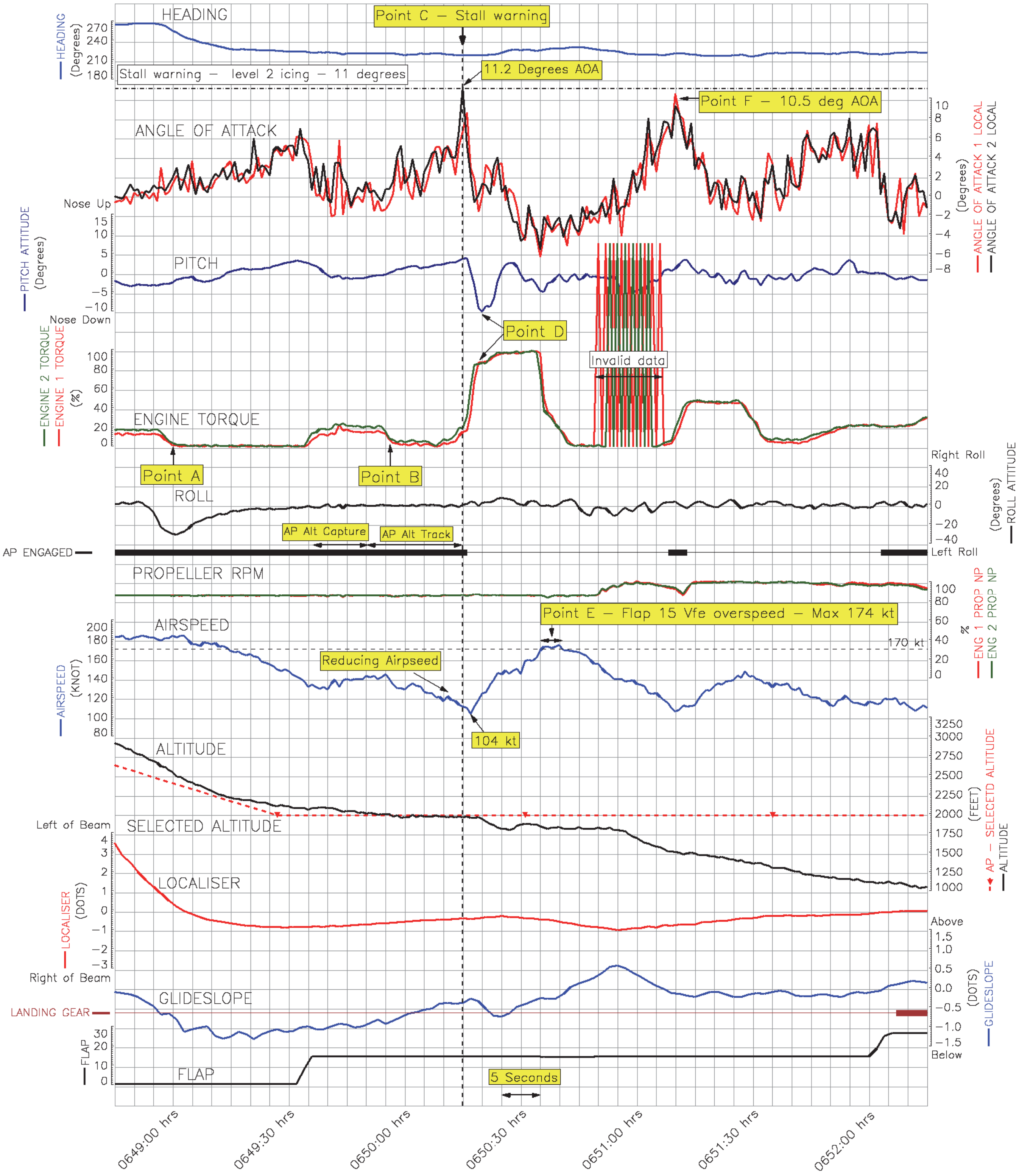

Figure 1

Approach to Glasgow Airport Runway 23

Airspeed reduced to 104 KIAS before increasing. The pitch attitude remained approximately -10° and the co-pilot called "NOSE UP NOSE UP" to which the commander replied "NO". At 125 KIAS the commander started to pitch the aircraft nose-up, having descended to approximately 1,600 ft agl.

