Air Accident Investigation Unit Ireland

SYNOPTIC REPORT

ACCIDENT
Airbus A320-214, EI-CVA
London Flight Information Region
7 September 2012

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.

AAIU Report No: 2014 - 003
State File No: IRL00912100
Report Format: Synoptic Report
Published: 27 May 2014

In accordance with Annex 13 to the Convention on International Civil Aviation, Regulation (EU) No 996/2010 and the provisions of SI 460 of 2009, the Chief Inspector of Air Accidents on 7 September 2012, appointed Mr Paddy Judge as the Investigator-in-Charge to carry out an Investigation into this Accident and prepare a Report.

Aircraft Type and Registration:	Airbus A320-214, EI-CVA	
No. and Type of Engines:	2 x CFM56-5B4/P	
Aircraft Serial Number:	1242	
Year of Manufacture:	2000	
Date and Time (UTC)[4]:	7 September 2012 @ 20.30 hrs	
Location:	London Flight Information Region (FIR), 120 NM southeast of Dublin (EIDW)	
Type of Operation:	Commercial Air Transport, Scheduled Passenger	
Persons on Board:	Crew - 6	Passengers - 62
Injuries:	Crew - 1	Passengers - 0
Nature of Damage:	Nil	
Commander's Licence:	Airline Transport Pilot Licence (ATPL) issued by the Irish Aviation Authority (IAA)	
Commander's Details:	Male, aged 40 years	
Commander's Flying Experience:	7,200 hours, of which 3,137 were on type	
Notification Source:	Watch Manager, Dublin ATC	
Information Source:	AAIU Report Form submitted by the Commander AAIU Field Investigation	

[4] **UTC:** Universal Time Coordinated (local time was one hour ahead of UTC at time of occurrence).

SYNOPSIS

While the scheduled passenger flight was in the cruise at Flight Level (FL) 380, the Flight Crew received an initial clearance from Air Traffic Control (ATC) to descend to FL340. However, FL240 was set in the altitude window. During the descent ATC was queried regarding the cleared level and confirmation was obtained that FL340 was the cleared level as the aircraft was approaching FL340. The autopilot was disconnected and a manual control input was made to quickly level the aircraft. As a result of the rapid pitch change, a Cabin Crew Member (CCM), who was stationed in the aft galley area of the aircraft, sustained a broken ankle.

One Safety Recommendation is made to the Operator as a result of this Investigation.

NOTIFICATION

Although the occurrence occurred in UK airspace, when notified, the UK Air Accidents Investigation Branch (AAIB) delegated the Investigation to the AAIU. The French Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile (BEA) of the state of manufacture appointed an accredited representative to the Investigation.

1. FACTUAL INFORMATION

1.1 History of the Flight

The flight departed Milan, Italy (LIMC) at 18.44 hrs on the evening of 7 September 2012 with EIDW as its scheduled destination. The occurrence took place during a descent from the cruising altitude of FL380 approximately 120 NM southeast of EIDW. At that time, the aircraft was within the London FIR heading initially to waypoint BADSI and then to waypoint LIPGO.

The descent towards EIDW was commenced at 20.28 hrs. Four minutes later in the descent the aircraft was abruptly levelled at FL340. CCM No. 3, who was working in the aft galley, sustained a serious injury to her ankle. A PAN[5] call was subsequently transmitted to ATC following which the aircraft was given traffic priority and later made a normal landing at Dublin at 20.51 hrs. The four CCMs were brought to hospital and all but CCM No. 3 were later discharged.

1.2 Damage to Aircraft

The aircraft did not sustain any damage as a result of this occurrence.

1.3 Interviews

All Crew Members were interviewed by the Investigation and provided statements in relation to the occurrence.

[5] **PAN:** A state of urgency is declared by speaking the words "PAN-PAN" three times in order to ensure priority handling by ATC (ICAO Standard phraseology).

1.3.1 Commander

The Commander, who was the Pilot Flying (PF), reported the occurrence in accordance with regulations and company policy. He subsequently gave a comprehensive account of the sequence of events when interviewed by the Investigation. He stated that once the descent began, confusion arose over the actual cleared level. ATC then confirmed that the cleared level was FL340 and not FL240 which the PF had previously selected. With the aircraft descending in Open Descent mode (OPS DES)[6], he attempted to reset the Flight Control Unit (FCU)[7] altitude window to enable the aircraft to automatically level off at the cleared FL340. He stated that when this did not happen he disconnected the autopilot and made a manual pitch input on the side stick to arrest the descent. Once level at FL340, he re-engaged the autopilot.

On reflection he believed that an incorrect cleared flight level had initially been set on the FCU and that an adequate cross-check of the cleared level by both pilots had not taken place. He recalled that the seatbelt sign was off at the time and that there was no conflicting air traffic present on the Traffic Collision Avoidance System (TCAS), which is shown on the Navigation Display (ND) screen.

