

# Investigation Report

The Investigation Report was written in accordance with para 18 Law Relating to the Investigation into Accidents and Incidents Associated with the Operation of Civil Aircraft stating facts only.

## Identification

Type of Occurrence:	Incident
Date:	16 June 2017
Location:	Hamburg
Aircraft:	Airplane
Manufacturer / Model:	Airbus Industry/A319-114
Injuries to Persons:	None
Damage:	None
Other Damage:	None
State File Number:	BFU17-0716-PX

## Factual Information

On 16 June 2017 at 1403 hrs<sup>1</sup> the flight crew of an Airbus A319-114 reported smoke in the cabin and declared emergency during approach to runway 33 of Hamburg Airport.

## History of the Flight

The flight crew conducted a non-precision approach (localizer approach) to runway 33 of Hamburg Airport. During the approach phase, at about 6,000 ft AGL, the responsible approach controller issued the approach clearance to runway 33 and instructed the flight crew to change to the Tower frequency. In this phase the flight crew noticed an unpleasant smell in the cockpit: "[...] *es riecht verbrannt, wie verbranntes Chemiezeug* (it smells burnt, like burnt chemical stuff) [...]". The co-pilot asked the senior cabin crew member via the intercom whether she had noticed an unpleasant smell in the cabin as well. She confirmed this and then told the co-pilot that a colleague had reported an unpleasant smell in the aft cabin area. The flight crew decided to declare emergency: "*Mayday, mayday we have smoke smell in the cockpit*". The co-pilot donned his oxygen mask. After emergency had been declared the Tower controller issued the landing clearance for runway 33. The Pilot in Command (PIC) told the Tower controller that at that time they had severe smell but not smoke in the cabin.

During the subsequent part of the approach the aircraft configuration was changed and the flaps put in position 2. The smell in the cockpit became more intense. Then the PIC too donned his oxygen mask.

The senior cabin crew member called the cockpit via the intercom and told them that now there was smoke visible in the aft cabin. Then she made an announcement to the passengers: "*Meine Damen und Herren, bitte benutzen Sie Tücher, um durch die Tücher zu atmen* (Ladies and gentlemen, please use handkerchiefs, and breath through them)".

The PIC informed the Tower controller that smoke was visible in the cabin and requested the fire brigade and mobile stairs should be available after landing.

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<sup>1</sup> All times local, unless otherwise stated.

The PIC conducted the landing, steered the airplane from the runway to taxiway E3, and stopped. The Auxiliary Power Unit (APU) was switched on and the engines were shut off.

The report of the PIC stated that the cabin crew had been instructed to prepare the passengers for a possible evacuation.

After deliberation of the facts the PIC decided to let the passengers disembark via mobile stairs at door 1L.

In the vicinity of the aircraft the fire brigade was on standby on taxiway E3. On the ground, no fire or smoke was determined in the cabin.

Subsequently, the entire crew underwent precautionary examination at a hospital. Interviews and the filled-in BFU cabin air questionnaires showed that the crew had not suffered from any impairments during the flight.

## Personnel Information

### Pilot in Command

The 57-year-old PIC held an Airline Transport Pilot's Licence (ATPL(A)) issued on 2 June 2015 by the Luftfahrt-Bundesamt (German aviation authority, LBA) in accordance with Part-FCL (Flight Crew Licensing). The licence listed the ratings as PIC for Airbus A320<sup>2</sup> in accordance with Instrument Rules (PIC IR); valid until 30 November 2017. In addition, the rating as Type Rating Instructor (TRI) on A320 was listed. It was valid until 30 November 2018.

The BFU was provided with a class 1 medical certificate valid until 30 November 2017.

According to the statement of the operator the PIC had a total flying experience of approximately 16,088 hours; of which about 10,097 hours were flown on A319/A320/A321.

The operator provided the mission schedule of the last 7 days. It showed that the PIC had conducted two missions prior to the occurrence.

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<sup>2</sup> Includes A319/A320/A321

## Co-pilot

The 37-year-old co-pilot held an Airline Transport Pilot's Licence (ATPL(A)) issued on 8 August 2014 by the Luftfahrt-Bundesamt in accordance with Part-FCL. The licence listed the ratings as co-pilot for Airbus 320 in accordance with Instrument Rules (COP IR). The rating was valid until 31 August 2017.

The BFU was provided with a class 1 medical certificate valid until 18 May 2018.

According to the statement of the operator the co-pilot had a total flying experience of approximately 4,615 hours on A319/A320/A321.