The commander levelled the aircraft at about 1,900 ft amsl. Engine torque was now 98 % and airspeed continued to increase. Having received no response, the controller asked again if the aircraft was established on the ILS. The co-pilot replied that the aircraft was established on the localiser, and the controller instructed the pilots to contact the tower controller. As the co-pilot read the instruction back to the controller, the airspeed exceeded the flap 15° V_{fe} limit of 170 KIAS and the overspeed warning system activated. Airspeed peaked at 174 KIAS and the limit was exceeded for around 5 seconds (see Figure 1, Point E). The commander retarded the power levers, reducing engine torque rapidly to 35%, and then more gradually to about 1%. A moment later the co-pilot suggested "PUT THE AUTOPILOT IN" to which the commander replied "SHHH JUST STEADY ON".

The co-pilot set propeller rpm to MAX on command. The flight director began to capture the glideslope 4.8 nm from the runway at about 1,850 ft amsl, 0.5 dot above the glideslope.

As the aircraft descended, its airspeed reduced to a minimum of 111 KIAS and the angle of attack reached 10.5° (0.5° below the stall alert/stick shaker threshold) (see Figure 1, Point F). Passing approximately 1,500 ft amsl, the flight crew attempted to re-engage the autopilot but it disconnected immediately. Simultaneously, engine torque was increased to 45%, airspeed increased and the angle of attack reduced. The controller asked if the aircraft was still on frequency and the co-pilot replied "AFFIRM, STANDBY WE'VE JUST GOT... EH...A FEW PROBLEMS", before advising the controller that the problem had been resolved and that he would contact the tower.

At an airspeed of 115 KIAS, 3.4 nm from the runway, the autopilot was engaged and the aircraft was fully configured for landing with flap 30° selected. The remainder of the approach and landing was completed without further incident until touchdown, when a nacelle overheat warning activated. The flight crew did not action the associated procedure. The commander taxied the aircraft to its parking position and the crew shut down the aircraft.

Reporting of the event

An engineer met the aircraft on its stand. The commander briefed the engineer that there had been a problem with the autopilot. The co-pilot then informed the engineer that the autopilot was not faulty, and that the flight recorder should be preserved. No formal reporting action was taken regarding the incidents in flight and no entry was made in the technical log relating to the stall alert, overspeed, or nacelle overheat.

Having finished their flying duty, the flight crew went to their hotel. The co-pilot then contacted the company's flight safety department and an internal investigation began. The company informed the Irish Air Accidents Investigation Unit on 23 February, and the AAIB was informed on 24 February.

The previous sector

The CVR recording contained the latter part of the flight from Paris to Newcastle. Analysis showed that the commander (who was pilot monitoring during this sector) did not apply standard phraseology in his transmissions to ATC, omitting words such as 'flight level' and 'heading', even in transmissions containing read-backs of both. He yawned on occasion, and remarked to ATC that it was "LATE". He initiated or continued conversation on non-operational topics several times during the CVR recording, above and below FL100, and omitted some standard calls. On arrival at Newcastle, the co-pilot corrected an error by the commander concerning shutting down an engine whilst taxiing towards the aircraft's parking position.

The CVR continued to record during part of the turn-around at Newcastle, during which the commander was again heard to yawn.

Engineering

An inspection of the aircraft revealed no damage or abnormalities.

Flight crew

The two pilots had not flown together previously, but had spent a week on standby in Paris together.

The commander

In the three weeks prior to 20 February, the commander had been on a recurrent training course and then on leave, and during this time he slept at night and had been awake during the day. After a normal night's sleep he woke at about 0900 hrs on 21 February, and returned to bed for a few hours during the afternoon, before driving for 2 hrs 45 mins to Manchester to begin his flying duty. Although he stated that the first two days of night duty following a period of sleeping at nights were 'quite difficult' in terms of achieving rest, he said that he was 'well rested' prior to flight.

The commander recalled practising, in a simulator during recurrent training, recovery following a stall alert.