1.3.2 First Officer (FO)

The FO, who was acting as Pilot Monitoring (PM), stated that the flight had been smooth and that there had been no operational constraints. While still in UK airspace at FL380 they received and he acknowledged an ATC clearance to descend to FL340 and to expect a further clearance to be at or below FL200 at LIPGO. He stated that this was a standard clearance for that particular route to EIDW when Runway (RWY) 28 was in use. He then wrote the top of descent figures on the flight log. He recalled that the PF had asked whether the clearance was to be at or below FL240 at LIPGO, and he responded that it was at or below FL200. The PF then entered that restriction into the Multi-purpose Control and Display Unit (MCDU)[8]. The PM stated that he believed he had initially written "\240" on the flight log as the cleared level because that was what the PF had called and set in the FCU. Following the later clarification from ATC he amended the flight log to read "\340".

He was about to make a '2,000 ft to level off' call at FL360, as required by the Operator's Standard Operating Procedures (SOPs), when he noticed that FL240 was set on the FCU. He believed that he asked the PF to level out while he checked the descent clearance with ATC but the radio frequency was busy at the time. He managed to contact ATC whilst the aircraft was descending through approximately FL352. ATC confirmed that the clearance was to FL340. He believed that at this point they were descending through approximately FL345. The PF disconnected the autopilot and they levelled off at FL340.

[6] **OPS DES:** A selected Flight Guidance mode during which the auto-flight system commands a pitch attitude that maintains a constant speed while auto thrust (if active) maintains IDLE thrust.
[7] **FCU:** Used to select flight parameters, autopilot, autothrust and different guidance modes (**Appendix A**).
[8] **MCDU:** The flight crew interface with the Flight Management System (FMS) through which long term navigational inputs are made.

Soon afterwards the Senior Cabin Crew Member (SCCM) contacted the cockpit stating that one of the CCMs had broken her ankle. He recalled disbelief when informed that a CCM had been injured. He stated that the SCCM informed them shortly afterwards that all CCMs were feeling unwell and that they would need medical attention on arrival at EIDW. As a result a PAN call was made to ATC which gave the aircraft a direct clearance to EIDW for an immediate landing.

He stated that he understood SOPs to require, following receipt of a descent clearance, that it should be set in the FCU, crosschecked and recorded in the flight log.

1.3.3 Senior Cabin Crew Member

The SCCM stated that she was in the forward galley with a catering cart when the event happened. She described experiencing an enormous pressure with a feeling of being held down with symptoms such as ringing ears, numb limbs and seeing black spots. She then observed that the other CCMs were on the floor in different positions in the cabin. The SCCM recalled feeling a general state of confusion and disorientation. The injured CCM No. 3, who had been working in the aft galley area of the cabin, was observed to be lying on the floor. The SCCM stated that she went down to CCM No. 3 and it was clear that she had a broken ankle. CCM No. 2 also appeared to be in pain with her back. She immediately contacted the cockpit and informed the FO that a CCM had sustained an injury. She recalled that he expressed disbelief that this had occurred. A passenger address announcement was made in order to find out if there was a doctor on board and the first aid kit was brought aft to the casualty. The CCM was attended to by a passenger who identified himself as a medical doctor. Later, the SCCM briefed an able bodied passenger to assist in opening the doors in the event of an emergency evacuation after landing.

The SCCM stated that on arrival at EIDW, she informed the Commander that all CCMs required medical attention. The Cabin Crew were immediately replaced by a reserve crew before the passengers were disembarked. Following this, all CCMs were examined by paramedics before being transported to hospital by ambulance where CCM No. 3 was detained.

She felt that her training had adequately prepared her to deal with this occurrence.

1.3.4 Injured Cabin Crew Member

The CCM, who suffered the ankle injury, stated that she was assigned the No. 3 position and was working in the aft galley area. She stated that passengers in the immediate area were seated and that a number of seat rows were vacant at that time. When the event occurred, she was standing between the two toilets and described that it was like being on a roller coaster. She reported a feeling of being lifted off her feet and then pushed down to the floor of the cabin. She ended up on the floor facing forward and called another CCM for assistance as she felt that her ankle was injured.

A passenger, who was a doctor, examined her following which splints were put on her leg. After landing, she was taken to hospital where tests showed that her ankle was broken.

1.4 Personnel Information

1.4.1 Flight Crew

Both Commander and FO were type rated and qualified to operate the flight. Both were experienced on type and had been employed by the Operator for several years. The Flight Crew's experience was as follows:

1.4.2 Aircraft Commander:

Personal Details:	Male, aged 40 years
Licence:	ATPL (A) JAA (Ireland), valid to 28 December 2012
Medical:	Class 1, valid to 16 September 2012
Ratings:	A320, valid to 30 April 2013

Flying experience:

Total Flying Time:	7,200 hours
Total on Type:	3,137 hours
Total P1 on Type:	1,753 hours
Last 12 months:	762 hours
Last 90 Days:	210 hours
Last 28 Days:	23.5 hours
Last 24 Hours:	4.5 hours

1.4.3 First Officer:

Personal Details:	Male, aged 52 years
Licence:	ATPL (A) JAA (Ireland), valid to 27 January 2013
Medical:	Class 1
Ratings:	A320, valid to 27 August 2013

Flying Experience:

Total Flying Time:	10,300 hours
Total on Type:	2,550 hours
Last 12 months:	717 hours
Last 90 Days:	180 hours
Last 28 Days:	8 hours
Last 24 Hours:	4.5 hours

The duty time of the Flight Crew was 6 hours and 21 minutes at the time of the event, their rest before the flight being 17 hours and 28 minutes (Commander) and 15 hours and 44 minutes (FO).