The operator provided the mission schedule of the last 7 days. It showed that the co-pilot had conducted two missions prior to the occurrence.

## Aircraft Information

The Airbus A319-114 is a short and medium range transport aircraft equipped with two fan jets.

Manufacturer	Airbus Industry
Year of manufacture:	1997
Manufacturer's Serial Number (MSN)	00723
Operating time	52,607 hours
Flight cycles	40,564
Maximum take-off mass	68,000 kg
Engine type	CFM56-5A5

## Meteorological Information

At the time of the incident it was daylight. According to the aviation routine weather report (METAR) of Hamburg Airport of 1050 hrs visibility was more than 10 km. Wind velocity was 280°, 19 knots, gusts 32 kt. The cloud cover at 2,500 ft GND was 1/8 to 2/8 and at 3,000 ft GND 3/8 to 4/8. Temperature was 17°C, the dewpoint 11°C, and the barometric air pressure (QNH) 1,014 hPa. No significant change (NOSIG) within the next 2 hours was expected.

## Aids to Navigation

The approach was conducted as non-precision approach (LOC DME) to runway 33.

## Radio Communications

Radio transmissions with the respective air traffic control were conducted in the English language.

## Aerodrome Information

Hamburg Airport is located 8.5 km north of the city of Hamburg. Aerodrome elevation is 53 ft AMSL. The airport has two runways in the directions 050°/230° (05/23), and 152°/332° (15/33).

## Flight Recorder

### Flight Data Recorder and Cockpit Voice Recorder Information

Manufacturer CVR	L3 Communications
Model	A200S
Part number	S200-0012-00
Serial number	01651

Manufacturer FDR	L3 Communications
Model	F1000
Part number	S800-3000-00
Serial number	00883

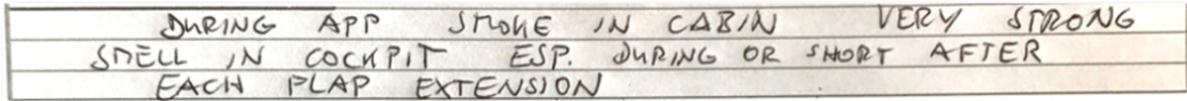
### Recorder Condition

The CVR and the FDR were seized by the BFU and read out at the avionics laboratory at the BFU facility. Both recorders were undamaged.

The FDR had recorded 348 parameters. No irregularities, such as warnings generated by the Electronic Centralized Aircraft Monitor (ECAM), during the time of the occurrence were determined.

## Findings at the Aircraft

After the occurrence the PIC made the following entry in the technical flight log:



DURING APP STROKE IN CABIN VERY STRONG  
 SMELL IN COCKPIT ESP. DURING OR SHORT AFTER  
 EACH PLAP EXTENSION

(1) Entry in the technical flight log

Source: Operator

## Determined Technical Dysfunction

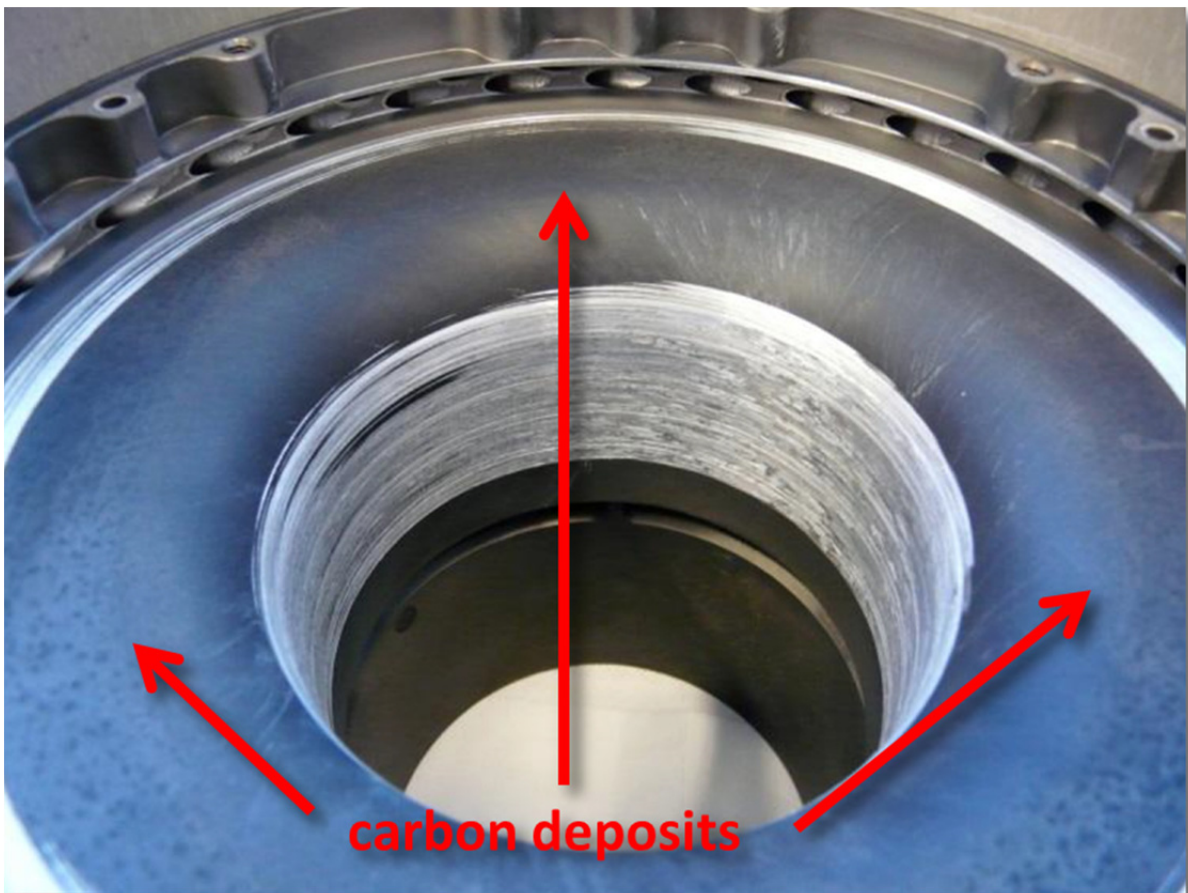
The maintenance organisation of the operator examined the left air conditioning system (PACK No. 1) and determined that the cause for the smoke development was a defective air cycle machine. As part of the maintenance work, the air cycle machine and a recirculation filter were replaced. After the components had been installed both air conditioning systems (PACKS No. 1 and 2) were checked. Their proper function, without any irregularities, was determined. On 17 June 2017 the aircraft was released to service.

## Examination by the Maintenance Organisation

The maintenance organisation examined the removed air cycle machine and determined the following:

The turbine casing showed heavy chafing marks caused by the turbine wheel. The surface was scratched and showed chafing marks caused by the high temperatures the chafing of the turbine wheel had generated.

The dark colour was caused by carbon deposits during normal operation.



(2) Turbine casing of the air cycle machine

Source: Maintenance organisation/BFU

The turbine wheel showed corresponding rubber marks resulting from the chafing against the turbine casing. The dark colour at the air intake of the turbine wheel was due to carbon deposits during normal operation.



(3) Turbine wheel within the air cycle machine

Source: Maintenance organisation/BFU

The thrust bearing showed chafing marks and rubbed-off anti-friction coating.



(4) Thrust bearing (anti-friction coating)

Source: Maintenance organisation/BFU

On the turbine side the disc showed chafing marks.



(5) Disc

Source: Maintenance Organisation

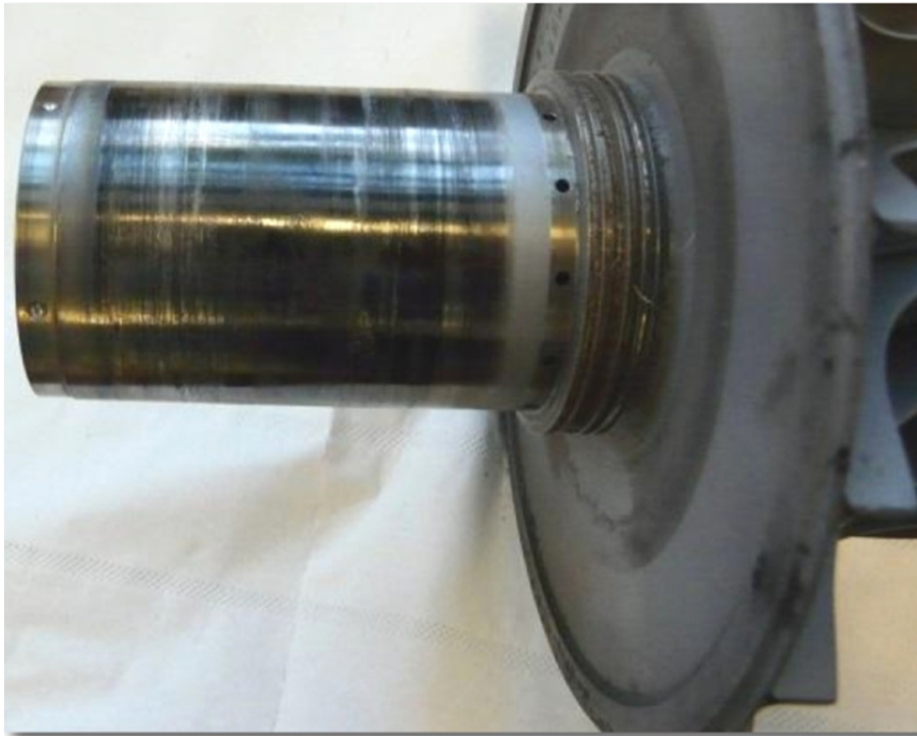
At the turbine side the journal bearing failed. This journal bearing was an air bearing.