The co-pilot

Throughout the weekend of 18 and 19 February the co-pilot slept during 'normal' (night-time) hours. On 20 February, he relaxed in his hotel room before operating a night flight (with a different commander) from Glasgow to Paris and Manchester, where the operator provided a hotel room. He went to bed at approximately 0645 hrs, but was woken by a cleaner in the hotel corridor at 1205 hrs, and only managed to 'doze' for approximately an hour in the afternoon, before reporting for the flying duty to Paris.

He said that his quality of sleep was good for the first four or five hours during a day-stop, after which his quality of sleep reduced and he was more likely to be woken. Although he acknowledged that four or five hours sleep was generally *'not sufficient'*, he stated that he was not tired during the approach to Glasgow.

Guidance on avoiding fatigue

Civil Aviation Publication 371 – *'The Avoidance of Fatigue in Aircrews'*, published by the United Kingdom CAA, did not apply directly to this operation, which was regulated by the Irish Aviation Authority (IAA). However, it included the relevant statement:

> *'Travelling time, from home to departure aerodrome, if long distances are involved, is a factor influencing any subsequent onset of fatigue. If the journey time from home to normal departure airfield is usually in excess of 1½ hours, crew members should consider making arrangements for temporary accommodation nearer to base.'*

Recorded information

The aircraft was equipped with a (Flight Data Recorder) FDR and a 120-minute duration CVR. FDR data and CVR audio was available for the entire incident flight.

FDR documentation

FDRs record binary data containing encoded parametric information. The binary data can then be converted to engineering units (knots, feet etc.) by referencing detailed documentation specific to the aircraft installation. The generic name for this documentation is the Data Frame Layout (DFL). Commission Regulation (EC) 859/2008, referred to as EU-OPS, provides common technical requirements and administrative procedures applicable to commercial transportation by aeroplane. EU-OPS 1.160 '*Preservation, production and use of flight recorder recordings*', states:

> *'(4) When a flight data recorder is required to be carried aboard an aeroplane, the operator of that aeroplane shall:*
>
> *(ii) Keep a document which presents the information necessary to retrieve and convert the stored data into engineering units.'*

The FDR system fitted to EI-FXA had been modified by a former operator. The modification was designed by Delta Engineering Corporation and approved by the FAA. It consisted of the fitment of an Additional Flight Data Acquisition Management Unit (AFDAMU)[4] and sensors which increased the number of parameters recorded on the FDR. The modification was required so that the aircraft, which was then operated on the US register, was compliant with the requirements of FAR 121.344. The aircraft manufacturer was not involved in the design of the modification nor the creation of the DFL documentation.

The operator provided the AAIB with two DFL documents; one produced by the AFDAMU manufacturer and the other by the aircraft manufacturer. During the readout of the FDR by the AAIB, conversion information for the aileron and elevator surfaces was found to be incorrect. A third document was then provided. This contained different information for the conversion of the aileron and elevator positions, but the document contained no reference to an approved design organisation. Thirteen days after the initial request from the AAIB, the operator provided a fourth document which it had obtained from the originator of the modification. The operator advised that it had not previously been aware of this document, which was found to contain the relevant information for the aileron and elevator parameters. On this occasion, the delay in providing accurate DFL information did not impede the investigation.

FDR readouts

The operator was required by the IAA to conduct a readout of the FDR once every two years. Prior to the AAIB being notified of the incident, the operator had made a copy of the FDR and sent it to an avionics company that specialised in the readout of FDR's. Before conducting its own replay, the AAIB evaluated the report provided to the operator by that company and found that both the flap and elevator parameters were wrongly displayed. Both parameters were later confirmed serviceable and the errors attributed to incorrect conversions applied within the avionics company's equipment.

Evaluation of the two previous reports provided by the same company for EI-FXA, dated October 2010 and January 2008, contained the same errors. The operator advised that it had assumed that it was the responsibility of the avionics company providing the readout service to confirm the serviceability of the FDR parameters and that the operator had consequently not checked the readouts for errors. However, discussions with the UK

Footnote

[4] SAGEM manufactured unit, part number ED35E109-05-01.