1.4.4 Cabin Crew

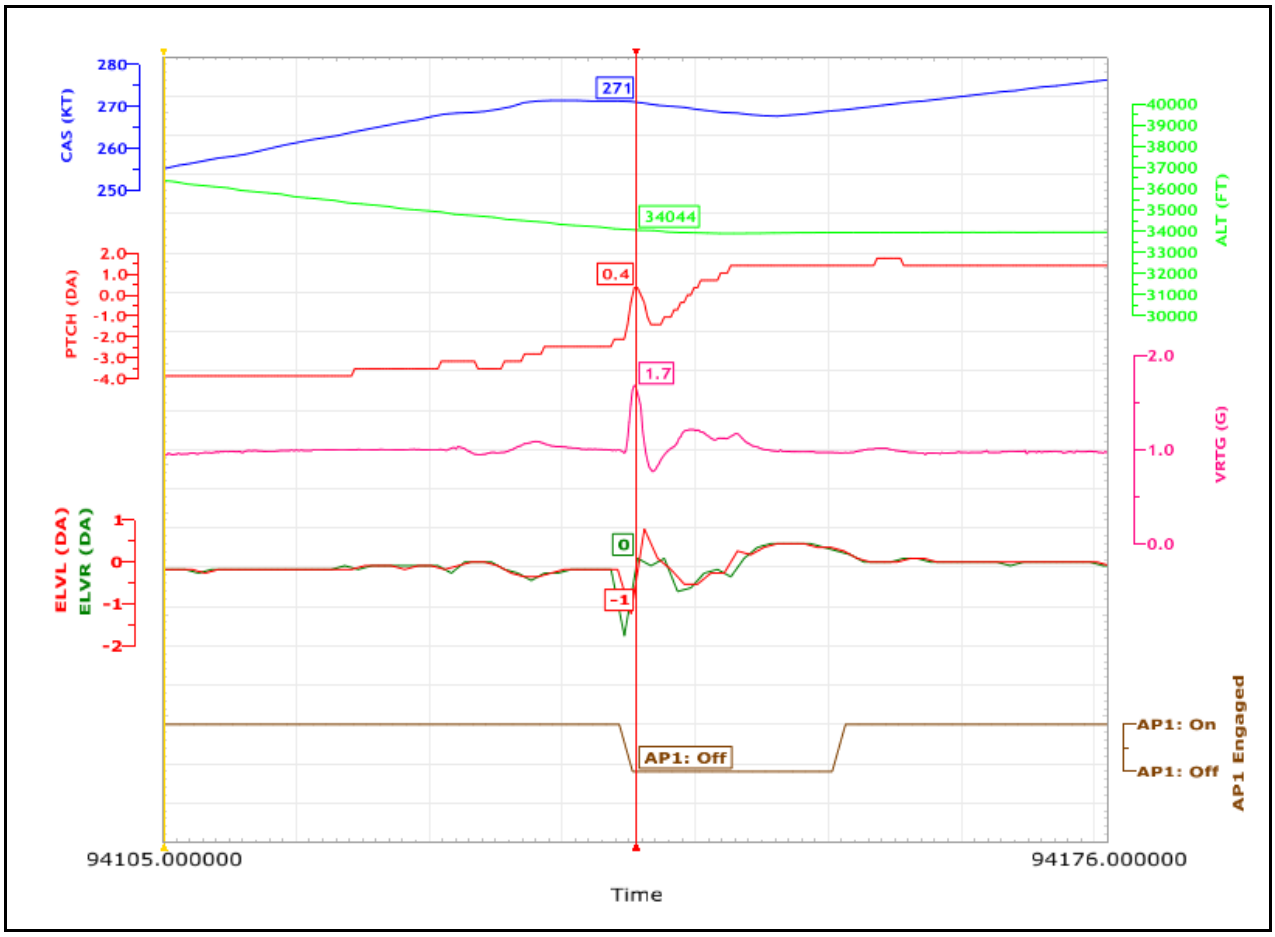
The documentation of all CCMs was inspected and all were trained and current on type.

1.5 Flight Recorders

1.5.1 Digital Flight Data Recorder (DFDR)

The DFDR was obtained from the Operator and downloaded by the Investigation. The flight data recovered was of good quality. **Graphic No. 1** shows that during the occurrence the vertical acceleration (g)[9] increased sharply from 1g to 1.7g and then decreased to approximately 0.8g over a period of 3.4 seconds. It then oscillated slightly before settling back at 1g.

There was a corresponding pitch change of +2.9°, from -2.5° to +0.4°. Although not depicted in the graphic, the vertical speed in the initial descent was approximately 4,000 ft/min. This had reduced to 2,800 ft/min when the occurrence commenced. The Commander's side stick information, as recorded on the DFDR, was not reliable or consistent with the other recorded data.



