SERIOUS INCIDENT

Aircraft Type and Registration:	Airbus A319-111, G-EZAW
No & Type of Engines:	2 CFM 56-5B5/P turbofan engines
Year of Manufacture:	2006 (Serial no: 2812)
Date & Time (UTC):	3 July 2017 at 1931 hrs
Location:	Munich Airport, Germany
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 6 Passengers - 149
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to the nose and right main landing gear
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	41 years
Commander's Flying Experience:	11,179 hours (of which 9,300 were on type) Last 90 days - 192 hours Last 28 days - 35 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

The aircraft was established on an ILS approach to Runway 26L at Munich Airport. When the aircraft was at about 1,500 ft aal, the commander's Flight Management Guidance Computer (FMGC)1 failed. The crew were unable to alter the target approach speed, and the engines began to spool up un-commanded. The pilot flying disconnected the autopilot and autothrust and the rest of the approach was flown manually. Below 50 ft the pitch attitude of the aircraft was reduced slightly just before the aircraft was flared for landing, and it touched down heavily in a relatively flat attitude. The normal acceleration recorded at touchdown was 3.01 g, which is classified as a Severe Hard Landing. All three landing gear legs were replaced, although subsequent examination revealed that only the nose and right main gear were damaged.

History of the flight

The aircraft was performing a scheduled passenger service between Edinburgh and Munich Airports. The co-pilot was pilot flying (PF). The aircraft was established on an approach to Runway 26L at Munich when, at about 1,500 ft aal, FMGC1 froze. Both flight crew attempted to alter the target approach speed but were unable to do so through either the FMGC or the Flight Control Unit. At 1,288 ft aal, the engines began to spool up un-commanded by the crew, so the autopilot (AP) and autothrust (A/THR) were disconnected by the PF. The rest of the approach was flown manually with manual thrust.

During the approach, a cabin pressure landing elevation fault was triggered, thought to be associated with the failure of FMGC1.

As the aircraft approached the touchdown point, the PF selected a lower-than-normal pitch attitude and the aircraft touched down firmly. The crew taxied the aircraft to the stand as normal but a LOAD<15> report[1] was printed automatically, indicating the aircraft had suffered a hard landing. Subsequent enquiries revealed the touchdown had resulted in a maximum recorded vertical acceleration of 3.01 g.

Aircraft information

Autothrust

When disconnecting the AP on the A319 to fly manually, the system is designed so that the A/THR can remain engaged because it offers protection against gusts and possible airspeed excursions. Although it is usual to fly the approach and landing with the A/THR engaged, the company Operations Manual requires it to be disconnected '*in case the PF is not satisfied with the A/THR operation',* and the operator considered disconnection of the A/THR to be an appropriate response to an un-commanded thrust increase.

Sidesticks

The aircraft is fitted with a sidestick for each pilot located outboard of the seating position. The sidesticks are not linked mechanically so the movement of one sidestick will not move the other. It can be difficult for one pilot to see the inputs of the other pilot because of the sidestick location.

LOAD <15> report

The A319 is fitted with a system that senses when landing parameters have been exceeded and generates a LOAD<15> report, following which the aircraft must be inspected for damage. A LOAD<15> report will automatically be sent to the aircraft printer and the operator's engineering centre during a landing if any of the following conditions are met:

- The normal acceleration is greater than 2.6 g at touchdown. If the aircraft weight exceeds the maximum landing gross weight, the normal acceleration is reduced to 1.7 g.
- The rate of descent on the radio altimeter is greater than 9 ft/sec at touchdown. If the aircraft weight exceeds the maximum landing gross weight, the radio altimeter descent rate is reduced to 6 ft/sec.
- During a bounced landing, the normal acceleration exceeds 2.6 g.

The normal acceleration data for the LOAD <15> report is provided by an accelerometer mounted near the aircraft's centre of gravity which also provides data for the flight data

Footnote

[1] Details of load report printing (LOAD<15>) contained in Aircraft information.

recorder (FDR). The output of the accelerometer is only recorded at a certain frequency which means that the maximum recorded normal acceleration may not always reflect the maximum actually attained. It also cannot measure the acceleration levels which may be experienced by other areas of the airframe such as the nose landing gear.

Aircraft examination

The aircraft was inspected for a Severe Hard Landing as required by the manufacturer's Aircraft Maintenance Manual. This inspection revealed damage to the nose landing gear and the right main landing gear as well as some cracking of the paint and sealant in the nose gear bay and avionics bay. The inspection showed there was no other damage to the aircraft.