(6) Defective journal bearing

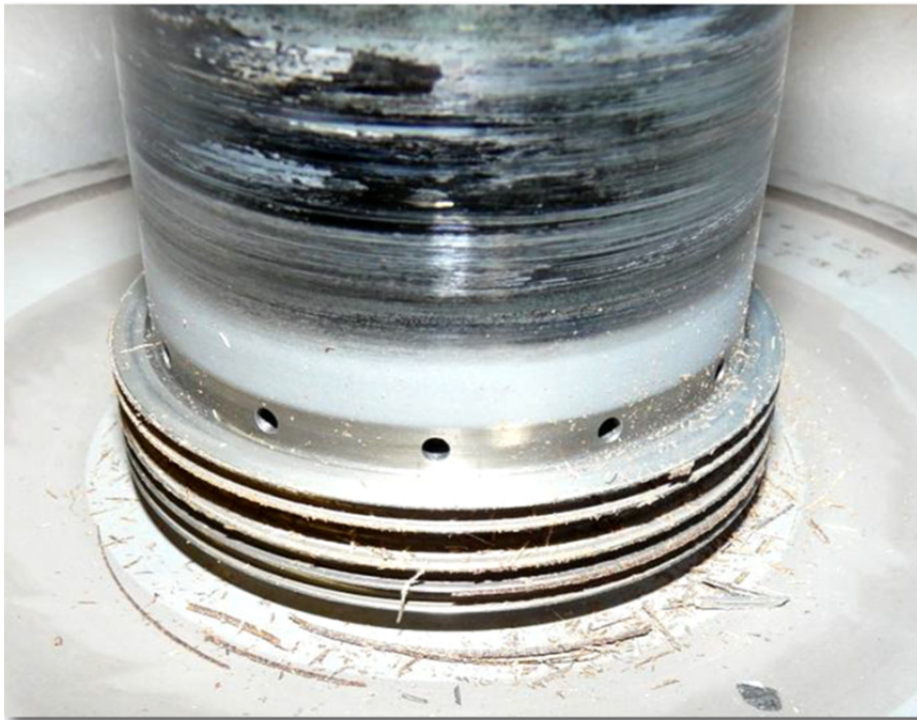
Source: Maintenance Organisation

Worn and discoloured compressor shaft as a result of the failed journal bearing.



(7) Worn and discoloured compressor shaft

Source: Maintenance Organisation



(8) Abraded compressor shaft

Source: Maintenance Organisation

The thrust bearing failed and the disc chafed against the anti-friction coated metal with high rotational speed. This caused the overheating of the air bearing. The failure of one of the journal bearings at the turbine side was identified as the cause of the smoke and smell development. The maintenance organisation stated that such a damage pattern is not unusual if an air cycle machine fails.

During normal operation of the air bearings the metal does not come into contact with the disc. The journal bearing failed and caused a compressor shaft imbalance. It chafed against the inside of the turbine casing. The turbine casing and the compressor shaft consisted of an aluminium alloy.

## Additional Information

### Description of the Air Conditioning System

Two air conditioning systems (PACKs) regulate the cabin temperature and the cabin pressure in the Airbus A319. Each PACK consists of three main components: Mix manifold, pressure and temperature regulators.