Graphic No. 1: DFDR parameters

[9] **g:** A measurement of acceleration due to gravity which is normally felt as weight. At 2g, the human body feels a gravitational force equal to twice its normal weight

1.5.2 Cockpit Voice Recorder (CVR)

The CVR was also obtained by the Investigation and taken to the (UK) AAIB for download. The CVR data gave a good quality recording of cockpit communications over the relevant time period. Prior to the occurrence, communications between the Flight Crew were professional and relaxed. **Table No. 1** shows the relevant events relating to the occurrence. Time is depicted in hours, minutes and seconds from commencement of the CVR recording.

Time	Who	Record
1.25:50	ATC	Shamrock Four three Papa when ready descend to flight level three four zero expect the usual two hundred by LIPGO
1.26:01	PM	Ah when ready descend to flight level three four zero expecting two hundred by LIPGO Shamrock four three Papa
1.26:07	PF	So two four zero blue ["blue" indicates that this number was observed in blue on the PFD[10]]
1.26:08	PM	Two four zero blue checks
1.26:10	PF	And LIPGO minus two four zero
1.26:13	PM	Check
1.26:14	PF	[indecipherable].. two four zero
1.26:19	PM	Ah no its two hundred by LIPGO [overlap]
1.26:20	PF	……two hundred by LIPGO two hundred thanks [overlap]
1.26:32	PF	So we need to go down very soon

Table No. 1: CVR Recording Extract 1

The Flight Crew then conducted a full briefing for an Instrument Landing System (ILS) approach to RWY28. Towards the end of this briefing a descent was commenced at 1.27:59 hrs.

1.29:00	PM	Can you just level off there for a minute
1.29:02	PF	Sorry
1.29:03	PM	Will you just level off there for a minute I I just want to check
1.29:07	PM	London from the Shamrock four three ah papa just confirm our cleared level
1.29:13	ATC	Four three papa flight level three four zero
1.29:16	PM	Roger level three four zero four three papa
1.29:21	PM	Level off three four zero
1.29:24		Autopilot disconnected sound
1.29:24	ATC	Four three papa contact London one three three decimal six
1.29:27	PM	London one three three decimal six bye four three papa
1.29:32	PM	You obviously weren't with me with what I was saying
1.29:42	PF	I owe you a big one there

Table No. 1: CVR Recording Extract 2

[10] **PFD:** Primary Flight Display.

At 1.30:02 hrs the cabin interphone call sounded while the Flight Crew was receiving a further clearance from ATC. Following receipt the FO responded to the SCCM's call who then informed him that a CCM had broken her ankle. This information was initially treated with disbelief and the SCCM repeated her message. While this was occurring the CVR recorded a public address announcement by a CCM seeking a doctor.

1.6 Meteorological Information

An area of high pressure existed in the region and no in-flight turbulence was reported by the crew.

1.7 Aircraft Information

The aircraft was operated within the normal weight and centre of gravity envelope and was not carrying any relevant deferred defects. It had a valid certificate of airworthiness. Regarding g forces, the certified operating envelope of the aircraft with flaps up is +2.5g to -1.0g.

1.7.1 High Altitude Aerodynamics

Aircraft operating at flight altitudes in excess of 25,000 feet are considered to be in the high altitude environment. Lift, thrust and drag are all affected by air density[11]. At altitude, air density is reduced and consequently wings (lifting surfaces) need a higher angle of attack to maintain the same co-efficient of lift as that produced at lower altitudes, assuming a constant true airspeed (TAS). This results in increased drag.

In addition, flight handling characteristics change significantly with reduced aerodynamic damping affecting the overall stability and controllability of the aircraft. The reduced density of air flowing over control surfaces at high altitudes also decreases their effectiveness. This effect is masked by the Airbus A320 flight control system in normal law which modifies control surface displacement so that the aircraft responds consistently to side stick inputs. Lower air density reduces jet engine thrust and increases the time it takes to accelerate.

An increase in g, brought about by environmental conditions such as turbulence or manoeuvring, potentially increases the stall speed and/or decreases the Mach buffet speed. Increased g loading effectively lowers the aerodynamic ceiling for a given aircraft gross weight. These issues must be taken into account when operating in a high altitude environment.

In the United States, following recommendations by the National Transportation Safety Board (NTSB) the Airplane Upset Recovery working group was formed by industry partners to provide awareness training regarding high altitude aircraft handling characteristics and upset recovery techniques. The group's presentation[12] made a number of recommendations to industry. At high altitudes, where the operational envelope is reduced, it is recommended that pilots:

[11] FAA Advisory Circular 61-107B provides advice to pilots engaging in high altitude operations
[12] Airplane Upset Recovery Training Aid Team, Rev.2, November 2008.

- Make small control adjustments rather than large or abrupt inputs.
- Be smooth with pitch and power inputs.
- Recognise and correct any upset situations (particularly stall conditions).

In addition, the group recommended that training should reinforce operator/pilot understanding of high altitude operations and that particular attention should be given to risks associated with handling techniques. Furthermore, the group highlighted the importance of understanding individual aircraft type flight envelope[13] protections and the appropriate use of automation.