On the advice of the manufacturer, all three landing gears on the aircraft were replaced and sent for detailed inspection. These inspections revealed that both the nose landing gear and the right main landing gear had suffered excessive loads during the landing and could not be returned to a serviceable condition. The nose landing gear shock-absorber cylinder was found buckled (Figure 1) with the barrel and forestay lower arm pin found to be out of tolerance. The right main landing gear sliding tube and shock-absorber were also found to be outside acceptable tolerances when measured. The left main gear was undamaged.

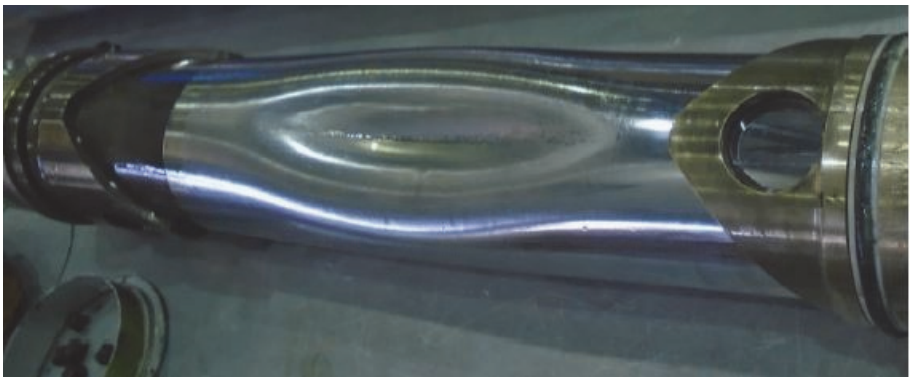

Figure 1

Nose landing gear shock absorber cylinder

Recorded flight data

The aircraft's FDR was removed from the aircraft, downloaded and the recordings analysed by the AAIB.

The data (Figure 2) shows the aircraft established on a stable ILS approach, correctly configured and at the approach speed. At 1,228 ft radio altitude, the AP and A/THR were disconnected. As the aircraft approached 30 ft radio altitude, there was a forward sidestick input and the pitch attitude began to decrease. The aircraft reached close to 1° nose-down less than a second before touchdown. At around 10 ft radio altitude, the PM applied a small amount of aft stick but this had a negligible effect on the pitch attitude and touchdown.

The LOAD <15> report showed that, at touchdown, the aircraft's attitude was 0.7° nose-down with a slight roll to the right, and its rate of descent was 11.9 ft/sec. The maximum recorded vertical acceleration was 3.01 g.