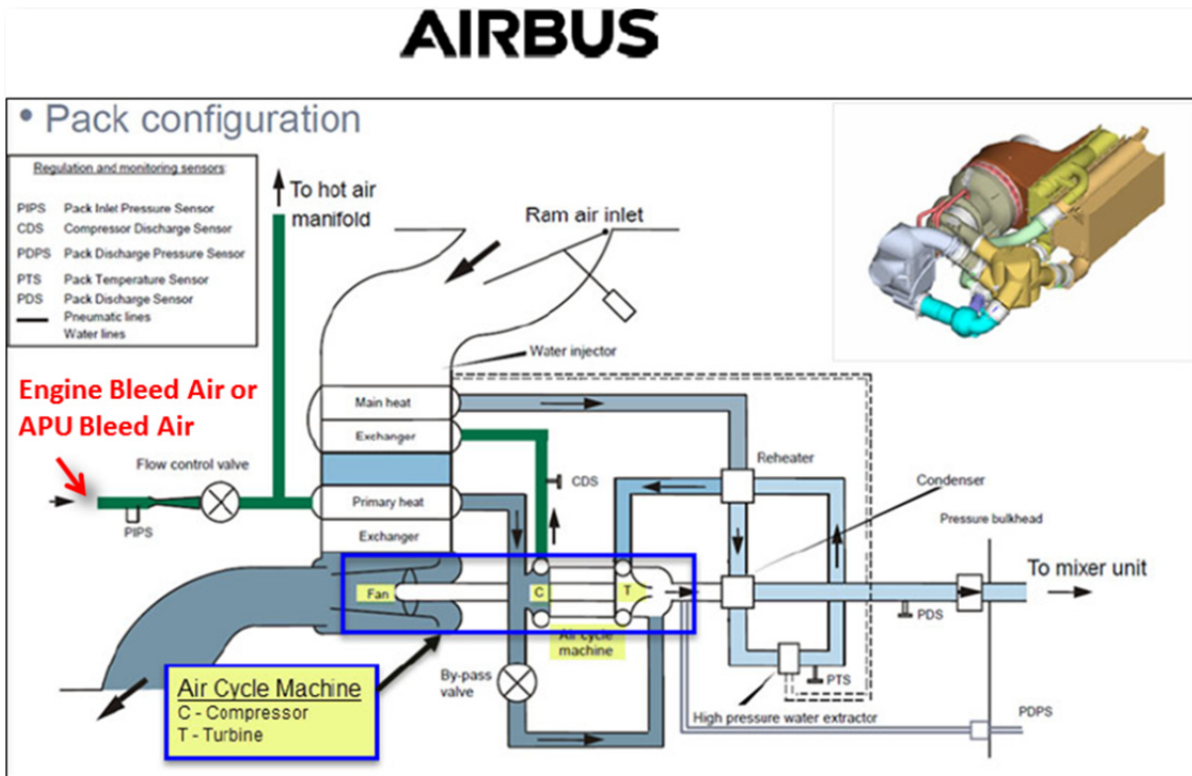
The two PACKs work parallel and independent of each other and use the engine bleed air of the respective compressor stage. This bleed air has a very high temperature and, depending on the source, a gauge pressure of several bar. In addition, the APU can supply pressurised air for the operation of the PACKs.

### Air Cycle Machine

The air cycle machine consists of the radial compressor and the turbine. Via a shaft the rotation energy of the turbine powers the radial compressor.

The engine bleed air flows through the first heat exchanger before entering the radial compressor. The heat exchanger is assisted in its cooling effect by outside air flowing in. After the radial compressor the engine bleed air enters another heat exchanger until the air is expanded and cooled down further. The cooled engine bleed air from the air cycle machine flows into the mix manifold. Hot engine bleed air is mixed in via the trim air pipes in order to achieve the desired cabin air temperature.

The following schematic graph shows the flow of the engine bleed air within the PACKs.



(9) Airbus A319 air conditioning system

Source: Airbus industry/ BFU

Investigator in charge:

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Assistance:

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Braunschweig 26 July 2018

This investigation was conducted in accordance with the 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 and the Federal German Law relating to the investigation of accidents and incidents associated with the operation of civil aircraft (*Flugunfall-Untersuchungs-Gesetz - FIUUG*) of 26 August 1998.

The sole objective of the investigation is to prevent future accidents and incidents. The investigation does not seek to ascertain blame or apportion legal liability for any claims that may arise.

This document is a translation of the German Investigation Report. Although every effort was made for the translation to be accurate, in the event of any discrepancies the original German document is the authentic version.

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