An aircraft pitches about its Centre of Gravity in flight. When the pilot makes an aft stick input, a downward force acts on the tailplane and the aircraft nose pitches up, causing an increase in the angle of attack between the aircraft and the relative wind thus generating an increase in the total lifting force. In this case, occupants feel changes in vertical acceleration or g force, perceived as changes in their weight. The distance forward or aft of the Centre of Gravity will affect the magnitude of the vertical acceleration experienced. Large and/or abrupt pitch control movements should therefore be avoided in most circumstances.

1.7.2 Use of Automation

The Operator's automation policy[14] states that both pilots should be aware of settings and changes to the aircraft's auto flight systems. Cockpit automation and technology is designed to reduce pilot workload and enhance crew situational awareness. The Operator's policy recommends the use of autopilot, flight director and auto thrust under most flight conditions and that pilots should be prepared to revert to manual operation to the extent necessary to maintain safe flight. The flight crew are ultimately responsible for choosing the appropriate levels and use of automation.

The aircraft Manufacturer recommends appropriate levels of automation for specific tasks but also that pilots should take over control when the aircraft does not respond as expected.

1.7.3 Airbus A320 flight controls

The Airbus A320 is a fly-by-wire (FBW) aircraft with a computerised flight control system that incorporates flight envelope protection. FBW systems are intended to make aircraft safer, more efficient and easier to fly[15].

In the A320 cockpit, sidesticks are used by pilots to control pitch and roll. Computer signals control flight surface movements as required by manual side stick or autopilot inputs. The aircraft's flight control laws (Normal, Alternate and Direct) provide for various types of flight envelope protection.

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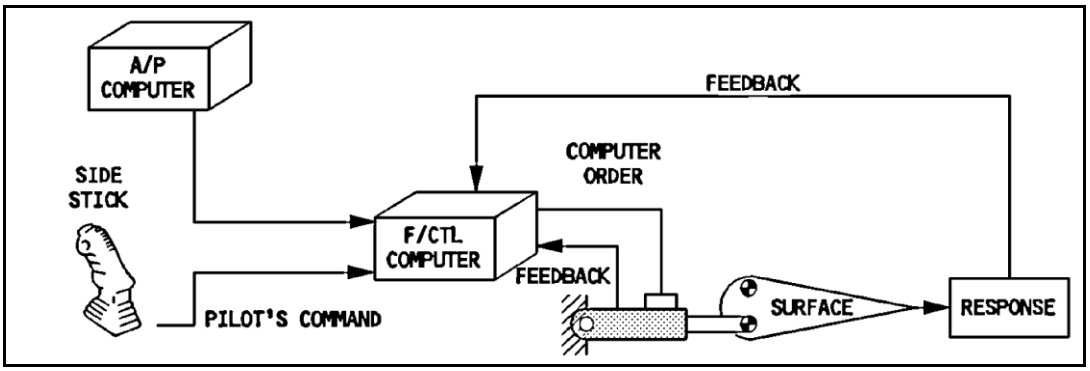
[13] **Flight Envelope:** The defined conditions of airspeed, altitude, etc. wherein the aircraft is permitted to operate.

[14] Operations Manual, Part A, page A-8-182 .

[15] Airbus fly-by-wire at a glance - a pilot's first view, *FAST (Airbus Technical Digest)*, December 1996.

In Normal law, in which the subject aircraft was operating, control surface movements are automatically limited which inter alia keep the aircraft within certain parameters in pitch and roll. A side stick pitch input demands a proportional load factor from the flight control system and the control surfaces move accordingly. The Autoflight System automatically trims the aircraft through the elevator and trimmable horizontal stabiliser (THS) to maintain a vertical load factor of approximately 1g. Pilot input is not required to trim the aircraft in manual flight or with the autopilot engaged. The A320 Flight Control System architecture is shown schematically in **Graphic No. 2**.



Graphic No. 2: A320 Flight Control System Architecture (*A320 FCOM*)

Normal law protections prevent excessive pitch attitude and angle of attack. Speed and bank angle are also protected with load factor limitations provided. In a clean configuration, the
11 A320 will maintain the load factor between +2.5g and -1g, regardless of pilot stick input. This means that full manual control stick inputs can be made without stalling, over-speeding or overstressing the aircraft, thus preventing a loss of control while allowing use of the full flight envelope.