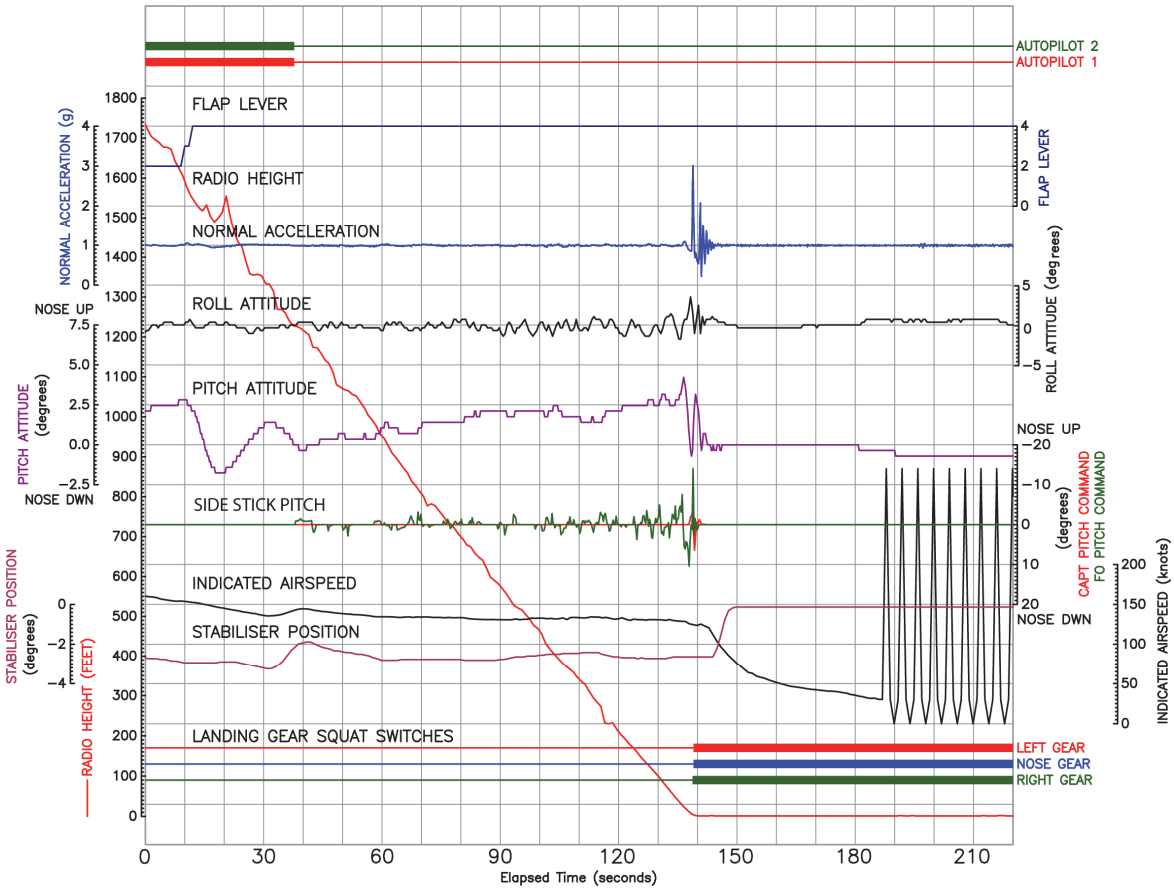

Figure 2

Salient FDR parameters for the approach and touchdown

Meteorology

The weather report for Munich at 1920 hrs showed a surface wind of 290°M at 2 kt, CAVOK, temperature 20°C, dewpoint 10°C and pressure 1022 hPa. There was no significant change between 1920 hrs and 1950 hrs.

Sunset at Munich Airport was at 1916 hrs with the end of civil twilight[2] at 1957 hrs. The aircraft landed in the period of civil twilight which, under EASA rules, is defined as daylight.

Footnote

[2] Civil twilight is defined as the period at sunrise and sunset when the sun's centre is between 0° 50' and 6° below the horizon.

Airfield information

After receiving radar vectors to the approach, the aircraft was cleared for an ILS approach to Runway 26L. The runway has a full set of approach lights which were illuminated, including a standard approach light system, touchdown zone lights, sequenced flashing lights and PAPI set at 3°. There is no displaced threshold. The runway is 4,000 m long and 60 m wide, and slopes down by 0.1°.

Personnel

The co-pilot had just over two years flying experience with the operator during which he had completed 1,644 hours flying on Airbus A320 series aircraft.

The commander was initially dealing with the failure of FMGC1 and the cabin pressure landing elevation fault and, from his perspective, the aircraft was on a normal stable approach. He did not notice any nose-down control inputs because he was concentrating on the runway and touchdown point. Approximately 0.5 seconds before touchdown, the commander called out “watch it”, as he detected the aircraft was not in the usual attitude for landing, but the aircraft had touched down before he had time to react in any way which might have altered the outcome.

Analysis

The aircraft was established on a standard approach to Munich Airport in good weather and light winds. At around 1,500 ft aal, FMGC1 froze. Because of the perceived misbehaviour of the failed FMGC, including the un-commanded increase in thrust, the PF disconnected both the AP and A/THR and flew the approach manually. This would have increased his workload, as would the distraction caused by the FMGC failure and cabin pressure landing elevation fault.

As the aircraft passed through 30 ft radio altitude, there was a nose-down sidestick input which lowered the pitch attitude of the aircraft. The commander did not notice the control input because he was looking ahead and did not notice the abnormal landing attitude until it was too late to act effectively. The touchdown was flat or slightly nose-down with a rate of descent high enough to damage the right main and nose landing gear.

The reason for the nose-down sidestick input could not be determined but it was possible that a combination of the distractions caused by the FMGC1 failure with the higher workload of flying the aircraft with the A/THR disconnected had a contributory effect.

Conclusion

Following an ILS approach during which an FMGC failed, neither pilot realised that the aircraft was in the incorrect attitude for landing until it was too late to take corrective action. As a result, the aircraft landed heavily causing damage to the nose and right main landing gear. It is possible that distractions and high workload during the approach contributed to the nose-down pitch input being made immediately before touchdown.