CAA and IAA confirmed that it was the responsibility of the operator to confirm the serviceability of FDR readouts. The operator advised that it has updated its procedures and that the readout company has addressed the erroneous decoding issues identified.

Ice protection

Ice protection on the ATR-42 is achieved by pneumatic and electrical equipment. Pilots select the appropriate modes, commonly referred to as level one, two, and three, according to the operating conditions. Level one, which is selected ON regardless of flight conditions, provides heating of the pitot probes and windshields. Level two is selected when icing conditions are encountered and provides anti-icing of the propellers, flight control horns, and side windows. Level three is selected when ice accretion is detected on the aircraft and provides airframe and engine de-icing. The levels are selected cumulatively.

When level two is selected, the angle of attack for activation of the stall alert and stick shaker reduces and pilots are required to use higher minimum speeds, known as 'icing speeds'[5].

An illuminated push-button, labelled ICING AOA is fitted on the instrument panel to the left of the engine instruments. It illuminates as soon as level two anti-icing is selected ON, and reminds pilots that the stall alert threshold is lower in this condition and that higher speeds must be used. If the aircraft then leaves icing conditions, and the flight crew confirm that no ice is on the airframe, the push-button may be selected off and 'non-icing' speeds used.

Stall protection and recovery

On the ATR-42, stall protection is provided by a stall alert and a separate stick pusher. The stall alert activates a 'cricket' sound in the flight deck, and a stick shaker which vibrates the control columns, when an angle of attack approaching the stall is detected. At a greater angle of attack, closer to the angle at which aerodynamic stall occurs, a stick pusher applies a nose-down pitch input. Angle of attack is sensed by probes fitted on both sides of the forward fuselage and processed by the centralized crew alerting systems.

Instructions applicable in case of stall warning activation (cricket audio warning and stick shaker) are detailed in the Flight Crew Operating Manual (FCOM), section 2.02.12 of which states:

> *'Recovery of stall approaches should normally be started as soon as stall alert is perceived: a gentle pilot push (together with power increase if applicable) will then allow instant recovery.'*

Analysis

Although the flight progressed normally until the approach to Glasgow there was evidence that the commander was not operating in a manner consistent with the company's procedures. Standard calls and responses were not always carried out correctly, he engaged in conversation on non-operational topics below FL100 and did not always use standard radiotelephony phrases. Several items from the company's prescribed briefing topics were omitted from the approach briefing for Glasgow.

This was his first night-flying duty following a period during which he had slept 'normal' hours, at local night. Although he stated that he was well-rested prior to flight, the incident occurred almost 24 hours after the

Footnote

[5] The angle of attack values are different during and just after takeoff.

end of his last proper sleep. Before his flying duty, he drove approximately 2 hrs and 45 minutes to his base. Consequently, knowingly or not, he may have been tired or fatigued.

The manner in which the commander responded to monitoring calls by the co-pilot is likely to have discouraged further input at a time when effective cross-cockpit communication would have assisted in ensuring safe flight. Fatigue or tiredness caused by the pilots' diminished quality of rest in the period prior to this flight duty would have influenced effective monitoring.

At touchdown, the NACELLE OVERHEAT warning was triggered. The Flight Crew Operating Manual (FCOM) contained a procedure to be followed in event of this warning, but the flight crew did not apply the procedure.

The stall alert should have been reported promptly to the company's operations department; the overspeed and nacelle overheat should have been reported and entries made in the technical log to enable engineers to carry out appropriate checks. It was fortunate that the co-pilot reported this serious incident in a sufficiently timely manner to enable preservation of the CVR recording.

Conclusion

The appropriate airspeed was not maintained during the approach because standard operating procedures were not observed, monitoring was not effective and there was diminished crew cooperation during recovery actions. The performance of the crew may have been affected by tiredness or fatigue, caused by diminished quality of rest in the period prior to flight duty.

BULLETIN CORRECTION

The online version of this report was corrected on Friday, 9 August 2013

The first line of the first paragraph on page 12 incorrectly states that the co-pilot obtained the Newcastle ATIS report, this should read:

> 'The co-pilot obtained the **Glasgow** ATIS report, which stated that …..'