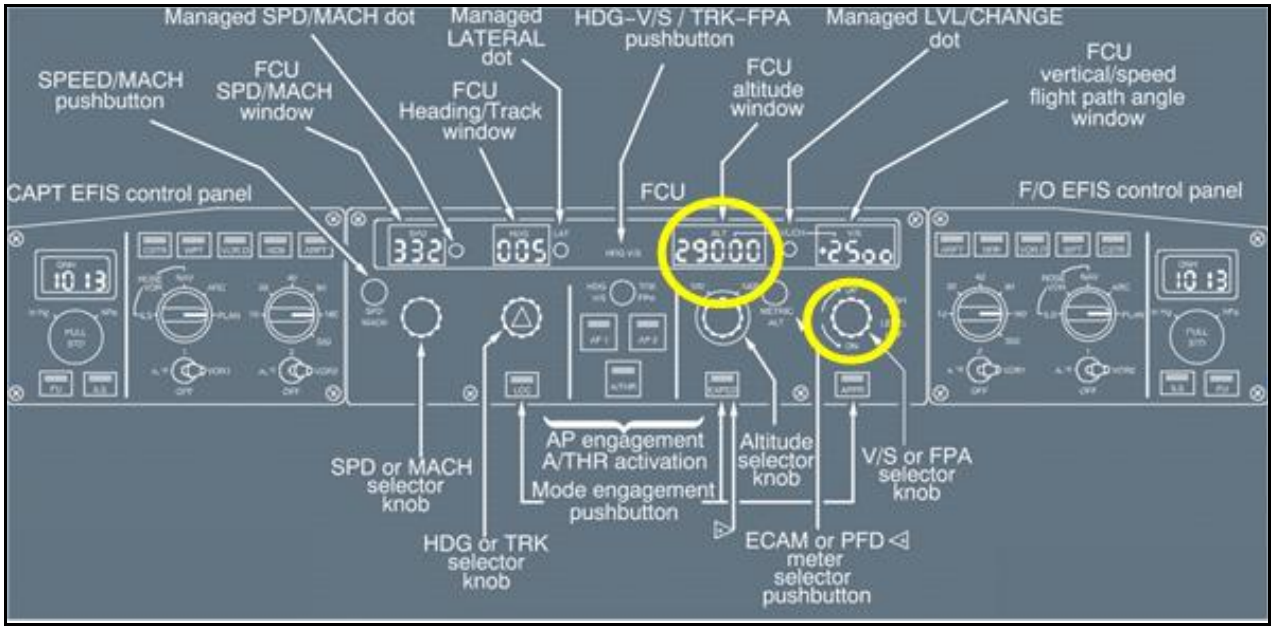
The Flight Management and Guidance System (FMGS) provides for fully managed flight guidance and also allows direct pilot input. Crew interface with the FMGS takes place through the MCDU, through which the flight plan waypoints, together with any altitude restrictions, are entered (**Appendix A**).

Direct, tactical short term inputs can be made by flight crew using the FCU control panel (**Graphic No. 3**). FCU inputs are known as selected guidance and have priority over managed guidance. Pilots use the FCU to make altitude, speed and flight path trajectory selections. In the case of a selected altitude change this appears in blue on the PFD. The FCU is also used to select autopilot and auto thrust functions.
The FCOM[16] systems description DSC 22 10 40 20 states:

> *When the flight crew pushes in the V/S or FPA[17] knob, the system commands an immediate level-off by engaging the V/S or FPA mode with a target of zero.*

[16] **FCOM:** Flight Crew Operating Manual.
[17] **V/S or FPA:** Vertical Speed or Flight Path Angle.

Thus when the autopilot is engaged and an immediate level-off is desired, pressing the V/S or FPA selector knob will command the aircraft to conduct a smooth level off to zero vertical speed.



Graphic No. 3: FCU control panel showing altitude window and V/S or FPA selector (*Airbus*).

1.8 Operator Information

1.8.1 Standard Operating Procedures (SOPs)

The SOPs used by the Operator are derived from the Manufacturer's recommendations and also from operators' experience and expertise. SOPs are detailed in the Operator's Operations Manual Parts A and B, Airbus Flight Crew Operating Manual (FCOM) and A320 Quick Reference Handbook (QRH) as well as in normal operating checklists.

Operator procedures[18] specify that whenever clearance to an altitude or flight level is received, it should be set in the FCU altitude window by the flying pilot, using the Altitude selector knob and written down by the pilot monitoring. This altitude setting must then be cross-checked visually and verbally by both crew members. Any discrepancies must be resolved with ATC and not between crew members. In general, procedures are designed to minimising cockpit crew distractions, which can contribute to the possibility of climbing or descending to an incorrect flight level or altitude.

The Operations Manual (OM) Part B-2-23 states, inter alia:

With the AP[19] engaged, the PF usually makes FCU and tactical MCDU selections, announcing such changes to the PM. All re-programming inputs should be crosschecked by PM.

[18] Operations Manual, Part A, page A-8-124
[19] **AP:** Autopilot

ATC clearances, especially level changes, should be written down by the PM as they are received. On the other hand, routine flight log entries should be delayed until above 10,000 ft/FL100, when an accurate and up to date flight log should be maintained by the PM.

Completion of the flight log should not interfere with proper monitoring of flight progress.

The Investigation examined the flight log for the subject flight regarding the clearance to FL340 that was issued by ATC. A descent to FL240 was initially recorded on the flight log which was subsequently amended to FL340.

1.8.2 Operator Training Program

Initial and recurrent training is provided by the Operator to all pilots and cabin crew in many aspects of normal and non-normal aircraft operations. In-flight upset recovery training is provided to pilots periodically, as part of the Operator's approved three year recurrent training cycle. Crew Resource Management (CRM) training is also provided during this cycle. The Operator's Operations Manual (OM) Part D, Section 2.1.5.2 states *inter alia* that:

> *Analysis of accident statistics from the last 30 years clearly shows that 70% of commercial aircraft accidents are caused - at least in part - by the failure of the crew to "manage" all available resources. Ineffective communications, inadequate leadership, poor teamwork and high stress levels among crewmembers can have catastrophic consequences. Furthermore, approximately 57% of accidents occur where no mechanical defects were present. Failure to Identify Threats, Manage Errors and Actively Monitor has been proven time and time again to be detrimental to safe flight.*

And also that:

> *CRM is the effective use of all available resources (e.g. equipment, procedures and people) to achieve safe and efficient flight operations. CRM training develops the skills, which pilots use to gather information, analyse that information, develop solutions, implement the decision and evaluate the outcome.*

The Operator's CRM training is intended to provide crews with the skills to effectively manage all available resources to achieve safe and efficient flight operations. For example, CRM performance standards in areas such as decision making, workload management and communications help flight crew to identify threats, manage errors and actively monitor aircraft operation.

Pilot CRM performance is assessed during annual line and periodic simulator checks and both Flight Crew Members were current in this regard. Recurrent pilot simulator training largely focuses on non-normal situations.

2. ANALYSIS

2.1 General

The flight had been normal up to the time of the occurrence, when a routine descent clearance was received from ATC.. No in-flight turbulence was reported by either the Flight Crew or the Cabin Crew. The CVR recorded Flight Crew communications with ATC and the Cabin Crew. The DFDR and CVR confirmed the accuracy of the statements and the candid reports provided by all crew members. Analysis of the DFDR data showed a rapid change in g forces during the occurrence.

2.2 Descent Clearance

The CVR revealed a good relationship between the PF and PM, with a professional but relaxed atmosphere. The descent clearance given by ATC was correctly read back by the PM. However, the CVR recorded that the ATC descent clearance to FL340 was understood by the PF to be to FL240, which he proceeded to set on the FCU altitude selector. The subsequent crosscheck by the PM failed to detect that an incorrect flight level had been set by the PF.

Operator SOPs state that ATC clearances, especially level changes, should be recorded in the Flight Log by the PM as they are received. The flight log should then be used to cross-check what the PF sets in the FCU. The PM believed he wrote FL240 on the flight log as the cleared level because that was what the PF had set and announced. This indicates that the ATC clearance was not recorded at the time it was received but some seconds later. As the PM had recorded on the flight log what the PF had incorrectly set and announced, as opposed to what he himself had correctly read back to ATC, the crosscheck was ineffective and the error was not trapped at that time.

The Operator SOPs provide guidance to flight crew for safe and efficient aircraft operation. These procedures emphasise the importance of setting and cross checking altitudes/flight level clearances by both flight crew members.
The procedures require the flight crew to obtain confirmation from ATC when there is any doubt or disagreement between pilots about a clearance. Although confirmation was received, this was at a late stage when close to the cleared altitude, thus leaving little time to level off and avoid an altitude excursion (“level bust”).

2.3 Level Off Manoeuvre

Shortly after the PF commenced descent with the autopilot engaged, the PM had misgivings about the altitude they had set on the FCU and felt the need to reconfirm the cleared level with ATC, as required by procedure. He asked the PF to level off without specifying a reason. The CVR recording revealed that the PF was confused by this request, as he was evidently unaware of why it was made. The PM then confirmed the cleared flight level with ATC. The unclear communications between the Flight Crew led to the PF not realising that he might have set an incorrect flight level until the aircraft was quite close to the actual cleared level.

His attempts to capture the altitude by re-selecting the flight level on the FCU were not successful and, although pushing the V/S-FPA knob would have levelled the aircraft automatically, the PF reacted by disconnecting the autopilot and quickly levelled off using a manual, side stick pitch input. It is possible that the reason the PF did not push the V/S-FPA knob is that this action is rarely done in normal operation whereas reselecting a flight level is a routine activity.

The injured CCM, working in the aft galley area, reported experiencing a feeling of weightlessness, probably due to the initial downward movement of the tail during the pitching manoeuvre. The subsequent increase to 1.7g, as the aircraft descent was arrested, probably coincided with her fall to the floor and resulted in her injury. This increased g force was also experienced by the other CCMs, who reported typical symptoms of varying g forces, such as the feeling of being held down and seeing black spots while standing even though the positive g force only lasted under one second. As the CCMs working forward of the rear galley were uninjured, this indicates that the greatest effect of the abrupt manoeuvre was probably experienced in the rear of the aircraft. The variation in g forces and their duration (which occurred over a four second period) were conditions not normally experienced by cabin occupants when in-flight turbulence is not a factor although the highest recorded vertical acceleration of 1.7g was well within the certified flight envelope for the aircraft.

This rapid change in g forces, due to aircraft pitch changes, probably caused the CCM's injury.

2.4 Aircraft Handling

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Although descending, the aircraft was still at an altitude where careful consideration should have been given to the aerodynamic handling aspects of high altitude operations. Although the Airbus A320 fly-by-wire system incorporates flight envelope protection, and the aircraft was operating well within its usual g limits, industry recommendations are that consideration should always be given to aircraft energy management and the careful manipulation of flight controls. Large and/or abrupt manual flight control inputs should be avoided, particularly at high altitudes where the potential for aircraft upset and activation of flight envelope protection exists (**Section 1.7.3**).

Recurrent pilot training largely focuses on non-normal situations, where the flight controls are manipulated to the extent necessary to avoid terrain or to recover from unusual attitudes. This is usually conducted in a flight simulator where no passengers or cabin crew are present. However, in the actual aircraft passengers and cabin crew experience the full effects of abrupt control inputs. It is likely that the manual control input was an instinctive reaction by the PF in attempting to level off at FL340 and thus avoid an altitude excursion. It is evident from the CVR that the Flight Crew did not appreciate the effects of what seemed to them to be a reasonable control input, in the late attempt to comply with their ATC clearance.

Consequently, a Safety Recommendation is issued to the Operator that it should review its training and procedures to ensure that its flight crew are familiar with the use of levelling off procedures and the risks associated with manual flight control input during high altitude operations.

3. CONCLUSIONS

(a) Findings

1. Both Pilots were properly licensed and held valid medical certificates.
2. All CCMs were trained and current on type.
3. The airworthiness certification of the aircraft was valid.
4. There were no relevant technical issues with the aircraft.
5. Turbulence was not a factor during the occurrence.
6. The descent clearance to FL340 was correctly read back by the PM but not immediately recorded.
7. FL240 was incorrectly set in the FCU altitude window by the PF and recorded by the PM on the flight log.
8. The descent clearance cross-check as performed was not in accordance with procedures.
9. PM doubt over the cleared flight level was not clearly communicated to the PF.
10. The clearance was checked with ATC, which confirmed the correct clearance shortly before FL340 was reached.
11. An abrupt manual pitch input was used to arrest aircraft descent, rather than a more appropriate autopilot selection.
12. The pitch input resulted in g forces that caused a CCM in the rear galley to fall to the cabin floor, sustaining a broken ankle.

(b) Probable Cause

An abrupt manual pitch input resulted in higher than usual g forces being experienced by the Cabin Crew Members.

(c) Contributory Cause(s)

1. The ATC Flight Level clearance was not immediately recorded when received.
2. Unclear communication between the Flight Crew when confusion arose over the cleared flight level.

4. SAFETY RECOMMENDATIONS

No.	It is Recommended that:	Recommendation Ref.
1.	Aer Lingus should review its training programs and procedures to ensure that its flight crew are familiar with the use of levelling off procedures and the risks associated with manual flight control input during high altitude operations.	IRLD2014012

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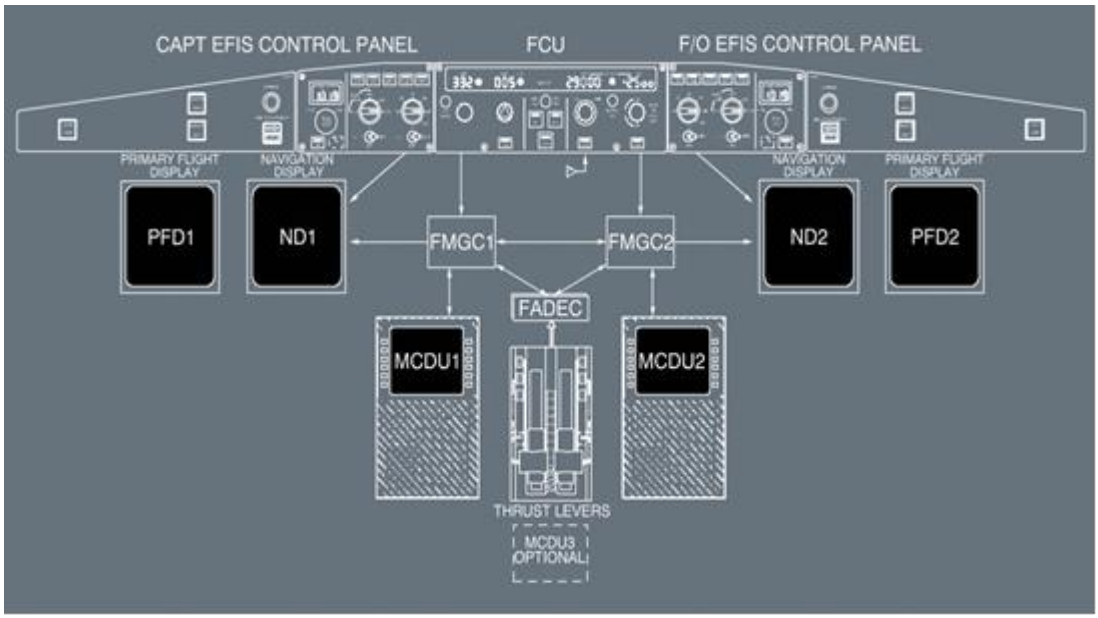
- END -

Appendix A

(Appendix Title Text FMGS Panels, Indicators and Pilot Interface)



Graphic No. 4: FCU panel.

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.

Produced by the Air Accident Investigation Unit

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